

# METROPOLITAN WASHINGTON 2030 CLIMATE AND ENERGY ACTION PLAN

November 2020



Metropolitan Washington  
**Council of Governments**

## **METROPOLITAN WASHINGTON CLIMATE ACTION PLAN**

Prepared by the Climate, Energy and Environment Policy Committee (CEEPC)

Adopted on November 18, 2020

### **ABOUT COG**

The Metropolitan Washington Council of Governments (COG) is an independent, nonprofit association that brings area leaders together to address major regional issues in the District of Columbia, suburban Maryland, and Northern Virginia. COG's membership is comprised of 300 elected officials from 24 local governments, the Maryland and Virginia state legislatures, and U.S. Congress.

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# EXECUTIVE SUMMARY

The Metropolitan Washington Council of Governments (COG) is a hub for partnerships to facilitate sustainable growth, a well-maintained transportation system, clean air, water, and land, safe and healthy communities, and a vibrant economy. This work is guided by COG's comprehensive *Region Forward* vision, to ensure a more prosperous, accessible, livable, sustainable, and equitable future for all area residents. In this role, COG has established goals to mitigate greenhouse gas emissions and improve regional climate resiliency. The COG Board established new 2030 goals to supplement earlier 2020 and 2050 goals. The new goals call for further reducing greenhouse gas emissions by 2030, and being a Climate Ready Region, including increased investments in resiliency, by 2030.<sup>i</sup>

This 2030 Climate and Energy Action Plan builds on previous action plans and establish priority collaborative actions for COG's Climate, Energy and Environment Policy Committee (CEEPC) members to work on together over the next ten years to help move the region towards meeting its' 2030 goals. All the actions in the plan are voluntary; the success of the plan will depend on active regional collaboration and implementation.

## Plan Purpose and Scope

According to the Intergovernmental Panel on Climate Change (IPCC), a body of the United Nations that assesses the science related to climate change, the world is already experiencing the impacts of 1 degree Celsius of global warming above pre-industrial levels. Additionally, the IPCC notes that more severe climate impacts could be avoided if global warming is limited to 1.5 degrees Celsius. Globally, emissions need to fall by 45 percent from 2010 levels by 2030 and carbon neutral by 2050 to limit global warming to 1.5 degrees Celsius. The IPCC acknowledges rapid and far reaching transitions are needed world-wide in order to limit global warming.<sup>ii</sup>

The 2030 greenhouse gas (GHG) emission reduction goals adopted by the COG Board of Directors on October 14, 2020 align with the level of effort called for by the IPCC. COG Board Resolution R45-2020 established interim climate change goals including:<sup>iii</sup>

- The climate mitigation goal of 50 percent greenhouse gas emission reductions below 2005 levels by 2030;
- The climate resilience goal of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030; and
- The need to incorporate equity principles and expand education on climate change into COG's CEEPC and its members' actions to reach the climate mitigation and resiliency goals.

To be a Climate Ready Region by 2030, all local governments must assess current and future climate risks, and be actively integrating climate planning across government plans, operations, and communications. To fully be a Climate Resilient Region, the region must have the ability to adapt and absorb against disturbances caused by current and future, acute and chronic climate impacts and successfully maintain essential functions.

The purpose of this plan is to establish priority collaborative actions for COG and its members to work on together over the next ten years to help move the region towards meeting the 2030 goals. Achieving the regional goals would require unprecedented, aggressive cross-sectoral action from all COG members and its state and federal partners.

## GUIDING PRINCIPLES

Ten principles guide this plan's voluntary collaborative climate action implementation process. These principles reflect CEEPC's commitment to environmental quality, economic prosperity, and equity. As climate leaders, CEEPC is committed to the following principles:

- 1. Collective Action:** We will continue to work together to leverage our impact and facilitate application at scale.
- 2. Effective Partnerships:** We will continue to share best practices, learn together, and coordinate on implementation to advance regional transformation.
- 3. Lead by Example:** We have a continued commitment to internal implementation of long-term solutions to reduce the climate impacts of our operations.
- 4. Integration:** We understand climate action is inherently multidisciplinary and will promote cross-department coordination, including in areas such as equity, health, and economic development.
- 5. Flexibility:** We understand the need for flexibility in how our public agencies and stakeholders across the District of Columbia, Maryland, and Virginia work to achieve regional GHG goals.
- 6. Transparency:** We will continue to measure and report progress in a manner easily understandable by all.
- 7. Innovation:** We support a just transition to a clean energy economy through the application of innovative technology, policies, and processes by public and private sectors.
- 8. Community Leadership:** We will continue to educate, motivate, and empower action from our community's institutions, businesses, non-profits, and residents.
- 9. Inclusive Engagement:** We commit to inclusive community engagement and equitable provision of climate and energy programs and services.
- 10. Advocacy:** We will continue to support state and federal policies and programs that protect the human and environmental health of our communities.

## Plan Elements

There are four core elements to this plan, including:

- **Greenhouse Gases:** This section of the plan provides a summary of regional GHG inventory trends from 2005 to 2018, business-as-usual (BAU) GHG emission projections through 2030, and technical scenario showing what it will take for the region to reach GHG reductions of 50 percent below 2005 levels by 2030.
- **Climate Mitigation Strategy:** This section of the plan identifies CEEPC's priority collaborative mitigation actions to move the region toward achieving the GHG emission reduction goal of 50 percent by 2030, below 2005 levels. The action areas include Planning, Equity, Clean Electricity, Zero Energy Buildings, Zero Emission Vehicles, Mode Shift and Travel Behavior, Zero Waste, and Sequestration.
- **Climate Risks and Vulnerabilities:** This section of the plan provides a summary of the Regional Climate, Risk and Vulnerability Assessment (CRVA). The CRVA evaluates climate hazards including extreme heat, drought, lightning and thunderstorms, flash and riverine flooding, coastal flooding and extreme winter conditions. The CRVA also evaluates factors



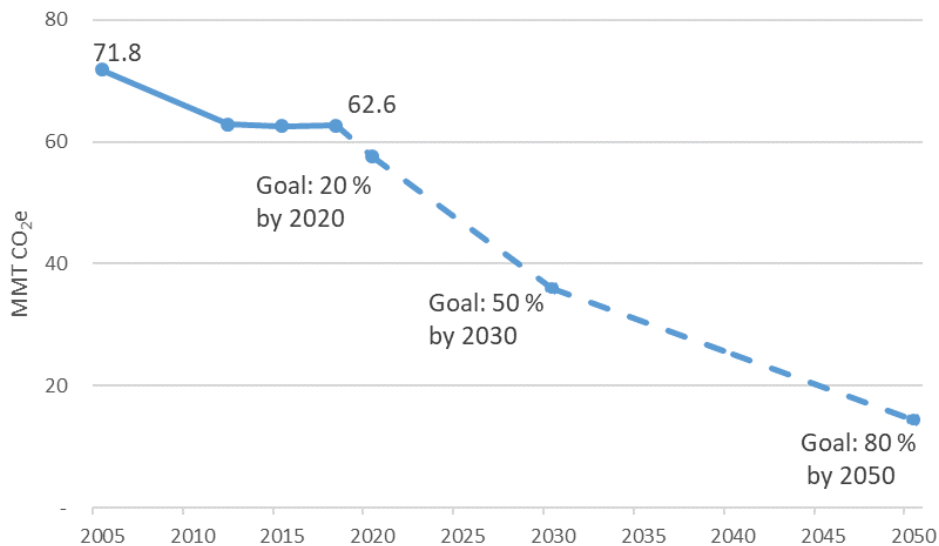
impacting adaptive capacity, such as infrastructure conditions and maintenance, access to basic services, and public health.

- **Climate Resilience Strategy:** This section of the plan identifies CEEPC’s priority collaborative climate resilience actions to move the region toward achieving the goal of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030. The action areas include Planning, Equity, and Resilient Infrastructure.

## GHG Inventory

COG’s greenhouse gas inventories show that the region’s progress to date towards the GHG emission reduction goals has been mixed. The region exceeded its 2012 goal but is lagging on progress towards its 2020 goal. The most recent inventory indicates that 2018 GHG emissions in the region decreased by approximately 13 percent below 2005 levels, despite a 19 percent growth in population. Per capita emissions decreased between 2005 and 2018 from 15.6 metric tons of carbon dioxide equivalent (MTCO<sub>2e</sub>) in 2005 to 11.4 MTCO<sub>2e</sub> in 2018. Expedited and concerted actions will be needed throughout the region to achieve future goals of 50 percent GHG emission reduction by 2030 and 80 percent by 2050 (Figure ES-1).

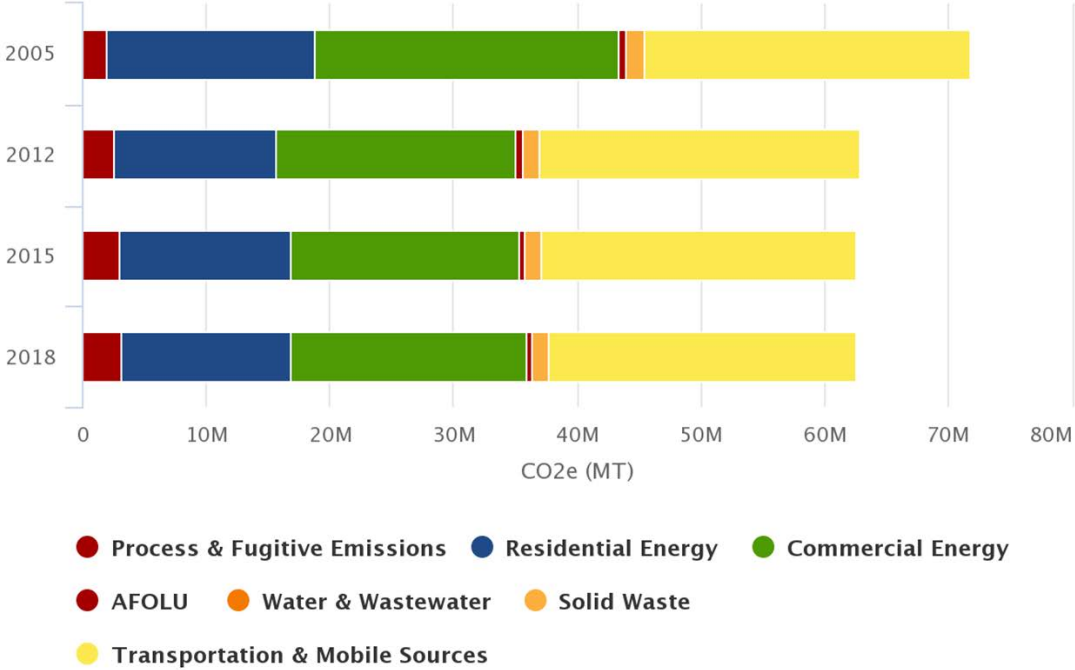
**Figure ES-1: Metropolitan Washington GHG Trends and Goals**



## EMISSIONS ACTIVITIES

The inventories measure GHG-emitting activities undertaken by residents, businesses, industry, and government located in metropolitan Washington, as well as emissions from visitors. Approximately 90 percent of metropolitan Washington’s GHG emissions come from residential and commercial building energy consumption and transportation. Building energy consumption accounts for 52 percent and 40 percent is from transportation. The remainder of emissions comes from other activities and sources including solid waste, wastewater treatment, agriculture and fugitive emissions (Figure ES-2).

**Figure ES-2: Metropolitan Washington GHG Emissions by Activity**

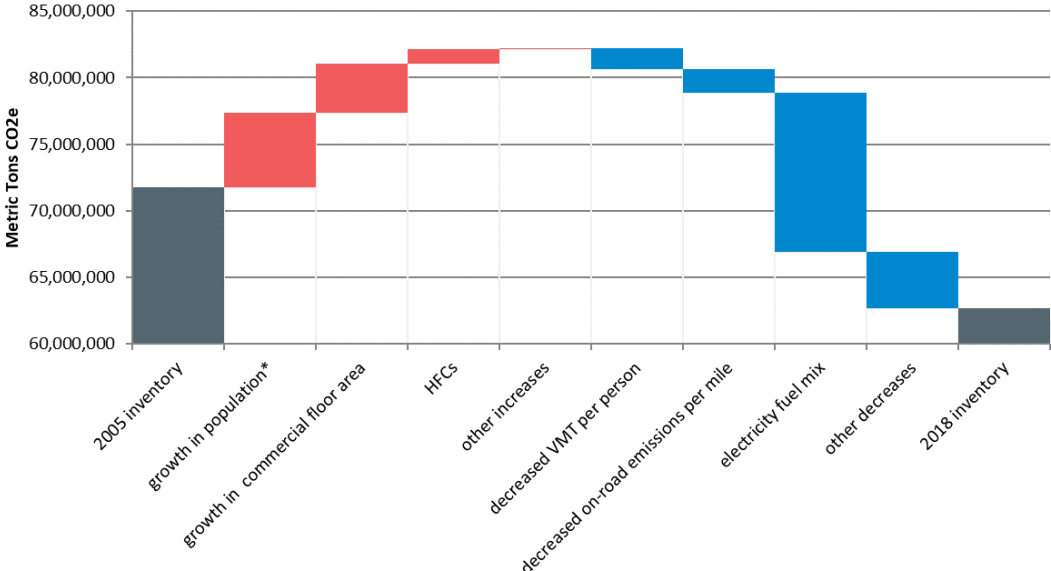


Source: ICLEI’s ClearPath, an online greenhouse gas inventory tool.

**DRIVERS OF GHG CHANGE**

The metropolitan Washington GHG Contribution Analysis results in Figure ES-3 shows what has driven increases and decreases in emissions between inventory years 2005 and 2018. The main drivers increasing emissions (red bars) include growth in population, commercial space, and hydrofluorocarbons (HFCs). Driving down emissions (blue bars) is mainly a cleaner grid, cleaner cars and reduced vehicle miles traveled (VMT) per person.

**Figure ES-3: Drivers of Metropolitan Washington GHG Changes**

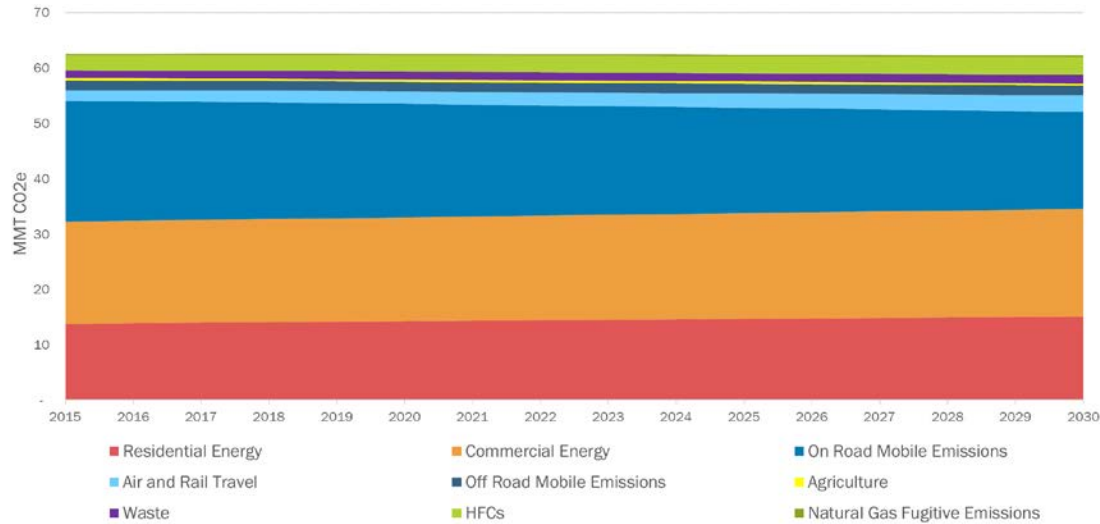


\*Includes effects of population on residential energy, VMT and waste generation.

## Business-As-Usual Projections<sup>iv</sup>

Business-as-usual (BAU) projections provide a baseline scenario for future GHG emissions. BAU projections take into account population, housing, and commercial growth as well as policies and practices that have been in place and implemented to-date to reduce GHG emissions. Figure ES-4 shows that the region’s anticipated BAU emissions projected out to 2030 overall remain flat.

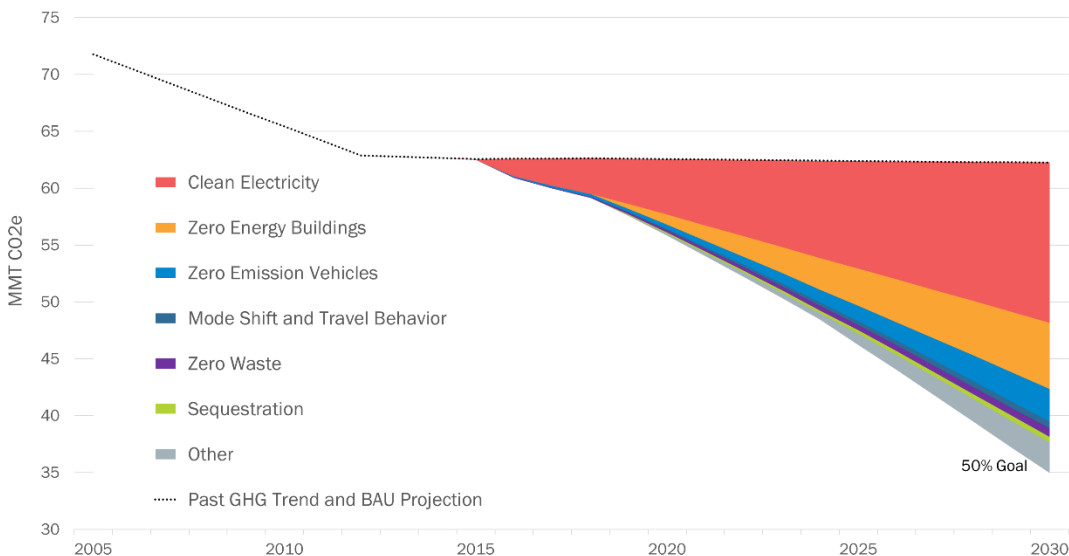
**Figure ES-4: Metropolitan Washington Business-As-Usual Projections**



## 2030 Scenario<sup>v</sup>

The 2030 scenario for this plan analyzes the technical potential of "What Would It Take" for metropolitan Washington to reach a 50 percent reduction in GHG emissions by 2030 from 2005 levels. This scenario leverages results from a previous scenario analysis conducted in 2015 by COG’s Ad-Hoc Multi-Sector Work Group and results have been updated based on new data and progress since that time. Figure ES-5 on the shows a summary of the 2030 scenario results. Considerable action across local, regional, state, and national levels will be needed.

**Figure ES-5: Metropolitan Washington “What Would It Take” Scenario Results**



## Regional Mitigation Strategy

The Regional Mitigation Strategy includes collaborative actions to support the region in achieving the GHG emission reduction goals of 50 percent by 2030 below 2005 levels and 80 percent by 2050.

The climate action areas included in the Regional Climate Mitigation Strategy address: Planning, Equity, Clean Electricity, Zero Energy Buildings, Zero Emission Vehicles, Zero Waste, Mode Shift and Travel Behavior and Sequestration. Within these action areas are high-level priority actions for COG and its members to focus on through 2030. All actions are voluntary. Table ES-1 is a summary of the climate action areas and priority collaborative actions described in this strategy.

**Table ES-1: Metropolitan Washington Priority Collaborative Mitigation Actions**

Climate Action Area	Action ID	Priority Collaborative Action
Planning	PL - 1	Advance Climate Planning and Track Progress
Equity	EQ - 1	Enable Equitable Planning Practices
	EQ - 2	Prioritize Sustainable Energy Access for All
Clean Electricity	CE - 1	Advocate for Aggressive Renewable Portfolio Standards
	CE - 2	Accelerate Development of On-Site Renewables
	CE - 3	Accelerate Deployment of Battery Storage
	CE - 4	Accelerate Development of Microgrids for Critical Infrastructure
	CE - 5	Accelerate Development of Large-Scale Off-Site Renewables
	CE - 6	Advocate for and Implement Community Choice Aggregation
Zero Energy Buildings	ZEB - 1	Expand Building Benchmarking Requirements
	ZEB - 2	Accelerate Deep Building Retrofits
	ZEB - 3	Enhance Green Building Codes and Policies to Facilitate Net Zero Energy Building Development
	ZEB - 4	Expand Proper Disposal and Leak Detection of Refrigerants
Zero Emission Vehicles	ZEV - 1	Expand Light-Duty Electric Vehicle Deployment
	ZEV - 2	Accelerate Electrification of Medium- and Heavy-Duty Vehicles
	ZEV - 3	Build Out Regional Electric Vehicle Charging Network
Mode Shift and Travel Behavior	MSTB - 1	Invest in Infrastructure that Increases Transit, Carpooling, and Non-Motorized Travel
	MSTB - 2	Bring Jobs and Housing Closer Together
	MSTB - 3	Enhance Options for Commuters
Zero Waste	ZW - 1	Implement Curbside Organics Recycling Programs
	ZW - 2	Reduce Solid Waste Generation
	ZW - 3	Build Markets for Circularity
Sequestration	SQ - 1	Strategically Plant New Trees on Publicly Owned Land
	SQ - 2	Enhance Regulatory Capacity to Manage Tree Canopy and Forest Protection
	SQ - 3	Enhance Incentives and Financing Mechanisms for Tree Planting and Preservation on Privately Owned Lands

## Climate Risk and Vulnerabilities

In 2018, The Intergovernmental Panel on Climate Change (IPCC) released the *Global Warming of 1.5 °C*, an IPCC special report, highlighting that the world is already experiencing the impacts of 1 degree Celsius warming above pre-industrial levels but more severe climate impacts could be avoided if global warming is limited to 1.5 degrees Celsius. If the rate of warming continues, 1.5 degrees Celsius warming is likely to occur between 2030 and 2052 with more frequent and severe extreme weather events becoming even more prevalent.<sup>vi</sup>

As the IPCC noted internationally, metropolitan Washington is also experiencing the impacts of a changing climate. Observations in metropolitan Washington show that temperatures and the water surface level in the Potomac River have been rising and will continue to rise. Extreme weather events and increases in the number of extreme heat and cold days will increase risks to health, energy usage patterns, plant and animal habitats, and infrastructure. These changes are also affecting stormwater, drinking water, and wastewater. Implementing regional adaptation strategies are necessary to reduce the impacts of climate change.<sup>vii</sup>

A climate risk and vulnerability assessment (CRVA) was conducted for metropolitan Washington with the goal of understanding the climate hazards that face the region and assessing the likelihood and impact of current and future hazards on the region. Climate change may increase the frequency or severity of climate hazards in metropolitan Washington, including extreme heat (high day and night temperatures), drought, flooding (flash, riverine, and coastal), lightning and thunderstorms, and extreme winter conditions.

## METHODOLOGY

The regional CRVA methodology is based on the Global Covenant of Mayors for Climate and Energy (GCoM) framework. GCOM is a global alliance of cities and local governments that support voluntary action to address climate change and ensure a low emission, climate resilient future.<sup>viii</sup> The CRVA identifies and describes current and anticipated climate hazards metropolitan Washington faces. As shown in Table ES-2, each hazard is assigned a risk level, based on probability and level of consequence (probability x consequence). After the hazard risks are identified, an assessment is conducted to determine the future change in intensity and frequency, and the timeframe over which this will occur: Immediately, Short Term (by 2025), Medium Term (by 2050), and Long Term (after 2050).

**Table ES-2: Climate Risk Sourcing Matrix**

		Probability		
		Low (1)	Moderate (2)	High (3)
Consequence	High (3)	3	6	9
	Moderate (2)	2	4	6
	Low (1)	1	2	3

Next, vulnerabilities were assessed to determine the degree in which the people, systems, sectors, and systems are susceptible to current and future climate impacts. The impacts assessed include, but are not limited to: services lost, environmental impact, property damages, public health threats, economic losses, and other disruptions to day-to-day operations. For each hazard, relevant population groups in the region were identified that are most vulnerable to future climate hazards and impacts. Finally, for each hazard, factors were assessed that may impact the region’s adaptive capability.

As shown in Table ES-3, the most prominent climate hazards facing metropolitan Washington include extreme heat and flash and riverine flooding. More frequent extreme heat days will lead to public health concerns, increase energy demand, travel disruptions, and maintenance and infrastructure damages. With more frequent and intense storms, flash and riverine flooding will increase disruptions and damages to infrastructure and emergency services, and further threaten vulnerable populations.

**Table ES-3: Risk Level of Hazards in Metropolitan Washington**

Hazard	Probability	Consequence	Risk
Extreme Heat	3	3	9
Drought	2	3	6
Flooding (Flash and Riverine)	3	3	9
Coastal Flooding	3	2	6
Lightning/Thunderstorm	3	2	6
Extreme Winter Conditions	2	3	6

The region must adapt to climate change. Adaptive capacity is defined as “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences.”<sup>ix</sup> Table ES-4 shows the degree of challenge identified for each sector evaluated in the CRVA. Infrastructure conditions pose the highest degree of challenge due to the impacts on maintenance costs, aging facilities, interoperability, and increased demand. Resilient critical infrastructure is essential to the well-being, health, and safety of the people in metropolitan Washington. Implementing resilient measures for all critical infrastructure by 2050 is necessary to respond to a changing climate.

**Table ES-4: Metropolitan Washington Adaptive Capacity Degree of Challenge**

Factor	Degree of Challenge
Infrastructure Conditions/Maintenance	High
Access to Basic Services	Moderate
Access to Healthcare	Moderate
Public Health	Moderate
Housing	Moderate
Poverty	Moderate
Community Engagement	Moderate
Environmental Conditions	Moderate
Economic Health	Low

## VULNERABLE POPULATIONS

Climate change will impact people and communities differently. Potentially vulnerable populations may include low-income, minority, marginalized groups, women and girls, persons in sub-standard housing, people with limited English proficiency, the elderly, children, people with chronic health problems, or disabled persons. As vulnerable populations face greater risks, their consideration and inclusion in climate change planning is essential to ensure equitable distribution of benefits. Creating resilient communities is only possible when inclusion of vulnerable populations' needs are met.

## Regional Resilience Strategy

The Regional Climate Resilience Strategy includes collaborative actions to support the region in achieving the climate resilience goals of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030. To move the region toward becoming more resilient, the region needs to ensure that all populations are included and prioritize resilience of the region's most vulnerable populations.

The climate action areas included in this Regional Climate Resilience Strategy address: Planning, Equity, and Resilient Infrastructure. Within these action areas are high-level priority actions for COG and its members to focus on through 2030. All actions are voluntary. Table ES-5 is a summary of the climate action areas and priority collaborative actions described in this strategy. The actions are based on the needs identified in the regional climate risk and vulnerabilities assessment.

**Table ES-5: Metropolitan Washington Priority Collaborative Resilience Actions**

Climate Action Area	Action ID	Priority Collaborative Action
Planning	PL - 2	Support Capacity Building for Climate Resilience Planning
	PL - 3	Develop Integrated Approach to Climate Resilience Planning
	PL - 4	Update Local and Regional Plans to Address Climate Risks
Equity	EQ - 3	Support Engagement of the Public on Climate Risks, with a Particular Emphasis on Potentially Vulnerable Populations
	EQ - 4	Support Equitable Secure Energy Access
Resilient Infrastructure	RI - 1	Support Establishment of Resilience Hubs
	RI - 2	Improve the Resilience of Critical Infrastructure
	RI - 3	Implement Measures to Equitably Address Urban Heat Island
	RI - 4	Enhance Green Infrastructure Networks
	RI - 5	Implement Measures to Reduce Flood Risk

## Conclusion

COG's Climate and Energy Program is one of the nation's first initiatives to address climate change on a regional level. The regional effort is led by the Climate, Energy and Environment Policy Committee (CEEPC) and guided by this plan. COG will continue to work with its regional partners to meet its goals for 2030 and beyond.





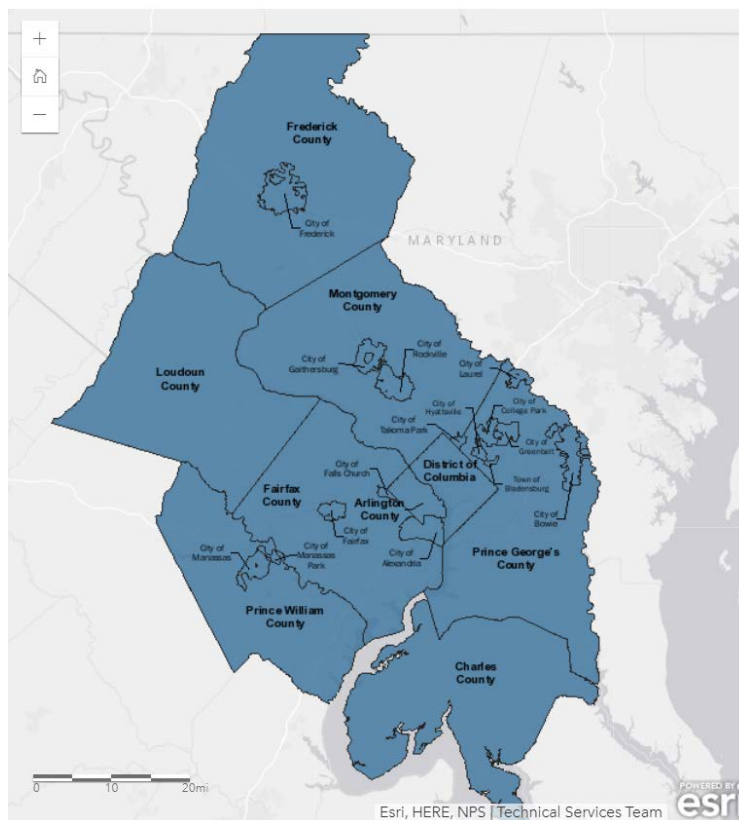
# INTRODUCTION

## COG and the Region

Metropolitan Washington is a diverse and dynamic region home to more than five million people and one of the nation's largest economies. The Metropolitan Washington Council of Governments (COG) is an independent, nonprofit association comprised of 24 jurisdictions featuring urban, suburban, and rural communities across metropolitan Washington that range in size from about 10,000 to more than one million residents (Figure 1).

COG is a center for partnerships to facilitate sustainable growth, a well-maintained transportation system, clean air, water, and land, safe and healthy communities, and a vibrant economy. This work is guided by COG's comprehensive *Region Forward* vision, to ensure a more prosperous, accessible, livable, sustainable, and equitable future for all area residents. The *Region Forward* goals are:<sup>x</sup>

**Figure 1: COG Region and Member Local Jurisdictions**



### Climate and Energy

- We seek a significant decrease in greenhouse gas (GHG) emissions, with substantial reductions from the built environment and transportation sector.
- We seek efficient public and private use of energy region-wide, with reliance upon renewable energy and alternative fuels for buildings, vehicles, and public transportation.



### Environment

- We seek to maximize protection and enhancement of the region's environmental resources by meeting and exceeding standards for our air, water, and land.
- We seek preservation and enhancement of our region's open space, green space, and wildlife preserves.



### Transportation

- We seek a broad range of public and private transportation choices for our region which maximizes accessibility and affordability to everyone and minimizes reliance upon single occupancy use of the automobile.
- We seek a transportation system that maximizes community connectivity and walkability and minimizes ecological harm to the region and world beyond.



### Land Use

- We seek the enhancement of established neighborhoods of differing densities with compact, walkable infill development, rehabilitation and retention of historic sites and districts, and preservation of open space, farmland, and environmental resource land in rural areas.
- We seek transit-oriented and mixed-use communities emerging in Activity Centers that will capture new employment and household growth.



### Housing

- We seek a variety of housing types and choices in diverse, vibrant, safe, healthy, and sustainable neighborhoods, affordable to persons at all income levels.
- We seek to make the production, preservation, and distribution of affordable housing a priority throughout the region.



### Economy

- We seek a diversified, stable, and competitive economy, with a wide range of employment opportunities and a focus on sustainable economic development.
- We seek to minimize economic disparities and enhance the prosperity of each jurisdiction and the region as a whole through balanced growth and access to high-quality jobs for everyone.
- We seek to fully recognize and enhance the benefits that accrue to the region as the seat of the national government and as a world capital.



### Health and Human Services

- We seek communities in which every person enjoys health and well-being.



### Education

- We seek to provide greater access to the best education at all levels, from pre-kindergarten to graduate school.
- We seek to make our region a pre-eminent knowledge hub, through educational venues, workforce development, and institutional collaboration.



### Public Safety

- We seek safe communities for residents and visitors.
- We seek partnerships that manage emergencies, protect the public health, safety, welfare, and preserve the lives, property, and economic well-being of the region and its residents.

Equity is being woven in throughout the *Region Forward* goals and this plan. COG recognizes equity is achieved when all people are fully able to participate in the region's economic viability, contribute to the region's readiness for the future and connect to the region's assets and resources. COG seeks fairness and justice in the formation of priorities, policy, and programs and we will be anti-racist, actively oppose racism, and will advance equity in our work together across the region. Equity will be woven throughout COG's analyses, operations, procurement, programs, and priorities.

The Board of Directors is COG's governing body and is responsible for its overall policies. A wide network of policy, technical, and advisory committees, partnerships, and programs advance COG's work to achieve the *Region Forward* vision and goals.

# COG's Climate and Energy Program

## BACKGROUND <sup>xi</sup>

In 2007, the Metropolitan Washington Council of Governments (COG) celebrated its 50th anniversary. As part of its 50th anniversary year, the COG Board of Directors examined the extraordinary changes that took place during the first half century of COG's existence and how COG grew up along with the region and helped shape its growing and vibrant communities. The COG Board then set its sights on the next fifty years. It recognized global climate change as a profound force fundamental to defining the decades ahead. The COG Board resolved that the region would become a leader in the growing national and international effort to combat this major challenge to the region's quality of life.

On April 11, 2007, the COG Board adopted Resolution R31-07, creating a regional climate change initiative. In its resolution, the COG Board stated: "The failure to reduce greenhouse gases can undermine the quality of life in our region and its economic and environmental sustainability." The COG Board action called for creating one of the nation's first regional climate change programs that would include developing a greenhouse gas inventory, setting regional goals, identifying best practices for reducing emissions, advocating policies at the federal and state levels, making recommendations on regional climate change policy, and recommending a structure to guide COG's efforts in the future.

By adopting R31-07, the COG Board placed itself front and center on the national landscape of local jurisdictions and states taking leadership action on climate change. Resolution R31-07 established a Climate Change Steering Committee (CCSC) to guide the initiative. The committee's work ultimately led to the development of the National Capital Region Climate Change Report. <sup>xii</sup>

The National Capital Region Climate Change Report includes a 2005 baseline regional GHG inventory, examines potential climate change impacts, evaluates mitigation and adaptation strategies and establishes regional GHG emission reduction goals of: 10 percent below business as usual (BAU) projections by 2012 (bringing regional emission back down to 2005 levels), 20 percent by 2020 and 80 percent by 2050 (below the 2005 baseline). The COG Board of Directors adopted this report and its goals with Resolution R60-08 on November 12, 2008. The COG Board also established the Climate, Energy and Environment Policy Committee (CEEPC) to move the region toward meeting the regional GHG emission reduction goals.

## CLIMATE, ENERGY AND ENVIRONMENT POLICY COMMITTEE

The CEEPC guides the COG region in taking action to meet regional GHG emission reduction goals. CEEPC supports the *Region Forward Vision* by providing leadership and advising the COG Board on climate change, energy, green building, alternative fuels, solid waste and recycling issues, and by supporting area governments as they work together to meet regional goals. <sup>xiii</sup>

CEEPC includes representatives from COG's member local governments, state environmental and transportation agencies, state legislatures, the Air and Climate Public Advisory Committee (ACPAC), federal and regional agencies, electric and gas utilities, environmental organizations, business organizations, and members of the academic community. Several subcommittees, technical working groups, and partners provide essential input and support to CEEPC, including: <sup>xiv</sup>

- The **Climate and Energy Legislative Committee** leads the development of the COG Board's annual legislative priorities for climate and energy and advocates at the state and federal levels for policies and programs that support regional GHG emission reduction and enhances climate resilience. This committee consists of a sub-group of the local elected officials appointed to CEEPC.
- The **Air and Climate Public Advisory Committee (ACPAC)** provides a meaningful opportunity for appointed members of the public to advise CEEPC on climate and energy issues and initiatives. ACPAC's members represent diverse community interests and opinions from across the region. Members have various backgrounds including business/industry, education/scientific, environmental/health and civic organizations.
- The **Built Environment and Energy Advisory Committee (BEEAC)** serves as a technical advisory committee to CEEPC. Membership includes local government energy managers, green building program managers, sustainability coordinators and regional stakeholders, such as Metro. The group serves as a forum for discussion, sharing/learning, and monitoring of energy and green building issues in the region.
- The **Regional Emergency Support Function #12 (RESF-12)** is an energy committee coordinated by BEEAC members in cooperation with COG's Homeland Security and Public Safety Program. The group is responsible for coordinating with state and local agencies and emergency response teams to maintain continuous and reliable energy supplies through preventive measures, restoration, and recovery actions.
- The **Regional Tree Canopy Committee (RTCC)** is dedicated to maintaining a healthy tree and forest canopy in the face of climate change and an ever-changing landscape of air quality and stormwater management regulations. Committee members include local foresters and climate, air quality and stormwater experts who work together to facilitate a unified approach to tree and forest canopy management efforts.
- The **Solid Waste Managers and Recycling Committees** are comprised of COG member local jurisdiction representatives working on solid waste and recycling. Members come together to share best practices and lessons learned as well as tackle regional challenges such as commercial recycling, recycling markets, and advancing organics composting infrastructure in the region.
- The **Greater Washington Region Clean Cities Coalition (GWRCCC)** works with vehicle fleets, fuel providers, community leaders and stakeholders to reduce petroleum use in transportation. Initially launched and housed as a COG program, the GWRCC grew to a separate private-public partnership that still closely collaborates with COG to advance deployment of zero emission vehicles.<sup>xv</sup>
- A number of **Ad-Hoc Work Groups** have been established to operate for limited timeframes or come and go as needed to advance significant new initiatives or address members' needs. Examples of work group focuses have been establishing greenhouse gas accounting methodologies; developing model energy engagement programs; developing an electric vehicle readiness plan for the region; developing model solar permitting and inspections checklists and review processes; training for and developing model commercial PACE (Property Assessed Clean Energy) programs, policies and procedures; and much more.

## Progress

Since its inception, CEEPC has adopted short-term plans to set priorities and spur action between 2010 and 2020. Each plan builds off the last, to help move the region toward its goals to reduce GHG emissions, enhance resilience, and address the newest practices and member needs. CEEPC consistently pushes the bar for the outcomes they want to see for the region and then members work to help accomplish those outcomes. There has been a tremendous amount of effort in the region on climate and energy action over the last 10-15 years and while it would be difficult to capture it all in this plan, some highlights of commitments, accomplishments and initiatives are provided. Some examples of overall progress include:<sup>xvi</sup>

- The region surpassed its 2012 goal of 10 percent reduction in greenhouse gas (GHG) emissions below business as usual projections, bringing regional emission back down to 2005 levels. Overall emissions region-wide have decreased 13 percent between 2005 and 2018, despite a 19 percent growth in population. An immense undertaking is still needed to meet the GHG reduction goals moving forward.
- As of 2018, 13 percent of total regional electricity consumption came from renewable energy sources. This equates to more than 8.9 million MWHs of renewables.
- The region has surpassed both CEEPC's 2016 goal of 5,000 grid-connected renewable energy systems in the region and its 2020 goal of 30,000 systems. Distributed renewable energy deployment has grown at a tremendous rate from less than 470 systems in 2009 to more than 44,000 systems in 2019 operating with more than 479 megawatts of capacity.
- Buildings with a higher level of environmental performance are verified through programs such as Leadership in Energy and Environmental Design (LEED), ENERGY STAR, EarthCraft, Passive House and Living Buildings Challenge. The number of these certified high-performance buildings have grown from 3 in 2005 to 4,198 buildings of summer 2019.
  - Metropolitan Washington is consistently ranked in the top few metropolitan areas for ENERGY STAR rated buildings. In 2020, the Washington D.C. metro area was ranked 2<sup>nd</sup> for ENERGY STAR certified buildings.<sup>xvii</sup>
  - Maryland and Virginia are consistently ranked in the top 10 states for LEED development. In 2019, Maryland was ranked 6<sup>th</sup> and Virginia was ranked 7<sup>th</sup> for gross square footage of new space LEED certified. Although the District of Columbia is not officially included in the state rankings, the rankings recognize that the District had more LEED development than any state in the 2019 rankings.<sup>xviii</sup>
- Hybrid and electric vehicles owned in the region have grown from 11,843 hybrids in 2005 to 123,826 hybrid and electric vehicles in 2016. Only 8,225 of these vehicles are battery electric vehicles (BEV) or plug-in hybrid electric (PHEV) vehicles that need to plug into charging stations. As of 2016, hybrid and electric vehicles together account for 3 percent of all light duty vehicles in the region.
- Owners of BEVs and PHEVs need to be supported with a robust network of charging stations. Charging stations locations in the region increased from 124 in 2012 to 852 in 2019. The 852 station locations include 2,424 charging plugs.
- The regional recycling rate, one indicator to track progress towards zero waste, has increased from approximately 33 percent in 2005 to 47 percent in 2016.



## REGIONAL INITIATIVES

### COG Climate and Energy Team

COG's Climate and Energy Program provides support and resources to communities seeking to implement policies, programs and initiatives to reduce GHG emissions and enhance resilience. Types of support may include capacity building and training, data and tools, research, planning, policy/program development, project feasibility assessments, advocacy, and cooperative procurement. Areas of focus for the COG Climate and Energy Program have been greenhouse gas accounting, efficiency and green building, renewables, energy financing, energy infrastructure, clean fuel vehicles, emergency preparedness, urban tree canopy, recycling and waste management, climate resilience planning, cooperative procurement, equity, and engagement. COG local jurisdictions, states, and stakeholders work together to learn from experts and each other and to help facilitate implementation at-scale. Some examples of the Climate and Energy Team's collaborative work includes:

- **Greenhouse Gas Accounting:** Since its inception, CEEPC has made it a priority for all COG member jurisdictions to conduct GHG inventories to track progress towards emission reduction goals. COG's GHG inventory work provides for completeness, consistency, accuracy, replicability, transparency, and quality control for all 24 COG members and the region. In addition, COG continues to support enhancements to national protocols for community-scale inventories and development of tools to support decision-making.<sup>xix</sup>
- **Green Building:** COG's Intergovernmental Green Building Group (IGBG) was established in 2005 and lead development of the Regional Green Building Policy that the COG Board adopted in 2007. It called for all new local government construction to achieve Leadership in Energy and Environmental Design (LEED) Silver Certification and all commercial construction to be LEED Certified. The policy and IGBG encouraged and supported wide-spread adoption of local green building policies that have significantly influenced green building development in the region. IGBG eventually merged with COG's Energy Advisory Committee to form BEEAC where continued capacity building, training and encouragement of enhanced green building policies continues.<sup>xx</sup>
- **Renewables:** Coordinated bulk procurement initiatives helped result in more than 31 megawatts of solar deployment as of 2016. In 2010, the EPA GPP, COG and its members partnered to conduct 170 on-site solar feasibility assessments at public facilities and coordinated on bulk solar procurements. Under the U.S. Department of Energy SunShot Initiative, COG and its members partnered to adopt model solar permitting and inspection guidelines and launch solar co-ops in a dozen communities, many of which have continued to launch additional co-ops rounds.<sup>xxi</sup>
- **Energy Financing:** The Mid-Atlantic PACE Alliance (MAPA) is a partnership between stakeholders in Virginia, Maryland, and the District of Columbia - including COG - to accelerate the implementation of Commercial Property Assessed Clean Energy (C-PACE) programs and projects in the region. C-PACE is a financing mechanism for owners of commercial property to fund energy-related property improvements with no upfront costs. The MAPA Toolkit offers comprehensive program development guidelines for local governments. More than 10 PACE Programs have been launched and 35 projects in the region have been financed as of summer 2020 by C-PACE programs.<sup>xxii</sup>
- **Energy Infrastructure:** The accomplishments of CEEPC and its members have also earned the region recognition as a White House Climate Action Champion. This designation made

COG and its members eligible for targeted federal technical assistance and grant funding from 2014 – 2016. One way COG leveraged this opportunity was to conduct local clean energy infrastructure assessments at 6 sites across the region to determine the feasibility of microgrids, combined heat and power (CHP), geothermal or net zero energy development. Two examples of progress at these sites include the Falls Church School Campus is developing a net zero energy ready school campus with geothermal and the Washington Hospital Center is seeking funding for microgrid deployment.

- **Clean Fuel Vehicles:** In 2015, COG partnered with Vision Fleet to develop opportunity assessments to maximize overall fleet efficiency for four local government vehicle fleets, including the District of Columbia, Alexandria, Prince George’s County and Frederick County. Complete light-duty fleet inventories included detailed, vehicle-specific total cost of ownership estimates and more efficient, cost-effective substitutes for each vehicle. The comprehensive assessment recommendations were both quantitative and qualitative to maximize financial and fuel savings and reduce carbon emissions through electric vehicle deployment, car-sharing programs, strategic right-sizing, or increase asset utilization.<sup>xxiii</sup>
- **Emergency Preparedness:** COG has been doing energy emergency coordination since the 1970s gas shortage crisis and the development of the 1973 Metropolitan Washington Tri-State Energy Emergency Coordination Agreement. Regional plans and coordination over the years have addressed energy conservation and management, natural gas emergency alerts, and energy emergencies. The most recent plan addressing energy emergencies is the 2010 Regional Emergency Coordination Plan. Over the years, COG has coordinated several energy emergency exercises with emergency responders, local energy managers, and energy and water utilities.
- **Urban Tree Canopy:** CEEPC formed a Tree Canopy Subcommittee to further recommendations of the 2018 Tree Canopy Management Strategy. The Subcommittee is developing a “cookbook” of model tree ordinance provisions, recommendations for minimum percent tree canopy coverage for differing land use types, and a Regional Tree Canopy Action Plan.
- **Recycling and Waste Management:** COG works with local waste management and recycling program managers, waste management and recycling companies, and other stakeholders to share best practices, market conditions, and other information to assist optimization of local waste management and recycling practices. COG sponsors the annual Go Recycle public information program and the America Recycles Day program with schools across the region.
- **Climate Resilience Planning:** COG is currently coordinating with the U.S. Army Corps of Engineers Baltimore District and local cost-share partners on a coastal storm risk management study to evaluate the performance of current flood protection infrastructure along the northern Virginia bank of the Potomac and its tidal tributaries. The project includes analyzing tidal flooding risks and developing designs for new flood protection systems – including green and gray infrastructure – to reduce to risk to northern Virginia communities and built assets.<sup>xxiv</sup>
- **Cooperative Procurement:** The basic objective of COG’s Cooperative Procurement Program and our Mid-Atlantic Purchasing Team (MAPT) is to reduce costs through economies of scale created through volume buying. The COG Rider Clause provides the opportunity for members to join existing awards and avoid the need to do in-house bidding. CEEPC and its

members have leveraged the program and rider clause for procurements such as solar, energy efficient lighting, electric vehicles, and climate planning.<sup>xxv</sup>

- **Equity:** Adopted by CEEPC in 2017, the Environmental Justice Toolkit provides guidance to policymakers on incorporating social equity, cultural sensitivity, and community health considerations into air quality, climate, and energy planning. Environmental justice has been a priority of ACPAC and members took the lead on developing the toolkit to help communities address issues of equity, access to decision makers, and meaningful engagement of the public, when making decisions that affect the local and regional environment.<sup>xxvi</sup>
- **Engagement:** COG's Climate and Energy Leadership Awards, coordinated by ACPAC, recognizes organizations that develop climate stewardship projects and programs that engage and serve the region's underserved communities. Over the last 6 years, the awards program has highlighted a broad range of climate solutions for their unique engagement practices as well as their results, creativity, and replicability.<sup>xxvii</sup>

### **National Capital Region Transportation Planning Board**

In 2018, the National Capital Region Transportation Planning Board (TPB), staffed by COG, approved Visualize 2045, a federally mandated, long-range transportation plan for the region. Visualize 2045 shows land use and transportation projects being planned for the region to support forecasted growth in population and employment. The performance analysis of the Visualize 2045 constrained elements projects long-term GHG reductions relative to today due to factors such as:

- Growth in the region's vehicle miles travelled (VMT) (20 percent) will be less than population growth (23 percent), which means that on average, a person is forecast to drive 3 percent fewer miles in 2045.
- More residents will have better access to high-capacity transit in the future. In 2045, 38 percent of the region's population is forecast to live within walking distance of such transit, compared to 29 percent today. Furthermore, 59 percent of jobs will be accessible by high-capacity transit, compared to 51 percent today.
- By 2045, 71 percent of Activity Centers will be connected to high-capacity transit, up from 59 percent.
- The region's residents can reach 369,000 jobs within a 45-minute transit commute in the morning peak period. By 2045, with addition of population and jobs, mostly in or near activity centers and high capacity transit stations, and transit improvements, residents will be able to access 518,000 jobs within a 45-minute transit commute, which is a 40 percent increase relative to today.
- Today, on average, the region's residents can reach 864,000 jobs within a 45-minute drive from home in the morning peak period. By 2045, with the addition of population and jobs, mostly in Activity Centers, and transportation improvements, residents will be able to access 909,000 jobs within a 45-minute auto commute, which represents a 5 percent increase.<sup>xxviii</sup>

The TPB's Visualize 2045 Plan includes seven initiatives representing priorities to guide the region's future concerted action on transportation projects, programs, and policies, and land use. These initiatives all have the greatest potential to significantly improve the region's transportation system performance compared to current plans and programs, including achieving further GHG emissions reductions. The TPB is urging member agencies to prioritize implementing transportation projects, programs, and policies that advance the aspirational initiatives:



- Bring Jobs and Housing Closer Together
- Expand Bus Rapid Transit and Transitways Regionwide
- Move More People on Metrorail
- Provide More Telecommuting and Other Options for Commuting
- Expand Express Highway Network with Enhanced Express Bus System
- Improve Walk and Bike Access to Transit
- Complete the National Capital Trail Network<sup>xxxix</sup>

In addition, the Environmental Justice analysis of Visualize 2045 identified Equity Emphasis Areas (EEAs). EEAs are small geographic areas that have significant concentrations of low-income, minority populations, or both. The TPB's primary purpose for the EEAs map is as an analytical tool to analyze the long-range transportation plan for disproportionately high and adverse impacts on low-income and minority populations. The EEAs are also being used in other regional and community planning activities, including in analyzing climate impacts and risks in this 2030 Climate and Energy Action Plan.<sup>xxx</sup>

### **Washington Metropolitan Area Transit Authority (METRO)**

As the backbone of the regional mobility system, Metro provides access to places, jobs, services, and opportunity for hundreds of thousands of residents and visitors. High capacity transit, such as Metrorail, is a critical element for connecting Activity Centers, which are places with high concentrations of jobs and population with mixed land use. Metro growth in ridership and service expansion has allowed for more compact development. Metrorail, bus, and paratransit services enable people to access their destinations while reducing reliance on cars, which reduces the need for single-occupancy vehicle trips and leads to reduced GHG emissions.<sup>xxxi</sup>

In addition, Metro is fine tuning its own operations to reduce its energy and resource usage and mitigate risks. As one of the single largest energy users in the region, Metro is an important partner for meeting regional energy goals. In 2019, Metro adopted its Energy Action Plan, a detailed roadmap for saving energy and money through efficiency investments, modernized design and operation, and engagement in the regional energy market. In FY20 Metro advanced several programs that increased energy efficiency, including accelerated completion of LED lighting upgrades at 48 underground stations (track bed, pylon and parapet lighting); signed a Solar Ground Lease to install 17-acres of community solar providing revenue generation for Metro over the next 25 years; and continued energy market engagement with major regional energy policy groups and new partnerships for energy purchasing.<sup>xxxii</sup>

## **GOALS AND COMMITMENTS**

### **Regional Goals and Commitments**

COG's *Region Forward* Vision focuses on creating a more prosperous, accessible, livable, sustainable, and equitable metropolitan Washington. In 2010, the COG Board adopted the *Region Forward* Vision and Goals that include climate and energy goals to reducing GHG emissions and the efficient use of energy, with reliance on renewable energy and alternative fuels.<sup>xxxiii</sup>

The COG Board previously established specific GHG emission reduction goals of 10 percent below business as usual projections by 2012 (bringing regional emission back down to 2005 levels), 20 percent by 2020 and 80 percent by 2050 (below the 2005 baseline). In 2019, CEEPC became a Signatory to the Global Covenant of Mayors for Climate and Energy (GCoM). Signatories pledge to minimally reduce CO<sub>2</sub> emissions by at least 40 percent by 2030 and to increase their resilience to the impacts of climate change. The GCoM commitment also includes following its framework of

global best practices for climate planning. CEEPC reviewed both the GCoM framework and updated IPCC recommendations in preparing this plan. Therefore, this plan was developed, CEEPC followed the GCoM framework and the need for action for 2030. Based on this review and a recommendation from CEEPC, the Board approved new 2030 climate goals including: <sup>xxxiv</sup>

- The climate mitigation goal of 50 percent greenhouse gas emission reductions below 2005 levels by 2030;
- The climate resilience goal of becoming a Climate Ready Region and making significant progress towards becoming a Climate Resilient Region by 2030.

To be Climate Ready by 2030, all local governments must assess current and future climate risks, and be actively integrating climate planning across government plans, operations, and communications. To fully be a Climate Resilient Region, the region must have the ability to adapt and absorb against disturbances caused by current and future, acute and chronic climate impacts and successfully maintain essential functions.

### **Local Goals and Commitments**

In 2010, all COG local jurisdiction members signed onto the *Region Forward* vision and goals via action by their local governing bodies (i.e. city council, county board or commission). The climate and energy goals include commitments to reducing GHG emissions and the efficient use of energy, with reliance on renewable energy and alternative fuels.

The majority of COG members have adopted specific local GHG emission reduction goals that align with the COG goals adopted by the COG Board in 2008. The Cities of Alexandria, Frederick and Takoma Park as well as Frederick and Montgomery Counties have declared climate emergencies that commit to achieving more aggressive GHG goals sooner. For example, Montgomery County's Emergency Climate Mobilization Resolution established goals for the County to reduce GHG emissions to 80 percent below 2005 levels by 2027 and to 100 percent by 2035. The other jurisdictions who have declared emergencies, as well as the District of Columbia and Arlington County, also have committed to carbon neutrality by 2035 or 2050.

Additionally, more than half of COG members committed to the We're Still In Pledge, a commitment to support climate action to meet the Paris Agreement. Several COG members have also made commitments to reduce GHG emissions to initiatives such as the Global Covenant of Mayors for Climate and Energy, Climate Mayors, and much more.

Throughout metropolitan Washington, local jurisdictions have recognized the importance of incorporating resiliency into local climate planning to adapt to climate change and minimize climate impacts. The District of Columbia's Climate Ready DC plan assesses current and future climate risks and provides goals, targets, and actions to adapt to climate change. Alexandria's Environmental Action Plan 2040 has multiple resiliency action items including supporting legislative initiatives for climate adaptation and resiliency, developing a Green Infrastructure Program, and creating a Stormwater Management Master Plan to reduce the impacts of flooding and drainage issues. Arlington County's Community Energy Plan includes a goal to ensure Arlington's energy resilience and includes policy actions that focus on developing resilient energy infrastructure, enhancing energy assurance, assessing microgrid opportunities for critical services, and leveraging biophilic urban design to mitigate the need for energy. <sup>xxxv</sup>

For a complete list of local GHG reduction goals, climate action plans, and commitments, see Appendix C: List of Metropolitan Washington GHG Emission Reduction Plans and Goals and Appendix

D: COG Member Collaborative Climate Program Commitments. Sample highlights of local actions to support reaching their goals are weaved into the Mitigation and Resilience Strategy sections of this plan.

### State Goals and Commitments

Table 1 shows the State Goals and Commitments that are currently in place. Renewable Portfolio Standards (RPS) are the most impactful tool to reduce the amount of fossil fuel-generated electricity on the grid. The District of Columbia, Maryland, and Virginia have all adopted aggressive RPS goals. The District of Columbia, Maryland and Virginia have adopted buildings codes that drive greater energy efficiency in the built environment. Additionally, the District of Columbia and Maryland are part of the Regional Greenhouse Gas Initiative (RGGI), which establishes a regional cap on the amount of carbon dioxide (CO<sub>2</sub>) emissions that can be emitted by power plants. This is achieved through the issuance of tradable CO<sub>2</sub> allowances. Virginia is set to join RGGI on January 1, 2021. The District of Columbia, Maryland, and Virginia are all participating in the Transportation Climate Initiative (TCI). This initiative is a collaboration of 12 states and the District, which seeks to reduce carbon emissions from the transportation sector.

**Table 1: State Goals, Commitments and Legislation that Support GHG Reduction**

Goals/Commitments	District of Columbia	Maryland	Virginia
Greenhouse Gas Reduction Goals*	50% Reduction below 2006 levels by 2032	40% Reduction below 2006 levels by 2030	N/A
	Carbon Neutral by 2050	N/A	N/A
Renewable Portfolio Standards	100% by 2032	50% by 2030, and 100% by 2040	30% by 2030, and 100% by 2050
Adopted Building Codes:**			
International Energy Conservation Code (IECC)	2015 IECC	2018 IECC	2015 IECC
International Green Construction Code (IgCC)	2012 IgCC	2018 IgCC	N/A
Regional Greenhouse Gas Initiative (RGGI) Participation	✓	✓	Pending - Virginia is scheduled to join RGGI in January 2021
Transportation Climate Initiative (TCI) Participation	✓	✓	✓

\*Greenhouse Gas Reduction Goals reflected in Table 1 are state-level goals and do not reflect COG's regional GHG reduction goals or more aggressive goals made by local jurisdictions in the metropolitan Washington region.

\*\*According to the U.S. Department of Energy (U.S. DOE), all Building Codes reflected in Table 1 have amendments made at the state level. The District of Columbia has significantly amended the 2015 IECC for residential construction. U.S. DOE's determination of their code compliance states that they meet the 2009 IECC for residential construction. Maryland has adopted the 2018 IECC, but there are a number of local amendments for commercial construction that only require jurisdictions to meet the 2015 IECC. Virginia has adopted the 2015 IECC. Energy components originally amended related to insulation and measured air

changes in residential construction to meet the 2009 IECC for residential construction. The most recent October 2020 adopted update of the Statewide Building Code Standards is closer to alignment with the 2015 IECC.<sup>xxxvi</sup>

For a complete list of state GHG reduction goals, commitments and legislation that support GHG reduction, see Appendix D: COG Member Collaborative Climate Program Commitments and Appendix E: List of State Legislation Supporting GHG Emission Reduction in Metropolitan Washington.

Adapting to climate change is one of the biggest challenges metropolitan Washington faces. In addition to climate mitigation efforts, the District of Columbia, Maryland and Virginia have implemented resiliency policy initiatives and programs to ensure the region can adapt to a changing climate.

The District of Columbia in 2016 passed legislation establishing the Commission on Climate Change and Resiliency. The commission is responsible for identifying best practices in resiliency, conducting vulnerability assessments for critical infrastructure and systems and making recommendations for legislative or regulatory changes needed to reduce vulnerabilities, and other duties. Resilience actions and projects undertaken in the District are guided by the District's Climate Ready DC plan, the overarching plan make the District more resilient to climate change.<sup>xxxvii</sup>

Maryland has enacted several resiliency initiatives to adapt to climate change. In 2012, Maryland enacted the initiative "Coast Smart" construction which directs all state agencies to consider the risk of coastal flooding and sea level rise in the design of state structures to minimize impacts. In 2018, this was expanded to better manage sea level rise and improve coastal adaptation efforts. The state also established the Maryland Commission on Climate Change (MWCC), which was codified into law in 2015. The commission provides resilience and mitigation advice to the General Assembly and the Governor on strategies to adapt to climate change. Within the MWCC, The Adaptation and Resiliency Work Group (ARWG) supports developing and implementing a strategy to adapt to climate change. The ARWG is building off the Maryland's Climate Action Plan (2013) which assesses the impacts associated with sea level rise and coastal storms, and provides reduces risks through building societal, economic, and ecological resilience. Moreover, Maryland has been extending programs to incorporate resiliency projects, Maryland's Energy Administration introduced in the 2020 Resilient Maryland Program, providing funding for projects to increase microgrids and other distributed energy resource in order to improve energy resiliency.<sup>xxxviii</sup>

Virginia is taking steps to adapt to sea level rise. In 2018, Governor Northam issued Executive Order Number 24, which provides an avenue to increase resilience to flooding, incorporating sea level rise into projections, and establishes a provision for the State's first Coastal Resilience Master Plan. In 2020, Virginia HB1313, formalized the role of a Chief Resilience Officer, who serves as the main coordinator of resilience and adaptation initiatives. In October 2020, Virginia released the Virginia Coastal Resilience Master Plan setting out the goals, objectives, guiding principles, and key actions the Commonwealth will pursue to enhance coastal resilience, with a focus on protecting key assets, developing cost-effective strategies, conserving and enhancing natural flood controls, and ensuring equity for underserved communities. Virginia also joined Maryland in the Regional Greenhouse Gas Initiative (RGGI), a program to reduce carbon dioxide emissions from power plants, which in Virginia, allows revenues from the sale of carbon allowances in part, to be directed to municipalities to develop low-income energy efficiency programs and flood resiliency initiatives.<sup>xxxix</sup>

# THE CLIMATE AND ENERGY ACTION PLAN

## Purpose and Scope

According to the Intergovernmental Panel on Climate Change (IPCC), a body of the United Nations that assesses the science related to climate change, the world is already experiencing the impacts of 1 degree Celsius of global warming above pre-industrial levels. Additionally, the IPCC notes that more severe climate impacts could be avoided if global warming is limited to 1.5 degrees Celsius. Globally, emissions need to fall by 45 percent from 2010 levels by 2030 and carbon neutral by 2050 to limit global warming to 1.5 degrees Celsius. The IPCC acknowledges rapid and far reaching transitions are needed world-wide in order to limit global warming.<sup>xi</sup>

The 2030 greenhouse gas (GHG) emission reduction goals adopted by the COG Board on October 14, 2020 align with the level of effort called for by the IPCC to limit global warming to 1.5 degrees Celsius. COG Board Resolution R45-2020 established interim climate change goals including:<sup>xii</sup>

- The climate mitigation goal of 50 percent greenhouse gas emission reductions below 2005 levels by 2030;
- The climate resilience goal of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030; and
- The need to incorporate equity principles and expand education on climate change into COG's Climate, Energy and Environment Policy Committee (CEEPC) and COG members' actions to reach the climate mitigation and resiliency goals.

To be a Climate Ready Region by 2030, all local governments must assess current and future climate risks, and be actively integrating climate planning across government plans, operations, and communications. To fully be a Climate Resilient Region, the region must have the ability to adapt and absorb against disturbances caused by current and future, acute and chronic climate impacts and successfully maintain essential functions.

The purpose of this plan is to establish priority collaborative actions for COG and its members to work on together over the next ten years to help move the region towards meeting the 2030 goals. All the actions in the plan are voluntary; the success of the plan depends on active regional collaboration and implementation. Achieving the regional goals would require unprecedented, aggressive cross-sectoral action from all 24 COG member local jurisdictions, as well as its state and federal partners.

## GUIDING PRINCIPLES

Ten principles guide this plan's voluntary collaborative climate action implementation process. These principles reflect CEEPC's commitment to environmental quality, economic prosperity, and equity. As climate leaders, CEEPC is committed to the following principles:

- 1. Collective Action:** We will continue to work together to leverage our impact and facilitate application at scale.
- 2. Effective Partnerships:** We will continue to share best practices, learn together, and coordinate on implementation to advance regional transformation.
- 3. Lead by Example:** We have a continued commitment to internal implementation of long-term solutions to reduce the climate impacts of our operations.

4. **Integration:** We understand climate action is inherently multidisciplinary and will promote cross-department coordination, including in areas such as equity, health, and economic development.
5. **Flexibility:** We understand the need for flexibility in how our public agencies and stakeholders across the District of Columbia, Maryland, and Virginia work to achieve regional GHG goals.
6. **Transparency:** We will continue to measure and report progress in a manner easily understandable by all.
7. **Innovation:** We support a just transition to a clean energy economy through the application of innovative technology, policies, and processes by public and private sectors.
8. **Community Leadership:** We will continue to educate, motivate, and empower action from our community's institutions, businesses, non-profits, and residents.
9. **Inclusive Engagement:** We commit to inclusive community engagement and equitable provision of climate and energy programs and services.
10. **Advocacy:** We will continue to support state and federal policies and programs that protect the human and environmental health of our communities.

## GLOBAL COVENANT OF MAYORS FOR CLIMATE AND ENERGY

In 2019, COG was selected as a Regional and Metro Scale Climate Leader by the Global Covenant of Mayors for Climate and Energy (GCoM). GCoM provides a framework of global best practices for climate planning. CEEPC became a GCoM Signatory, committing to follow the framework for the development of this plan. GCoM has provided COG with guidance and technical assistance to ensure this plan follows the GCoM framework.<sup>xliii</sup>

The GCoM framework requires inventories, targets, and plans of Signatories to follow their global best practices. The framework breaks the planning process into two areas. The first addresses baseline conditions and mitigation actions to reach regional GHG emission reduction goals. The second involves completion of a regional Climate Risk and Vulnerability Assessment (CRVA) and identification of resiliency actions to reduce the risk and make the region more climate change ready.

In addition, this plan incorporates GCoM's priority for providing improved access to secure, sustainable, and affordable energy. While the protocol has not been fully defined for North American energy markets, it accommodates addressing equitable access to clean and secure renewable power sources at affordable prices and providing energy-efficient housing to all sectors of the market.

## Plan Elements

There are four core elements to this plan, including:

- **Greenhouse Gases:** This section of the plan provides a summary of regional GHG inventory trends from 2005 – 2018, business-as-usual (BAU) GHG emission projections through 2030, and technical scenario showing what it will take for the region to reach GHG reductions of 50 percent below 2005 levels by 2030.
- **Climate Mitigation Strategy:** This section of the plan identifies CEEPC's priority collaborative mitigation actions to move the region toward achieving the GHG emission reduction goal of



50 percent by 2030, below 2005 levels. The action areas include Planning, Equity, Clean Electricity, Zero Energy Buildings, Zero Emission Vehicles, Mode Shift and Travel Behavior, Zero Waste, and Sequestration.

- **Climate Risks and Vulnerabilities:** This section of the plan provides a summary of the Regional Climate, Risk and Vulnerability Assessment (CRVA). The CRVA evaluates climate hazards including extreme heat, drought, lightning and thunderstorms, flash and riverine flooding, coastal flooding and extreme winter conditions. The CRVA also evaluates factors impacting adaptive capacity, such as infrastructure conditions and maintenance, access to basic services, and public health.
- **Climate Resilience Strategy:** This section of the plan identifies CEEPC's priority collaborative climate resilience actions to move the region toward achieving the goal of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030. The action areas include Planning, Equity, and Resilient Infrastructure.

## Stakeholder Engagement

The core stakeholder groups engaged during the development of the Metropolitan Washington 2030 Climate and Energy Action Plan were COG's Air and Climate Public Advisory Committee (ACPAC), the Built Environment and Energy Advisory Committee (BEEAC), and the Climate, Energy and Environment Policy Committee (CEEPC). These bodies and its members work together to implement the Plan's recommendations both locally and regionally. ACPAC serves as the public advisory committee to CEEPC and BEEAC serves as the technical advisory committee to CEEPC. CEEPC is the COG policy committee on climate and energy and the lead advisor on these issues to the COG Board. The COG Board establishes the overarching climate goals for ACPAC, BEEAC and CEEPC to work towards and is the final authority adopting regional goals. More information about these bodies can be found in the Introduction section of this plan.

At its September 25, 2019 meeting, CEEPC became a GCoM Signatory and officially launched the development of this plan. As one of the first regions in the U.S. to commit to follow GCoM's framework, CEEPC pledged to implement policies and undertake measures to reduce GHG emissions, prepare for the impacts of climate change, increase access to sustainable energy, and track progress toward these objectives. CEEPC also reviewed the scope and timeline for the 2030 Regional Climate and Energy Action Plan that was developed to align with the GCoM framework. In advance of the September CEEPC meeting, CEEPC advisory committees, ACPAC and BEEAC, had the provided input and offer support for the GCoM commitment and scope for the Plan.<sup>xliii</sup>

In November 2019, ACPAC, BEEAC and CEEPC members held a joint 2-day Climate Planning Work Session. The first day was dedicated to mitigation where the group reviewed progress towards regional 2020 goals and new drafts of the region's GHG emissions business-as-usual (BAU) projections and 2030 low carbon scenarios. The second day was dedicated to resilience where the group discussed the draft regional climate risk and vulnerability assessment (CRVA). Over the 2-day session, participants provided input on the challenges, opportunities and next steps related to regional goals, collaborative actions, sustainable energy access and equity for both mitigation and resilience.<sup>xliv</sup>

Based on input from the November Work Session, revisions were made to the BAU projections, scenarios and CRVA and goals and a preliminary list of priority collaborative actions were developed. Due to the outbreak of the COVID-19 pandemic, stakeholder engagement was pushed back by a

month and stakeholder engagement for the remainder of the planning process moved to virtual platforms in lieu of in-person engagement. Virtual stakeholder engagement sessions to move the Plan toward adoption included:<sup>xlv</sup>

- In April 2020, ACPAC, BEEAC and CEEPC members were invited participate in a virtual work session to review preliminary list of goals and actions for this plan.
- In May 2020, CEEPC hosted a roundtable discussion on local climate goals, actions and progress. The impacts and effects of COVID-19 on climate planning and implementation were discussed.
- In June 2020, a technical Q&A webinar was held to review and provide input on BAU and scenario revisions.
- In July 2020, members of ACPAC, BEEAC and CEEPC had the opportunity to provide input on the revised the plan goals at their respective virtual meetings.
- In September 2020, the COG Board received an update on the planning process and potential goals.
- In September 2020, ACPAC, BEEAC and CEEPC reviewed the draft plan and draft resolution to the COG Board on updated regional climate goals. CEEPC approved the resolution to the COG Board.
- In October 2020, the COG Board reviewed and adopted the recommended resolution from CEEPC establishing 2030 climate mitigation and resilience goals.<sup>xlvi</sup> Additional virtual sessions were held to listen to stakeholder comments and discuss changes to the plan based on comments received.
- In October 2020, the National Capital Region Transportation Planning Board (TPB) adopted a resolution endorsing the COG Board's resolution on region's 2030 climate goals.
- In November 2020, CEEPC approved the Metropolitan Washington 2030 Climate and Energy Action Plan.

After each work session for the Plan, stakeholders were provided a comment period to allow time for further review and written comments.

## Implementation and Monitoring

CEEPC and its advisory committees will follow the Guiding Principles identified above to work together to support implementation of this plan. For the region to meet the regional climate change goals, aggressive local actions and on-the-ground change will need to occur across the entire region. Additionally, the goals cannot be met if the climate injustices faced by underserved, potentially vulnerable communities are not addressed head-on. All climate action and implementation need to occur with an equity lens. The purpose of stakeholders voluntarily coming together to collaborate on action across the region, is to leverage our impact and facilitate innovation and action at scale.

To monitor progress toward the Plan's goals, COG will report out on progress every two years. As a GCoM Signatory, CEEPC developed this plan to follow global best practices in climate planning, which includes reporting progress to GCoM every two years on implementation and progress on both mitigation and resilience. While the reporting survey template changes year-to-year and data availability may vary, progress reported may include GHG emissions, examples of local and regional action, and examples of implementation progress on this plan's priority collaborative actions. This biennial update on progress will provide an opportunity to discuss progress with CEEPC and its advisory committees, discuss needs and new issues, and adjust next steps, as needed.



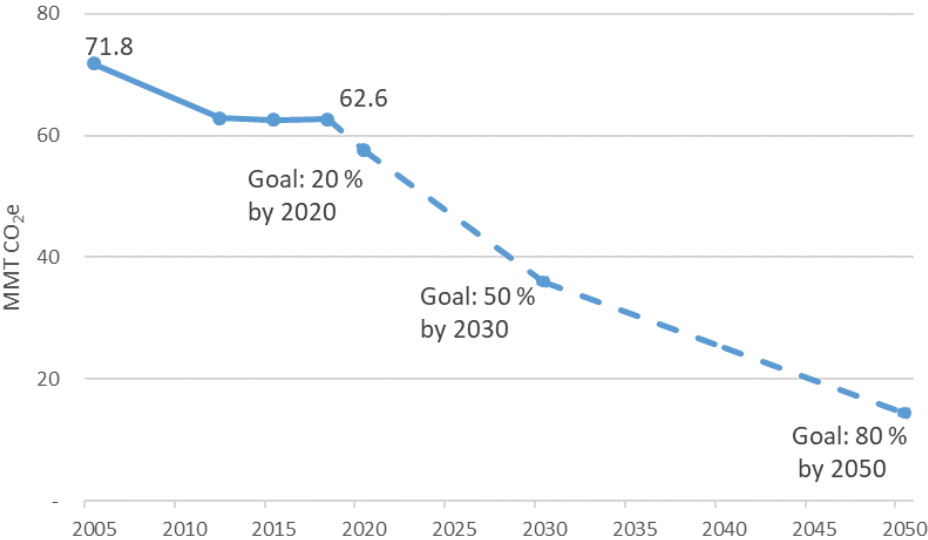
# GREENHOUSE GAS EMISSIONS

## Inventory

Since its inception, the Climate, Energy and Environment Policy Committee (CEEPC) has made it a priority to track progress toward local and regional greenhouse gas (GHG) emission reduction goals. The ability to develop relevant, robust sets of inventories supports decision-making around policies and programs that reduce emissions. COG has completed GHG inventories for 2005, 2012, 2015, and 2018 to track progress towards the goals of 10 percent below the business as usual emissions projections by 2012 (back down to 2005 emission levels) and 20 percent below 2005 emissions by 2020.

COG’s greenhouse gas inventories show that the region’s progress to date towards the above goals has been mixed. The region exceeded its 2012 goal but is lagging on progress towards its 2020 goal. The most recent inventory indicates that 2018 GHG emissions in the region decreased by approximately 13 percent below 2005 levels. Despite a 19 percent growth in population, GHG emissions reduced from 71.8 million metric tons of carbon dioxide equivalent (MMT<sub>CO<sub>2</sub>e</sub>) in 2005 to 62.6 MMT<sub>CO<sub>2</sub>e</sub> in 2018. Per capita emissions decreased between 2005 and 2018 from 15.6 metric tons of carbon dioxide equivalent (MTCO<sub>2</sub>e) in 2005 to 11.4 MTCO<sub>2</sub>e in 2018. Expedited and concerted actions will be needed throughout the region to achieve future goals of 50 percent GHG emission reduction by 2030 and 80 percent by 2050 (Figure 2).

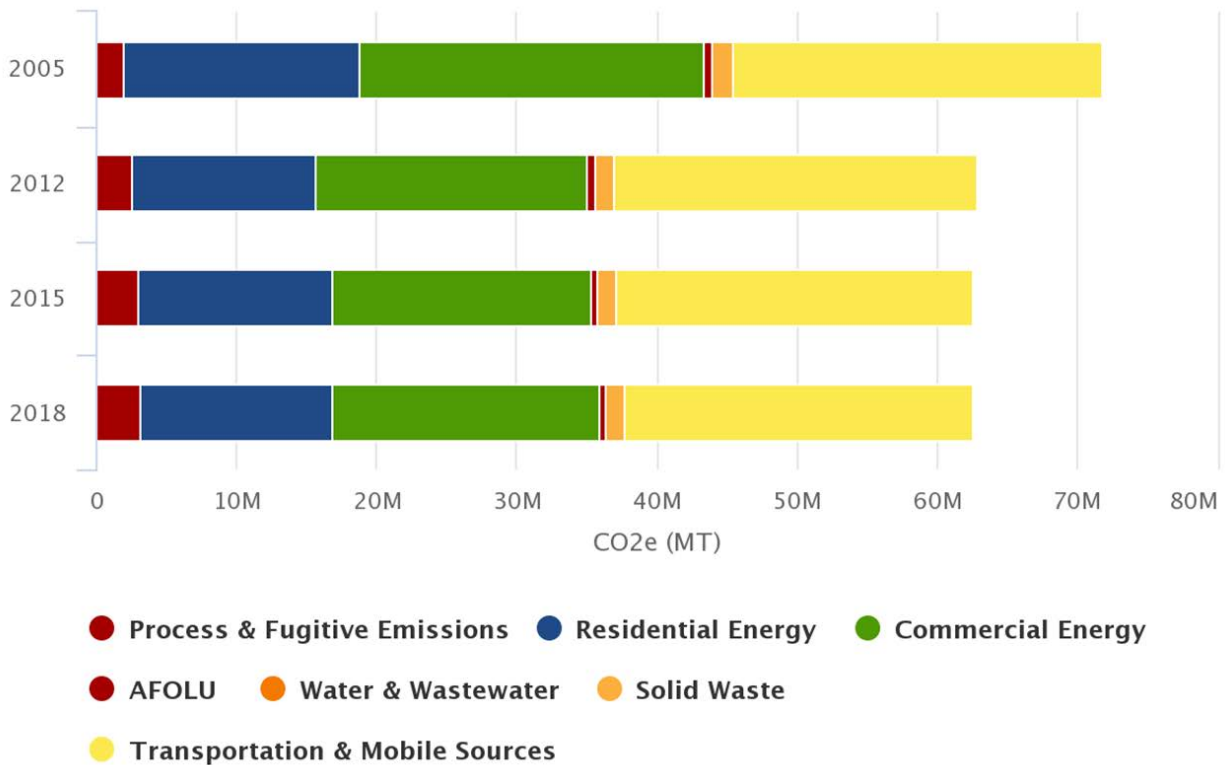
**Figure 2: Metropolitan Washington GHG Trends and Goals**



## EMISSIONS ACTIVITIES

The inventories measure GHG-emitting activities undertaken by residents, businesses, industry, and government located in metropolitan Washington, as well as emissions from visitors. Approximately 90 percent of metropolitan Washington’s GHG emissions come from residential and commercial building energy consumption and transportation. Building energy consumption accounts for 50 percent and 40 percent is from transportation. The remainder of emissions comes from other activities and sources including solid waste, wastewater treatment, agriculture and fugitive emissions (Figure 3).

**Figure 3: Metropolitan Washington GHG Emissions by Activity**



Source: ICLEI’s ClearPath, an online greenhouse gas inventory tool.

**METHODOLOGY**

The inventories have been developed to be compliant with both the U.S. Communities Protocol for Accounting and Reporting Greenhouse Gas Emissions (USCP), Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC), and Global Covenant of Mayors (GCoM) reporting framework. COG mainly follows the calculation guidance from USCP as the USCP identifies sources of data widely available to communities in the US. COG uses ICLEI’s ClearPath tool Community Scale Inventory Module for preparing GHG inventories, which is consistent with both US and global accounting protocols.<sup>xlvii</sup>

COG makes every effort to capture a complete and accurate picture of GHG trends across the region, while also providing for a consistent methodology that is replicable across communities and inventory years. COG inventories follow an activities-based approach, meaning emissions are calculated based on the result of activities happening in each of the COG members’ communities. Local results are totaled to create a picture for the region as a whole. For a detailed description of the methodology, see Appendix F: Greenhouse Gas Inventory Methodology.

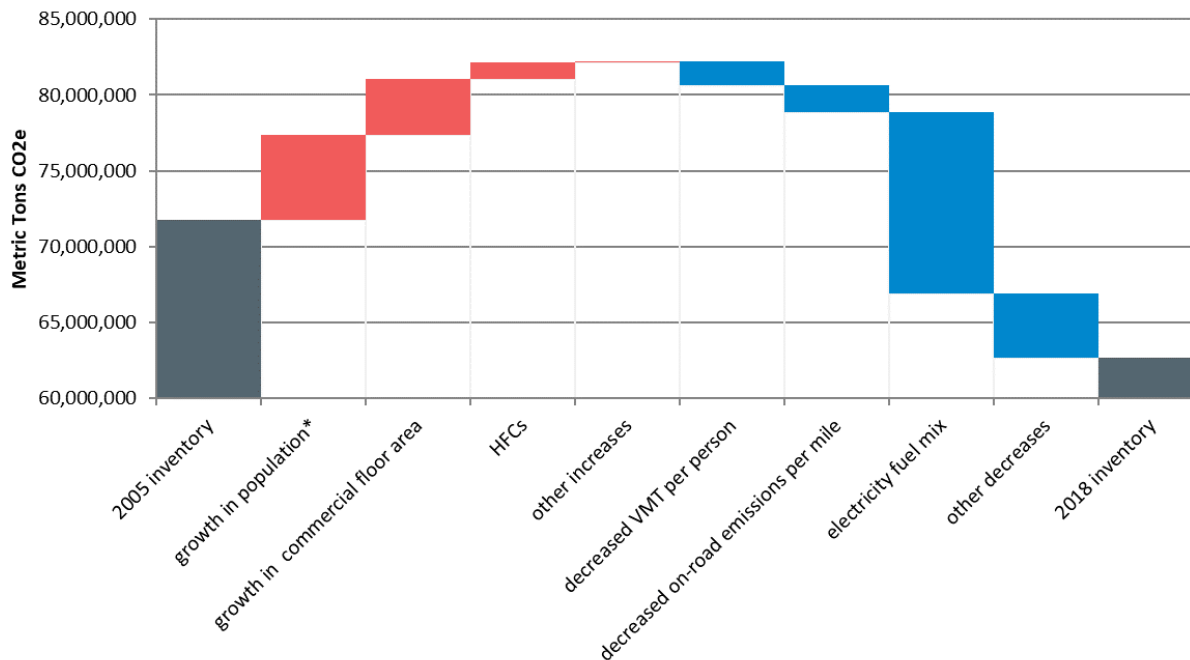
**DRIVERS OF GHG CHANGE**

ICLEI’s GHG Contribution Analysis Tool evaluates the biggest drivers influencing GHG performance of cities, counties and regions. The tool provides for a deeper understanding of what is driving emissions changes between GHG inventory years to help identify and prioritize more effective actions to reduce GHG emissions. COG was a partner on a national team under the U.S. Department

of Energy Cities Leading through Energy Analysis and Planning (CLEAP) Program to develop the Contribution Analysis model and toolkit.<sup>xlviii</sup>

The metropolitan Washington GHG Contribution Analysis results in Figure 4 shows what has driven increases and decreases in emissions between inventory years 2005 and 2018. The main drivers increasing emissions (red bars) include growth in population, commercial space, and hydrofluorocarbons (HFCs). Driving down emissions (blue bars) is mainly a cleaner grid, cleaner cars and reduced vehicle miles traveled (VMT) per person.

**Figure 4: Drivers of Metropolitan Washington GHG Changes**



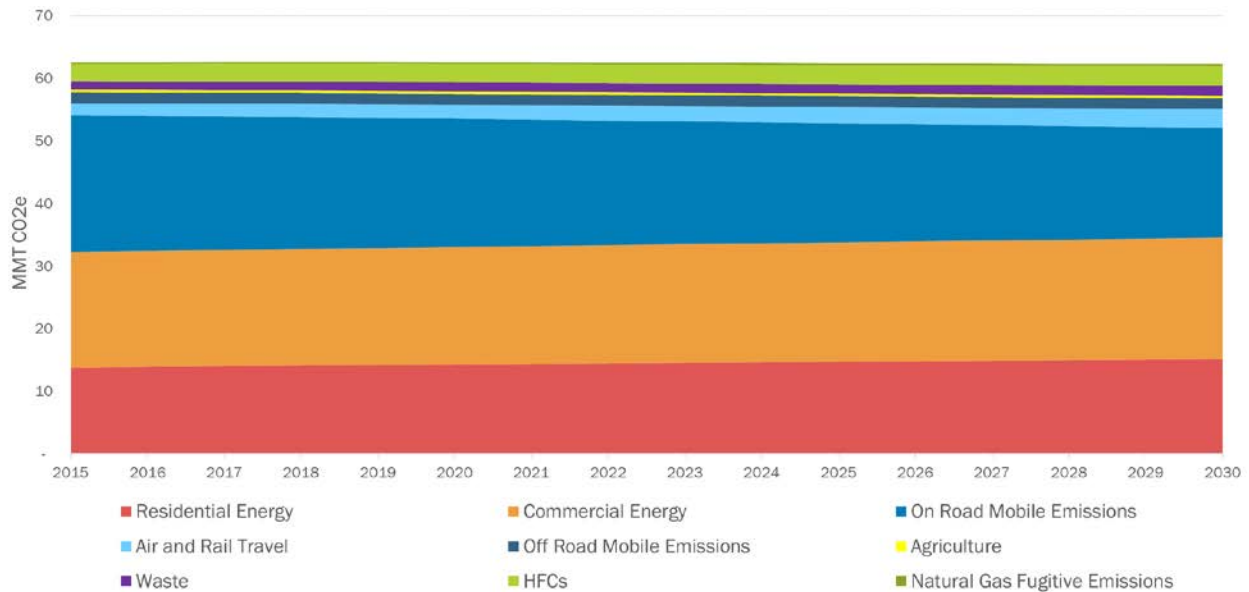
\*Includes effects of population on residential energy, VMT and waste generation.

## Business-As-Usual Projections<sup>xlix</sup>

Business-as-usual (BAU) projections provide a baseline scenario for future GHG emissions. BAU projections take into account driving factors such as growth in population, housing and commercial development and the impact they will have on future GHG emissions. BAU projections reflect policies and practices that have been in place and implemented to-date to reduce GHG emissions, but do not incorporate any additional GHG emission reductions from anticipated future action.

The metropolitan Washington BAU scenario for this Plan projected emissions out to 2030. Based on the assumptions used, total emissions overall remained flat between 2015-2030. Figure 5 shows the region’s anticipated BAU emissions projected out to 2030. See Appendix G: BAU and 2030 Scenario Assumptions for a summary table on the assumptions.

**Figure 5: Metropolitan Washington Business-As-Usual Projections**



## 2030 Scenario

The 2030 scenario for this plan analyzes the technical potential of "What Would It Take" for metropolitan Washington to reach a 50 percent reduction in GHG emissions by 2030 from 2005 levels. This scenario leverages a previous scenario analysis conducted in 2015 by the Multi-Sector Working Group and results have been updated based on new data and progress since that time.

Figure 6 on the following page shows a summary of the results to the "What Would It Take" scenario to reduce emissions 50 percent by 2030 below 2005 levels. Considerable action across local, regional, state and national levels will be needed. Clean Electricity, Zero Energy Buildings and Zero Emission Vehicles account for most of the potential emission reductions.

Clean Electricity includes state Renewable Portfolio Standards (RPS), distributed energy generation, and green power purchases. The single most impactful action throughout the 2030 scenario is the implementation of state RPS. Distributed energy generation has increased over the past ten years from less than 500 grid-connected renewable energy systems in 2009 to more than 44,000 systems in 2019. The region would need to deploy more than 200,000 additional solar systems in the next ten years to support meeting the 2030 goal. This is equivalent to 24 percent of single-family homes in the region installing solar photovoltaics on their roofs. The region will also need to have an additional 10 percent annual growth of green power purchases to meet the 2030 goal.

Zero Emission Vehicles in the 2030 scenario reflects the National Renewable Energy Laboratory (NREL) Electrification Futures Study high scenario electric adoption rates. As of 2016, less than 1 percent of vehicles on the road in metropolitan Washington were battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). By 2030, BEVs and PHEVs would need to increase to more than 30 percent light duty cars, 9 percent light duty trucks, 4 percent medium and heavy-duty trucks, and 30 percent transit buses to meet the 2030 GHG emission reduction goal.

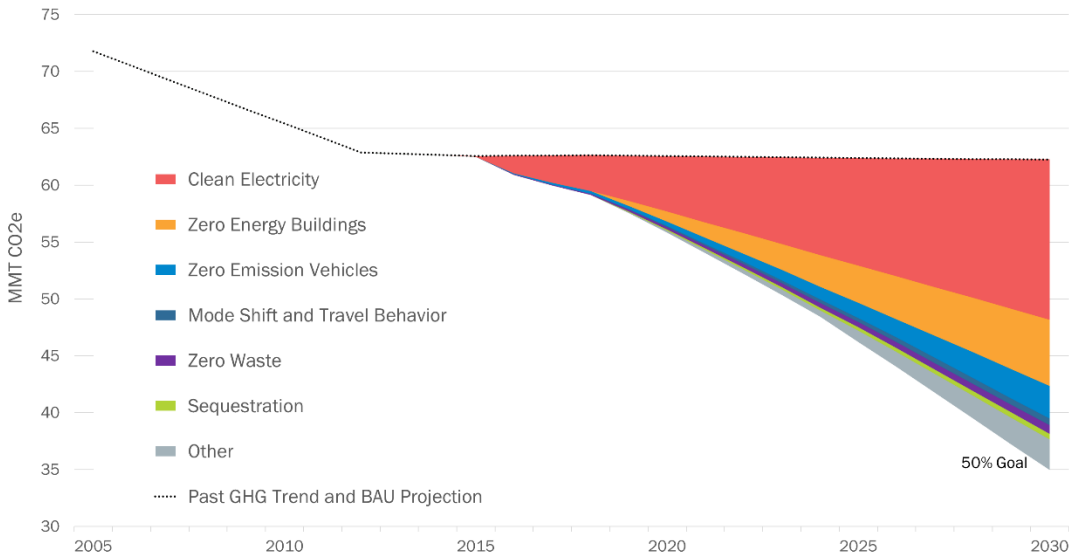
Mode Shift and Travel Behavior changes to reduce single occupancy vehicle trips and vehicle miles travelled (VMT) per capita will be needed to meet the 2030 GHG emissions reduction goal. The scenario includes the regional goal of 75 percent of new housing to be constructed in Activity

Centers and near high capacity transit. The scenario also includes strategies for travel demand management such as priced parking, transit incentives, and transit fare reductions.

Zero Waste and Sequestration are also climate action areas in the scenario. For Zero Waste, the region as a whole would need to move from a recycling rate of less than 50 percent to 80 percent by 2030 to meet the 2030 GHG emission reduction goal. Carbon sequestration can further enhance emission reductions if the regional tree canopy is increased by 2.4 percent by 2030 from 2012 levels. In 2012, there was an estimated 1,127 million acres of regional tree canopy.

The actions in this plan’s Mitigation Strategy directly address the scenario and the levels of implementation needed to achieve a 50 percent reduction in GHG emissions by 2030 below 2005 levels with one exception. The “Other” category includes actions that are needed to reach the 2030 goal but are not addressed in this plan. This includes deployment of renewable natural gas, enhanced gas repair leak initiatives, commercial aviation improvements, and non-road engine emission reduction. These actions need to be addressed by local utilities, airlines and industry but were not identified as priority collaborative actions for COG and its member local governments.

**Figure 6: Metropolitan Washington “What Would It Take” Scenario Results**



See Appendix G: BAU and 2030 Scenario Assumptions for a summary table on the assumptions. Information on actions to achieve this 2030 scenario are outlined in the next section: Regional Climate Mitigation Strategy.

# REGIONAL CLIMATE MITIGATION STRATEGY

## Moving Toward Zero

The Regional Mitigation Strategy includes collaborative actions to support the region in achieving the greenhouse gas (GHG) emission reduction goals of 50 percent by 2030 below 2005 levels and 80 percent by 2050. In order to move the region toward the climate mitigation goals the region needs to emphasize an equitable transition to clean electricity, zero energy buildings, zero emission vehicles and zero waste as well as influence mode shift and travel behavior and enhance sequestration.

## PRIORITY COLLABORATIVE MITIGATION ACTIONS

The climate action areas included in the Regional Climate Mitigation Strategy address: Planning, Equity, Clean Electricity, Zero Energy Buildings, Zero Emission Vehicles, Zero Waste, Mode Shift and Travel Behavior and Sequestration. Within these action areas are high-level priority actions for COG and its members to focus on through 2030. All actions are voluntary. Actions have a 1-page description that includes:

- An action overview with example policies, programs, or projects;
- How the action supports regional GHG emission reduction goals;
- Identifies what level of implementation is needed by 2030 and beyond (based on the “What Would It Take” scenario to reduce emissions 50 percent by 2030);
- Examples of how COG and COG member local jurisdiction efforts that can support implementation (it’s not an exhaustive list); and
- How the action benefits other *Region Forward* goals.

Table 2 is a summary of the climate action areas and priority collaborative actions described in this strategy. While these actions focus on what COG and its members can do together to move the region towards the 50 percent by 2030 goal, significant action will be needed across all sectors and all levels of government in order to meet the goal.

**Table 2: Metropolitan Washington Priority Collaborative Mitigation Actions**

Climate Action Area	Action ID	Priority Collaborative Action
Planning	PL - 1	Advance Climate Planning and Track Progress
Equity	EQ - 1	Enable Equitable Planning Practices
	EQ - 2	Prioritize Sustainable Energy Access for All
Clean Electricity	CE - 1	Advocate for Aggressive Renewable Portfolio Standards
	CE - 2	Accelerate Development of On-Site Renewables
	CE - 3	Accelerate Deployment of Battery Storage
	CE - 4	Accelerate Development of Microgrids for Critical Infrastructure
	CE - 5	Accelerate Development of Large-Scale Off-Site Renewables
	CE - 6	Advocate for and Implement Community Choice Aggregation
Zero Energy Buildings	ZEB - 1	Expand Building Benchmarking Requirements
	ZEB - 2	Accelerate Deep Building Retrofits
	ZEB - 3	Enhance Green Building Codes and Policies to Facilitate Net Zero Energy Building Development
	ZEB - 4	Expand Proper Disposal and Leak Detection of Refrigerants
Zero Emission Vehicles	ZEV - 1	Expand Light-Duty Electric Vehicle Deployment
	ZEV - 2	Accelerate Electrification of Medium- and Heavy-Duty Vehicles
	ZEV - 3	Build Out Regional Electric Vehicle Charging Network
Mode Shift and Travel Behavior	MSTB - 1	Invest in Infrastructure that Increases Transit, Carpooling, and Non-Motorized Travel
	MSTB - 2	Bring Jobs and Housing Closer Together
	MSTB - 3	Enhance Options for Commuters
Zero Waste	ZW - 1	Implement Curbside Organics Recycling Programs
	ZW - 2	Reduce Solid Waste Generation
	ZW - 3	Build Markets for Circularity
Sequestration	SQ - 1	Strategically Plant New Trees on Publicly Owned Land
	SQ - 2	Enhance Regulatory Capacity to Manage Tree Canopy and Forest Protection
	SQ - 3	Enhance Incentives and Financing Mechanisms for Tree Planting and Preservation on Privately Owned Lands

## PL-1: ADVANCE CLIMATE PLANNING AND TRACK PROGRESS

### Action Overview

Local jurisdictions play a central role in the global effort to reduce GHG emissions. Climate action planning provides local jurisdictions with the direction needed to achieve the overarching vision and goals for the community while also curbing GHG emissions. The United Nations states that climate action plans should be ambitious, inclusive and fair, comprehensive and integrated across sectors, relevant and actionable, evidence-based, transparent and verifiable. Conducting GHG inventories is an important part of measuring changes over time to track progress toward goals.<sup>ii</sup>

The City of Bowie develops climate action plans in 5-year intervals and tracks progress annually. Bowie's Vision for 2030 includes GHG emission to be 50 percent below 2015 levels, more than half of energy consumption comes from renewables and one-third of privately owned vehicles are electric. Government action is being led by an intergovernmental Sustainability Staff Team and community action is led by a Mobilization Team comprised of a diverse group of community leaders. COG develops the City's community-scale inventories to track progress toward the plan's goals.<sup>iii</sup>

### Supporting Overall GHG Reduction Goal

With more than 90 percent of total GHG emissions in the region associated with the built environment and transportation, implementation of plans to reduce emissions from these sectors have the potential to significantly reduce emissions. Local jurisdictions and the region cannot monitor progress if it is not measured; therefore, GHG inventories are an important piece of supporting GHG emission reduction goals.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

**Developing and implementing equity-focused climate plans and tracking progress through GHG inventories lays the foundation for reducing GHG emissions 50 percent below 2005 levels by 2030.**

### How COG Can Support

- Complete GHG emission inventories at milestone dates to measure local and regional progress. Follow and help advance U.S. and global best practices for inventories.
- Develop and incorporate net emissions, from sources such as forests/trees and renewable procurement.
- Update GHG Contribution Analyses for new inventory years to evaluate what is driving GHG change across the region.
- Support jurisdictions in climate planning initiatives, including equitable climate policy, program and decision-making processes.
- Support tracking of local and regional goals, plans, and progress. Share and encourage best practices.

### How Member Jurisdictions Can Support

- All COG member jurisdictions should adopt GHG emission reduction goals.
- All COG member jurisdictions should adopt climate/energy plans.
- Adopt climate emergency policies.
- Review COG community-scale inventory work and modify local results, where appropriate. Conduct local government operations inventories.
- Educate public on GHG impacts to the community and engage community in equitable solutions.

### Region Forward Co-Benefits:

- **Equity and Education:** Engage all parts of the community in climate planning initiatives. COG Equity Emphasis Areas can be leveraged as a resource for equitable engagement opportunities.



## EQ-1: ENABLE EQUITABLE PLANNING PRACTICES

### Action Overview

Integrating equity into all components of planning practices is critical to ensuring that climate policies and programs address the concerns of all community members, particularly those in underserved communities. Underserved communities have been disproportionately impacted by environmental exposures, including ambient air pollution and climate-change-related health impacts. This trend will continue unless planning processes at all levels of government make addressing these historical inequities central to climate change decision-making processes.<sup>liii</sup>

To support communities looking for guidance on best practices for incorporating equity considerations in planning processes, COG released the Environmental Justice Toolkit (EJ Toolkit) in 2017. The EJ Toolkit is intended to be a resource on government measures, practices, and policies aimed at creating cooperative solutions to issues of fair and just treatment and equitable access in the development, application, and enforcement of environmental policies.<sup>liv</sup>

### Supporting Overall GHG Reduction Goal

Achieving the region's overall GHG emissions reduction goals will not be possible without the implementation of equitable planning processes that fully integrate the concerns and needs of disadvantaged communities. Engaging and activating these communities will be critical to achieving these goals.

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### Level of Implementation Needed to Reach Overall GHG Goal:

To meet the overall GHG reduction goal, equity will need to be a central component of planning practices for all member jurisdictions.

### How COG Can Support

- Continue to support local jurisdictions on racial equity planning and integrating climate planning within this context.
- Continue to identify and share tools, datasets, and resources, such as Equity Emphasis Areas and the Environmental Justice Toolkit, to help jurisdictions define what equity means in their local context and engage underserved communities.<sup>lv</sup>
- Continue to share best practices through regional meetings and materials on how to perform equitable engagement and planning processes and how to design climate action equitably.

### How Member Jurisdictions Can Support

- Develop an equity plan that incorporates addressing climate impacts to vulnerable populations.
- Develop a process for mainstreaming equitable community engagement during climate and energy projects and planning processes.
- Provide accessible and meaningful engagement opportunities for underserved communities and develop a shared understanding of community needs.
- Support community leadership development in underserved communities.
- Provide data, information, and resources to underserved communities and engage community members in citizen science so they are a part of developing relevant data for their community.

### Region Forward Co-Benefits:

- **Economy and Education:** Equitable advancement of the clean economy includes supporting green job training programs and providing economic benefits to disadvantaged communities through investment in green infrastructure and sustainable housing.
- **Health and Human Services:** With a more equitable approach to planning, some health and climate risks can be addressed in underserved communities that experience the highest risk.

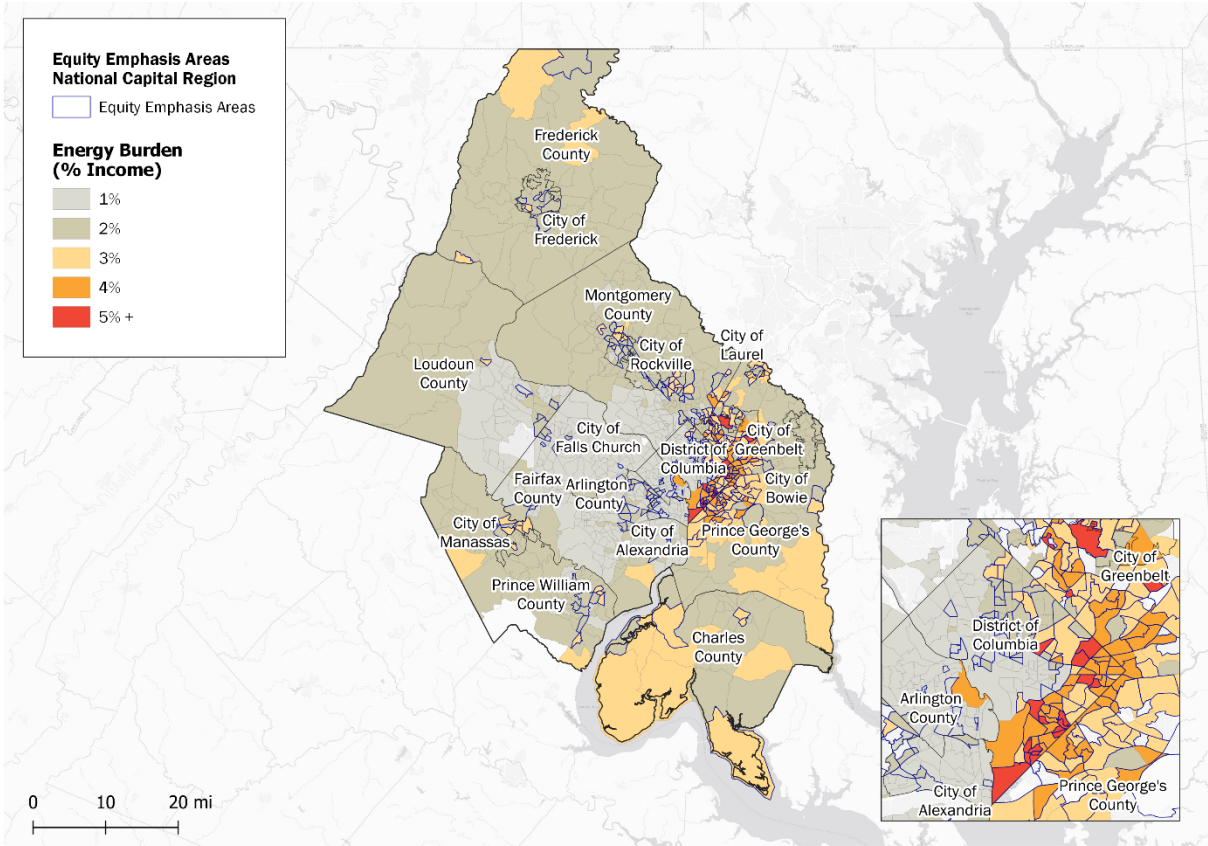
# EQ-2: PRIORITIZE SUSTAINABLE ENERGY ACCESS FOR ALL

## Action Overview

Ensuring that all residents and local businesses have access to sustainable and affordable energy is key to reducing GHG emissions while simultaneously ensuring that underserved communities are well positioned to achieve economic stability and improve their overall quality of life. Historically, there have been significant disparities in renewable energy deployment based on race and ethnicity. For example, even when adjustments for household income and homeownership rates are made, black and Hispanic residents are significantly less likely to install and reap the cost savings benefits of rooftop solar photovoltaics (PV) systems. <sup>lvi</sup>

Overall “energy burden,” or the percentage of household incomes that goes towards energy costs, is also a significant concern for underserved communities. Across the region, underserved communities spend a larger portion of income on home energy cost than other residents. Figure 7 shows that mean energy burden across census tracts in Equity Emphasis Areas (EEAs) is 6.6 percent higher than all other census tracts in the region. Metropolitan Washington EEAs, identified by COG and its members, include communities that have a higher than average concentration of low-income, minority populations, or both. Ensuring equitable energy access to underserved communities ensures energy burdens don’t limit residents’ ability to choose between paying energy bills or living essentials. <sup>lvii</sup>

**Figure 7: Equity Emphasis Areas and Energy Burden**



Source: US Department of Energy Low-Income Energy Affordability Data (LEAD) Tool and COG Equity Emphasis Areas

Jurisdictions can enact policies and programs that aim to increase access to sustainable energy and reduce energy burden. For example, D.C.'s Solar for All program, established in 2016, aims to provide 100,000 low-to-moderate income families with the benefits of locally generated clean energy and help reduce their energy bills 50 percent by 2032. The program is funded through the District's Renewable Energy Development Fund. At the state level, Maryland's community solar program has a low-income "carve-out," meaning that about 125 megawatts (MW) of the total 418 MW statewide cap is set aside for projects focused on low- and moderate-income customers. The carve-out increases the attractiveness of these projects to potential developers and increases the overall likelihood that these projects will be built.<sup>lviii</sup>

### Supporting Overall GHG Reduction Goal

Investing in the deployment of solar PV and energy efficiency improvements in underserved communities has the potential to both decrease the emissions associated with electricity consumption and reduce total energy consumption associated with buildings in these areas. Since over 35 percent of total GHG emissions in the region are associated with the electricity consumption, increasing access to sustainable and affordable energy has significant potential to reduce emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

Increasing deployment of on-site renewables in underserved communities will be critical to reaching the overarching target of 3.4 percent of total electricity supply being provided by on-site solar PV by 2030.

### How COG Can Support

- Identify priority populations or areas that are energy burdened and could benefit most from solar PV investment and energy efficiency improvements.

### How Member Jurisdictions Can Support

- Develop and implement energy efficiency and renewable energy programs for low income households.
- Engage with underserved communities to identify a shared understanding of community needs and share available resources for building energy improvement programs and incentives.
- Support clean energy economy and workforce development in underserved communities.

### Region Forward Co-Benefits:

- **Economy:** Low-income populations in the region are disproportionately burdened by the cost of energy and are least likely to have the capital or support to upgrade their homes to be more energy efficient. A focus on supporting these communities will reduce costs while reducing regional GHG emissions.
- **Health and Human Services:** Energy bills can be highest in the summer as temperatures rise and cooling demand increases. With reduced energy cost burdens, lower income households may be able to afford to run cooling equipment throughout the summer, protecting occupants from extreme heat and the associated health risks.
- **Environment:** In addition to reducing electricity use and its related emissions, energy efficiency improvements can have an added benefit of reduced environmental impacts if they are products are also water efficient or use sustainable materials.

## CE-1: ADVOCATE FOR AGGRESSIVE RENEWABLE PORTFOLIO STANDARDS

### Action Overview

A Renewable Portfolio Standard (RPS) is a regulatory measure that requires a certain proportion of the state's energy to come from renewable sources including solar, wind, and other alternatives to fossil fuel electricity generation. It is the most successful method of increasing the amount of renewable electricity generated within a grid system and drives greater deployment of renewable energy projects.<sup>lix</sup>

In 2018, the District of Columbia updated its RPS, requiring 100 percent of electricity sales to come from renewable energy sources by 2032 with a 10 percent solar carveout by 2041. In 2019, Maryland updated its RPS, requiring 50 percent of electricity sales in the state to come from renewable sources by 2030. It also includes a solar carveout of at least 14.5 percent by 2030, and at least 1,200 MW of offshore wind by 2030. In 2020, Virginia passed the Clean Economy Act, which requires that 100 percent of electricity sales in the state comes from renewable sources by 2045 or 2050 (depending on the utility classification). This is a significant increase from the state's previous RPS, which only established a voluntary 15 percent RPS goal by 2025.<sup>lx</sup>

### Supporting Overall GHG Reduction Goal

Carbon-intensive fossil fuels remain responsible for a significant percentage of total electricity generation provided to the regional grid. In 2015, utility supplied renewable energy in metropolitan Washington made up over 8 percent of electricity sales that year. With aggressive RPS goals, this percentage will grow significantly in the coming decades. With 36 percent of total GHG emissions in the region associated with electricity consumption, state RPS programs that accelerate the deployment of renewable energy on the region's grid is crucial for reducing GHG emissions.<sup>lxi</sup>

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, states and utilities are able to continue adding renewable generation capacity to achieve the following percentages of renewable energy in terms of overall grid mix: Washington D.C. (87 percent), Maryland (50 percent), and Virginia (35 percent).

### How COG Can Support

- Continue to support strong state-level RPS and encourage REC markets.
- Encourage solar carve-outs in RPS policies to support solar project development in the region.
- Support development of utility scale solar and offshore wind to achieve state-level RPS.

### How Member Jurisdictions Can Support

- Continue to support strong state-level RPS and encourage REC markets.

### Region Forward Co-Benefits:

- **Economy:** RPS sends a signal to utilities and businesses to increase renewable energy investment. Increased renewable energy deployment will also bring greater numbers of clean energy employment opportunities.
- **Health and Human Services:** By decreasing market demand for fossil-fuel electricity generation technologies, RPS can decrease criteria air pollutants and associated adverse health impacts.

## CE-2: ACCELERATE DEVELOPMENT OF ON-SITE RENEWABLES

### Action Overview

On-site renewable energy systems can both reduce electricity costs for local residents and businesses and increase the percent of renewable electricity supplied to the regional grid. Local governments have several tools available for increasing the capacity of renewables installed in their communities including directly installing renewables on government facilities, mandating or incentivizing renewables on newly constructed buildings in the community, implementing solar co-ops, and meeting EPA Green Power Partnership (GPP) requirements.

A number of local governments have installed solar on municipal buildings, including the District of Columbia, Montgomery County, Prince George's County, the City of Bowie, and others. Solarize NoVA is a community-based outreach initiative sponsored by the Northern Virginia Regional Commission (NVRC) that facilitates the deployment of solar energy to homes and businesses in Northern Virginia. Through bulk purchasing and free solar site assessments, they have played a prominent role in more than 370 solar energy systems installed in Northern Virginia, totaling 3.9 megawatts of capacity.<sup>lxii</sup>

### Supporting Overall GHG Reduction Goal

Carbon-intensive fossil fuels remain responsible for a significant percentage of total electricity generation provided to the regional grid. On-site renewable installations help to reduce the region's reliance on these fossil fuel resources. With 36 percent of total GHG emissions in the region associated with electricity consumption, local policies and programs to accelerate the deployment of on-site renewables have the potential to significantly reduce emissions.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

**By 2030, on-site renewables will account for 2 percent of total electricity supply in the region. This is equivalent to needing 200,000 more rooftop solar systems.**

### How COG Can Support

- Support member jurisdictions:
  - Adopt solar-ready new construction ordinances or incentive programs;
  - Form and operate solar cooperatives and support associated solar mapping effort; and
  - Install renewable energy systems on schools and municipal infrastructure.
- Provide clean energy feasibility assessments at key facilities (campuses, hospitals, etc.).

### How Member Jurisdictions Can Support

- Establish residential and commercial new construction ordinances or incentives that require the installation of solar or solar-ready construction to enable solar installation at a later date.
- Provide or promote incentives to encourage installation of solar in the community.
- Form new or expand existing solar cooperatives.
- Install renewable energy systems on all new and existing municipal buildings and facilities.
- Achieve and maintain EPA GPP at government operations and community levels.

### Region Forward Co-Benefits:

- **Economy and Equity:** On-site renewable systems can reduce the financial burden associated with energy costs. Incentives and cooperative campaigns can be designed to maximize participation rates among economically disadvantaged communities.
- **Public Safety:** When paired together, on-site renewable systems and battery storage systems have the potential to supply electricity during grid outages and add to grid resilience by decreasing peak loads and stress on the distribution system.



## CE-3: ACCELERATE DEPLOYMENT OF BATTERY STORAGE

### Action Overview

Battery storage deployment supports renewable energy as it has the capability of reliably supplying renewable energy to the grid when there is high demand. One of the main barriers to renewable energy being widely adopted has been the challenge of on-demand operation and providing a “baseload” of power to the grid. When renewables are deployed with battery storage, energy load reliability is dramatically improved. An additional benefit of battery storage deployment is that it boosts the resilience of facilities where it is deployed.<sup>lxiii</sup>

Virginia’s Grid Transformation & Security Act of 2018 allows Dominion Energy to invest in up to 30 megawatts of battery storage pilot projects. In 2020, Dominion has had four battery storage pilot projects approved, which will pave the way for additional energy storage technology projects needed to support the company’s commitment to achieve net zero carbon and methane emissions by 2050, increase renewable energy deployment and improve grid reliability.<sup>lxiv</sup>

### Supporting Overall GHG Reduction Goal

Carbon-intensive fossil fuels remain responsible for a significant percentage of total electricity generation provided to the regional grid. Battery storage deployment reduces the region’s reliance on these fossil fuel resources, while bolstering the region’s resilience. With 36 percent of total GHG emissions in the region associated with electricity consumption, local policies and programs to accelerate the deployment of battery storage have the potential to support significant GHG emissions reductions.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, to realize the full emission reduction and grid stabilization potential of on-site solar photovoltaics (PV) installed across the region, approximately 10 percent of PV installations will need to be paired with battery storage systems.

### How COG Can Support

- Support state and national incentives and opportunities that enhance battery storage deployment in the region.
- Identify on-site and grid-scale battery storage deployed in the region.
- Partner on grant applications or provide contract support for project planning and implementation support.

### How Member Jurisdictions Can Support

- Advocate for utility-scale battery storage deployment.
- Implement battery storage pilot initiatives at public facilities.
- Provide or promote incentives to community for energy storage systems.
- Incorporate community energy infrastructure needs, goals, and strategies in master plans, comprehensive plans, and small area plans.

### Region Forward Co-Benefits:

- **Economy and Equity:** Battery storage programs and incentives has the potential to provide cost savings to local governments, businesses and economically disadvantaged. Accelerating battery storage installations also has the potential to create high quality jobs in the region.
- **Public Safety:** Battery storage has the potential to supply electricity during grid outages and add to grid resilience for critical facilities (e.g. hospitals, schools, nursing homes) and in underserved communities.

## CE-4: ACCELERATE DEVELOPMENT OF MICROGRIDS FOR CRITICAL INFRASTRUCTURE

### Action Overview

A microgrid is a localized energy grid with its own control system, allowing it to disconnect from the traditional grid and operate autonomously, as well as connect to the grid and act as a distributed power resource. Microgrids can provide a form of energy resilience and independence for local residents and businesses due to their ability to “island” from the larger grid. This is especially important for critical infrastructure when energy is needed during blackouts or other interruptions in service. Additionally, microgrids can provide a way to secure energy access to vulnerable populations.<sup>lxv</sup>

Montgomery County has installed a microgrid project at the County’s Public Safety Headquarters, as part of a comprehensive effort to ensure the resiliency of critical public services during major electric distribution system outages. The project includes multiple clean energy technologies, which will reduce GHG emissions by 5,900 metric tons annually. Montgomery County has also installed a microgrid at the County’s Correctional Facility, which will reduce GHG emissions by 950 tons annually.<sup>lxvi</sup>

### Supporting Overall GHG Reduction Goal

Microgrids provide resilience through their localized power sources. These power sources are largely renewable and are often combined with energy storage systems. This reduces reliance on the larger grid, which provides a significant power from carbon-intensive fossil fuels. With 36 percent of total GHG emissions in the region associated with electricity consumption, greater numbers of microgrids has the potential to significantly reduce emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

Development of microgrids at critical facilities like schools and hospitals will help the region achieve needed 2030 implementation levels for on-site renewable energy and battery storage and improve overall resilience.

### How COG Can Support

- Support the identification and selection of critical infrastructure for microgrid implementation.
- Partner on grant applications or provide contract support for project planning, feasibility, and implementation support.
- Support state incentives and opportunities to help facilitate microgrid deployment.
- Coordinate with members and partners to reduce barriers to deployment.

### How Member Jurisdictions Can Support

- Assess feasibility of and implement microgrids at critical infrastructure.
- Coordinate with utilities and critical infrastructure partners to deploy microgrid solutions that support potentially vulnerable populations and underserved communities.

### Region Forward Co-Benefits:

- **Public Safety and Equity:** Microgrids have the potential to supply electricity during grid outages and add to grid resilience for most critical facilities (e.g. hospitals, schools, nursing homes) and in underserved communities.
- **Education:** Schools present great opportunity for microgrids and add renewable energy to schools, increase resilience and help to educate students and community members on benefits of microgrids.



## CE-5: ACCELERATE DEVELOPMENT OF LARGE-SCALE, OFF-SITE RENEWABLES

### Action Overview

Large-scale, off-site renewable energy systems can reduce electricity costs for local governments, businesses and residents while increasing the percent of renewable electricity supplied to the regional grid. Power purchase agreements (PPAs) are the main vehicle for providing large-scale renewable energy to the grid. A PPA is an arrangement between a third-party developer, who installs, owns, and operates an energy system on a customer's property; and the customer, who purchases the system's electricity. Additionally, a renewable energy credit (REC) is an instrument that can be used to substantiate renewable energy claims. RECs represent the rights to environmental, social, and other non-power attributes of renewable energy.<sup>lxvii</sup>

At the end of 2019, Fairfax County announced contracts with multiple solar PPA service providers, which will allow for the installation of solar arrays at government, school, and park sites. This initiative is the largest of its kind in Virginia to date and has the potential to save the County more than \$60 million in electricity costs, while supporting the County's greenhouse gas reduction goals. Similarly, Frederick County entered into a PPA with Tesla for a solar array on the County's landfill.<sup>lxviii</sup>

### Supporting Overall GHG Reduction Goal

Carbon-intensive fossil fuels remain responsible for a significant percentage of total electricity generation provided to the regional grid. With 36 percent of total GHG emissions in the region associated with electricity consumption, local governments have the potential to significantly reduce emissions through PPAs for renewable energy. This expands the delivery of renewable energy to government facilities, as well as local businesses and other stakeholders seeking to procure more renewable energy.

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### Level of Implementation Needed to Reach Overall GHG Goal:

**By 2030, 9.5 percent of total electricity supplied in the region will need to come from 100 percent renewable electricity procured through contractual instruments, including PPAs and RECs. This 9.5 percent of renewables will be achieved through a combination of Community Choice Aggregation (CCAs) and PPAs and RECs outside of CCAs.**

### How COG Can Support

- Examine the possibility of regional demand aggregation.
- Attempt cooperative purchasing initiatives or energy purchasing consortia.

### How Member Jurisdictions Can Support

- Establish PPA(s) to provide clean electricity to local government facilities, potentially aggregating demand with other local jurisdictions or large local businesses to reduce cost.
- Encourage large, local businesses to investigate PPAs.

### Region Forward Co-Benefits:

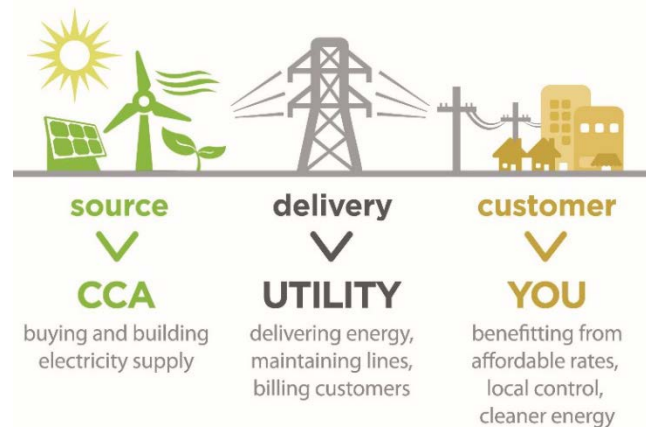
- **Economy and Equity:** There are potential cost savings to local governments, businesses, and economically disadvantaged, if they are sought out in PPA partnerships. Accelerating large-scale solar installations also has the potential to create high quality jobs in the region.
- **Health and Human Services:** By decreasing market demand for fossil-fuel electricity generation technologies, CCAs can decrease criteria air pollutants and associated adverse health impacts.

## CE-6: ADVOCATE FOR AND IMPLEMENT COMMUNITY CHOICE AGGREGATION

### Action Overview

Community Choice Aggregation (CCA) – sometimes referred to as Municipal Aggregation or Community Choice Energy - programs enable local governments to pool the electricity load of residents and businesses within the community and procure electricity on their behalf (Figure 8). CCAs provide local jurisdictions with greater control over their electricity generation mix and the opportunity to increase the percentage of renewables within the mix at potentially lower energy prices. Additionally, CCA programs can provide a platform for increasingly advanced methods for supplying customers with renewable electricity and investing in local distributed energy projects.<sup>lxxix</sup>

Figure 8: How Community Choice Aggregation Works



In March 2020, the Maryland House of Delegates passed HB 561 that sets the path for allowing Montgomery County to establish CCA pilot program, potentially opening the door for additional CCAs across the state. Virginia Code § 56-589 allows municipalities in the state to establish CCAs.<sup>lxxx</sup>

### Supporting Overall GHG Reduction Goal

Because CCAs enable local jurisdictions to determine the percent of electricity from renewable sources supplied to residents and businesses, they have the potential to significantly reduce electricity emissions, which account for 36 percent of the region’s total GHG emissions. Most CCAs operate on an “opt-out” basis, meaning residents and businesses are automatically enrolled in the program with the option to not participate. This leads to high participations rates, furthering their GHG emissions reduction potential.

### Level of Implementation Needed to Reach Overall GHG Goal:

In addition to state-level RPS requirements and renewable electricity generated on-site, an additional 9.5 percent of total electricity supplied in the region will need to come from 100 percent renewable electricity by 2030 procured through contractual instruments, including PPAs and RECs.

### How COG Can Support

- Advocate for policies to help overcome barriers to CCA adoption in Maryland and Virginia.
- Leverage COG Cooperative Procurement Program to fast-track local implementation.

### How Member Jurisdictions Can Support

- Advocate for State policy to support authorization of CCAs and reduce barriers to CCA adoption.
- Implement and share best practices from CCA pilot programs, where applicable

### Region Forward Co-Benefits:

- **Economy and Equity:** CCAs have the potential to lower electricity costs to residents and businesses, helping to reduce economic disparities and make the economy more competitive.<sup>lxxxi</sup>
- **Health and Human Services:** By decreasing market demand for fossil-fuel electricity generation technologies, CCAs can decrease criteria air pollutants and associated adverse health impacts.

## ZEB-1: EXPAND BUILDING BENCHMARKING REQUIREMENTS

### Action Overview

Benchmarking programs applicable to municipal, commercial, and multifamily buildings enable building managers to measure the energy efficiency of their building against comparable buildings from across the region and identify buildings that could benefit most from energy efficiency improvements. Benchmarking programs can be voluntary or mandatory, include energy and/or water consumption, and can be customized by square footage and building type.

The vast majority of building benchmarking ordinances rely on the use of the EPA's ENERGY STAR Portfolio Manager, a free online benchmarking tool that helps building managers track data and measure progress using a 1-100 ENERGY STAR scoring system. Both Washington D.C. and Montgomery County have enacted benchmarking ordinances that apply to commercial and multifamily buildings over 50,000 square feet and to buildings owned and operated by the jurisdiction. Although Virginia State law currently prohibits mandatory benchmarking ordinances, Arlington County benchmarks and discloses all County facilities and has offered support, training, energy challenges, and incentives for commercial and multi-family buildings.<sup>lxvii</sup>

### Supporting Overall GHG Reduction Goal

Through the identification of inefficient buildings, a benchmarking ordinance can be effective in driving increased participation in existing energy audit and efficiency programs. Because over 24 percent of total GHG emissions in the region are associated with commercial and municipal buildings, there is significant potential to reduce emissions from benchmarked buildings.

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, assuming 30 percent of buildings receiving deep energy retrofits have been benchmarked, approximately 117 million square feet of multi-family and commercial space will need to have been benchmarked.

### How COG Can Support

- Share best practices and lessons learned from existing benchmarking programs and provision of materials including policy/program implementation and resource guides.
- Advocate for legislation in Virginia to enable jurisdictions to adopt benchmarking ordinances.

### How Member Jurisdictions Can Support

- Develop and implement or expand government operations building benchmarking initiatives (applicable in MD, VA, DC).
- Develop and implement or expand community commercial and multifamily building benchmarking ordinances (applicable in MD, DC) or provide financial or development incentives (such as floor-to-area ration, streamlined permitting, tax incentives, etc.) to buildings that agree to annual benchmarking (applicable in MD, VA, DC).
- Utilize benchmarking program as a mechanism to drive increased participation in existing government or utility energy audit and energy efficiency incentive programs.
- Promote voluntary benchmarking for commercial and multifamily buildings through marketing and outreach campaigns, providing guidance, technical support and promoting cost savings.

### Region Forward Co-Benefits:

- **Environment:** Benchmarking programs can also help to identify buildings that use water inefficiently and preservation of water resources remains a *Region Forward* priority.
- **Economy and Equity:** Benchmarking programs leading to more energy efficient multifamily and commercial buildings reduce the financial burden associated with energy costs.

## ZEB-2: ACCELERATE DEEP BUILDING RETROFITS

### Action Overview

Deep energy retrofits aim to reduce energy consumption in buildings by at least 50 percent by taking a systems-thinking approach that evaluates interactions between different components of a building. Deep retrofit improvements include improvements to the building envelope through additional insulation, air sealing, and window replacements and upgrades to or replacements of inefficient heating, cooling, and hot water systems.

While deep retrofits result in higher cost savings, they also require higher up-front cost. For this reason, it is critical to provide attractive financing options to property owners through programs such as Commercial Property Assessed Clean Energy Financing (C-PACE), green banks, state and utility energy efficiency incentives, and programs tailored to retrofit low-income housing. More than 10 PACE Programs have been launched in the region and 35 projects have been financed thus far by C-PACE programs. The District of Columbia and Montgomery County have established green banks. Arlington/Alexandria Energy Masters is a program focused on low-income retrofits. Prince George's County provides energy grants and loans, including ENERGY STAR certification and green leasing grants. Expanded participation in existing programs and new programs, particularly targeting low-income residents and businesses, are needed to accelerate retrofits.<sup>lxxiii</sup>

### Supporting Overall GHG Reduction Goal

By addressing financial barriers to capital-intensive deep energy retrofits, C-PACE and green banks can be effective in significantly reducing heating and cooling loads of commercial, municipal, and residential buildings. Since more than half of all GHG emissions in the region are associated with the built environment, deep energy retrofits have significant potential to reduce emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

Annually, 2 percent of all residential and commercial buildings will need to receive a deep retrofit to support the region in meeting the 2030 GHG emission reduction goals.

### How COG Can Support

- Provide technical guidance and support to assist local jurisdictions in expanding participation in existing and new energy efficiency programs.
- Facilitate regional sharing of net zero energy code language for building retrofits.

### How Member Jurisdictions Can Support

- Retrofit existing public facility(ies) to net zero energy.
- Offer innovative energy financing solutions for residential or commercial sectors (e.g. green bank, PACE, loan loss reserves, etc.).
- Promote state and utility incentives and technical assistance for residential and commercial deep energy retrofits. Consider supplementing with local incentives.
- Expand programs that implement deep energy improvements in affordable housing.

### Region Forward Co-Benefits:

- **Environment:** Energy efficiency programs can also identify buildings that use water inefficiently.
- **Economy and Equity:** Improving the energy efficiency reduces the financial burden associated with energy costs for both residents and local businesses. Accelerating retrofit work also has the potential to create high quality jobs in the region.
- **Health and Human Services:** Green buildings with enhanced ventilation help to increase indoor air quality, reduce illness, and improve productivity.<sup>lxxiv</sup>

## ZEB-3: ENHANCE GREEN BUILDING CODES AND POLICIES TO FACILITATE NET ZERO ENERGY BUILDING DEVELOPMENT

### Action Overview

Green building codes are laws established by states or local jurisdictions applying to newly constructed buildings or major renovations that mandate increased levels of energy efficiency and often include a requirement for the inclusion of on-site renewable energy systems. Green building codes can help to accelerate the adoption of net zero energy buildings – those that produce as much energy as they use - across the region.

Maryland, Virginia, and the District of Columbia have all adopted building codes that incorporate energy efficiency components outlined in the International Energy Conservation Code (IECC) and the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) standards. While local jurisdictions in Maryland are permitted to pass more stringent codes that exceed state minimum standards (“stretch codes”), local jurisdictions in Virginia are not. Member jurisdictions in Maryland, including Montgomery County and City of Rockville, have a history of adopting codes that are more stringent than those required by the state. Currently, Montgomery County is in the process of adopting the 2018 International Green Construction Code (IGCC).<sup>lxxv</sup>

### Supporting Overall GHG Reduction Goal

Adopting more stringent building codes, both at the state and local level, can be effective in significantly reducing the total energy consumption and increasing the level of on-site renewable energy generation of commercial, municipal, and residential buildings. Since half of all GHG emissions in the region are associated with the built environment, green building codes have significant potential to reduce emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

**All jurisdictions will need to implement building codes that require net zero energy standards in new construction by 2030, through either adoption of local stretch codes or compliance with potential future state requirements that mandate net zero energy construction.**

### How COG Can Support

- Convene technical experts and facilitate information exchange that enable creation of policies and programs and address barriers to action.
- Coordinate local government input to the national model energy code development process.
- Encourage adoption of building codes and incentives to facilitate net zero building construction.

### How Member Jurisdictions Can Support

- Participate in the national energy code development process.
- Adopt policy for all new local public facilities to be net zero energy.
- Adopt net zero energy codes or incentives for private development.
- Include net zero energy goals and strategies in master, comprehensive, and small area plans.
- Establish a net zero energy building district or portfolio.<sup>lxxvi</sup>
- Provide education and training on new and advanced green construction standards.

### Region Forward Co-Benefits:

- **Environment:** Building codes can be designed to address both energy and water efficiency.
- **Health and Human Services:** Green buildings with enhanced ventilation help to increase indoor air quality, reduce illness, and improve productivity.<sup>lxxvii</sup>
- **Public Safety:** As net zero building codes continue to deemphasize reliance on natural gas in new construction, the risks associated with natural gas leaks and explosions will decrease.



## ZEB-4: EXPAND PROPER DISPOSAL AND LEAK DETECTION OF REFRIGERANTS

### Action Overview

Refrigerants are chemicals found in a variety of building equipment – including air conditioners, refrigerators, and freezers – that absorb and release heat to enable chilling. Refrigerant gasses are a significant source of GHG emissions because of their high global warming potential (GWP).

The Kigali Amendment to the Montreal Protocol is an international agreement between 99 countries and the European Union to gradually reduce the consumption and production of hydrofluorocarbons (HFCs), the group of chemicals most commonly used today for refrigeration. The United States has not ratified the Kigali Amendment. In the absence of federal regulations, Maryland and Virginia have taken action. In 2020, Maryland Department of Environment proposed regulations to reduce use of HFCs 25 percent by 2030 and Virginia approved a law requiring its Air Pollution Control Board to adopt HFC restrictions modeled after the EPA’s Significant New Alternative Policy (SNAP) Rules that were overturned by a federal court in 2017.<sup>lxxviii</sup>

### Supporting Overall GHG Reduction Goal

Advocating for increasingly aggressive state policies, educating private businesses on refrigerant management best practices, and adopting these same best practices in government operations can significantly reduce emissions associated with refrigerant leaks. A small yet growing portion of total GHG emissions in the region are associated with refrigerants and advancing refrigerant policies and best practices has significant potential to reduce these emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, refrigerant emissions will need to be reduced by 66 percent through a combination of 1) Leak detection and related upgrades to systems like refrigerators and HVAC systems, and 2) A phase out of high-GWP HFCs at the state level.

### How COG Can Support

- Share best practices through regional meetings and materials (fact sheets, resource guides etc.).
- Organize advocacy efforts to help advance legislation at state and district level restricting the use of HFCs.
- Develop education on proper handling, disposal, and leak detection for high GWP refrigerants from coolers, air conditioners, and other appliances.

### How Member Jurisdictions Can Support

- Support advocacy efforts.
- Institute best practices in refrigerant management in government operations, including leak detection and monitoring, leak reporting, reporting and record keeping and retrofitting or retiring older systems.
- Promote awareness and climate impacts of proper disposal techniques and refrigerant management best practices.

### Region Forward Co-Benefits:

- **Economy and Equity:** Many upgrades to reduce refrigerant leakages also improve the overall energy efficiency of equipment. Accelerating the detection of leaks and retrofitting of equipment would help these businesses save money and also create high quality refrigerant technician jobs.
- **Public Safety:** Leaks of some refrigerants, including freon, pose a serious health risk.

## ZEV-1: EXPAND LIGHT-DUTY ELECTRIC VEHICLE DEPLOYMENT

### Action Overview

Several barriers are currently preventing the adoption of light-duty electric vehicles (EVs), including vehicle cost, limited number of models available, lack of consumer awareness, long charging times and the lack of capable charging infrastructure. However, as EV technology advances and the EV market matures, these obstacles are breaking down. The cost of EVs are decreasing as battery prices continue to decline, the number and range of available models is increasing as manufacturers become more heavily invested in EV development, and the speed of charging continues to increase with the expanded deployment of level 2 and DC fast charging stations.<sup>lxxx</sup>

Continuing to overcome these barriers will be critical to rapidly increasing the number of EVs on the road and will require action at the state, regional and local levels. Several local jurisdictions have taken steps to electrify government fleets. For example, Montgomery County has purchased 39 battery electric vehicles (BEVs). Also, Alexandria has committed to the purchase of only electric or hybrid gas/electric general purpose sedans and is undertaking a pilot to test the feasibility of electric and hybrid police cruisers.<sup>lxxx</sup>

### Supporting Overall GHG Reduction Goal

Light-duty on-road vehicles are responsible for 60 percent of transportation emissions in the region. As the regional electricity supply continues to increasingly rely on renewable sources of generation, the emission reduction potential of EVs compared to internal combustion vehicles continues to increase. With 24 percent of total GHG emissions in the region generated by light-duty, fossil fuel on-road vehicles, local policies and programs to accelerate the adoption of EV passenger vehicles have the potential to significantly reduce emissions.

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, of the approximately 4.1 million light duty vehicles on the road in the region, 34 percent or 1.4 million of those vehicles will need to be battery electric (BEV) or plug-in hybrid-electric (PHEV).

### How COG Can Support

- Support aggregation of demand via COG Cooperative Purchasing Program and local EV buying co-ops. Coordinate closely with Clean Cities, Washington Area New Dealers Association (WANADA), and electric EV supply equipment (EVSE) industry.
- Advocate for regional, state and national incentives and mandates for purchasing EVs.
- Support the work of the Transportation and Climate Initiative (TCI).

### How Member Jurisdictions Can Support

- Implement community-wide EV buying co-ops.
- Promote state and national incentives and mandates for purchasing EVs.
- Transition fleets to zero emission vehicles. Adopt green fleet policy and plans or participate in cooperative procurement opportunities for public fleets to support transition.

### Region Forward Co-Benefits:

- **Economy and Equity:** Fuel and maintenance cost savings, combined with battery production prices continuing to drop, have the potential to make EVs a more cost-effective option. Programs to incentivize EV ownership should prioritize disadvantaged communities.<sup>lxxxi</sup>
- **Health and Human Services:** Use of gasoline, and particularly diesel, to power passenger vehicles is a major cause of criteria air pollutants and associated adverse health impacts. EVs, which release no tailpipe emissions, can help to significantly reduce local air pollution.



## ZEV-2: ACCELERATE ELECTRIFICATION OF MEDIUM- AND HEAVY-DUTY VEHICLES

### Action Overview

In recent years, light-duty electric vehicles have achieved significant market penetration. However, electrification of medium- and heavy-duty vehicles (MHDVs) remains in the early phases and technological advancements are needed for electric MHDV to be deployed at scale. By electrifying MHDV public fleets and working collaboratively with private fleets to pursue fleet electrification, COG member jurisdictions and regional partners can advance electric MHDVs in the region.<sup>lxxxii</sup>

Bolstered by significant levels of federal and state funding, buses are one application where MHDV electrification has made progress. In 2020, 15 states, including Maryland, and the District of Columbia announced a joint memorandum of understanding committing to work collaboratively to accelerate the market for electric MHDVs with the goal of ensuring that 100 percent of new MHDV sales be zero emissions by 2050, with an interim goal of 30 percent by 2030. Local transit agencies including the D.C. Circulator, Frederick County TransIT, Montgomery County's RideOn and Alexandria's DASH have deployed electric buses. Through a partnership with Dominion, Virginia localities including Arlington, Alexandria, Fairfax County and Prince William County, are deploying electric school buses as part of a plan to move Virginia towards all-electric school bus fleets by 2030. Metro is engaging in zero emission bus planning and designing bus garages as EV-ready.<sup>lxxxiii</sup>

### Supporting Overall GHG Reduction Goal

MHDVs are responsible for 25 percent of transportation emissions in the region. As the regional electricity supply continues to increasingly rely on renewable sources of generation, the emission reduction potential of EVs compared to internal combustion vehicles continues to increase. With 10 percent of total GHG emissions in the region generated by MHDVs, local policies and programs to accelerate the adoption of electric MHDVs have the potential to significantly reduce emissions.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, approximately 7 percent of medium-duty and 6 percent of heavy-duty vehicles will need to be battery electric vehicles (BEVs) or plug-in hybrid-electric vehicles (PHEVs).

### How COG Can Support

- Advocate for regional, state and national actions, mandates, or incentives to fund MHDV electrification.
- Support partners with grant applications to advance electric MHDV deployment.
- Support Clean Cities, local jurisdictions, and industry partners in engaging and educating local industry on opportunities and incentives to electrify their MHDV fleets.

### How Member Jurisdictions Can Support

- Transition public fleet MHDVs to electric.
- Connect private fleets with partners and opportunities to educate and incentivize electrification.

### Region Forward Co-Benefits:

- **Economy and Equity:** Expanding EV charging infrastructure to support electrification of MHDVs can create high quality electrician and construction industry jobs.
- **Health and Human Services:** MHDV diesel vehicles are a key source of local air pollution.<sup>lxxxiv</sup> To reduce localized air pollution, electrification prioritization should be given to vehicles that primarily operate in underserved communities with a concentration of industries.

## ZEV-3: BUILD OUT REGIONAL ELECTRIC VEHICLE CHARGING NETWORK

### Action Overview

A critical barrier to the accelerated adoption of electric vehicles (EVs) by residents and businesses in the region is a lack of adequate EV charging stations. Enabling access to EV charging, especially at home, the workplace and along key corridors for long-distance trips, is critical to reducing drivers' fear of running out of electricity before reaching a destination ("range anxiety").

Local governments have several tools available for accelerating the build out of the EV charging network, including directly installing EV charging at publicly owned facilities, mandating or incentivizing newly constructed buildings in the community to accommodate EV charging, and developing EV infrastructure plans to guide deployment. The City of Frederick adopted a Plug-In EV Infrastructure Implementation Plan to establish a roadmap for enhancing the network of EV charging infrastructure across the City to meet future demand. Arlington County and community partners have implemented combined solar and EV charger buying cooperatives.<sup>lxxxv</sup>

### Supporting Overall GHG Reduction Goal

As the regional electricity supply continues to increasingly rely on renewable sources of generation, the emission reduction potential of EVs compared to internal combustion vehicles continues to increase. With 34 percent of total GHG emissions in the region generated by fossil fuel on-road vehicles, local policies and programs to accelerate the build out of the EV charging network have the potential to significantly reduce emissions.<sup>lxxxvi</sup>

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, assuming 50 percent of EV drivers have access to at-home charging, the region will need an estimated 71,000 workplace level 2, 42,000 public level 2, and 7,600 DC fast chargers to support 34 percent of all light duty vehicles being EVs.

### How COG Can Support

- Support jurisdictions in adopting EV-ready new construction ordinances or incentives.
- Conduct regional EV gap analysis to identify most critical gaps in EV charging network.
- Support state/national incentives for EV charging deployment and technology advancement.
- Support local EV planning, including public fleet, transit, and community-scale initiatives.

### How Member Jurisdictions Can Support

- Require new developments to install EV infrastructure or be EV-Ready.
- Provide or promote incentives for EV infrastructure deployment in the community.
- Develop EV infrastructure plans for community deployment.
- Develop EV infrastructure strategy for the public fleet and deploy EV infrastructure at public facilities, garages, and refueling facilities.
- Partner with utilities, transit agencies, and EV infrastructure providers to deploy in community.
- Implement innovative pilot initiatives to advance new technologies, including vehicle-to-grid, regenerative power, and solar-powered EV infrastructure.

### Region Forward Co-Benefits:

- **Equity:** Plans to build out EV charging should prioritize disadvantaged communities to ensure equitable access to charging.
- **Health and Human Services:** Use of gasoline, and particularly diesel, to power passenger vehicles is a major cause of criteria air pollutants and associated adverse health impacts. EVs, which release no tailpipe emissions, can help to significantly reduce local air pollution.

## MSTB-1: INVEST IN INFRASTRUCTURE THAT INCREASES TRANSIT, CARPOOLING, AND NON-MOTORIZED TRAVEL

### Action Overview

According to the Visualize 2045 performance analysis, between 2019 and 2045, the region anticipates adding approximately 1.2 million more people and one million more jobs, resulting in an additional 3.7 million more trips per day. Auto trips (single and multi-occupant) are forecast to continue to be the predominant mode of travel (78 percent of weekday trips). The following aspirational elements of Visualize 2045 call for strategic investments in the transportation network that would provide more transit options for travelers, encouraging shifts away from single-occupant vehicle (SOV) driving, while also reducing congestion, emissions, and improving reliability:

- Expand bus rapid transit and transitways – provides diverse transit options and expanded access to jobs, especially when coupled with bicycle and pedestrian access to the new services.
- Expand express highway (toll) network – helps reduce fuel consumption and emissions by reducing congestion. Pricing travel encourages carpooling and generates revenue, from tolls, to operate the toll roads and new extensive and reliable regional high-quality bus services.
- Move more people on Metrorail – strategic expansion of services and increased reliability reduces auto dependency, fuel consumption, and emissions.
- Improve walk and bike access to transit – increases transit ridership by removing barriers for walkers and bicyclists with safe and comfortable non-motorized access to transit stations/stops.
- Complete the National Capital Trail Network – connects people with places, and increases walk and bike access to jobs and other activities reducing vehicular travel and related emissions.<sup>lxxxvii</sup>

### Supporting Overall GHG Reduction Goal

Thirty-four percent of total GHG emissions in the region are generated by fossil fuel, on-road vehicles, and most of these emissions come from passenger cars and passenger trucks. Strategies that reduce VMT, vehicle trips, and congestion contribute to GHG reductions. While these strategies become less effective as vehicle technology and fuel efficiency improve, they are very important to reduce the increase in VMT that growth in population and jobs brings.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, improving transit travel times and reducing headways by 12.5 percent should improve ridership by 3 percent. Reducing transit fares regionally by 22.5 percent should boost transit ridership by an additional 5 percent.

### How COG Can Support

- Enhance multi-sectoral coordination to integrate climate change goals and consideration in the regional planning activities undertaken by all boards and committees.
- Continue supporting and advocating for projects, programs, and policies that increase transit usage, carpooling, and non-motorized travel.

### How Member Jurisdictions Can Support

- Support efforts to prioritize projects, programs, and policies that advance TPB's aspirational initiatives as they help reduce emissions.
- Coordinate to transform region's bus systems to an efficient, heavily-used, high-quality service.
- Ensure safe and comfortable bicycle and pedestrian access to transit services.

### Region Forward Co-Benefits:

- **Economy and Equity:** Increased reliability of the transportation network supports regional economic growth and provides increased access to jobs.

## MSTB-2: BRING JOBS AND HOUSING CLOSER TOGETHER

### Action Overview

Visualize 2045 acknowledges housing availability and affordability as an urgent and critical challenge for the region to address. The region's population is expected to increase by 1.2 million, and the number of jobs is expected to grow by about 1 million by 2045. While this growth will exacerbate the need for housing for the region's workforce, it will place additional demands on the transportation system. In addition to increasing housing supply, increasing the proximity of jobs and housing is critical to reducing SOV trips, commute distances, congestion, and emissions.

One of the Transportation Planning Board's (TPB) seven aspirational initiatives is bringing jobs and housing closer together in the region's Activity Centers and near high capacity transit stations where it is easier to walk, bike, or take public transit. Today, Activity Centers contain 29 percent of the region's population and 65 percent of the region's jobs. The Visualize 2045 land-use forecasts anticipate these percentages to increase to 35 percent and 67 percent, respectively, by 2045. <sup>lxxxviii</sup>

### Supporting Overall GHG Reduction Goal

Thirty-four percent of total GHG emissions in the region are generated by fossil fuel on-road vehicles and most of these emissions come from passenger cars and passenger trucks. Concentrating most of the future regional growth near Activity Centers and high capacity transit helps reduce auto travel and related GHG emissions. Residents in Activity Centers and near high capacity transit stations are less reliant on driving in SOVs for work, daily errands, and other trips. Commute trips account for just 21 percent of all trips, with the remainder being non work related. As such, when jobs and housing are closer and in Activity Centers or near transit, it promotes transit usage and walking or biking, not just in commuting to work, but for all other activities.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, 75 percent of new housing must be developed in Activity Centers and near high capacity transit, up from the 68 percent reflected in Visualize 2045.

### How COG Can Support

- Continued coordination with local planning directors and integration of the transportation and emissions reduction benefits into land use and community planning efforts.

### How Member Jurisdictions Can Support

- Coordinate local policy revisions to zoning and plans to allow more people to live closer to jobs.
- Take actions to achieve the regional housing targets that provide for additional housing units in Activity Centers and near high capacity transit, especially underused Metro stations.
- Improve walk and bike access to transit to provide additional safe and comfortable paths by removing barriers for walkers and bicyclists.
- Complete the National Capital Bike Trail Network to increase access to opportunities and other activities via non-motorized modes.

### Region Forward Co-Benefits:

- **Economy:** Reduce commuting impacts from the "east-west" divide.
- **Equity, Land use, and Housing:** Prioritizing housing affordability in transit-oriented, mixed-use communities and job centers for a just transition to meeting regional housing and GHG goals.
- **Environment:** Focusing new job and housing growth in Activity Centers can help protect forests and green infrastructure networks.

## MSTB-3: ENHANCE OPTIONS FOR COMMUTERS

### Action Overview

Commuters are more likely to drive alone than to use any other mode, both today and in 2045. The financially constrained element of Visualize 2045 includes funding for travel demand management (TDM) programs such as the TPB's Commuter Connections program. Such programs encourage and incentivize telework and transit use through employer-provided transit benefits, among other actions. They help push our region to more rapidly adopt alternative transportation strategies to reduce vehicle miles traveled, relieve congestion, and reduce emissions.

The TPB's aspirational initiatives call for providing more teleworking and other TDM options for commuters. Many of these actions are successful policies and programs that are already in place in the region and have room for expansion. Actions include expanding telework options, providing transit and carpool benefits to employees, alternative work schedules, providing parking cash-outs for employees that drive and receive free paid parking, and reducing subsidized parking at work.<sup>lxxxix</sup>

Recent experience from the COVID-19 pandemic shows the yet untapped potential to significantly increase teleworking in the region. A particularly informative experience from the COVID-19 pandemic period is that the 20 percent reduction in roadway volumes during summer 2020 as compared to the previous year contributed to a significant improvement in operating speeds during the peak period. Emissions of certain pollutants and fuel consumption tend to be higher during congested speeds. As such, increased telework will not only reduce congestion, it can also reduce transportation emissions.<sup>xc</sup>

### Supporting Overall GHG Reduction Goal

Thirty-four percent of total GHG emissions in the region are generated by fossil fuel on-road vehicles and the majority of these emissions come from passenger cars and passenger trucks. Enhancing commute options and telework for employees reduces the number of vehicle trips and VMT, lessens congestion, and reduces GHG emissions without needing to build any new roads or infrastructure.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

**By 2030, expanding the rate of telework to 20 percent and implementing other TDM strategies, such as pricing commuter parking regionwide and ensuring a majority of employees receive monthly transit benefits, could reduce VMT by 6 percent and SOV trips by 20 percent.**

### How COG Can Support

- Support continuing and expanding TPB's Commuter Connections Program and local programs.
- Continuing or initiating SOV trip reduction strategies for employment centers, particularly those in areas well served by transit.

### How Member Jurisdictions Can Support

- Continue, expand, or initiate transit benefits and teleworking for public sector employees.
- Support teleworking and transit benefits programs for private sector employees.
- Discontinue free parking at employment sites within Activity Centers and near high capacity transit stations.

### Region Forward Co-Benefits:

- **Economic:** Provides savings for commuters.

## ZW-1: IMPLEMENT CURBSIDE ORGANICS RECYCLING PROGRAMS

### Action Overview

Curbside organic composting enables residents and businesses to have separated, organic waste collected with regular trash and recycling collection. This organic waste, including food scraps and yard trimmings, is then directed to dedicated organic composting sites, opposed to landfill or waste-to-energy (WTE) facilities, where it is used to produce nutrient-rich soil additives for growing foods and plants.

Prince George's County's Organic Composting Facility is the largest municipal installation of its kind on the East Coast. The County launched a food scraps curbside collection pilot from December 2017 to January 2019 with approximately 200 households from four diverse communities. An estimated total of 112,000 pounds or 56 tons of food scraps were collected and diverted from the landfill in 14 months. The program is now expanding to 3,000 households and plans county-wide deployment in the next two to three years. Alexandria, Arlington County, Washington D.C. and several additional jurisdictions provide dedicated locations for residents to drop off food scraps.<sup>xc1</sup>

### Supporting Overall GHG Reduction Goal

Organic material that decomposes under anaerobic (without oxygen) conditions present in a landfill causes large amounts of methane (CH<sub>4</sub>) – a GHG 25 times more power than carbon dioxide (CO<sub>2</sub>) – to be released into the atmosphere. However, under the aerobic (with oxygen) conditions present at a composting facility, the breakdown of organic material does not produce methane because methane-producing microbes are not active in the presence of oxygen.<sup>xcii</sup> More than 2 percent of total GHG emissions in the region are associated with solid waste disposal to landfills and WTE facilities and curbside organic recycling programs has the potential to reduce emissions in the waste sector.

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### Level of Implementation Needed to Reach Overall GHG Goal:

**By 2030, curbside composting will need to be expanded significantly to support the region in diverting 80 percent of all materials (including composting and recycling) from landfills and WTE facilities.**

### How COG Can Support

- Aggregate regional demand for curbside organic recycling collection to bring down costs associated with contracted waste haulers and development/expansion of composting facilities.
- Facilitate regionally shared composting projects.

### How Member Jurisdictions Can Support

- Implement composting programs.
- Invest in composting infrastructure.
- Install compost collection bins/sites outside multi-unit dwellings and public facilities.

### Region Forward Co-Benefits:

- **Land Use:** Diverting organics from landfills decreases the amount of overall waste sent to landfills and, as a result, the amount of open space occupied by landfills.
- **Economy and Equity:** Expanding curbside composting programs and the development of composting facilities will create jobs across the region in the waste hauling and construction industries. To ensure equitable access to curbside composting, disadvantaged communities should be prioritized for pilot initiatives and program expansion.



## ZW-2: REDUCE SOLID WASTE GENERATION

### Action Overview

Reducing solid waste generation prevents waste from being sent to landfill or waste-to-energy (WTE) facilities. Reducing waste at the source is the most preferred waste management strategy (Figure 9). This can be done through behavior change or by reusing items, reducing packaging, redesigning wasteful products, and buying in bulk. Recycling is another strategy for reducing solid waste, where products are recycled into raw materials and then remanufactured into new products. <sup>xciii</sup>

The Prince William County Eco-Park, including the landfill and compost facility, is an example of transforming waste into a resource that produces energy, recovers and recycles, and provides opportunities for education. Annually, more than 52,000 tons of waste is diverted from the landfill for recycling, while an additional 40,000 tons of yard waste is composted. In addition, the Eco-Park will soon have a solar energy generating facility on-site as well as food composting. <sup>xciv</sup>

### Supporting Overall GHG Reduction Goal

Reducing solid waste generation reduces the amount of waste that is sent to landfill or WTE facilities, thereby reducing solid waste GHG emissions. WTE facilities burn garbage and typically generate electricity from the combustion of solid waste, which also produces GHG emissions. More than 2 percent of total GHG emissions in the region are associated with solid waste disposal to landfills and WTE facilities. Minimizing waste generation reduces emissions, while contributing to a cleaner, healthier region.

### How COG Can Support

- Support coordination on more direct measures at reducing waste above and beyond the more common approach of plastic and paper bag fees.
- Continue Go Recycle Campaign and incorporate education to consumers on problems associated with single-use packaging.

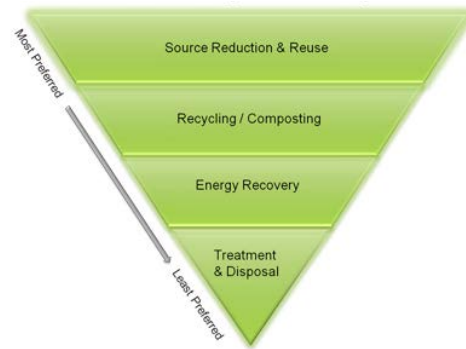
### How Member Jurisdictions Can Support

- Implement single-use plastic and polystyrene bans.
- Invest in waste collection systems and infrastructure, including recycling facilities, and improve waste collection services in underserved communities.

### Region Forward Co-Benefits:

- **Land Use:** Reducing the amount of waste sent to landfills decreases the amount of open space occupied by landfills.
- **Economy and Equity:** Investments in waste collection systems and infrastructure has the potential to create local jobs in the waste and construction industries.
- **Equity:** Focusing on expanding and improving on waste collection services offered to historically underserved communities can help improve the communities' overall quality of life.

Figure 9: Waste Management Hierarchy



### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, local residents and businesses addressing their consumption and disposal patterns will be critical to support the region in diverting 80 percent of all materials from landfills and WTE facilities. Additionally, by 2030, single-use plastics will need to be banned in the majority of jurisdictions to support the 80 percent diversion target.



## ZW-3: BUILD MARKETS FOR CIRCULARITY

### Action Overview

Building markets for circularity encompasses principles that eliminate waste and pollution, while fostering economic productivity through the reuse of materials set aside as waste. The more traditional linear economy is where resources are taken, made into products, and discarded when no longer needed. Circular economy markets can reduce waste, while also creating jobs and supporting economic prosperity.<sup>xcv</sup>

Fairfax, Arlington, Loudoun, and Prince William Counties and the City of Alexandria have partnered together to recover and recycle glass waste in Northern Virginia. There are currently 36 purple glass-only drop-off containers located across these jurisdictions that serve to collect glass waste, which is then brought to Fairfax County's "Big Blue" processing plant. The plant crushes glass bottles and jars into sand and gravel, which can then be used for paving, construction, and landscaping, as well as stormwater control applications. Some glass is also sent out of state to be turned into bottle glass and other projects.<sup>xcvi</sup>

### Supporting Overall GHG Reduction Goal

Building markets for circularity reduces the amount of waste that is sent to landfill or waste-to-energy (WTE) facilities, thereby reducing solid waste GHG emissions. WTE facilities burn garbage and typically generate electricity from the combustion of solid waste, which also produces GHG emissions. More than 2 percent of total GHG emissions in the region are associated with solid waste disposal to landfills and WTE facilities.

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### Level of Implementation Needed to Reach Overall GHG Goal:

By 2030, local residents and businesses addressing their consumption patterns and maximize reuse of materials will be critical to support the region in diverting 80 percent of all materials from landfills and WTE facilities.

### How COG Can Support

- Identify potential to build markets for circular economy products and services, as well as recovered materials in public works projects.
- Continue Go Recycle Campaign and incorporate education to consumers on circular economy.

### How Member Jurisdictions Can Support

- Implement strategies and good practices for circular consumption.
- Incentivize exchange programs and markets for second-hand products.
- Promote repair and restoration services.
- Set up programs for training and employment in the circular economy.

### Region Forward Co-Benefits:

- **Land Use:** Promoting circular consumption, exchange programs, and markets for second-hand products reduces the amount of waste sent to landfills and decreases the amount of open space occupied by landfills.
- **Economy and Equity:** Businesses and programs that make use of recovered materials have the potential to reduce emissions, with the added benefit of increasing economic productivity.
- **Education:** Establishing programs for training in the circular economy will provide significant educational value to the community.

## SQ-1: STRATEGICALLY PLANT NEW TREES ON PUBLICLY OWNED LAND

### Action Overview

Carbon sequestration is the process by which atmospheric CO<sub>2</sub> is absorbed by trees and other vegetation through photosynthesis and stored as carbon in biomass, including trunks and roots. Because trees and vegetation absorb CO<sub>2</sub>, they are known as ‘carbon sinks’ – reservoirs that absorb more carbon than they release. Carbon sinks help to offset other sources of GHG emissions, including those derived from the combustion of fossil fuels.<sup>xcvii</sup>

The most direct way that member jurisdictions can increase levels of carbon sequestration in their communities is by taking action to expand tree canopies on publicly owned lands – including parks, buildings and facilities. Developing a tree inventory can serve as a critical, first step for jurisdictions to assess the baseline tree canopy cover and prioritize publicly owned properties that could accommodate and benefit from additional tree canopy. Over three quarters of COG member jurisdictions have completed a tree canopy assessment and have established a tree canopy cover goal. Leveraging nonprofit partners and community volunteers to play a key role in the inventorying, planting, and stewardship of trees on public lands will be key to achieving these canopy cover goals. For example, “ReLeaf” partners, including Arlington and Fairfax ReLeaf, have been instrumental in organizing volunteers to plant thousands of trees along public highways and public lands.<sup>xcviii</sup>

### Supporting Overall GHG Reduction Goal

Expanding the tree canopy on publicly owned lands can help offset emissions from difficult-to-eliminate fossil fuels, including those combusted to heat buildings. As regional emissions continue to decrease, and difficult-to-eliminate emissions make up a larger share of total emissions, having the ability to offset emissions through sequestration will be critical.

---

### Level of Implementation Needed to Reach Overall GHG Goal:

Planting trees on land owned by jurisdictions will be critical to supporting the overall target of increasing regional tree canopy cover 2.4 percent above 2012 levels by 2030.

### How COG Can Support

- Host trainings and workshops among regional volunteer groups to share best practices.

### How Member Jurisdictions Can Support

- Inventory trees on publicly owned land.
- Identify areas on publicly owned lands appropriate and available for additional planting.
- Provide base funding to support volunteer tree stewardship of existing and newly planted trees on publicly owned lands.
- Maintain or improve community initiatives supporting tree management or planting.

### Region Forward Co-Benefits:

- **Land Use and Environment:** Tree preservation improves air and water quality. Tree preservation is directly linked to preservation of open space, green space, and wildlife habitat and helps to reduce stormwater runoff.<sup>xcix</sup>
- **Health and Human Services and Equity:** Tree preservation reduces health risks by improving air quality, improving water quality, and reducing urban heat island effects. Tree planting should be prioritized in disadvantaged communities with limited access to parks and green spaces.<sup>c</sup>

## SQ-2: ENHANCE REGULATORY CAPACITY TO MANAGE TREE CANOPY AND FOREST PROTECTION

### Action Overview

Ensuring that member jurisdictions programs are structured in such a way to provide tree canopy and forest protection initiatives with adequate regulatory capacity is critical to achieving the region's carbon sequestration goals. Establishing tree canopy cover goals and a tree canopy management policy, allocating adequate staff time and budget, and consistent monitoring are needed to reach these goals. One method for ensuring that member jurisdictions are on the right path for developing regulatory capacity is through participation in the Tree City USA designation process.<sup>ci</sup>

The majority of COG member jurisdictions have established tree canopy goals and earned the Tree City USA designation. Several member jurisdictions have also taken additional key steps to adequately fund tree canopy initiatives. For example, to ensure adequate funding is available for monitoring, inspection, and enforcement of tree canopy regulations, Falls Church's Zoning Ordinance requires owners to deposit a cash bond in an escrow account prior to the issue of building or development permits. Additionally, the City of Frederick recently launched the Tree Frederick Program, a 50-50 cost share program to help residents cover the costs of planting trees and make progress towards the city's 40 percent tree canopy cover goal.<sup>cii</sup>

### Supporting Overall GHG Reduction Goal

Increasing regulatory capacity to manage tree canopy programs can help offset emissions from difficult-to-eliminate fossil fuels, including those combusted to heat buildings. As regional emissions continue to decrease, and difficult-to-eliminate emissions make up a larger share of total emissions, having the ability to offset emissions through sequestration will be critical.

### Level of Implementation Needed to Reach Overall GHG Goal:

Ensuring sufficient regulatory capacity for tree canopy and forest protection initiatives will be critical to supporting the overall target of increasing regional tree canopy cover 2.4 percent above 2012 levels by 2030.

### How COG Can Support

- Develop a Regional Urban Forest Action Plan.
- Support COG members' in calculating and establishing canopy goals for major land use classes.
- Provide technical assistance to support local adoption of tree canopy management policies.

### How Member Jurisdictions Can Support

- Adopt a tree canopy/forest cover goal.
- Calculate and establish tree canopy goals for major land use categories.
- Earn and maintain Tree City USA designation.
- Define a tree canopy management policy in local regulations.
- Dedicate budget and staff time to manage tree planting and preservation initiatives.
- Define annual progress monitoring and reporting requirements.

### Region Forward Co-Benefits:

- **Land Use and Environment:** Tree preservation improves air and water quality. Tree preservation is directly linked to preservation of open space, green space, and wildlife habitat and helps to reduce stormwater runoff.<sup>ciii</sup>
- **Health and Human Services and Equity:** Tree preservation reduces health risks by improving air quality, improving water quality, and reducing urban heat island effects. Tree planting should be prioritized in disadvantaged communities with limited access to parks and green spaces.<sup>civ</sup>

## SQ-3: ENHANCE INCENTIVES AND FINANCING MECHANISMS FOR TREE PLANTING AND PRESERVATION ON PRIVATELY OWNED LANDS

### Action Overview

One of the most effective strategies for expanding tree canopy coverage in the region is through the provision of incentives and funding mechanisms that encourage landowners to protect their trees. Options available to member jurisdictions include mitigation banking, adopt-a-tree programs, memorial trees programs, and incentives for planting trees to achieve specific environmental or ecological goals.<sup>cv</sup>

During the construction and development process, many jurisdictions require the replacement of trees that have been damaged or removed. In cases where this is not possible, tree banking enables developers or landowners pay into a dedicated tree planting fund which then uses the funds to plant trees in an alternative location. In Prince George's County, for example, developers or landowners are required to purchase credits from a woodland conservation bank if requirements cannot be met on-site. These woodland conservation banks are land that has been intentionally preserved as perpetual woodlands to satisfy the conservation requirements of other properties in the county.<sup>cvi</sup>

### Supporting Overall GHG Reduction Goal

Increasing tree canopy through incentives and funding can help offset emissions from difficult-to-eliminate fossil fuels, including those combusted to heat buildings. As regional emissions continue to decrease, and difficult-to-eliminate emissions make up a larger share of total emissions, having the ability to offset emissions through sequestration will be critical.

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#### Level of Implementation Needed to Reach Overall GHG Goal:

Providing incentives and funding mechanisms to support tree planting and preservation will be critical to supporting the overall target of increasing regional tree canopy cover 2.4 percent above 2012 levels by 2030.

### How COG Can Support

- Develop fundraising guidebook and resources for interested COG members.
- Support COG members in identifying priority co-benefit areas with tree planting and preservation.

### How Member Jurisdictions Can Support

- Establish local tree planting and preservation incentives, funding mechanisms and policies.
- Establish on-site and off-site metrics for tree preservation such as tree mitigation banks or funds.
- Create or enhance adopt-a-tree and memorial tree programs to expand funding sources.

### Region Forward Co-Benefits:

- **Land Use and Environment:** Tree preservation improves air and water quality. Tree preservation is directly linked to preservation of open space, green space, and wildlife habitat and helps to reduce stormwater runoff.<sup>cvii</sup>
- **Housing:** Providing alternatives to on-site tree preservation compliance enables denser housing development near transit/activity centers while still preserving trees.
- **Health and Human Services and Equity:** Tree preservation reduces health risks by improving air quality, improving water quality, and reducing urban heat island effects. Tree planting should be prioritized in disadvantaged communities with limited access to parks and green spaces.<sup>cviiii</sup>

# CLIMATE RISKS AND VULNERABILITIES

## Assessment Overview

In 2018, The Intergovernmental Panel on Climate Change (IPCC) released the *Global Warming of 1.5°C*, an IPCC special report, highlighting that the world is already experiencing the impacts of 1 degree Celsius warming above pre-industrial levels but more severe climate impacts could be avoided if global warming is limited to 1.5 degrees Celsius. If the rate of warming continues, 1.5 degrees Celsius warming is likely to occur between 2030 and 2052 with more frequent and severe extreme weather events becoming even more prevalent.<sup>cix</sup>

As the IPCC noted internationally, metropolitan Washington is also experiencing the impacts of a changing climate. Observations in metropolitan Washington show that temperatures and the water surface level in the Potomac River have been rising and will continue to rise. Extreme weather events and increases in the number of extreme heat and cold days will increase risks to health, energy usage patterns, plant and animal habitats, and infrastructure. These changes are also affecting stormwater, drinking water, and wastewater. Implementing regional adaptation strategies are necessary to reduce the impacts of climate change.<sup>cx</sup>

A climate risk and vulnerability assessment (CRVA) was conducted for metropolitan Washington with the goal of understanding the climate hazards that face the region and assessing the likelihood and impact of current and future hazards on the region. Climate change may increase the frequency or severity of climate hazards in metropolitan Washington, including extreme heat (high day and night temperatures), drought, flooding (flash, riverine, and coastal), lightning and thunderstorms, and extreme winter conditions.

## METHODOLOGY

The regional CRVA methodology is based on the Global Covenant of Mayors for Climate and Energy (GCoM) framework. GCOM is a global alliance of cities and local governments that support voluntary action to address climate change and ensure a low emission, climate resilient future.<sup>cxii</sup> The CRVA identifies and describes current and anticipated climate hazards metropolitan Washington faces. As shown in Table 3, each hazard is assigned a risk level, based on probability and level of consequence (probability x consequence). After the hazard risks are identified, an assessment is conducted to determine the future change in intensity and frequency, and the timeframe over which this will occur: Immediately, Short Term (by 2025), Medium Term (by 2050), and Long Term (after 2050).

**Table 3: Climate Risk Sourcing Matrix**

		Probability		
		Low (1)	Moderate (2)	High (3)
Consequence	High (3)	3	6	9
	Moderate (2)	2	4	6
	Low (1)	1	2	3

Next, vulnerabilities were assessed to determine the degree in which the people, systems, and sectors are susceptible to current and future climate impacts. The impacts assessed include, but are not limited to: services lost, environmental impact, property damages, public health threats, economic losses, and other disruptions to day-to-day operations. For each hazard, relevant population groups in the region were identified that are most vulnerable to future climate hazards and impacts. Finally, for each hazard, factors were assessed that may impact the region’s adaptive capability.

To conduct the CRVA relevant climate studies and reports were leveraged followed by stakeholder engagement in climate planning work sessions. Both the research and stakeholder engagement informed the final CRVA results to determine the adaptive capability of the region. The findings of the CRVA provides guidance to the priority collaborative resilience actions identified in this plan.

## SUMMARY RESULTS

As shown in Table 4, the most prominent climate hazards facing metropolitan Washington include extreme heat and flash and riverine flooding. More frequent extreme heat days will lead to public health concerns, increase energy demand, travel disruptions, and maintenance and infrastructure damages. With more frequent and intense storms, flash and riverine flooding will increase disruptions and damages to infrastructure and emergency services, and further threaten vulnerable populations.

**Table 4: Risk Level of Hazards in Metropolitan Washington**

Hazard	Probability	Consequence	Risk
Extreme Heat	3	3	9
Drought	2	3	6
Flooding (Flash and Riverine)	3	3	9
Coastal Flooding	3	2	6
Lightning/Thunderstorm	3	2	6
Extreme Winter Conditions	2	3	6

The region must adapt to climate change. Adaptive capacity is defined as “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences.”<sup>cxii</sup> Table 5 shows the degree of challenge identified for each sector evaluated in the CRVA. Infrastructure conditions pose the highest degree of challenge due to the impacts on maintenance costs, aging facilities, interoperability, and increased demand. Resilient critical infrastructure is essential to the well-being, health, and safety of the people in metropolitan Washington. Implementing resilient measures for all critical infrastructure by 2050 is necessary to respond to a changing climate.

**Table 5: Metropolitan Washington Adaptive Capacity Degree of Challenge**

Factor	Degree of Challenge
Infrastructure Conditions/Maintenance	High
Access to Basic Services	Moderate
Access to Healthcare	Moderate
Public Health	Moderate
Housing	Moderate
Poverty	Moderate
Community Engagement	Moderate
Environmental Conditions	Moderate
Economic Health	Low

## VULNERABLE POPULATIONS

Climate change will impact people and communities differently. Potentially vulnerable populations may include low-income, minority, marginalized groups, women and girls, persons in sub-standard housing, people with limited English proficiency, the elderly, children, people with chronic health problems, or disabled persons. Where possible, the regional CRVA overlays the Equity Emphasis Areas (EEAs) developed originally for transportation planning and evaluation of communities with more health challenges with climate risks as a starting point to identify potentially vulnerable populations. Metropolitan Washington EEAs, identified by COG and its members, include communities that have a higher than average concentration of low-income, minority populations, or both. As vulnerable populations face greater risks, their consideration and inclusion in climate change planning is essential to ensure equitable distribution of benefits. Creating resilient communities is only possible when inclusion of vulnerable populations’ needs are met.<sup>cxiii</sup>

## Climate Hazards, Risks and Impacts

### EXTREME HEAT

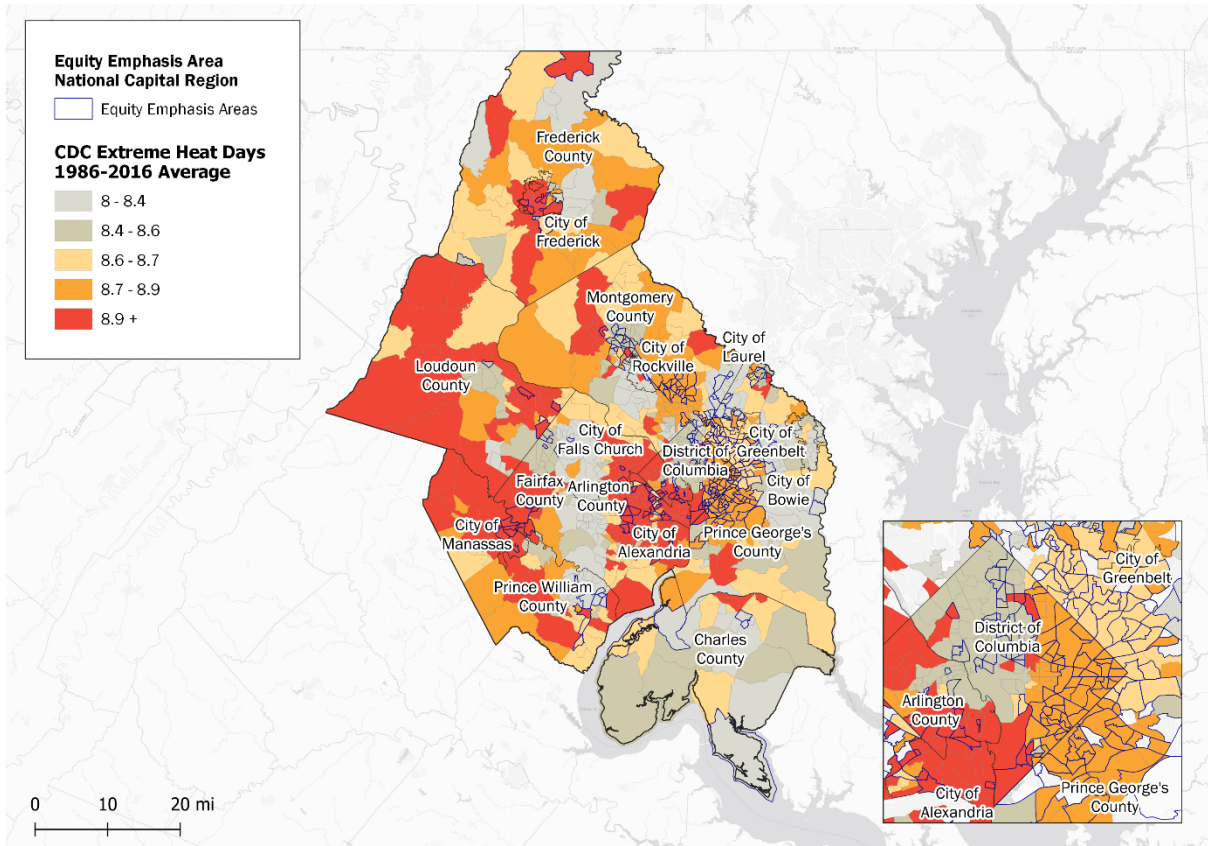
Extreme heat occurs when temperatures that occur in the summertime are significantly higher or more humid than the average temperature the area typically experiences. Extreme heat has a high probability of occurring in metropolitan Washington and poses a high threat to human life.<sup>cxiv</sup>

Probability	Consequence	Risk
3	3	9

Heat is the number one cause of weather-related injuries and fatalities in the region. In 2019, 53 days at or above 90°F and 13 days at or above 95°F were recorded at Dulles International Airport. Across the region, Figure 10 shows the average number of extreme heat days from 1986- 2016 overlaid with EEA’s in the region. EEAs are more heavily burdened by extreme heat. The median number of extreme heat days a year in the region is 8.61 days, the median in EEAs is 8.75 days. Potentially vulnerable populations may face barriers such as access to air conditioning, housing, and cooling centers. Populations that rely on electronic medical devices and refrigerated medication face a greater risk during power outages from extreme heat days. Populations that reside in urban areas, are more at risk due to urban heat island effects.<sup>cxv</sup>



**Figure 10: Extreme Heat Days and Equity Emphasis Areas**

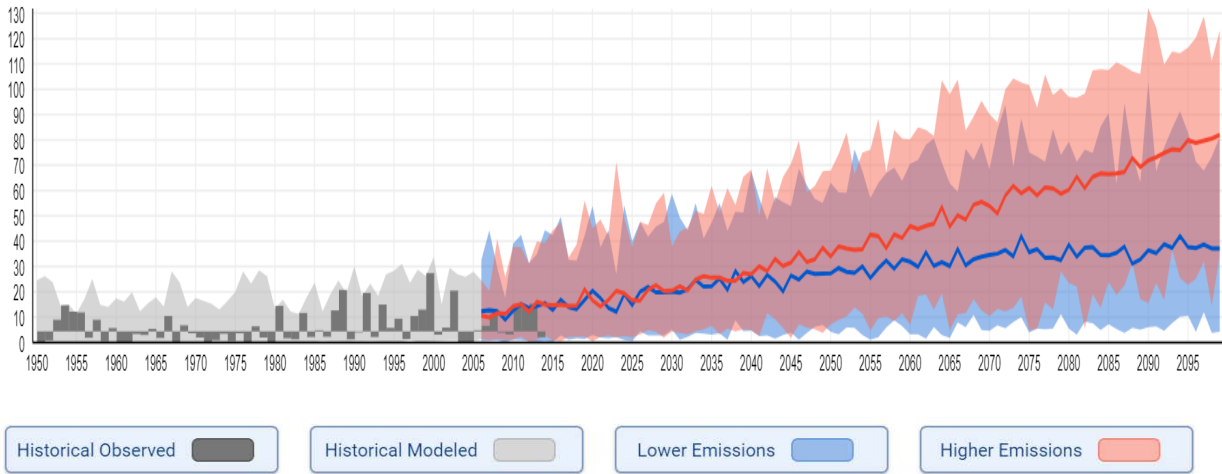


Source: Centers for Disease Control and Prevention (CDC) National Environmental Public Health Tracking Network Analysis Data Explorer and COG Equity Emphasis Areas

The number of extreme heat days will increase by 2025, with both extreme heat days and heat waves occurring more frequently. As seen in Figure 11, the National Oceanic and Atmospheric Administration (NOAA) Climate Explorer shows the number of days per year with temperatures greater than 95 °F from 1950 to 2095, the red and blue fill indicates the range of future projected temperatures under high and low emissions scenarios, respectively. The data indicates a significant increase in the projected number of heat days; that the number of days per year with temperatures above 95 °F may reach more than 50 to 100 days by 2065 under the high emissions scenario.<sup>cxvi</sup>

Similarly, the Climate Ready DC Plan projects that the District of Columbia would experience 40 to 75 days with temperatures above 95 °F by 2080 under a high emission scenario.<sup>cxvii</sup>

**Figure 11: Number of Projected Days Over 95 °F from 1950 until 2095**



Source: NOAA Climate Explorer

Extreme heat presents challenges to infrastructure. Extreme heat can lead to more frequent travel disruptions, increased road surface damage and pavement softening, increase in rail infrastructure deterioration from buckling and expansion, impact aviation runways and plane takeoff, and impact electrical infrastructure (i.e. sagging lines). An increase in the number of extreme heat days may accelerate deterioration of other assets such as buildings, bridges, and vegetation, and increase cost of maintenance. Higher temperatures will result in increased cooling costs and energy demands and disruptions and damages to utility infrastructure.

Increased days of extreme heat can also lead to higher ozone pollution levels and could make it more difficult for the region to attain or maintain attainment with National Ambient Air Quality Standards (NAAQS) for ozone. High heat, unhealthy air days can trigger heat stroke, respiratory problems, heat exhaustion, hyperthermia, and death. The elderly, small children, persons with chronic diseases, persons with allergies, low-income populations, and outdoor workers are especially vulnerable to heat-related illnesses. An increase and prolonged number of extreme heat days will increase the transmission of diseases, making a longer tick and mosquito season common and increase the likelihood of vector-borne diseases. By the 2060s, the season could begin three weeks earlier in Virginia than it did from 1992 to 2007.<sup>cxviii</sup>

## DROUGHT

Drought is affected by the number of precipitation-free days and warmer temperatures, causing greater evaporation

Probability	Consequence	Risk
3	2	6

and evapotranspiration. Drought can cause dry weather patterns, low water supply, and can affect agricultural crops. While upstream reservoirs provide some protection from drought for metropolitan Washington, the region is particularly at risk due to the heavy reliance on the Potomac River as the primary source of potable water. Some jurisdictions are 100 percent reliant on water withdrawals from the Potomac River. Conditions in the Potomac River Basin frequently differ between the upper and lower portions of the Basin. Drought has a moderate probability of occurring but has a high consequence of impact in the region on the water supply and agricultural systems.<sup>cxix</sup>

Although droughts account for a small percentage of hazards in the region, impacts can be severe. In September 2010, due to unusually dry conditions, COG’s Drought Coordination Committee (DCC) declared a drought ‘WATCH’; The WATCH ended when Tropical Storm Nicole hit the region. Since 2000, several smaller community water systems have briefly declared WARNING or EMERGENCY stages due to limited rainfall and less resilient water supply systems. In October 2019, The October 1, 2019 U.S. Drought Monitor for the Potomac Watershed indicated that abnormal dryness (D0) and moderate drought (D1) exist throughout the region due to an unusually hot and dry September.<sup>cxix</sup>

By 2050, droughts may occur more frequently and be prolonged, with an increased intensity. As most of the region’s drinking water comes from the free-flowing Potomac River, more frequent and intense droughts may increase the demand of water, lower base flows in the Potomac River watershed, and degrade water quality. The food and agriculture sector may face reduced crop yield and crop losses. Vulnerable populations are at a high risk, due to the indirect impacts of the disruptions of agriculture and water systems.<sup>cxix</sup>

## FLASH AND RIVERINE FLOODING

Flash flooding occurs when the ground exceeds the ability to absorb heavy or excessive rainfall. Riverine flooding occurs

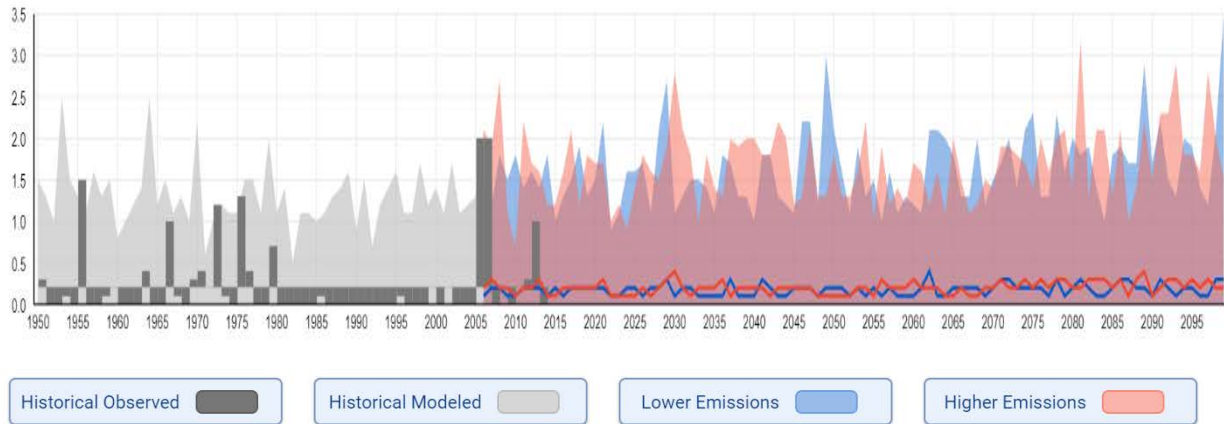
Probability	Consequence	Risk
3	3	9

when excessive rainfall causes high flow rates and water levels to rise over the top of riverbanks. This may occur due to thunderstorms, combined rainfall and snowmelt, ice jam, or heavy rain from tropical storms. Flash and riverine flooding have a high probability and high consequence of impact, posing a high risk to public health, transportation, water supply and sanitation, and properties. Coastal storm surge has a lower probability and medium consequence in metropolitan Washington.<sup>cxix</sup>

The region has experienced many flash and riverine flooding events. In 2006, Washington D.C., experienced several days of intense rainfall, equivalent to a 200-year storm. The precipitation overwhelmed the storm sewer system. Several Federal agencies, Smithsonian museums including the National Gallery, and the Washington Metropolitan Area Transportation Authority (WMATA) had severe impacts to their operations, buildings, and infrastructure. In addition to damages to infrastructure and businesses, the event caused disruptions to critical services. A couple other notable examples of flash and riverine include May 2018 flash flooding in Frederick and July 2019 flash flooding in Northern Virginia.<sup>cxix</sup>

The frequency and intensity of heavy precipitation events are likely to increase. Figure 12, shows precipitation projections will occur at a higher range than historical records, demonstrating the possibility of more frequent heavy precipitation events. A 100-year precipitation event could become a one in 25-year event by mid-century, and a one in 15-year event by the 2080's.<sup>cxix</sup>

**Figure 12: Projected Number of Days per Year with Over 3 Inches of Precipitation**

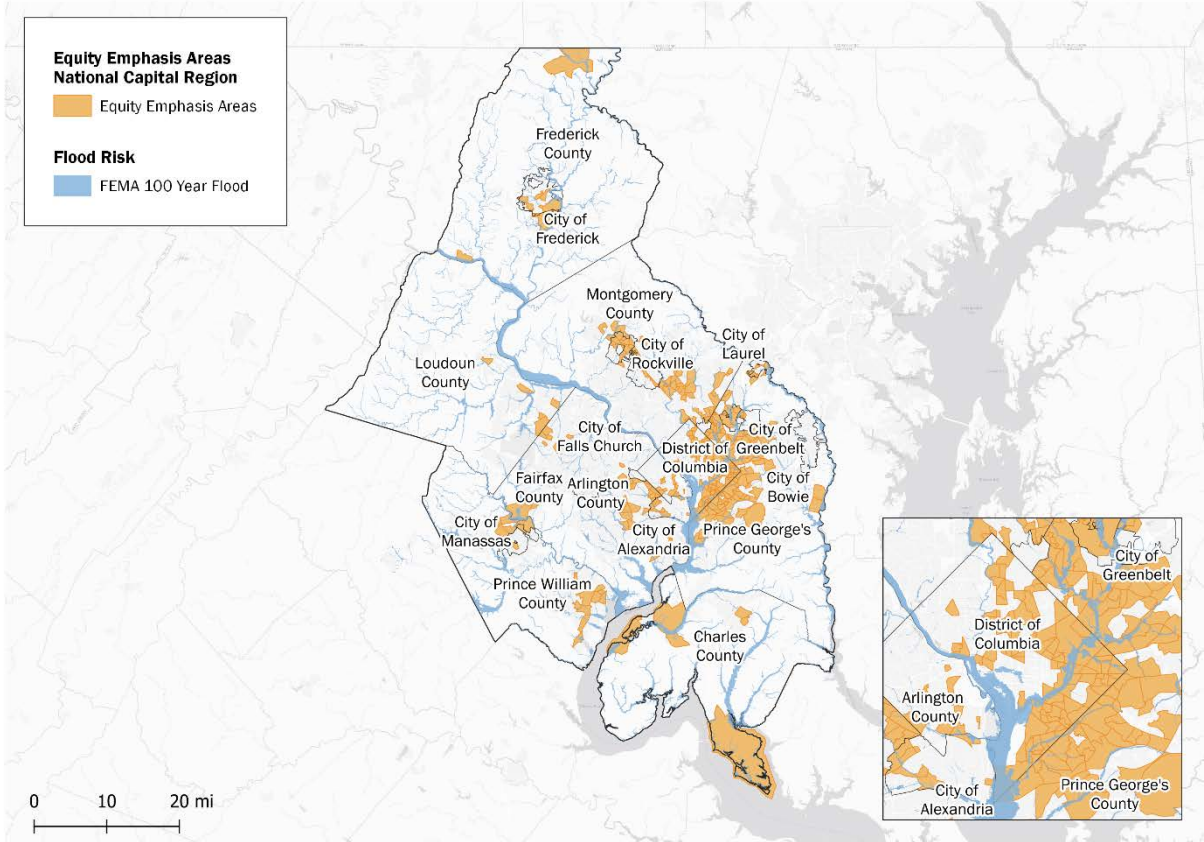


Source: NOAA Climate Explorer

An increase in the number and intensity of flash and riverine flooding may cause disruptions to the transportation and energy sector including flooding roadways, physical damages, loss and disruption to critical and emergency services, and wide-scale power outages. Sewer systems may be damaged due to the overwhelming level of water and pollution from storm water runoff may increase a degradation of water quality and shoreline loss.

Individuals with lower socioeconomic status, such as low-income households, persons in sub-standard housing, and unemployed persons are more likely to have limited resources that may hinder their ability to prepare for flooding and evacuate before and during an event. Persons with disabilities, the elderly, persons with chronic conditions, and language barriers are also at risk during flood events. Persons residing in flood zones are at risk for loss of property and injuries. As seen in Figure 13, Federal Emergency Management Agency’s (FEMA) 100-year floodplains run through more than 60 percent of Equity Emphasis Areas (EEAs), where currently approximately 1 million people reside. Also notable, is that more than half of the region’s EEAs are within the Anacostia watershed (mainly in the District of Columbia and western border of Prince George’s County). These areas can serve as a starting point for local jurisdiction to work with these communities to further identify potentially vulnerable populations, how they will be impacted by riverine flooding, and how to address their needs.<sup>cxxv</sup>

**Figure 13: Equity Emphasis Areas and FEMA's 100-Year Floodplains**



Source: FEMA and COG Equity Emphasis Areas

## COASTAL FLOODING

Coastal flooding can occur in the form of nuisance or tidal flooding during extreme high tides and during coastal storms that produce intense rain, storm surges and high waves. Coastal flooding poses a risk to human health including injuries, death, and illnesses associated with contaminated water including diarrhea and stomach illnesses.<sup>cxxvi</sup> Coastal flooding poses risks to transportation services, infrastructure, residential housing, businesses, and the economy.

Probability	Consequence	Risk
3	2	6

In the past 90 years, the Potomac and Anacostia River, both tidal rivers have experienced 11 inches of sea level rise. Nuisance flooding has increased over 300 percent along the riverfront. Effects of sea level rise are observable, including shoreline erosion and deterioration of tidal wetlands. Recent examples of coastal flood events include impacts of Hurricane Isaac (2003), the 2006 Mid-Atlantic Storm and Tropical Storm Lee (2011).<sup>cxxvii</sup>

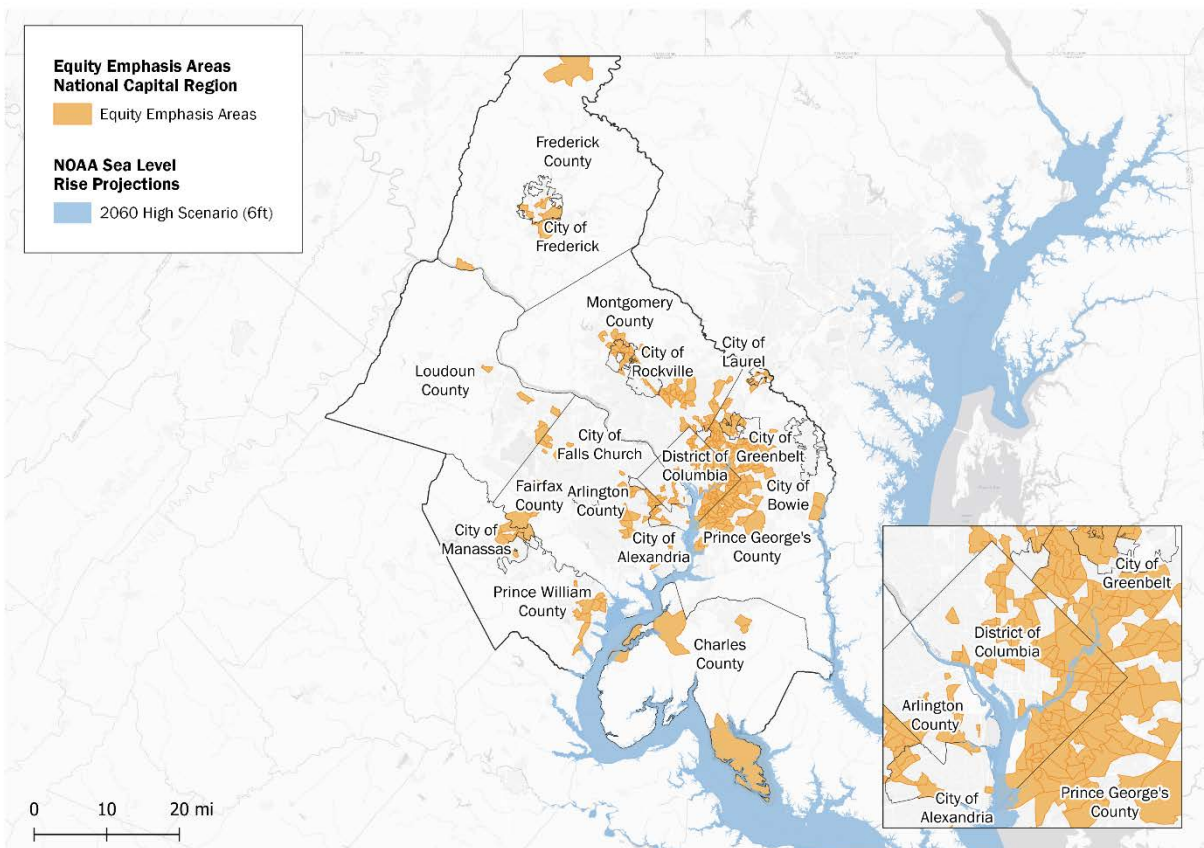
The region may experience more intense and more frequent coastal flooding impacts. The District of Columbia could experience 2 to 6 feet of additional sea level rise towards the end of the century. Increases in sea level rise will cause tidal and nuisance floods with more severe impacts and a reduction of time in between floods. Storm surge floods will be more threatening in the long term with added sea level rise.<sup>cxxviii</sup>



Coastal areas in metropolitan Washington contain a critical convergence of infrastructure (water, energy, and communication utilities, transportation hubs, facilities and buildings) that the region’s local governments, businesses, institutions, and communities depend upon. The region is also home to many federal buildings, military installations, national security facilities, and significant national monuments and cultural treasures. As sea level rises, the coastline may change and critical infrastructure that was previously not at risk may face a greater risk of flooding from storm surges. More frequent and intense coastal flooding may impact these infrastructure and facilities potentially causing damage, disruptions, and economic losses.

Coastal flooding puts vulnerable populations that live and work near the coast at a higher risk. Populations with socioeconomic barriers, including low-income households, the elderly, persons in sub-standard housing, and individuals with language barriers face greater challenges to prepare and respond to flood events. Figure 14 demonstrates the number of EEAs that fall within NOAA’s high sea level rise projections (6ft). More than 10 percent of EEAs will be affected by a 6-foot sea level rise. More than 100,000 people currently live in these EEAs. These areas can serve as a starting point for local jurisdictions to work with these communities to further identify potentially vulnerable populations, how they will be impacted by coastal flooding, and how to address their needs.<sup>cxix</sup>

**Figure 14: Equity Emphasis Areas and NOAA Sea Level Rise Projections High Scenario (2080 6ft)**



Source: NOAA and COG Equity Emphasis Areas



## SEVERE THUNDERSTORMS/LIGHTNING

A thunderstorm is a combination of precipitation, thunder, and lightning.

A severe thunderstorm may additionally

include hail, wind gusts of 50 knots or more or may even form into a tornado. Severe thunderstorms may also cause flooding. Severe thunderstorms and lightning have a high probability of occurring with a moderate level of impact.

Probability	Consequence	Risk
3	2	6

The June 2012 Derecho that hit the region was a violent thunderstorm with winds recorded at upwards of 85 mph. The storm demonstrated the consequences of climate impacts on infrastructure failures. Millions of people experienced power outages for several days during a heatwave. The Washington Suburban Sanitary Commission (WSSC) experienced power loss at Potomac and Patuxent filtration plants and at more than 50 of its facilities. Transportation routes were blocked due to downed trees and power lines. The Derecho event resulted in communication infrastructure damages and 9-1-1 outages affected more than 1.5 million people in Northern Virginia and 68,000 people in the District of Columbia. <sup>cxxx</sup>

In October 2012, the region experienced sustained winds and heavy rain during Superstorm Sandy. Impacts were lessened due to the region not being directly hit, pre-landfall preparedness, and coordination during response and recovery operations. During Sandy, the region experienced flooding, power outages, downed power lines and trees. The Potomac and Patuxent Water Filtration Plants maintained full power; however, other water utilities experienced short power outages, flooding, or sewer overflows. Washington Metropolitan Area Transit Authority (WMATA) suspended Metrorail and bus services for two days. <sup>cxxxi</sup>

With rising temperatures, severe thunderstorms and lightning have a high probability to occur more frequently by 2025. Future projections show the frequency and intensity of extreme precipitation events are projected to increase from 10 days per year with 1 inch of rain in a 24-hour period, to 11 days in the 2020s and 12 days by 2050. The number of days per year with more than 2 inches of rainfall per 24-hour period is expected to increase from 1 day to 3 days by the 2020s and 3.5 days by the 2050s. <sup>cxxxii</sup>

More frequent and intense severe storms will cause additional impacts to energy, transportation, water, and communication services and assets. Power outages and transportation disruptions will occur due to extreme rainfall events and downed trees. Severe thunderstorms and lightning pose a public health challenge, as power outages can disrupt medical services and emergency response. More intense rainfall can damage and overwhelm water infrastructure. More frequent lightning will increase fire risk. Additionally, an increasing electric fleet may be impacted by power outages.

Long-term power outages particularly pose challenges to potentially vulnerable populations including the elderly, persons with chronic conditions, persons who rely on electric medical equipment, homeless, and those reliant on refrigerated medication. Prolonged power outages pose public health challenges and can become life threatening during heat waves and extreme cold events.

## EXTREME WINTER CONDITIONS

Extreme winter conditions are a combination of heavy snow, blowing snow or dangerous wind chills. Extreme winter storms can create

blizzards which causes low visibility due to blowing snow and wind. Ice storms occur when at least

Probability	Consequence	Risk
2	3	6

0.25 inches of ice accumulates on an exposed surface.<sup>cxxxiii</sup> The region may see increases risk of ice storms as winter temperatures rise and more storms will occur near 32°F in temperature. Extreme winter conditions have a moderate probability and a high consequence, as these events pose a life-threatening risk to human health and life.

The region has experienced extreme winter conditions resulting in loss of life, significant economic impacts, and infrastructure damages. Recent winter storms events affecting metropolitan Washington include: Snowzilla (2016), Carmageddon (2011), Snowmageddon (2010), and Snowpocalypse (2009). As seen in Figure 15, the February 2010 severe winter storm named Snowmageddon impacted the Atlantic coastline, dropping several feet of snow in metropolitan Washington. Washington's Dulles Airport recorded 32.4 inches of snow. A State of Emergency was declared in Washington D.C, Virginia, and Maryland. Widespread power outages occurred with hundreds of thousands without power. The Federal government and schools in the region were closed for several days. Infrastructure damages and disruptions to transportation routes occurred due to excessive snow on roadways, downed trees, abandoned vehicles and vehicle accidents. It took several days to clear roads and pedestrian paths after the storm.<sup>cxxxiv</sup>

**Figure 15: Satellite Image of Snowmageddon**



Source: National Aeronautics and Space Administration (NASA) Terra Satellite

Extreme winter conditions will occur more frequently and increase in intensity by 2025. While average annual temperatures are increasing, extreme winter events and cold snaps may continue to occur. Extreme winter conditions cause impacts to both infrastructure and people. Infrastructure can experience road surface damages and closures resulting in travel disruptions and higher maintenance costs. Roadway accidents, injuries, and fatalities are likely to coincide with winter conditions. Energy infrastructure may experience transmission structure failures resulting in power outages for many customers. Extreme cold temperatures pose a public health risk especially to persons facing homelessness, low-income households, the elderly, and persons with chronic conditions who rely on daily access to services.

# REGIONAL CLIMATE RESILIENCE STRATEGY

## Moving Toward Resilience

The Regional Climate Resilience Strategy includes collaborative actions to support the region in achieving the climate resilience goals of becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030. To move the region toward becoming more resilient, the region needs to ensure that all populations are included and prioritize resilience of the region's most vulnerable populations.

### CLIMATE READY REGION BY 2030

Recognizing everything cannot be implemented at once due to the significant capital outlay required for resilience, the region first needs to be climate ready. To be Climate Ready by 2030, all local governments must assess current and future climate risks, and be actively integrating climate planning across government plans, operations, and communications. More specifically, Climate Ready involves metropolitan Washington undertaking five key components:

1. Local climate risks have been assessed and climate planning is incorporated into all government plans.
2. Climate risks are being communicated across governmental offices and to the public, with a particular emphasis on empowering diverse populations.
3. Climate planning is actively being incorporated into government operations.
4. All communities are implementing actions to reduce climate risks.
5. Establish the necessary plans, networks, funding, and other actions to ensure implementation of full resilience.

### CLIMATE RESILIENT REGION

To fully be a Climate Resilient Region, the region must have the ability to adapt and absorb against disturbances caused by current and future, acute and chronic climate impacts and successfully maintain essential functions. This will be realized when:

1. The region is a network of resilient and socially connected people, governments, and institutions that have constructed resilient communities. (Resilient people = resilient communities).
2. Measures have been implemented across the region to mitigate against current and future climate impacts.
  - All critical infrastructure and functions are climate resilient.
  - Resilient solutions to protect public health and safety, particularly of potentially vulnerable populations, have been deployed.
3. The region is monitoring measures to address current and future climate risks and vulnerabilities.

### PRIORITY COLLABORATIVE RESILIENCE ACTIONS

The climate action areas included in this Regional Climate Resilience Strategy address: Planning, Equity, and Resilient Infrastructure. Within these action areas are high-level priority actions for COG and its members to focus on through 2030. All actions are voluntary. Actions have a 1-page description that includes:

- An action overview with example policies, programs, or projects;
- How the action supports regional resilience goals;
- Identifies what level of implementation is needed to meet by 2030 and beyond;
- Examples of how COG and local jurisdiction efforts that can support implementation (it's not an exhaustive list); and
- How the action benefits other *Region Forward* goals.

Table 6 is a summary of the climate action areas and priority collaborative actions described in this strategy. The actions are based on the needs identified in the regional climate risk and vulnerabilities assessment described in the previous section of this plan. While these actions focus on what COG and its members can do together to move the region towards becoming Climate Ready and Climate Resilient, significant action will be needed across all sectors and all levels of government in order to meet these goals.

**Table 6: Metropolitan Washington Priority Collaborative Resilience Actions**

Climate Action Area	Action ID	Priority Collaborative Action
Planning	PL - 2	Support Capacity Building for Climate Resilience Planning
	PL - 3	Develop Integrated Approach to Climate Resilience Planning
	PL - 4	Update Local and Regional Plans to Address Climate Risks
Equity	EQ - 3	Support Engagement of the Public on Climate Risks, with a Particular Emphasis on Potentially Vulnerable Populations
	EQ - 4	Support Equitable Secure Energy Access
Resilient Infrastructure	RI - 1	Support Establishment of Resilience Hubs
	RI - 2	Improve the Resilience of Critical Infrastructure
	RI - 3	Implement Measures to Equitably Address Urban Heat Island
	RI - 4	Enhance Green Infrastructure Networks
	RI - 5	Implement Measures to Reduce Flood Risk

## PL-2: SUPPORT CAPACITY BUILDING FOR CLIMATE RESILIENCE PLANNING

### Action Overview

Metropolitan Washington is home to 24 diverse local jurisdictions that have unique capabilities, availability, and resources for climate resilience planning. To ensure an equitable climate resilient future, capacity building will require greater coordination, coherence, and integration. This is especially important to address climate hazards that have impacts that are felt across the region simultaneously. Communicating and capacity building will need to be mainstreamed across local government departments to achieve a common understanding of climate risks amongst all government staff.

To improve resiliency, the region's local governments need to continue to collaborate with a network of external organizations to support capacity building and training on climate resilience. One example effort is how COG coordinated from 2012 – 2014 with the National Aeronautics and Space Administration (NASA), National Capital Planning Commission (NCPC), US General Services Administration (GSA), US Global Change Research Program (GCRP), and the Smithsonian Institution to bring federal, regional and local agencies in the region together to learn about climate impacts, conduct and share agency-level vulnerabilities assessments, and identify common solutions.

### Supporting A Climate Ready Region

The impacts of a changing climate are already evident in the region, with an increasing number of extreme heat days, change in precipitation patterns, and an increase in the severity of storms. Continuing to capacity build, provide training, and grow resilience expertise among government staff, non-governmental organizations, academic partners and the community is crucial to reaching climate readiness by 2030. Continuing to grow and identify avenues for integrated climate trainings and capacity-building resources, will support local level resiliency planning.

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#### Level of Implementation Needed to Address Climate Risks

**COG members participating regularly in capacity building on climate risks and resilience strategies will help the region be Climate Ready by 2030. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/ thunderstorms and extreme winter conditions.**

### How COG Can Support

- Continue to grow capacity building through workshops and committee meetings, and coordinate with members and partners to increase opportunities for training.
- Support implementation of a climate planning training series for local government staff.

### How Member Jurisdictions Can Support

- Encourage active participation in climate planning training initiatives.
- Provide training and capacity-building across governmental departments and sectors to address climate risks and resiliency planning.

### Region Forward Co-Benefits:

- **Equity and Education:** Jurisdictions with limited resources would benefit from capacity to increase regional knowledge of heightened climate impacts on vulnerable populations in the region.



## PL-3: DEVELOP INTEGRATED APPROACH TO CLIMATE RESILIENCE PLANNING

### Action Overview

Regional consensus on climate planning projections and climate resilience definitions, metrics and design standards will provide a common framework for resilience planning across the region. With 24 local governments located in two states and the District of Columbia, availability of funding and resources differs across the region. Many programs would benefit from sharing of climate materials that will assist in incorporating resilience in local and regional plans. Increasing regional collaboration will allow metropolitan Washington to pool resources that benefits local governments and the region to leverage expertise from a variety of climate planning sources.

To address climate risks, the coordination and sharing of activities, best practices, consistent forward-looking climate science, and technical resources to enhance local and regional capacity is essential. The region has substantial networks, notable examples collaborative work in the region include the District of Columbia's Silver Jackets, Northern Virginia Regional Commission's Resiliency Planning Work Group, and National Oceanic and Atmospheric Administration's Climate Resiliency Workgroup.

### Supporting A Climate Ready Region

Reducing vulnerabilities to human life, infrastructure, ecosystems, and the economy require a collaborative response, as climate projections and impacts of extreme events cross jurisdictional boundaries. Adopting an integrated approach and consensus on climate projections, forward-looking climate science, and resilient design standards by the region will better align climate planning efforts.

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### Level of Implementation Needed to Address Climate Risks

Developing a regional consensus on climate projections and climate resilience definitions, metrics, and design standards is an important step towards becoming a Climate Ready Region by 2030. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/thunderstorms and extreme winter conditions.

### How COG Can Support

- Continue sharing of best practices with local governments, federal and state agencies, businesses, non-governmental organizations, and the academic community to address climate risks, planning, modeling, and standards development.
- Continue to identify avenues for shared contractual support for climate planning, feasibility, and implementation.
- Develop a regional consensus on projections on climate risks and definitions to use in planning.
- Develop regionally appropriate climate resilient design standard guidelines.

### How Member Jurisdictions Can Support

- Provide expertise and sharing of best practices of resiliency planning.
- Integrate common climate projections, metrics and resilient design standards across all departments.
- Design new and rehabilitated infrastructure to meet future-looking climate conditions.

### Region Forward Co-Benefits:

- **Equity and Education:** The region is a network of diverse local governments with various levels of resources and need. Growing climate networks and encouraging information sharing will assist in creating an equitable resilient future.



## PL-4: UPDATE LOCAL AND REGIONAL PLANS TO ADDRESS CLIMATE RISKS

### Action Overview

Climate projections in metropolitan Washington show more frequent and severe weather events will occur, which can lead to larger disruption of critical services and increased threat to human life. To ensure the region is prepared for climate-related disasters and possesses the ability to recover quickly, climate projections, risks and actions to reduce risks to potentially vulnerable populations need to be mainstreamed into all government plans, including but not limited to emergency plans, hazard mitigation plans, comprehensive plans, transportation plans, stormwater and watershed plans, and capital improvement plans. Mainstreaming occurs when climate considerations are a part of the overall planning process rather than outliers not central to policy and investment decisions.

<sup>cxxxv</sup>

In 2017, Prince George's County adopted an updated Hazard Mitigation Plan to incorporate climate planning data. Within the plan's flood-related hazard analyses, a variety of climate data was used including data from the Maryland Department of Natural Resources Coast Smart program. The Coast Smart Flood Hazard Analysis of sea level rise on the Potomac and Patuxent Rivers was used to conduct a coastal flooding analysis and to map potential sea level rise. <sup>cxxxvi</sup>

### Supporting A Climate Ready Region

The climate is changing, and all government departments will need to have the ability to anticipate, address, and adapt to new and changing climate risks in order to reduce impacts on people, critical services, infrastructure, and the economy. All government offices need to understand how climate risks and impacts affect their ability to do their job and continue to provide services to the community.

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### Level of Implementation Needed to Address Climate Risks

**To become a Climate Ready Region by 2030, COG and its members will need to update all plans to address climate risks. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/ thunderstorms and extreme winter conditions.**

### How COG Can Support

- Review and update regional emergency response and other relevant plans to reflect climate-risks and projections.
- Incorporate future climate projections and risks into regional emergency response exercises.
- Host a training series on how to incorporate resilience into all types of government plans. Develop toolkit(s), where appropriate.

### How Member Jurisdictions Can Support

- Incorporate climate projections and climate risks into emergency and other government plans.
- Actively reach out to ensure participation by vulnerable groups in disaster preparedness, response, and recovery programs.
- Assess long-term energy resilience planning into energy and other plans and guidelines.
- Update zoning, building codes, ordinances, and the development review process to ensure new development is more resilient to forward-looking local climate impacts.

### Region Forward Co-Benefits:

- **Public Safety and Equity:** Integrating climate strategies with emergency preparedness will enhance region's ability to prepare for and recover from disasters and meet the needs of the most vulnerable populations.
- **Economy:** Integrating climate projections into emergency plans can reduce economic damages from disasters.

## EQ-3: SUPPORT ENGAGEMENT OF THE PUBLIC ON CLIMATE RISKS, WITH AN EMPHASIS ON POTENTIALLY VULNERABLE POPULATIONS

### Action Overview

Metropolitan Washington is at risk to a range of threats - extreme heat, flooding, winter storms, drought, and lightning and thunderstorms. Engaging local communities to discuss climate risks and solutions is an important step to achieving common understanding of climate risks and enhancing the resilience of local communities and its people. Potentially vulnerable populations face a heightened risk to climate change while simultaneously can be the hardest groups to reach. Therefore, emphasis must be taken to strengthen engagement initiatives to these communities.

Montgomery County's Resilience Ambassador Program was established in 2020 to further understand and improve solutions around inequality within the county's transportation, equity, climate, energy justice program areas as well as COVID-19 pandemic support for the most vulnerable communities. The program also aims to increase representation of Black, Indigenous, and People of Color (BIPOC), low-income communities, and immigrants in the county's programs, which includes better incorporation of racial equity and social justice in the county's climate planning process.<sup>xxxvii</sup>

### Supporting A Climate Ready Region

Climate change will impact the region's most vulnerable populations disproportionately. Adapting to these risks rely heavily on the development of accessible and meaningful engagement opportunities with these populations. Typical outreach strategies may not be reaching our most vulnerable residents. Communication efforts must be expanded to ensure climate risk communications are accessible, digestible, and empower diverse communities to understand risks, and engage in the dialogue on resilience measures to ensure an equitable climate future.

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### Level of Implementation Needed to Address Climate Risks

All local governments need to engage the public, with an emphasis on engaging and empowering potentially vulnerable communities, to support the goal of becoming a Climate Ready by 2030. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/ thunderstorms and extreme winter conditions.

### How COG Can Support

- Support information sharing of best practices and region-specific messaging for effective community outreach strategies to diverse communities.
- Provide region-wide information identifying vulnerable populations such as transportation Equity Access Areas and community level health impact data.

### How Member Jurisdictions Can Support

- Integrate climate projections, risks, and strategies into existing community outreach programs.
- Further build partnerships with community groups and leaders to improve communication and engagement strategies.
- Engage potentially vulnerable communities in assessing their vulnerabilities (social, ecological, economic, public health) to climate impacts.
- Provide direct assistance (technical and financial) to potentially vulnerable populations.
- Develop metrics to measure the effectiveness of outreach efforts with diverse communities.

### Region Forward Co-Benefits:

- **Equity and Education:** As vulnerable populations are disproportionately impacted by climate change, efforts to engage diverse communities helps ensure an equitable climate future.

## EQ-4: SUPPORT EQUITABLE SECURE ENERGY ACCESS

### Action Overview

Energy equity ensures the fair distribution of energy supply to all residents regardless of socio-economic status, accessibility, and affordability. As the region transitions to a clean energy economy, the most vulnerable populations in our region must have access to secure and affordable clean energy to ensure an equitable climate future for all. Vulnerable populations may have less ability to respond to or recover from climate impacts. Secure and reliable energy access, especially during and after extreme events, will assist in reducing economic and social disparities in our region.

In 2019, the Arlington County Board adopted the Community Energy Plan that establishes equity as a focus to inform design, investment and implementation of the plan. The plan ensures equitable access to a clean, reliable, and secure grid for vulnerable populations and low-to-moderate income communities. Prince George's County launched an Energy Resiliency Communities to improve the energy resiliency of seven underserved communities. The county is providing grants to homeowners for electric and natural gas improvements, solar installations, and installation of a socket that can provide a limited amount of power from the solar installation during widespread power outages.<sup>cxxxviii</sup>

### Supporting A Climate Ready Region

As climate change puts an increasing stress on energy infrastructure, ensuring systems and assets are resilient to flooding, extreme heat, and extreme weather events while providing accessible and affordable clean energy to all residents is critical to provide life-saving services before, during, and after acute events and in response to chronic conditions. Future climate impacts will require a reliable and resilient energy system that can withstand frequent, severe climate events while delivering affordable and reliable energy to all residents including the most vulnerable in our communities.

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### Level of Implementation Needed to Address Climate Risks

Implementing mechanisms to ensure equitable secure energy access for all will help grow towards the goal of a climate resilient region by 2050 through empowering the notion of resilient communities. This action addresses climate risks of extreme heat, flooding (flash, riverine, and coastal), lightning/ thunderstorms and extreme winter conditions.

### How COG Can Support

- Support sharing of best practices for equitable access to secure, affordable clean energy.
- Advocate for state and federal actions to enhance access to secure, affordable clean energy.

### How Member Jurisdictions Can Support

- Implement local government energy assurance initiatives in potentially vulnerable communities.
- Direct resilience incentives and technical assistance to potentially vulnerable communities.
- Coordinate with utilities and promote electric grid and natural gas pipeline hardening, bulk fuel suppliers to promote resilient supply chains, and prioritize infrastructure improvements in potentially vulnerable communities.
- Prioritize microgrid deployment in potentially vulnerable communities.
- Ensure vulnerable communities will have access to basic services during power outages.

### Region Forward Co-Benefits:

- **Equity:** Vulnerable populations are disproportionately affected by climate impacts. Efforts to provide equitable secure energy ensures all residents have access to an equitable future.
- **Public Safety:** Providing secure access to energy for all ensures the public can have access to lifesaving services during extreme events.

## RI-1: SUPPORT ESTABLISHMENT OF RESILIENCE HUBS

### Action Overview

A resilience hub is a community-serving accessible facility that provides community-building activities, steady state support to local residents, and life-saving resources before, during, and after climate events. Resilience hubs not only provide safe haven for residents during extreme events but provide year-round support to improve local adaptive capacity and foster community building. Additionally, resilience hubs can be energy independent, which proves vital energy supply during power outages and extreme weather events, including emergency heating and cooling, charging ability, and storing of emergency medication and equipment.<sup>cxix</sup>

As part of Washington D.C.'s comprehensive efforts to implement Climate Ready DC, the Department of Energy and Environment (DOEE) is working with the Ward 7 community to develop a neighborhood-scale resilience hub in a trusted space by the community. Ward 7 faces disproportional climate risks compared to the majority of the city. The resilience hub will provide yearlong community support as well as emergency services and resources during crises.<sup>cxl</sup>

### Supporting A Climate Ready Region

Vulnerable populations face an increased risk to climate hazards and may have limited resources to adapt to a changing climate. Within vulnerable neighborhoods, residents may lack access to resources necessary to prepare for and recover from climate events. During extreme events, resilience hubs can provide lifesaving supplies (food, water, power, etc.). Resilience hubs enhance social cohesion within communities by shifting power to local communities to establish community-driven climate resilience.

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#### Level of Implementation Needed to Address Climate Risks

Establishment of resilience hubs in vulnerable communities to serve the people most impacted by climate change will help the region achieve full resilience by 2050. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/thunderstorms and extreme winter conditions.

### How COG Can Support

- Partner on grant applications and provide engineering support through regional contracts.
- Coordinate the sharing of best practices through workshops and materials (fact sheet, resource guides etc.).

### How Member Jurisdictions Can Support

- Identify most climate vulnerable communities and assess the potential to establish resilience hubs in those communities.
- Leverage relationships with community organizations and leaders to identify needs of the community and implement resilience hubs and other neighborhood-scale resilience solutions.
- Partner with energy providers to develop resilience hubs with an uninterruptable energy supply.

### Region Forward Co-Benefits:<sup>cxli</sup>

- **Equity:** Resilience hubs empower local communities by shifting segments of decision-making efforts to members of the community as well as help residents access resources, materials and support year-round.
- **Public Safety:** Implementing resilient hubs ensures the public can have access to lifesaving services during extreme events.
- **Economy:** Resilience hubs can provide resources, tools, and job training for economic stability.

## RI-2: IMPROVE THE RESILIENCE OF CRITICAL INFRASTRUCTURE

### Action Overview

The consequences to metropolitan Washington’s energy, water, transportation, and communication systems from climate impacts are life threatening and may cause long-term physical and economic damages. Extreme events, such as Hurricane Sandy and Derecho event of 2012, severely impacted the region’s ability to provide critical services during times of crisis. Priority critical infrastructure, such as hospitals and 9-1-1 centers, will need to further implement measures that increase resilience to continue to operate and serve the community during and after disasters. As climate change further strains the region’s aging infrastructure, implementing measures to ensure critical infrastructure is resilient to a changing climate is essential.

As part of a comprehensive effort to ensure the resilience of critical public services during major outages, Montgomery County installed a microgrid at its Public Safety Headquarters (PSHQ). The project features 2 megawatts of solar photovoltaic parking lot canopies, an 800-kilowatt Combined Heat and Power (CHP) system, electric vehicle charging stations and a cyber security system.<sup>cxliii</sup>

### Supporting A Climate Ready Region

As existing infrastructure ages and populations grows, infrastructure will need to be replaced, upgraded, and expanded. Climate projections show as the number of hot and cold days will be increasing, more frequent and severe extreme weather events may impact infrastructure. Water utility, and energy utility infrastructure that already incur sizable maintenance costs and risks may face an increased strain and will require upgrades and design standards that take into consideration future climate projections.

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### Level of Implementation Needed to Address Climate Risks

Assessing critical infrastructure now is essential to establish the necessary actions to ensure all critical infrastructure and functions are climate resilient in the region by 2050. This action addresses all climate risks including extreme heat, drought, flooding (flash, riverine, and coastal), lightning/ thunderstorms and extreme winter conditions.

### How COG Can Support

- Support systematic planning for protection of critical infrastructure identified through the COG Critical Infrastructure Working Group.
- Increase capacity to utilize Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Program funding and identify other sources of funding.
- Coordinate the sharing of feasibility studies and best practices for measures to increase resilience of critical infrastructure.
- Partner with local governments on risk studies.

### How Member Jurisdictions Can Support

- Assess vulnerability of existing and planned critical infrastructure for transportation, communication, energy, and water system assets.
- Flood proof critical water, stormwater, and wastewater systems to reflect climate projections.
- Revise infrastructure design standards to be more resilient to heat, flooding, and other climate impacts.
- Incorporate resilient critical infrastructure investments into long-range plans.

### Region Forward Co-Benefits:

- **Public Safety:** Implementing resilient measures to existing infrastructure ensures public safety entities can provide lifesaving services during extreme events.

## RI-3: IMPLEMENT MEASURES TO EQUITABLY ADDRESS URBAN HEAT ISLAND

### Action Overview

Heat is one of the leading causes of weather-related injuries and fatalities in metropolitan Washington. As extreme heat days become more prevalent, the region will face a high threat from extensive heat waves. Extensive development within metropolitan Washington has resulted in a significant number of areas with impervious surfaces and limited tree canopy. Populations residing in these areas, especially vulnerable peoples, will be more severely impacted by extreme heat. <sup>cxliii</sup>

The District of Columbia is taking many steps to reduce the impacts of the urban heat island effect. The District's Urban Tree Canopy Plan aims to increase a healthy tree canopy cover to 40 percent by 2032. The District's RiverSmart Green Roof Rebate Program offers rebates between \$10-15 per square foot to promote the voluntary installation of green roofs. The green roofs help reduce the urban heat island effect and improve stormwater management practices. <sup>cxliiv</sup>

### Supporting A Climate Ready Region

Extended periods of extreme heat can result in loss of human life, power outages, and infrastructure damages. The elderly, low-income persons, persons with allergies and underlying health conditions are especially vulnerable to extreme heat. As development increases, incorporating cooling strategies that prioritizes vulnerable populations is essential to reduce the urban heat island effect. Passive cooling mechanisms such as tree canopy and vegetation will substantially reduce risks to human life without increasing the regions reliance on energy. <sup>cxlv</sup>

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### Level of Implementation Needed to Address Climate Risks

Reducing the impacts of extreme heat and the urban heat island effect assists the region in becoming Climate Ready by 2030. This action primarily addresses the climate risk of extreme heat but can also flooding (flash, riverine, and coastal) risks.

### How COG Can Support

- Strategically coordinate the planting of new trees to expand the regional tree canopy to lower ambient air temperatures during summer months. <sup>cxlvi</sup>
- Prioritize and assess funding opportunities for implementation measures including cool and green roofs, and green walls.
- Support urban heat island and vulnerability mapping across the region.

### How Member Jurisdictions Can Support

- Develop thermal mapping to identify urban heat island hot spots, impacted vulnerable populations, and potential areas for mitigation strategies.
- Assess existing and future cooling centers based on extreme heat projections and needs of vulnerable populations. Consider factors including accessibility, language interpreters, backup power support, medical assistance, and food and water supplies.
- Support urban forestry programs and incentives to maximize canopy in vulnerable communities.
- Implement cool and green roofs, and green walls.

### Region Forward Co-Benefits:

- **Equity:** Tree planting should be prioritized in vulnerable communities with limited access to parks and green spaces. <sup>cxlvii</sup>
- **Health and Human Services:** Urban tree canopy can improve air quality, reduce mental distress, and may have positive health effects. <sup>cxlviii</sup>
- **Land Use and Environment:** Urban trees improve air and water quality. Urban trees helps cool air temperatures and reduce stormwater runoff. <sup>cxlix</sup>



## RI-4: ENHANCE GREEN INFRASTRUCTURE NETWORKS

### Action Overview

Protections against climate-driven risks can take the form of hard infrastructure improvements such as flood walls or constructing resilience hubs, or nature-based, resilient green infrastructure networks to restore and manage natural ecosystem functions to increase capacity to adapt to a changing climate. Green infrastructure is an interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other important natural areas. An interconnected system of natural areas protects biodiversity, enhances natural community resiliency, and buffers the impacts of development—all while providing multiple public benefits. In some contexts, the term green infrastructure refers to low impact development and stormwater management, or recreational trail networks. For the purposes of this measure, green infrastructure relates to land cover and waterways.<sup>cl</sup>

There are several ways to enhance nature-based, resilient green infrastructure network, such as green infrastructure plans, natural resource management plans, or green space plans. Prince George's County's Green Infrastructure Plan identifies existing green infrastructure elements throughout the county and proposes conservation mechanisms to preserve, protect, and enhance these elements. Fairfax County Natural Resource Management Plan focuses on protecting and enhancing natural capital, restoring ecosystems and fostering stewardship.<sup>ci</sup>

### Supporting A Climate Ready Region

Resilient green infrastructure can reduce the need for hard infrastructure improvements. The region has existing nature-based protections, such as the parkland located along many of the region's waterways and existing urban tree canopy that can be expanded on.

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### Level of Implementation Needed to Address Climate Risks

**Resilient green infrastructure can reduce the impacts of extreme heat and flooding to support the region in becoming Climate Ready by 2030.**

### How COG Can Support

- Work with partners to evaluate coastal, inland and overland flooding risks and options to use green infrastructure and natural systems to reduce climate risks.

### How Member Jurisdictions Can Support

- Design and plan for resilient green infrastructure before development occurs.
- Implement a plan to preserve and enhance ecologically valuable green spaces in urban, suburban and rural areas, such as a green infrastructure plan, natural resource management plan, or green space plan.
- Invest in nature-based, resilient green infrastructure network solutions to reduce risk from flooding and extreme heat.

### Region Forward Co-Benefits:

- **Equity:** Resilient green infrastructure enhancements should be prioritized in vulnerable communities with limited access to parks and green spaces.
- **Health and Human Services:** Enhancing green infrastructure networks can decrease pollution from stormwater runoff into rivers and streams and reduce associated adverse health impacts.
- **Land Use and Environment:** Enhancing green infrastructure networks supports preservation of open space, green space, wildlife habitat, and helps reduce stormwater runoff.

## RI-5: IMPLEMENT MEASURES TO REDUCE FLOOD RISKS

### Action Overview

Changes in the frequency and severity of flooding, and sea level rise will require the region to adapt to an increasing flood risks that threatens the regions ability to provide water, energy, and transportation services. Reducing risks to flooding is heavily influenced by the amount and type of development, shore protection measures, site and building design, stormwater drainage infrastructure, nature-based solutions (wetlands, vegetation, etc.), structural (floodwalls, levees, bulkheads etc.) and non-structural measures (relocation, zoning and flood insurance) and other resilience flood measures. The region relies on shared infrastructure for water, communications, energy, and transportation services; therefore, each entity/system within our region is only as protected as the weakest link in the regional infrastructure system. <sup>clii</sup>

The City of Alexandria is undertaking a multi-year capital flood project on the city's waterfront to reduce flooding and improve stormwater collection and transport. Some of the measures include elevating areas that frequently flood, a new bulkhead and elevated walkway, and integrating low flood walls to protect against the 10-year flood. Metro conducted a system-wide flood resiliency infrastructure upgrades assessment and has started designing some critical infrastructure projects to protect against the adverse effects of climate change. <sup>cliii</sup>

### Supporting A Climate Ready Region

Flooding is a main hazard of concern in metropolitan Washington. More frequent and severe precipitation events and water level rise, aging infrastructure, and rapid development and population growth will strain stormwater and sewer collection systems. The impacts of flooding are expected to be exacerbated with a changing climate, leading to asset damage and deterioration, threatening operability of critical infrastructure, increasing stormwater runoff, and property damage.

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#### Level of Implementation Needed to Address Climate Risks

Incorporating measures to reduce flood risks green can reduce the impacts of flooding and support the region in becoming Climate Ready by 2030.

### How COG Can Support

- Partner to evaluate coastal, inland and overland flooding risks and options to reduce risks.
- Support legislation and funding opportunities that address flood control and management, water quality programs, and stormwater management in the region.

### How Member Jurisdictions Can Support

- Identify at-risk facilities based on flooding and sea level rise. Prioritize resilience strategies based on age of facilities and critical need.
- Use nature-based solutions, non-structural, and structural measures to reduce flood risks.
- Increase the resilience of water, stormwater, and wastewater system. Secure investments for green and grey infrastructure to improve the capacity of these systems.
- Prioritize existing properties vulnerable to flooding for buyouts, incentives and easements.
- Adopt and implement green street policies and programs.

### Region Forward Co-Benefits:

- **Economy and Equity:** Incorporating resilience measures can limit the financial impacts of flooding events and reduce the burden to vulnerable populations.
- **Health and Human Services:** Incorporating resilience measures can decrease pollution from stormwater runoff into rivers and streams and reduce associated adverse health impacts.

## Mitigation-Resilience Co-Benefits

Responding to climate change requires addressing both mitigation and resilience strategies. Mitigation strategies primarily focus on reducing the causes of climate change, while resilience strategies center around limiting the impacts of climate change and adapting to a new climate. Many of the mitigation and resilience actions provide co-benefits that reduce greenhouse gas emissions and reduce vulnerabilities to the negative consequences of climate change.

As climate events become more severe and frequent, incorporating actions that have both mitigation and resilience benefits is even more invaluable. This is addressed in a number of areas in this plan.

- Efforts to enhance tree canopy provides both mitigation benefits via carbon sequestration and reduced energy consumption due to shading during the cooling season and resilience benefits via minimizing the urban heat island effect. Additionally, efforts to enhance tree canopy provide water quality environmental benefits as it reduces stormwater runoff into surface waters and enhances the qualities of and increases the value of open space.
- Public education efforts about climate change can use resiliency risks as a more tangible example of why climate change should be addressed. The longer-term benefits of mitigation may be less apparent to the public. Using resiliency, particularly tied to current events, such as floods from heavy summer storms or hurricanes, a derecho, or the increased western United States fires, as a way to open the door can more effectively enable people to see the direct effects on their lives. This then can be used to motivate mitigation action.
- Resilience hubs both can provide a short-term benefit to communities during an acute event and serve as an example of mitigation actions. One factor driving adoption of distributed solar is the presence of other distributed solar in a community. New adopters may become more comfortable to adopt the technology when they see neighbors, either houses or businesses, successfully using on-site solar. Incorporating on-site solar into resiliency hubs serves to address resiliency risks and meet mitigation goals.
- Accelerating deployment of battery storage similarly serves both resiliency and mitigation goals. Battery storage improves resiliency by providing for emergency power when alternative energy systems cannot produce. They also enhance mitigation as they can increase the use of renewable energy by storing excess generation for later use.
- Property Assessed Clean Energy (PACE) financing is one tool to increase the adoption of deep building retrofits, an important mitigation goal. PACE financing is now eligible in some jurisdictions, such as Fairfax County, as a funding source for resiliency improvements such as floodproofing.
- One of the keys to market circularity is to use what otherwise would be a waste material as an input to other systems. One method to provide for circularity is to provide energy production from wastes. These actions can reduce net greenhouse gas emissions while providing an electricity source that can serve as a black-start resource if needed after loss of electric generation and transmission. In its simplest form, black-start resources are able to start when the rest of the grid goes dark, which can then be used to bring the rest of the grid's resources back online.

This discussion addresses some of the co-benefits of mitigation and resiliency strategies. As is true of most systems, energy systems are so inter-related that other mitigation actions will enhance resiliency, and vice-a-versa, although in a less direct manner.

## CONCLUSION

Climate change is a major environmental issue affecting both human health and natural ecosystems. COG's Climate and Energy Program is one of the nation's first initiatives to address climate change on a regional level. The regional effort is led by the Climate, Energy and Environment Policy Committee (CEEPC) and guided by this plan. Communities in the region are already implementing renewable energy and energy efficiency initiatives, facilitating electric vehicle adoption, and other programs to help reduce greenhouse gas (GHG) emissions. This plan further provides a roadmap for collaborative action by COG, its members and stakeholders communities to facilitate a move toward zero energy buildings, zero emission vehicles, zero waste and more. COG will continue to work with its regional partners to evaluate project-level feasibility and cost-effectiveness of measures to meet the 2030 goals of reducing GHG emissions 50 percent below the 2005 levels and becoming a Climate Ready Region and making significant progress to be a Climate Resilient Region by 2030. The next ten years of action will set the stage for the 2050 vision for achieving 80 percent GHG emission reduction and a resilient metropolitan Washington.

## IN MEMORIAM

Honoring the legacy of CEEPC Members and their strong contributions and leadership for climate and energy policy within the region.



Dan Sze  
City of Falls Church



Erik Gutshall  
Arlington County



Lisa Feldt  
(Formerly) Montgomery County  
(Source: Chesapeake Bay Foundation)

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- <sup>i</sup> Metropolitan Washington Council of Governments. (2016). *COG and Our Region webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/about-us/cog-and-our-region/>.
- Metropolitan Washington Council of Governments. (2020). *Certified Resolution R26-2020 – Racial Equity as a Fundamental Value*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/07/08/certified-resolution-r26-2020---racial-equity-as-a-fundamental-value-equity/>.
- Metropolitan Washington Council of Governments. (2020). *Certified Resolution R45-2020 – Endorsing Regional Climate Mitigation and Resiliency Goals*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/10/14/certified-resolution-r45-2020---endorsing-regional-climate-mitigation-and-resiliency-goals/>.
- <sup>ii</sup> Intergovernmental Panel on Climate Change. (2018). *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5 Degrees Celsius*. Retrieved from <https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/>.
- <sup>iii</sup> Metropolitan Washington Council of Governments. (2020). *Certified Resolution R45-2020 – Endorsing Regional Climate Mitigation and Resiliency Goals*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/10/14/certified-resolution-r45-2020---endorsing-regional-climate-mitigation-and-resiliency-goals/>.
- <sup>iv</sup> Intergovernmental Panel on Climate Change. (2018). AR5 Annex II Glossary. Retrieved from [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-AnnexII\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-AnnexII_FINAL.pdf).
- Metropolitan Washington Council of Governments. (2019). *Climate Planning Work Session Meeting Documents*. Washington D.C. Retrieved from <https://www.mwcog.org/events/2019/11/20/climate-planning-work-sessions/>.
- <sup>v</sup> Metropolitan Washington Council of Governments. (2016). *Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region Final Technical Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2016/08/01/multi-sector-approach-to-reducing-greenhouse-gas-emissions-in-the-metropolitan-washington-region-final-technical-report/>.
- Metropolitan Washington Council of Governments. (2019). *The Future of Housing in Greater Washington*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2019/09/10/the-future-of-housing-in-greater-washington/>.
- National Renewable Energy Laboratory. (2018). *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States*. Golden, CO. Retrieved from <https://www.nrel.gov/analysis/electrification-futures.html>.
- Derived from: ICF. (2020). *Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area*. Fairfax, VA. Retrieved from <https://washingtongasdclimatebusinessplan.com/>.
- <sup>vi</sup> Intergovernmental Panel on Climate Change. (2018). *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5 Degrees Celsius*. Retrieved from <https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/>.
- <sup>vii</sup> Metropolitan Washington Council of Governments. (2014). *Building A Climate Resilient National Capital Region*. Washington D.C. Retrieved from <https://www.mwcog.org/about-us/newsroom/2014/10/02/building-a-climate-resilient-national-capital-region-climate-change-climate-resiliency/>.
- District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climate-ready>.
- <sup>viii</sup> Global Covenant of Mayors for Climate and Energy. (2018). *Global Covenant of Mayors Common Reporting Framework*. Retrieved from [https://www.globalcovenantofmayors.org/wp-content/uploads/2019/04/FINAL\\_Data-TWG\\_Reporting-Framework\\_website\\_FINAL-13-Sept-2018\\_for-translation.pdf](https://www.globalcovenantofmayors.org/wp-content/uploads/2019/04/FINAL_Data-TWG_Reporting-Framework_website_FINAL-13-Sept-2018_for-translation.pdf).
- <sup>ix</sup> Ibid
- <sup>x</sup> Metropolitan Washington Council of Governments. (2016). *COG and Our Region webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/about-us/cog-and-our-region/>.
- Metropolitan Washington Council of Governments. (2020). *Certified Resolution R26-2020 – Racial Equity as a Fundamental Value*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/07/08/certified-resolution-r26-2020---racial-equity-as-a-fundamental-value-equity/>.
- Metropolitan Washington Council of Governments. (2016). *Region Forward Goals webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/community/planning-areas/regional-planning/region-forward/goals/>.
- <sup>xi</sup> Metropolitan Washington Council of Governments. (2008). *National Capital Region Climate Change Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2008/11/12/national-capital-region-climate-change-report-climate-change/>.
- <sup>xii</sup> Metropolitan Washington Council of Governments. (2008). *National Capital Region Climate Change Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2008/11/12/national-capital-region-climate-change-report-climate-change/#:~:text=Summary,and%20citizens%20meet%20the%20targets>.
- <sup>xiii</sup> Metropolitan Washington Council of Governments. (2016). *Climate, Energy, and Environment Policy Committee Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/committees/climate-energy-and-environment-policy-committee/>.
- <sup>xiv</sup> Ibid
- Metropolitan Washington Council of Governments. (2020). *Environmental Committees Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/committees/>.
- <sup>xv</sup> Greater Washington Region Clean Cities Coalition. (2020). *GWRCCC Home Webpage*. Washington D.C. Retrieved from <http://www.gwrccc.org/>.
- <sup>xvi</sup> Metropolitan Washington Council of Governments. (2019). *Climate and Energy Progress Dashboard*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/data-and-tools/climate-and-energy-progress-dashboard/>.



- 
- <sup>xvii</sup> ENERGY STAR. (2020). *2020 ENERGY STAR Top Cities*. Retrieved from <https://www.energystar.gov/buildings/topcities>.
- <sup>xviii</sup> US Green Building Council. (2019). *Top Ten States for LEED*. Washington D.C. Retrieved from <https://www.usgbc.org/resources/top-ten-states-lead-2019>.
- <sup>xx</sup> Metropolitan Washington Council of Governments. (2019). *Greenhouse Gas Inventories Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/planning-areas/climate-and-energy/greenhouse-gas-inventories/>.
- <sup>xx</sup> Metropolitan Washington Council of Governments. (2011). *2010 Regional Climate and Energy Action Workplan Progress Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2015/12/01/annual-climate-and-energy-progress-report-climate--energy-climate-change-energy/>.
- <sup>xxi</sup> Metropolitan Washington Council of Governments. (2016). *White House Climate Action Champions Solar Case Study*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2016/3/2/climate-action-champion-solar-case-study/>.
- <sup>xxii</sup> Metropolitan Washington Council of Governments. (2019). *Energy Efficiency Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/planning-areas/climate-and-energy/high-performance-buildings/>.
- <sup>xxiii</sup> Metropolitan Washington Council of Governments. (2015). *April 1, 2015 EV Work Group Meeting Documents*. Washington D.C. Retrieved from <https://www.mwcog.org/events/2015/04/01/ev-work-group-meeting/>.
- <sup>xxiv</sup> Metropolitan Washington Council of Governments. (2019). *Climate Resilience Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/planning-areas/climate-and-energy/climate-preparedness/>.
- <sup>xxv</sup> Metropolitan Washington Council of Governments. (2020). *Cooperative Purchasing Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/purchasing-and-bids/cooperative-purchasing/>.
- <sup>xxvi</sup> Metropolitan Washington Council of Governments. (2017). *Environmental Justice Toolkit*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2017/08/10/new-toolkit-provides-resources-to-ensure-equity-in-clean-air-and-climate-policies/>.
- <sup>xxvii</sup> Metropolitan Washington Council of Governments. (2019). *Climate and Energy Leadership Awards Webpage*. Retrieved from <https://www.mwcog.org/environment/planning-areas/climate-and-energy/climate-awards/>.
- <sup>xxviii</sup> National Capital Region Transportation Planning Board. (2018). *Visualize 2045: A Long-Range Transportation Plan for the National Capital Region*. Washington D.C. Retrieved from <https://www.mwcog.org/visualize2045/document-library/>.
- <sup>xxx</sup> *ibid*
- <sup>xxx</sup> Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.
- <sup>xxxi</sup> Washington Metropolitan Area Transit Authority. (2020). *2019 Annual Sustainability Report*. Washington D.C. Retrieved from <https://www.wmata.com/initiatives/sustainability/Annual-Sustainability-Report.cfm>.
- Washington Metropolitan Area Transit Authority. (2020). *2025 Energy Action Plan*. Washington D.C. Retrieved from <https://www.wmata.com/initiatives/sustainability/2025-Energy-Action-Plan.cfm>.
- <sup>xxxii</sup> *ibid*
- <sup>xxxiii</sup> Metropolitan Washington Council of Governments. (2016). *Region Forward Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/regionforward/>.
- Metropolitan Washington Council of Governments. (2020). *Certified Resolution R26-2020 – Racial Equity as a Fundamental Value*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/07/08/certified-resolution-r26-2020---racial-equity-as-a-fundamental-value-equity/>.
- <sup>xxxiv</sup> Metropolitan Washington Council of Governments. (2019). *Region received global recognition for leading the way on climate*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2019/09/25/region-receives-global-recognition-for-leading-the-way-on-climate/>.
- Metropolitan Washington Council of Governments. (2020). *Certified Resolution R45-2020 – Endorsing Regional Climate Mitigation and Resiliency Goals*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/10/14/certified-resolution-r45-2020---endorsing-regional-climate-mitigation-and-resiliency-goals/>.
- <sup>xxxv</sup> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.
- City of Alexandria. (2019). *Environmental Action Plan 2040*. Alexandria, VA. Retrieved from <https://www.alexandriava.gov/uploadedFiles/tes/EAP2040v25.pdf>.
- Arlington County. (2019). *Community Energy Plan*. Arlington, VA. Retrieved from <https://environment.arlingtonva.us/energy/community-energy-plan-cep/>.
- <sup>xxxvi</sup> U.S. Department of Energy. (2020). *Building Energy Codes Program*. Retrieved from <https://www.energycodes.gov/adoption/states/>.
- Virginia Energy Efficiency Council. (2020). *Building Codes Webpage*. Richmond, VA. Retrieved from <https://vaeec.org/programs/building-codes/>.
- <sup>xxxvii</sup> District of Columbia. (2016). *D.C. Law 21-185. Commission on Climate Change and Resiliency Establishment Act of 2016*. Washington D.C. Retrieved from <https://code.dccouncil.us/dc/council/laws/21-185.html>.
- District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.
- <sup>xxxviii</sup> Maryland Department of Natural Resources. *Maryland CoastSmart Council Webpage*. Annapolis, MD. Retrieved from [https://dnr.maryland.gov/climateresilience/Pages/cs\\_Council.aspx](https://dnr.maryland.gov/climateresilience/Pages/cs_Council.aspx).
- Maryland Department of Environment. (2020). *Maryland Commission on Climate Change Webpage*. Baltimore, MD. Retrieved from <https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Pages/index.aspx>.

---

Maryland Department of Environment. Climate Change Maryland Adaptation Webpage. Baltimore, MD. Retrieved from <https://climatechange.maryland.gov/adaptation/>.

Maryland Energy Administration. (2020). *Resilient Maryland Program Webpage*. Baltimore, MD. Retrieved from <https://energy.maryland.gov/business/Pages/ResilientMaryland.aspx>.

<sup>xxxix</sup> Virginia Secretary of Natural Resources. Coastal Adaptation & Resilience Master Plan Webpage. Richmond, VA. Retrieved from <https://www.naturalresources.virginia.gov/initiatives/resilience/masterplan/>.

Virginia's Legislative Information System. (2020). *HB 1313 Chief Resilience Officer; Governor to designate*. Retrieved from <https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1313>.

Metropolitan Washington Council of Governments. (2020). *MWCOG Letter of Support for HB 981, Legislative Initiatives to Enable the Clean Energy and Community Flood Preparedness Act: February 6, 2020*. Washington D.C.

<sup>xi</sup> Intergovernmental Panel on Climate Change. (2018). *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5 Degrees Celsius*. Retrieved from <https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/>.

<sup>xii</sup> Metropolitan Washington Council of Governments. (2020). *Certified Resolution R45-2020 – Endorsing Regional Climate Mitigation and Resiliency Goals*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/10/14/certified-resolution-r45-2020---endorsing-regional-climate-mitigation-and-resiliency-goals/>.

<sup>xiii</sup> Metropolitan Washington Council of Governments. (2019). *Region received global recognition for leading the way on climate*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2019/09/25/region-receives-global-recognition-for-leading-the-way-on-climate/>.

<sup>xiiii</sup> Metropolitan Washington Council of Governments. (2019). *Region receives global recognition for leading the way on climate*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2019/09/25/region-receives-global-recognition-for-leading-the-way-on-climate/>.

Metropolitan Washington Council of Governments. (2019). *CEEPC September 25, 2019 Meeting Documents*. Washington D.C. Retrieved from <https://www.mwcog.org/events/2019/9/25/climate-energy-and-environment-policy-committee-meeting/>.

<sup>xlv</sup> Metropolitan Washington Council of Governments. (2019). *Climate Planning Work Session Meeting Documents*. Washington D.C. Retrieved from <https://www.mwcog.org/events/2019/11/20/climate-planning-work-sessions/>.

<sup>xlvi</sup> Metropolitan Washington Council of Governments. (2019-2020). *Environment Meetings and Events*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/meetings-and-events/>.

<sup>xlvii</sup> Metropolitan Washington Council of Governments. (2020). *Officials approve new 2030 regional greenhouse gas emissions reduction goal*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2020/10/14/officials-approve-new-2030-regional-greenhouse-gas-emissions-reduction-goal-/#:~:text=A%20New%202030%20Climate%20Goal&text=This%20opens%20in%20a%20new%20window.&text=The%20COG%20Board%20first%20set,by%2013%20percent%20by%202018>.

<sup>xlviii</sup> ICLEI. (2019). *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Version 1.2*. Retrieved from <https://iclei.usa.org/publications/us-community-protocol/>.

ICLEI. (2020). *ClearPath Webpage*. Retrieved from <https://iclei.usa.org/clearpath/>.

World Resources Institute, C40, and ICLEI. (2014). *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories*. Retrieved from <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>.

<sup>xlix</sup> ICLEI. (2018). *GHG Contribution Analysis Webpage*. Retrieved from <https://iclei.usa.org/ghg-contribution-analysis/>.

<sup>l</sup> Intergovernmental Panel on Climate Change. (2018). AR5 Annex II Glossary. Retrieved from [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-AnnexII\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIAR5-AnnexII_FINAL.pdf).

Metropolitan Washington Council of Governments. (2019). *Climate Planning Work Session Meeting Documents*. Washington D.C. Retrieved from <https://www.mwcog.org/events/2019/11/20/climate-planning-work-sessions/>.

<sup>i</sup> Metropolitan Washington Council of Governments. (2016). *Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region Final Technical Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2016/08/01/multi-sector-approach-to-reducing-greenhouse-gas-emissions-in-the-metropolitan-washington-region-final-technical-report/>.

Metropolitan Washington Council of Governments. (2019). *The Future of Housing in Greater Washington*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2019/09/10/the-future-of-housing-in-greater-washington/>.

National Renewable Energy Laboratory. (2018). *Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States*. Golden, CO. Retrieved from <https://www.nrel.gov/analysis/electrification-futures.html>.

Derived from: ICF. (2020). *Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area*. Fairfax, VA. Retrieved from <https://washingtongasclimatebusinessplan.com/>.

<sup>ii</sup> United Nations Human Settlements Programme. (2015). *Guiding Principles for Climate Action Planning*. Nairobi. Retrieved from <http://e-lib.iclei.org/wp-content/uploads/2016/02/Guiding-Principles-for-City-Climate-Action-Planning.pdf>.

<sup>iii</sup> City of Bowie. (2020). *Climate Action Webpage*. Bowie, MD. Retrieved from <https://www.cityofbowie.org/897/Climate-Action>.

<sup>iiii</sup> US Global Change Research Program. (2018). *Fourth National Climate Assessment*. Washington D.C. Retrieved from <https://nca2018.globalchange.gov/>.

<sup>lv</sup> Metropolitan Washington Council of Governments. (2017). *Environmental Justice Toolkit*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2017/07/27/environmental-justice-toolkit/>.

- 
- <sup>lv</sup> Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.
- <sup>lvi</sup> Sunter, D.A., Castellanos, S. & Kammen, D.M. (2019). *Disparities in rooftop photovoltaics deployment in the United States by race and ethnicity*. Retrieved from <https://www.nature.com/articles/s41893-018-0204-z>.
- <sup>lvii</sup> United States Department of Energy. (2018). *Low-Income Energy Affordability Data (LEAD) Tool*. Retrieved from <https://www.energy.gov/eere/slsc/maps/lead-tool>.
- Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.
- <sup>lviii</sup> District Department of Energy and Environment. *Solar For All Webpage*. Washington D.C. Retrieved from <https://doee.dc.gov/solarforall>.
- <sup>lix</sup> National Renewable Energy Laboratory. (2019). *Renewable Portfolio Standards Webpage*. Retrieved from <https://www.nrel.gov/state-local-tribal/basics-portfolio-standards.html>.
- <sup>lx</sup> National Conference of State Legislatures. (2020). *State Renewable Portfolio Standards and Goals Webpage*. Retrieved from <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>
- <sup>lxi</sup> Metropolitan Washington Council of Governments. (2016). *Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region: Renewable Energy Supplemental Analysis. Technical Report*. Washington D.C.
- <sup>lxii</sup> Solarize NoVA. (2020). *About Solarize NoVA Webpage*. Fairfax, VA. Retrieved from <https://solarizenova.org/about-us>.
- <sup>lxiii</sup> National Renewable Energy Laboratory. (2018). *Valuing the Resilience Provided by Solar and Battery Energy Storage Systems*. Golden, CO. Retrieved from <https://www.nrel.gov/docs/fy18osti/70679.pdf>.
- <sup>lxiv</sup> Dominion Energy. (2019). *Dominion Energy Announces Battery Storage Pilot Projects Webpage*. Richmond, VA. Retrieved from <https://news.dominionenergy.com/2019-08-06-Dominion-Energy-Announces-Battery-Storage-Pilot-Projects>.
- <sup>lxv</sup> Department of Energy. (2014). *How Microgrids Work Webpage*. Washington D.C. Retrieved from <https://www.energy.gov/articles/how-microgrids-work>.
- <sup>lxvi</sup> Montgomery County Government. (2020). *Microgrids Webpage*. Rockville, MD. Retrieved from <https://www.montgomerycountymd.gov/dgs-oes/Microgrids.html>.
- <sup>lxvii</sup> EPA Green Power Partnership. (2020). *Solar Power Purchase Agreements Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/greenpower/solar-power-purchase-agreements>.
- <sup>lxviii</sup> Fairfax County. (2019). *Fairfax County Awards Solar Power Purchase Agreement Contracts, Launches Large-Scale Renewable Energy Initiative Webpage*. Fairfax, VA. Retrieved from <https://www.fairfaxcounty.gov/environment-energy-coordination/cleanenergy/news/fairfax-county-awards-solar-power-purchase-agreement>.
- <sup>lxix</sup> City of Santa Monica. (2017). *How Local Energy Aggregation Works*. Santa Monica, CA. Retrieved from: <https://www.santamonica.gov/blog/santa-monica-community-choice-aggregation>.
- <sup>lxx</sup> LegiScan. (2020). *Maryland House Bill 561*. Retrieved from <https://legiscan.com/MD/bill/HB561/2020>.
- Virginia Clean Energy. (2020). *CCA in Virginia*. Retrieved from <https://www.virginiacleanenergy.org/cca-in-virginia.html>.
- <sup>lxxi</sup> U.S. Environmental Protection Agency. (2020). *Community Choice Aggregation Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/greenpower/community-choice-aggregation#:~:text=Prices%20for%20electricity%20under%20CCAs,communities%20and%20current%20market%20trends>.
- <sup>lxxii</sup> ENERGY STAR. *Interactive maps for energy benchmarking data, programs, and policies*. Retrieved from <https://www.energystar.gov/buildings/program-administrators/state-and-local-governments/see-federal-state-and-local-benchmarking-policies>.
- District Department of Energy and Environment. *Energy Benchmarking Webpage*. Washington D.C. Retrieved from <https://doee.dc.gov/energybenchmarking>.
- Montgomery County. (2020). *Building Energy Benchmarking Webpage*. Rockville, MD. Retrieved from <https://www.montgomerycountymd.gov/green/energy/benchmarking.html>.
- American Council for an Energy-Efficient Economy. (2017). *State and Local Policy Database: Arlington County, VA*. Retrieved from <https://database.aceee.org/city/arlington-county-va>.
- <sup>lxxiii</sup> Metropolitan Washington Council of Governments. (2019). *Energy Efficiency Webpage*. Washington D.C. Retrieved from <https://www.mwcog.org/environment/planning-areas/climate-and-energy/high-performance-buildings/>.
- DC Green Bank. (2019). *Potential Financial Products*. Washington D.C. Retrieved from <https://dcbank.org/about-us/>.
- Montgomery County Green Bank. (2019-2020). *Montgomery County Green Bank Programs Webpage*. Rockville, MD. Retrieved from <https://mcgreenbank.org/all-programs/>.
- EcoAction Arlington. (2020). *Energy Masters Webpage*. Arlington, VA. Retrieved from <https://www.ecoactionarlington.org/community-programs/energy-masters/>.
- Prince George's County. (2020). *Sustainable Energy Initiatives Webpage*. Upper Marlboro, MD. Retrieved from <https://www.princegeorgescountymd.gov/2863/Sustainable-Energy-Initiatives>.
- <sup>lxxiv</sup> Allied Environmental Consultants Limited. (2019). *Green Building – A Tool to Improve Employees' Health and Productivity*. Retrieved from <https://gresb.com/green-building-tool-improve-employees-health-productivity/>.
- <sup>lxxv</sup> Montgomery County Council. (2017). *Resolution No.: 18-894*. Rockville, MD. Retrieved from [https://www.montgomerycountymd.gov/COUNCIL/Resources/Files/res/2017/20170919\\_18-894.pdf](https://www.montgomerycountymd.gov/COUNCIL/Resources/Files/res/2017/20170919_18-894.pdf).

- City of Rockville. (2020). *Article XIV. Green Building Regulations*. Rockville, MD. Retrieved from [https://www.rockvillemd.gov/DocumentCenter/View/50/building\\_code\\_15\\_XIV?bidId=](https://www.rockvillemd.gov/DocumentCenter/View/50/building_code_15_XIV?bidId=).
- Stuart Kaplow. (2020). *2018 IgCC Poised to be Adopted for the First Time*. Cockeysville, MD. Retrieved from <https://www.greenbuildinglawupdate.com/2020/08/articles/igcc/2018-igcc-poised-to-be-adopted-for-the-first-time/>.
- <sup>lxxxvi</sup> World Resource Institute. (2019). *Accelerating Building Decarbonization: Eight Attainable Policy Pathways To Net Zero Carbon Buildings For All*. Retrieved from <https://www.wri.org/publication/accelerating-building-decarbonization#:~:text=Buildings%20For%20All,Accelerating%20Building%20Decarbonization%3A%20Eight%20Attainable%20Policy%20Pathways%20to,Zero%20Carbon%20Buildings%20For%20All&text=The%20report%20identifies%20eight%20pathways,demand%20and%20cleaning%20energy%20supply>.
- <sup>lxxxvii</sup> Allied Environmental Consultants Limited. (2019). *Green Building – A Tool to Improve Employees’ Health and Productivity*. Retrieved from <https://gresb.com/green-building-tool-improve-employees-health-productivity/>.
- <sup>lxxxviii</sup> UN environment programme. (2020). *Kigali Amendment hits milestone 100<sup>th</sup> ratification, boosting climate action*. Nairobi. Retrieved from <https://www.unenvironment.org/news-and-stories/press-release/kigali-amendment-hits-milestone-100th-ratification-boosting-climate>.
- Maryland Department of Environment. (2020). *Maryland moves to phase out hydrofluorocarbons and reduce methane*. Baltimore, MD. Retrieved from <https://news.maryland.gov/mde/2020/08/17/maryland-moves-to-phase-out-hydrofluorocarbons-and-reduce-methane-emissions/>.
- North American Association of Food Equipment Manufacturers. (2020). *Colorado, Virginia join efforts to phase down HFCs*. Chicago, IL. Retrieved from <https://www.nafem.org/news/colorado-virginia-join-efforts-to-phase-down-hfcs/>.
- <sup>lxxxix</sup> International Energy Agency. (2020). *Global EV Outlook 2020*. Paris. Retrieved from <https://www.iea.org/reports/global-ev-outlook-2020>.
- <sup>lxxx</sup> Montgomery County Government. (2020). *Green Fleet Webpage*. Rockville, MD. Retrieved from <https://www.montgomerycountymd.gov/DGS-FMS/GreenFleet.html>.
- City of Alexandria. (2019). *City Manager’s Message February 19, 2019*. Alexandria, VA. Retrieved from <https://www.alexandriava.gov/uploadedFiles/budget/info/budget2020/Section%2002%20-%20City%20Manager%20Message.pdf>.
- <sup>lxxxix</sup> International Energy Agency. (2020). *Global EV Outlook 2020*. Paris. Retrieved from <https://www.iea.org/reports/global-ev-outlook-2020>.
- <sup>lxxxii</sup> U.S. Department of Energy. (2019). *Medium- and Heavy-Duty Vehicle Electrification: An Assessment of Knowledge and Gaps*. Retrieved from <https://info.ornl.gov/sites/publications/Files/Pub136575.pdf>.
- <sup>lxxxiii</sup> *Ibid*
- California Air Resources Board. (2020). *15 states and the District of Columbia join forces to accelerate bus and truck electrification*. Sacramento, CA. Retrieved from <https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification>.
- ARLnow.com. (2020). *APS Adding Two Electric School Buses to Fleet, Thanks to Dominion*. Arlington, VA. Retrieved from <https://www.arlnow.com/2020/01/16/aps-adding-two-electric-school-buses-to-fleet-thanks-to-dominion/>.
- Steve Bohnel. (2020). *Frederick County leading the way in incorporating green technology for bus fleet*. Frederick, MD. Retrieved from [https://www.fredericknewspost.com/news/politics\\_and\\_government/levels\\_of\\_government/county/council/frederick-county-leading-the-way-in-incorporating-green-technology-for-bus-fleet/article\\_c9825770-4b46-5e71-9e05-9777cc2c840d.html](https://www.fredericknewspost.com/news/politics_and_government/levels_of_government/county/council/frederick-county-leading-the-way-in-incorporating-green-technology-for-bus-fleet/article_c9825770-4b46-5e71-9e05-9777cc2c840d.html).
- Mark Kane. (2018). *Washington D.C. Deploys Proterra Electric Buses Across Nation’s Capital*. Miami, FL. Retrieved from <https://insideevs.com/news/337789/washington-dc-deploys-proterra-electric-buses-across-nations-capital/>.
- Luke Lukert. (2020). *Alexandria’s DASH adds electric buses to fleet*. Retrieved from <https://wtop.com/dc-transit/2020/10/alexandrias-dash-adds-electric-buses-to-fleet/>.
- Pete Muntean. (2020). *Electric buses in Maryland could make Virginia and DC go green, too*. Gaithersburg, MD. Retrieved from <https://www.wusa9.com/article/traffic/electric-buses-montgomery-county-ride-on-public-transit-system/65-d93495b7-9222-48b8-8344-94e00479e8dc>.
- Washington Metropolitan Area Transit Authority. (2020). *Zero Emissions Bus Update*. Washington D.C. Retrieved from <https://www.wmata.com/initiatives/sustainability/Zero-Emission-Bus-Update.cfm>.
- <sup>lxxxiv</sup> California Air Resources Board. (2020). *Overview: Diesel Exhaust and Health Webpage*. Sacramento, CA. Retrieved from <https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health>.
- <sup>lxxxv</sup> City of Frederick. (2018). *A Resolution Concerning The Adoption Of A Plug-In Electric Vehicle Charging Infrastructure Implementation Plan*. Frederick, MD. Retrieved from <https://www.cityoffrederickmd.gov/DocumentCenter/View/10005/18-04-Concerning-the-Adoption-of-a-Plug-in-Electric-Vehicle-Charging-Infrastructure-Implementation-Plan?bidId=>.
- Arlington County. (2020). *Arlington Initiative To Rethink Energy Webpage*. Arlington County, VA. Retrieved from <https://environment.arlingtonva.us/energy/>.
- <sup>lxxxvi</sup> Model for of the U.S. Department of Energy Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite. Retrieved from <https://afdc.energy.gov/evi-pro-lite>.
- <sup>lxxxvii</sup> National Capital Region Transportation Planning Board. (2018). *Visualize 2045: A Long-Range Transportation Plan for the National Capital Region*. Washington D.C. Retrieved from <https://www.mwcog.org/visualize2045/document-library/>.
- <sup>lxxxviii</sup> *ibid*
- <sup>lxxxix</sup> *ibid*
- <sup>xc</sup> National Capital Region Transportation Planning Board. (2020). *COVID-19 Travel Monitoring Snapshot*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2020/10/27/covid-19-travel-monitoring-snapshot/>.



- 
- <sup>xci</sup> Metropolitan Washington Council of Governments. (2019). *Officials applaud local actions advancing regional climate goals*. Washington D.C. Retrieved from <https://www.mwcog.org/newsroom/2019/10/10/officials-applaud-local-actions-advancing-regional-climate-goals/>.
- <sup>xcii</sup> Greenhouse Gas Protocols. *Global Warming Potential Values*. Retrieved from [https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29\\_1.pdf](https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf).
- U.S. Environmental Protection Agency. (2020). *Basic Information about Landfill Gas Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/lmop/basic-information-about-landfill-gas>.
- <sup>xciii</sup> U.S. Environmental Protection Agency. (2017). *Sustainable Materials Management: Non-Hazardous Materials and Waste Management Hierarchy Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy>.
- <sup>xciv</sup> Prince William County. (2015). *EcoPark Webpage*. Prince William County, VA. Retrieved from <https://www.pwcgov.org/government/dept/publicworks/trash/Pages/Eco-Park.aspx>.
- Prince William County. (2015). *County Landfill EcoPark Presentation to the Board of County Supervisors*. Prince William County, VA. Retrieved from <http://www.pwcgov.org/government/dept/publicworks/trash/Documents/Energy%20Park%20Update%20-%20Stakeholders%20Jan%202015%20v3.pdf>.
- <sup>xcv</sup> Ellen MacArthur Foundation. (2017). *What is a Circular Economy?* United Kingdom. Retrieved from <https://www.ellenmacarthurfoundation.org/>.
- <sup>xcvi</sup> Fairfax County. (2020). *Public Works and Environmental Services - Glass*. Fairfax County, VA. Retrieved from <https://www.fairfaxcounty.gov/publicworks/recycling-trash/glass>.
- Fairfax County. (2019). *Regional Approach to Glass Recycling Leads to Creation of the Purple Can Club*. Fairfax County, VA. Retrieved from <https://www.fairfaxcounty.gov/publicworks/news/regional-approach-glass-recycling-leads-creation-purple-can-club>.
- <sup>xcvii</sup> U.S. Environmental Protection Agency. *Carbon Storage in Forests*. Retrieved from [https://cfpub.epa.gov/roe/indicator\\_pdf.cfm?i=86](https://cfpub.epa.gov/roe/indicator_pdf.cfm?i=86).
- <sup>xcviii</sup> Metropolitan Washington Council of Governments. (2018). *Tree Canopy Management Strategy*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/tree-canopy-management-strategy/>.
- <sup>xcix</sup> National Recreation and Park Association. (2010). *Air Quality Effects of Urban Trees and Parks*. Retrieved from <https://www.nrpa.org/globalassets/research/nowak-heisler-research-paper.pdf>.
- U.S. Environmental Protection Agency. (2020). *Soak Up the Rain: Trees Help Reduce Runoff Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/soakuptherain/soak-rain-trees-help-reduce-runoff#:~:text=Trees%20are%20increasingly%20recognized%20for,the%20soil%20that%20promote%20infiltration.>
- <sup>c</sup> The Nature Conservancy. (2017). *Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health*. Arlington, VA. Retrieved from [https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health\\_FINAL.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health_FINAL.pdf).
- <sup>ci</sup> Arbor Day Foundation. (2020). *Tree City USA Standards*. Lincoln, NE. Retrieved from <https://www.arborday.org/programs/treecityusa/standards.cfm>.
- <sup>cii</sup> Municode Falls Church. Sec. 48-1180. - *Tree canopy coverage required for single-family residential development*. Retrieved from [https://library.municode.com/va/falls\\_church/codes/code\\_of\\_ordinances?nodeId=PTIICOOR\\_CH48ZO\\_ARTVSURE\\_DIV8LA\\_S48-1180TRCACORESIMIREDE](https://library.municode.com/va/falls_church/codes/code_of_ordinances?nodeId=PTIICOOR_CH48ZO_ARTVSURE_DIV8LA_S48-1180TRCACORESIMIREDE).
- Hannah Himes. (2020). *2020 Tree Frederick Program tree order forms now available*. Retrieved from [https://www.fredericknewspost.com/news/economy\\_and\\_business/agriculture/2020-tree-frederick-program-tree-order-forms-now-available/article\\_e5bc9cdf-745a-552d-a671-7e65b8cf9f3f.html](https://www.fredericknewspost.com/news/economy_and_business/agriculture/2020-tree-frederick-program-tree-order-forms-now-available/article_e5bc9cdf-745a-552d-a671-7e65b8cf9f3f.html).
- <sup>ciii</sup> National Recreation and Park Association. (2010). *Air Quality Effects of Urban Trees and Parks*. Retrieved from <https://www.nrpa.org/globalassets/research/nowak-heisler-research-paper.pdf>.
- U.S. Environmental Protection Agency. (2020). *Soak Up the Rain: Trees Help Reduce Runoff Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/soakuptherain/soak-rain-trees-help-reduce-runoff#:~:text=Trees%20are%20increasingly%20recognized%20for,the%20soil%20that%20promote%20infiltration.>
- <sup>civ</sup> The Nature Conservancy. (2017). *Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health*. Arlington, VA. Retrieved from [https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health\\_FINAL.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health_FINAL.pdf).
- <sup>cv</sup> Metropolitan Washington Council of Governments. (2018). *Tree Canopy Management Strategy*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/tree-canopy-management-strategy/>.
- <sup>cvi</sup> The Maryland-National Capital Park and Planning Commission and Prince George's County planning Department. (2010). *Environmental Technical Manual*. Retrieved from <http://www.pgplanning.org/DocumentCenter/View/1072/Environmental-Technical-Manual---September-22-2010-PDF?bidId=>.
- <sup>cvi</sup> National Recreation and Park Association. (2010). *Air Quality Effects of Urban Trees and Parks*. Retrieved from <https://www.nrpa.org/globalassets/research/nowak-heisler-research-paper.pdf>.
- U.S. Environmental Protection Agency. (2020). *Soak Up the Rain: Trees Help Reduce Runoff Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/soakuptherain/soak-rain-trees-help-reduce-runoff#:~:text=Trees%20are%20increasingly%20recognized%20for,the%20soil%20that%20promote%20infiltration.>
- <sup>cvi</sup> The Nature Conservancy. (2017). *Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health*. Arlington, VA. Retrieved from [https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health\\_FINAL.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health_FINAL.pdf).
- <sup>cix</sup> Intergovernmental Panel on Climate Change. (2018). *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5 Degrees Celsius*. Retrieved from <https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/>.

---

<sup>cx</sup> Metropolitan Washington Council of Governments. (2014). *Building A Climate Resilient National Capital Region*. Washington D.C. Retrieved from <https://www.mwcog.org/about-us/newsroom/2014/10/02/building-a-climate-resilient-national-capital-region-climate-change-climate-resiliency/>.

District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.

<sup>cx</sup><sub>i</sub> Global Covenant of Mayors for Climate and Energy. (2018). *Global Covenant of Mayors Common Reporting Framework*. Retrieved from [https://www.globalcovenantofmayors.org/wp-content/uploads/2019/04/FINAL\\_Data-TWG\\_Reporting-Framework\\_website\\_FINAL-13-Sept-2018\\_for-translation.pdf](https://www.globalcovenantofmayors.org/wp-content/uploads/2019/04/FINAL_Data-TWG_Reporting-Framework_website_FINAL-13-Sept-2018_for-translation.pdf).

<sup>cx</sup><sub>ii</sub> Ibid

<sup>cx</sup><sub>iii</sub> Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.

<sup>cx</sup><sub>iv</sub> Centers for Disease Control and Prevention. (2017). *Extreme Heat Webpage*. Retrieved from [https://www.cdc.gov/disasters/extremeheat/heat\\_guide.html](https://www.cdc.gov/disasters/extremeheat/heat_guide.html).

<sup>cx</sup><sub>v</sub> Metropolitan Washington Council of Governments Air Quality Staff. *Calculated Number of Heat Days in – Preliminary Monthly Climate Data, Dulles International Airport*. Retrieved from <https://w2.weather.gov/climate/index.php?wfo=Iwx>.

Metropolitan Washington Council of Governments. (2013). *Summary of Potential Climate Change Impacts, Vulnerabilities and Adaptation Strategies*. Washington D.C. <https://www.mwcog.org/documents/2013/07/01/summary-of-potential-climate-change-impacts-vulnerabilities-and-adaptation-strategies-climate-change/>.

Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.

Centers for Disease Control and Prevention. (2018). *National Environmental Public Health Tracking Network Data Explorer*. Atlanta, GA. Retrieved from <https://ephtracking.cdc.gov/>.

<sup>cx</sup><sub>vi</sub> Northern Virginia Regional Commission. (2018). *Resilient Critical Infrastructure: A Roadmap for Northern Virginia*. Fairfax, VA. Retrieved from <https://www.novaregion.org/1354/Resiliency-Planning>.

National Oceanic and Atmospheric Administration. *The Climate Explorer*. Retrieved from <https://crt-climate-explorer.nemac.org/>.

<sup>cx</sup><sub>vii</sub> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.

<sup>cx</sup><sub>viii</sub> Natural Resources Defense Council, Inc. (2018). *Climate Change and Health in Virginia*. Washington D.C. Retrieved from <https://www.nrdc.org/sites/default/files/climate-change-health-impacts-virginia-ib.pdf>.

<sup>cx</sup><sub>ix</sub> National Oceanic and Atmospheric Administration, National Centers For Environmental Information. *Definition of Drought Webpage*. Asheville, NC. Retrieved from <https://www.ncdc.noaa.gov/monitoring-references/dyk/drought-definition#:~:text=Hydrological%20drought%20occurs%20when%20low,many%20months%20of%20meteorological%20drought>.

Metropolitan Washington Council of Governments. (2013). *Summary of Potential Climate Change Impacts, Vulnerabilities and Adaptation Strategies*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2013/07/01/summary-of-potential-climate-change-impacts-vulnerabilities-and-adaptation-strategies-climate-change/>.

<sup>cx</sup><sub>x</sub> Ibid

<sup>cx</sup><sub>xi</sub> Metropolitan Washington Council of Governments. (2019). *Regional Drought and Water Supply Status*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2019/11/01/regional-drought-and-water-supply-status--drinking-water-drought-wise-water-use-campaign/>.

<sup>cx</sup><sub>xii</sub> Centers for Disease Control and Prevention. (2018). *Preparing for The Health Effects of Drought – A Resource Guide For Public Health Professionals*. Retrieved from [https://www.cdc.gov/nceh/hsb/cwh/docs/CDC\\_Drought\\_Resource\\_Guide-508.pdf](https://www.cdc.gov/nceh/hsb/cwh/docs/CDC_Drought_Resource_Guide-508.pdf).

Centers for Disease Control and Prevention. (2020). *Droughts and Public Health in the U.S.* Retrieved from [https://www.cdc.gov/nceh/multimedia/infographics/drought\\_public\\_health.html](https://www.cdc.gov/nceh/multimedia/infographics/drought_public_health.html).

<sup>cx</sup><sub>xiii</sub> National Oceanic and Atmospheric Administration. *Severe Weather 101 Webpage*. Retrieved from <https://www.nssl.noaa.gov/education/svrwx101/floods/>.

<sup>cx</sup><sub>xiv</sub> National Capital Planning Commission. (2008). *Report on Flooding and Stormwater in Washington, D.C.* Washington D.C. Retrieved from [https://www.ncpc.gov/docs/Flooding\\_and\\_Stormwater\\_in\\_Washington\\_DC\\_Jan2008.pdf](https://www.ncpc.gov/docs/Flooding_and_Stormwater_in_Washington_DC_Jan2008.pdf).

Federal Triangle Stormwater Study Working Group. (2011). *Companion Report: Federal Triangle Stormwater Drainage Study*. Washington D.C. Retrieved from [https://www.fema.gov/doc/about/employees/federal\\_triangle\\_stormwater\\_drainage\\_study\\_companion\\_report.pdf](https://www.fema.gov/doc/about/employees/federal_triangle_stormwater_drainage_study_companion_report.pdf).

<sup>cx</sup><sub>xv</sub> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.

National Oceanic and Atmospheric Administration. *The Climate Explorer*. Retrieved from <https://crt-climate-explorer.nemac.org/>.

<sup>cx</sup><sub>xvi</sub> Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.

<sup>cx</sup><sub>xvii</sub> Centers for Disease Control and Prevention. (2017). *Coastal Flooding, Climate Change, and Your Health: What you Can Do to Prepare*. Retrieved from <https://www.cdc.gov/climateandhealth/pubs/CoastalFloodingClimateChangeandYourHealth-508.pdf>.

<sup>cx</sup><sub>xviii</sub> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.



<sup>cxxviii</sup> Ibid

Boesch, D.F., W.C. Boicourt, R.I. Cullather, T. Ezer, G.E. Galloway, Jr., Z.P. Johnson, K.H. Kilbourne, M.L. Kirwan, R.E. Kopp, S. Land, M. Li, W. Nardin, C.K. Sommerfield, W.V. Sweet. (2018). *Sea-level Rise: Projections for Maryland 2018*. University of Maryland Center for Environmental Science, Cambridge, MD. Retrieved from <https://www.umces.edu/sea-level-rise-projections>.

Centers for Disease Control and Prevention. (2017). *Coastal Flooding, Climate Change, and Your Health: What you Can Do to Prepare*. Retrieved from <https://www.cdc.gov/dimiteandhealth/pubs/CoastalFloodingClimateChangeandYourHealth-508.pdf>.

Metropolitan Washington Council of Governments. (2013). *Summary of Potential Climate Change Impacts, Vulnerabilities and Adaptation Strategies*. Washington D.C. <https://www.mwcog.org/documents/2013/07/01/summary-of-potential-climate-change-impacts-vulnerabilities-and-adaptation-strategies-climate-change/>.

<sup>cxxix</sup> Metropolitan Washington Council of Governments. (2018). *Equity Emphasis Areas for TPB's Enhanced Environmental Justice Analysis*. Washington D.C. Retrieved from <https://www.mwcog.org/transportation/planning-areas/fairness-and-accessibility/environmental-justice/equity-emphasis-areas/>.

<sup>cxxx</sup> Water Environment Research Foundation. (2014). *Water/Wastewater Utilities and Extreme Climate and Weather Events. Case Studies on Community Response, Lessons Learned, Adaptation, and Planning Needs for the Future*. Alexandria, VA. Retrieved from <https://cpo.noaa.gov/sites/cpo/SARP/CC7C11%20web.pdf>.

Public Safety and Homeland Security Bureau and Federal Communications Commission. (2013). *Impact of the June 2012 Derecho on Communications Networks and Services Report and Recommendations*. Retrieved from <https://docs.fcc.gov/public/attachments/DOC-318331A1.pdf>.

<sup>cxxxi</sup> Water Environment Research Foundation. (2014). *Water/Wastewater Utilities and Extreme Climate and Weather Events. Case Studies on Community Response, Lessons Learned, Adaptation, and Planning Needs for the Future*. Alexandria, VA. Retrieved from <https://cpo.noaa.gov/sites/cpo/SARP/CC7C11%20web.pdf>.

Dominion Energy. (2012). *News Release: Dominion Virginia Power Working To Restore Service To Customers Affected By Hurricane Sandy*. Richmond, VA. Retrieved from <https://news.dominionenergy.com/2012-10-30-Dominion-Virginia-Power-Working-To-Restore-Service-To-Customers-Affected-By-Hurricane-Sandy>.

Government of the District of Columbia, Executive Office of the Mayor, Office of Communications. (2012). *Press Release Mayor Gray Applauds the President's Signature of D.C. Disaster Declaration for Superstorm Sandy Damage*. Washington D.C. Retrieved from [https://hsema.dc.gov/sites/default/files/dc/sites/hsema/release\\_content/attachments/Hurricane\\_Sandy\\_Disaster\\_Declaration\\_Signed\\_Release\\_FINAL.pdf](https://hsema.dc.gov/sites/default/files/dc/sites/hsema/release_content/attachments/Hurricane_Sandy_Disaster_Declaration_Signed_Release_FINAL.pdf).

<sup>cxxxii</sup> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.

<sup>cxxxiii</sup> National Oceanic and Atmospheric Administration National Severe Storms Laboratory. *Severe Weather 101: Types of Winter Weather Webpage*. Norman, OK. Retrieved from <https://www.nssl.noaa.gov/education/svrwx101/winter/types/>.

<sup>cxxxiv</sup> National Aeronautics and Space Administration Goddard Space Flight Center. (2010). *Heavy Snow around US Capital*. Greenbelt, MD. Retrieved from <https://earthobservatory.nasa.gov/images/42568/heavy-snow-around-us-capital>.

Melissa Nord, Topper Shutt, Howard Bernstein, Miri Marshall. (2020). *10 years ago Snowmageddon hit DC*. Washington D.C. Retrieved from <https://www.wusa9.com/article/weather/weather-blog/65-95aa5889-d90c-4974-b6b5-547538429d06>.

<sup>cxxxv</sup> District Department of Energy and Environment. (2016). *Climate Ready D.C.* Washington D.C. Retrieved from <https://doee.dc.gov/climateready>.

Centers for Disease Control and Prevention. (2015). *Planning for an Emergency: Strategies for Identifying and Engaging At-Risk Groups. A guidance Document for Emergency Managers*. Retrieved <https://www.cdc.gov/nceh/hsb/disaster/atriskguidance.pdf>.

<sup>cxxxvi</sup> Prince George's County and City of Laurel. (2017). *Hazard Mitigation Plan Update*. Retrieved from <https://www.princegeorgescountymd.gov/2623/Hazard-Mitigation-Plan>.

<sup>cxxxvii</sup> Montgomery County Department of Environmental Protection. (2020). *Resilience Ambassadors Amplify Underrepresented Voices Through Community Outreach*. Rockville, MD. Retrieved from <https://mygreenmontgomery.org/2020/resilience-ambassadors-amplify-underrepresented-voices-through-community-outreach/>.

<sup>cxxxviii</sup> Arlington County. (2019). *Community Energy Plan*. Arlington, VA. Retrieved from <https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/13/2019/10/Final-CEP-CLEAN-003.pdf>.

Prince George's County. (2020). *Sustainable Energy Resources Webpage*. Upper Marlboro, MD. Retrieved from <https://www.princegeorgescountymd.gov/2866/Sustainable-Energy-Resources>.

<sup>cxxxix</sup> Urban Sustainability Directors Network. *Resilience Hubs*. Retrieved from <http://resilience-hub.org/>.

Maryland Energy Administration. (2019). *Resiliency Hubs Webpage*. Baltimore, MD. Retrieved from <https://energy.maryland.gov/Pages/Resiliency-Hub.aspx>.

<sup>cxl</sup> Georgetown Climate Center. (2018). *Ward 7 Equity Advisory Group presents community recommendations for climate action in the District of Columbia*. Washington D.C. Retrieved from <https://www.georgetownclimate.org/articles/ward-7-equity-advisory-group-presents-community-recommendations-for-climate-action-in-the-district-of-columbia.html>.

<sup>cxli</sup> Urban Sustainability Directors Network. *Resilience Hubs*. Retrieved from <http://resilience-hub.org/>.

<sup>cxlii</sup> Montgomery County Government. (2020). *Public Safety Headquarters Microgrid*. Rockville, MD. Retrieved from <https://www.montgomerycountymd.gov/dgs-oes/MGP-PSHQ.html>.

<sup>cxliii</sup> Metropolitan Washington Council of Governments. (2013). *Summary of Potential Climate Change Impacts, Vulnerabilities and Adaptation Strategies*. Washington D.C. <https://www.mwcog.org/documents/2013/07/01/summary-of-potential-climate-change-impacts-vulnerabilities-and-adaptation-strategies-climate-change/>.

---

<sup>cxiv</sup> District Department of Energy and Environment. *Trees In the District Webpage*. Washington D.C. Retrieved from <https://doee.dc.gov/trees>.

District Department of Energy and Environment. *Green Roofs in the District of Columbia Webpage*. Washington D.C. Retrieved from <https://doee.dc.gov/greenroofs>.

<sup>cxv</sup> Centers for Disease Control and Prevention. (2019). *Extreme Heat Webpage*. Retrieved from <https://www.cdc.gov/disasters/extremeheat/index.html>.

<sup>cxvi</sup> Metropolitan Washington Council of Governments. (2018). *Tree Canopy Management Strategy*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/tree-canopy-management-strategy/>.

<sup>cxvii</sup> The Nature Conservancy. (2017). *Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health*. Arlington, VA. Retrieved from [https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health\\_FINAL.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/Trees4Health_FINAL.pdf).

<sup>cxviii</sup> United States Department of Agriculture. (2018). *Urban Nature for Human Health and Well-Being*. Retrieved from [https://www.fs.usda.gov/sites/default/files/fs\\_media/fs\\_document/urbannatureforhumanhealthandwellbeing\\_508\\_01\\_30\\_18.pdf](https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/urbannatureforhumanhealthandwellbeing_508_01_30_18.pdf).

<sup>cxix</sup> National Recreation and Park Association. (2010). *Air Quality Effects of Urban Trees and Parks*. Retrieved from <https://www.nrpa.org/globalassets/research/nowak-heisler-research-paper.pdf>.

U.S. Environmental Protection Agency. (2020). *Soak Up the Rain: Trees Help Reduce Runoff Webpage*. Washington D.C. Retrieved from <https://www.epa.gov/soakuptherain/soak-rain-trees-help-reduce-runoff#:~:text=Trees%20are%20increasingly%20recognized%20for,the%20soil%20that%20promote%20infiltration.>

<sup>ci</sup> Maryland-National Capital Park and Planning Commissions. *Approved Green Infrastructure Master Plan Webpage*. Riverdale, MD. Retrieved from <https://www.mncppc.org/1266/Approved-Green-Infrastructure-Master-Pla>.

Natural Resources Spatial Analysis Lab. (2020). *Green Infrastructure Planning Basic Principles*. Athens, GA. Retrieved from <http://narsal.uga.edu/projects/green-infrastructure-planning/basic-principles/>.

Virginia Department of Conservation and Recreation. (2020). *Virginia Conservation Vision*. Richmond, VA. Retrieved from <https://www.dcr.virginia.gov/natural-heritage/vaconvision>.

Green Infrastructure Center. *How Can You Engage in Green Infrastructure Planning?* Scottsville, VA. Retrieved from <http://www.gicinc.org/methodsmain.htm>.

The Conservation Fund. (2016). *Greenspace in Megaregions: Collective Action for Green Infrastructure*. Arlington, VA. Retrieved from <https://www.conservationfund.org/blog/cities/1431-greenspace-in-megaregions-collective-action-for-green-infrastructure>.

<sup>cii</sup> Maryland-National Capital Park and Planning Commissions. *Approved County-wide Green Infrastructure Master Plan*. Riverdale, MD. Retrieved from <https://www.mncppc.org/1266/Approved-Green-Infrastructure-Master-Pla>.

Fairfax County Park Authority. (2014). *Natural Resource Management Plan*. Fairfax, VA. Retrieved from <https://www.fairfaxcounty.gov/parks/sites/parks/files/assets/documents/naturalcultural/nrmp012914.pdf>.

<sup>ciii</sup> Metropolitan Washington Council of Governments. (2017). *Metropolitan Washington, District of Columbia Coastal Storm Risk Management Study*. Washington D.C. Retrieved from <https://www.mwcog.org/file.aspx?&A=Dn%2FAgm1KZw5D6SxSenzT0IKC3AsIbGGzY3V5jV5Gv4%3D>.

Metropolitan Washington Council of Governments. (2015). *State of the Region Infrastructure Report*. Washington D.C. Retrieved from <https://www.mwcog.org/documents/2016/2/18/state-of-the-region-infrastructure-report/>.

<sup>ciiii</sup> City of Alexandria. (2019). *Flood Mitigation Implementation*. Alexandria, VA. Retrieved from <https://www.alexandriava.gov/special/waterfront/default.aspx?id=85880>.