

Priority Climate Action Plan for the Baltimore Region

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PREPARED FOR:

U.S. Environmental Protection Agency Region 3

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Purpose

A partnership between jurisdictions of the Baltimore Metropolitan Council has come together with assistance from the U.S. Environmental Protection Agency's (EPA's) Climate Pollution Reduction Grant (CPRG) Planning Grant Program to create a Priority Climate Action Plan (PCAP). This plan covers Baltimore City, and the counties of Baltimore, Anne Arundel, Carroll, Harford, Howard, and Queen Anne's.

The purpose of the PCAP is to:

1. Improve our understanding of current and future greenhouse gas (GHG) emissions in the Baltimore region,
2. Identify priority strategies to reduce these emissions and to identify the potential other benefits of those strategies, and
3. Engage a variety of stakeholders in an emissions reduction planning process.

Additionally, the PCAP will inform the Comprehensive Climate Action Plan (CCAP), which is due two years from the date of the grant award made in July 2023.

The BMC, the Steering Committee, and the subgrantee - ICLEI-USA, have coordinated with the Maryland Department of Environment (MDE) to ensure methods of greenhouse gas (GHG) inventory development align to a reasonable degree with the State's approach.

Key Definitions and Acronyms

Priority Climate Action Plan (PCAP): a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions.

Comprehensive Climate Action Plan (CCAP): a narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.

Greenhouse Gas (GHG) Inventory: a list of emission sources and sinks and the associated emissions quantified using standard methods. The PCAP includes a simplified inventory. The CCAP will include a comprehensive inventory of emissions and sinks for the following sectors: industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management.

Low Income / Disadvantaged Communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. The project team is using the [Climate and Economic Justice Screening Tool](#) and the [Environmental Justice Screening and Mapping Tool](#) to identify LIDACs in the Baltimore region, as recommended by EPA. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution,

transportation, water and wastewater, and workforce development. Please see the Appendix for a list of LIDAC communities in the region.

MSA: metropolitan statistical areas as defined by the U.S. Census 2020 MSA population.

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1 Introduction

1.1 CPRG Overview

Seven local jurisdictions of the Baltimore-Columbia-Towson Metropolitan Statistical Area and the Baltimore Metropolitan Council (BMC) have come together in an effort to develop a shared plan for moving the region forward in addressing harmful greenhouse gas emissions. This shared effort will consist of the following:

- ❖ A Priority Climate Action Plan (PCAP);
- ❖ A Comprehensive Climate Action Plan (CCAP), due approximately July 31, 2025; and,
- ❖ A Status Report, due at the close of the four-year grant period.

The Baltimore Metropolitan Council (BMC) oversaw and coordinated the development of this PCAP. This document focuses on developing a recommended set of priority greenhouse gas (GHG) reduction measures for the Baltimore region. As part of the process of developing the list of priority GHG reduction measures, the following were prepared:

- A preliminary regional greenhouse gas emissions inventory with a 2021 emissions reporting year,
- GHG emissions projections for 2030 and 2050,
- GHG reduction targets
- An initial benefits analysis for Low Income Disadvantaged Communities (LIDAC),
- A review of authority to implement, and,
- An initial workforce planning analysis.

Given the variation in climate action planning readiness across the seven jurisdictions in the MSA, the intent of the PCAP is to identify regional priorities to reduce the emissions of greenhouse gases, sequester carbon and highlight the most urgent climate mitigation and adaptation needs for climate-vulnerable communities in each county/city participating in this planning process. Current priorities outlined in existing climate action, sustainability, resilience or other related plans from jurisdictions in the MSA are reflected in this document.

BMC contracted with ICLEI-Local Governments for Sustainability USA (ICLEI) to develop a regional greenhouse gas inventory. With input from ICLEI on the potential reductions possible from various reduction measures, the Steering Committee developed a list of high impact greenhouse gas emission reduction measures, called the priority GHG reduction measures. Emission reductions from these measures, achievable by 2030 and 2050 were calculated by ICLEI, and are included in Appendix A. The CCAP, to be developed in 2024, and completed in 2025, will include a more comprehensive regional greenhouse gas emissions inventory, GHG emissions projections for 2030 and 2045, GHG reduction targets, a more comprehensive list of quantified greenhouse gas emission reduction measures, a benefits analysis including analyses for LIDAC, a review of authority to implement and intersection with other funding available, and a workforce planning analysis.

The priority measures identified in the PCAP will most likely be included in the CCAP. Additional measures to reduce GHG emissions will be identified and quantified. The additional measures will also

be evaluated for other items including LIDAC benefits. As in the PCAP, ICLEI will perform technical analyses necessary for the CCAP.

In developing the PCAP, the [State of Maryland's Climate Pollution Reduction Plan](#) and existing local climate action plans were reviewed as demonstrated in Section 2.1. Jurisdictions led a significant amount of local engagement to develop local climate action plans, which then contributed towards the Baltimore Region PCAP and its priority emission reduction measures.

1.2 Scope of the PCAP

The geographic scope of the PCAP covers the City of Baltimore and Anne Arundel, Baltimore, Carroll, Harford, Howard, and Queen Anne's Counties. The greenhouse gas inventory (GHGI) as well as the reductions resulting from emission reduction measures consider the entire geographic planning area above. It is our intent to look further into emissions from each individual jurisdiction in the CCAP document in 2025.

1.3 Approach to Developing the PCAP

The Baltimore Metropolitan Council (BMC) oversaw and coordinated the development of this Priority Climate Action Plan covering all of the jurisdictions in the Baltimore-Columbia-Towson Metropolitan Statistical Area (MSA). This PCAP includes a preliminary regional greenhouse gas emissions inventory, a list of priority greenhouse gas emission reduction measures, an initial benefits analysis for LIDAC, and a review of authority to implement.

2 State/MSA Context

The Baltimore-Columbia-Towson Metropolitan Statistical Area (hereafter referred to as Baltimore MSA) includes 6 counties in the State of Maryland - Anne Arundel, Baltimore, Carroll, Harford, Howard, and Queen Anne's - and the City of Baltimore. Figure 1 below depicts the geographic region.

The Baltimore Metropolitan Council is a quasi-governmental nonprofit entity in which there is a Board made up of the elected officials of the participating seven jurisdictions. BMC staff led the non-competitive planning grant for the region's PCAP, provided project management, oversaw subaward efforts, contracts with consultant(s), and will house the compiled regional greenhouse gas inventory data. Local jurisdictions in the MSA have a number of existing climate action plans, greenhouse gas inventories, and local government initiatives and ordinances that help to achieve greenhouse gas emission reductions (see below). However, more than half of the jurisdictions do not have updated community-wide GHG inventories or plans focused on reducing greenhouse gas emissions. Much effort in the past several years in the region has focused on resilience to the effects of climate change, due to the proximity of the region to the shoreline of the Chesapeake Bay. Below are just a few examples of existing plans, efforts, and goals.

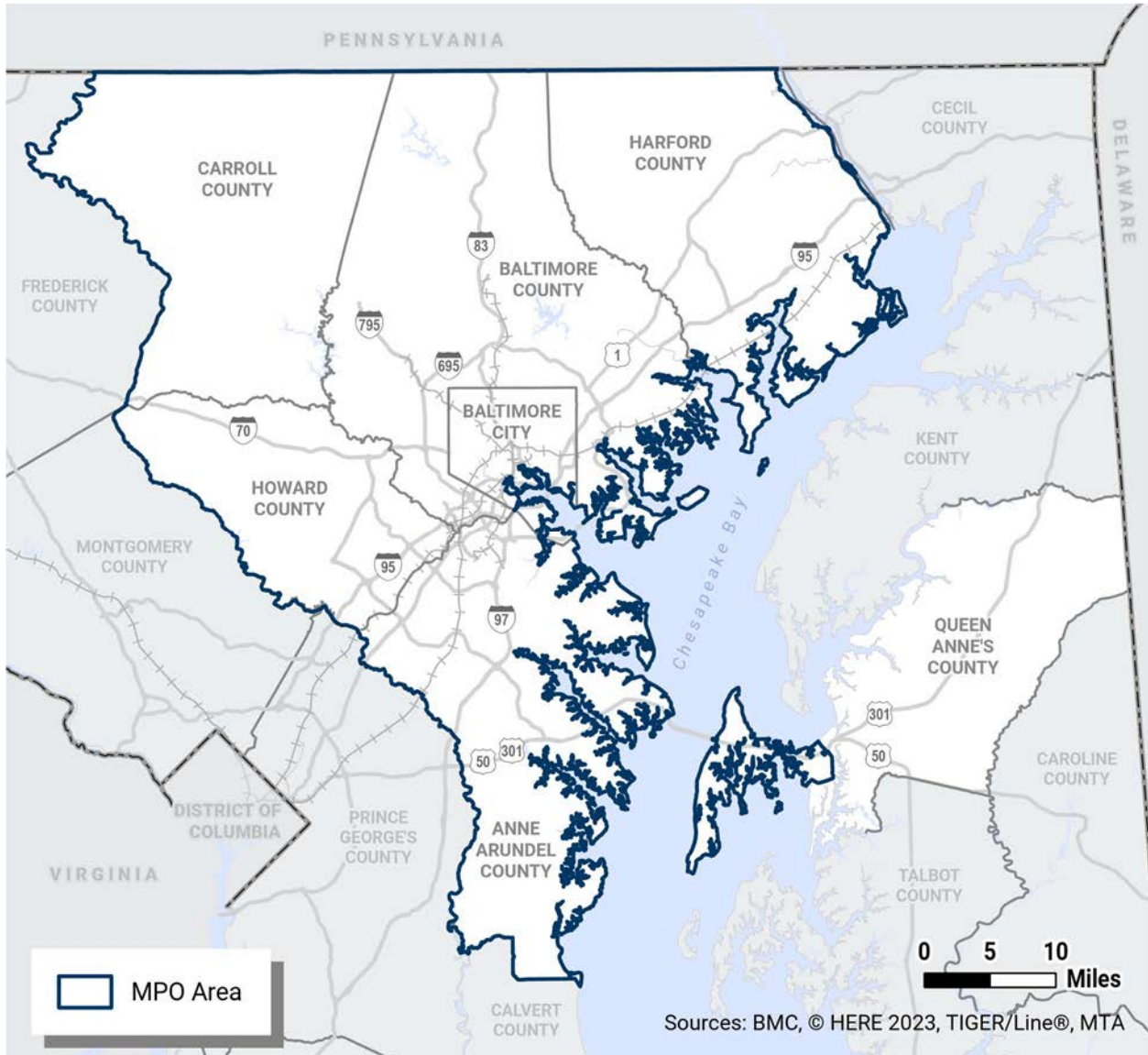


Figure 1. Geographic Planning Area for the Baltimore Region PCAP

2.1 Existing/In Development Climate Action or Related Plans

The following existing or in-development Climate Action Plans were taken into account when developing this PCAP:

- **Howard County Climate Forward: Climate Action and Resiliency Plan¹** is a community-wide and whole-of-government work plan to achieve a 60% reduction in GHG emissions by 2030 and become net-zero by 2045. The plan includes policy context, the impacts of climate change locally, differential impacts to underserved communities, a GHG inventory, and subsequent

¹ <https://www.epa.gov/system/files/documents/2023-12/howard-county-climate-action-plan.pdf>

strategies, actions, and next steps that the County and community need to take to reach the goals specified in the plan.

- **Baltimore City's 2024 Climate Action Plan update**² is a guide to how Baltimore will meet its ambitious and critical goal to reduce carbon emissions by 60% by 2030. Following requirements in Baltimore City Ordinance 22-131, this CAP Update considers concerns beyond GHG reduction, including key environmental justice and community benefits such as public health. The resulting plan is a roadmap for the City in making decisions that reduce GHG emissions, address environmental injustice and compliments several citywide climate plans including the 2019 Sustainability Plan, 2023 Disaster Preparedness Planning Project or DP3, Solid Waste Management Plan and a Complete Streets Manual. These climate-focused plans in combination with CPRG funding provide a path toward a more sustainable, equitable, and resilient future.
- **Baltimore County Climate Action Plan (2021)**³
- **Queen Anne's County Climate Resilience Planning and Financing Draft Plan (2019 -)**

Additionally, several of the region's local jurisdictions have established climate-related goals, as demonstrated below:

- Queen Anne's County Climate Resolutions (2007, 2008)
- Baltimore City [Disaster Preparedness](#) and [Climate Action](#) Plans (2023/2024)
- Baltimore City carbon neutrality commitment by 2045 (2022)
- Howard County's carbon neutrality commitment by 2045 (2022)

As local jurisdictions in the region create various planning products, such as mobility plans, solid waste plans, and master plans, these may include climate pollution reducing measures and measures to mitigate the effects of climate change:

- City of Annapolis Mobility Plan
- [Anne Arundel County Green Infrastructure Master Plan](#)
- [Anne Arundel County, Plan2040 General Development Plan](#)
- [Howard County By Design \(General Plan\) 2023](#)
- Baltimore City [Complete Streets Manual](#), [10-Year Solid Waste Management](#) & [Our Baltimore - Comprehensive Plan](#)

The PCAP for the Baltimore MSA builds on strategies, actions and activities in jurisdiction-led climate plans to inform a regional implementation grant proposal.

3 PCAP elements

The PCAP includes the following elements below: a greenhouse gas inventory (GHGI), GHG emission projections, GHG reduction measures, LIDAC benefits analysis, a review of authority to implement, and an initial workforce analysis.

² <https://baltimoreplanning.wixsite.com/climate>

³ <https://resources.baltimorecountymd.gov/Documents/Executive/sustainability/climateactionplan.pdf>

3.1 Greenhouse Gas Inventory (GHGI)

3.1.1 GHGI Scope

This Greenhouse Gas Inventory (GHGI) covers emissions from the Baltimore MSA. This Metropolitan Statistical Area represents an estimated 2021 population of 2,837,237. The base year for the regional GHGI is 2021. The grantees have chosen this year because of federal, state, and local data availability. This year also is representative of general emissions patterns. This inventory represents emission estimates for primary GHGs (i.e., CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃)⁴ for the Baltimore-region.

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions⁵, and additional activities/sources are considered in accordance with the Global Protocol for Community-Scale GHG Emissions Inventories. The Global Protocol was used as the methodological framework for the regional inventory. The scope covers sources and activities since they are the two central categorizations⁶ of emissions.

3.1.2 Methodology & Data Overview

GHG emissions are quantified in two ways:

1. Measurement-based methodologies refer to the direct measurement of GHG emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
2. Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

$$\text{Activity Data} \times \text{Emission Factor} = \text{Emissions}$$

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity (e.g. MT CO₂/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath Climate Planner tool⁷. **Tables 5 through 10 in Appendix B** provide an overview of data sources, methodologies and data gaps or assumptions.

3.1.3 GHG Emission Results

Table 1. Summary of Emissions by Sector, below, details the total metric tons of CO₂e by sector across the Baltimore MSA. Based on a GHGI for 2021, an estimated 45.5% of regional emissions in the MSA are due to transportation and mobile sources alone. As such, the first two reduction measures focus on reducing emissions by reducing vehicle miles traveled and propelling the adoption of zero emission

⁴ GHGs aside from CO₂, CH₄, N₂O are estimated from Industrial Processes and entered as CO₂ equivalent (CO₂e)

⁵ ICLEI. 2019. US Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from <http://www.iclei.org/tools/ghg-protocol/community-protocol>

⁶ 1) GHG emissions that are produced by "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities."

⁷ <https://iclei.org/clearpath/>

vehicles. Energy-related emissions contributed to 44.1% of regional MSA emissions in 2021, with residential, commercial and industrial emissions contributing 20.9%, 19.7% and 3.5%, respectively.



The third reduction measure focuses on decarbonizing, or electrifying stationary energy sources in the residential, commercial and industrial sectors while promoting energy efficiency. Collectively these sources contribute to 44.1% of regional emissions. Measure 4 focuses on waste reduction by both reducing and diverting waste from landfilling and incineration, in addition to reducing waste-related emissions. We include both solid waste and waste water in this measure, which together equal 3.21% of the total. Measure 5 relates to the sequestration of carbon and strengthening carbon sinks through nature-based solutions.

Measures 6 and 7 are not directly related to emission reductions, but focus on enhancing the capacity of local governments to achieve climate goals and engagement targets to scale up behavior change across the region. We include these measures to highlight the inputs, outputs and activities which will feed into the aforementioned reduction targets.

Figure 2 is a pie chart reflecting the percentage of each emission category in relation to the total. See **Table 2: Regional Greenhouse Gas Inventory in Appendix A** which details the findings of the regional GHGI and all sector-related emissions included.

Metric Tons CO₂e by Sector

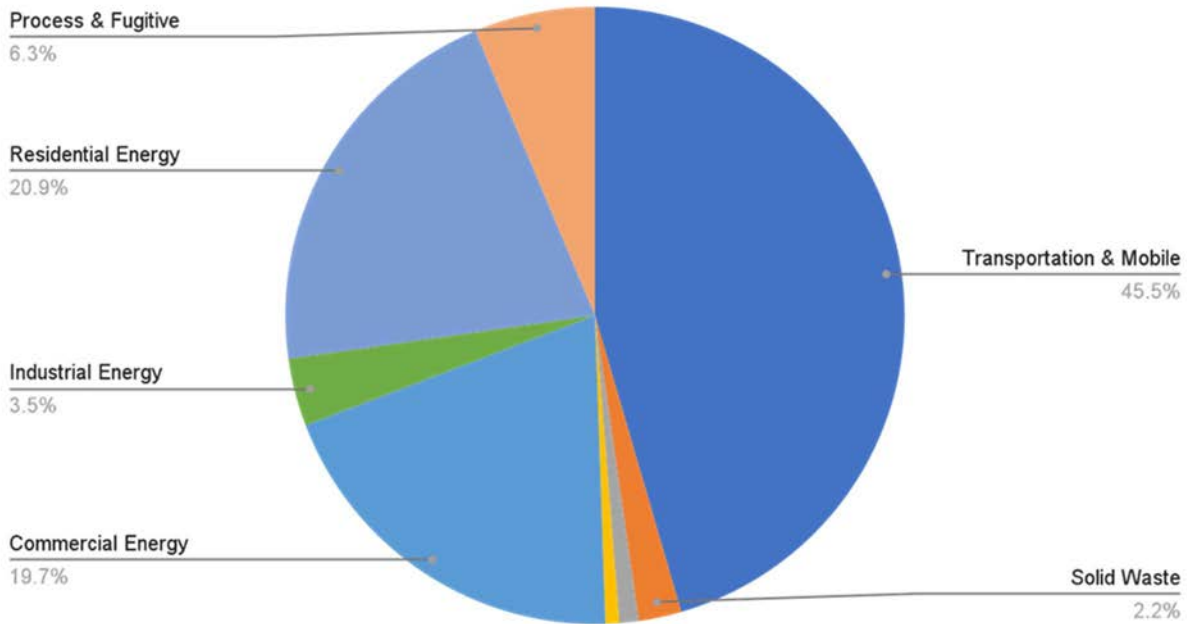


FIGURE 2. Metric Tons CO₂e by Sector

3.2 GHG Emissions Projections

3.2.1 GHG Emissions Projections Overview

This Priority Climate Action Plan uses a Business as Usual projection from 2021 (base year) to 2030 and 2050. This projection was carried out for every activity/source based on various activity growth rates and carbon intensity growth rates. These growth rates are detailed in **Tables 3: BAU Emissions, Net Reductions per Action, & Remaining Emissions after Implementation (MT CO₂e)** and **Table 4 GHG Reduction Projections (MT CO₂e) and Percent Change from Baseline.**

Projections in **Figure 3** and **Figure 4** are Business As Usual (BAU), representing expected emissions changes based on current activities (passed legislation, growth, etc.) and does not consider any intervention such as GHG reduction strategies.

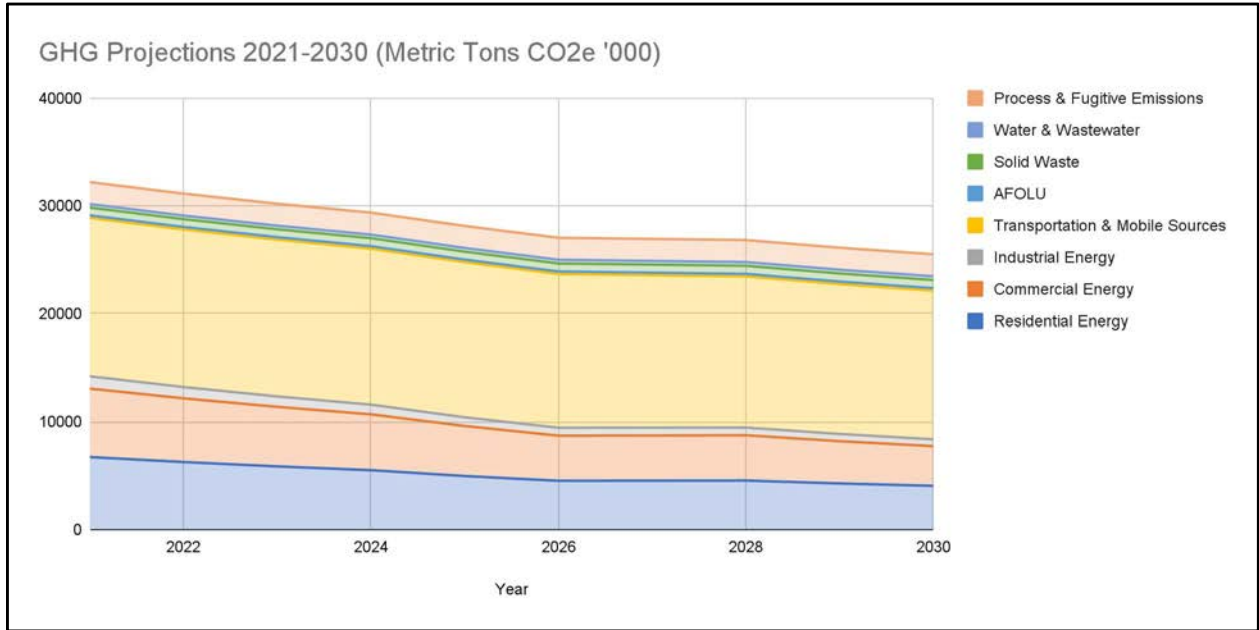


FIGURE 3. GHG Projections 2021-2030

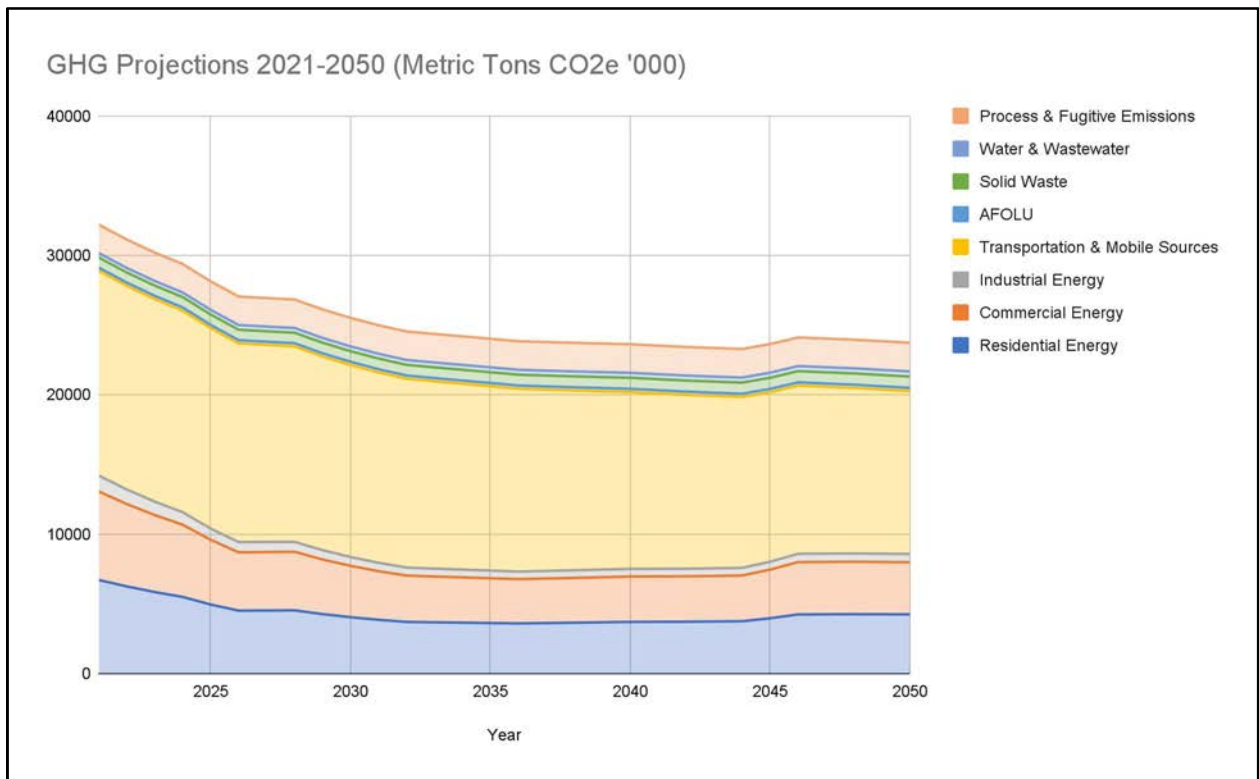


FIGURE 4. GHG Projections 2021-2050

3.3 GHG Reduction Targets

The Baltimore MSA has set the following priority targets in alignment with the State of Maryland's 2022 Climate Solutions Now Act:

- 60% by 2031 (compared to 2006 baselines)
- Net-Zero by 2045

The MSA has prioritized targets to maintain consistency with the state's goals and Science-Based Targets⁸ (SBTs). While the state's baseline is 2006 and this priority GHGI is the region's first baseline inventory (2021), both goals are generally in line⁹ with Science-Based Targets. Science-based targets (SBTs) are climate goals in line with the latest climate science. They represent a community's fair share of the ambition necessary to meet the Paris Agreement commitment to keep warming below 1.5 °C. To achieve this goal, the Intergovernmental Panel on Climate Change (IPCC) states that we must reduce global emissions by 50% by 2030 and achieve climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%.

3.4 GHG Reduction Measures

Based upon an analysis of the GHGI, existing local and state climate action plans, and consideration of impact on LIDAC communities, and co-benefits, the following list of Priority GHG Reduction Measures was decided upon by the Baltimore MSA CPRG Steering Committee. It includes a total of seven measures that reduce GHG emissions and those that enhance carbon sinks. **Appendix C** includes several local plans with additional actions and priorities in alignment with the seven measures detailed here.

Given the significant portion of regional emissions from transportation and energy-related sources, we recommend that investments support activities that reduce emissions in these sectors.

Maryland's Climate Solutions Now Act (CSNA), adopted in 2022 by the Maryland General Assembly, makes broad changes to the State's approach to reducing statewide GHG emissions and addressing climate change. The federal Carbon Reduction Program, created by the Bipartisan Infrastructure Law (BIL), also facilitates:

- The use of public transportation facilities, pedestrian facilities, bicycle facilities, and shared or carpoled trips to reduce vehicle miles traveled by single-occupancy operated vehicles;
- The use of vehicles or modes of travel that result in lower transportation emissions; and,
- Approaches to the material use and construction of transportation assets that lower transportation emissions.

A Maryland Carbon Reduction Strategy, developed in consultation with the metropolitan planning organizations in Maryland, outlines approaches, programs, and projects to address transportation sector emissions. The National Blueprint for Transportation Decarbonization, resulting from a joint agreement among the U.S. Department of Energy (DOE), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), and U.S. Department of Housing and Urban Development (HUD), is a strategy for cutting all GHG emissions from the transportation sector by 2050. Locally,

⁸ [Science-Based Targets](#)

⁹ 2031 target is more than 50%, which considers the MSA's fair share of global emissions reduction

Maryland Department of Transportation (MDOT) will help lead and coordinate State and local action to implement the strategy. Maryland and the Baltimore-MSA are also exploring future, expanded transit options through the revived Red Line Project led by the Maryland Transit Administration (MTA) and supported by the City's Department of Transportation. The proposed Red Line is a 14-mile transit line that would provide service between the Woodlawn area of Baltimore County and the Johns Hopkins Bayview Medical Center. When complete, the Red Line will make it easier, faster, and cheaper to travel across the greater Baltimore area. Measures for the Baltimore MSA PCAP are also in alignment with those in Maryland's Climate Pollution Reduction Plan.

MEASURE 1: REDUCE TRANSPORTATION-RELATED EMISSIONS 25% BY 2030; 91% BY 2050

- VMT Reduction – 25% by 2050 – Gasoline: The 2021 regional GHGI reflected gasoline-powered vehicles contribute to a total of **24 billion VMT** and make up **32.5% (10.5 MMTCO₂e)** of all regional emissions. To reduce VMT, the participating jurisdictions plan the following public transportation support measures:
 - Develop pedestrian zones in communities lacking adequate pedestrian-centered design. These pedestrian zones are intended to:
 - Foster/encourage mode shift from single occupant vehicles to more active forms of transportation such as walking, biking or the use of public transit.
 - Incorporate ecologic amenities that enhance overall community-level access to climate pollution reduction resources into historically divested communities (See **Appendix C** for examples)
 - Foster safer routes for children to/from school, area bus stops or paths/trails
 - Develop new parking standards with strategically placed restrictions and approaches to remove parking minimums
 - Establish electric car-sharing infrastructure and partner with rideshares to augment paratransit and mobility Programs through the Maryland Transit Administration
 - Deploy community electric vehicle sharing programs regionally to provide low-income or no-car households access to flexible electric-powered modes of transportation
 - Distribute free transit passes to those in need and as part of targeted outreach campaigns to strategically increase ridership
 - Identify neighborhoods that would benefit from microtransit options and conduct microtransit pilot projects or implement microtransit in areas of greatest need.
 - Install bus stop cooling infrastructure
 - Support more sustainable commuting patterns through education, outreach, and incentive programs to promote telework, downsizing office space, and office share models
- VMT Reduction – 25% reduction by 2050 – Diesel: An estimated **9.7% (3.12 MMTCO₂e)** of all regional emissions from the 2021 GHGI were attributed to diesel-powered vehicles. Emission reductions related to diesel-powered vehicles require legislation, but local jurisdictions have the authority to implement actions that increase the electric charging infrastructure across the region. These actions focus on those within the MSA's authority to implement and the actions we can support the State of Maryland with.
 - Decarbonize waste-related fleets such as those vehicles used for organics hauling, curbside recycling and trash pick up for residential purposes
 - Support state/local public transit bus electrification
 - Freight planning to shift from road to rail

- Planning, coordinating and maintain electric charging corridors for mid and heavy-duty vehicles

MEASURE 2: ELECTRIFYING CARS AND TRUCKS

17% ELECTRIC VEHICLE ADOPTION BY 2030, 99% IN 2050

27.5% HEAVY DUTY VEHICLE ADOPTION, 99% IN 2050

- Advanced Clean Cars II and Clean Trucks:
 - Support the installation of EV charging infrastructure on government property for county fleets and/or for the public through cost-share and technical assistance
 - Support the installation of public EV charging infrastructure in partnership with local businesses through cost-share and technical assistance
 - Pilot new EV charging technologies

MEASURE 3: REDUCE BUILDINGS & ENERGY RELATED EMISSIONS BY AN AVERAGE OF

48% IN 2030 AND BY AN AVERAGE OF

82% BY 2050

Combined, residential, commercial and industrial energy make up 44.1% of all estimated emissions across the region in 2021.

- Residential Energy: A total of **20.9% (6.7 MM TCO₂e)** of the Baltimore MSA's emissions are from residential energy sources. Within residential energy emissions - **60% (4 MM TCO₂e)** is from electricity production and, **30% (2 MM TCO₂e)** from natural gas and the remaining **9% (0.7 MM TCO₂e)** is due to combination of fuel sources such as wood, propane and kerosene. Reducing emissions among residential energy sources or buildings, will focus on strategies to electrify, decarbonize and enhance energy efficiency among single family homes, multi dwelling units or other public housing sites. This could include:
 - Programs to educate residents and contractors about energy saving and fuel switching technologies, their benefits, and available rebates and incentives.
 - Workforce development for HVAC technicians, electricians, salesforce, and energy auditors to expand knowledge of electrification and to develop an electrification audit program
 - Programs to help low-income oil and propane users shoulder the burden of electrification after rebates
 - Pilot program funding at least two district geothermal projects as proof of principle
 - Education, outreach, and technical and financial assistance programs to promote onsite solar, community solar, and purchases of 100% renewable energy from third party suppliers
 - Community solar projects from solar canopies installed over parking on county government property, providing discounts on electricity for low-income residents.
- Commercial Energy: A total of **19.7% (6.4 MM TCO₂e)** of emissions for the region are due to commercial energy uses. Within commercial emissions - **64% (4.1 MM TCO₂e)** are due to electricity, **25% (1.6 MM TCO₂e)** due to burning natural gas and the remaining roughly **10% (0.6 MM TCO₂e)** are from a combination of propane, kerosene and other commercial fuels. Measures to reduce emissions from commercial energy could include initiatives such as:

- Education, outreach, and partnership programs to increase business participation in energy efficiency and fuel switching incentives and promote tools such as C-PACE
- Technical and financial assistance programs to promote onsite solar and purchases of 100% renewable energy from third party suppliers
- Fund for green procurement consultants for businesses
- Pilot programs to demonstrate electrification projects, especially in underserved communities and for small businesses, including outreach and education for residents and other businesses
- Energy efficiency, fuel switching, and solar projects on county-owned property

**MEASURE 4: REDUCE MUNICIPAL SOLID WASTE EMISSIONS BY
65% IN 2030 AND
90% BY 2050**

- Waste diversion: Reducing solid waste related emissions entails a combination of strategies that prevent, divert or support the reuse of potential waste sources. A total of **3.21% (1.04 MM TCO_{2e})** of the regional emissions are due to waste and wastewater. This number does not reflect 1) emissions related to hauling waste, 2) global warming potential from organic waste that releases methane, 3) embodied carbon from materials entering municipal waste streams, 4) the immense cost municipal solid waste operations have on local governments or 5) the value of materials lost to the local economy when items are disposed of. The following activities address the aforementioned waste streams, and provide residents in the region access to organic waste diversion options:
 - Residential-level food scrap diversion through
 - i. Establishing and expanding curbside pick-up programs for organic material, including food waste
 - ii. Launching farmer's market-based food scrap drop-off programs
 - iii. Food scrap drop-off programs located at accessible community facilities
 - Climate Art for Communities made with upcycled waste materials
 - Fixit and repair clinics to reduce, divert and prevent e-waste and waste from household goods
 - Provide Household Reuse Packages as An Incentive to Recycle Right (including reusable bags, food containers, utensils, water bottles, and reusable straws for up to 4 people)
 - Establishing wood reutilization centers based on the success of Baltimore City's Camp Small initiative
 - Expand food waste diversion infrastructure in the form of a mid-to large sized compost facility
 - Support end-use markets for soil amendment or other compost products resulting from food waste diversion
 - Protect and relocate local waste collection stations as necessary to prevent flooding impacts and improve current and future access to waste collection stations.
 - Improve local government procurement to align with climate and sustainability goals

MEASURE 5: SEQUESTER 5 MMTCO_{2e} BY 2030 AND 50 MMTCO_{2e} BY 2050

- Nature-based solutions and sequestration: The 2021 regional GHGI reflects a carbon sink of roughly **1.45 MMTCO_{2e}** or **4.5%** of the total CO_{2e} regionally. This number can be interpreted as a 4.5% carbon sequestration, but was not modeled in the current inventory or projections.

However, it serves as an estimate for the potential CO₂e that can be captured through nature-based solutions.

- Expand tree canopy through planting efforts and by maintaining existing forest
- Protection of public places for water access and passive recreation of natural habitat; watershed protection of forest habitat. (for example, see [Queen Anne's County Sea Level Rise and Coastal Vulnerability Assessment and Implementation Plan, March 2016](#))
- Establish outreach campaign, including demonstration projects, to raise awareness, acceptance, and appreciation of soil health, native plants, reduced mow areas, and meadows
- Protect passive recreation of natural habitat, including watersheds
- Integrate carbon sequestration elements and emphasis into private property stormwater programs and incentives
- Support farmers with incentives and technical assistance in implementing healthy soils practices to sequester carbon
- Use biochar as a soil amendment to enhance carbon sequestration potential
- Integrate other co-benefits of climate mitigation and adaptation into projects regionally to foster polysolutions
- Mitigate the health impacts of extreme heat and the urban heat island effect

MEASURE 6: ENHANCE CLIMATE CAPACITY ACROSS LOCAL GOVERNMENTS BY 50% BY 2030

- Facilitate trainings to enhance climate literacy among local government staff to make climate connections in key roles
- Provide sector-specific professional development trainings for municipal government staff to ensure local governments workforces have the knowledge skills and education to solve complex climate challenges
- Develop a robust training program for local jurisdiction staff and/or leadership in basic climate science and methods to mitigate climate change and adapt to changes to better integrate climate goals and outcomes into many if not all of their projects and work plans.
- Foster climate career pathways for early career professions, with a focus on those from LIDAC, Black, Indigenous, or Other People of Color (BIPOC) or other underrepresented communities in the climate profession
- Hire needed climate staff to increase capacity for local governments

MEASURE 7: ENGAGE 50% OF RESIDENTS IN THE BALTIMORE MSA BY 2030 THROUGH CPRG IMPLEMENTATION

- Allocating CPRG funds in a manner that prioritizes authentic, meaningful engagement to connect LIDAC communities with CPRG investments while working to address environmental injustices in the region.
- Deploy culturally relevant outreach, education and engagement strategies that meet people where they are in their understanding of climate change and its impacts.

Figure 5 below displays remaining emissions and net greenhouse gas emissions reductions per strategy through 2050. This is a modeling of priority actions only, so it does not include actions addressing smaller sectors that would be needed to reach zero emissions, or measures 6 and 7 related to capacity and engagement. In addition, while emissions data for the region is not available back to the state baseline year of 2006, electricity emissions intensity in particular has already declined significantly from 2006 to 2021. Thus the overall 2030 emissions reduction with these actions, if it were measured against

the state’s 2006 baseline, would be greater than the reduction from the region’s 2021 baseline shown in this chart.

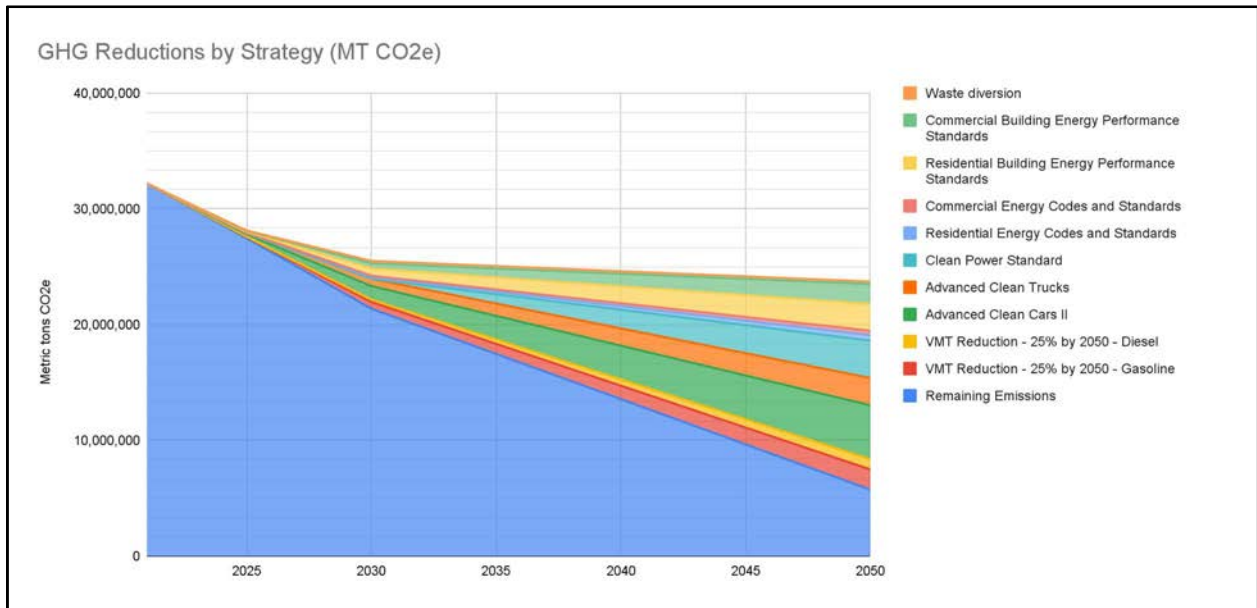


FIGURE 5. GHG Reductions by Strategy

3.5 Low Income Disadvantaged Communities Benefits Analysis

Identifying LIDACs

The Inflation Reduction Act does not formally define LIDACs. However, based upon recommendations from the US EPA, the Steering Committee decided to use the [Climate and Economic Justice Screening Tool](#) and the [Environmental Justice Screening and Mapping Tool](#) to identify LIDACs located within the Baltimore region. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. A list of LIDAC communities by census tract which could have particular benefits from each priority reduction measure was compiled by ICLEI and will be used to target areas for investment in the region’s implementation grant proposal. The map in **Figure 6** below displays the LIDAC census tracts in the Baltimore region.

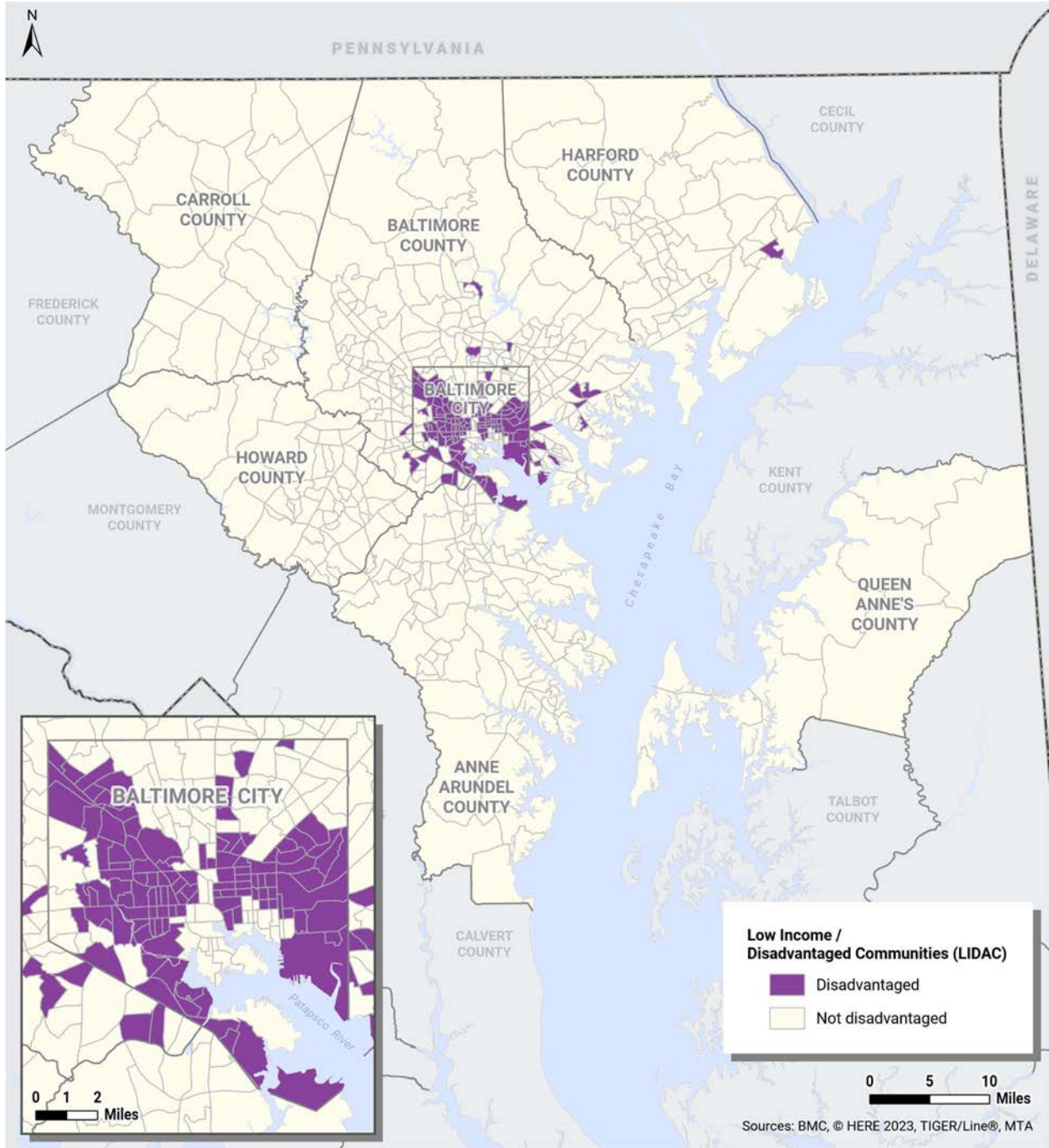


Figure 6. Low Income/Disadvantaged Communities (LIDAC) in the Baltimore Region

Existing Climate Risks, Impacts, and Vulnerabilities among LIDACs - determined from the 2021 State Hazard Mitigation Plan¹⁰

- *Flood*
 - **Coastal hazards:** Includes tropical depression, tropical storm, hurricane, storm surge/ tide, coastal flood, and nuisance flood. All of the counties within the MSA fall within the *medium*, *medium-high*, and *high* overall ranking of coastal hazard risk, with the exception of Carroll County, which was ranked at *medium-low* risk. Flooding may lead to safety hazards. Coastal communities are subject to destruction of land and property and potential displacement of populations. Damage to infrastructure could lead to burdened electrical grids and closures of transportation routes. Coastal hazards and major changes to the coastline, including erosion, land loss, and subsidence, will drain state, county, and local resources. The economic costs related to flood mitigation and relocation measures will be high, in addition to the economic burden caused by loss of land.
 - **Severe storms and increased precipitation:** similar vulnerabilities as above, with more emphasis on those that live in floodplain or FEMA flood zones. All of the counties within the MSA fall within the *medium*, *medium-high*, and *high* overall ranking of flooding.
 - **Dam failure:** All of the counties within the MSA fall within the *medium* to *medium-high* ranking of dam failure, with the exception of Queen Anne’s County, ranked at *medium-low*. Similarly to flooding coastal hazards, inundation from dam failure could lead to safety hazards and economic burden from destruction of land and property. Flooding or damage to infrastructure could lead to closures of transportation routes or impacts to water supply.

LIDAC communities in the US are disproportionately vulnerable to flooding. In Maryland specifically, 11% of the population within the 100-year floodplain is considered in poverty. LIDAC communities face immediate and long-term human health risks from inundation and may not have access to adequate health care. They may be burdened with higher costs attributed to lack of adequate home or renters insurance coverage, may have a harder time relocating, and may not be able to afford the upfront costs of rebuilding, even with FEMA assistance (many FEMA options only offer reimbursements).

- *Severe Weather-*
 - **Extreme Heat:** Extreme temperatures events paired with high humidity are anticipated to span several days at a time, creating a *medium* to *medium-high*, and *high* risk threat to the counties in the MSA. Heat threatens public health directly, specifically children, elderly, those with preexisting health conditions, and those without access to cooling. These events also add immense burden to the electrical grid, further removing access to cooling. Additionally, low income communities without adequate home insulation or less efficient cooling systems are more vulnerable to increased costs of heating. According to the EPA, urban areas are expected to reach 1-7°F higher than surrounding areas. The highest temperature recorded in Maryland is 109°F.

¹⁰ <https://mema.maryland.gov/community/Pages/Mitigation.aspx>

- **Winter Storms:** Although temperatures are generally warming, winter storms still threaten the state. Extreme cold threatens those without sufficient access to heating. Additionally, low income communities without adequate home insulation or less efficient heating systems are more vulnerable to increased costs of heating
- **Thunderstorms, Tornado/ High Wind:** Damage to infrastructure could lead to burdened electrical grids and closures of transportation routes. Those that primarily work outside are most vulnerable.

LIDAC communities are vulnerable to severe weather. Extreme heat directly threatens communities, especially those without cooling due to costs, infrastructure, or work setting. Heat, storms, and high winds all threaten utilities, specifically the electrical grid, further preventing necessary cooling.

Potential Benefits (qualitative/quantitative) of GHG Emission Reduction Measures to LIDACs

1. **Clean Power Standard - 100% Renewable Energy by 2035**
 - a. *Qualitative impacts:*
 - i. *Local economic improvements- Deployment of renewable energy could translate into local job creation.*
 - ii. *Local economic improvements- Decreased reliance on price volatile energy sources and supply disruptions.*
 - iii. *Public health- Decreased health risks from reduction of fossil fuel combustion.*
 - iv. *Increased local energy resiliency- Decentralized energy supply from renewable energy sources increases the ability to adapt to grid disruptions.*
 - v. *Cost reductions- Decreased energy costs from energy efficiency improvements and more resilient energy sources.*
 - vi. *Reduced risk to climate hazards- Emissions reductions ultimately slows climate change, therefore reducing the risk to climate hazard events induced by climate change.*
2. **Advanced Clean Cars II - 100% of new cars, light-duty trucks, and sport utility vehicles (SUVs) sold in Maryland to be ZEVs by 2035.**
 - a. *Qualitative impacts:*
 - i. *Public health- Reduced exposure to particulate emissions, ozone, and noise leads to a decrease in health risks.*
 - ii. *Local economic improvements- Increased community capacity building and job creation due to additional training and infrastructure for electric vehicles.*
 - iii. *Equity- Expansion of charging stations and public financial support lowers barriers and improves access to EV ownership.*
3. **Advanced Clean Trucks - heavy duty EVs - model based Rocky Mountain Institute data**
 - a. *Qualitative impacts:*
 - i. *Public health- Reduced exposure to diesel particulate emissions, ozone, and noise leads to a decrease in health risks.*
 - ii. *Local economic improvements- EV charging Infrastructure construction will create new or improved local jobs and build capacity through training; new jobs will be created in EV manufacturing and other technology sectors.*

4. **Maryland Transportation Plan** - 20% reduction for all on road vehicles by 2050 (assuming 2050 since this is the 2050 Transportation Plan) (this includes all fuel types included EVs)
 - a. Qualitative impacts:
 - i. *Public health- Reduced vehicle miles traveled results in local reduced exposure to particulate emissions, ozone, and noise.*
 - ii. *Reduced risk to climate hazards - Emissions reductions ultimately slows climate change, therefore reducing the risk to climate hazard events induced by climate change.*
5. **Energy Codes and Standards** - 37% savings for all new buildings and 20% savings for existing Commercial and Residential (5% of homes retrofit each year) (all data is defaults)
 - a. Qualitative impacts:
 - i. *Commercial*
 1. *Local economic improvements- Lowering operational costs for businesses could allow them to direct more funding into their workforce, leading to more employment opportunities.*
 2. *Reduced risk to climate hazards- Commercial and industrial reductions typically are at a larger scale than residential. Emissions reductions ultimately slows climate change, therefore reducing the risk to climate hazard events induced by climate change.*
 - ii. *Residential*
 1. *Cost reductions- Decreased, more stable energy costs can ease the energy burden most LIDAC communities face.*
 2. *Public health- Increases in resilience to cope with temperature extremes by incorporating and/or upgrading heating, ventilation and air conditioning systems (HVAC), installing off the grid solar energy capacity, and upgrading home building envelope (insulation).*
 3. *Public health- Increased housing quality, comfort, and safety from reduced costs, increased efficiencies, and improved indoor air quality.*
 4. *Reduced risk to climate hazards- Emissions reductions ultimately slows climate change, therefore reducing the risk to climate hazard events induced by climate change.*
6. **Building Energy Performance Standards** - 100% of commercial buildings by 2045 fully electrified (The State of Maryland Building Energy Performance target aims for buildings larger than 35,000 sq ft and ends in 2040. Since we do not have sq ft data currently, we extended this to 2045 to account for other commercial buildings). Also will apply this assumption to
 - a. Qualitative impacts:
 - i. *Public health- Electrification of all buildings in a community reduces indoor exposure to fossil fuel combustion, improving indoor air quality.*
 - ii. *Local economic improvements- Deployment of electrification could translate into local job creation targeting low-income and unemployed people and communities.*
7. **Food Residuals Diversion Law** - 2% of food reduced per year (this is an assumption)
 - a. Qualitative impacts:

- i. *Reduced risk to climate hazards- Emissions reductions ultimately slows climate change, therefore reducing the risk to climate hazard events induced by climate change.*

The following documentation specifies which census tracts are most impacted by the aforementioned strategies:

- [BaltimoreMetro_CEJST](#)
- [BaltimoreMetro_CEJST-LIDAC Analysis- Identification Methodology Affected Census Tracts.pdf](#)

*It is important to recognize that all of the census tracts present in the data set fall into the 90th percentile or higher for any given criteria and are disproportionately impacted. For this reason and with recognition that each criteria contains disproportionately impacted community members, nearly every census tract will be impacted by the identified GHG reduction measures. Additionally, the reduction measures will result in community wide emissions reductions and will affect all census tracts indirectly, if not directly.

3.6 Review of Authority to Implement

The jurisdictions in the Baltimore MSA in partnership with the State of Maryland have the authority to implement all measures detailed in this PCAP, though some of that authority is primarily with the state, with local government authority being limited. **Table 11: Authority to Implement** details what authorities are with local governments, in which actions require authorities from the state.

3.7 Workforce Planning Analysis

A previous analysis of workforce readiness for building electrification was performed for local government in the Baltimore region. Additional workforce planning analysis will be completed ahead of the comprehensive climate action plan in 2025.

Through a previous analysis, it was assessed that the existing building workforce currently is not prepared to accommodate the anticipated steep acceleration of building electrification in Maryland. Building electrification is a comparatively recent strategy in the overall mission to decarbonize energy. As such, existing energy auditors and building contractors are often not qualified to perform electrification audits and planning. During stakeholder engagement, Howard County staff identified this as the main bottleneck in the push toward building electrification.

The existing workforce of building energy auditors has been trained to assess energy efficiency with a focus on weatherization and energy saving strategies, but not to evaluate electrification potential, capacity needs, and the need for service upgrades or workarounds, and to develop adequate strategies that incorporate recent technologies and incentives. Similarly, the existing workforce of HVAC professionals has been trained to install equipment without consideration of broader electrification strategies which households are increasingly being incentivized to pursue, and generally tends to replace equipment with the same type for ease of installation. Contractors who have been in the field for decades and their corresponding salesforce also sometimes have outdated knowledge on technologies and rebates available for switching from fossil fuel combustion equipment to electric alternatives.

Households and businesses wishing to implement electrification upgrades are left to navigate equipment options and an overwhelming array of utility, local, state, and federal incentives. Electric service limitations and the strategies they necessitate are rarely considered by a lay person when seeking equipment upgrades. The ability to perform systematic electrification audits and provide building owners with all relevant information is a crucial qualification for building professionals in light of the current push for building electrification. Past training curricula have not prepared existing professionals for this need.

The greater emphasis expected over the next decade on electrification, energy efficiency improvements, EV charging infrastructure and solar will similarly increase demand for electricians and solar installers.

4 Next Steps

Following the release of this PCAP, the Steering Committee and consultants will begin work on preparation of the Comprehensive Climate Action Plan (CCAP). BMC and Steering Committee members will work with a consultant on the development of the CCAP and public engagement. Emission reduction measures in the CCAP are expected to build upon and potentially expand on the list of priority action measures in this PCAP.

- **MILESTONE 1 - Determine amount of CPRG implementation funding awarded**
 - March 2024: Submit the Priority Climate Action Plan (PCAP) for the Baltimore MSA by March 1
 - April 2024: Baltimore MSA CPRG Steering Committee submit a competitive grant application for the CPRG implementation grant by April 1.
- **MILESTONE 2: Meet deliverables of the CPRG planning grant funds**
 - May 2024: While the CPRG competitive grant proposal is under review, the Baltimore MSA CPRG Steering Committee will meet monthly to proactively prepare for the implementation and continue coordinating progress on the CPRG planning grant led by the Baltimore Metropolitan Council.
 - June 2024: The Baltimore MSA CPRG Steering Committee will begin drafting an outline for the Comprehensive Climate Action Plan (CCAP)
 - July 2024: Determine if the MSA's proposal was funded, partially funded or if other funding sources need to be sought through federal, state, philanthropic or other sources.
 - August 2024: Facilitate planning meetings with the Baltimore MSA coalition partners, subawardees and other stakeholders to coordinate and plan for adjusting funding priorities based on the award notice (if awarded) and funding amount. These planning meetings will also be used to prepare for the expedient execution of necessary administrative processes for subawards, competitive procurement and other administrative needs.
- **MILESTONE 3 - Prepare for regional implementation of CPRG**
 - September 2024: Host regional coordinating meetings for the REDUCE coalition to provide direction, advice, and support to each partner in the facilitation of the CPRG and complete key pre implementation tasks
 - i. Draft language, scopes and parameters for request for proposals as necessary for competitive procurement in alignment with EPA procurements rules

- ii. Engage with targeted communities to raise awareness about the process for CPRG implementation and impacts for their respective communities.
- iii. Revisit and finalize work plan timeline as needed
- o October 2024: Depending on when funds are allocated to lead applicants, facilitate the allocation of funds to subawardees, contractors, consultants and program beneficiaries.

The Baltimore MSA Steering committee will determine additional steps needed for effective implementation as the members continue to coordinate for the CPRG implementation grant.

APPENDICES

APPENDIX A: Regional Greenhouse Gas Inventory and Reduction Projections

TABLE 2: Regional Greenhouse Gas Inventory					
Sector/Activity	Fuel or Source	2021 Usage/Activity	Units	2021 Emissions (MT CO ₂ e)	Percent of Total
Residential Energy	Electricity	13,131,506,026	kWh	4,026,759	12.51%
	Wood	1,926,115	MMBtu	18,764	0.06%
	Distillate Fuel Oil No. 2	6,623,955	MMBtu	493,177	1.53%
	Propane	3,194,532	MMBtu	198,249	0.62%
	Kerosene	93,957	MMBtu	7,113	0.02%
	Natural Gas	37,488,768	MMBtu	1,993,776	6.19%
	Residential Energy Total				6,737,838
Commercial Energy	Electricity	13,333,284,169	kWh	4,088,634	12.70%
	Distillate Fuel Oil No. 2	3,549,084	MMBtu	264,242	0.82%
	Propane	5,978,384	MMBtu	371,012	1.15%
	Natural Gas	30,533,424	MMBtu	1,623,868	5.04%
	Kerosene	48,618	MMBtu	3,681	0.01%
	Other Commercial Fuels	-	-	4,940	0.02%
	Commercial Energy Total				6,356,377
Industrial Energy	Electricity	1,862,600,409	kWh	571,164	1.77%
	Natural Gas	26,745,309	MMBtu	469,167	1.46%
	LPG	16,587	MMBtu	1,023	0.00%
	Distillate Fuel Oil No. 2	296,934	Gallons	17,772	0.06%
	Other Industrial Fuels	-	-	81,025	0.25%
	Industrial Energy Total				1,140,151
On Road Transportation	Gasoline	24,002,996,939	Vehicle Miles Traveled (VMT)	10,455,598	32.47%
	Diesel	2,197,349,539	Vehicle Miles Traveled (VMT)	3,123,678	9.70%
	CNG	23,351,041	Vehicle Miles Traveled (VMT)	2,364	0.01%
	Ethanol	42,270,949	Vehicle Miles Traveled (VMT)	3,649	0.01%

	Electricity	164,673,988	Vehicle Miles Traveled (VMT)	81,049	0.25%
Rail Transportation	Diesel	651,438	MMBTU	48,603	0.15%
Waterborne Transportation	Gasoline	538,605	MMBTU	38,781	0.12%
	Diesel	141,989	MMBTU	10,508	0.03%
Off Road Transportation & Mobile Sources	Gasoline	4,601,077	MMBTU	330,478	1.03%
	Diesel	6,125,066	MMBTU	453,254	1.41%
	CNG	164,348	MMBTU	10,364	0.03%
	LPG	1,504,860	MMBTU	92,677	0.29%
	Transportation & Mobile Sources Total			14,651,004	45.50%
Solid Waste	Waste Generation	1,172,453	Tons	484,613	1.51%
	Landfill Gas Flaring	446,259	MMBTU	5,494	0.02%
	Solid Waste Incineration	6,619,110	MMBTU	229,478	0.71%
	Closed Landfills	-	-	99,087	0.31%
	Solid Waste Total (does not include Closed Landfills)			719,585	2.23%
Water and Wastewater	Wastewater Treatment	-	-	325,157	1.01%
	Water and Wastewater Total			325,157	1.01%
Process & Fugitive Emissions	Fugitive Emissions from Natural Gas Distribution	85,056,325	MMBTU	157,051	0.49%
	Oil and Gas Production and Processing	-	-	3,290	0.01%
	Industrial Process & Product Use	-	-	1,876,474	5.83%
	Process & Fugitive Emissions Total			2,036,816	6.33%
Agriculture, Forestry, and other Land Uses (AFOLU)	Livestock	-	-	149,135	0.46%
	Crops	-	-	82,009	0.25%
	Land/Forestry	-	-	-1,452,350	-
	AFOLU Total (does not include Land/Forestry)			231,144	0.72%
Total 2021 Regional Emissions				32,198,072	

	TABLE 3: BAU Emissions, Net Reductions per Action, & Remaining Emissions after Implementation (MT CO2e)		
	2025	2030	2050
Business As Usual Emissions	28,128,384	25,503,512	23,719,593
Action	Net Reductions		
VMT Reduction - 25% by 2050 - Gasoline	105,691	579,093	1,745,018
VMT Reduction - 25% by 2050 - Diesel	33,955	203,733	882,845
Advanced Clean Cars II	199,881	1,170,684	4,662,100
Advanced Clean Trucks	93,525	635,066	2,354,686
Clean Power Standard	0	0	3,228,167
Residential Energy Codes and Standards	23,749	142,494	474,983
Commercial Energy Codes and Standards	19,141	114,849	382,828
Residential Building Energy Performance Standards	92,472	618,272	2,308,824
Commercial Building Energy Performance Standards	65,683	450,911	1,725,072
Waste diversion	35,705	214,229	214,228
Remaining Emissions after Implementation			
Remaining Emissions after Implementation	27,458,582	21,374,181	5,740,842
Percent Change (%) from 2021 Baseline	-14.72%	-33.62%	-82.17%

	TABLE 4: GHG Reduction Projections (MT CO ₂ e) and Percent Change from Baseline			
	2021 Baseline	2025	2030	2050
Industrial Energy	1,140,151	805,315 (-29.37%)	631,097 (-44.65%)	469,160 (-58.85%)
Residential Energy	6,737,838	4,886,770 (-27.47%)	3,391,856 (-49.66%)	333,476 (-95.05%)
Commercial Energy	6,356,375	4,594,802 (-27.71%)	3,232,077 (-49.15%)	477,562 (-92.49%)
Transportation & Mobile Sources	14,651,004	13,854,053 (-5.44%)	10,953,762 (-25.24%)	1,205,312 (-91.77%)
Water & Wastewater	325,157	336,154 (3.38%)	343,262 (5.57%)	367,597 (13.05%)
AFOLU	231,144	231,144 (0%)	231,144 (0.00%)	231,144 (0.00%)
Process & Fugitive Emissions	2,036,816	2042127 (0.26%)	2,045,560 (0.43%)	2,057,314 (1.01%)
Solid Waste	719,585	708217 (-1.58%)	545,423 (-24.20%)	599,277 (-16.72%)

APPENDIX B: Charts and Tables for Methodologies

TABLE 5: Transportation & Mobile Sources			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
On-Road	Baltimore Metropolitan Council/Maryland Department of Transportation	After BMC provided MOVES, we aggregated data by county, fuel/vehicle type.	Data is for 2022, which is the most recent year. Original dataset provided specific vehicle classifications, which were aggregated into Motorcycle, Passenger, Light-Duty, and Heavy Duty
On-Road Transit	Baltimore Metropolitan Council/Maryland Department of Transportation	n/a	Included in on-road activity
Rail	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO ₂ /MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO ₂ /MMBTU emissions factor
Aviation	Not Included in PCAP		
Waterborne	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO ₂ /MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO ₂ /MMBTU emissions factor
Off-Road/ Mobile	EPA's 2020 National Emissions Inventory	Extracted county data by GHG type, estimated MMBtu using MT CO ₂ /MMBTU emissions factor	Because NEI does not provide activity data, we estimated MMBtu using the MT CO ₂ /MMBTU emissions factor
Emissions factors	EIA's Annual Energy Review, Bureau of Transportation Statistics Average Fuel Efficiencies, and EPA's Emission Factors for Greenhouse Gas Inventories	n/a	n/a

TABLE 6: Grid Electricity			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Residential Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county households out-of-state households	Since utility data was unavailable, this alternative was considered most applicable. This approach assumes every house uses grid electricity.
Commercial Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county commercial jobs : out-of-state commercial jobs	Since utility and state commercial data was unavailable, this alternative was considered most applicable.
Industrial Electricity	Energy Information Administration State Energy Summaries	Extracted state electricity consumption data and downscaled using a ratio of county industrial jobs : out-of-state industrial jobs	Since utility and state industrial data was unavailable, this alternative was considered most applicable.
Electricity Generation	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	This data is recorded but emissions are not considered in the GHGI total because electricity generation emissions are assumed to be captured in the residential, commercial, and industrial electricity emissions.
Emissions factors	EPA's eGRID2021	n/a	n/a

TABLE 7: Solid Waste			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Waste Generation (Open Landfills)	Maryland Department of Environment's MD Solid Waste Management and Diversion Report (2022, CY 2021 Data)	Enter site-specific Waste Accepted tonnage.	Waste data was split into Waste accepted, waste disposed, and waste transportation. We choose to use the waste accepted values as this best reflects annual generation. We assumed all landfills use typical landfill gas controls, have "wet" moisture contents, and all waste was generated and landfilled in the boundary.
Closed Landfills	FLIGHT data	Extracted site-specific data per county and directly entered raw metric tons CH4	n/a
Landfill Gas Flaring	Maryland Department of Environment's State-wide 2020 GHG Inventory	Extracted site-specific data	Source data is from 2020
Landfill Gas Combustion	Maryland Department of Environment's State-wide 2020 GHG Inventory	Extracted site-specific data	We assumed all energy from LFG combustion was sent to the grid. Source data is from 2020
Waste Characterization	Maryland Department of Environment's MD Solid Waste Management and Diversion Report (2022, CY 2021 Data)	n/a	Statewide waste characterization represents each landfill's waste composition. Because the waste composition categories differed from ClearPath categories, the following assumptions occurred: Paper and paperboard was split evenly into all 4 paper/cardboard categories, Yard trimmings was split evenly into grass, leaves, and branches, and 25% of the construction and demolition waste reported was lumber.
Emissions factors	EPA's Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)	n/a	n/a

TABLE 8: Other Sources			
Activity/Source	Data Source	Methodology	Data Gaps/Assumptions
Residential Stationary Fuel	Energy Information Administration State Energy Summaries	Extracted state stationary fuel consumption data and downscaled using a ratio of county households : out-of-state households	Since utility data was unavailable, this alternative was considered most applicable.
Commercial Stationary Fuel	Energy Information Administration State Energy Summaries	Extracted state stationary fuel consumption data and downscaled using a ratio based on county commercial jobs : out-of-state commercial jobs	Since utility and state commercial square footage data was unavailable, this alternative was considered most applicable.
Industrial Stationary Fuel	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	Assumed the majority of industrial stationary fuel consumption is captured in EPA FLIGHT.
Fugitive Emissions from Natural Gas Distribution	Energy Information Administration State Energy Summaries & FLIGHT	Enter natural gas consumption (MMBtu) per county	Used defaults from ClearPath Fugitive Emissions From Natural Gas Distribution Calculator
Fugitive Emissions from Oil and Natural Gas Systems	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	Assumed any emissions from natural gas distribution is captured in "Fugitive Emissions from Natural Gas Distribution"
Industrial Process & Product Use	EPA FLIGHT	Extracted site-specific data per county and directly entered raw metric tons (per GHG)	GHGs are captured internally and entered as CO2 equivalent (CO2e)
Water Treatment Energy	n/a	n/a	Assumed to be captured in the commercial and/or industrial electricity and stationary fuel consumption estimates.
Wastewater Treatment	Maryland Department of Environment's State-wide 2020 GHG Inventory	Downscaled emissions data using population ratios and directly entered emissions	Due to the unavailability of site-specific wastewater treatment operations data, we assumed that wastewater is generated and treated in boundary location. Because MDE's 2020 GHGI provided total CH4 for wastewater treatment, we directly entered these emissions under septic activity.

			Source data is from 2020
Agriculture: Livestock and Crops	U.S. Department of Agriculture's (USDA) 2017 Census of Agriculture, County Data	Extracted livestock headcounts and crop counts and utilized the EPA's State Inventory Tool, Agriculture Module to estimate emissions	Due to the differing categorizations of the EPA's SIT Agriculture Modules and the USDA's 2017 Census of Agriculture county data, the following categories were grouped together/assumptions were made: Milks Cows = Dairy Cows; Cows and heifers that calved = Feedlot Heifers; Cattle/calves = Calves; Beef cows = Beef Cows; Other cattle = Heifer Stockers; Hogs are all assigned to the "Market 120-179 lbs" category, Layers = Layers; Pullets for laying flock replacement = Pullets/ Chickens; Broilers and other meat-type chickens = Broilers; All sheep = Sheep on Feed
Forestry and Land Use	Land Emissions And Removals Navigator (LEARN) Tool	Extracted county-level emissions and removals for forests, changes in forestry, urban trees, etc.	This data is recorded but emissions are not considered in the GHGI total per ICLEI's US Community Protocol (emissions and removals from forestry and land use should not count towards gross emissions) Used Baltimore, MD as the "representative urban area" for emissions factors
Stationary Fuel Emissions Factors	EPA's GHG Emission Factors Hub	n/a	n/a
Fugitive Emissions from Natural Gas Distribution	Environmental Defence Fund's (EDF) User Guide for Natural Gas Leakage Rate Modeling Tool	n/a	n/a
Wastewater Treatment Emissions Factors	IPCC Methods for Greenhouse Gas Inventories	n/a	n/a
Agriculture Emissions factors	EPA's State Inventory Tool Agriculture Module	n/a	n/a

Forestry and Land Use	U.S. Forest Service's Forest Inventory and Analysis (FIA) database	n/a	n/a
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Table 9: Projection Growth Rates				
Activity/Source	Type	Data Source	Methodology	Data Gaps/Assumptions
Maryland State Grid Projections to 2050	Electricity Carbon Intensity Rate	2021 baseline data from eGRID2021 and projection data from National Renewable Energy Laboratory's (NREL) Cambium Scenario Viewer	n/a	n/a
Population Growth	Growth Rate (for various activities)	Baltimore Metropolitan Council, Round 10 Cooperative Forecasts	n/a	n/a
Household Growth	Growth Rate (for residential activities)	Baltimore Metropolitan Council, Round 10 Cooperative Forecasts	n/a	n/a
Commercial Employment	Growth Rate (for commercial activities)	S&P Global	n/a	Used non-manufacturing counts for commercial projections
Industrial Employment	Growth Rate (for industrial activities)	S&P Global		Used manufacturing employment counts for industrial projections
CAFE Standards Default On Road Carbon Intensity Factors	On Road (passenger/light duty) Carbon Intensity Rate	Center for Climate and Energy Solutions (C2ES)	Miles per Gallon fleet averages were converted to Gallons per Mile. Values were then utilized to calculate a Compound Annual Growth Rate from 2010 to 2040. Values were carried forward to 2050.	Although CAFE standards apply to medium/heavy-duty trucks, the provided Carbon Intensity Factors are based on passenger cars and light-duty trucks because limited analysis of the fleetwide impact has been performed. The test procedure for CAFE standards is different from that used for MPG of vehicles in actual driving conditions.

No Growth	n/a	n/a	n/a	n/a
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TABLE 10: GHG Reduction Strategies			
Strategy	Data Used	Data Gaps/Assumptions	Data Source
VMT Reduction - 25% by 2030 - Gasoline	25% in 2050	State plan aims for a 20% reduction, the region increased this by 5%	Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
VMT Reduction - 25% by 2030 - Diesel	25% in 2050	State plan aims for a 20% reduction, the region increased this by 5%	Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
Advanced Clean Cars II	-Modeling of vehicle turnover -17% EV in 2030, 99% in 2050	6.2% of fleet turns over per year (16.2 years for full turnover)	DOE Alternative Fuels Data Center, Statista, California Air Resources Board
Advanced Clean Trucks	Heavy Duty Vehicles -27.5% EV in 2030, 99.6% in 2050	12.5% of fleet turns over per year (8 years for full turnover).	DOE Alternative Fuels Data Center, Statista, Rocky Mountain Institute (RMI)
Clean Power Standard	100% Renewable Energy by 2035		Maryland Department of Environment's Maryland's Climate Pollution Reduction Plan
Residential Energy Codes and Standards	-37% efficiency improvement for all new buildings -5% of homes and commercial space retrofit each year. -20% savings from retrofit	5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year. It can make sense to do an efficiency upgrade at the same time as equipment replacement - the efficiency may allow for a smaller, less expensive AC unit or furnace. -ACEE reported 10% typical energy savings for a 'light' retrofit and 29% for a 'medium' retrofit - so 20% falls in the middle between those.	Pacific Northwest National Laboratory (PNNL), U.S. Energy Information Administration

		<p>-Default Energy savings in new buildings was 37%, 37% improvement for new buildings comes from comparing estimated EUI (energy use intensity) for 2018 commercial model energy code with average EUI of existing commercial buildings from 2012 commercial buildings energy consumption survey.</p>	
<p>Commercial Energy Codes and Standards</p>	<p>-37% efficiency improvement for all new buildings -5% of homes and commercial space retrofit each year. -20% savings from retrofit</p>	<p>5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year. It can make sense to do an efficiency upgrade at the same time as equipment replacement - the efficiency may allow for a smaller, less expensive AC unit or furnace. -ACEEE reported 10% typical energy savings for a 'light' retrofit and 29% for a 'medium' retrofit - so 20% falls in the middle between those. -Default Energy savings in new buildings was 37%, 37% improvement for new buildings comes from comparing estimated EUI (energy use intensity) for 2018 commercial model energy code with average EUI of existing commercial buildings from 2012 commercial buildings energy consumption survey.</p>	<p>Pacific Northwest National Laboratory (PNNL), U.S. Energy Information Administration</p>

Residential Building Decarbonization	-5% of buildings electrified per year (100% by 2044) -Heat pump coefficient of performance 3.19 for Baltimore from RMI	-Default value of existing housing units with natural gas electrified per year is 5%, 5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year.	EnergyStar, Schroders (Peiser, R., & Wiegelmann, T.. "Real Estate and Sustainability: The Moral Imperative." Property Chronicle.) Rocky Mountain Institute
Commercial Building Energy Performance Standards	-5% of buildings electrified per year (100% by 2044) -Heat pump coefficient of performance 3.19 for Baltimore from RMI	5% of building stock per year: Typical heating/cooling equipment life is around 15-20 years, and 20 years translates to 1/20, or 5%, each year.	EnergyStar, Schroders (Peiser, R., & Wiegelmann, T.. "Real Estate and Sustainability: The Moral Imperative." Property Chronicle.) Rocky Mountain Institute
Waste Diversion	-Current waste diversion of 49.2% (in 2017). Diversion increases to 65% in 2030 and stays at 65% through 2050.	Since 50% waste goes to landfill/incinerator in the baseline, increasing to 65% total diversion will reduce the waste tonnage to landfill/incinerator by 30%.	Maryland Department of Environment

TABLE 11: Authority to Implement			
Category	Measure	Additional Authority to Implement Required?	Timeline to Acquire Additional Authority
Transportation	VMT Reduction - 25% by 2050	Yes, local governments have the authority to advance the implementation of Maryland's Transportation Plan that aims to reach a 20% reduction.	Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Transportation	Advanced Clean Cars II	Yes, local governments have the authority to implement actions related to supporting the adoption of electric vehicles. State government has the ultimate authority to implement this action. The Advanced Clean Cars II law in Maryland requires manufacturers to continuously increase the share of vehicles they sell that are electric - reaching 100% of passenger car and light truck sales in model year 2035.	N/A Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Transportation	Advanced Clean Trucks	Yes, local governments have the authority to implement actions related to supporting the adoption of electric and/or zero emission trucks for municipal operations. State government has the ultimate authority to implement this action.	N/A Any aspects local government cannot currently implement, we will collaborate with the State of Maryland to achieve those goals.
Grid Electricity	Clean Power Standard - 100% Renewable Energy by 2035	Limited, the authority to implement this goal sits with local public utilities and regulatory authorities across the state such as the public service commission. Local governments can only control renewable electricity use for government operations.	Authority will be coordinated with the necessary state partners.
Grid Electricity	Energy Codes and Standards	Yes, local governments have the ability to implement local energy and building codes.	N/A
Grid Electricity	Building Energy Performance Standards	Yes, local governments will work closely with the State's Department of Environment to support the implementation of the CSNA.	N/A
Solid Waste	Food Residuals Diversion Law	Yes, local governments will work closely with the State's Department of Environment to support the implementation of HB264. MDE has regulatory authority through this law.	N/A

APPENDIX C: Jurisdiction-Level Climate Plans & Actions

ATTACHMENT A: Baltimore City Climate Actions from 1) The 2019 Baltimore Sustainability Plan, 2) 2023 Disaster Preparedness and Planning Project, 3) 2023 Solid Waste Management Plan and 4) the 2024 Climate Action Plan. The Full 2024 CAP is included as an attachment to this PCAP and all actions are supported under measures 1-7.

Plan	Action	Type	Status
Sustainability	Build capacity and create opportunities for conversations around racial equity to breakdown biases and increase understanding, assisted by experts in cultural competency, diversity, and equity.	Engagement	Ongoing
Sustainability	Engage, promote, and support voices who may not traditionally be heard: youth, seniors, non-English speakers, and returning citizens, among others.	Engagement	Ongoing
Sustainability	Develop avenues for incorporating resident knowledge and voices into decision-making processes with government, nonprofits, businesses, and more. Shared language and visions for change increase participation and build connections.	Engagement	Ongoing
Sustainability	Promote resident and neighborhood successes using media to regularly share stories in and between neighborhoods. Highlight and promote the work of residents engaged in positively shaping the lives of neighbors, with a focus on elevating those voices that have been historically underserved. Continue the “Every Story Counts” campaign.	Engagement	Ongoing
Sustainability	Support resident dialogue and social capital building in neighborhoods by using outreach such as social media campaigns and other community based, phone-friendly tools to share knowledge and information. Distribute electronic and paper program guides widely, and translate program marketing materials for non-English speakers. Include free wi-fi where possible.	Engagement	Ongoing
Sustainability	Expand and elevate the network of low- and no-cost programming in neighborhoods, including supporting resident-led skill-sharing, adult education, and youth programming.	Programming	
Sustainability	Establish measures for city government’s equitable community engagement with residents.	Operations	
Sustainability	Create educational campaigns for local elections to increase voter participation, particularly in neighborhoods with traditionally low turnout.	Promotions/Outreach	Ongoing
Sustainability	Use community-driven processes and develop tools to envision, create, and activate safe, accessible community gathering spaces to connect residents with one another and with neighborhood groups; ensure the preferences of families, older adults, youth, and differently-abled adults are addressed.	Planning	Ongoing
Sustainability	Support resident-generated ideas for neighborhood events, including active and passive recreation, movie nights, community cleanups, cookouts, and more.	Programming	Ongoing
Sustainability	Create an annual permit-free day for neighbors to connect by hosting cookouts and events in public spaces. Seek sponsorships to support these community-led events.	Programming	Ongoing
Sustainability	Engage youth and designate spaces for youth to gather based on their interests during out-of-school time, including before and after school as well as scheduled breaks (such as school-based recreation programming during non-school hours)	Programming	Ongoing
Sustainability	Engage school leadership in sustainability and environmental justice education and practices, and provide teachers with resources and professional development.	Education	

Sustainability	Expand and provide professional development in environmental literacy including environmental justice to increase the number of teachers who integrate it into the curriculum. Additionally, connect teachers to partners for on- and off-site support, as well as to each other for peer mentoring and networking.	Education	
Sustainability	Incorporate meaningful outdoor learning experiences into science classes at every grade level by developing and instituting aligned curricula. In addition, outdoor learning at every school should go beyond science to include other disciplines such as language and art.	Project	
Sustainability	Foster sustainability-minded school leaders, because these are the common denominator amongst schools that successfully prioritize environmental literacy. Invested school leaders can motivate and support teachers who pursue sustainability education and practices. To this end, increase awareness of the benefits of environmental literacy among school leaders, as well as teachers, staff, and parents. Cocreate and share sustainability goals, practices, and opportunities, and integrate sustainability concepts into on-boarding for staff. Additionally, seek and support funding for these initiatives, including financial incentives for teachers who go above and beyond in this field.	Engagement	Ongoing
Sustainability	Support student-led environmental projects by providing grants, training opportunities, mentoring, and other resources, targeting schools and communities with less resources and greater need. Further support youth in developing advocacy, leadership, and entrepreneurship skills; connect youth to decision makers by offering programmatic opportunities to interact with elected officials and senior city staff; and involve youth in oversight and implementation of the City Schools Sustainability Policy and Plan.	Programming	
Sustainability	Pursue youth-based economic sustainability programs by promoting opportunities for paid internships, service learning, summer jobs, industry certifications, and fellowships—encouraging high school students to gain work experience. These opportunities should include student learning opportunities in building design, construction, and operations. Expand technical skills programs related to green industries, and teach financial literacy.	Programming	
Sustainability	Make environmental literacy meaningful for families and communities, as their engagement is a critical link for student success. Strengthen school climate and structures to support family and community engagement on environmental issues, including by involving families and communities in school decisionmaking, as well as by developing opportunities for parent learning and involvement in sustainability issues.	Programming	Ongoing
Sustainability	Expand and sustain meaningful partnerships to provide culturally responsive resources, services, afterschool programs, field trips, and advocacy for families, students, teachers, and schools.	Engagement	Ongoing

Sustainability	Increase the number of Baltimore City Public Schools that are green certified by promoting certification; recognized programs include the Maryland Association of Environmental and Outdoor Education's Maryland Green Schools Program, the National Wildlife Federation's Eco-Schools Program, and the U.S. Department of Education's Green Ribbon Schools Program. Support staff that are working towards certification by providing more funding for hands-on environmental projects, and make coverage available for regular duties when staff are working on completing the certification application	
Sustainability	Improve indoor air quality in all schools by eliminating pesticide usage, increasing use of approved green cleaning products.	Policy
Sustainability	Provide clean, local potable water via water fountains in all schools.	Project
Sustainability	Ensure acceptable temperatures, light, and acoustics in all schools.	Policy
Sustainability	Fund a Community School Coordinator in every school and maintain an active School Wellness Team to improve school climate and address family and community needs. Involve families and community members in school decisions, and develop opportunities for parent learning.	Engagement
Sustainability	Maintain clean and attractive buildings and grounds, including adding more student-designed art and murals, landscaping with native plants, and increasing social and emotional development activities.	Maintenance
Sustainability	Increase student consumption of nutritious food by prioritizing fresh and regionally-sourced products in cafeterias, implementing Farms to Schools strategies that support the local agricultural economy, and support schoolyard gardens and relationships between schools and farms.	Procurement
Sustainability	Adapt school grounds into inviting outdoor areas by increasing age-appropriate nature-based play spaces and schoolyard gardens, training teachers to integrate outdoor spaces into student learning and engagement, and hosting trainings on the care of spaces.	Project
Sustainability	Make schoolyards and indoor and outdoor spaces available for public use during non-school hours.	Policy
Sustainability	Promote physical activities, both indoors and outdoors, and promote visits to local parks, trails, farms, and gardens. Support students in walking or biking to school, implementing programs like the "walking school bus" and holding events like "Bike to School Day."	Promotion/Outreach
Sustainability	Reduce waste and increase recycling through rightsize food ordering, maximizing food recovery, and composting food waste and compostable trays. Recycle at all schools, and increase electronics, light bulb, and construction waste recycling. Minimize paper waste by replacing print and mail notifications with electronic communication systems (like email or text message).	Operations
Sustainability	Green the school system's fleet of vehicles. Ensure all vehicles meet emission and fuel efficiency standards, minimize vehicle and bus idling, and explore alternative fuel sources with the goal of moving toward zero emissions.	Operations

Sustainability	Follow green design and construction practices in large renovations and new construction—as required by the City’s International Green Construction Code. In facility upgrades, include life-cycle cost analysis, such as energy efficiency and sustainability practices. Promote net-zero energy buildings.	Operations
Sustainability	Provide free recycling bins to all Baltimore residents; increase commercial recycling; conduct continuous, deep engagement on what can be recycled.	Promotion/Outreach
Sustainability	Launch an anti-litter, pro-recycling campaign. Use positive, actionable messages, ensuring racially and ethnically diverse materials are provided, along with additional support and infrastructure to communities most impacted by trash and litter.	Promotion/Outreach
Sustainability	Create and implement a plan to achieve zero waste, meaning we “are working toward or diverting over 90 percent of our discards from landfilling or incineration.” Ensure extensive outreach and a plan that addresses the needs of the entire population.	Planning
Sustainability	Implement the City’s Food Waste and Recovery Strategy to build community, create jobs, and increase the resilience of our city	Operations
Sustainability	Site a local composting facility to build the city’s capacity to accept food and yard waste while creating local jobs; work with communities to ensure placement does not exacerbate conditions in underinvested neighborhoods.	Project
Sustainability	Investigate revising codes and/or creating ordinances to eliminate waste and maximize reuse of deconstructed building materials, etc. Establish reuse businesses along with marketplaces for selling products, located strategically to ensure access for the entire population. Require these businesses to employ local unemployed or underemployed residents.	Policy
Sustainability	Create a revolving loan fund for investment in recycling and composting infrastructure and loans for companies that address infrastructure.	Funding
Sustainability	Enact legislation to impose a fee for plastic bags, and support state legislation instituting beverage container deposits.	Legislation
Sustainability	Create a City government procurement committee that incentivizes source reduction, efficiencies, the purchase of goods that have longer life spans, and purchases from local businesses.	Procurement
Sustainability	Develop a plan for a “Save As You Throw” program to reduce waste that is landfilled or burned; incentivize reductions in the amount of household garbage placed on the curb using coupons or vouchers (recycling would remain free of charge). Ensure early and ongoing input from communities, communicate about the program with racially and ethnically diverse materials, and include provisions for neighborhoods with high litter and trash rates.	Incentives
Sustainability	In partnership with urban agriculture practitioners, develop site criteria for identifying City-owned land that may be suitable for farming. Encourage private and institutional landholders to similarly establish agricultural space (both indoor and outdoor).	Study/Data

Sustainability	Protect and support existing farms, ensuring that City-owned land and vacant lots currently being used for urban agriculture are protected in the long-term. Amend local and state policies and requirements to make existing programs and incentives more appropriate to urban agriculture operations.	Policy
Sustainability	Create better defined and supported pathways to ownership, and offer incremental opportunities to guarantee long-term land tenure and/or ownership of agricultural spaces, such as “lease to purchase” and other models. Also support the expansion of community-based land trusts intended to give lowincome neighborhoods control of their own food production.	Policy
Sustainability	Connect growers (both new and experienced) to educational resources and training, such as Good Agricultural Practices certification, pollinator-friendly defined integrated pest management, and organic farming. This can be achieved by supporting and developing partnerships. Also, incorporate educational opportunities into land-leasing programs, and support a new farm “incubator.”	Convene/Facilitate
Sustainability	Support existing social networks and non-profits of growers, and integrate partners into city-level decision-making processes. Create a centralized, searchable, public database of urban agricultural sites and projects, so that growers can connect to one another and share skills, expertise, and equipment. The database would also allow the city to collect data on food and farm production, to better understand the impacts of urban agriculture.	Study/Data
Sustainability	Improve strategies for engaging communities in urban agriculture projects. Develop a public awareness campaign to inform residents about existing urban agriculture and encourage residents to purchase and eat local farm products. Create guides or otherwise assist residents in understanding, participating in, and accessing opportunities and programs. Ensure opportunities and supports are delivered in a culturally competent manner and made available specifically to residents that may face high barriers to participate in.	Engagement
Sustainability	Create and expand City programs, and connect more growers to public, private, and philanthropic programs and incentives, to increase and improve their production and economic viability. Resources could include water, equipment, hoop houses, compost, and transportation, as well as infrastructure for production in non-soil environments, such as hydroponics.	Program
Sustainability	Support aggregation among small farms. Build stronger urban-rural linkages to develop agricultural aggregation opportunities for diverse growers and markets. Aggregation helps small farms combine their products to serve the needs of larger buyers and institutional markets such as schools, hospitals, and universities.	Program

Sustainability	Increase demand for locally grown products. Foster demand and facilitate the sale of urban-produced food and products at a variety of markets, such as farmers markets, farm stands, CSAs, public markets, and corner stores. Especially focus on markets that may provide additional social, cultural, or economic benefits, and especially in neighborhoods where food access and other equity indicators are low.	Promotion/Outreach	
Sustainability	Continue the City's Neighborhood Planning Academy to equip residents with the tools to shape the future of their neighborhoods. Establish transparent communication, and continue to build trust between the City and residents, by sharing an understanding of local urban planning and design and community engagement processes; deepen outreach to areas of the city most impacted by distress, vacancy and elevated crime rates; use community-generated ideas to build additional capacity-building initiatives for residents.	Engagement	Ongoing
Sustainability	Support residents in developing neighborhood plans, baselines, and/or maps that include key assets and issues, along with strategies to create or enhance community venues. Ensure targeted outreach to, engagement with, and collaboration with underrepresented communities. Neighborhood plans can be used to raise awareness, lift community priorities, and raise funds.	Planning	
Sustainability	Continue to increase resident-led and city-supported improvements with a focus in under-served neighborhoods; these include repairing more street lights, sidewalks, and roads; planting more trees; and increasing enforcement of speeding and other traffic violations.	Project	
Sustainability	Seek to increase the volume of investment in small businesses in neighborhoods to keep dollars in the community, and to provide needed resources and job opportunities for residents.		
Sustainability	Annually evaluate city government capital funding through an equity lens.	Study/Data	Ongoing
Sustainability	Review historic preservation and other renovation tax credit programs and provide recommendations to make these programs more effective in incentivizing building rehabilitation and neighborhood revitalization. Support the tax credit study effort of the Commission for Historical and Architectural Preservation (CHAP).	Incentives	
Sustainability	Increase funding for affordable housing. Use the Affordable Housing Trust Fund, Neighborhood Impact Investment Fund grants and others to fill in gaps in distressed markets; increase high quality renovations, infill construction, mixed-use development, and affordable housing and services; couple these funds with supports to remove as many barriers as possible from the development process.	Funding	
Sustainability	Continue to provide operating support for capacity building programs such as the city-funded Community Catalyst Grant to help community-based organizations involved in community development.	Program	Ongoing

Sustainability	Improve the investment landscape in under-invested communities. Connect investors to communities to ensure investment is compatible with residents' vision. Encourage banks doing business in Baltimore to meet the investment needs of residents. Equip residents with information about local lending, investment and services, and support them in gaining an understanding how to advocate for change.	Connect/Facilitate
Sustainability	Require new developments to be accessible by all—meaning they include elements that support pedestrian activity, transit use, and public space.	Policy
Sustainability	Increase Code Enforcement to ensure that vacant buildings and blighted, occupied homes do not remain in neighborhoods for long periods.	Policy
Sustainability	Ensure commercial outlets, such as corner stores and bars, are not nuisances and are supported by the community.	Policy
Sustainability	Implement the Complete Streets ordinance, which prioritizes the safety of all people using the street over the speed of moving cars. Complete Streets often have slower speed limits, wide and maintained sidewalks and crosswalks, pedestrian-focused lighting, protected bike lanes, bus lanes and bus shelters, and beautification such as trees and plantings. Prioritize these in high-crash areas.	Project
Sustainability	Use City resources to leverage funds to preserve housing and create affordable housing. Support, encourage, and fund development of programs that preserve existing housing; encourage redevelopment of existing structures. Spur production of new, affordable units, including by supporting both non- and for-profit development entities such as the Baltimore City Affordable Housing Trust Fund. Seek increased Community Reinvestment Act commitments from financial institutions operating in the city	Connect/Facilitate
Sustainability	Explore tools to ensure significant new development projects support existing residents and minimize resident displacement. The highest goal is for developments to include units that are permanently affordable and available to residents with very low, low, and moderate incomes.	Study/Data
Sustainability	Continue to strategically demolish vacant structures, working closely with guidance from neighborhood residents directly impacted by vacant and nuisance properties and in consideration of future use of the site for redevelopment or maintained open space. Importantly, to every extent possible, deconstruct vacant structures.	Project
Sustainability	Facilitate the transfer of vacant, abandoned properties to owners who have capacity to rehabilitate them. Increase City receivership, an innovative legal approach to reducing nuisance properties that are privately owned but neglected. Explore means to coordinate receivership with affordable housing developers, including community land trusts and other nonprofit models. Explore development of a "land bank," which would bundle properties, particularly whole blighted blocks, for redevelopment.	

Sustainability	Increase awareness of financial assistance and incentives to help low-income homeowners maintain their homes and keep them healthy through programs that support weatherization, rehabilitation, ADA compliant updates and system upgrades; address health and safety issues; reduce energy and water utility costs; and offer discounts on property taxes. Increase awareness of the Homeowners Tax Credit for older adults. Increase promotion of tax credits and energy assistance to renters. Encourage households to take advantage of opportunities for solar tax credits and community solar to increase clean energy generation.	Promotion/Outreach
Sustainability	Increase financial resources (and increase awareness of them) to assist low-income and older adults with ADA compliant updates for people of all ages and abilities.	Incentives
Sustainability	Increase financial resources (and increase awareness of them) to assist low-income households to become homeowners or to keep their homes through financial and homeowner counseling, coaching, credit enhancement, and down payment and closing cost assistance, as well as estate planning.	Incentives
Sustainability	Expand outreach about energy and water rebates to residential, commercial, municipal, and industrial occupants and owners, including information about available incentives as well as behavioral change techniques.	Promotion/Outreach
Sustainability	Develop a financing toolkit to assist building owners to understand available energy and water efficiency financing options.	Education
Sustainability	Promote Property Assessed Clean Energy (P.A.C.E.) financing to large-building owners to promote energy and water upgrades and renewable energy installations.	Promotion/Outreach
Sustainability	Expand outreach to private landlords of low-income and affordable housing units to familiarize them with the benefits of conducting energy and water efficiency upgrades to reduce maintenance costs, and encourage landlords to lower tenants' utility burden.	Education
Sustainability	Develop programs to retrofit affordable housing units into energy- and water-efficient units. Emphasize conservation-first, high-performance, building-enclosure-focused strategies to improve the most durable and fundamental aspects of our built environment. Research wall systems used in affordable, high-performance housing, for both new and retrofit applications that meet these objectives.	Program
Sustainability	Analyze long-term return on investment opportunities for deep energy and water retrofits in the low-income housing market; develop a financial decision tool to help affordable housing providers assess incremental costs, benefits, and greenhouse gas emission savings for implementing energy measures.	Study/Data
Sustainability	Increase workforce programs in energy efficiency, renewable energy and health upgrades, emphasizing local hiring. Promote apprenticeships for local workers.	Program
Sustainability	Create residential disclosure for energy and water use at time of sale or lease agreement requiring owners to disclose energy and water consumption levels to potential renters or buyers using a displacement risk analysis. Take into account how market information, such as energy disclosure, can influence rents in a tight rental market.	Policy

Sustainability	Develop and pass benchmarking legislation to promote commercial, municipal, and institutional energy and water efficiency and renewable energy, and a disclosure ordinance for yearly energy and water use.	Legislation
Sustainability	Evaluate existing utility and city-wide energy- and water-savers programs to further advance incentives and efficiency. Explore graduated pricing structures for energy and water resources depending on time of use, peak demands, and income level.	Study/Data
Sustainability	Review the City's existing green building code and amend to fully support occupant health and comfort in addition to water and energy efficiency	Policy
Sustainability	Work with architects and designers to create systematic approaches to sustainable building designs that integrate and restore the natural environment; use concepts of buildings that are living, restorative and adaptive	Education
Sustainability	Support the development of holistic, neighborhoodwide, deep energy retrofit projects that reduce energy and water use and improve comfort and economic resiliency. Emphasize the use of low toxicity and lowtech, high craftsmanship methods to build community knowledge base, yielding more local economic development	
Sustainability	Explore requiring development plans to include operational efficiency cost-benefit analyses and return on investment calculations for the whole project, including common spaces and residential aspects	Study/Data
Sustainability	Integrate energy- and water-savings strategies and promote gray-water harvesting and stormwater capture to serve efficiency and non-potable water needs. Storm-water reservoirs could be used to integrate site design features (irrigation of urban green infrastructure and agriculture) and serve as thermal mass for district heating and cooling.	Policy
Sustainability	Advance the Central Maryland Regional Transit Plan by working with regional partners including transit riders, city and state agencies, and nonprofits, elected officials, business leaders, and anchor institutions to consider alternative and creative models for systems.	Engagement
Sustainability	Support a dedicated funding source for public transportation and safety improvements in the region, including investing in alternative vehicles (such as autonomous vehicles for use as public transit) and investigate the use of vehicle-related revenue to promote pedestrian-first policies.	Funding
Sustainability	Increase equitable investment in road resurfacing, maintenance, and reporting, ensuring resources are distributed first to historically under-served neighborhoods.	Funding
Sustainability	Standardize ongoing coordination between city and state agencies and the public. Formulate and jointly publish goals and performance metrics in an accessible annual report.	Study/Data
Sustainability	Implement Baltimore's Complete Streets ordinance that creates a process for evaluating how streets and corridors serve pedestrians, transit, bicycling, freight, and single-occupancy vehicles, and enhance the use of data to guide equitable mobility and infrastructure investments. Ensure early and extensive resident input, and ensure equity considerations are built into the Complete Streets hierarchy.	Study/Data

Sustainability	Create and implement a Pedestrian Master Plan that includes a sidewalk and a lighting inventory to identify areas of high density with poor connectivity and walkability, with the long-term goal of providing continuous and widened sidewalks, shorter crossings, improved streetscapes, and traffic calming.	Study/Data
Sustainability	Fully implement the Bicycle Master Plan to improve safety and accessibility for cyclists, ensuring equitable distribution of bike infrastructure.	Project
Sustainability	Alter traffic signal timing citywide, shortening cycle lengths in order to lower traffic speeds and shorten wait-times for pedestrians and cyclists	Infrastructure
Sustainability	Seek opportunities to implement more pedestrian-only spaces, such as public plazas, to provide a safe haven for pedestrians while also creating places for people to gather and improve health and well-being; start with pop-up events.	Infrastructure
Sustainability	Develop and maintain transit hubs between public transit routes as well as connections to bike sharing, car sharing, electric vehicle chargers, and/or ride hailing near employment centers and in areas where car ownership is low. Improve pedestrian and bicycle connections between and to transit stops and hubs; maximize safety and include better lighting, signage for wayfinding, disaster protocol, solar power, and trees.	Infrastructure
Sustainability	Create more efficient public transit options; reinstate the plan to implement Baltimore's east-west light rail corridor and expand and enforce dedicated bus lanes and other mechanisms giving buses priority in transit areas with high ridership and congestion; build a system that improves economic opportunity for everyone and provides the mobility that young workers depend upon.	Infrastructure
Sustainability	Eliminate parking subsidies and mandates, and offer employee incentives to encourage commuting by modes other than single-occupancy vehicles.	Incentives
Sustainability	Encourage green commutes to work and school by coordinating with on-demand ride hailing services to provide affordable connections to destinations beyond the range of the transit system.	Program
Sustainability	Create new regulations to bring the noise ordinance in line with best practices. This process must be done with early and extensive input from the people impacted. Examples of best practices include working with industrial businesses to minimize noise and developing regulations for noise produced by generators or HVAC systems.	Policy
Sustainability	Strengthen enforcement of commercial and industrial noise standards.	Policy
Sustainability	Engage a group (or groups) of residents representing city demographics to discuss noise and seek ways to address it.	Connect/Facilitate
Sustainability	Inventory noise pollution throughout the city, seeing how it varies from neighborhood to neighborhood, and target improvement efforts for greater equity.	Study/Data
Sustainability	Initiate outreach activities to increase community awareness of noise standards, impacts of noise, and ways to reduce noise. Focus these in neighborhoods with recurring noise issues and complaints.	Education

Sustainability	Direct tree planting and other efforts to muffle noise in neighborhoods with less tree canopy and in communities which are at higher risk of adverse outcomes from noise pollution.	Project	
Sustainability	Enhance City floodplain regulations and building codes to increase standards for buildings and safeguard against flood events projected to be higher than historic levels.	Policy	
Sustainability	Update Capital Improvement Process, integrating proactive initiatives based on climate data and social vulnerability, into the process (as well as into other City and community plans)	Policy	
Sustainability	Streamline the permitting process for buildings designed to higher standards for flood, sea level rise, and/or wind hazards; provide financial assistance to disadvantaged residents for home retrofits to meet these standards	Operations	
Sustainability	Upgrade infrastructure to minimize threat to our most vulnerable communities. Identify utility, facility, and infrastructure components for priority upgrades through a community-driven process to reduce vulnerability to flooding, sea level rise, and wind damage.	Plan	
Sustainability	Develop a post-disaster plan to guide long-term recovery efforts following a disaster and to ensure those with the least resources are prioritized.	Plan	
Sustainability	Apply an equity lens to all-hazards mitigation and climate adaptation planning and implementation. Include a new assessment of the risk of man-made hazards, including that of hazardous material releases on roads and railways.	Plan	
Sustainability	Finalize flood alert system upgrade, ensuring that warnings are translated or interpreted and reach the most vulnerable communities in a timely manner.	Operations	
Sustainability	Continue to host workshops on “community preparedness,” inviting residents to collaborate and organize preparation strategies for natural hazards. To foster inclusive and accessible engagement, host workshops at locations where people gather, such as stores, day-care centers, or pop-ups; also translate materials into safe harbor languages.	Engagement	
Sustainability	Continue to support the growth of “community resiliency hubs” in disinvested, high-impact areas to provide protection and resources for residents during excessive heat, hurricanes, other extreme weather events, and local emergencies.	Program	In progress
Sustainability	Develop “community resiliency plans” in areas where risks and economic and health vulnerabilities are highest	Plan	
Sustainability	Increase the number of residents receiving community preparedness training in low-resourced neighborhoods.	Education	
Sustainability	Expand energy efficiency, conservation and renewable energy education programming to reach homeowners and renters with a specific focus on low-income populations; expand energy education programs in schools, businesses, local organizations, colleges and government.	Education	

Sustainability	Seek increased financing for energy programs including home efficiency and improvement programs, energy assistance, and weatherization, solar, battery storage, microgrids, and alternative vehicles; explore ways for low-income residents, community groups and others to become investors and participate in revenues generated by community solar projects.	Program	
Sustainability	Expand solar job training programs and job placement opportunities to train and employ the unemployed and underemployed; require that city government renewable energy projects either use trainees in these programs or hire program graduates.	Program	
Sustainability	Increase the supply of clean, renewable electricity and battery storage, including community solar and rooftop solar opportunities for low-income homeowners and renters, and tie to building improvements	Planning	
Sustainability	Advocate for a higher State of Maryland renewable portfolio standard (RPS) as well as affordable pathways to electrification.	Advocate	
Sustainability	Increase electric vehicle adoption through awareness campaigns to promote the climate and air quality benefits of electric vehicle ownership and publicize the locations of publicly-accessible charging stations.	Promotion/Outreach	
Sustainability	Adopt a goal for electric vehicle charging stations; provide neighborhood and business district charging stations and implement electric vehicle, car-sharing pilots in low-income neighborhoods and neighborhoods most burdened by air pollution.	Project	
Sustainability	Review current building codes and regulations, and adopt a residential green building code to increase energy efficiency in residential buildings.	Policy	
Sustainability	Complete the conversion of streetlights to LEDs and pilot streetlights with solar panels, temperature monitoring and sensors that can spot parking spaces and track air pollution. Ensure equitable geographic distribution.	Project	
Sustainability	Increase installation of cool roofs and green roofs and plant more shade trees in neighborhoods where concrete and other hard surfaces trap and collect heat, creating "urban heat islands".	Project	
Sustainability	Promote and expand installation of energy-efficient combined heat and power and district energy systems which capture and reuse waste heat.		
Sustainability	Set a goal to reduce petroleum consumption and increase use of alternative fuel vehicles and equipment in the city government fleet.	Policy	
Sustainability	Update the Climate Action Plan by 2020, using an equity lens.	Plan	In progress
Sustainability	Establish a Climate Change Advisory Committee, engaging diverse community stakeholders in identifying and implementing strategies to prevent and reduce greenhouse gas emissions, to achieve a "drawdown" of carbon dioxide, and to equitably adapt to the impacts of climate change.	Convene/Facilitate	
Sustainability	Set an ambitious reduction target specifically for government operations and adopt policies and standards to achieve these reductions through less fuel use, greater energy efficiency and conservation, and the use of renewable energy.	Policy	Complete

Sustainability	Require a life-cycle evaluation of energy savings and emission reduction options during the City's capital improvement request process.	Policy	
Sustainability	Update codes, requiring new development projects to consider impacts from future climate events (such as heat waves and flooding) and to be designed for resiliency against these events, including through greater energy efficiency and use of renewable energy.	Policy	
Sustainability	Work with community members and organizations to develop strategies to mitigate harm to, and to also increase the benefits accrued by the communities from climate actions.	Convene/Facilitate	
Sustainability	Develop outreach campaigns focused on actions to reduce emissions, such as switching to LED lights (which are 88 percent more efficient than incandescent bulbs). Work in partnership with community members, businesses, and institutions. Identify and promote actions already being done by communities to conserve energy.	Promotions/Outreach	
Sustainability	Commit to being a "Carbon Neutral City," meaning we would have a net zero impact on greenhouse gas emissions.	Policy	Complete
Sustainability	Reduce short-term pollutants, developing an action plan to reduce emissions of short-lived climate pollutants (such as the harmful chemicals found in some refrigerators and air conditioning units), which cause significantly greater warming than carbon dioxide and other greenhouse gases.	Plan	
Sustainability	Encourage state-of-the-art pollution controls on all "point source pollution" emitters and improve review of the effect of new permit applications for air pollution sources, particularly those in and near zip codes with high asthma hospitalization rates.	Operations/Management	
Sustainability	Work with federal, state, and regional agencies to reduce toxic air emissions from transportation, especially reducing pollution from freight vehicles.	Policy	
Sustainability	Work with the Port of Baltimore and Maryland Department of the Environment to further reduce diesel emissions through retrofitting and replacing short distance trucks and cargo handling equipment, and through further electrification of operations.	Project	
Sustainability	Enact and enforce strong anti-idling regulations for commercial cars, buses, and trucks.	Policy	
Sustainability	Partner with researchers to install air quality monitors equitably throughout the city to determine and map how air quality varies in different areas and at different times of year.	Study/Date/Metrics	
Sustainability	Integrate information about unhealthy air quality days into community preparedness workshops.	Promotions/Outreach	
Sustainability	Adopt a policy or plan for eliminating use of pesticides and other toxic chemicals on public properties. Encourage integrated pest management and organic land care at hospitals, older adult facilities, restaurants and hotels, daycares, and other hospitality facilities.	Plan	
Sustainability	Develop an alert system for Code Red days to encourage residents to avoid using paints, aerosols, gas lawn mowers, or other things which contribute to poor air quality. Ensure alerts are translated into the City's safe harbor languages.	Promotions/Outreach	

Sustainability	Implement an Indoor Air Quality management program for the school system to centrally monitor issues, log complaints, and address problems. Ensure that the safest products are purchased when procuring paints, building materials, carpets, and cleaning supplies.	Operations/Management
Sustainability	Increase inspections, enforcement, and hazard remediation in rental properties related to mold, pests, furnace maintenance and venting, and other hazards, without passing on costs to vulnerable tenants.	Operations/Management
Sustainability	Integrate food system priorities across government so that City agencies work to support implementation of the Healthy Food Environment Strategy 3 and the Milan Urban Food Policy Pact, 4 which address retail, nutrition assistance, and urban agriculture to increase access to healthy, affordable, and culturally-appropriate food through policy, technical assistance, and incentives.	Policy
Sustainability	Implement equitable food policies by conducting robust research and strategic planning to inform policy that enhances the food environment in intentional and equitable ways. Implement tools that evaluate policies for race and equity metrics. This includes mapping the food environment, engaging residents, giving residents decision-making power in policy, and sharing bestpractices nationally	Plan
Sustainability	Engage residents in policy creation and support community-led processes that seek to build greater food sovereignty 5 along with participation in and control of the local food system.	Engagement
Sustainability	Reduce acute food insecurity by protecting federal nutrition assistance programs (SNAP and WIC), federal meal programs (such as school breakfast, school lunch, summer meals, and senior Eating Together), and programs like food pantries. Ensure these are effectively implemented and utilized so that no residents experience hunger	Program
Sustainability	Increase overall resilience so that the need for food assistance in emergency situations decreases. Promote all residents' familiarity with nutrition, as well as with growing, storing, preparing, consuming, and properly disposing of food. Incorporate food into the Disaster Preparedness Plan update, and seek to make households, neighborhoods, and our entire city more resilient—able to withstand disruptions to the food system.	Plan
Sustainability	Support equitable food systems by acknowledging and working to address the power imbalances that exist with respect to land, control of resources, and decisionmaking power. Develop better metrics to measure progress.	Study/Date/Metrics
Sustainability	Leverage the purchasing power of the City and other institutions by adopting "Good Food Procurement" standards that prioritize nutritious, local, and values based food.	Procurement
Sustainability	Support and cultivate local, food-based businesses to stimulate the local economy and provide much-needed work opportunities (especially for those with less access to employment). Include models that have multiple sustainability benefits, such as cooperatively-owned or not-for-profit stores, as well as projects that incubate small businesses and/or provide job training.	Program
Sustainability	Increase food recovery as a means to build community empowerment, resilience, and workforce skills, while decreasing food waste and food insecurity.	Operations/Management

Sustainability	Provide opportunities for residents to define and shape concepts of nature and incorporate them into plans and programs.	Engagement	Ongoing
Sustainability	Reconnect youth and families to the concepts and places of nature by co-creating programs to expose people to gardens, farms, green school yards, parks, and forests. These programs will have the added benefit of providing places of calm and relaxation. For example, increase youth-centered nature programming at Carrie Murray Nature Center.	Program	
Sustainability	Connect with residents on ways to take action to support a diversity of species while healing ourselves and the nature around us. Examples include installing bat houses, removing grass and planting native gardens in yards, eliminating herbicide and pesticide use, preventing window strikes by birds, and safely disposing of home garden products containing neonicotinoids (a class of insecticide which is highly toxic to bees, and which is now illegal).	Engagement	
Sustainability	Develop high quality nature immersion programs for young children as a coping tool for trauma and stress.	Program	
Sustainability	Expand the Docs in the Parks program by increasing the number of participating local medical professionals and developing a park locator map to show what features and amenities are accessible to patients.	Program	
Sustainability	Expand nature programming and support organizations that provide experiences to promote biodiversity, such as increased programming at the Carrie Murray Nature Center and the annual Bioblitz.	Program	
Sustainability	Expand habitat for pollinators and other wildlife such as aquatic wildlife, soil invertebrates and more, by creating, restoring, and maintaining natural areas, recognizing that one third of our food supply relies on pollinators. For example, create meadows with large plantings that support pollinators and explore creating a policy to permit intentionally growing grass.	Project	
Sustainability	Acquire and maintain permanent green spaces. Use the Develop policies to eliminate pollinator-harming insecticides (especially the class of “neonicotinoids”) from City property maintenance procedures. Likewise, avoid mosquito spraying in favor of non-toxic practices	Policy	
Sustainability	Link natural systems within the city and to the regional network in order to improve the overall capacity of these systems to support flood control, air filtration, and other services.	Project	
Sustainability	Complete Forest Management Plans for the largest forested parks, with an emphasis on choosing a diversity of trees, plants, and shrubs that feed pollinators and wildlife through the seasons. Also identify additional natural systems areas for future management plans. Ensure early and frequent engagement from local communities.	Plan	

Sustainability	Implement invasive species management for both plants and animals in and outside of parks. Consider adopting an ordinance requiring control of listed priority invasive species, and/or enact a preferred plant ordinance for public and private landscaping. Species of concern include English ivy and white tailed deer.	Operations/Management
Sustainability	Develop and implement organic land care policies and/or plans, requiring the use of safer, non-chemical alternatives to chemical fertilizers, pesticides, and herbicides, and increasing use of organic land care. Adopt and follow the Precautionary Principle. ⁴	Policy
Sustainability	Develop workforce training programs for residents to restore and protect natural resources that lead to resident employment while actively avoiding community displacement.	Program
Sustainability	Identify mechanisms to ensure protection and maintenance of habitat areas on public and private lands, in perpetuity.	Operations/Management
Sustainability	Assess the potential for requiring natural spaces and onsite quality-of-life amenities in development plans. Requirements may include the creation of parks, trails, and open spaces, as well as payments into an account used to create and maintain open spaces.	Study/Data/Metrics
Sustainability	Continue prioritizing, planting, and caring for trees. Create more tree wells. Ensure that existing and new tree wells are as large as the sidewalk allows while meeting the current four-foot-by-eight-foot size standard, and expand the standard.	Project
Sustainability	Expand the call-to-action to plant and care for trees. Under the umbrella of TreeBaltimore, engage more residents and local organizations into a unified advocacy platform that reaches residents, politicians, and funders. Deepen and expand partnerships with residents and organizations in neighborhoods with the fewest trees to gain support and guide the process.	Engagement
Sustainability	Insure a diversity of tree species. Emphasize the use of native plants and planting “the Right Tree, in the Right Place.” Consider future climate conditions in plantings.	Operations/Management
Sustainability	Create a workforce development program employing residents to plant and care for trees and forests. Train and hire neighborhood residents and engage employers in hiring graduates of these programs for jobs that pay a living wage and provide a career ladder for advancement.	Program
Sustainability	Assess forests in all large parks and utilize the street tree inventory and tree canopy change data as a management tool to proactively plan, prioritize, and track plantings and tree care.	Study/Data/Metrics
Sustainability	Create and implement plans to reduce harm to trees from invasive plant and animal threats, like the emerald ash borer and white tail deer, as well as from climate change.	Plan
Sustainability	Develop unified, long-term strategies to increase support and funding for managing forests and forest patches, and for planting and caring for trees.	Operations/Management
Sustainability	Develop and implement policy to manage parks to ensure tree-protective language is placed in all contracts and plans, and include best management practices and standards for invasive management, reforestation, and restoration.	Policy

Sustainability	Classify trees and forests as public infrastructure, similar to (and as valued as) sidewalks and street lights.	Policy	
Sustainability	Adopt a tree ordinance to preserve trees and forests on public and private property.	Policy	In progress
Sustainability	Investigate the creation of a forest land-banking credit program and other methods for supporting and promoting forest preservation, such as land trusts and permanent easements.	Program	
Sustainability	Investigate a mechanism for monitoring long-term forest protection on public and private property to preserve and improve the health of forests.	Study/Data/Metrics	
Sustainability	Prioritize the Proactive Neighborhood Pruning Program, utilizing the tree inventory and basing rank on maintenance need. The goal is that every neighborhood receives tree maintenance on a five-to-seven-year rotation, and every tree above five inches circumference is pruned or removed to ensure trees remain healthy.	Program	
Sustainability	Connect more people to water in safe ways via fishing, boating, and activities at the water's edge so they can relax, reduce stress, and enjoy nature. Identify and address concerns and barriers to achieving meaningful engagement with water bodies. These may include geographic, economic, historical, linguistic, cultural, institutional, or other barriers.	Engagement	
Sustainability	Increase education and pursue progressive actions to reduce pollutants entering our waterways. For example, consider an awareness campaign to reduce litter and pet waste and encourage proper disposal of fats, oils, and grease. Also expand efforts to train volunteers on reporting suspected sewage leaks.	Education	
Sustainability	Develop a combination of incentives and deterrents aimed at industrial, commercial, and institutional property owners to reduce pollution impacts, such as promoting innovative financing mechanisms for investment in water quality, developing a recognition program, and proactively pursuing enforcement against "bad actors."	Incentives	
Sustainability	Foster cross-jurisdictional partnerships to address water quality, water access, and increased healthy habitat for fish and other aquatic life, and to coordinate meaningful engagement with residents.	Engagement	
Sustainability	Increase restoration of riparian corridors, and pursue other innovative habitat restoration such as floating wetlands, living shorelines, and oyster gardens. Consider small-scale and block-level greening projects in tandem with educational, stewardship, and social fabric building activities.	Project	
Sustainability	Remove invasive species along waterway buffers, replant with native species, and increase resources for management and maintenance. Promote awareness in neighborhoods surrounding projects.	Project	
Sustainability	Identify, prioritize, and remediate sources of human fecal bacteria in waterways using the best available technology, including microbial source tracking techniques.	Study/Data/Metrics	

Sustainability	Develop and promote legislation and policy at the City and State level to reduce pollution of our waterways, including restricting the use of pesticides and herbicides and reducing the use of single-use plastics (such as plastic bags and beverage bottles).	Legislation
Sustainability	Improve watershed management for the City's three raw water reservoirs, by developing and implementing a forest management plan for each. Work with surrounding jurisdictions to improve land-use controls and watershed management in the three watersheds.	Plan
Sustainability	Evaluate the potential for water re-use. Secure grant funding to identify potential incentives, and work with partners to implement a pilot incentive program to promote water re-use.	Study/Data/Metrics
Sustainability	Promote assistance programs for low-income residents and seniors by connecting those needing assistance to programs providing water bill assistance.	Program
Sustainability	Evaluate an Offsite Stormwater Mitigation Credit or Pay for Performance program, determining interest, demand, and feasibility, and then establish programs as appropriate.	Incentives
Sustainability	Create standard design specifications and a streamlined permitting process to implement green infrastructure practices particularly for projects under 5,000 square feet.	Operations/Management
Sustainability	Support and expand programs to establish and maintain green infrastructure on private property, including incentives as well as free and/or reduced-cost materials.	Program
Sustainability	Create a coordinating committee to evaluate and improve policies, processes, roles, and site evaluation for green infrastructure on public property. Ensure engagement from those who will be most impacted, and follow best practices in transparency for all processes of the committee.	Convene/Facilitate
Sustainability	Create a green infrastructure workforce development program based on a study of best practices. Recruit neighborhood residents to participate, providing jobs and encouraging neighborhood pride; engage employers to hire program graduates to living wage jobs.	Program
Sustainability	Seek funding to develop stewardship models and recruit neighborhood residents to maintain and monitor projects using these models.	Funding
Sustainability	Create a database of green infrastructure sites identifying all parties who are responsible for their funding and maintenance.	Study/Data/Metrics
Sustainability	Create a standard agreement for green infrastructure to be sited on public property but maintained by non-City entities; create standards that those outside entities need to meet, to ensure all green infrastructure continues to function per its design.	Operations/Management
Sustainability	Analyze displacement pressures that new green investments may have on low-income communities and include strategies to mitigate impacts.	Study/Data/Metrics
Sustainability	Ensure design and location of green infrastructure practices are appropriate within the neighborhood context by engaging community members early in planning processes.	Operations/Management
Sustainability	Create demonstration projects on public land, along with educational signage. Ensure that they are all continually maintained.	Project

Sustainability	Create, maintain, and promote the use of educational mapping tools such as printed maps and brochures, mobile apps, presentations, and tours. These can provide locations and explain benefits of green infrastructure.	Study/Data/Metrics
Sustainability	Set purchasing preferences and supplier diversity goals with businesses, anchor institutions, government, and others to invest and buy locally.	Procurement
Sustainability	Grow cooperative business models run and operated by the people who work in them, as an innovative and inclusive vehicle to overcoming economic and social inequity.	Policy
Sustainability	Expand the adoption of environmentally-friendly business practices, such as the use of green technologies, policies, and programs—reduced packaging, reuse and recycling of materials, energy reduction and renewable energy. Also promote the Maryland Green Registry.	Operations/Management
Sustainability	Provide support services to grow businesses, help develop new market channels, improve access to affordable and safe production spaces, and enhance retail and sales opportunities. Support and encourage minority business ownership in sectors with economic strength.	Program
Sustainability	Build the capacity of Made in Baltimore and other entrepreneurial support organizations to create supportive networks and prosperous business environments for emerging entrepreneurs while increasing neighborhood-based small manufacturing businesses.	Convene/Facilitate
Sustainability	Advocate for state and local policies such as tax exemption programs that support manufacturers and owner-operated business. Review regulations related to home-based businesses, and regulations related to reinvesting in older manufacturing facilities. These include, but are not limited to, preserving light industrial zoning.	Advocate
Sustainability	Continue to address needs unique to minority- and women-owned businesses by supporting existing programs and developing new programs and strategies. These include access to capital and equity investments, technical assistance, and program marketing.	Operations/Management
Sustainability	Continue to align Baltimore City's MBE/WBE certification with the State of Maryland's, assist more companies in attaining certification, and prepare more companies for opportunities at both levels. Improve tracking and transparency of city agency spending and encourage large businesses and anchor institutions to set minority-owned business goals and to track spending.	Operations/Management
Sustainability	Promote increased access to alternative sources of financing and technical assistance to support social enterprises and community wealth-building strategies.	Promotions/Outreach
Sustainability	Create and adopt an economic plan that supports local production, purchasing, and exporting strategies; addresses training on inclusion and bias and increases access to job training and living-wage jobs. Promote hiring practices to equitably include more women; more people from racial, ethnic, and religious minorities; and more LGBTQIA, differently-abled, and formerly incarcerated people.	Plan

Sustainability	Expand green job training programs for the unemployed, underemployed, and those facing barriers to unemployment in areas such as clean energy, energy efficiency, energy auditing, green infrastructure, and waste. Build people's skills, qualifications, and credentials to succeed.	Program
Sustainability	Ensure green jobs are part of a larger, centralized case management system to help jobseekers find support services, while also tracking their progress. Establish clear points of entry for in-person, call-in, and digital jobseekers, so that they can easily find the support services and providers they need.	Program
Sustainability	Ensure wrap-around services and support are built into green training programs. These services include developing basic interview and resume skills, providing test preparation and GED completion services, providing legal services and expungements, and offering support obtaining a driver's license and addressing transportation barriers. Help trainees establish a timeline of milestones to build financial security, including financial services education, credit building, tax preparation, and savings.	Program
Sustainability	Ensure green jobs are part of a job-matching tool that will identify highly qualified and newly trained workers from all existing training programs. Develop a screening process and use this tool to fill job orders.	Project
Sustainability	Increase the number of nonprofits and industry partners involved in green and sustainable jobs who are connected to the network of providers organized by the Mayor's Office of Employment Development, to integrate service delivery programs and share best practices	Convene/Facilitate
Sustainability	Fuse a relationship between Baltimore City Public Schools and green industries to promote experience, apprenticeships, paid jobs, and workforce industry relationships. Include a pilot program with high school seniors utilizing YouthWorks.	Convene/Facilitate
Sustainability	Promote city government workforce training programs that lead to jobs. Continue the Department of Public Work's Youth Water Mentoring Program and promote additional programs that provide on-the-job-training and support to equip youth with the skills needed to fill entry-level City positions, and to increase potential for advancement to meet the City's future workforce needs.	Promotions/Outreach
Sustainability	Collect common data points on green job seekers using the Mayor's Office of Employment Development's standard assessment tool. This data should be collected at every touchpoint, and then interpreted to identify program improvements.	Study/Data/Metrics
Sustainability	Institute the use of common performance metrics by workforce providers and funders to start building lessons learned. Produce an annual report to track and share progress on these measures citywide.	Study/Data/Metrics
Sustainability	Work with employers to find pathways, interventions, and service gaps in supporting workers in green and sustainability fields including career pathway programs, incumbent worker training, apprenticeships, and mentoring. Ensure feedback loops are intact so that training programs are responsive to employer needs and linked to living wage jobs.	Technical Assistance

Sustainability	Develop funding opportunities to support long-term engagement with people who come through job placement services, find a job, but are not supported beyond that milestone.	Funding
Sustainability	Require publicly funded arts organizations to track audience engagement with the goal of engaging audiences representative of the demographics of Baltimore. Future funding should be contingent on meeting this goal, which may include increasing outreach to local artists of color, and to art organizations that serve younger and emerging artists across disciplines.	Study/Data/Metrics
Sustainability	Increase artist-led decision making such as increasing representation on review committees, commissions, selection panels, festival planning committees, and more. The goal should be representation based on the racial demographics of the city.	Engagement
Sustainability	Support and expand youth arts programs in areas of the city underserved by cultural institutions and programs. Provide resources to existing and emerging programs, such as marketing and communications support, additional staffing, funding, and free space for programming.	Technical Assistance
Sustainability	Implement the recommendations of the Mayor's Task Force on Safe Arts Space, giving top priority to providing funding and free technical assistance to artist-run spaces so they may become code-compliant. Also make suitable, City-owned properties available at low- or no-cost for community-led arts programming, or for acquisition by arts organizations.	Funding
Sustainability	Host free or low-cost professional development and entrepreneurial workshops for artists and art-based organizations.	Education
Sustainability	Fully implement the City's "1% for Art" program. Evaluate how the City could establish an "artist-in-residence" program, bringing artists to work within City agencies in order to share creative perspectives and propose innovative solutions. Also create new funding streams for arts programs.	Operations/Management
Sustainability	Seek a dedicated fund for art, such as a grant making program. Also create and support social enterprises that would serve as platforms for artists of color to highlight, promote, share, and celebrate their work.	Funding
Sustainability	Equitably distribute funding to artists ensuring broader cultural representations. Require that publicly supported arts grants be awarded to recipients who reflect the racial demographics of the City, and create new artist grant programs designed for non-Western artistic traditions.	Operations/Management
Sustainability	Create and support spaces for discourse by fostering mobile museums, pop ups, and onsite art, engaging people through art-making.	Program
Sustainability	Provide funding and support for local leaders to engage artists, arts organizations, and residents to cultivate a broad range of arts, cultural, and heritage resources and activities.	Convene/Facilitate
DP3	Conduct educational outreach for city-owned, residential, commercial, and industrial buildings about proper storage and disposal of hazardous materials and heating oil	Promotions/Outreach

DP3	Require hazardous materials stored in city-owned, residential, commercial, and industrial buildings within the regulatory floodplain to be elevated a minimum of 1 foot above the flood protection elevation	Policy
DP3	Coordinate delivery of fuel and/or access to fuel for critical facility emergency generators	Operations/Management
DP3	Design new projects to be resilient based on sea level rise projections based on best available data and adaptable to longer term impacts	Operations/Management
DP3	Continue to regulate to the 0.2% annual chance flood area in existing tidal floodplain delineation	Operations/Management
DP3	Incorporate outfall elevation regulations	Policy
DP3	Identify alternative buildable land to deter development in the regulatory floodplain where feasible, when not feasible develop and share construction Best Practices for development within the regulatory floodplain	Study/Data/Metrics
DP3	Train all code enforcement and building inspectors about floodproofing techniques and the local floodplain ordinance	Education
DP3	Encourage green roof installations to include vegetative and reflective technologies for all new commercial, industrial, multifamily, and city-owned development	Promotions/Outreach
DP3	Require new critical facilities to be designed with redundant operating systems	Policy
DP3	Require pre-wiring for generators at all facilities designated critical to agency operations and hazard response	Policy
DP3	Review zoning code and strengthen language (where necessary) in order to better protect residents and the environment and increase resiliency in buildings	Policy
DP3	Utilize open space category in zoning code to protect sensitive areas (stormwater sites, steep slopes, floodways, etc.)	Operations/Management
DP3	Review and consider adoption of the International Green Construction code	Policy
DP3	Assess the utility of establishing or merging with an existing Resilience Authority and other institutional structure to develop, finance, and support resilience projects.	Study/Data/Metrics
DP3	Continue to acquire property (including repetitive loss properties) in the regulatory floodplain, where feasible and appropriate	Infrastructure
DP3	Prioritize Hazard Mitigation Assistance and other funding opportunities for mitigation of repetitive loss properties and severe repetitive loss properties	Operations/Management
DP3	Develop a creative financing program for flood resiliency in industrial buildings	Program
DP3	Pursue grants to acquire flood prone properties when and where feasible	Funding
DP3	Review local building codes to determine if revisions are needed to improve the structure's ability to withstand greater wind velocities, storm impacts, and impacts from debris and projectiles	Study/Data/Metrics
DP3	Determine engineering effectiveness and cost benefit of various earthquake mitigation measures using computer modeling	Study/Data/Metrics
DP3	Prioritize retrofitting and increasing resiliency of Public Housing units in the regulatory floodplain and other high-risk areas	Operations/Management

DP3	Educate building owners within the regulatory floodplain to ensure that all electrical, mechanical, and key building systems are above the base flood elevation and meet existing codes	Education
DP3	Pursue grants to elevate flood prone properties when and where feasible	Funding
DP3	Pursue grants for dry flood proofing of Commercial and Historic structures in the most flood prone areas when and where feasible	Funding
DP3	Assess the feasibility of backflow preventers for residential buildings and incorporate educational outreach where backflow preventers are determined to be a feasible option.	Promotions/Outreach
DP3	Install energy-efficient and low-water-use equipment during renovations in all City-owned buildings	Project
DP3	Support energy efficiency efforts at Baltimore City Public Schools as part of its Sustainability Plan.	Project
DP3	Offer multiple compliance paths for green building standards for new and substantially renovated construction of city-owned buildings	Operations/Management
DP3	Conduct educational outreach and provide information about savings related to reduced water use	Promotions/Outreach
DP3	Educate and provide resources and information about utility rebate programs	Promotions/Outreach
DP3	Provide energy efficiency education to include information on conserving electrical power, efficiency retrofits, and building management systems. Emphasize reductions during summer peak demand hours (S)	Promotions/Outreach
DP3	Utilize engineering studies and cost-benefit analyses to identify additional mitigation needs and actions	Plan
DP3	Evaluate various building design enhancements to reduce losses generated by earthquakes, floods, and storm surge	Study/Data/Metrics
DP3	Work with the Maryland Public Service Commission (PSC) to minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities located within Baltimore City	Infrastructure
DP3	Evaluate Baltimore City of Baltimore's utility distribution system, and identify "underground utility districts" using BGE's May 2013 short-term reliability improvement plan	Study/Data/Metrics
DP3	Support BGE's collaboration with the Maryland Public Service Commission to implement various smart grid solutions that will provide Baltimore City with real-time access to data during events	Study/Data/Metrics
DP3	Identify, harden, and water seal critical infrastructure relative to pump stations, treatment plants, electrical, heating, and ventilation facilities within the regulatory floodplain	Project
DP3	Work with stakeholders to encourage facility owners to develop decentralized power generation and fuel flexibility capabilities	Engagement

DP3	Develop a comprehensive maintenance and training program for City employees at facilities with backup generators to ensure proper placement, hook-up, and function during hazard events	Program
DP3	Install external generator hookups for critical City facilities that depend on mobile generators for backup power	Project
DP3	Partner with utilities to evaluate protecting power and utility lines from all hazards	Study/Data/Metrics
DP3	Determine low-lying substation vulnerability and outline options for adaptation and mitigation	Study/Data/Metrics
DP3	Encourage critical facilities and institutions to connect to existing cogeneration systems, or develop new cogeneration systems	Promotions/Outreach
DP3	Continue Baltimore City's electricity demand-response program during peak usage or pre-blackout periods	Operations/Management
DP3	Evaluate and ensure backup power generation is available to healthcare facilities (nursing homes, critical care facilities, hospitals, etc.)	Project
DP3	Investigate off-grid, on-site renewable energy systems, generators, and technologies for critical facilities to ensure redundancy of energy systems	Study/Data/Metrics
DP3	Seek funding to purchase and install generators for all city buildings designated as critical to agency functions	Funding
DP3	Work with BGE to ensure existing preparedness plans for Spring Gardens liquefied natural gas site incorporate its vulnerability to present and predicted flooding, storm surge and sea level rise	Technical Assistance
DP3	Adopt building code that requires anchoring of 50-gallon storage tanks or larger	Policy
DP3	Support the Maryland Public Service Commission's effort to accelerate replacement of aging natural gas infrastructure, which will harden the system against flooding	Operations/Management
DP3	Design and implement a generator program that assists private gas stations in securing backup generators, especially those stations along major evacuation routes. Exchange for a commitment to fueling emergency response vehicles during a hazard event	Program
DP3	Increase and ensure fuel availability during distribution disruptions. Priority given to critical facilities and emergency responders	Operations/Management
DP3	Utilize new technologies such as fiber optics, external hook-ups, and mobile generators to improve resiliency	Operations/Management
DP3	Evaluate, improve, and build redundancy into all public and inter-agency warning and communication systems	Operations/Management
DP3	Identify best practices for the installation and management of floodproofing for all communication infrastructure at risk of water damage	Study/Data/Metrics
DP3	Implement additional nurse triage phone lines and community health centers to reduce medical surge on hospitals	Project

DP3	Ensure continued operation of City government's various computer mainframes for email, control systems, and internet service by having stand-by batteries for each with a capacity sufficient for backup generation to operate	Operations/Management
DP3	Determine the coastal storm vulnerability and complete an exposure assessment of City transportation assets	Study/Data/Metrics
DP3	Improve stormwater management, operations and maintenance for stream flooding that erodes bridge supports	Infrastructure
DP3	Incorporate compliance with earthquake standards to withstand a magnitude 8 earthquake for all new, improved, and rebuilt bridges	Operations/Management
DP3	Design bridge expansion joints for longer periods of high heat, and develop a more robust inspection and maintenance process	Project
DP3	Research utilizing existing and new rating systems for all new infrastructure and road projects	Study/Data/Metrics
DP3	Identify, investigate, and incorporate Best Management Practices related to transportation design, construction, and maintenance	Operations/Management
DP3	Require that backup solar-powered streetlights and signals be integrated along evacuation routes and high-traffic areas	Policy
DP3	Promote portable EV charging to ensure availability of charging in the instance of impacts to fixed EV charging facilities during emergencies.	Operations/Management
DP3	Evaluate existing systems and coordinate a comprehensive evacuation plan with regional partners	Plan
DP3	Develop and prioritize clearance of specified transportation routes for delivery of emergency response supplies	Project
DP3	Educate the public on the dangers of driving through flooded roads	Promotions/Outreach
DP3	Make available a network of dedicated pedestrian and bicycle transportation routes leading into and throughout Baltimore City	Infrastructure
DP3	Prioritize infrastructure upgrades for roads identified at risk of flooding through the use of elevation data and Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model results	Policy
DP3	Raise streets in identified flood prone areas as they are redeveloped	Project
DP3	Encourage development of Green Streets in flood prone areas and throughout Baltimore City	Promotions/Outreach
DP3	Assess need for new culvert capacity and identify where upgrades are needed	Study/Data/Metrics
DP3	Conduct an in-depth analysis of the impacts of drainage areas that discharge to the harbor	Study/Data/Metrics
DP3	Expand and reinforce existing stormwater education programs	Program
DP3	Design and implement floodgates and barriers for transportation tunnels and subterranean roadways.	Project

DP3	Encourage Federal and State Government to design and install floodgates and barriers at vulnerable transportation tunnels	Advocate
DP3	Upgrade existing floodgate hardware and mechanisms to control rise rate of water into all city tunnels	Project
DP3	Repair cracks and leaks in all tunnels to reduce impact of seismic activity	Project
DP3	Follow Federal, State, and local criteria for the stabilization of historic transportation tunnels (e.g., Howard Street)	Study/Data/Metrics
DP3	Install a seismically resistant fire standpipe, air monitoring, and automatic valve system in all tunnels to provide a fully automated and monitored fire suppression system	Project
DP3	Implement a repaving strategy that reduces heat-related damage to asphalt and incorporates maintenance and operations that extend the life of the road surface	Project
DP3	Develop deicing strategies and materials that are effective in extreme cold temperatures and prolonged events to stabilize roadway and bridge surfaces	Plan
DP3	Raise bulkhead height along shoreline areas most at risk	Project
DP3	Encourage the development of integrated flood protection systems that use structural (engineering) and non-structural (wetlands) measures	Policy
DP3	Review and enhance coastal area design guidelines to better mitigate the impacts of flooding	Policy
DP3	Determine the elevation of sewage treatment buildings, tank construction details, and if the plant is at risk of back flow, for improvements to withstand coastal storm events	Policy
DP3	Develop and adopt increased level of protection for construction, redevelopment, and design of all water and wastewater facilities that incorporate future climate projections	Policy
DP3	Establish protocols and ensure effective operations and security for wastewater treatment plants when facilities are overwhelmed during large storm events	Operations/Management
DP3	Conduct a risk assessment of Baltimore City's current water and sewer systems to identify age, condition of infrastructure, capacity, weaknesses, and areas for priority upgrades	Study/Data/Metrics
DP3	Conduct and utilize a detailed risk assessment to determine vulnerability of the sewage treatment plant to prevent overflows from extreme storm events	Study/Data/Metrics
DP3	Repair leaks and improve connection from all City reservoirs and the Susquehanna River	Project
DP3	Provide water conservation education, and continue to protect our watersheds to assist in maintaining water quality	Promotions/Outreach
DP3	Ensure dam emergency plans account for impacts of climate change	Plan
DP3	Identify and document post-damage responsibilities in memorandums of understanding as addendums to the Reservoir Watershed Management Agreement	Policy
DP3	Review dam capacity, load and failure points and review them against 1,000-year and 10,000-year precipitation events	Study/Data/Metrics
DP3	Conduct a study to determine seismic design standards and seismic resiliency of drinking water distribution system (tunnels, piping, clean water pump stations, dams, shafts, and tanks)	Study/Data/Metrics

DP3	Evaluate the impacts of sediment loading on reservoir capacity	Study/Data/Metrics
DP3	Manage watershed forests to provide maximum benefits for water quality and to maintain resiliency during extreme weather events	Operations/Management
DP3	Adopt new policies on salt application to prevent high salinization of drinking water supplies	Policy
DP3	Establish a structured Firming Program to maintain adequate storage and water quality in the source-water reservoirs during drought conditions	Program
DP3	Maintain appropriate agreements with Susquehanna River Basin Commission (SRBC) and Exelon Power Company to ensure adequate water withdrawals from the Susquehanna River during drought emergency	Operations/Management
DP3	Replace old and malfunctioning pipes with new pipes and pipe-lining technologies	Operations/Management
DP3	Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit	Project
DP3	Prioritize storm drain upgrades and replacement in areas with reoccurring flooding	Project
DP3	Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk	Project
DP3	Preserve and protect natural drainage corridors	Operations/Management
DP3	Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall	Operations/Management
DP3	Pursue grants for Flood Control measures to alleviate flooding in the most flood prone areas when and where feasible	Funding
CAP	Promote Energy Efficiency and Renewable Energy Incentive Programs	Promotions/Outreach
CAP	Implement No or Low-Emission Ready Requirements to Power New Construction	Operations/Management
CAP	Partner with Utilities and Relevant Government Entities and Others to Improve Electric Infrastructure	Technical Assistance
CAP	Purchase Clean Electricity for City Government Operations	Operations/Management
CAP	Require Electric Ready and Solar Ready for New or Majorly Renovated City Government Facilities	Policy
CAP	Coordinate with Partners to Advance Energy Efficiency and Solar	Convene/Facilitate
CAP	Improve Energy Efficiency in City Government Facilities	Project
CAP	Incentivize Energy Efficiency and Electrification Retrofits	Legislation

CAP	Expand Access to the Weatherization Assistance Program and Retrofitting Services	Program
CAP	Enhance Education, Training, Compliance and Enforcement of the Existing International Green Construction Code (IgCC)	Education
CAP	Evaluate Zoning Regulations and Integrate Climate-Informed Zoning Approaches	Study/Data/Metrics
CAP	Create Net-Zero Plan for City Government Facilities	Plan
CAP	Implement and Monitor Energy Benchmarking for City Government Facilities	Operations/Management
CAP	Implement Energy Audits and Retro-Commissioning for City Government Facilities	Operations/Management
CAP	Require Fossil Fuel Free New Construction	Legislation
CAP	Require Fossil Fuel Free New Construction for City Government Facilities	Legislation
CAP	Explore Point of Sale/Lease Electrification Ordinance	Study/Data/Metrics
CAP	Encourage, and when possible, incentivize the use of rooftop technology and techniques that minimize the effect of extreme heat	Promotions/Outreach
CAP	Improve Transit for Low-Income Neighborhoods and Other Communities in Need of Transit Options	Project
CAP	Support State Public Transit Efforts	Advocate
CAP	Make Roads More Walkable and Bikeable	Project
CAP	Support Transit-Oriented Communities	Policy
CAP	Require or Incentivize Active Transport-Friendly Programs and Infrastructure	Policy
CAP	Implement Revised Parking Standards and Encourage Developers to Reduce Parking	Policy
CAP	Establish Car-Free Areas	Policy
CAP	Incentivize Micro-mobility	Incentives
CAP	Promote EV Sharing	Promotions/Outreach
CAP	Partner with Rideshares to Improve Paratransit to Augment MTA Mobility Programs	Convene/Facilitate
CAP	Promote Electric Car Share and Ride Share	Promotions/Outreach
CAP	Expand Public EV Charging Network	Project
CAP	Work with Gas Stations to Install EV Chargers	Technical Assistance
CAP	Promote and Expand Existing Commute Trip Reduction Programs	Promotions/Outreach

CAP	Enhance Awareness of Alternative Transport for Baltimore City Employees	Promotions/Outreach
CAP	Promote Zero-Emission Bus Transition	Operations/Management
CAP	Transition to Zero- or Low-Emissions Fleet	Project
CAP	Develop a Plan to Transition City to Low- or Zero-Emission Off-Road Vehicles and Tools	Plan
CAP	Complete a route optimization study focused on reducing carbon emissions for routine municipal fleet routes.	Study/Data/Metrics
CAP	Establish Sustainable Procurement Protocol	Procurement
CAP	Introduce City-wide composting	Project
CAP	Coordinate Citywide Food Rescue Program	Convene/Facilitate
CAP	Enhance Existing Organic Waste Diversion Policy Awareness, Compliance, and Enforcement of MD HB-264 – Organics Recycling and Waste Diver Law.	Promotions/Outreach
CAP	Support Expansion of Waste Diversion and Reduction Programs	Program
CAP	Develop Waste Diversion Incentives	Incentives
CAP	Promote and Partner with Circular-Economy Local Businesses	Convene/Facilitate
CAP	Establish Waste Community Leaders	Engagement
CAP	Seek ways to ensure any new waste disposal facilities processing municipally generated waste comply with carbon neutrality goals.	Operations/Management
CAP	Encourage Water Savings Program	Program
CAP	Establish Emissions Plan for Wastewater Facilities	Plan
CAP	Explore Reducing Energy Use at Wastewater Facilities	Study/Data/Metrics
CAP	Collect data to inform policy and decision making regarding how to reduce pollutants generating from waste processing facilities, including waste incinerators.	Study/Data/Metrics
CAP	Support and, as possible, expand upon, legislation that bans recyclable materials from landfill and incineration.	Legislation
CAP	Require plans for new buildings to provide sufficient indoor and outdoor space for recycling, composting and materials reuse.	Policy
CAP	Accelerate the achievement of Baltimore’s tree canopy goal to reach 40% tree canopy by 2037.	Project
CAP	Assess City parklands to identify and seek opportunities to enhance or expand natural features.	Study/Data/Metrics
CAP	Create and maintain more public green spaces.	Project

CAP	Increase green stormwater infrastructure, particularly in flood-prone and frontline communities	Project
CAP	Partner with community-based groups to increase neighborhood nature-based solutions and educate communities about climate resilience.	Engagement
CAP	Analyze potential solar or renewable energy farm locations.	Study/Data/Metrics
CAP	Develop Centralized Tool for Climate Actions	Study/Data/Metrics
CAP	Create an Education and Outreach Program	Promotions/Outreach
CAP	Create a Heat Management Plan	Plan
CAP	Improve Distribution of Climate-Relevant Data	Promotions/Outreach
CAP	Partner with Institutions to Inform Climate Action Plan Update Implementation	Study/Data/Metrics
CAP	Connect and convene communities, individuals, organizations, businesses, researchers, agencies and others working to advance actions outline in the CAP Update.	Convene/Facilitate
SWMP	Support local and state legislation that bans recyclable materials from landfill and incineration. Any material with publicly accessible avenues for recycling should be considered for a disposal ban.	Legislation
SWMP	Support local and state legislation banning single-use plastics. Examples include outright bans (such as the polystyrene and plastic bag bans implemented by the City) or “skip the stuff” laws which ban restaurants from automatically supplying straws, cutlery, sauce packets, etc. unless they are specifically requested by customers.	Legislation
SWMP	Support City ordinances that require deposits on beverage containers. These deposits can be repaid upon recycling the bottles (container deposit law).	Legislation
SWMP	Support local and state legislation that requires businesses of all sizes to recycle.	
SWMP	Support a City ordinance or state legislation requiring mandatory recycling reporting from all nonresidential entities.	Legislation
SWMP	Support local and state legislation to create recyclable content purchase mandates for private businesses (including, but not limited to restaurants, offices, and hotels).	Legislation
SWMP	Support local legislation to create enforcement mechanisms that penalize violation of recycling requirements.	Legislation
SWMP	Propose local laws to enable and encourage refill businesses (i.e., those businesses that use reusable packaging or those that sell their products without packaging).	Legislation
SWMP	Hold community-engaged seminars intended to gather data on residents’ barriers and motivations as they relate to recycling, gather group pledges to foster behavior change around recycling habits, and build public understanding of the connections between zero waste, recycling, health, climate change, and local resilience.	Engagement

SWMP	Build a zero-waste coalition to gather stakeholders from the residential, institutional, and recycling sectors with the city to identify benefits, barriers, and priorities for zero-waste programs and services in the city.	Convene/Facilitate
SWMP	Develop and deploy resources to improve recycling habits. Resources may include a guide to dispose of hard-to-recycle materials at residential drop-off centers, a reuse directory, social media campaigns to dispel myths around recycling, or a “business case for zero waste” flyer to highlight the incentives of recycling. Resources can be deployed residents, businesses, and city schools to improve recycling behaviors.	Promotions/Outreach
SWMP	Develop community-based social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Offer workshops to help residents experiment with sustainable resource management behavior shifts. Workshops may include creative reuse classes or community recycling sorts to identify contamination.	Education
SWMP	Offer recycling and reuse educational workshops at Baltimore City Schools to promote waste prevention habits in K-12 students.	Education
SWMP	Standardize recycling in city-owned and leased buildings (such as City Hall, The War Memorial Building, public markets, and other event venues) to educate city staff about proper recycling practices and minimize waste generated within city-owned and leased buildings.	Operations/Management
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Coordinate with the DHCD, BCHD, and other City agencies to develop incentive programs for apartments and condominiums that recycle and self-report their recycling tonnages.	Study/Data/Metrics
SWMP	Coordinate with DHCD to determine mechanisms to enforce recycling at apartments and condominiums. Note that improving enforcement will likely require hiring additional staff (or reallocating staff) to perform inspections. Due to the current state of the labor market and staffing shortages at the City, this is currently unlikely. However, over the planning period, it is anticipated that the City will be able to hire additional staff or reallocate existing staff to perform inspections and improve enforcement.	Plan
SWMP	Improve education and outreach at public schools to improve participation in existing recycling programs. It is hoped that by holding workshops and events at public schools, the City may inspire school leadership to prioritize recycling and provide more consistent recycling services.	Education
SWMP	Review and Update Contract Policies and Standards for Issuing Requests for Proposals	Policy
SWMP	Consider ways to improve transparency around recycling rates, recycling contamination, recycling markets and vendors, city contracts, and where waste and recycling is exported.	Study/Data/Metrics
SWMP	Access funding mechanisms by conducting a comprehensive capital, operational, and fiscal study on potential funding mechanisms for waste diversion and disposal.	Funding

SWMP	Collaborating with other Agencies and entities like the Baltimore Development Corporation and the Mayor's Office of Employment Development.	
SWMP	Advocate for green procurement processes for the City that mandate recycled paper and paper products constitute at least 50% of the total dollar value of paper and paper products purchased by or for the City government.	Procurement
SWMP	Hold market development workshops between local businesses that use recycled materials and local recyclers to promote the development of local recycling markets.	Education
SWMP	Apply for public, private, federal, state, and philanthropic funding opportunities to support waste diversion programming.	Funding
SWMP	Offer sustainable business certification to promote waste diversion programs and waste prevention planning in the private sector and build a network of organizations that regularly report and measure their waste streams.	Promotions/Outreach
SWMP	The City will deploy additional recycling cans in public spaces (such as parks, public markets, city-owned/leased buildings etc.) to improve collection of recyclables and reduce litter. The City may also consider using public recycling cans that feature distinctively shaped lids to incentivize the separated collection of paper from bottles and cans.	Project
SWMP	The City plans to reinstate weekly recycling collection to improve waste diversion. This is described further in Section 5.4.	Operations/Management
SWMP	The City will optimize routes to ensure that recycling pick up schedules and routes are efficient and logistically reliable. This is described further in Section 5.4.	Operations/Management
SWMP	Support state legislation that expands upon the Bill Emerson Good Samaritan Act to extend liability protection to nonprofits selling recovered food at discounted prices (as well as their donors), extends liability protections to donations made by food service establishments and retailers directly to individuals, and explicitly extend protections to past-date foods.	Legislation
SWMP	Support the revision or implementation of local legislation and zoning codes to ensure that City code allows for organics collection and processing.	Legislation
SWMP	Support MDE in enforcing HB264 (2021) by supporting food waste related data collection among food waste generators including grocery stores, restaurants, food halls and/or eateries/markets and large food production sites such as hospitals and universities.	Legislation
SWMP	Support a ban on commercial organics disposal in the city. To build on HB264, the City will support a total ban on commercial organics disposal during the planning period. This ban could be implemented at the city or state level. In addition to a total ban on organics disposal, the City may also support implementing incentives for businesses that report their diversion activities to the City.	Legislation
SWMP	Support a blanket landfill ban on organic materials	Legislation

SWMP	Hold community-engaged seminars intended to gather data on residents' barriers and motivations as they relate to food-waste-reduction activities, gather group pledges to foster behavior change around food-waste-reduction habits, and build public understanding of the connections between zero waste, food waste, health, climate change, and local resilience.	Engagement
SWMP	Build a zero-waste coalition to gather stakeholders from the residential, institutional, and food-service sectors with the City to identify benefits, barriers, and priorities for zero-waste programs and services in the city.	Convene/Facilitate
SWMP	Develop and deploy resources to improve food-waste-reduction habits. Resources may include a food waste donation directory, guides to reduce food waste at home, social media campaigns to dispel myths around reducing food waste, donation and food rescue, online food-waste-reduction tools, or a "business case for zero waste" flyer to highlight the financial incentives of reducing food waste or donating food. Resources can be deployed to residents, businesses, and city schools to improve food-waste-reduction behaviors.	Promotions/Outreach
SWMP	Develop interactive community-based social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Schedule workshops, such as circular cooking classes, to help residents experiment with sustainable resource management behavior shifts.	Education
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Support or develop online or mobile applications and mobile apps to connect food rescue agencies and LMOs with consumers and clients.	Promotions/Outreach
SWMP	Hold regular stakeholder meetings between the City, food donors, food rescue organizations, LMOs, and clients build relationships and support strategic planning.	Engagement
SWMP	Encourage the use of produce "seconds" by creating a resource guide for individuals and businesses wishing to use produce "seconds" and support creation of a vendors market for unsold produce from wholesale distributors.	Promotions/Outreach
SWMP	Support the development of a Food Recovery Network chapter in every higher education institution in the city.	Promotions/Outreach
SWMP	Evaluate strategies for making donated food more geographically accessible to clients	Study/Data/Metrics
SWMP	Conduct a needs assessment for the city's food recovery system.	Plan
SWMP	Conduct surveys to see if there are enough community partners to handle the volume of all surplus food that can be rescued or donated and checking that these partners are adequately resourced (refrigeration, hauling, etc.).	Study/Data/Metrics
SWMP	Track food donations received from local sources each year at food rescue organizations.	Study/Data/Metrics

SWMP	Conduct a detailed study of individual communities in the city to gauge the desire and interest in consuming surplus foods.	Study/Data/Metrics
SWMP	Explore and develop incentive programs for food donation, or businesses sourcing recovered food.	Program
SWMP	Promote the use of applications that allow customers to support restaurants and save money on popular food items.	Promotions/Outreach
SWMP	Consider audit subsidies.	Study/Data/Metrics
SWMP	Distribute how-to guides on do-it-yourself audits.	Promotions/Outreach
SWMP	Develop guidelines for "rightsizing" food ordering to reduce food waste.	Policy
SWMP	Encourage food waste tracking to help residents and businesses improve their bottom line through food waste reduction and charitable donations of edible surplus food to local communities in need.	Study/Data/Metrics
SWMP	Explore methods to estimate and track food waste generation in the city as a way to track the progress and success of food-waste-reduction initiatives.	Study/Data/Metrics
SWMP	Explore and develop incentive programs to support and encourage development of yard waste reuse facilities, including wood pellet energy and biochar production.	Incentives
SWMP	Assess disposal fee restructuring. The City intends to assess disposal fee restructuring to allow tip fees at organics processing facilities to remain lower than those at disposal facilities in the city. This could provide a financial incentive for businesses and residents to divert rather than dispose of organics or a "shared savings" model, where compost businesses receive revenue from the City that represents the cost savings in avoiding disposal tipping fees.	Policy
SWMP	Hold community-engaged seminars intended to gather data on residents' barriers and motivations as they relate to organics diversion activities, gather group pledges to foster behavior change around organics diversion habits, and build public understanding of the connections between zero waste, organics diversion, health, climate change, and local resilience.	Education
SWMP	Develop and deploy resources to improve organics diversion habits. Resources may include a guide to divert organic material at residential drop-off centers, a directory of community composting organizations, social media campaigns to dispel myths around organics diversion, or a "business case for zero waste" flyer to highlight the financial incentives of diverting organic waste. Resources can be deployed to residents, businesses, and city schools to improve organics diversion behaviors.	Program
SWMP	Develop community-based social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Hold workshops, such as home composting courses, to help residents experiment with sustainable resource management behavior shifts.	Education

SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Coordinate with the DHCD to develop incentive programs for large commercial generators that divert food waste and self-report their diverted tonnages.	Operations/Management
SWMP	Coordinate with the MDE and DHCD to improve enforcement of diversion from large commercial generators. Note that improving enforcement will likely require hiring additional staff (or reallocating staff) to perform inspections. Due to the current state of the labor market and staffing shortages at the City, this is currently unlikely. However, over the planning period it is anticipated that the City will be able to hire additional staff or reallocate existing staff to perform inspections and improve enforcement.	Operations/Management
SWMP	Review the City's zoning code to see what if any changes would be needed to facilitate private development of composting facilities in the city.	Policy
SWMP	Improve access to backyard compost bins to residents by subsidizing or providing free backyard composting tools.	Project
SWMP	Initiate education and outreach programs to promote backyard composting.	Promotions/Outreach
SWMP	Support the creation of community composting locations in Baltimore neighborhoods.	Infrastructure
SWMP	Expand the use of City-owned organics processing facilities (e.g., Camp Small).	Infrastructure
SWMP	Encourage on-farm composting (perhaps by expanding on partnerships developed from the Food Matters Program).	Program
SWMP	Expand existing food scrap drop-off locations to take meat and animal products.	Project
SWMP	Conducting a feasibility study to identify funding, staffing, and equipment needs	Study/Data/Metrics
SWMP	Securing the necessary funding, human capital, and equipment needed to properly staff and equip the Pilot expansion (based on the results of the feasibility study)	Funding
SWMP	Expanding collection of SSO from public schools (PS) and city government offices (CG) after securing funding, human capital, and equipment by supplying bins and dumpsters to participating PS and CG locations for collecting and consolidating SSO.	Project
SWMP	Establishing a three-bin pilot program for collecting trash, recycling, and organics from single family residences in representative samples of the city by providing bins and weekly SSO collection to each serviced residence.	Project
SWMP	Conducting a performance evaluation for the Pilot program by evaluating metrics such as participation rate, contamination, collection costs, etc. The Phase II expansion will only be pursued after the Pilot is deemed successful	Study/Data/Metrics
SWMP	Conducting a feasibility study to identify funding, staffing, and equipment needs at each stage of the proposed expansion	Study/Data/Metrics

SWMP	Constructing a compost training facility. The facility will be less than 5,000 square feet in size (and so will not require a compost facility permit per COMAR 27.04.11.05) and have a capacity of approximately three tons of organic waste per week. This training facility will not only be used to process organics collected from the City's residential drop-off centers and Pilot collection program but will also be used to host workshops and trainings to build resident and workforce competency in the composting field (i.e., to support community composting efforts).	Project
SWMP	As organics collection through the Pilot program increases, the City intends to develop several covered aerated static pile (CASP) composting facilities to facilitate SSO diversion. This is described in more detail in Section 5.6.	Project
SWMP	Support City-mandated deconstruction policy to require C&D projects to divert a certain percentage of their waste from disposal and encourage reuse of C&D materials. It is anticipated that this deconstruction policy will target high-value reusable components of C&D debris such as lumber and clay bricks. The City will also support a policy that retains industrial zoned buildings for use by local manufacturers.	Policy
SWMP	Support City-mandate on source separation of recyclable materials from construction, remodeling, and demolition projects.	Policy
SWMP	Support a mandatory diversion ordinance to improve C&D diversion. It is anticipated that the ordinance could be implemented in a stepwise manner to facilitate construction and expansion of private C&D MRFs in the city to accommodate the expected increase in diversion.	Policy
SWMP	Remove any barriers to reuse in building inspection code.	Policy
SWMP	Support a citywide policy and procedure for procuring construction services that prioritize the use of recycled materials instead of virgin materials for city-led construction or repair projects.	Policy
SWMP	Support a citywide policy and procedure to encourage architectural salvage programs by ensuring that City-generated deconstruction materials are being diverted to higher use via local salvage businesses before being recycled or disposed of. To support this policy, the City intends to provide educational materials and seek out partnerships with construction companies to improve reuse of C&D materials.	Policy
SWMP	Develop a comprehensive C&D diversion and reuse plan to guide City strategy over the planning period.	Plan
SWMP	Support right to repair bills intended to allow consumers the ability to repair and modify their own consumer products, rather than being obligated by the manufacturer of such devices to use their (often expensive) repair or replacement services, at the state level for electronics, vehicles, and industrial equipment.	Legislation

SWMP	Hold community-engaged seminars intended to gather data on residents' barriers and motivations as they relate to bulk waste reuse and recycling activities, gather group pledges to foster behavior change around bulk waste reuse and recycling habits, and build public understanding of the connections between zero waste, recycling, health, climate change, and local resilience.	Engagement
SWMP	Build a zero-waste coalition to gather stakeholders from the residential, institutional, and bulk waste donation and recycling sectors with the city to identify benefits, barriers, and priorities for zero waste programs and services in the city.	Convene/Facilitate
SWMP	Develop and deploy resources to improve bulk waste reuse and recycling habits. Resources may include a guide to dispose bulk waste materials at residential drop-off centers, a reuse directory, social media campaigns to dispel myths around bulk waste recycling, or a "business case for zero waste" flyer to highlight the incentives of bulk waste recycling. Resources can be deployed to residents and businesses to improve recycling behaviors.	Promotions/Outreach
SWMP	Develop community-based social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Offer workshops to help residents experiment with sustainable resource management behavior shifts. Workshops may include creative reuse classes or repair clinics.	Education
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Support programs that turn waste into art by donating bulk waste to local artists, which could help raise awareness of bulk waste recycling opportunities in the community. The City plans to reach out to reach out to the Maryland Institute College of Art and other art institutions to partner on this initiative.	Program
SWMP	Support or provide fix-it/repair clinics at existing facilities such as Green Resources and Outreach for Watersheds (GROW) Centers to help residents learn how to repair broken electronics, appliances, bikes, etc., rather than disposing of them. This will also encourage residents to be more thoughtful about consumption and reduce their waste generation.	Program
SWMP	Provide opportunities for reuse and swap events, which could be hosted at existing facilities or GROW Centers to help facilitate reuse or exchange of appliances or other bulk wastes.	Engagement
SWMP	Develop additional recycling and reuse/donation capacity for bulk waste. It is anticipated that additional recycling and donation capacity for bulk waste would be hosted at existing residential drop-off centers. This described in more detail in Section 5.4.	Operations/Management
SWMP	Support EPR bills at the state level to encourage producers to take more responsibility for the waste that they generate (either through packaging or the product itself).	Advocate

SWMP	Support statewide or local product stewardship legislation to encourage manufacturers to produce reusable, recyclable, and biodegradable products.	Advocate
SWMP	Hold community-engaged seminars intended to gather data on the barriers and motivations of residents as they relate to waste reuse and recycling activities, gather group pledges to foster behavior change around waste reuse and recycling habits, and build public understanding of the connections between zero waste, recycling, health, climate change, and local resilience.	Engagement
SWMP	Build a zero-waste coalition to gather stakeholders from the residential, institutional, and bulk-waste donation and recycling sectors with the city to identify benefits, barriers, and priorities for zero-waste programs and services in the city.	Convene/Facilitate
SWMP	Develop and deploy resources to improve reuse and recycling habits. Resources may include a guide to dispose of other waste materials at residential drop-off centers, improved signage at residential drop-off centers, a reuse directory, and social media campaigns to dispel myths around recycling. Resources can be deployed to residents and businesses to improve recycling behaviors.	Promotions/Outreach
SWMP	Develop community-based social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Offer workshops to help residents experiment with sustainable resource management behavior shifts and roundtables with community members to solicit feedback on program improvements and possible new offerings.	Education
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Contract with a private recycling company to recycle residential mattresses collected at the residential drop-off facility at the landfill and discourage disposal of mattresses at QRL.	Operations/Management
SWMP	Participate in textile recycling through the contract available with the Northeast Maryland Waste Disposal Authority.	Operations/Management
SWMP	Partner with nonprofits and local farmers to divert whole Christmas trees for shoreline restoration or goat feed.	Program
SWMP	Partner with the Department of Health and a local organics processing facility to accept animal carcasses for composting.	Policy
SWMP	Use available City data and engaging multiple City departments (including DOT, DHCD, Baltimore City Police Department [BCPD], and DPW) and nearby universities to assess litter in the city and identify vulnerable neighborhoods. As part of this process, DPW will create a new internship position to focus on data assessment.	Study/Data/Metrics
SWMP	Contact and engage with selected residents, community leaders, and public officials in impacted, vulnerable communities to conduct public meetings, identify new or recurring incidents, and respond to those incidents promptly.	Engagement

SWMP	Recruit, train, and promote future employees from impacted, vulnerable neighborhoods to create a pipeline of job opportunities in DPW for young people aged 18–24.	Program
SWMP	Work with community partners to stress the negative impacts of blight and litter.	Engagement
SWMP	Conduct a robust communications campaign about available programs and regarding blight and litter removal.	Promotions/Outreach
SWMP	Deliver a comprehensive educational program to children in Baltimore public schools through the ECO Ambassador Program.	Education
SWMP	Organize and launch a robust volunteer program citywide that will empower residents to take ownership of the conditions in their neighborhoods.	Program
SWMP	Promote awareness of composting opportunities through educational materials and social media.	Promotions/Outreach
SWMP	Conduct a robust communications campaign educating residents regarding enforcement, codes, and potential fines for litter.	Promotions/Outreach
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit	Promotions/Outreach
SWMP	Partner with programs that offer day-labor and provide mandated community service work, such as Youth Works, ECO Ambassador programs, and YH2O, to create volunteer projects.	Program
SWMP	Prioritize litter collection in the most vulnerable neighborhoods through coordinated deployment of City departments, community partners, volunteers, and residents.	Policy
SWMP	Increase the use of signs regarding litter and illegal dumping.	Operations/Management
SWMP	Establish proactive protocols for communication across City departments.	Operations/Management
SWMP	Create a method to inform residents of service request status.	Operations/Management
SWMP	Coordinate community volunteers to engage in street cleanup efforts and publicly acknowledging communities where behavior demonstrates change.	Engagement
SWMP	Identify accessible locations within the city for easy access for organizations and individuals to pick up supplies.	Study/Data/Metrics
SWMP	Provide operations support with community organizations engaged in the Mayor’s Clean Corps program by using community liaisons to provide communication and feedback loops.	Engagement
SWMP	Expand the Community Pitch-in Program capacity.	Program
SWMP	Improve coordination between the Pitch-In Program and 311.	Operations/Management
SWMP	Expand the number of interior neighborhood trash and recycling cans following an assessment of staffing and operational needs.	Project

SWMP	Pursue a multipronged and interdepartmental approach to enforcement using tickets, signs, resident reporting, license plate tracking, and other tools to identify those who litter and dump illegally. City departments that will be involved in this effort include DPW, DHCD, BCPD, and the mayors' office.	Policy
SWMP	Create a DPW Environmental Enforcement Unit to patrol high-incidence areas and cite violators. This unit will focus on litter and illegal dumping hot spots and will rely on interagency collaboration, increased enforcement staffing, and community liaison presence.	Operations/Management
SWMP	Designate graffiti walls for graffiti artists	Program
SWMP	Improve education and outreach around diversion programs and initiatives: Described in Section 5.2 (SSR, organics, bulk waste, and other diversion programs). Improving education and outreach should improve participation in existing programs and increase residential diversion rates.	Promotions/Outreach
SWMP	Reinstate weekly curbside SSR collection: Described in Section 5.4 (curbside collection of SSR). Reinstating weekly curbside collection should improve participation and increase diversion rates for residential SSR (which are currently below 35% for paper, plastic, and metals).	Operations/Management
SWMP	Improve and expand organics collection: Described in Section 5.2 (organics) and Section 5.4 (yard waste and leaf collection). Expanding organics collection programs should allow more people to participate, improving diversion rates for organic waste (which are currently well below the 35% goal).	Operations/Management
SWMP	Construct (or support construction) of an in-city composting facility: Described in Section 5.2 (pilot facility) and Section 5.6 (full-scale facilities). Constructing an in-city organics processing facility should improve organics diversion from both the residential and commercial sectors (which are considerably below the 35% goal).	Infrastructure
SWMP	Improve reporting and enforcement of recycling from the commercial sector: Described in Section 5.2 (SSR, organics) and Section 5.4 (SSR collection). Improving enforcement of existing recycling mandates should improve participation in the programs, which should improve MRA rates. Improving reporting of recycling tonnages from the commercial sector should also improve MRA rates.	Study/Data/Metrics
SWMP	Install license tag readers and license scanners at QRL and the transfer station to better identify out-of-city vehicles and commercial haulers.	Operations/Management
SWMP	Install additional fencing and security cameras at residential drop-off centers to keep trespassers out and reduce illegal dumping inside the facilities.	Operations/Management
SWMP	Work with the Department of Human Resources to complete a class and compensation study to improve pay and benefits.	Study/Data/Metrics
SWMP	Implement a retention and hiring bonus policy for CDL drivers.	Operations/Management
SWMP	Hold monthly hiring fairs where CDL positions are prioritized.	Engagement

SWMP	Expand the CDL training program to allow for external candidates to participate in the program.	Program
SWMP	Provide shelters and upgrade break facilities for laborers at residential drop-off centers.	Infrastructure
SWMP	Create a plan to improve accessibility at residential dropoff centers.	Study/Data/Metrics
SWMP	Assess priorities for constructing a regional resource recovery park, reuse and repair clinics, and tool libraries to supplement the existing system of residential drop-off centers. The City is committed to engaging with regional partners to develop strategies and solid waste infrastructure to encourage source reduction, reuse, and diversion.	Study/Data/Metrics
SWMP	Consider implementing a cardboard bailing operation at one of the drop-off centers.	Study/Data/Metrics
SWMP	Consider a glass separation pilot program to improve the quality of diverted glass.	Study/Data/Metrics
SWMP	Expand opportunities for tire, HHW, and metal recycling.	Operations/Management
SWMP	Assess ways to increase the number of HHW recycling days offered at drop-off centers.	Project
SWMP	Repair or replace the inactive maintenance building.	Infrastructure
SWMP	Repair deteriorating parking lot and road conditions.	Infrastructure
SWMP	Construct a composting facility (see Section 5.6 for additional details).	Project
SWMP	Encourage construction of a nearby reuse facility (such as a food bank, C&D salvage and reuse center, a thrift store, or a fix-it/repair clinic). It is anticipated that this facility would be constructed by the private sector.	Technical Assistance
SWMP	Improve functionality and traffic flow.	Operations/Management
SWMP	Construct ETS	Project
SWMP	Expand and renovate the other drop-off centers to improve waste diversion and increase capacity and functionality.	Infrastructure
SWMP	After expanding the Bowleys Lane and Reedbird Drop-off Centers, the City intends to provide additional reuse and diversion opportunities at these and the Sisson Street facility. Additional reuse and diversion opportunities considered at the expanded facilities include the following: a. Bulk waste donation and reuse b. Mattress recycling c. Textile donation.	Operations/Management
SWMP	Advocate for an increase in funding levels to maintain a 20% reserve of vehicles and staff.	Advocate
SWMP	Develop and implement a collection performance standard for its trash and SSR collection fleet.	Policy
SWMP	Work with the Department of Human Resources, labor unions representing solid waste workers, and the Office of the Labor Commissioner to complete a class and compensation study to improve pay and benefits.	Study/Date/Metrics

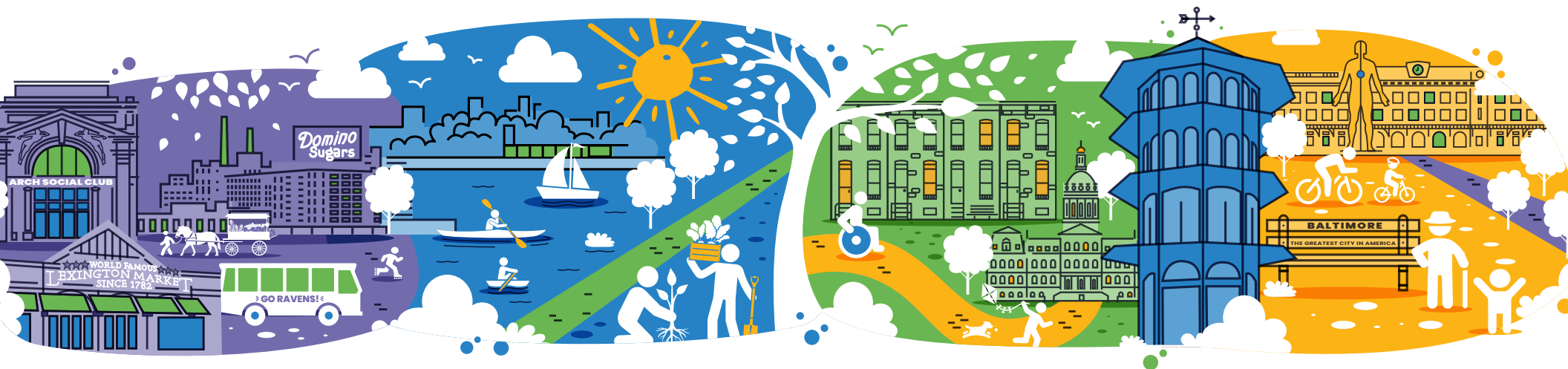
SWMP	Implement a retention and hiring bonus policy.	Operations/Management
SWMP	Hold monthly hiring fairs where CDL positions are prioritized.	Engagement
SWMP	Expand the CDL training program to allow for external candidates to participate in the program.	Education
SWMP	Coordinate with DHCD to develop incentive programs for landlords that provide trash and recycling bins to residents.	Incentives
SWMP	Coordinate with DHCD to improve enforcement of trash and recycling collection at apartments and condominiums.	Operations/Management
SWMP	Implement stricter hauler licensing requirements to require private haulers to report on the source, destination, and tonnage of all materials collected or disposed in or outside the city.	Policy
SWMP	Hold community-engaged seminars intended to gather data on the barriers and motivations of residents as they relate to recycling activities, gather group pledges to foster behavior change around recycling habits, and build public understanding of the connections between zero waste, recycling, health, climate change, and local resilience.	Study/Data/Metrics
SWMP	Build a zero-waste coalition to gather stakeholders from the residential, institutional, and recycling sectors with the City to identify benefits, barriers, and priorities for zero-waste programs and services in the city.	Convene/Facilitate
SWMP	Develop and deploy resources to improve recycling habits. Resources may include a guide to what is and is not recyclable in the curbside program or social media campaigns to dispel myths around recycling.	Promotions/Outreach
SWMP	Develop community-based, social-marketing campaigns to inspire behavior change using social norms, social diffusion, and public pledges as mechanisms for change.	Promotions/Outreach
SWMP	Offer workshops to help residents experiment with sustainable resource management behavior shifts. Workshops may include community recycling sorts to identify contamination.	Education
SWMP	Ensure education and outreach initiatives are equitable and accessible by incorporating language access practices, providing access to residents with disabilities, and holding workshops and seminars in locations that are accessible by public transit.	Promotions/Outreach
SWMP	Increase the number of full-time CDL trash and SSR collection drivers and laborers.	Operations/Management
SWMP	Improve vehicle maintenance to achieve a breakdown rate of less than 20%.	Operations/Management
SWMP	Reduce the number of stops per route to 1,050 for trash collection and 2,200 for recycling collection.	Operations/Management
SWMP	Increase the number of full-time CDL trash and SSR collection drivers and laborers.	Operations/Management
SWMP	Increase the size of the SSR collection fleet.	Operations/Management

SWMP	Work with the Department of Planning, DGS, and DOT to update fleet to accommodate alleys and bike lanes.	Project
SWMP	Reduce the number of stops per route to 950 for trash collection and 1,300 for recycling collection.	Operations/Management
SWMP	Return to weekly recycling collection as soon as possible contingent on acquiring necessary equipment and meeting staffing demands.	Program
SWMP	Upgrade its collection fleet to include onboard technology to improve routing efficiency and performance.	Operations/Management
SWMP	Develop a system to improve data tracking on business recycling collected curbside.	Study/Data/Metrics
SWMP	Perform an operational review to determine the best path forward to optimizing bulk waste collection.	Operations/Management
SWMP	Improve staff training.	Education
SWMP	Create a method to recycle white goods collected curbside.	Operations/Management
SWMP	Improve the process for tire and propane tank pickup.	Operations/Management
SWMP	Explore options to make bulk waste pickup more accessible to residents with disabilities.	Operations/Management
SWMP	Improve education and outreach initiatives	Promotions/Outreach
SWMP	Improve access to backyard composting: See Section 5.3 (Organics).	Operations/Management
SWMP	Develop a separate yard waste and leaf collection program: See section 5.2 (Organics).	Program
SWMP	Construct or encourage construction of an organics processing facility: See Section 5.7 (Proposed Composting Facilities).	Infrastructure
SWMP	Purchase additional equipment to increase the amount of material that can be accepted and processed)Specific equipment is identified in the SWMP)	Project
SWMP	Implement a Workforce Development Program at Camp Small with a six-month paid training course to city residents facing employment barriers	Program
SWMP	Conduct a marketing campaign to educate and inform residents about Camp Small and wood recycling.	Promotions/Outreach
SWMP	Collaborate with DPW and the Office of Waste Diversion to provide woody material for composting after the City develops local composting capacity (see Section 5.2.2 and 5.6.3).	Project
SWMP	Conduct a financial and feasibility study to determine the preferred option for developing additional processing capacity.	Study/Data/Metrics

Baltimore Climate Action Plan Update

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LAND ACKNOWLEDGMENTS

The Baltimore Office of Sustainability acknowledges that, according to research conducted by the Maryland State Arts Council through tribal consultation, feedback from local experts, and archeological findings, the precolonial histories of the lands known today as Baltimore City and Baltimore County are linked to ancestors of the Piscataway, whose various bands still live in Maryland, the Susquehannock, and other tribal nations. Since the mid-twentieth century, Baltimore has also been home to the largest community of Lumbee people outside of their tribal homeland in North Carolina, as well as members of other southeastern tribal nations such as the Haliwa Saponi and Coharie. Furthermore, Baltimore is presently home to members of many different tribal nations who hail from all parts of the Americas.

The Baltimore Office of Sustainability also recognizes:

- The complex history of the land upon which our city was founded and currently has jurisdiction over. We pay respect and give thanks to the Indigenous tribes who have stewarded these lands since before they were colonized, and to Black/African American, Latino, Asian, immigrant and migrant populations, members of the LGBTQ++ communities, persons with disabilities, and others who have been historically exploited in this region through enslavement, indentured servitude, incarceration, and subjugation, or otherwise mistreated or excluded from contributing to critical land-use decisions about the lands that comprise the greater Baltimore region. We also want to address a too-common impression that Native people (also known to others as Native Americans, American Indians, Indigenous Peoples, Original Peoples of North America, or First Nations) are not presently in Baltimore City. This does not accurately reflect the fact that Native peoples of many nations exist, dwell and contribute to Baltimore City and its surrounding region.
- This statement is not in and of itself an outcome, accomplishment or symbol of progress, but merely a starting place from which to begin deeper and more contextualized dialogue and thoughtful actions that address the pains, struggles and joys of our shared and unique pasts and the futures we'd like to curate together as a city. Land use decisions play a critical role in the past, present and future of our city.

- The history of enslaved Africans, whose descendants now may identify as Black and/or African American, Caribbean American or Afro-Latino, or with another country of origin, or as Native peoples and other subjugated peoples on these lands. The enslavement of Africans was tethered to white supremacy, capitalism, and extractive economies – yielding a yet to be quantified amount of wealth for private industries, institutions (academic and otherwise), and local and other descendants of wealthy colonial land-owning families.
- The complex past of these lands known in present day as Baltimore City, that were stewarded by the aforementioned peoples and their descendants who were displaced, enslaved, incarcerated, subjugated or otherwise mistreated or excluded from contributing to critical land-use decisions on the lands that comprise the greater Baltimore region and the Chesapeake Bay Watershed, call for repair, reconciliation and atonement through the most appropriate measures. These measures may include but should not be limited to the allotment of sacred lands for Native peoples of these lands, reparations for Native peoples and descendants of enslaved Africans, intentional incorporation of Indigenous peoples’ teachings and practices into modern narratives and practices of environmental protection, and other actions to compensate for the harm inflicted upon Indigenous, Black and other People of Color on these lands, and reconciliation with past atrocities which took place on the land today known as Baltimore City, MD.



A HEARTFELT THANK YOU

We thank everyone across Baltimore City who helped make the 2023 Climate Action Plan a robust, timely roadmap to reducing greenhouse gas emissions.

Thousands of residents and stakeholders responded to surveys, attended virtual and in-person workshops, events, and meetings, and shared their thoughts, comments, and ideas to guide climate action for years to come. Their suggestions and support will have a lasting impact on Baltimore.



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LETTER FROM THE MAYOR

On behalf of the City of Baltimore, I am honored to present the 2023 Climate Action Plan. The climate crisis is the defining challenge of our lifetimes and we are already feeling its impact. To tackle it, we must confront the crisis relentlessly.

This plan provides a comprehensive framework for the City of Baltimore to reach its ambitious greenhouse gas emissions goals while enhancing environmental justice, social equity, quality of life, and economic prosperity for everyone who lives, works, and plays in Baltimore.

Baltimore's 2023 Climate Action Plan (CAP) charts a path forward to increased energy efficiency, switching to low or no emission fuels, reducing and diverting waste, encouraging greater use of electric vehicles, public transit, and much more. The plan is just the beginning of a decade-long vision for ambitious climate actions that will require diverse strategies, significant time, talent, and support to accomplish. Through collaboration between agencies, governments, communities, and one another, our city can ensure we build resiliency and take the steps necessary to do our part in combating this crisis.

While Baltimore City government will play a critical leadership role in the implementation of this plan, achieving carbon neutrality by 2045 will require everyone. Engaged community members have worked alongside City employees, technical experts, nonprofit leaders, and so many others to set the goals and shape the actions included in this plan. As a result, the actions included in this plan are community-oriented. Both equity and effectiveness drove the creation of this plan to ensure people, businesses, wildlife, and ecosystems can thrive in Baltimore.

The 2023 CAP is a bold update to the 2012 Climate Action Plan that reflects our current climate challenges and – in combination with our 2019 Sustainability Plan – will guide our work to ensure our city is as resilient as possible as we confront the unprecedented challenges ahead.

We are all united by the common danger posed by the climate crisis. Together, we can, we will, we must make Baltimore a leader in climate resiliency.


Brandon Scott



LETTER FROM THE SUSTAINABILITY COMMISSION

The Commission on Sustainability is thrilled to share with you the 2023 Climate Action Plan. Since the original Climate Action Plan was adopted in 2012, residents, government agencies, nonprofit partners, and businesses have made major strides in reducing our city's greenhouse gas emissions. However, there is more to be done to achieve our targets, including making significant emissions reductions by the end of the decade and achieving full carbon neutrality by 2045.

While the 2012 plan had a strong focus on actions to reduce emissions, the updated plan includes a stronger emphasis on the social and economic impacts and benefits of the actions needed to reach our goals. This will enhance the ability of the City and local partners to consider the community benefits, costs, and cost savings of our climate actions as we prioritize implementation. The implementation roadmaps included in the plan provide guidance to the City and its partners to navigate and stay on track while pursuing the most complex elements of the plan.

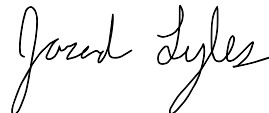
It is the job of the Sustainability Commission to monitor the implementation of the Sustainability Plan and Climate Action Plan. These plans are reflections of the voices of Baltimore, with parameters set for equity. As we have for the past decade, each year we will conduct an annual review, prepare an annual report, and actively seek your feedback as we ask "How are we doing?"

We hope that you will see the value in subscribing to working together as we renew our commitment to creating a more sustainable and resilient Baltimore.



Mia Blom

Co-chair, Commission on Sustainability



Jared Lyles

Co-chair, Commission on Sustainability



LETTER FROM BALTIMORE OFFICE OF SUSTAINABILITY & DEPARTMENT OF PLANNING

2023 has been a critical year for climate action planning in Baltimore City, the State of Maryland, and the entire country. Historic levels of federal funding combined with new ambitious climate targets under Maryland's Climate Solutions Now Act align well with our citywide climate planning. Climate change and resilience are top of mind for a growing number of people in Baltimore and beyond as the realities of climate threats are inescapable. As a waterfront city in the Chesapeake watershed, we experience rising sea level rivaled by few U.S. cities. Wildfires located hundreds or even thousands of miles away have led to dangerous air quality. Extreme weather continues to be more common and results in myriad challenges that threaten the health and well-being of people in the City, especially the most vulnerable people.

Our 2023 Climate Action Plan was developed in tandem with the FEMA-mandated Disaster Preparedness and Planning Project or DP3, and two critical state-regulated city plans: the Solid Waste Management Plan, and Our Baltimore, a comprehensive land use plan. We thank and greatly appreciate all the input, perspective that contributed to each of these planning efforts, especially from our residents. Your voices enhanced the CAP actions, challenged us to be more ambitious, bolder and move the needle on climate actions that mitigate the impacts of climate change.



Progress is already underway. Baltimore continues to be a leader in urban sustainability, having earned the Leadership in Energy and Environmental Design (LEED) Gold certification for cities, the world's most widely used green building rating system, by the U.S. Green Building Council, making the Climate Disclosure Project's A-List of city's leading climate change issues, expanding to 100+ publicly available EV chargers, and always anchoring our climate work to racial, and economic justice. Yet, we know much more aggressive action is needed. We look forward to working across city, state and federal agencies, collaborating with different governments and working with you, the people of Baltimore, so that 10 years from now people around the country will think of Baltimore as an international leader in urban climate resilience.



Chris Ryer
Director, Department of Planning



Ava Richardson
Director of Sustainability



GUIDING PRINCIPLES

The Climate Action Plan Update and other public plans set clear, measurable, and realistic objectives to improve Baltimore’s climate resilience and sustainability, however it is important that, as a city and community, we must consistently consider our activities, processes, and ways of operating to promote more sustainable, resilient practices. Implementation of Baltimore City’s 2023 CAP will be centered on the following principles. We encourage all those pursuing climate work across Baltimore City to use these principles to plan, execute, and evaluate your work.

1. Center equity by addressing mitigating, or alleviating unequal environmental burdens placed on environmental justice communities.
2. Recognize that environmental, social, and economic well-being is interconnected and take advantage of the transition to sustainable practices and to protect both our communities and the natural environment.
3. Regard climate resilience and sustainability as fundamental to improving the health, safety, and quality of life of the people who live, work, and play in Baltimore.
4. Seek to create co-benefits for the people, economy, and environment in Baltimore through climate action.
5. Consider long-term impact and benefits rather than only first costs in policy development and financial decision making, including but not limited to achieving carbon neutrality goals, mitigating risk related to extreme weather and natural disasters, and expanding people-centric design for increased non-vehicular traffic or low or zero emission transit as well as nature-based solutions.
6. Understand that public participation is critical to achieving carbon neutrality and environmental justice goals and authentically, strategically, and meaningfully engage the public in climate resiliency planning and in climate action.
7. Foster inter-agency and cross sector collaboration and authentic, strategic, and meaningful public participation in climate resiliency planning and climate action.



8. Value, preserve, steward, and promote our assets including the waters, natural resources, green spaces, and recreational features in Baltimore's urban environment and ensure equitable access for future generations to clean, healthy, and protected natural spaces and water.
9. Redesign, reduce, reuse, recycle and compost and recirculate would-be wasted materials into the local economy.
10. Leverage City general funds, investments, infrastructure, or capital projects to reflect the above stated values in all City-led projects, development, and infrastructure upgrades, and in City operations.



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ACRONYMS

BCRP: Baltimore City Recreation & Parks Department

BEPS: Building Energy Performance Standards

BGE: Baltimore Gas and Electric

BIPOC: Black, indigenous, and other people of color

CAP: Climate Action Plan

CO₂: Carbon dioxide

COVID-19: Coronavirus Disease of 2019

CSNA: Climate Solutions Now Act

DOE: U.S. Department of Energy

DOT: U.S. Department of Transportation

DP3: Disaster Preparedness and Planning Project

EPA: U.S. Department of Environmental Protection

EV: Electric vehicle

FEMA: Federal Emergency Management Agency

GGRA: Greenhouse Gas Reduction Act

GHG: Greenhouse gas

HUD: U.S. Department of Housing and Urban Development

IgCC: International Green Construction Code

LED: Light-emitting diode

MDE: Maryland Department of Environment

MDOT: Maryland Department of Transportation

MTA: Maryland Transit Administration

MTCO₂e: Metric Tons of Carbon Dioxide Equivalent

PPA: Power Purchase Agreement

SRECS: Solar Renewable Energy Certificate

SWMP: Solid Waste Management Plan

ZEV: Zero-emission vehicle



GLOSSARY

Key terms are defined below. Where these terms first appear in the document, the text is bolded to indicate that the term is defined in this glossary.

Baltimore Gas and Electric (BGE): a utility that provides service to more than 1.2 million electric customers and more than 650,000 natural gas/methane gas customers in central Maryland and is the primary service provider for Baltimore City.

Benchmarking: the practice of comparing the measured performance of a device, process, facility, or organization to itself, its peers, or established norms, with the goal of informing and motivating performance improvement. When applied to building energy use, benchmarking serves as a mechanism to measure energy performance of a single building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code).

Building Energy Performance Standards (BEPS)/ Building Performance Standards (BPS): policies that establish performance levels for buildings. These policies aim to reduce the carbon impact of the built environment by requiring existing buildings to meet energy and/or greenhouse gas (GHG) emissions-based performance targets. BEPS set a minimum threshold

for energy performance for existing buildings. BPS are energy or emissions targets that existing buildings must meet over time to improve energy efficiency and reduce climate and human health impacts.

Car-free zone: a district where motor vehicles are prohibited. Residents and visitors rely on public transport, walking, cycling or other modes that do not involve single use vehicles for travel within the zone as opposed to motor vehicles.

Carbon dioxide (CO₂): a chemical compound with the chemical formula CO₂. It is made up of molecules that each have one carbon atom covalently double bonded to two oxygen atoms. In the air, CO₂ is transparent to visible light but absorbs infrared radiation, acting as a GHG.

Carbon neutral: there is no net release of GHGs to the atmosphere by balancing the GHG emissions we create with the GHG emissions we remove from the air (also known as net zero emissions).

Circular economy: an economy that keeps materials, products, and services in circulation for as long as possible. A circular economy reduces material use; redesigns materials, products, and services to be less resource-intensive; and recaptures “waste” as a resource to manufacture new materials and products.

Clean energy: clean energy sources do not generate GHG emissions during the electricity generation process (e.g., sun, wind, geothermal, bioenergy, hydropower, biogas). Clean energy includes all renewable energy sources, but renewable energy does not include all clean energy sources.

Climate equity: The goal of recognizing and addressing the unequal burdens made worse by climate change, while ensuring that all people share the benefits of climate protection efforts. Achieving equity means that all people—regardless of their race, color, gender, age, sexuality, national origin, ability, or income—live in safe, healthy, fair communities.

Community land trust: a private, nonprofit organization that owns land on behalf of a community, promoting housing affordability and sustainable development and mitigating historical inequities in homeownership and wealth building.

Community leader: a person who represents, influences, and guides a community. A community leader may come from different sectors, such as government, nonprofit, or grassroots.

Community Solar: the U.S. Department of Energy (DOE) defines community solar as any solar project or purchasing program, within a geographic area, in which the benefits flow to multiple customers such as individuals, businesses, nonprofits, and other groups. In most cases, customers benefit from energy generated by solar panels at an off-site array.

COVID-19: Coronavirus disease of 2019 that created a global pandemic.

Electric vehicle (EV): a vehicle that uses electricity as a power source.

Energy audit: an examination of a building to find out how much energy is being used in it and if changes could be made to use less. It is an assessment of the energy efficiency of a building that identifies opportunities to save energy, reduce costs and improve the value of a property.

Energy burden: a measure of how affordable energy is for different households. It is determined by considering the percentage of household income spent on energy costs.

Environmental Justice Community: the U.S. Environmental Protection Agency defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. An environmental justice community is one that is overburdened and most impacted by environmental harms and risks.

Food rescue: the practice of gleaning edible food that would otherwise go to waste from places such as farms, produce markets, grocery stores, restaurants, or dining facilities and distributing it to people, not landfills or incinerators (also called food recovery, food salvage or surplus food redistribution)



Fossil fuels: fossil fuels are non-renewable resources that formed when prehistoric plants and animals died and were gradually buried by layers of rock. Fossil fuels include coal, oil, and natural gas. Fossil fuels produce large amounts of GHGs when burned.

Frontline or fence-line communities: areas in closest proximity to toxic, hazardous, or other harmful environmental exposures, thus on the front line of environmental injustices. These are often communities of color or low-income areas, whose neighborhoods often lack basic infrastructure to support them and who will be increasingly vulnerable as our climate deteriorates.

Greenhouse gases (GHGs): gases that trap heat. When fossil fuels are burned, they release GHGs into our atmosphere. The GHGs let the sun's heat through to the Earth and trap this heat around the Earth, causing climate change. Cities try to reduce the amount of GHGs they produce to fight climate change.

Green infrastructure: engineered solutions incorporating natural and built elements, such as rain gardens or green roofs.

Light-emitting diode (LED): a semiconductor device that emits light when an electric current flows through it. LED light bulbs are commonly used because they use less power than other options and they have long-lasting capabilities.

Low or no emission: low emission energy sources or vehicles/equipment produce fewer emissions than the average energy source or vehicle/equipment types. Low

emission fuel sources typically include biodiesel, ethanol, natural gas/methane gas, or propane. No emission energy sources or equipment produce no GHG emissions when used. No emission vehicles (also known as zero-emission vehicles) are certified to produce zero emissions of any criteria pollutants.

Maryland Transit Administration (MTA): a division of the Maryland Department of Transportation, and one of the largest multi-modal transit systems in the United States. MTA operates Local Buses (CityLink and LocalLink), Commuter Buses, Light Rail, Metro Subway, Maryland Area Regional Commuter (MARC) Train Service, and a comprehensive Paratransit (MobilityLink) system. It operates Baltimore's transit systems, including local buses.

Methane gas: a fossil fuel energy source (also known as natural gas).

Metric Tons of Carbon Dioxide Equivalent (MTCO₂e): the common unit for reporting an amount of GHGs. CO₂e can be determined by multiplying each GHG by its respective global warming potential.

Micro-mobility: a form of transportation using lightweight vehicles such as bicycles or scooters, especially electric ones that may be borrowed as part of a self-service rental program in which people rent vehicles for short-term use within a town or city.

Natural gas: a fossil fuel energy source that will be referred to as methane gas in this document.



Natural infrastructure: existing or rehabilitated environments for resilience, such as restored wetlands or urban forests.

Nature-based solutions: sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience.

Net zero: there is no net release of GHGs to the atmosphere by balancing the GHG emissions we create with the GHG emissions we remove from the air (also known as carbon neutrality).

Paratransit: a transportation service that supplements larger public transit systems by providing individualized rides without fixed routes or timetables.

Power Purchase Agreement (PPA): a long-term contract between an electricity generator and a customer, usually a utility, government or company.

Procurement: government procurement is the process by which the government acquires the goods and services it needs by purchasing from commercial businesses. Since agencies of the government use taxpayer money, there are a number of regulations on how to use it properly and responsibly.

Renewable energy: renewable energy is any form of energy that is replenished by natural processes at a rate that equals or exceeds its rate of use (e.g., sun, wind, geothermal, hydropower).

Retro-commissioning: a systematic process to enhance a building's current performance by recognizing operational improvements to ultimately save on energy.

Shared parking agreement: a contract between two or more parties that agree to share a parking area for a pre-determined amount of time.

Solar Renewable Energy Certificate (SREC): a market-based instrument that represents the property rights to the environmental, social, and other non-power attributes of renewable electricity generation. SRECs are created for each megawatt-hour of electricity generated from solar energy systems.

Zero-Emission Vehicle (ZEV): a vehicle that does not emit exhaust gas or other pollutants from the onboard source of power.



SUMMARY

In January 2022, Baltimore Mayor Brandon Scott set the following **greenhouse gas** (GHG) reduction goals:

- Reduce emissions 30% by 2025 below 2007 levels;
- Reduce emissions 60% by 2030 below 2007 levels; and,
- Reach carbon neutrality in Baltimore by 2045.

Baltimore's carbon neutrality goal aligns with those set forth in the Paris Agreement, a promise made by nearly 200 countries around the world to work together to fight climate change and limit global warming to 1.5 degrees Celsius compared to pre-industrial levels. Each country decides what they can do to help reduce their GHG emissions. It is a global effort to keep our planet and people safe. Similarly, under the Climate Solutions Now Act of 2022, **the State of Maryland aims to reduce emissions 60% below 2006 level by 2031 and achieve carbon neutrality by 2045.**

What does it mean to be carbon neutral?

Being **carbon neutral** means balancing the GHG emissions we create with the GHG emissions we remove from the air. We emit GHGs by cooking, driving cars, heating our homes, and other daily tasks. Actions that remove GHGs from the atmosphere, include planting trees or other vegetation, enhancing soil carbon or other ways to absorb carbon.

For years, the City has taken proactive steps to fight climate change. Certified as a LEED Gold city by the U.S. Green Building Council, Baltimore has pioneered innovative programs including the Community Resiliency Hub program, an impactful, community-centered initiative that increases capacity to prepare for, withstand, and respond to natural hazard impacts and emergency situations. The Hubs have provided services and assistance to thousands of people to relieve burdens caused by climate change and to provide support during hazard events. Another City of Baltimore program, TreeBaltimore, provides resources, materials, training, and coordination to empower community-based organizations to annually plant and distribute thousands of trees. The Department of Public Work's GROW Centers are pop-up events in neighborhoods and community gathering places across Baltimore where materials, resources and information are distributed in neighborhoods that help people make their communities greener, improve water quality, and more.

The City has progressed impactful climate actions, planning, and resource development. As a recent example, the City's green building code was updated in 2020 to improve energy efficiency in new buildings. In 2021, the Baltimore Complete Streets Manual was developed as a guide to help design roads, streets and blocks that are easier and safer to walk on, bike through, or more easily connect to buses, trains, and other forms of public transit.

The 2023 CAP Update is a guide to how Baltimore will meet its ambitious and critical goal to reduce carbon emissions by 60% by 2030. Following requirements in Baltimore City Ordinance 22-131, this CAP Update considers concerns beyond GHG reduction, including key environmental justice and community benefits such as public health. The resulting plan is a roadmap for the City in making decisions that reduce GHG emissions and address environmental injustice as we work toward a more sustainable, equitable, and resilient future.



RELATION TO OTHER BALTIMORE CITY PLANS AND BROADER CLIMATE RESILIENCE ACTIONS

The CAP Update dovetails with other public plans that outline climate and resilience actions and goals. This enables us to focus the CAP Update on GHG emissions reductions while advancing other important climate change-related activities. We conducted a thorough review of existing climate-related plans and coordinated with other planning efforts that were underway as the CAP Update was being developed (see **Appendix 1: Background Review**). Several key plans that complement the Climate Action Plan are summarized here.

SUSTAINABILITY PLAN (2019)

The Baltimore Sustainability Plan establishes priorities for how Baltimore can grow and prosper in ways that meet the current environmental, social, and economic needs of the community without compromising the ability of future generations to meet these needs. The Plan lays out a broad, inclusive, and community-responsive sustainability agenda to complement Baltimore’s existing Comprehensive Master Plan. It uses an equity lens to improve planning, decision-making, and resource allocation leading to more racially equitable policies and programs.¹

BICYCLE MASTER PLAN (2015)

The Bicycle Master Plan promotes and facilitates bicycling as a safe, convenient, and comfortable form of transportation and recreation in Baltimore. A plan to coordinate the formal integration of bicycles in existing infrastructure is necessary to improve safety and create a multi-modal transportation system friendly to the citizens of Baltimore. This plan guides Baltimore City in creating a lasting bicycle transportation program by²:

- Mapping out an integrated on-street and off-street bikeway network,
- Addressing bicycle parking and inter-modal bike/transit integration,
- Emphasizing safety education for motorists, bicyclists, and youths,
- Providing an action plan for biking encouragement and rules enforcement,
- Recommending transportation and development policy and program changes,

¹City of Baltimore. 2019. “Baltimore Sustainability Plan” *City of Baltimore*.

https://www.baltimoresustainability.org/wp-content/uploads/2019/01/SustainabilityPlan_Compressed_01-28-19.pdf

²City of Baltimore – Department of Planning. 2015. “Bicycle Master Plan.” *City of Baltimore*.

<https://transportation.baltimorecity.gov/bicycle-plan>



- Describing new bicycle facilities designs, and
- Detailing new roadway and trail maintenance management practices.

COMPLETE STREETS MANUAL (2021)

In 2018, Baltimore adopted a Complete Streets Ordinance that aims to change the local transportation landscape. The Complete Streets approach elevates the priority of pedestrians, bicyclists, and transit users in planning and roadway design to increase quality of life and mobility in Baltimore City. Major components of the Complete Streets Manual are³:

- Design standards for promoting safer streets, slower speeds, and increased walkability,
- Modal hierarchy for how the City government prioritizes different modes when planning and designing projects,
- Street typologies for classifying city streets and standardizing roadway layout,
- Project prioritization process that identifies and screens projects with an equity lens, and
- Community engagement policies centered around equity.

COMPREHENSIVE MASTER PLAN (2024)

The Department of Planning is developing an updated Comprehensive Master Plan for the City to direct economic growth and quality of life initiatives for the next 10 years. The new Comprehensive Master Plan, *Our Baltimore*, will be released in 2024 and will act as a comprehensive plan to guide the physical development of the city. The plan will be based on community input and values, with a focus on topics related to urban planning. It will identify what equitable neighborhood development looks like and map a concrete set of recommendations to move toward this goal.⁴

³City of Baltimore – Department of Transportation. 2021. “Baltimore Complete Streets.” *City of Baltimore*.

<https://transportation.baltimorecity.gov/sites/default/files/Baltimore%20Complete%20Streets%20Manual%20Final%20March%202021-compressed.pdf>

⁴City of Baltimore – Department of Planning. 2024. “Comprehensive Master Plan.” *City of Baltimore*.

<https://planning.baltimorecity.gov/planning-master-plan>



DISASTER PREPAREDNESS AND PLANNING PROJECT (DP3) (2023)

The DP3 is Baltimore’s combined hazard mitigation plan and climate adaptation plan. It is updated every five years to detail the City’s strategy to address existing and future local hazards due to intensifying climate change impacts. Risk is determined by quantifying hazard impacts on community assets, such as the population, built and natural environments, and the economy. The DP3 fulfills Federal Emergency Management Agency (FEMA) requirements to update Baltimore’s Hazard Mitigation Plan every five years to maintain eligibility for certain pre-disaster mitigation and post-disaster recovery funds. This funding, in addition to other funding sources, supports implementation of the long-term mitigation strategy developed during the DP3’s planning process.

SOLID WASTE MANAGEMENT PLAN (SWMP) (2023)

The Baltimore City 10 Year SWMP is a regulatory plan submitted to the Maryland Department of Environment (MDE) to map operational needs, constraints, and improvements for waste management within the City over 10 years. The plan consolidates goals for managing the City’s solid waste stream and assesses the existing solid waste collection systems, current and future disposal capacity needs, and how zero waste strategies like reuse, recycling, and composting are to be implemented.⁵

In addition to the plans listed, forthcoming plans, such as those focused on forest management, offer opportunities to support carbon removal and other actions that will advance GHG emissions reductions.



⁵City of Baltimore.– Department of Public Works. 2023. “10-Year Solid Waste Management Plan.” *City of Baltimore*. <https://publicworks.baltimorecity.gov/pw-bureaus/solid-waste/plan>

RELEVANT LEGISLATION AND GOVERNMENT INITIATIVES

Significant federal, state, and local legislation exists to govern how cities respond to climate change and to provide resources and assistance to help cities take climate action. While an exhaustive list would be too long to include in this plan, several recent laws and initiatives influence the CAP Update and provide some context to the actions and are summarized below.

The **Climate Solutions Now Act (CSNA)**, adopted in 2022 by the Maryland General Assembly, makes broad changes to the State's approach to reducing statewide GHG emissions and addressing climate change. The CAP Update goal to reach carbon neutrality by 2045 aligns with the CSNA goals.

The federal **Carbon Reduction Program**, created by the Bipartisan Infrastructure Law (BIL), facilitates:

- Use of public transportation facilities, pedestrian facilities, bicycle facilities, and shared or carpoled trips to reduce vehicle miles traveled by single-occupancy operated vehicles;
- Use of vehicles or modes of travel that result in lower transportation emissions; and,
- Approaches to the material use and construction of transportation assets that lower transportation emissions.

The Maryland **Carbon Reduction Strategy**, developed in consultation with the metropolitan planning organizations in Maryland, outlines approaches, programs, and projects to address transportation sector emissions.

The **National Blueprint for Transportation Decarbonization**, resulting from a joint agreement among the U.S. Department of Energy (DOE), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), and U.S. Department of Housing and Urban Development (HUD), is a strategy for cutting all GHG emissions from the transportation sector by 2050. Locally, Maryland Department of Transportation (MDOT) will help lead and coordinate State and local action to implement the strategy. Maryland and Baltimore are also exploring future, expanded transit options through the revived Red Line Project led by the **Maryland Transit Administration (MTA)** and supported by the City's Department of Transportation.⁶ The proposed Red Line is a 14-mile transit line that would provide service between the Woodlawn area of Baltimore County and the Johns Hopkins Bayview Medical Center. When complete, the Red Line will make it easier, faster, and cheaper to travel across the greater Baltimore area.

⁶ Redline. 2023. "The Baltimore region deserves great transit." *Redline*. <https://redlinemaryland.com/>



Maryland's **Greenhouse Gas Reduction Act (GGRA)** (2016) requires the State to achieve a 40% reduction in GHG emissions from 2006 levels by 2030 across all economic sectors. In 2021, the Maryland Department of the Environment published the 2030 GGRA Plan containing strategies to reduce GHGs across sectors, including investments in energy efficiency, clean and **renewable energy** solutions, clean transportation projects, widespread adoption of electric vehicles, and improved management of forests and farms to absorb carbon. In 2023, [Maryland's Climate Pathway Report](#) was released, detailing an analysis of actions that can help achieve statewide GHG emissions reduction goals.

A bill (23-0385) titled **Study and Report – Baltimore City Climate Resilience Authority** was signed by Baltimore Mayor Scott in October 2023 and requires the Director of Finance, the City Solicitor, the Director of Transportation, the Director of Public Works, the Director of Planning, and the Director of Sustainability to submit a report detailing how Baltimore City may establish a local climate resilience authority. A resilience authority is one mechanism for Maryland jurisdictions to organize and manage funding structures for large-scale infrastructure projects specifically aimed at addressing the effects of climate.



AUTHENTIC, MEANINGFUL & INTENTIONAL ENGAGEMENT

The CAP Update would not have been possible without involvement and feedback from thousands of residents, **community leaders**, stakeholders, and collaborators across our great city. We worked diligently to provide everyone who lives, works, plays, learns, grows, and ages in Baltimore an opportunity to play a role in the development of this plan. We also used plan outreach as a chance to spread the word about the impacts of climate change, to learn more about community concerns that relate to climate action, and to identify ways to work together to take the actions outlined in the CAP Update. We asked for your opinions and collected your ideas over more than two years. In our outreach and engagement process, we sought input from communities too often left out of climate conversations, decisions, and planning: **frontline**; environmental justice; black, indigenous, and other people of color (BIPOC); and under served communities. These efforts aside, we acknowledge the limitations of our outreach resources and capacity during the plan engagement process. We thank everyone who took the time to push us to be bolder, challenged the scope or limits of actions, attended public events, completed surveys, and provided comments and thoughtful, constructive feedback. We owe special thanks to the CAP Resident Advisory and Technical Advisory Councils, two groups that helped significantly shape the plan. See **Chapter 1: The Purpose of Our Climate Action Plan** for more information about CAP Update outreach and engagement.

CAP UPDATE

This CAP Update will help the City take steps to address the issue of climate change by reducing its GHG emissions. The focus of this plan is meeting the 2030 target of reducing emissions by 60% compared to 2007 levels, with strategies and actions that will prepare the city to achieve their long-term carbon neutrality target. The plan identifies community-wide sources of GHGs, sets goals to reduce emissions, and centers climate equity in implementation. The climate actions within this plan are divided into: community-wide actions and municipal actions

- **Community-wide actions** focus on reducing community-wide GHG emissions and require broad participation.
- **Municipal actions** focus on reducing emissions produced by City government activities.

The CAP Update contains five focus areas described below that address electricity, buildings, transportation, waste, and **nature-based solutions** that remove carbon.



BUILDINGS

Baltimore's 2019 Sustainability Plan actions advance energy efficiency, decrease the use of **fossil fuels**, and promote programs to reduce energy burdens. In 2019, buildings and other facilities across Baltimore generated 64% of all GHGs emitted (electricity use generated 34% of total emissions while methane gas and heating oil use generated 30% of total emissions). Methane gas and home heating oil are burned in power heaters, stoves, and other equipment in buildings across the city.⁷ Switching to all-electric options aligns with Baltimore's climate goals as a city and can improve indoor air quality, lower asthma risks, and reduce household toxins. In this section we focus on actions that can be taken in Baltimore to reduce GHG emissions from buildings by:

- Enhancing energy efficiency,
- Reducing the amount of energy used to heat, cool or light buildings, and
- Switching to equipment and appliances that are electric or use other **low or no emission** energy sources.

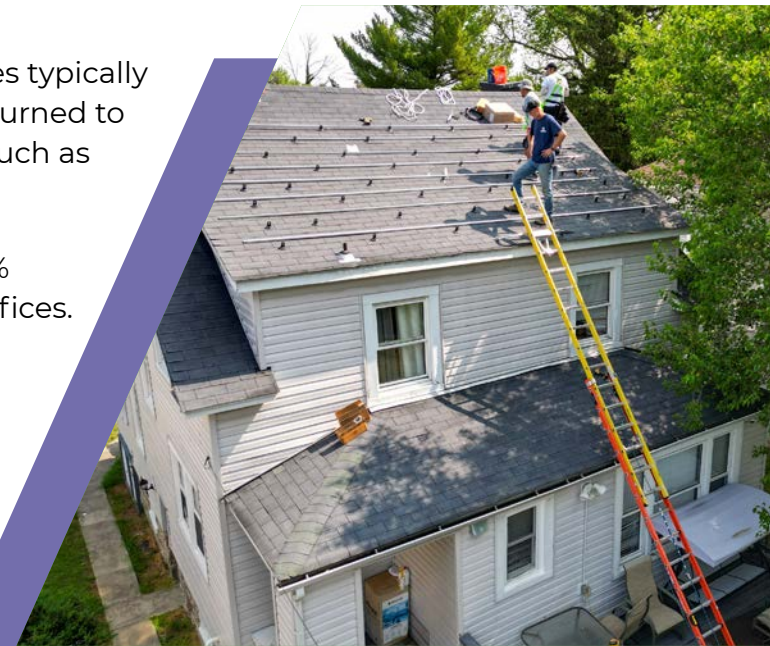
ELECTRICITY

Electricity can be generated from many different energy sources. These sources typically include fossil fuels, such as coal, methane gas, and oils that emit GHGs when burned to make electricity. Electricity can also be generated from clean energy sources such as solar, wind, or geothermal.

In Baltimore, 34% of electricity emissions were from residential homes and 66% were from industrial and commercial buildings likes restaurants, stores, and offices.

A primary reason that the city's electricity use produces such a large amount of GHGs is because over half of our electricity is generated by burning fossil fuels. We can reduce GHG emissions from electricity by using cleaner energy sources.

As we transition towards electric buildings and vehicles to reduce GHG emissions, it will be critical that we also switch our electric energy sources to **clean energy** sources in an equitable, thoughtful way.



⁷ Natural gas is referred to as methane gas throughout this document.

This will help ensure that our electric infrastructure can reliably support the increased demand, that our electric grid improvements are centered in climate equity, and that new clean energy development is done in a way that protects natural habitats and migratory patterns. To reach our 2030 emission target of a 60% reduction, more buildings need to be powered by clean energy sources, meaning we will need more rooftop, **community solar**, and creative ways to capture solar energy such as solar canopies, solar trees, and solar in parks. In this section we focus on actions that:

- Promote the adoption of clean energy locally, and
- Improve the capacity and reliability of electric infrastructure

TRANSPORTATION

The [Baltimore Complete Streets Manual](#), released in March 2021, commits the city to a “transportation network that is safe, accessible, and efficient for all users of all abilities.” Complete Streets sets a “modal hierarchy” that first prioritizes walking; then cycling, public transit, and **micro-mobility**; followed by taxis, commercial transit, or shared vehicles. Gas-powered cars, trucks, or other single occupant vehicles are the least preferred method of transportation for people based on this hierarchy.

In Baltimore, transportation is a major source of GHGs, generating 23% of all community-wide emissions in 2019. Streets designed for people on foot (walking) or wheels (including wheelchairs, bikes, scooters, or other small wheels) to travel safely for school, work, shopping, or leisure is central to our shared sustainable and equitable futures. Baltimore’s transportation inequities result in poor access to safe travel options – too often an added burden for Black, Latino, marginalized and low-income communities. Many of the same communities dealing with few accessible transit options must also deal with worse air quality due to heavy traffic or vehicle idling.

We can use Complete Streets guidelines to provide people-centered design that creates safer streets while addressing unequal or insufficient access to reliable transit modes and reducing GHG emissions.



Transportation actions will result in additional community benefits that will help reduce traffic and noise, make it easier and safer to get around, support better air quality by reducing local air pollutants, and foster more active lifestyles. Actions in the transportation section of the CAP Update aim to:

- Reimagine neighborhoods so that homes, workplaces, and shops are closer together,
- Make it easier to get around by biking, walking, and taking public transportation,
- Expand access to **electric vehicle** charging stations,
- Promote the use of electric vehicles, and
- Encourage and increase opportunities to conveniently carpool and vanpool to work.

WASTE

In the 2018 Food Waste Recovery Strategy, Baltimore set goals to reduce commercial food waste by 50% and divert 90% of City government food and organic waste and 80% of household waste from landfills or incineration by increasing composting and other strategies. In 2023, Baltimore’s latest SWMP was also adopted to guide our path to a zero-waste future.⁸

Section 1.2 of the SWMP expresses Baltimore’s “desire to move toward a **circular economy**, and [...] to prioritize reduction, reuse, recycling, and composting options wherever possible.” A circular economy “keeps materials, products, and services in circulation for as long as possible” and “reduces material use, redesigns materials, products and services to be less resource intensive, and recaptures ‘waste’ as a resource to manufacture new materials and products.”

Waste generates 13% of our GHG emissions, but the environmental burdens and health impacts of waste-related facilities are not equally shared across the city. For instance, South Baltimore residents, families, and children shoulder an unequal, unjust burden of living near waste facilities that pose public health threats. Preventing, diverting, and recirculating the value of waste items in our local economy is imperative to protecting the health and well-being of environmental justice communities and all people in Baltimore.

⁸ City of Baltimore – Department of Sustainability. 2018. “Baltimore Food Waste & Recovery Strategy.” *City of Baltimore*. https://www.baltimoresustainability.org/wp-content/uploads/2018/09/BaltimoreFoodWasteRecoveryStrategy_Sept2018_FINAL.pdf

Legislative, administrative, and programmatic goals across seven diversion programs are detailed in the SWMP's 10-year vision. In this section, we build on SWMP actions to identify additional actions with public health, environmental justice, and GHG reduction impacts, while elaborating on the actions climate partners across Baltimore can take to meet waste reduction goals, such as:

- Supporting local and state legislation that bans organics, single-use plastics, or other recyclable materials from landfilling and/or incineration,
- Improving education, outreach, and engagement related to waste prevention, reduction, diversion, zero waste planning, composting, and other organic waste reduction goals and pathways to a circular economy, and
- Supporting the City-mandated deconstruction policy to require construction and development projects to divert a certain percentage of their waste from disposal and encourage reuse of construction and demolition materials.

NATURE-BASED SOLUTIONS

People and wildlife in Baltimore benefit every day from existing natural resources, such as forests and street trees, that help us cope with increasing temperatures and store carbon. As a city with an iconic waterfront with two ports, a robust park and green space system, one of the largest urban forests in the country, and many other natural assets, many of our businesses, industries, community connections, and recreational opportunities are linked to our natural resources.

The CAP Update seeks to protect existing nature-based solutions through conservation, increase them through environmental restoration and, support sound land use and management policies. These solutions provide great community benefits such as cool spaces to enjoy on hot days and beautiful places for community gathering. **Green infrastructure** such as rain gardens attract pollinators and slow and filter stormwater before it pollutes our waterways. Vacant and underutilized spaces can be converted into land that serves community needs such as hyperlocal food production or play spaces where children can enhance their creativity and problem-solving skills. They can be home to native and migratory species and so much more.

In this section of the CAP Update, we draw attention to the Sustainability Plan, as well as plans created by Baltimore Department of Recreation and Parks and others. We also call attention to efforts underway in communities led by



nonprofit organizations and other local champions of nature-based resilience solutions. Actions in this section aim to:

- Remove carbon from the atmosphere by expanding public and private green spaces, and
- Promote green and natural infrastructure that provides climate resiliency benefits.

To carry out this plan, we will monitor GHG emissions by conducting a GHG inventory every three years. The GHG inventory estimates the amount of GHGs Baltimore creates each year. It also shows the sources of GHGs, like from transportation or buildings. Updating the inventory keeps us on track to becoming carbon neutral by 2045.

To put this plan into action, we will partner with communities to find the tools and resources needed to secure the right solutions for each community, with priority given to frontline communities. We will work to empower and uplift young people, businesses, institutions, and other stakeholders to do their part in carrying out the actions in this plan. We will coordinate with the State and federal government and participate in international coalitions to secure resources and ideas for Baltimore to learn from and apply here at home. On a local level, City agencies will work together through an inter-agency Sustainability and Resiliency Subcabinet to implement the actions in the CAP Update, find opportunities to integrate resiliency into City activities and functions, and identify new ways to help us achieve the goal of reducing GHGs by 60% by 2030.



The Purpose of Our Climate Action Plan

- Background
- Focus on Equity & Climate Justice
- Getting Everyone Involved
- Community Feedback Highlights



BACKGROUND

We burn **fossil fuels**, such as coal, oil, and **natural gas** (referred to as **methane gas** in this document), to drive our cars, heat our homes, and make electricity. Fossil fuels create pollution and release **GHGs** that act like a blanket around our planet, trapping the sun's heat and making the Earth warmer. This warming effect contributes to **climate change**, which leads to extreme temperatures, flooding, storm surge, and drought. This negatively impacts human health, property, and the environment.

The U.S. EPA states that even a 1-2 degree Celsius (2-4 degrees Fahrenheit) change in temperature can result in dangerous shifts in weather and climate. The EPA also reports that the global average temperature increased by 1.8 degrees Celsius (3.2 degrees Fahrenheit) between 1901 and 2016.⁹ People in Baltimore already live with the impacts of climate change. The [National Oceanic and Atmospheric Administration's](#) tidal gauge at Fort McHenry, as well as other official reports, show that relative sea level in the Harbor area has increased by 12 inches since 1900 and that high-tide flooding is now 300% to more than 900% more frequent along U.S. coastlines than it was 50 years ago. Flooding is becoming more common in Baltimore's waterfront areas, along streams, and even in neighborhoods. In addition to the risk to human lives, threats like sea level rise and flooding put businesses and infrastructure at risk, compromising jobs, economic prosperity, and overall livability.¹⁰

Air pollution and temperature extremes also pose public health risks. Summer days of extreme heat are more than just uncomfortable. They place people at risk of dangerous conditions such as heat stroke and heat exhaustion and can worsen many other health issues, particularly for children, older adults, and people with preexisting conditions. Extreme heat is expected to be one of the most common climate change-related health threats we all face. In 2023, Baltimore had seven code red days indicating that extreme heat is a great risk, especially for many of Baltimore's more vulnerable residents. Baltimoreans are dealing with climate change-related challenges that are expected to increase if we, as a community, do not take a more sustainable and equitable path forward. **Frontline, fence-line, or environmental justice communities** are more likely to be located near sources of pollution such as waste incinerators, coal-fired power plants, or other polluting industries; have poorer air quality, fewer trees, and less green space or foliage; and are more affected by extreme heat. BIPOC populations often live in environmental justice and

⁹ US EPA. 2022. "Impacts of Climate Change." *US EPA*. www.epa.gov/climatechange-science/impacts-climate-change

¹⁰ City of Baltimore – Department of Sustainability. 2020. "City of Baltimore Nuisance Flood Plan ." *City of Baltimore*. https://planning.baltimorecity.gov/sites/default/files/Nuisance%20Flood%20Plan_2020.pdf

¹¹ USGCRP. 2018. "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II". *U.S. Global Change Research Program*, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.



frontline communities, as race is the greatest predictor of unfair, unjust exposure to environmental toxins¹¹. The EPA notes that “Black and African American individuals are 40% more likely than non-Black and non-African American individuals to currently live in areas with the highest projected increases in mortality rates due to climate-driven changes in extreme temperatures.”¹² People in frontline communities are more likely to suffer negative health outcomes that result from climate change and more likely to lack the resources to mitigate the issues they face. In Baltimore’s communities broadly, greater attention and resources must be given to frontline communities to create an equitable, resilient city. We identify frontline communities according to the EPA definition for Environmental Justice communities.

This CAP Update will help the City take steps to address the issue of climate change by reducing its GHG emissions. The focus of this plan is meeting the 2030 target of reducing emissions by 60% compared to 2007 levels, with strategies and actions that will prepare the city to achieve their long-term 2045 carbon neutrality target. **This plan shows where our GHGs come from, sets goals to emit less, and explores how to achieve these goals.** Read this plan to learn:

- How we made this plan,
- The origins of our GHG emissions,
- How we plan to emit less, and
- The actions we will take to put the plan into practice.

¹²EPA. 2021. “Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency,” *EPA 430-R-21-003*. <https://www.epa.gov/cira/social-vulnerability-report>

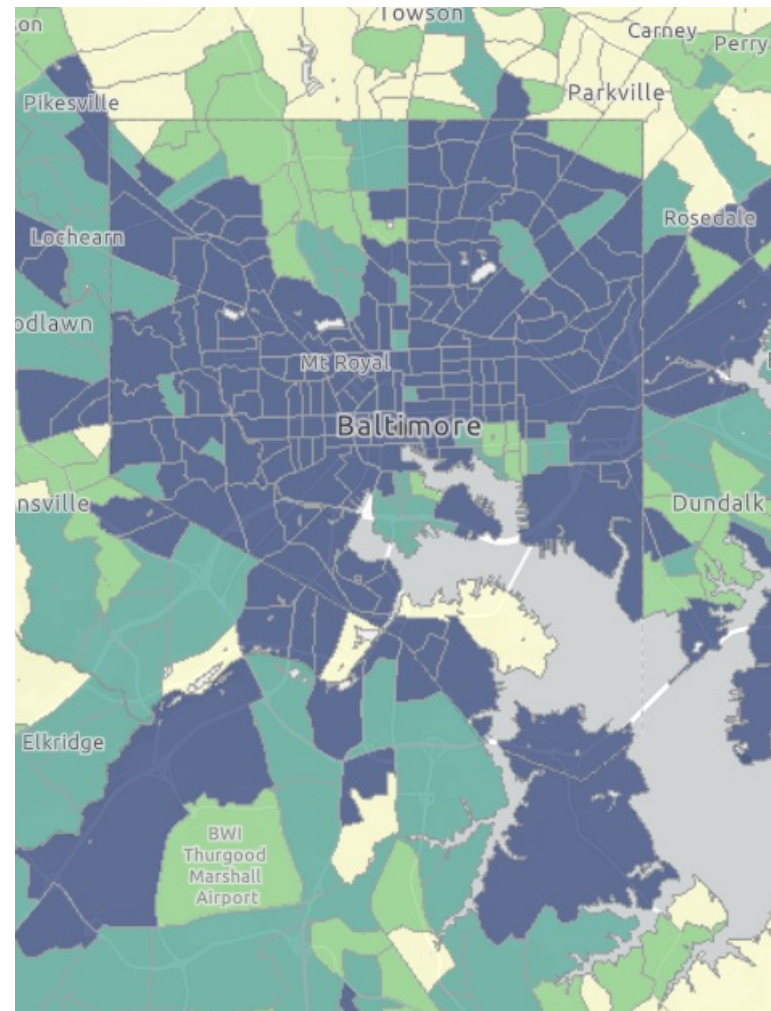
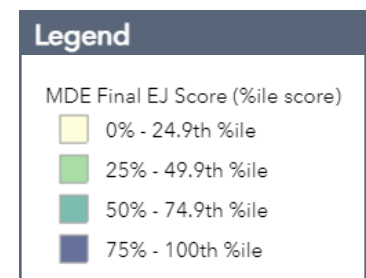


Figure 1: EPA Environmental Justice Communities
Source: EPA



Key Terms

Fossil fuels are burned in cars, power plants, and other equipment to produce energy. According to the American Geosciences Institute, three fossil fuels—coal, methane gas, and petroleum—accounted for nearly 78% of energy production in the U.S. in 2017.¹³ Petroleum, also known as oil, is made into gasoline and diesel, which powers most cars. Coal is often used in power plants to make electricity. Methane gas is often used in power plants and to heat our homes. Burning fossil fuels releases GHGs.

GHGs are gases that trap heat. When we burn fossil fuels, we release GHGs such as carbon dioxide, methane, and nitrous oxide into the atmosphere. The GHGs let the sun's heat through to the Earth and then trap this heat around the Earth, causing climate change. Cities try to reduce their GHG emissions, or the amount of GHGs they produce, to fight climate change.

Climate change describes how the Earth's temperature and weather is changing over time. Climate change causes many diverse issues. It can cause extreme heat *and* extreme cold. It can also lead to wildfires, droughts, storms, and floods. The climate has changed many times over the past millions of years, but now the climate is changing at an unprecedented pace because humans are releasing large amounts of GHGs.

Frontline or fence-line communities are those areas in closest proximity to toxic, hazardous, or other harmful environmental exposures, thus on the front line of environmental injustices. These are often communities of color or low-income areas, whose neighborhoods often lack basic infrastructure to support them and who will be increasingly vulnerable as our climate deteriorates.

Environmental justice communities The U.S. Environmental Protection Agency defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. An environmental justice community is one that is overburdened and most impacted by environmental harms and risks.

¹³American Geosciences Institute. 2018. "What Are the Major Sources and Users of Energy in the United States?" American Geosciences Institute, *American Geosciences Institute*, www.americangeosciences.org/critical-issues/faq/what-are-major-sources-and-users-energy-united-states

FOCUS ON ENVIRONMENTAL JUSTICE & CLIMATE EQUITY

Baltimore remains one of the most segregated cities in the United States, according to Census data. It is undeniable that historic policy and planning decisions created and exacerbated inequity and inequality in Baltimore. Policies to deliberately segregate white and black residents—such as restrictive covenants, the Federal Housing Administration’s openly racist system for mortgage loan approval, urban renewal, redlining, and other policies—directly contributed to many of the environmental economic and social challenges Baltimore faces today. These challenges are often made more complex by climate change.

In the past and today, neighborhoods in Baltimore receive different levels of resources and investment. Climate change-related hazards have the potential to cause the most strain for low-income residents, who have fewer resources and face greater barriers to safety, adequate medical aid, and economic recovery after a climate event. Frontline, fence-line, or environmental justice communities face climate change challenges more than other neighborhoods. For example, frontline communities experience the following:

- Extreme heat made worse for environmental justice communities experiencing the urban heat island effect, which makes neighborhoods with fewer trees and green spaces hotter because heat becomes trapped in concrete and asphalt pavement. Little shade on very hot days to provide relief from the heat can lead to warmer temperatures compared to areas with more trees. As a result, people are more likely to experience health risks due to heat. Older homes in many environmental justice communities may not have air conditioners because retrofitting buildings is expensive or the extra energy required to operate them is cost-prohibitive, which are examples of energy poverty. Overall, extreme heat is typically more dangerous for people with lower incomes or social vulnerabilities. Climate change is causing more hot days, making this problem worse.
- In many Baltimore neighborhoods, the stormwater system is very old. As climate change causes more frequent and sudden rains, homes and streets are more likely to flood, particularly when neighborhoods have little green space, few trees, or other features to capture excess rainwater. This can place a great burden on any household, but the burden of expensive home repairs and replacement of possessions is likely to affect low-income households more. A house in a flood-prone area is likely to depreciate as more floods occur in the area, meaning that property values in flood-prone, frontline communities may decrease over time. Also, dampness and mold from flooding could worsen allergies, asthma, and other medical conditions if people are exposed to indoor flood damage.



- Much of the waste we throw out is burned or landfilled at facilities near the frontline community of Curtis Bay. The waste incinerator in south Baltimore is one of the city’s highest single-point sources of toxic pollution and GHGs, responsible for roughly 10% of all city emissions. Nationally, more than 75% of waste incinerators are in environmental justice communities. A 2019 report published by the New School revealed that “distinct characteristics of garbage incinerators in the United States is that they are often sited in communities of color and low-income communities, also known as environmental justice (EJ) communities.”¹⁴ This reality gives new meaning to the act of throwing away trash, waste, or other unwanted materials, because nothing truly goes away.

This plan was developed using a lens of equity and climate justice. Through implementation of this plan and other plans, Baltimore is taking needed steps to fully integrate equity into GHG emissions and all-hazards mitigation, climate adaptation planning, and implementation to support our most climate-vulnerable residents. While creating this plan, we were careful to make choices that would help reduce problems for frontline and environmental justice communities and to balance our decisions with high-impact actions that will benefit everyone in Baltimore. We talked to thousands of people who live across Baltimore. We visited frontline communities and spoke with people to make sure their concerns were addressed in the CAP Update, and to hear about their ideas regarding how City government could help them and their neighbors better address climate change in their communities. In addition to developing the actions in this plan with community members, we added several actions in response to feedback during the public comment period, including a section on nature-based resilience solutions, to ensure the plan reflects community values and priorities.

What is Climate Equity?

EPA notes that **climate equity** is the goal of recognizing and addressing the unequal burdens made worse by climate change, while ensuring that all people share the benefits of climate protection efforts. Achieving equity means that all people—regardless of their race, color, gender, age, sexuality, national origin, ability, or income—live in safe, healthy, fair communities.¹⁴

¹⁴ US EPA. 2023. “Climate Equity.” EPA. <https://www.epa.gov/climateimpacts/climate-equity#:~:text=Achieving%20equity%20means%20that%20all,safe%2C%20healthy%2C%20fair%20communities.>

GETTING EVERYONE INVOLVED

We spent months receiving input from people around Baltimore with a focus on reaching frontline communities, including attending nearly 100 community events to seek input. Community members, representatives from local organizations, and technical experts were deeply engaged in the development of the plan, particularly through the Resident Advisory Council (RAC) and the Technical Advisory Council (TAC).

RESIDENT ADVISORY COUNCIL

A group of 14 residents, called the RAC, helped with every part of making this plan. Over 80 applications to join the RAC were received. Members were selected based on why they want to help Baltimore become sustainable. Careful consideration was given to the composition of the group to ensure members came from diverse backgrounds and neighborhoods. Of the 14 members, half of the members identified as African American, Hispanic, Latino, Latinx, Native American, Indigenous, or Mixed Race. Six members were 35-50 years of age, two were 51-64 years of age, two were over 65 years of age, two were 25-34 years of age, one was 18-24 years of age and one was under 18 years of age. Each member brought unique perspectives, knowledge, and interest to the group. Two RAC members were students who shared a youth perspective. Members of the City's Sustainability Commission joined the RAC. RAC members were also compensated for their time to remove any potential financial barriers to participating in RAC work.



TECHNICAL ADVISORY COUNCIL (TAC)

Twenty-eight technical experts met regularly for months to help shape the CAP Update. TAC members came from different fields of practice, backgrounds, and areas of focus to help us identify actions that are well-rounded, effective, ambitious, and achievable.

We also spoke with several other groups and conferred with regional and national experts in climate change and in specific fields referred to in the CAP Update. Examples of these groups included the Mayor's Sustainability and Resiliency Subcabinet, the Sustainability Commission, and Community Resiliency Hubs.

OUR COMMUNITIES

More importantly, we heard from you and your neighbors. Community members shared ideas and concerns so that we could craft a plan that elevates and addresses climate issues and sparks ideas that are important to people in Baltimore, especially frontline communities. We attended community events like farmer's markets, festivals, and GROW Center pop-ups. We held open houses where people shared their thoughts. We held in-person and virtual workshops to discuss what goes into this plan, to consider how actions in the CAP Update could have additional benefits, and to ensure the actions are well-considered and increase the overall well-being of the people, communities, businesses, and all others in Baltimore.

As part of the engagement process, the City circulated a community survey asking residents about a range of topics. We wanted to know how extreme weather affects you, the modes of transportation used across the city, if climate change impacts how Baltimoreans feel in their homes' and in their neighborhoods', and how our community wants Baltimore City to respond to climate



change. Over 500 people responded to the survey. Of these, 25% of identified as African American or black; 39% of respondents were between the age of 25 and 35. City leaders, RAC members, TAC members, and many others helped us spread the word about CAP Update events, meetings, and its public comment period. We sent promotional toolkits and emails to hundreds of neighborhood associations and community groups as well as to the offices of public officials and others and asked them to spread the word. We distributed fliers at events and local libraries. We posted on social media to help people share their ideas. We made the draft CAP Update available for comment online and provided presentations and tutorials to walk you through the CAP Update so you could share comments. To show our respect for the time people invested, we paid people to participate in public meetings.

Moving forward, we will continue to work with community members across Baltimore to co-create solutions and work together as we implement the actions in the CAP Update.

Read more about the CAP Update community engagement process in **Appendix 2A: Community Engagement Plan** and **Appendix 2B: Community Engagement Summary**.

“ Thank you for all you’re doing to bring residents into this process. I know it takes a lot of work from lots of different folks to make it happen!” thought it was a very well-facilitated workshop.

“ I would love to learn more about how I can participate more actively to help Baltimore to become the greenest most-equitable city in the US. I believe that the city has so much potential and we are on the cusp of unlocking. ”

— **Baltimore Residents**





500+ SURVEY RESPONSES

Individuals who participated in Baltimore's Climate Action Plan Public Survey



2400+ UNIQUE ENGAGEMENTS

Number of Individuals the Climate Action Plan team engaged throughout the Climate Action Plan process



400 SURVEYS DROPPED OFF AT 27 LOCATIONS

12 West Baltimore, 7 East Baltimore, 3 North Baltimore, 5 South Baltimore



475+ WORKSHOP SIGN-UPS

Individuals who expressed interested in engaging with Climate Action Plan workshops



13 RESIDENTS ADVISORY COUNCIL MEMBERS & 8 MEETINGS

AC members provide feedback on engagement process & plan to ensure we are meeting our goals



416 ORGANIZATIONS CONTACTED ONLINE

Baltimore City non-profits, community groups and more contacted via email



100+ CLIMATE ACTION PLAN EVENTS

Events the Climate Action Plan team attended



300+ WORKSHOP ATTENDEES

Individuals took part in in-person & online workshops in Spring 2022

Figure 2: People Engaged Through the Climate Action Plan Update Process

COMMUNITY FEEDBACK HIGHLIGHTS

Table 1 shows some of the feedback from community members collected at public meetings and through surveys.

Subject	Concerns/Challenges	Suggested Solutions
Overall	<ul style="list-style-type: none"> • Impact of environment on mental and physical health • Extreme heat and air pollution • Equity issues in access to resources, impact of City policies, etc. • Lack of community trust in City government 	<ul style="list-style-type: none"> • Provide centralized guide on existing and new programs/incentives • Deliver education/outreach through trusted messengers • City should lead by example
Buildings & Electricity	<ul style="list-style-type: none"> • Aging/outdated buildings and electric infrastructure • Renters have little control over their buildings – building owner may pass upgrade costs onto renters • Misinformation and greenwashing of solutions • High energy costs 	<ul style="list-style-type: none"> • Provide incentives for building upgrades • Focus on large property owners, landlords and low-income neighborhoods • Protect renters
Transportation	<ul style="list-style-type: none"> • High cost of car ownership • Reliability and accessibility of public transportation • Availability of bike lanes • Lack of electric vehicle infrastructure • Safety in all forms of transport 	<ul style="list-style-type: none"> • Install more protected active transportation infrastructure (e.g., protected bike lanes) • Improve public transit options and service • Prioritize active/public transit options over electric vehicles
Waste	<ul style="list-style-type: none"> • Pollution from incinerator • Community cleanliness 	<ul style="list-style-type: none"> • Provide more education/outreach on reducing and diverting waste • Promote composting and food recovery

Table 1: Summary of Community Member Feedback | Source: AECOM



Our Targets to Reduce GHGs

- Where Baltimore's GHGs Come From
- GHGs in 2045
- Pathway to Reduce GHGs
- Challenges of Getting to Carbon Neutrality



WHERE BALTIMORE’S GHGs COME FROM

The Department of Environmental Health and Engineering at Johns Hopkins University developed **GHG emissions inventories** for the City in 2007, 2017, 2018, 2019, and 2020 to account for the quantity of the city’s GHG emissions from three emissions sectors: Buildings, Transportation, and Waste. The inventory follows the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) reporting framework that was developed by the World Resources Institute, C40 Cities Climate Leadership Group, and ICLEI – Local Governments for Sustainability. The GPC provides an accounting and reporting standard for tracking city-scale GHG emissions across primary emissions sectors.

The City government releases its community-wide inventories every three years and plans to move toward annual reporting. The last inventory conducted for the city was for calendar year 2020. Since this was the height of the **COVID-19** pandemic, 2020 is considered an abnormal year for emissions given the wide scale shutdowns and related reductions in vehicle emissions. Therefore, the 2019 emissions inventory is presented here as it provides the most recent, pre-pandemic emissions results. The GHG inventory, along with local growth indicators, helps us to predict how GHG emissions might change over time. In developing the CAP Update, we used information from the GHG inventory and explored technological strategies the City government, residents, and businesses could pursue to reduce GHG emissions to create a **GHG reduction pathway**. We also looked at challenges that may impact Baltimore’s ability to be carbon neutral.

2019 Community-wide GHG Emissions (MTCO₂e)

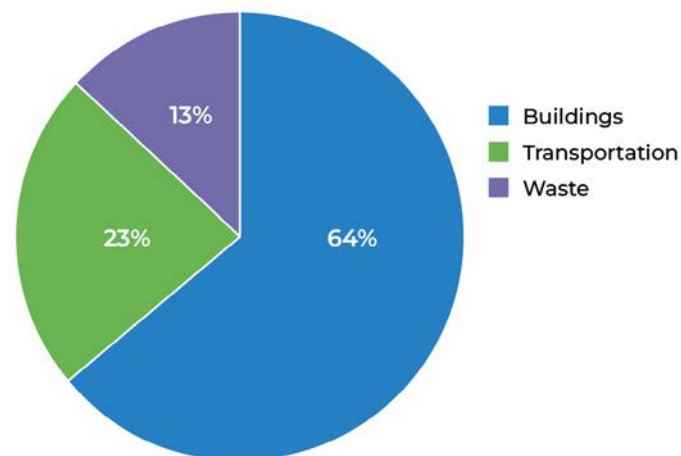


Figure 3: Community-wide Greenhouse Gas Emissions in 2019
Source: AECOM

“ I really think encouraging BOTH residents and commercial building owners/businesses/colleges to reduce energy will create a shared feeling of “we’re in this together.” ”

— Baltimore Residents at Community Workshop



COMMUNITY-WIDE GHG INVENTORIES

The community-wide GHG inventories show that the largest sources of emissions in Baltimore include buildings, which require heating and cooling; transportation, such as driving cars and trucks; and waste, which emits GHGs when processed. Figure 3 shows that the City produced 7,740,773 **metric tons of carbon dioxide equivalent (MTCO₂e)** in 2019. Buildings generate 64% of community-wide emissions by using electricity, methane gas, and heating oil. Electricity use alone generates 34% of community-wide emissions, from which 66% come from industrial and commercial buildings like restaurants, stores, and offices and 34% come from residential homes. This is because most of the city's electricity is generated by burning methane gas and coal. Transportation generated 23% of total emissions. Treating wastewater and sending waste to incinerators and landfills produced 13% of total GHG emissions.

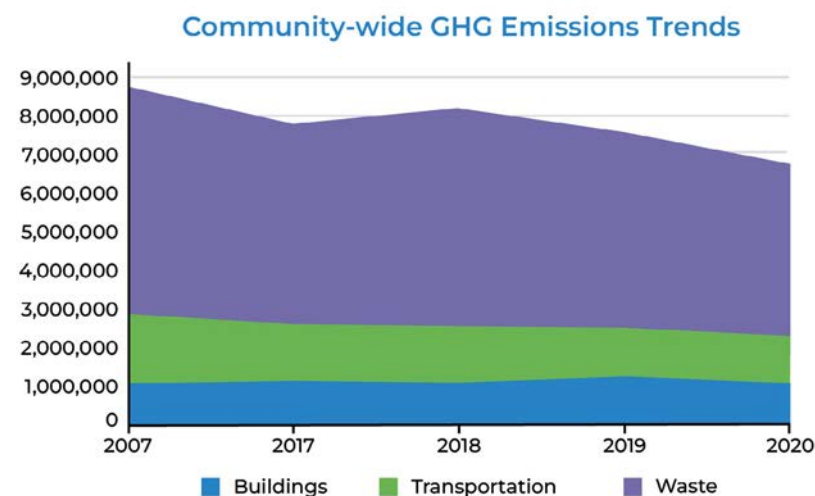


Figure 4: Community-wide Emission Trend | Source: AECOM

Overall, Baltimore reduced community-wide GHG emissions by 12% between its first GHG inventory in 2007 and 2019 (see Figure 4). In 2020, the city reduced community-wide GHG emissions by 23% compared to 2007. Some of that 2020 reduction came from COVID-19 restrictions, which have now ended.

MUNICIPAL GHG INVENTORIES

In addition to community-wide measurements, GHG emissions generated by City government activities were measured as well. City government GHG emissions are from activities such as operating government buildings like recreation centers and offices, driving vehicles to pick up trash and maintain infrastructure, and processing wastewater at treatment plants. Government activities generated 218,886 MTCO₂e in 2019. This was only 3% of total community-wide emissions. Just like Baltimore as a whole, most of the government's GHG emissions (68%) resulted from electricity use (see **Appendix 3: Municipal Greenhouse Gas Inventory and & GHG Reduction Pathway for more information**).

GHGs IN 2045

A **GHG forecast** predicts how the amount of GHGs may change over time. Figure 5 shows that Baltimore’s emissions could increase in the future if we do nothing, compared to what we need to do to reach our targets. If we took no further action to reduce emissions, GHGs may decline by 15% from 2007 levels by 2030 and 11% by 2045, meaning that we would not meet our GHG reduction goal. **Our targets are to achieve 60% lower GHG emissions by 2030 and carbon neutrality by 2045. To meet these goals, we need to take strong climate action right now.**

Community GHG Emissions Forecast and Target Trajectory

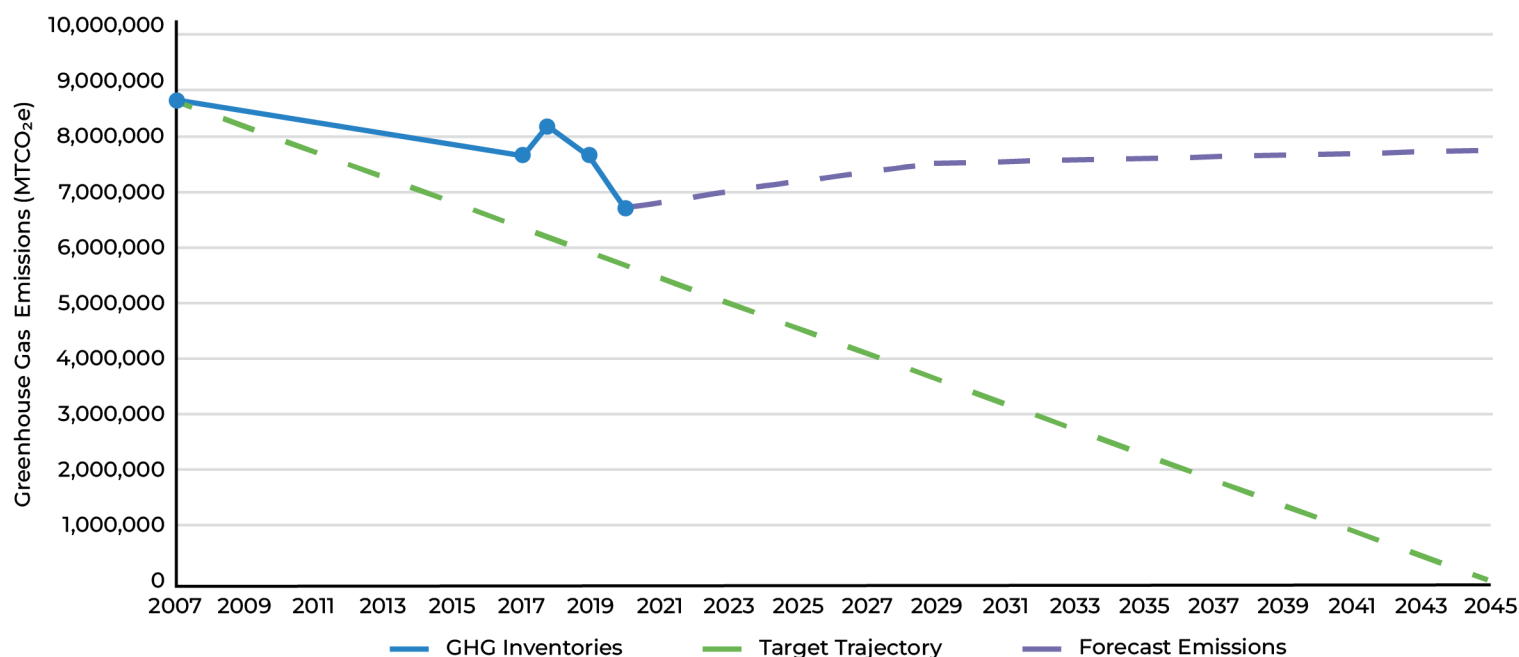


Figure 5: Community-wide GHG Emissions Forecast and Target Trajectory | Source: AECOM

PATHWAY TO REDUCE GHGs

To understand how to meet our targets, we developed a **GHG reduction pathway**. A GHG reduction pathway is made up of several **technological strategies** that help reduce GHGs. Technological strategies include increasing building energy efficiency, clean energy, and electric cars or other non-fossil fuel dependent technologies (see box below). The pathway shows what it will take for Baltimore to meet the 2030 and 2045 targets.



What are Technological Strategies?

Technological strategies are broad strategies that describe the technological shifts needed to reduce emissions in specific emission sectors. Each climate action in this CAP Update supports one or more of these broader strategies.

Decarbonize Electric Grid: Stop using electricity generated by burning fossil fuels. Switch to clean electricity sources such as wind and solar.

Building Efficiency and Fuel Switch: Design or upgrade buildings to use less energy. Use electricity instead of methane gas or heating oil to power buildings.

Vehicle Fuel Switch: Stop using cars and buses powered by fossil fuels. Instead, use vehicles powered by electricity or hydrogen fuel cells.

Travel Mode Shift: Stop driving in single-occupancy vehicles. Instead, walk, bike, and take public transportation.

Off-road Fuel Switch: Stop using fossil fuel-powered off-road vehicles and equipment, like cranes and tractors. Switch to vehicles that are not powered by low or no emission sources.

Waste Diversion: Reduce how much waste we send to the landfill or incinerator, especially organic waste such as food scraps and yard waste.

Wastewater Process Improvement: Improve how we clean and treat wastewater by using efficient processes.

Figure 6 shows Baltimore City's 2045 GHG reduction pathway.¹⁵ In this graph, the GHG forecast is the top dotted line. The bottom dotted line shows what is needed to meet Baltimore's GHG reduction targets. The GHG reduction strategies are the colored wedges between those two lines. Each colored section shows the GHG reductions from using a different strategy.

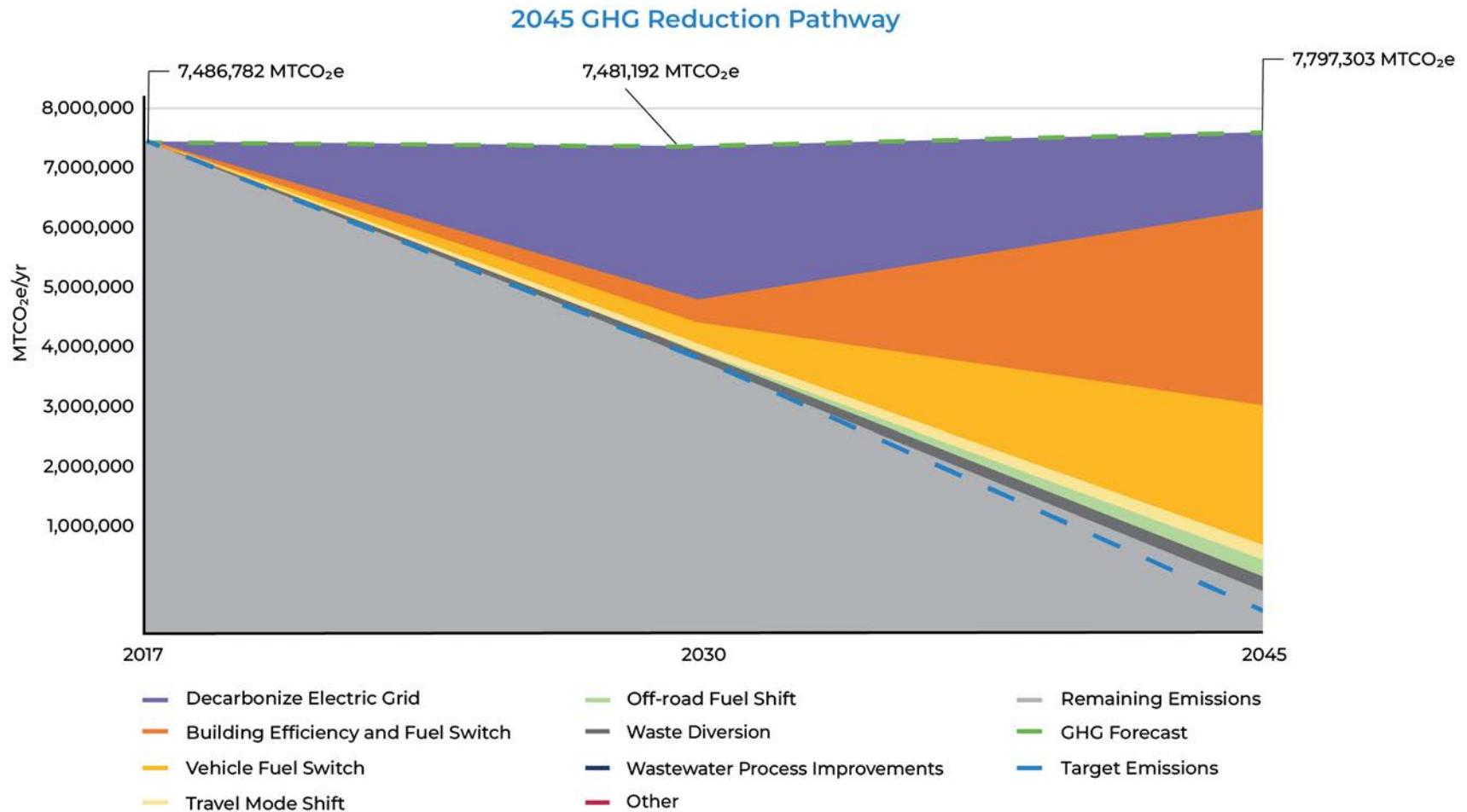


Figure 6: 2045 GHG Reduction Pathway | Source AECOM

¹⁵ 2017 was used as a starting point in the GHG reduction pathway instead of 2019 because 2019 data was not available at the time of pathway development. The 2017 inventory was updated from 7,486,782 MTCO₂e to 7,740,773 MTCO₂e by the Johns Hopkins University team after this pathway was developed.



The CAP Update and GHG reduction strategies focus on attaining Baltimore’s ambitious yet essential target of reducing emissions 60% by 2030. In Table 2, the column to the left shows the emissions source and the total GHG produced by that source. The column to the right describes the specific strategies that reduce GHGs from that source. Implementing these strategies now will be important steps to reach the 2045 goal.

Emissions Source and Percent of Total Emissions	Community-wide 2030 Greenhouse Gas Reduction Strategy (What it Will Take to Reach the 2030 Goal)
<p>Buildings: 64% of 2019 Emissions</p>	<ul style="list-style-type: none"> • 95% of the electricity used by the city is from clean energy sources.¹⁶ • 25% of fossil fuel building equipment and appliances are converted to highly efficient fossil fuel free or electric options. This means that most current equipment will need to be replaced with efficient electric options at the end of its useful life (60% conversion at end of life).
<p>Transportation: 23% of 2019 Emissions</p>	<ul style="list-style-type: none"> • 22% of vehicles used in Baltimore are electric or produce zero emissions. This means that most current vehicles will need to be replaced with electric vehicles (EVs) or zero-emission vehicles (ZEVs) at the end of their useful life (43% conversion at end of life). • 10% of the total vehicle miles traveled in the city are reduced by switching to active or public transportation. • 15% of off-road equipment is electric or produces zero emissions.
<p>Waste: 13% of 2019 Emissions</p>	<ul style="list-style-type: none"> • 42% of waste generated in the city is diverted from landfill • 5% of waste generated in the city is reduced • 5% of wastewater emissions are reduced

Table 2: Greenhouse Gas Reduction Pathway Strategies That Help Reach The 2030 Target. | Source: AECOM

¹⁶ Clean energy sources do not generate GHG emissions during the electricity generation process. Clean energy includes all renewable energy sources.

The **two most important strategies** are:

1. 95% of Baltimore’s electricity is from clean energy sources, like solar.
2. 25% of fossil fuel equipment in buildings (like methane gas heaters) is converted to efficient fossil fuel free or electric options.

These two strategies will create 85% of the emissions reductions needed to meet the 2030 goal.

We also developed a separate GHG reduction pathway for City government activities, which has similar strategies to the community pathway. See **Appendix 3: Municipal Greenhouse Gas Inventory and Reduction Pathway** for more information.

The community-wide GHG reduction pathway shows **what it will take** to meet the GHG reduction targets. It also helps us decide on **climate actions** that show **what Baltimore can do** to reduce GHGs. The climate actions identified in this CAP Update contribute to achieving one or more of these GHG reduction strategies.

CHALLENGES OF GETTING TO CARBON NEUTRALITY

The CAP Update prioritizes actions that reduce GHGs from the largest emissions sources. We recognize Baltimore and all communities seeking to achieve carbon neutrality will face technological, legal, behavioral, and financial challenges that may hinder progress. For example, it may be difficult for all large vehicles in Baltimore to be electric or zero-emission by 2045. There may not be optimal vehicle options available, or the new vehicles may be too expensive. Without expansion and upgrades, the electric grid could not support the significantly increased use of electricity, and those upgrades are likely to be costly which could increase electric rates for customers. Significant consideration and assessment have been given to potential trade-offs as we worked with community members and experts to develop the CAP Update. We will continue working with them and anyone who wishes to be involved so that the best climate solutions are chosen without placing additional burden on residents.



How We Are Taking Action

- Baltimore's Climate Actions
- Understanding How Actions Were Selected
- How to Read the Action Tables
- Actions That Help Reduce GHGs



BALTIMORE'S CLIMATE ACTIONS

In this document, an **action** is a specific task or step that will prevent or reduce the emission of GHGs. When we combine many actions, we can make progress toward our bigger goal, which is carbon neutrality by 2045. An action outlines what needs to be done, when it should be completed, and how to do it.

In this chapter we provide details about the specific actions we will take to reduce GHG emissions from electricity, buildings, transportation, waste, and we outline some additional actions focused on nature-based solutions, research, outreach, education, and coordination.

CHOOSING THE RIGHT ACTIONS

Climate actions were first developed by identifying specific steps City government could take to achieve each GHG reduction strategy. However, to achieve Baltimore's GHG reduction targets, actions needed to align with the Equity Implementation Guidelines in the city's 2019 Sustainability Plan, and bring together different groups of people. Careful consideration was given to think through the possible effects of each action. We were careful to make choices that would not unfairly burden existing environmental justice or frontline communities. We openly discussed trade-offs and the potential impact of actions at public meetings and in other forums so we could hear from a broader audience about how people may be affected by the actions taken. We thought of ways these actions could help the people who need it the most, while also considering best practices and opportunities for innovation. See **Chapter 1 The Purpose of Our Climate Action Plan** to learn more about the outreach and engagement process followed to develop this plan.

UNDERSTANDING HOW ACTIONS WERE SELECTED

Most climate actions do not just reduce GHG emissions, but also enhance community livability by improving air quality, supporting the local economy, providing opportunities for people to come together, and even offering opportunities for job and workforce development. Some actions are more impactful, some more costly, some take longer than others to start or complete, and some may require several steps like planning, policy development, or legislation to occur before we can begin working on them. To create a logical and effective action plan, we worked with the RAC to choose eight evaluation criteria to help prioritize which actions should be included in the CAP Update (see Table 3). These evaluation criteria help us test each action to decide which are most important to the community and should be pursued first.



Evaluation Criteria	Definition
GHGs Reduction Potential	How much the action will likely help reduce GHGs.
Public Health	How the action might affect people's health. For example, some actions help people live healthier and longer by making the air cleaner.
Economic Prosperity	How the action could affect Baltimore's economy. For instance, some actions create new jobs or provide opportunities for workforce development programs to train residents for jobs in growing industries like solar panel installation and maintenance.
Savings to Residents and Businesses	How the action might help people and businesses save money. For example, some actions help us spend less on power bills, travel costs, or fixing equipment in the future.
Resilience	How the action could help us address climate change events like floods or wildfires.
Social Cohesion	How the action might help people get along better and build stronger connections.
City Authority to Implement	How much power, capacity, and ability the City government has to make the action happen.
Savings to City of Baltimore Government	Whether the action could help the City government and the broader community save money over time.

Table 3: Evaluation Criteria and Definitions | Source: AECOM

Each action was scored on these eight criteria using the [Action Selection and Prioritization \(ASAP\) tool](#). This tool was created by the C40 Cities Climate Leadership Group to help cities select and prioritize climate actions through a comparison of benefits and challenges. The ASAP tool was used to evaluate the climate actions' GHG reduction potential and impact on the local evaluation criteria. The actions' GHG reduction potential was estimated by researching the impact of similar actions, while the actions' evaluation criteria impact was determined through discussions with City staff and other stakeholders.

Not every climate action can be taken immediately. Some actions require other actions, planning, or analysis to happen first to better inform decision making. To determine where to start, we used the ASAP tool results and community feedback to set a general **timeframe** for the actions and categorize them as near-, medium- and long-term (see Table 4). For actions categorized as medium- or long-term, action progress could potentially be made in the near-term, but actions may not be significantly advanced until later. To learn more about this process, see **Appendix 4: Action Prioritization**.

Timeframe*	Definition
Near-term	Actions will be advanced in 1-3 years
Medium-term	Actions will be advanced in 4-7 years
Long-term	Actions will be advanced in 8-10 years

*Action timeframes marked with an asterisk are already underway or ongoing

Table 4: Timeframe Level and Definitions | Source: AECOM

HOW TO READ THE ACTION TABLES

The actions are grouped by focus area:


- Buildings
- Electricity
- Transportation
- Waste
- Nature-Based Solutions
- Other Actions We Need to Take (these actions address multiple focus areas)

Each action is classified as a **community-wide action** or a **municipal** (City government) **action**. Community-wide actions reduce emissions across the entire community, while municipal actions reduce emissions from City government operations. Community-wide actions do not necessarily mean that community members will be in charge of enacting them—the City government will still have a leading role in action implementation, with community members serving a supporting role.



Most actions were evaluated for GHG reduction potential and community benefits. However, several actions were added in response to community feedback and were not part of the analysis that occurred before the CAP Update public comment period. Even though these actions did not undergo the same evaluation and selection process as other actions, they are important steps to take and are supported by the community and technical experts, so they were included in the CAP Update. These actions are included in the “Additional Actions” tables in each section.

The action tables show the action number, title, description, action type (community-wide or municipal), timeframe (near, medium, or long-term), GHG reduction potential (low, medium, high, or supporting), and community benefits (see Table 5).

Community Benefit	Public Health	Savings to Residents and Businesses	Economic Prosperity	Resilience	Social Cohesion
Symbol					

Gold Outline = Action has a very positive impact on the community benefit

Table 5: Community Benefits Symbols and Legend | Source: AECOM

BUILDINGS

A Story Set In 2030

*Keisha was excited for her family to rent their first ever **net zero** home! The home had LED bulbs that used very little energy and had solar panels on its roof. The windows had special coatings that kept the house warm in winter and cool in summer. Her family didn't need to run the heater or air conditioner as much. The appliances in the net zero home were super smart. The fridge, washing machine, and even the television were all chosen because they used less energy. And, the water heater was powered by the sun too, using a special solar water heater on the roof. Keisha didn't have to worry about high energy bills anymore. Their home's solar panels provided all the power her family needed.*

“ We need better codes, and more stringent. It needs to be a mandate, it can't be an incentive or a suggestion or an outreach, it needs to be mandatory for everyone if we want to survive in cities like Baltimore. ”

— Baltimore Resident at Community Workshop

In 2019, buildings and other facilities produced 64% of Baltimore's GHGs. We use electricity, methane gas, and heating oil to power our homes, office buildings, and retail spaces. While significant GHGs are emitted when we heat and cool homes, prepare food, and other daily actions, many older buildings lack heating, ventilation, and air-conditioning systems or other cooling mechanisms. As global temperatures rise, the risk of extreme heat grows along with the importance of energy efficient, zero-emission heating and cooling systems. As we make progress on emission reduction targets, we must also plan to prepare for more electricity use over time while transitioning to clean energy sources. This is an important consideration when thinking about reducing emissions from buildings. We can reduce GHG emissions from buildings by reducing the amount of energy used to heat or cool our buildings and we can switch to equipment and appliances that use electricity or produce low or no emissions. This helps keep energy bills low while protecting against temperature extremes. Baltimore residents will also benefit from having cleaner air inside our homes if we use equipment powered by electricity or low- or zero-emission sources instead of fossil fuels.

These climate actions will:

- Enhance energy efficiency,
- Reduce the amount of energy used to heat, cool, or light buildings, and
- Switch equipment and appliances from fossil fuels to clean energy options.



ACTIONS











Action # and Name	Description	Features
B1: Incentivize Energy Efficiency and Electrification Retrofits	Provide ongoing incentives and/or discounts to encourage existing building energy efficiency, electrification, and zero or low emission retrofits for all buildings, particularly those in environmental justice or frontline communities. Conduct outreach to owners, community land trusts , developers, landlords and other relevant audiences. Ensure maximum accessibility to lower income residents and emphasize the health benefits from improving indoor air quality due to reduced methane gas and oil use. Also, seek opportunities to streamline current permitting and inspection processes for retrofits.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: High</p> <p>Community Benefits: </p>
B2: Create Net Zero Plan for City Government Facilities	Evaluate how to transition City municipal buildings from fossil fuel energy to low or no emission energy sources and establish a maximum offset goal.	<p>Action Scope: Municipal</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
B3: Implement Energy Benchmarking for City Government Facilities	Collect and monitor data regarding municipal facility energy use to build on Maryland State performance standards for government facilities. This helps track the energy efficiency of City government buildings over time.	<p>Action Scope: Municipal</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Low</p>

Table 6: Building Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
B4: Implement Energy Audits and Retro-Commissioning for City Government Facilities	Standardize a process for routine energy audits and retro-commissioning programs for City-owned buildings and target buildings with opportunities for improvement.	<p>Action Scope: Municipal</p> <p>Timeframe: Medium*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:  </p>
B5: Evaluate Zoning Regulations and Integrate Climate-Informed Zoning Approaches	Review the existing zoning code to identify updates to better integrate climate action, climate adaptation, and resilience to climate hazards in future development. Climate-informed zoning updates may include encouraging density in areas at low risk to climate hazards, directing intense land uses away from flood-prone areas, incentivizing the use of green infrastructure, providing heat mitigation approaches, and creating public spaces.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium*</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits:   </p>
B6: Require Fossil Fuel Free and Solar-Ready New Construction	Make a rule that new buildings cannot use fossil fuels for power and be solar-ready. This will be undertaken in concert with efforts by utilities and the State and federal government to ensure the electric grid is able to support the transition toward all-electric buildings. Solar-ready means that buildings are built to allow people to easily install solar panels at a future time. Requiring all-electric new buildings helps residents and businesses more easily transition away from fossil fuels, while requiring solar-ready buildings helps promote clean electricity sources.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits:   </p>

*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
B7: Require Fossil Fuel Free and Solar-Ready for New or Majorly Renovated City Government Facilities	Require all new construction or major renovation project to be solar-ready and adopt low or no emission standards while ensuring alignment with State policy and law. Evaluate existing roofs for additional solar opportunities.	<p>Action Scope: Municipal</p> <p>Timeframe: Long</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:</p> 

ADDITIONAL ACTIONS

The following actions were added in response to community feedback after the initial actions were developed and evaluated.

Action # and Name	Description	Features
B8: Develop a Residential Energy Efficiency and Electrification Program	Enhance existing Weatherization Assistance Program (WAP) to advance transparency, awareness and literacy regarding energy efficiency, energy use, electrification, retrofitting and renewable energy adoption options for homeowners and landlords, with a focus on those with high energy burdens .	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p>

Table 7: Additional Building Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing

Action # and Name	Description	Features
B9: Enhance Education, Training, Compliance and Enforcement of the Existing International Green Construction Code (IgCC)	The Baltimore City Green Construction Code has been in place since April 2015 and is updated as new International Green Construction Code guidelines are adopted by the State of Maryland. The Code requires all design and construction to comply with the 2018 IgCC, as adopted by Ordinance 20-361, effective May 18, 2020, and subsequently amended. Enhanced capacity for enforcing the IgCC will be supported to better track how these codes are enforced and address training needs or other programming challenges.	Action Scope: Community-wide Timeframe: Long
B10: Explore Point of Sale/Lease Electrification Ordinance	Determine a course of action and potential resources for requiring home or building owners to replace fossil fuel equipment with electric, low or no emission options before a building is sold and/or new leases signed after tenant turnover in a manner that will not place a burden on renters or devalue buildings.	Action Scope: Community-wide Timeframe: Near
B11: Encourage and Incentivize the Use of Rooftop Technology and Techniques that Minimize the Effect of Extreme Heat	Use and promote techniques such as reflective paint and green roofs that minimize the effect of extreme heat for residential and commercial buildings. This will also reduce energy used for cooling.	Action Scope: Community-wide Timeframe: Near



ELECTRICITY

A Story Set In 2030

Rasheed was interested in installing solar panels on his roof to make clean energy and reduce his energy bill. At first, Rasheed was worried that solar would not work for him because his house is a quaint, old row home. He also was worried about the expense of installing solar panels. Rasheed's neighbor told him about a State and local program that gave him a grant to help pay for solar. A team of experts came to Rasheed's house to first improve its energy efficiency with air sealing and insulation, and then installed new solar panels that fit together perfectly like puzzle pieces. Rasheed watched with excitement as they finished the installation. He was even more excited when his electric bill showed that the weatherization and solar improvements saved him a lot of money.

“ I'm happy that we can purchase our electric supply through a neighborhood solar option. I'm supportive of efforts to add solar panels to parking lots and other large public properties with good sun exposure. ”

— *Baltimore Resident at Community Workshop*

In 2019, about 34% of the GHGs generated in Baltimore were from using electricity. As Baltimore shifts to using more electricity to power buildings, vehicles, and other items, it will be very important that we complement this transition with increased use of clean energy sources. It is also critical that we switch to clean energy sources in a responsible, intentional way to ensure we have reliable energy and do not overwhelm the electric grid. This requires a phased approach and close, thoughtful work with local utility providers, communities, and a broad coalition of partners. There are many local opportunities, such as **community solar**, that can be expanded in Baltimore. Emerging and new technologies may also provide more ways the city can transition from energy produced by fossil fuels to clean energy.

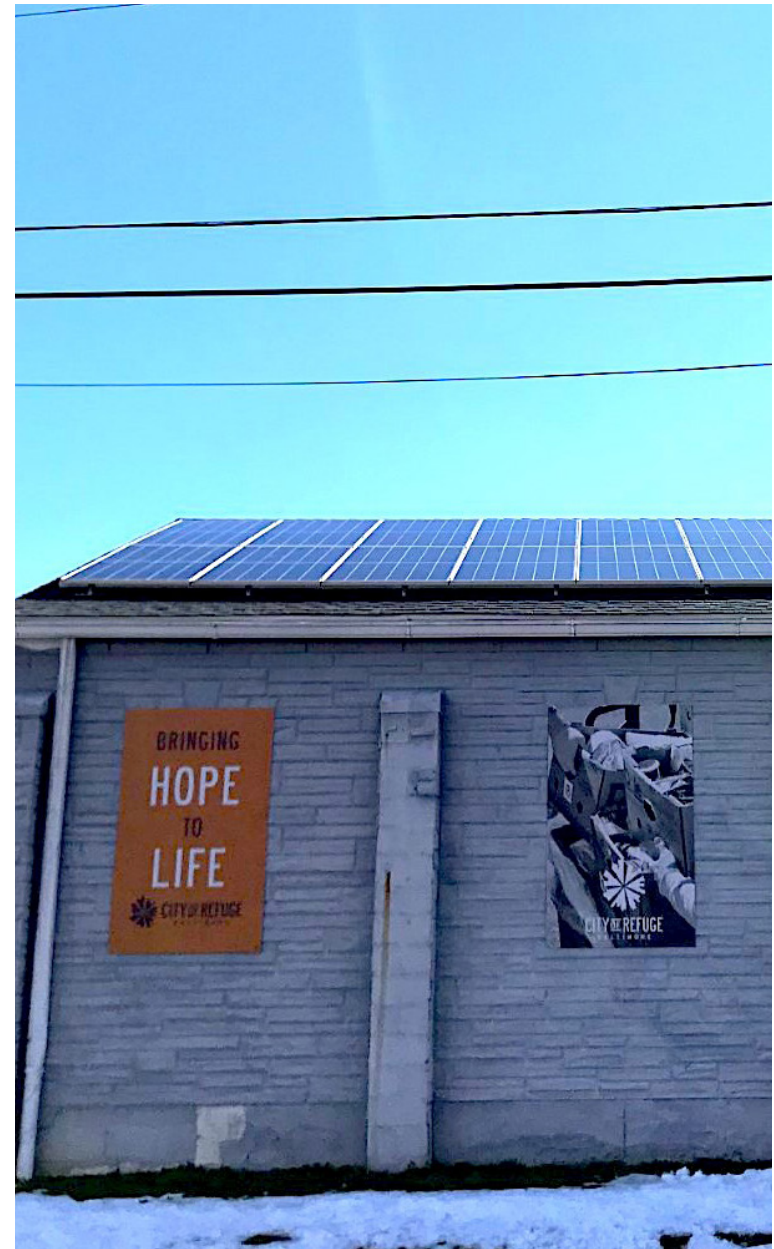


Residential buildings in Baltimore use 34% of community-wide electricity, which produces 12% of the city's total GHG emissions. The average Baltimore household uses 8,000 kWh a year, which produces roughly 3 MTCO₂e. Smaller households or apartment complexes typically use less electricity than larger, single-family households.

These actions will also have other benefits. For instance, our air will also be cleaner when we burn fewer fossil fuels. Also, installing solar panels with batteries for energy storage means that the connected buildings could still have power during blackouts and brownouts caused by storms and heat waves. Currently, solar panels with batteries are costly, but they could be used strategically in places that help community members respond to climate hazard events. A key example of this is our Community Resilience Hubs, many of which will be equipped with solar and battery backup in the coming years.

The Baltimore Sustainability Plan outlines several actions relevant to energy use reduction and transition to renewable or low or no emission energy sources. The CAP Update builds on the actions in the Baltimore Sustainability Plan to identify additional climate actions that will:

- Help more people install solar panels or use other low or zero emission energy sources in their homes
- Encourage community solar in Baltimore neighborhoods, and
- Improve the capacity and reliability of electric infrastructure.



ACTIONS


Action # and Name	Description	Features
E1: Promote Renewable Energy and Energy Efficiency Incentive Programs	Provide outreach and education on available solar and energy efficiency programs, and incentives (e.g., tax credits, rebates, net metering, solar renewable energy certificates (SRECs) , etc.) for residents, landlords, property managers, businesses, community land trusts and others, particularly those with properties in frontline communities. Encourage adoption of zero emission energy sources where possible and explore opportunities for legislation and policy changes to expand programs and incentives.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: High</p> <p>Community Benefits:</p> 
E2: Purchase Clean Electricity for City Government Operations	Buy clean electricity to power the City's municipal buildings. This action will increase power purchase agreements (PPAs) by at least 10% by 2030 to promote creation of new, regional clean energy projects.	<p>Action Scope: Municipal</p> <p>Timeframe: Long</p> <p>GHG Reduction Potential: High</p>

Table 8: Electricity Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing

ADDITIONAL ACTIONS

The following actions were added in response to community feedback after the initial actions were developed and evaluated.

Action # and Name	Description	Features
E3: Partner with Utilities and Relevant Government Entities and Others to Improve Electric Infrastructure	Work with Baltimore Gas and Electric (BGE) , the Maryland Public Service Commission, and others to develop electrification plans and implement the best energy transmission polices and development practices. This will help us understand future electrification and infrastructure needs and ensure the grid is positioned to meet or exceed future demand. Careful consideration and advocacy will be directed to ensuring infrastructure upgrades are prioritized in vulnerable communities and do not place an additional expense burden on customers, particularly people living in low-income households. Work with National Audubon of Baltimore and other topical experts to ensure protection of wildlife and important flyways for birds is considered while expanding electrical infrastructure.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p>
E4: Coordinate with Partners to Advance Solar	Coordinate local communities, the Maryland Clean Energy Center, Climate Access Fund, community green space managers, and others to advance community solar initiatives in Baltimore. Consider how to use vacant or under-utilized land in Baltimore to advance community solar. Raise awareness about and coordinate funding opportunities and tax incentives with a focus on those geared toward high energy burden communities.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p>

Table 9: Additional Electricity Actions | Source: City of Baltimore



TRANSPORTATION

A Story Set In 2030

Alejandra is thrilled to have moved into this transit-oriented community. In this neighborhood, everything was designed to be conveniently accessible without a car. The streets have wide sidewalks, perfect for strolling or riding bikes. Each school day, she walks to the nearby public transit wearing her backpack and arrives at school in no time. On weekends, Alejandra's family explores the city together. They hop on a bus or train to visit local attractions like the zoo, the museum, the farmer's market, or even visit other nearby cities. It is so much fun to leave the car behind and still get everywhere they want to go without creating pollution. The cleaner air has reduced how much Alejandra needs to use her inhaler.

"I agree with the comment that was made that Baltimore is currently planned as a car-based city. I personally would love to move away from that toward a public transportation-based city but agree that safety and reliability are major concerns right now..."

— Baltimore Resident at Community Workshop

In 2019, driving vehicles in Baltimore generated 23% of all GHG emissions. To reduce these emissions, we must drive less, choose vehicles that do not pollute, and use public transit, bikes, or walk. Many households spend a significant portion of their income on transportation, which is a burden for all but even more so for lower income households. In 2020, over 27% of Baltimore households did not own a vehicle.¹⁷ According to a 2017 study by the Baltimore Education Research Consortium, nearly 60% of Baltimore City high school students use public transit to get to and from school and 68% of them require at least one transfer, making the average commute time over 36 minutes per student taking public transit.¹⁸ Enhancing alternative forms of transportation such as public transit and active transportation infrastructure will not only help existing users, such as our youth and those without vehicles, but also encourage others to make the switch to more sustainable modes of transport.

¹⁷ Baltimore Neighborhood Indicators Alliance. 2021. "Percent of Households with No Vehicle Available – City." *City of Baltimore*. <https://data.baltimorecity.gov/datasets/bniajfi::percent-of-households-with-no-vehicle-available-city/about>

¹⁸ Stein, Marc L., Jeffrey Grigg, Curt Cronister, Celeste Chavis, and Faith Connolly. 2017. "Getting to High School in Baltimore: Student Commuting and Public Transportation." *Baltimore Education Research Consortium*. <https://baltimore-berc.org/wp-content/uploads/2017/01/GettingtoHighSchoolinBaltimoreJanuary2017.pdf>

Transportation actions help reduce air pollution, as well as traffic and noise, making it easier, safer, and quicker to get around Baltimore. These actions create opportunities to reduce or eliminate the use of individually owned vehicles, which can also reduce household expenses. Finally, many alternatives to cars, like walking and biking, help promote active lifestyles and improve public health.

These climate actions will:

- Reimagine neighborhoods so that homes, workplaces, and shops are closer together,
- Make it easier to get around by biking, walking, and taking the bus or train,
- Increase opportunities to charge and share EVs, and
- Encourage carpooling and vanpooling.

ACTIONS





Action # and Name	Description	Features
T1: Make Roads More Walkable and Bikeable	Implement the Bikeways and Complete Streets plan, Safe Routes to Schools projects, and other community plans to maintain and improve the safety and connectivity of active transportation infrastructure for non-vehicular and micro-mobility users such as pedestrians and bicyclists.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits:</p> 




Table 10: Transportation Actions | Source: City of Baltimore
*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
T2: Require or Incentivize Active Transport-Friendly Programs and Infrastructure	Create more pedestrian, bike and scooter friendly programs, and infrastructure throughout Baltimore, particularly in frontline communities.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
T3: Support Transit-Oriented Communities	Encourage people-oriented development over vehicular-oriented development so more people have easy, safe access to transit options and can access amenities by active and transit modes.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>
T4: Incentivize Micro-mobility	Provide incentives for residents, particularly those in frontline communities, to purchase micro-mobility vehicles (e-scooters, e-bikes, bikes, etc.) and explore opportunities to incentivize rental of micro-mobility vehicles.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>




*Action timeframes marked with an asterisk are already underway or ongoing












Action # and Name	Description	Features
T5: Improve Transit for Low-Income Neighborhoods and Other Communities in Need of Transit Options	Continually monitor bus and train legislative and policy activities and work with State of Maryland to advocate for improvements to MTA bus and train frequency and reliability for all of Baltimore. Prioritize connections for historically disinvested neighborhoods and communities with larger numbers of school-aged students that rely on public transit to get to and from school. Actively collaborate to enact State plans to improve transit in Baltimore.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
T6: Partner with Rideshares to Improve Paratransit to Augment MTA Mobility Programs	Partner with rideshare providers like Uber and Lyft to help make these services better for people who need special transportation because of disabilities and to promote carpooling options for people using their services.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
T7: Promote Zero Emission Bus Transition	Encourage the transition to electric or zero-emission vehicles for the Charm City Circulator and support the electrification of MTA buses.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>

*Action timeframes marked with an asterisk are already underway or ongoing




Action # and Name	Description	Features
T8: Promote EV Sharing	Encourage and support the creation of EV sharing programs at a hyper-local level to offer greater access to EVs to more community members.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>
T9: Promote Electric Car Share and Ride Share	Promote and raise awareness of existing electric car and ride share programs and support the transition of ride share companies to using electric vehicles.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>
T10: Expand Public EV Charging Network	With leadership from the Parking Authority of Baltimore, expand publicly accessible EV charging infrastructure for all, ensuring that resources are equitably distributed, available along main routes and in popular destinations, and near publicly owned properties such as City buildings and schools.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>

Action # and Name	Description	Features
T11: Work with Gas Stations to Install EV Chargers	Work with new or significantly renovated gas stations to add chargers for EVs.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:  </p>
T12: Establish Car-Free Areas	Define what car-free areas mean and how they are identified in Baltimore. Require inclusion of car-free areas within transit-oriented development areas and co-create opportunities to include car-free areas in other areas where possible and supported by the community.	<p>Action Scope: Community-wide</p> <p>Timeframe: Long</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits:  </p>
T13: Implement Revised Parking Standards and Encourage Developers to Reduce Parking	Conduct a parking study and revise minimum parking standards and other parking policies to eliminate excess parking while providing adequate parking for residents including people with limited or impaired mobility. Promote shared parking agreements and prepare parking facilities for zero emission vehicle and non-vehicular needs to reduce off street parking and excess asphalt coverage, which contributes to the heat island effect.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits:  </p>

Action # and Name	Description	Features
T14: Promote and Expand Existing Commute Trip Reduction Programs	Encourage the use and growth of existing commute trip reduction programs available through the MTA and other programs in alignment with Maryland Department of Transportation (MDOT) strategies to reduce use of single-occupancy vehicles by commuters. Explore opportunities to incentivize new sustainable commuting programs, such as discounted transit passes, parking cash out programs, and incentives for biking and walking to work for City employees. Coordinate with the State of Maryland or federal efforts to promote and strengthen employer commuter incentive programs for state or federal government employees working in Baltimore.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Medium</p> <p>Community Benefits: </p>
T15: Enhance Awareness of Alternative Transport for Baltimore City Employees	Raise City employee awareness of alternative transportation options (e.g., biking, walking, train, bus, water taxi) and explore feasibility of offering free or reduced transit for City employees.	<p>Action Scope: Municipal</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
T16: Transition to Zero or Low Emissions Municipal Fleet	Change the vehicles that the City government uses to ones that pollute less by expanding municipal EV charging infrastructure, transitioning the City fleet to zero or low emission vehicles, and proactively seeking other fleet efficiencies. This action will require training City maintenance crews to ensure they have the knowledge, skills and resources needed to maintain EVs.	<p>Action Scope: Municipal</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>

*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
T17: Develop a Plan to Transition City Government to Low or Zero Emission Off-Road Vehicles and Tools	Plan how to transition tools and off-road vehicles owned by the City and its contractors to low or zero emission options.	<p>Action Scope: Municipal</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:</p> 

*Action timeframes marked with an asterisk are already underway or ongoing

ADDITIONAL ACTIONS

The following actions were added in response to community feedback after the initial actions were developed and evaluated.

Action # and Name	Description	Features
T18: Support State Public Transit Efforts	Support State of Maryland efforts to improve and expand public transit in Baltimore, particularly east-west connections through the Red Line Project. Explore providing community members with transit passes to incentivize using public transit.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p>
T19: Complete a Route Optimization Study Focused on Reducing Carbon Emissions for Routine Municipal Fleet Routes	Determine how to optimize routinely traveled routes for municipal vehicles such as City waste collection vehicles to reduce vehicle emissions and conduct assessments that optimize other facets of route management.	<p>Action Scope: Municipal</p> <p>Timeframe: Medium</p>

Table 11: Additional Transportation Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing



WASTE

A Story Set In 2030

Camila was very glad Baltimore had its own composting program. City of Baltimore Department of Public Works had set up special bins in parks, schools, and neighborhoods where people could put their food waste. As her neighborhood's no-waste leader, Camila and a group of volunteers taught workshops and visited schools to show everyone how to compost. People learned that organic materials like banana peels, eggshells, and leaves can decompose and turn into something helpful for the environment. As time went on, the composting program became a way of life. People were amazed at how much less trash they were throwing away and how beautiful and healthy their community and gardens were.

“...I 100% support the initiative to continue expanding compost collection for residents. It would be great to eventually offer curbside collection!...”

— Baltimore Resident at Community Workshop

In 2019, managing and processing trash and wastewater produced 13% of all Baltimore's GHG emissions. The City manages about one-third of the city-wide waste stream, most of which goes to landfill or is incinerated. Baltimore's SWMP outlines a zero waste strategy for trash that includes 9 Rs: rethink, refuse, reduce, reuse, refurbish, remanufacture, repurpose, recycle, and recover, as alternatives to disposal. To reduce GHG emissions, we must generate less trash and use less water, repurpose materials and reuse items instead of throwing them away, and divert waste from landfills or incinerators, among other actions.

As two-thirds of waste materials are managed by private service providers in Baltimore, sustainable materials management requires coordinated adoption of zero waste strategies by the public and private sectors. Single-use containers and packaging are a major source of litter in Baltimore, so reducing or reusing those materials will result in cleaner streets. Reducing trash and building a circular economy can reap benefits that lead to job creation and job training opportunities. Efforts to reduce water use and incorporate more energy efficient wastewater treatment processes can reduce water bills. Further, diverting biodegradable materials from landfills not only reduces landfill methane emissions but can help increase the amount of compost we produce and use in communities. Compost can be used locally to aid in plant growth and beautify neighborhoods, help with food production, improve habitat areas, and help soils absorb more carbon.

The climate actions in this section will:

- Support local and state legislation that bans organics, single-use plastics, or other recyclable materials from landfill and incineration,
- Improve education, outreach, and engagement related to waste prevention, reduction, diversion, zero waste planning, composting, and other organic waste reduction goals and pathways to a circular economy, and
- Support City-mandated deconstruction policies to require construction and development projects to divert a certain percentage of their waste from disposal and encourage reuse of construction and demolition materials.

ACTIONS






Action # and Name	Description	Features
W1: Introduce City-wide Composting	Plan and implement a city-wide organic waste composting program and provide compost for free to residents and businesses. Additionally, compost more of the yard waste currently collected by the City. Inform and educate people about how and why to compost.	<p>Action Scope: Community-wide</p> <p>Timeframe: Long</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:</p> 
W2: Enhance Existing Organic Waste Diversion Policy Awareness, Compliance, and Enforcement of MD HB-264 – Organics Recycling and Waste Diversion Law	With leadership from Baltimore Department of Public Works, the Maryland Department of the Environment and other partners, coordinate actions and publicly communicate strategies being implemented to enhance existing organic waste diversion policy awareness, compliance and enforcement. Explore opportunities to improve the rules for separating and using organic waste, like food scraps.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits:</p> 

Table 12: Waste Actions | Source: City of Baltimore



*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
W3: Coordinate City-wide Food Rescue Program	Save excess food from being wasted by implementing Baltimore's Food Waste and Recovery Strategy and pursuing Baltimore's Zero Waste Strategy identified in the Solid Waste Management Plan. Enhance the regional food rescue capacity and coordinate local nonprofits that have expertise in food rescue programs to better support a stronger food rescue system in Baltimore.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
W4: Develop Waste Diversion Incentives	Encourage recycling and reuse over disposal of waste by developing incentives for reducing waste-derived emissions, increasing recycling, and diverting waste from landfills and incineration. Examples include save as you throw programs (an economic incentive-based program that would save residents and businesses money for producing less waste), recycling or organic waste bin capacity upgrades, and bottle return programs, among others.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
W5: Establish Waste Community Leaders	Establish or expand programs where community members, students, green space site managers, faith-based institutions, nonprofit organizations, and others promote waste management at a neighborhood level through direct action and by educating the community on how to reduce waste.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium*</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>

*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features
W6: Promote and Partner with Circular-Economy Local Businesses	Promote and/or partner with local businesses that use local recycled materials, avoid single-use materials, or pursue other actions outlined in the Department of Public Works Solid Waste Management Plan (2023). Educate businesses on how to participate in a circular economy and use the Sustainable Business Guidelines to help them to use local materials and reuse service providers. Explore opportunities to help local businesses and local government pursue Environmentally Preferred Purchasing options.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>
W7: Establish Sustainable Procurement Protocol	Revise existing municipal procurement rules to add a sustainable procurement protocol and incentives to align contracts and agreements with the principles of the CAP Update. As feasible, adopt the Environmentally Preferable Purchasing Program.	<p>Action Scope: Municipal</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Low</p>
W8: Encourage Water Savings Program	Create and promote a water conservation program in partnership with local nonprofit and community organizations. Possible activities include water collection and reuse or diversion and grey water reuse, among others.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p> <p>GHG Reduction Potential: Low</p> <p>Community Benefits: </p>

Action # and Name	Description	Features
W9: Establish Emissions Plan for Wastewater Facilities	Led by Baltimore Department of Public Works, develop and implement an emissions reduction plan for at least one of its wastewater treatment facilities.	<p>Action Scope: Municipal</p> <p>Timeframe: Long</p> <p>GHG Reduction Potential: Low</p>

ADDITIONAL ACTIONS

The following actions were added in response to community feedback after the initial actions were developed and evaluated.

Action # and Name	Description	Features
W10: Support Expansion of Waste Diversion and Reduction Programs	Support the implementation of the Solid Waste Management Plan, particularly actions focused on waste diversion and reduction programs that will reduce or eliminate municipal dependence on waste incineration and develop pathways to address construction and demolition diversion that promote the use of recycled or reused salvaged materials in new construction.	<p>Action Scope: Municipal</p> <p>Timeframe: Near</p>

Table 13: Additional Waste Actions | Source: City of Baltimore

Action # and Name	Description	Features
W11: Require Plans for New Buildings to Provide Sufficient Indoor and Outdoor Space for Recycling, Composting, and Materials Reuse	Require all new building plans to have designated space indoors and outdoors to collect recycling to advance the Solid Waste Management Plan goal of reaching 35% recycling in Baltimore businesses.	Action Scope: Community-wide Timeframe: Near
W12: Ensure New Waste Disposal Facilities Processing Municipally Generated Waste Comply with Carbon Neutrality Goals	Support a moratorium or other measures that would require any new waste disposal facilities processing municipally generated waste to comply with carbon neutrality goals.	Action Scope: Municipal Timeframe: Medium
W13: Collect Data to Help Reduce Pollutants Generated from Waste Processing Facilities	Partner with universities to monitor air quality and track pollutants from waste processing facilities, including waste incinerators. Work with waste processing facilities to require reporting of the source and destination of all waste haulers using Baltimore-based facilities and recommend zero-emission targets for their fleets.	Action Scope: Community-wide Timeframe: Medium
W14: Support and Expand upon Legislation that Bans Recyclable Materials from Landfill and Incineration	Support legislation that bans recyclable materials from landfill and incineration. Consider how this legislation may be expanded in Baltimore to include compostable materials.	Action Scope: Community-wide Timeframe: Medium*
W15: Explore Reducing Energy Use at Wastewater Facilities	Proactively pilot projects and explore ways to reduce energy use or effectively recover energy sources at wastewater facilities.	Action Scope: Municipal Timeframe: Near*

*Action timeframes marked with an asterisk are already underway or ongoing



NATURE-BASED SOLUTIONS

A Story Set In 2030

Malik is a community steward with a vision for transforming the neighborhood through the power of green infrastructure. The first step was to convert the vacant lots and underutilized spaces into vibrant green pockets. Malik and his team collaborated with local landscape architects to design rain gardens and permeable pavement installations. These green spaces not only added a touch of natural beauty to the urban surroundings but also served as innovative solutions to manage stormwater. To address the persistent issue of flooding on the streets, Malik and his team collaborated with the City to implement a network of tree-lined bioswales. These carefully designed channels ran alongside the roads, capturing and redirecting stormwater. The impact was profound. During the next heavy rainfall, the community witnessed the effectiveness of their green infrastructure. The rain gardens absorbed water like sponges, the bioswales directed runoff away from the streets, and the entire neighborhood became a model for sustainable stormwater management.

“ The suggestions on using trees and natural barriers to protect bike lanes and the electric zip cars were particularly interesting... ”

— Baltimore Residents at Community Workshop

Nature-based solutions are sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to promote carbon removal, adaptation, and resilience.

Nature-based solutions are an important part of a CAP because they help remove carbon from the atmosphere while preserving or increasing the number of trees and area of wetlands, forests, green spaces, and natural landscapes, which can also improve public health and quality of life for residents. In addition to being an important component to sustainable climate action, nature-based solutions are important to people in Baltimore and many community-based initiatives that involve nature-based solutions exist throughout the city. In Baltimore, 45% of land is covered in impervious surfaces, or surfaces that do not allow fluid to pass through.¹⁹ Impervious surfaces generate higher

¹⁹ City of Baltimore – Department of Planning. 2009. “Stormwater RunOff/Non-Point Pollution Prevention.” *City of Baltimore*. <https://planning.baltimorecity.gov/planning-master-plan/water/stormwater#:~:text=Under%20the%20City%E2%80%99s%20permit%20the%20Department%20of%20Public,of%20the%20total%2051%2C790%20acreage%20of%20the%20City.>

volumes of stormwater runoff that can pollute water, contribute to local flooding during large rain events, and raise temperatures in neighborhoods because they absorb heat. Trees, native plants, forests, and other green spaces provide pervious surfaces that help slow and treat stormwater. They also remove carbon from the atmosphere, lowering the total amount of GHG emissions, and provide cooling, which can reduce the need for air conditioning. Strategically located green spaces, wetlands or marshes, and other naturally occurring riparian areas can help buffer people, communities, critical infrastructure, and cultural assets from sea level rise. This is especially important in Baltimore because sea level rise is occurring at a faster pace in the Chesapeake Bay region than compared to the rest of the country.

While most nature-based solutions provide a GHG emissions reduction benefit, nature-based solutions can also act to protect people and property, or even mitigate the risk of hazards such as sea level rise, flash floods and extreme heat. Two common types of nature-based solutions focused on resilience are:

- **Green Infrastructure:** engineered solutions incorporating natural and built elements, such as rain gardens or green roofs, and
- **Natural Infrastructure:** existing or rehabilitated environments to build resilience, such as restored wetlands or urban forests.

Many people, organizations and businesses already contribute to creating and protecting nature-based solutions in Baltimore. For example, floating wetlands were installed in the Inner Harbor by the National Aquarium. The emerging Reimagine Middle Branch Plan includes ambitious and robust nature-based resilience solutions including marshland restoration that can help improve water quality, buffer neighborhoods from rising waters, and provide important habitat in South Baltimore.

Thoughtful investment in nature-based solutions will improve quality of life for people who live, work, play, learn, and age in Baltimore and provide opportunities to engage people in climate action in shared neighborhood spaces, improve habitat, and promote the recreational and aesthetic value of the city. Actions in this section aim to:

- Remove carbon by expanding public and private green spaces, and
- Promote green and natural infrastructure that provides climate resiliency benefits.



ACTIONS













Action # and Name	Description	Features ²⁰
N1: Accelerate the Achievement of Baltimore's Tree Canopy Goal to Reach 40% Tree Canopy by 2037	With leadership from Baltimore City Recreation & Parks Department (BCRP) Forestry Division, grow the urban tree canopy with street trees, open space trees, expanded forest patches, and forests. Safeguard the current tree canopy on both public and private property through the creation and enforcement of additional tree regulations in Baltimore City codes related to natural resources.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>Community Benefits:</p> 
N2: Assess City Parklands to Identify Opportunities to Enhance or Expand Natural Features	Support BCRP comprehensive planning and BCRP Playbook actions to assess the conditions of parkland assets and amenities to support effective maintenance. Use the information to identify opportunities to enhance or create new natural features within City parks.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>Community Benefits:</p> 
N3: Create and Maintain More Public Green Spaces	Advance goals set forth in the Baltimore Comprehensive Master Plan, the Green Network Plan, and other plans to increase the number of maintained public green spaces that can remove carbon. Doing so can also connect communities to nature, provide more opportunities for habitat and stormwater treatment, reduce the heat island effect, and increase safety in neighborhoods.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium*</p> <p>Community Benefits:</p> 

Table 14: Nature-base Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing

²⁰ The carbon removal potential of the nature-based solutions actions was not evaluated



Action # and Name	Description	Features ²⁰
N4: Increase Green Stormwater Infrastructure	Use the Nuisance Flood Plan and other relevant planning processes to identify flood-prone locations that would benefit from the installation of green infrastructure, particularly in flood-prone and frontline communities. Encourage best practices that include use of native plants and high-quality soil to improve carbon removal potential. Review existing policies and identify opportunities to reduce impervious surfaces in redevelopment and transportation infrastructure.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>Community Benefits:   </p>
N5: Partner with Community-Based Groups to Increase Neighborhood Nature-Based Solutions and Educate Communities About Climate Resilience	Seek opportunities to partner with existing green space stewards, urban farms, and other nonprofit and community-based groups to advance local understanding of climate resilience, climate-friendly techniques, and interventions such as installing native plants and soils and encourage the installation and maintenance of more nature-based solutions in Baltimore neighborhoods.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near</p> <p>Community Benefits:   </p>
N6: Analyze Potential Solar or Renewable Energy Farm Locations	Look for opportunities to increase community solar in coordination with potential tree planting locations to optimize land use.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p> <p>Community Benefits:   </p>

*Action timeframes marked with an asterisk are already underway or ongoing



OTHER ACTIONS

A Story Set In 2030

Aaliyah was happy to live next to a “cool zone,” which featured a block of streets treated with reflective surfaces to combat extreme heat and cool her entire community. She also has easy access to one of the hundreds of Community Resiliency Hubs across the city where she can go to pick up additional materials to keep cool at home. People gathered at their local Resiliency Hub during the summer’s hottest hours of the day. Libraries, community centers, and even some shopping malls opened their doors to give everyone a cool place to relax. Over the past seven years, the City helped people plant new trees and provided resources to paint rooftops, strategically adding more “cool zones” city-wide. Aaliyah noticed that the air felt fresher, and the neighborhood felt more comfortable to live in compared to 2023.

“...To get people involved in communities, local communities, communities of color in particular, also means that the job opportunities have to be localized in those communities as well...”

— Baltimore Resident at Community Workshop

This section lists actions that apply across multiple areas. Many of these actions help improve communication between the Baltimore City government and the community.


ACTIONS

Action # and Name	Description	Features
O1: Develop Centralized Tool for Climate Actions	Create a centralized tool to help everyone understand what climate actions are underway and how they can get involved. The tool will include a process guide and resources on how residents and businesses can acquire building energy efficiency upgrades, electrification options, solar installation options, community solar options, and green power purchasing options.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Supporting</p>

Table 15: Other Actions | Source: City of Baltimore

*Action timeframes marked with an asterisk are already underway or ongoing



Action # and Name	Description	Features ²⁰
O2: Create an Education and Outreach Program	Develop a comprehensive promotion strategy to advance all Climate Action Plan Update priority actions and provide resources to help people take action.	<p>Action Scope: Community-wide</p> <p>Timeframe: Near*</p> <p>GHG Reduction Potential: Supporting</p> <p>Community Benefits:</p> 

*Action timeframes marked with an asterisk are already underway or ongoing

ADDITIONAL ACTIONS

The following actions were added in response to community feedback after the initial actions were developed and evaluated.

Action # and Name	Description	Features
O3: Create a Heat Management Plan	Develop a comprehensive plan to reduce the risk of extreme heat to people in Baltimore and hire a Heat Mitigation Officer.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p>
O4: Improve Distribution of Climate-Relevant Data	Ensure everyone can get important information about climate change in Baltimore by improving the collection and circulation of climate relevant data. Partner with local colleges, universities, and research institutions to better track and share environmental data and research.	<p>Action Scope: Community-wide</p> <p>Timeframe: Medium</p>

Table 16: Additional Other Actions | Source: City of Baltimore



Action # and Name	Description	Features
O5: Partner with Institutions to Inform Climate Action Plan Update Implementation	Work with universities and research collaboratives to undertake research that will inform Climate Action Plan Update implementation.	Action Scope: Community-wide Timeframe: Near*
O6: Connect and Convene Communities, Individuals, Organizations, Businesses, Researchers, Agencies, and Others Working to Advance CAP Update Actions	Seek opportunities to bring together, coordinate, and uplift the network of climate champions in Baltimore, and coordinate across jurisdictions where beneficial for progressing Baltimore’s ability to achieve its carbon neutrality goal.	Action Scope: Community-wide Timeframe: Near*

*Action timeframes marked with an asterisk are already underway or ongoing



Carrying Out Our Plan

- Working with Partners
- Implementation
- Fulfilling Our Promise
- Paying for Climate Actions
- How You Can Help



WORKING WITH PARTNERS

To put this plan in action, we will work with communities, particularly frontline and environmental justice communities who are most directly affected by climate change, to address community climate priorities while also working on broader, city-wide strategies. We will also make sure that the City government keeps its commitments. Through our actions, we seek to build trust, accountability, and track implementation progress as guided by our Equity Implementation Framing in the 2019 Sustainability Plan.

In particular, we seek to co-create local solutions with frontline and environmental justice communities who face the greatest challenges from climate change.

BALTIMORE SOCIAL-ENVIRONMENTAL COLLABORATIVE (BSEC)

BSEC is a 5-year research effort in Baltimore funded by the Department of Energy, aiming to generate the climate science needed to inform equitable climate action in Baltimore. It is a research collaborative that includes Johns Hopkins University, Morgan State University, Pennsylvania State University, University of Maryland Baltimore County, additional research institutions, Baltimore City government, and community partner organizations. This collaboration among researchers, community, and City government provides a team that can co-generate climate action ideas and ensure robust evaluation of climate actions as they are implemented.

BSEC's goals are to:

- Understand how Baltimore experiences climate change, with a focus on partnering with Baltimore communities. Specific neighborhoods – especially those currently under served by climate measurements – will host sensors to measure heat, water, gases, pollutants, wind, and more. There will also be opportunities for community-engaged science. Collecting this data is an urgent scientific contribution because climate change in cities is not well understood.
- Collaborate with communities to identify climate action strategies that achieve residents' goals in alignment with the city's 2023 Climate Action Plan, as informed by local priorities and place-based knowledge. Climate strategies need to be suited to specific neighborhoods. Improving equity is a key focus.
- Design and evaluate ways to integrate community members into the research process.



- Design and evaluate a decision support tool, the “Equitable Pathways” process, that analyzes many possible interventions and identifies promising solutions that can be evaluated by the community and researchers.
- Ensure that the community is always benefiting from the science being done.

BUILDING CLIMATE LEADERSHIP

Baltimore benefits greatly from the work of many climate leaders, including nonprofit organizations, leading international research institutions, cross-sector partnerships, individuals, and community-based groups who educate and mobilize their neighbors to take action. The Office of Sustainability and other City agencies commit to partnering with climate leaders to implement this ambitious plan that we developed together.

Youth in Baltimore have taken a major role in advocating for more climate-friendly practices. For example, students took action that helped eliminate the use of Styrofoam trays in Baltimore City Public School System cafeterias. Youth engagement will be a focus of the CAP Update’s implementation strategy for building climate leaders. The Office of Sustainability plans to hire a Community & Youth Engagement Coordinator to help connect youth to opportunities to learn about and act to address climate change.

Because there is a great deal of climate action already underway in Baltimore, in addition to finding new partners and promoting more climate leaders, we will seek opportunities to coordinate with existing coalitions and groups to ensure a good flow of information, identify opportunities and resources, and better connect climate leaders to strengthen a cohesive climate action community working to meet Baltimore’s carbon neutrality goal.



COORDINATING ACROSS AGENCIES

We will keep working across agencies, governments, and partners as we put this plan into action. We will continue to work with existing partner organizations, seek new partners, and collaborate with communities on local initiatives to improve climate action.

Importantly, we will continue working with key municipal, regional, national, and international groups and collaborators and through public-private partnerships to advance Baltimore's carbon neutrality goal. A few examples of key efforts include:

- **Baltimore Commission on Sustainability:** The Commission oversees the implementation of the Baltimore Sustainability Plan and monitors and reports progress annually. This 21-member body represents environmental groups, community organizations, labor unions, public health and environmental justice interests, and private industry. Twenty members are appointed by the Mayor and one City Council representative member is appointed by the City Council President.
- **The Mayor's Sustainability and Resiliency Subcabinet:** An interagency group that works to advance implementation of the 2019 Sustainability Plan and other related plans, improve interagency collaboration, and fully embed sustainability and resiliency into government practices so Baltimore can achieve a more ambitious sustainability and resiliency agenda.
- **Community Resiliency Hubs:** Trusted, service-based, non-profit community organizations (including faith-based) with strong leadership located in under-resourced neighborhoods. Through this program, they develop public and private partnerships coordinated by the Baltimore Office of Sustainability to provide essential resources and community-based support during times of crisis. Currently, 18 Resiliency Hub partner organizations participate in the program.



IMPLEMENTATION

Through the CAP Update and other plans that advance climate action, Baltimore is committed to working toward climate justice while transitioning from an extractive economy to a living, circular economy within a safer, more vibrant city. As stated in the 2019 Baltimore Sustainability Plan, the Commission on Sustainability and the Office of Sustainability commit to more intentionally address implicit bias and remove barriers for racial and other marginalized groups as climate actions are pursued. Our goal is to help eliminate the forces that create and sustain institutional and structural racism and other entrenched inequities in Baltimore while addressing the great challenge of achieving carbon neutrality and resilience for all people who live, play, work, learn, and age in Baltimore.

An equity lens brings racial equity analysis to the foreground to ensure that the impacts of institutional racism are considered. Equity considerations and the equity framework that was followed when developing the CAP Update will continue to be utilized during CAP implementation and are available in **Chapter 6 of the Baltimore Sustainability Plan**.

When creating this plan, we selected ten complex climate actions that are priorities for the City government to receive additional guidance in the form of **implementation roadmaps**. The implementation roadmaps show how to approach these actions in the next ten years. Representatives of different City departments talked about the steps to make each action happen, including who is responsible, what partners are needed to accomplish the action, how to measure the success of the action, how to stay on track with action implementation, and funds and other support needed to complete the action. Careful consideration was given to ensure the implementation roadmaps can help those who need it the most. **Read Appendix 5: Implementation Roadmaps** to learn more.



FULFILLING OUR PROMISE

To make sure we are transparent about the work the City government undertakes to put this plan into action, we will continue to publish our Sustainability Annual Report and periodically share progress made toward climate actions. We will continue to routinely monitor Baltimore's GHG levels and emission sources and update the GHG emissions inventory that estimates the amount of GHGs Baltimore creates each year. Updating the inventory indicates if we are on track to becoming carbon neutral by 2045 and allows us to adjust actions and strategies as needed to keep us on track to achieving our goal. Also, several actions in the CAP Update will help us to capture more and better data and to increase outreach to better inform the public on the progress made and challenges encountered as we work to reach carbon neutrality by 2045.

PAYING FOR CLIMATE ACTIONS

We will be thoughtful about how we spend money to implement our climate actions. In addition to City investment, we will look for different sources of funding to pay for climate actions, such as grants and partnerships. Some of the plan's actions identify methods to work across sectors to achieve the climate actions.

We Took a Deep Dive to Determine the Costs and Cost Savings to Implement Three Actions for Municipal Activities:

B2: Create Net-Zero Plan for City Government Facilities

B7: Require Fossil Fuel Free and Solar-Ready for New or Majorly Renovated City Government Facilities (only the solar-ready portion of this action was evaluated)

T17: Develop a Plan to Transition City Government to Low- or Zero-Emission Off-Road Vehicles and Tools

Read **Appendix 6: Fiscal Analysis of Selected Municipal Actions** to learn more.

HOW YOU CAN HELP

Everyone in Baltimore plays a role in creating a more resilient, safer, and healthier city through climate action. Each of us can take big and small actions daily to produce fewer GHG emissions. We can reduce, reuse, and recycle. We can walk, bike, or use buses and trains instead of driving alone. We can support local farms and grow and maintain native plants. We can help maintain forests and use compost we make in our gardens. When we move to a different home or buy a car, we can pick electric and efficient options. All these things make a big difference and show others how they can help, too.

Baltimore's climate change goals require significant change. All of us, as a community, play an important role in making things better. Here are some ways you can help make the Baltimore Climate Action Plan happen:

- **Make sure of Baltimore government fulfills its promises.** Go to City Council meetings or talk to your City Council member. Tell them that fighting climate change is important to you. Ask them to set aside money for climate actions.
- **Get in touch with groups in your community that work to address climate change.** Support actions to help the environment, make homes people can afford, stop using fossil fuels, and improve buses and trains.
- **Have conversations with your friends, family, and neighbors about climate change.** Talk about how it affects Baltimore, your life, and what we can do to help. Help more people do something to stop climate change.

As we work to fulfill our promise, we also welcome opportunities to promote the incredible climate action occurring in communities. Please share information with sustainability@baltimorecity.gov and visit the Baltimore Office of Sustainability website to sign up to receive updates about how we, as the Baltimore community, are building a more resilient, healthy, safe, and vibrant city.



Explore Further: The Appendices

- Appendix 1: Background Review
- Appendix 2A: Community Engagement Plan
- Appendix 2B: Community Engagement Summary
- Appendix 3: Municipal Greenhouse Gas Inventory and Reduction Pathway
- Appendix 4: Action Prioritization
- Appendix 5: Implementation Roadmaps
- Appendix 6: Fiscal Analysis of Selected Municipal Actions

NOTE: Action numbers and titles have changed since the creation of the appendices. Therefore, the actions listed in the appendices will not exactly match what is in the CAP Update.

Report Prepared By AECOM, with the support of Assedo Consulting, in collaboration with the Baltimore Office of Sustainability, and many other contributors.

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HOWARD COUNTY CLIMATE FORWARD: Climate Action and Resiliency Plan

FINAL REPORT
2023





I am honored to present Howard County's Climate Forward: Climate Action and Resiliency Plan.

Howard County is a leader in the fight against climate change. We have cut our energy use through building energy upgrades and have entered into the largest solar power purchase agreement in the state. Since 2019, Howard County has also planted more than 65,000 trees, strengthened our forest conservation laws, and invested in green infrastructure.

While these are significant accomplishments, we cannot be satisfied with our past successes. There is much more to do. Well-established science tells us that climate change is one of the most urgent challenges of our generation and that we are

running out of time to act.

This plan sets an ambitious course for reaching a 60% reduction in greenhouse gas (GHG) emissions by 2030 and net zero by 2045. Based on extensive research, there are four areas Howard County will focus on to reach these goals: Energy, Transportation, Waste, and Nature-Based Solutions. These efforts will reduce our GHG emissions and remove greenhouse gasses in the air by protecting forests and increasing native trees, plants, and healthy soils.

We know we are already seeing the effects of climate change right here in Howard County and we must do our absolute best to reduce the causes of the damaging effects of climate change that are predicted for the future. Climate Forward is the first Howard County climate plan to focus on resiliency. The research that went into Climate Forward shows that flooding and extreme heat are the most pressing and dangerous outcomes. Climate Forward includes making sure our residents are prepared for emergencies, reducing heat islands, improving stormwater management to reduce flooding, and enhancing ecosystems. We will prioritize our projects with a special emphasis on vulnerable and underserved communities.

Climate change is not solely an environmental issue. It transcends agencies and departments, and includes essential topics such as health, infrastructure, economics, and more. Climate Forward outlines specific next steps including setting timelines and identifying implementors for each action. These implementation steps were devised from the ground up, with extensive collaboration with all Howard County Government agencies.

We do not do this work alone. There are many businesses, state and federal agencies, and non-profit organizations that we will continue to engage as partners to achieve these goals. Climate Forward also includes a community call to action to harness the power of our residents to bring the whole community together in this effort.

I am thrilled that the Climate Forward Plan is complete. But in many ways, publishing this plan is only the start of our work. Climate Forward will not be a plan that sits on a shelf; it will be an evolving effort that incorporates new ideas and technologies as they unfold.

I am grateful to be a part of a community that is so passionate about protecting our environment for current and future generations. Thank you to our dedicated County staff, partners, and community members for creating Climate Forward.

I look forward to our continued partnership to ensure our environment is clean and sustainable for current and future generations.

A handwritten signature in blue ink, appearing to read "Calvin Ball". The signature is fluid and cursive, with a large initial "C" and a stylized "B".

Calvin Ball
Howard County Executive

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Executive Summary

Howard County Climate Forward: Climate Action and Resiliency Plan is science-based and focused on immediate and practical action. To develop this plan, Howard County's Office of Community Sustainability conducted the following research and public participation efforts:

- Review of relevant local and regional climate action plans and climate vulnerability assessments.
- Community-wide and government operations GHG emissions inventory for calendar year 2019.
- Expert input from subcontractor ICF to prepare Mitigation and Resiliency Strategies based on climate science and maximum impact.
- Community survey, specifically reaching out to underserved populations, to gather feedback on climate emergency preparedness.
- Meetings with internal and external stakeholders to generate ideas and get a complete picture of the work already in progress.
- Focus groups across agencies to refine Mitigation and Resiliency Strategies.
- Public meetings and written comments on both the Preliminary Report and the draft Final Report.

This bold and historic plan includes:

- Detailed information about Howard County's climate vulnerabilities.
- The County's most recent community-wide greenhouse gas (GHG) emissions inventory.
- New climate goals.
- GHG modeling results showing GHG emissions reductions expected from mitigation strategies.
- Specific Mitigation and Resiliency climate solutions, including strategies, actions, and implementation plans for each action.
- Appendices with details about methods used to develop the inventory, vulnerability assessment, GHG emissions reduction modeling and information about Howard County government's existing sustainability and climate efforts and programs.

Howard County Climate Forward will serve as a science-based and shovel ready workplan for every department and level of Howard County government. It also includes some recommendations for what partners and individuals can do. In addition, for the first time, Howard County is including resiliency, adaptation, carbon sequestration, and a focus on underserved populations into its climate action plan.

A lot has happened since the last Howard County Climate Action Plan published in 2015. Howard County has experienced some significant instances of extreme weather events, including the severe flooding of historic Ellicott City in 2016 and 2018, heat waves, and weather-related disruptions to electricity.

Climate projections indicate that the County will experience more intense storms, hotter days, local flooding, increased pollution, and other impacts as the climate changes. These hazards could damage and undermine public health, critical infrastructure, and essential resources in ways that pose a direct threat to human health and the vitality of Howard County's operations, economy, and community. Howard County must do its part to reduce greenhouse gas emissions and be better prepared for the harsher weather conditions that climate change will bring.

Moreover, there is now an even stronger understanding about how certain communities and populations are affected differentially by the impacts of climate change, and how solutions can be applied in a way to achieve environmental equity.

By undertaking Howard County Climate Forward, there is increasing momentum across all levels of the government, as well as continued public support, to act. With new and large sources of funding becoming available from the federal government to address climate change and from the state government through the recently passed Maryland Climate Solutions Now Act to reduce greenhouse gas emissions statewide, it is an auspicious time to release a new and ambitious climate action strategy for the County.

This 2023 Climate Action and Resiliency Plan builds on Howard County’s existing efforts to reduce emissions, increase resiliency, and achieve environmental equity. This plan identifies strategies to reduce greenhouse gas emissions, sequester (store) carbon, and achieve greater resilience against the increases in extreme weather that are projected to occur.

This report includes the most impactful and equitable strategies to reduce GHG emissions for the entire county and from all sectors, public and private. It also includes strategies for carbon storage and for increasing resiliency of infrastructure, ecosystems, and communities to expected changes in weather and climate. By following the recommendations in this plan, Howard County will:

- **Reduce greenhouse gas emissions by 70% by 2045** compared with projected 2045 emissions. These reductions will come primarily from converting the community light-duty vehicle fleet to electric vehicles, reducing miles driven, increasing the use of renewable energy, and improving energy efficiency. While this doesn’t fully achieve the net zero goal by 2045, it lays an excellent foundation of priority strategies to focus on for the next 3-5 years. Howard County plans to build on this foundation to achieve the net zero emissions goal by increasing carbon storage with nature-based climate solutions, advocating for better state and federal policies, adopting new technologies, and calling on individuals, organizations, and businesses to join our efforts to reduce GHG emissions and increase carbon storage.
- **Increase carbon sequestration** by improving soil health of natural and working lands, protecting and maintaining existing forests and other natural resources, planting more trees and deep-rooting native plants, replacing turf grass with native plant gardens, and pursuing other nature-based climate solutions.
- **Increase community resilience to extreme weather events.** Increased resilience will manifest in many ways. First, the strategies will promote infrastructure investments that will enable Howard County’s infrastructure to better withstand extreme weather events. For example, where there are heavy rains, there will be less localized flooding. Second, it will enable communities to be more prepared to deal with the impacts that are experienced. For example, there will be improved communication about what to do and what not to do during major weather events; households will be better prepared for power outages; and improved insulation and energy efficiency will provide a buffer against rising energy bills.
- **Increase interdepartmental coordination and environmental equity across programs.** A major focus of Howard County Climate Forward is a deep level of engagement from nearly every department, bureau, and office within County government. This interdepartmental cooperation informed the development of a comprehensive climate action and resiliency plan and will continue during implementation. Climate Forward also emphasizes equity, inclusion, and justice in every initiative.

Climate Forward is more than just a document. It is a strategic workplan for every level of County government across all departments and staff. Recognizing that achieving these goals is dependent upon many variables, such as financial resources, technological advancements, and community participation, this workplan will remain fluid. Climate Forward outlines the best approach to reaching the goals given current knowledge and ability to implement actions. However, adaptive management will be utilized as the County continues to explore the most cost effective, equitable, and efficient methods for achieving climate goals over time. The County anticipates gradual advancements toward the goals in the first year or two while forming partnerships, researching best implementation strategies, beginning to implement programs, and increasing the community’s understanding of their role. Exponential advancements are expected in later years as new initiatives are underway, technology improves, and community participation rises. Over time, the means and timeline for achieving the actions laid out in Climate Forward may vary from this document, but the goals will remain the same. The County will report progress annually and will include any adjustments in implementation steps, timelines, or metrics in these annual reports.

Continued intergovernmental cooperation and improved community services are ensured through the appointment of a Climate Action Subcabinet. The Subcabinet will host interdisciplinary workgroups that meet regularly to move climate action plan implementation forward in the most innovative, equitable, collaborative, and efficient manner.

Background

Howard County has a strong history of acting on climate change. Howard County released its first Climate Action Plan in 2010. This plan set targets to reduce greenhouse gas emissions 7 percent below 2007 levels by 2012, and 80 percent by 2050. These emission reductions were to be achieved primarily through strategies that targeted building energy, transportation, and renewable energy development.

The County's next Climate Action Plan, published in 2015, reviewed 2012 data and demonstrated that Howard County had exceeded the original goal and reduced emissions from Howard County government operations 12 percent below 2007 levels by 2012. The 2015 Climate Action Plan focused primarily on County government operations and did not include inventories, goals, or strategies for the private sector.

In 2019, during a void in national leadership on climate change, Howard County Executive Calvin Ball stepped forward with other local leaders across the country and committed Howard County to meeting internationally agreed upon protocols to reduce GHG emissions enough to avoid the worst of potentially life-threatening heatwaves, sea level rise, and ecosystem loss. Also in 2019, Howard County was the first county in the United States to accept the Natural and Working Lands Challenge to actively pursue nature-based climate solutions to maximize opportunities to reach net zero emissions through carbon storage in healthy soils, forests, meadows, and farmland. At that time, Howard County set new, more ambitious goals for greenhouse gas emissions reductions from County government operations of 45% below 2010 levels by 2030 and net zero emissions by 2050.

Howard County has further demonstrated its commitment to combating climate change through an impressive array of sustainability and quality of life initiatives across the County's departments. Howard County's commitment to sustainability is further demonstrated by becoming the first county in the U.S. to achieve a LEED Platinum designation from the U.S. Green Building Council's LEED for Cities and Communities program.

While focused on making this great progress on fighting climate change, Howard County has not updated its Climate Action Plan since 2015 – until now. It is important to have regular updates to the County's Climate Action Plan, especially as new climate science is published that may impact GHG emissions reduction goals and as climate change impacts lead to more hazardous conditions such as heat waves and extreme storms. In recent years, the County has experienced damaging floods, more frequent and severe heat events, and more power disruptions due to severe storms. Climate scientists project that these hazards will continue to increase in the future. These changes in climate can threaten public health, cause expensive damage to infrastructure, increase utility bills, and reduce the quality of life in the County.

2022 Executive Order Climate Goals

Recent reports from the Intergovernmental Panel on Climate Change (IPCC) show that society needs to act even more quickly and aggressively than previously thought to avoid the most catastrophic impacts of climate change. Using the research already accomplished through Howard County Climate Forward, and with urgency in mind, Howard County Executive Calvin Ball decided to answer this challenge by creating new greenhouse gas emissions goals through an Executive Order.

Executive Order 2022-12 surpasses both Maryland and federal greenhouse gas emissions reduction goals. Howard County's new greenhouse gas emissions reduction goal is to achieve a 60% reduction over 2005 levels by 2030 and net zero emissions by 2045. The Executive Order also formally adopted the Climate Focused and Equitable Governance Strategies outlined in this plan, which ensure that equity is incorporated into the County's governance approach to climate action and is accounted for in all decision-making processes.

Policy Context

This Climate Action and Resiliency Plan is being released at an exciting—and critical—time. In 2021 and 2022, the US government passed two major pieces of legislation that provide substantial funding opportunities for reducing greenhouse gas emissions and increasing resilience: Infrastructure Investment and Jobs Act (IIJA) in 2021 and the Inflation Reduction Act (IRA) in 2022. These federal acts authorize a substantial amount of funding to be used to combat climate change and to increase the resiliency of our nation’s infrastructure.

These Acts come at an opportune time, as the State of Maryland, the Baltimore Metropolitan Council (BMC), and Howard County have already taken important steps toward addressing climate change. Most notably, Maryland passed the Climate Solutions Now Act in April 2022, which sets an aggressive goal of achieving net-zero greenhouse gas emissions by 2045. Meanwhile, BMC and Howard County have already established foundational efforts to tackle both greenhouse gas emissions and resiliency.

Therefore, this Climate Action Plan is being released at a time with strong policy mandates, unprecedented funding opportunities, and foundational efforts to combat climate change. With the support of this broader context, the strategies and actions presented in this Plan will guide Howard County in achieving meaningful reductions in emissions and substantially increasing resiliency to climate change hazards, while meeting the requirements set forth in the state’s Climate Solutions Now Act.

National, state, and local policies and programs of note are:

- Climate Solutions Now Act (Maryland)
- Inflation Reduction Act (Federal)
- Infrastructure Investment and Jobs Act (Federal)
- American Innovation and Manufacturing Act (Federal)

To learn more about these policies and programs, see the Federal and State Climate Action Section.

Regional and County Efforts

HoCo by Design

At the same time as developing this Climate Action and Resiliency Plan, Howard County also has been in the process of updating its general plan – an update that occurs approximately once every decade. The new general plan, which will be considered by the County Council in 2023, is called HoCo by Design. Developing these plans at the same time was helpful as Howard County is focused on incorporating climate action into all of its major plans. Howard County’s Office of Community Sustainability and its Department of Planning and Zoning worked together to ensure that these plans are complementary and achieve climate solutions for years to come.

Emergency Management Plans

Howard County’s Office of Community Sustainability and Office of Emergency Management coordinated extensively on the development of Howard County Climate Forward. There are several plans published by the Office of Emergency Management that address climate hazards and how the County responds to disasters, such as the Howard County Hazard Identification Risk Assessment (HIRA) Plan, Howard County Hazard Mitigation Plan, and the Howard County Comprehensive Emergency Response and Recovery Plan (CERRP). Office of Community Sustainability reviewed these plans to ensure that Climate Forward is coordinated with and responsive to these emergency management plans.

Other Regional Plans and Studies

Howard County Climate Forward was developed to complement and to incorporate relevant findings from other regional plans and studies. These include several efforts by the Baltimore Metropolitan Council (BMC), including its Vulnerable Populations Index that helps identify geographic locations with high concentrations of underserved populations that may be more vulnerable to climate change than other groups. In addition, BMC and the Baltimore Regional Transportation Board (BRTB) completed a resource guide for Departments of Public Works (DPWs) and Departments of Transportation (DOTs) in the Baltimore Region for addressing climate change. This guide is focused on ensuring that local DPWs and DOTs have key information on how the climate is projected to change in each county of the BMC region. The purpose is to help them make climate-informed decisions about infrastructure planning, design, maintenance, and more. Ensuring that future climate is considered when making these decisions is an important step toward achieving more resilient infrastructure.

In addition, Howard County reviewed reports by the Intergovernmental Panel on Climate Change, the Maryland Commission on Climate Change and recent Climate Action Plans produced by nearby jurisdictions. Some of these jurisdictions include Montgomery County, Prince George's County, Baltimore County, and Fairfax County. Howard County also reviewed many climate vulnerability assessments from across the Country to ensure that this plan included the most critical sectors and considered all possible climate impacts to those sectors. The Columbia Association's Climate Vulnerability Assessment was particularly helpful for local vulnerability information.

Other County Initiatives

Howard County Climate Forward builds on a wide variety of successful County initiatives to reduce GHG emissions and increase climate resiliency at the local level. Some of these include the Feed the Green Bin residential curbside food composting program, recent installation of dozens of new, publicly available electric vehicle (EV) charging stations, several major tree planting programs, extensive disaster risk management, the Ellicott City Safe and Sound flood management program, energy efficiency improvements at County facilities, quick adoption of new building codes, and much, much more. There are too many of these initiatives to detail here, but more information is provided about County initiatives that relate to each mitigation and resiliency action in the relevant sections of this document. In addition, an extensive, though not exhaustive, list of County climate initiatives is provided in Appendix G.

Overview of Approach

This plan contains priority strategies that will help the County achieve its emission reduction goals and increase resiliency. The plan uses the best available data and science to determine the most impactful strategies to pursue. The plan takes a long-term view, with projections to key milestones of 2030 and 2045, but also focuses on implementation over the next 5 years. Progress will be assessed annually, and staff will review and revise Climate Forward as needed after five years. A lot has changed in the last five years. Five years ago, there was no Climate Solutions Now Act, Inflation Reduction Act or Infrastructure Investment and Jobs Act. The electric vehicle industry was also a lot different just a few years ago and the push for building electrification was not as organized.

Climate Forward is a culmination of both analytical work and stakeholder input—both of which played an essential, but different, role in selecting the strategies and actions for this Plan. At the outset, Howard County committed to ensuring strategies were selected based on sound and objective analysis.

The County developed a greenhouse gas inventory and projections using the International Council for Local Environmental Initiatives (ICLEI's) ClearPath tool. The inventory and projections were critical to understanding the primary drivers behind the County's emissions, and how those drivers may change in the future. Using this information, the County identified strategies in the Energy and Built Environment, Transportation, and Solid Waste sectors, which are

responsible for more than 99% of the County's estimated emissions included in this Plan. Thus, the County can focus on strategies that will have the most impact on emissions reductions.

To identify appropriate resiliency strategies, Howard County needed to first identify its greatest risks from climate change. To do so, The County used the Temperate Tool to assess its primary climate change risks. The findings of this assessment revealed that the top priority climate hazards facing Howard County are extreme heat, flooding, and extreme weather. Therefore, the strategies in this document focus on addressing risks associated with those hazards.

Finally, the County conducted a separate heat assessment. Heat is expected to increase substantially in the future, and impacts can be experienced unequally across geographies and populations. Therefore, the County completed a spatial analysis to identify the areas of greatest anticipated heat increases and where they overlap with concentrations of underserved populations, using Baltimore Metropolitan Council's Vulnerability Index for each Census tract in Howard County.

The methods, data, and assumptions used in these analyses are documented in later sections of this report.

While objective analysis is essential for identifying priority strategies, Howard County knows that successful implementation requires robust input from the County departments that will be affected by the strategies. Therefore, the County conducted extensive stakeholder engagement throughout the process. These engagements included both internal Howard County government stakeholders and external stakeholders.

Determining the specific implementation steps has been a thorough and collaborative process. This plan is not intended to be a top-down approach. Every effort was made to be inclusive and obtain knowledge and buy-in within Howard County government operations.

Preliminary conversations with various County departments were held to exchange ideas about Climate Forward, and to start defining the role that each department would have in creating and implementing strategies and actions.

Internal stakeholders included:

- Department of Community Resources and Services
- Department of Finance
- Department of Housing and Community Development
- Department of Inspections, Licenses, and Permits
- Department of Planning and Zoning
- Department of Recreation and Parks
- Department of Public Works (including Bureaus of Facilities, Highways, Engineering, and Environmental Services)
- Department of Technology and Communications Services
- Office of Central Fleet
- Office of Community Sustainability
- Office of Emergency Management
- Office of Human Rights and Equity
- Office of Public Information
- Office of Real Estate Services
- Office of Transportation
- Office of Workforce Development

Once the strategies were drafted, the County held meetings and focus groups with representatives from the offices and departments that would ultimately have a role in implementing the strategies. From these conversations, the specific actions and steps were vetted. This step was critical to ensure that the strategies and actions have the buy-in of the staff who will be essential to their implementation. All departments and offices engaged in the process and mentioned in this Plan were given the opportunity to comment on written drafts of the document.

The County engaged external stakeholders as well. There are multiple groups in Howard County and the Baltimore metropolitan region that work on climate change issues. The County and these organizations collaborate and support each other as they work toward their own goals. Moreover, the County is ultimately charged with serving the citizens of Howard County, and their input informs County priorities.

The County held a public meeting at the beginning of the Climate Forward development process to solicit feedback from the public. The County also provided three opportunities for the public to provide written comments – once at the beginning of the process, once after the Preliminary Report was published in December 2022, and again when a draft of the full report was published in April 2023. The County collected and reviewed all comments and worked to incorporate them into Climate Forward wherever appropriate.

In addition, the County held several meetings with local nongovernmental organizations working on climate change issues and other key stakeholders that may be engaged in implementing some of the actions identified in the Plan.

Additional stakeholders included:

- Baltimore Gas & Electric
- Civic Works
- Community Action Council of Howard County
- Columbia Association Climate Change & Sustainability Advisory Committee
- Howard County Chamber of Commerce
- Howard County Economic Development Authority
- Howard County Environmental Sustainability Board
- Howard County Health Department
- Howard County Public School System
- Howard Soil Conservation District
- Workforce Development Board

The Office of Community Sustainability also conducted a survey of County citizens to understand more about their concerns surrounding climate change and where they have already felt impacts from climate-related events. More information about the survey and its results can be found in the Climate Change Preparedness Survey section of this report and in Appendix D.

Impacts of Climate Change

Climate change is shifting weather patterns with extreme weather events increasing in frequency and intensity. In 2019, the Baltimore Metropolitan Council (BMC) and the Baltimore Regional Transportation Board (BRTB) completed a study on historical changes in climate and projections for future changes in climate for all counties in the BMC region, including Howard County¹. In general, the study found that the greater Baltimore region is getting hotter and is likely to experience more extreme weather events. Howard County is already experiencing documented impacts from climate change such as increasing temperatures, precipitation, and extreme weather events. The Columbia Association's Climate Vulnerability Assessment, which explored the impacts of climate change as they relate to extreme precipitation and flooding, extreme temperatures, and extreme weather, documented these impacts.²

Howard County: Moving Toward More Extremes



Extreme Heat



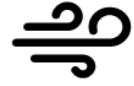
Extreme Cold



Flooding



Extreme Storms



Heavy Wind

The sections below provide more detailed information about anticipated changes in heat, precipitation, extreme weather, and the associated impacts. The final section provides additional discussion on how impacts are not uniformly experienced throughout the County. Appendix C includes the full projections of changes in heat and precipitation from the BMC study.³

Note that *observed* values represent the average across the 20-year period 1986-2005. *Near-term* is the 20-year average over 2020-39, *mid-century* is the average over 2040-50, and *end-of-century* is the average over 2080-90. The BMC study used 20-year averages to account for the fact that there is natural variability from one year to the next, so no single year is representative of the overall climate.

Extreme Heat

Observed and Projected Changes

According to BMC study, Howard County will become notably warmer in the future. Notable projections include:

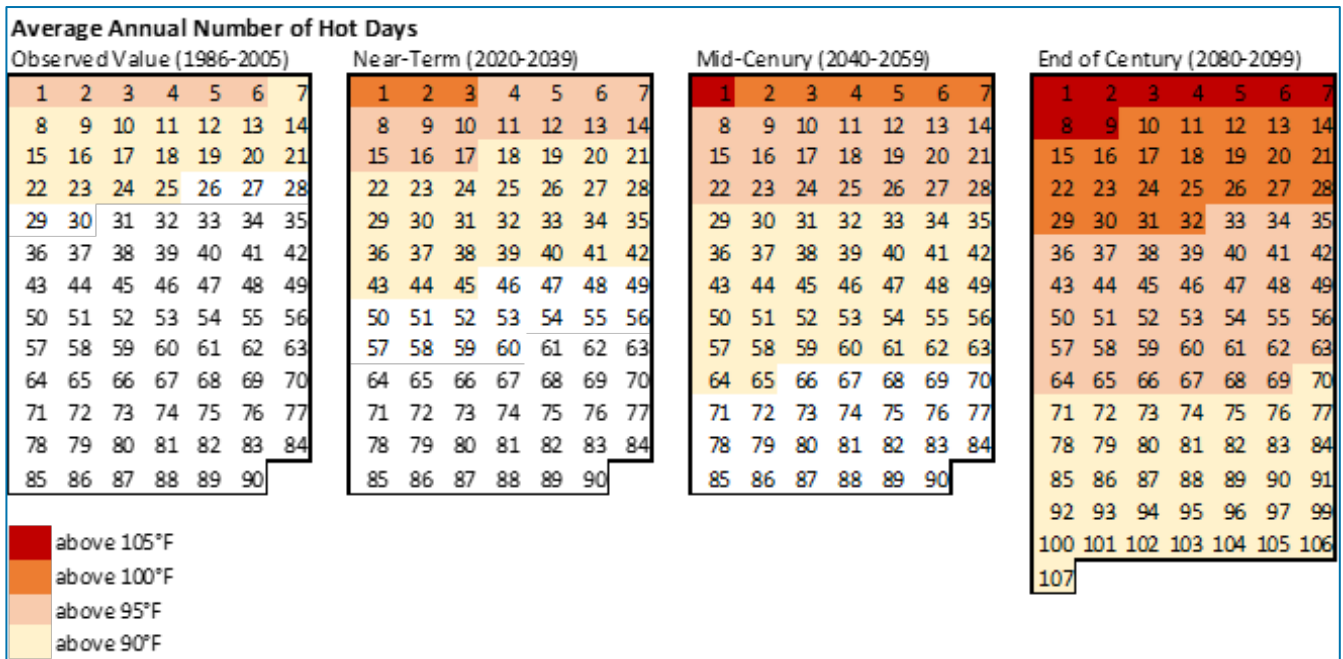
From the mid-1980s through the early 2000s, the number of heatwaves⁴ averaged about 1 per year. By the middle of this century, Howard County will experience an average 6 heatwaves per year, and 18 by the end of the century.

During the observed timeframe in Figure 1, there was typically less than 14 days (two weeks) where nighttime temperatures stayed above 70°F. By the middle of the century, there could be 29 additional days (nearly a month) where nighttime temperatures stay above 70°F. By the end of this century, there will be 73 additional days (about two and a half more months) above 70°F compared to the observed timeframe. Warmer nights means that buildings and materials do not get the chance to cool off overnight, which means additional energy is required to cool buildings the next day.

The hottest day of the year in Howard County was, on average, around 97°F during the observed timeframe. By mid-century, the hottest day of the year could be around 103°F on average, and 108°F by the end of the century.

As shown in Figure 1 below, the number of days exceeding thresholds of 90°F, 95°F, 100°F, and 105°F are expected to increase substantially. For example, there used to be only a few days per year that were 95°F or hotter (6 days, on average, 1986-2005). By mid-century, Howard County could experience 28 days on average that are 95°F and above, and 69 days on average that are 95°F and above by the end of the century.

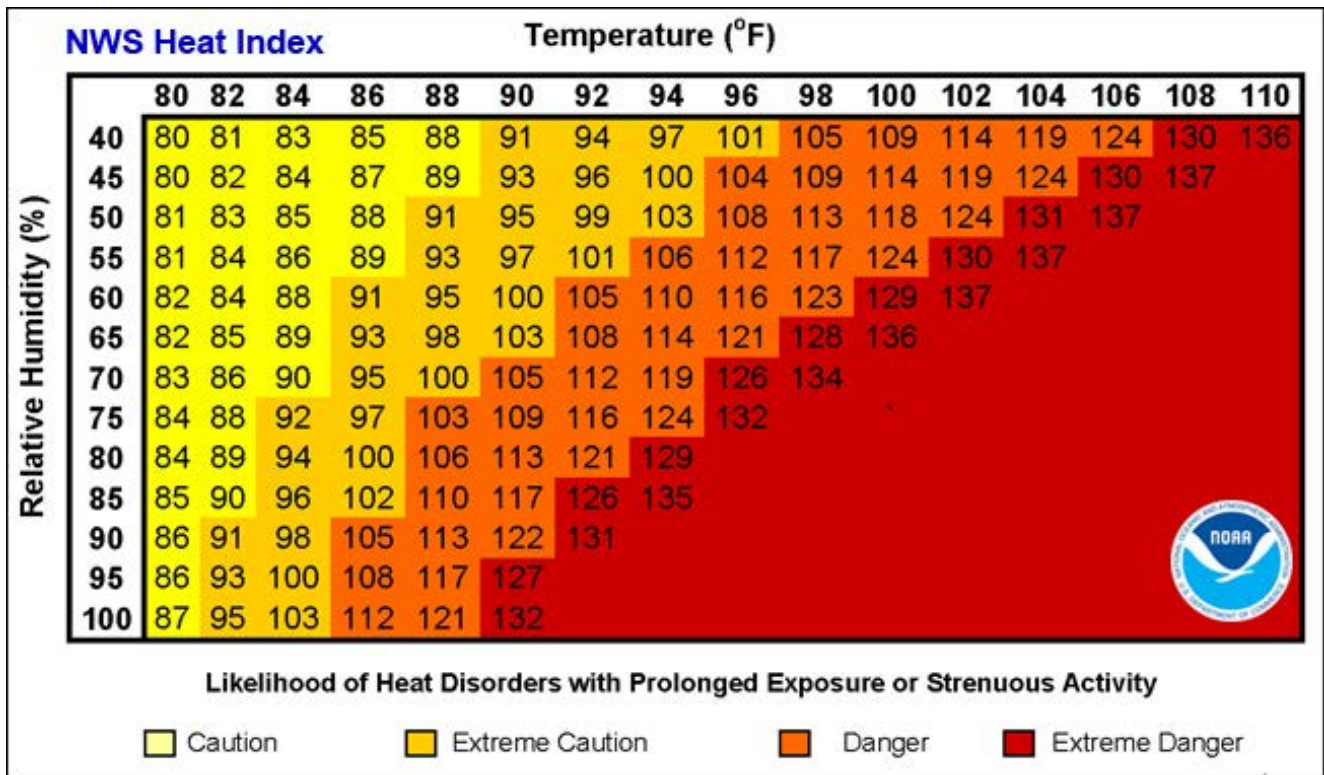
Figure 1: Average Annual Number of Hot Days



Average days where maximum temperatures exceed 90 °F, 95 °F, 100 °F, and 105 F from 1986 through the end of the century. Source: Developed using data from Baltimore Metropolitan Council

For perspective, the National Weather Service Heat Index (see Figure 2) considers 95°F to be potentially dangerous when humidity levels exceed around 45%—a level that is common in Howard County in the summer⁵. Therefore, these temperatures are not just uncomfortable, but are potentially dangerous. A heat index quantifies the temperature it feels to the human body when humidity and temperature is combined. According to the National Weather Service Index, a 96-degree Fahrenheit day with 45% relative humidity is considered dangerous and can make the human body feel like the temperature is 104 degrees Fahrenheit. It’s important to note that the heat index values below are measured in shady conditions, and exposure to sunny conditions can alarmingly increase heat index values by 15°F. This combination of dry air temperature and humidity is sometimes called the wet-bulb temperature. The term gets its name from how it is measured. A wet cloth over the bulb of a thermometer cools the temperature, but if the humidity in the air is high, less evaporation occurs so the wet-bulb temperature is closer to the dry temperature. The wet-bulb temperature measures how well humans will be able to cool themselves through sweating. Typically, the body will regulate its own temperature when it gets too hot through the act of perspiring or sweating. Then, the sweat evaporates and cools the body down. When humidity levels are high, the rate of evaporation slows. The body cannot cool down as fast leading to heat stroke, exhaustion, and other heat-related illnesses⁶.

Figure 2: National Weather Service Heat Index

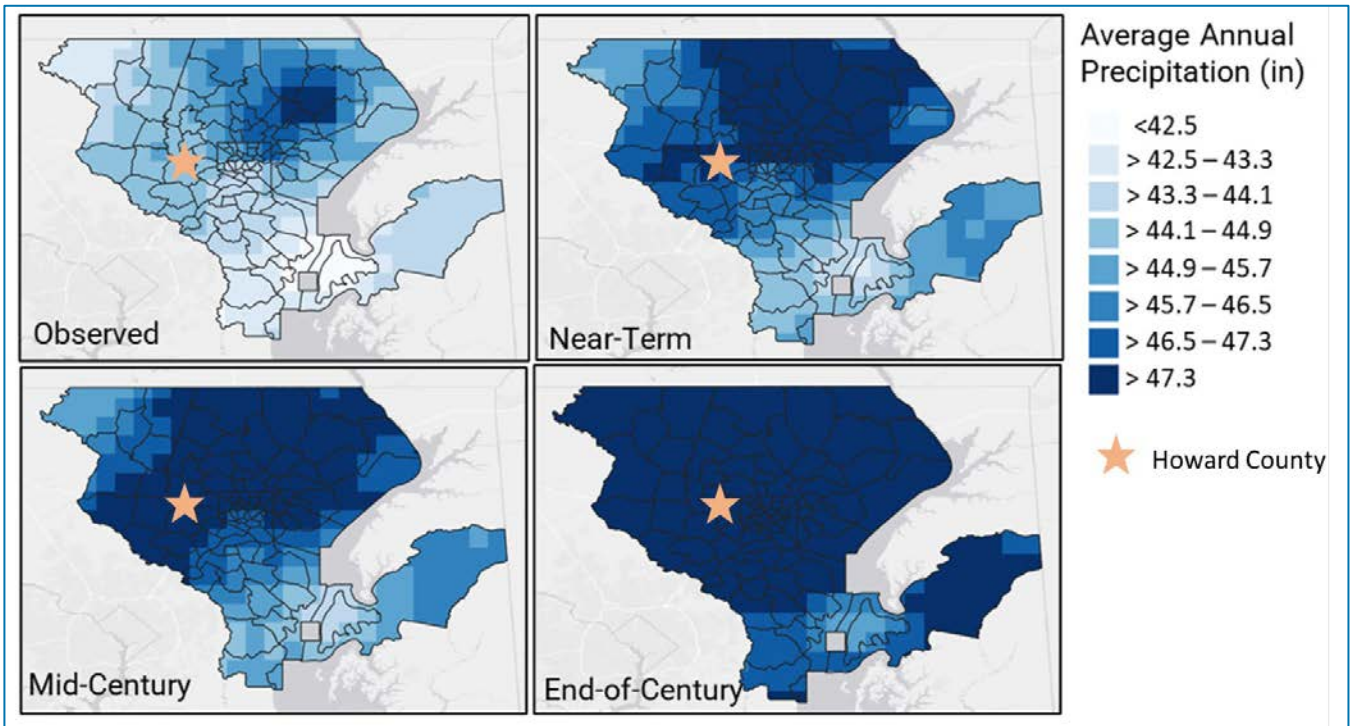


Source: National Weather Service, Heat Index chart. <https://www.weather.gov/ama/heatindex>

Precipitation

Climate change impacts surface temperatures causing them to rise, which in turn leads to an increase in evaporation. Following the simplified precipitation cycle, more evaporation leads to an increase in precipitation. Howard County is expected to experience more rain and snow over the coming decades. Figure 3 shows how average annual precipitation will change regionally from historical observations through near-term, mid-century, and end-of-century projections. Howard County, compared with other portions of the region, is statistically expected to see higher average annual precipitation. The County may see, on average, an additional 2.8 inches of precipitation per year by mid-century and an additional 5.1 inches by the end of the century. These increases in precipitation will not happen uniformly across the year. For example, the greatest increases are expected in the late winter and early spring, which may lead to more severe flooding during that time of year. While annual precipitation may only increase slightly, the precipitation is expected to come in shorter, more intense bursts. These precipitation events can be a particular strain on infrastructure and people. In contrast, more modest increases (or even decreases) in precipitation may occur in the late summer and early fall, which could lead to drought conditions.

Figure 3: Average Annual Precipitation Across the Region.

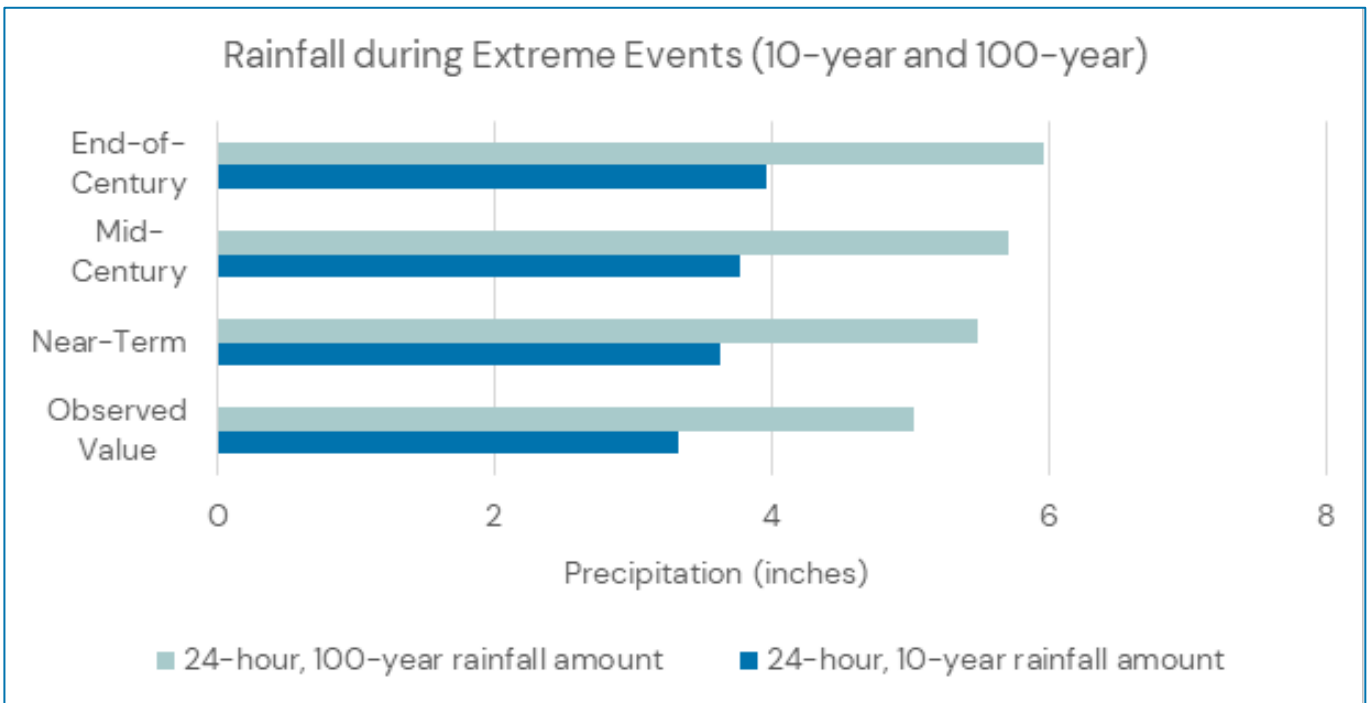


Average annual precipitation across the region. Projected values represent the 32-model ensemble mean for RCP 8.5. Source: BMC

Rainfall during extreme weather events is expected to increase significantly as well. During the observed timeframe (1986-2005), 1.5 inches of precipitation over a 24-hour period was considered an *extremely heavy precipitation* event.⁷ By mid-century, an *extremely heavy precipitation* event could include an additional 0.2 inches of rainfall in 24 hours—a 13% increase. By the end of century, an extremely heavy precipitation event would include 0.3 more inches of precipitation, or a 20% increase. Although 0.2-0.3 inches may not sound significant, the combined run-off of the additional precipitation over a large area can overwhelm stormwater drainage systems and cause flooding.

Figure 4 shows how rainfall during extreme weather events is expected to increase for both 24-hour 10-year and 100-year events. Rainfall during these events is expected to increase between half of an inch to one inch by the end of the century.

Figure 4: Rainfall During Extreme Weather Events



Rainfall during extreme weather events for the Baltimore region. Projected values represent an RCP 8.5 emissions scenario. Source: BMC (2021)

A “100-year” flooding event is commonly misconstrued to sound like it only occurs once every 100 years. A more accurate description of a “100-year” flood event is that it has a 1% chance of occurring each year. Similarly, a “10-year” flood event has a 10% chance of occurring each year. Climate change is expected to cause more frequent and more severe flooding events. As flooding events are expected to increase in frequency, the recurrence interval and the terms for flood events may need to be reevaluated. For example, the chance of a “1000-year” event happening each year is 0.1%. In both 2016 and 2018, Old Ellicott City experienced a “1000-year” flood, a very severe flooding event. These catastrophic floods were responsible for fatalities, property damage, loads of debris, erosion, and business closures.^{8,9}

More intense rainfall events can lead to more flooding. It is difficult to predict exactly where flooding will occur due to extreme rainfall events, as it depends on many factors. However, it is reasonable to expect that areas that already experience flooding will experience more frequent, and/or more severe, flooding events in the future. Flooding may also occur in areas that historically have not experienced flooding.

Other Extreme Weather Events

Scientists also predict more intense storms, which are associated with more wind damage and flooding. Climate change will lead to increasing frequency and intensity of extreme weather events across the entire Baltimore region. Storms will change in strength and volume due to warming atmospheric temperatures which provide additional energy to storms. For example, climate science trends are showing projected increases to the number of strong, Category 3 or higher, hurricanes through mid-century for the region.¹⁰ These storms are accompanied by heavy rains, flooding, and severe winds that can damage infrastructure and cause power outages.

Derechos are another type of intense storm that could become more frequent. Derechos are a long band of windstorms that stretch across a large area of land with winds similar in strength to tornados or hurricanes. These storms produce heavy winds, thunderstorms, and rain. Derechos can cause “straight-line wind damage” since the winds of a derecho

move in one direction. In June of 2012, a severe derecho with winds exceeding 80 mph struck the Maryland area and hit many states on the way. This derecho caused widespread outages and damages. This storm caused millions of power outages reported by electricity delivery companies. These storms may become more frequent since the conditions that are needed to form a derecho will increase with the warming environment.¹¹

Finally, although temperatures may increase overall, there may be more frequent winter cold snaps due to a cold air mass above the arctic, known as a polar vortex, weakening. A weakened polar vortex event pushes cold air into southern regions of the United States. Weakened polar vortex events and their impacts on the United States could be exacerbated due to climate change.^{12, 13, 14, 15}

Climate Change Vulnerability in Howard County

The anticipated changes to Howard County's climate will have negative impacts on human health, natural systems, basic services, infrastructure, and other community systems. Based on research done for this Climate Action and Resiliency Plan, extreme heat and flooding were determined to be the most dangerous hazards, requiring the most resiliency action. Further research done by the Columbia Association's Climate Vulnerability Assessment focuses on these two hazards as well. Extreme heat and flooding can cause utility disruptions, occupational hazards, ecosystem changes, health complications, and more.

To understand how Howard County might be vulnerable to these changes in climate, the County relied primarily on the ICLEI Temperate Adaptation Planner tool, which assesses the vulnerability of various community systems to different climate hazards. This tool relied on subject matter expert input from various County departments and key external partners.

Temperate Study

The Temperate study was performed by Howard County's Office of Community Sustainability to assess the County's risk related to climate change. The Temperate tool utilizes a series of prompts to solicit subject matter expert input on the perceived impacts of cyclones, droughts, extreme heat, extreme winter conditions, flooding, and severe wind on community systems. Community systems included agriculture, business continuity, ecological function, emergency management, energy delivery, food supply, internet and communications, public health, public safety, quality of life, and tourism. Subject matter experts from internal and external stakeholders provided their best professional judgement on how severe the impacts of each climate hazard would be on each community system. They also provided their best professional judgement on how easily each community system can adapt and bounce back from each climate hazard. This information was used to determine the impact score, adaptive capacity, and adaptive need for each community system in relation to each hazard. County staff then prioritized the systems and hazards resulting in a high adaptive need. A high adaptive need, according to ICLEI, is the result of a high impact score and a low adaptive capacity score, meaning a community system would be impacted moderately or severely by the climate hazard and would have a hard time bouncing back from that impact. The methodology used for this Climate Vulnerability Assessment is further detailed in Appendix C.

As extreme heat and flooding were determined to be the hazards with the greatest potential impact on Howard County systems and sectors, Climate Forward focuses the Climate Vulnerability Assessment primarily on heat and flooding.

The following list contains the impacts of extreme heat on Howard County systems and sectors with a high adaptive need:

People and Communities

- Increased risk of heat-related illness and deaths, especially for babies, student athletes, seniors, the chronically ill, and individuals without air conditioning.

- Increased risk of asthma attacks and cardiovascular events on very hot days due to increased ozone and other air pollutants.
- Chronic stress and other negative impacts on mental health from prolonged heat and the inability to exercise outdoors.
- Increased violence often seen with prolonged heat stress, particularly in areas with low tree cover.
- Increased gastrointestinal illness from loss of refrigeration in power outage or lax food safety.
- Reduced ability to access outdoor attractions and dining.

Employment and Working Conditions

- Outdoor workers at risk of heat stroke and dehydration.
- Inadequate air conditioning or brownouts from an overloaded grid can reduce productivity and cause health impacts.

Infrastructure and Basic Services

- High temperatures reduce roadway integrity.
- Brownouts interfere with computational networks and information transfer between County offices, businesses, and residents.
- Schools with inadequate air conditioning may need to close.

Economic Impacts

- Reduced productivity of outdoor workers.
- Increased sick days during heat waves from heat stress, asthma, and cardiovascular events.
- Loss of patronage at outdoor businesses.
- Increased cost of damage to infrastructure as temperatures increase.
- Need to upgrade air conditioning systems (residential, commercial, and governmental) to maintain health of occupants.

Natural Systems

- Increased average temperature affects growth rates, survival, overwintering, and reproductive success of native species of animals and plants.
- Changes in temperature can affect species differently, destabilizing species interactions involving pollination, competition, and predation.
- Changes in temperatures may give invasive species a competitive edge over native species.
- Declined water quality and dissolved oxygen in warmer ponds, streams, and wetlands, while pathogens increase. This harms freshwater animals and plants.
- Algal blooms can increase to dangerous levels as ponds and streams warm.
- Length and severity of fire season increase with temperature.

Agriculture and Gardening

- Rising summer temperatures increase risk of drought stress in plants, given that additional summer rain not expected.
- Effective pollination in crops like corn and tomatoes is reduced by high temperatures; flowers and fruit can abort.
- High temperatures reduce growth and fertility in domesticated animals and lower milk production in dairy cattle.
- Insect pest populations can spike; some insects may add another generation to yearly cycle.
- Some insect pests may gain the ability to overwinter in Maryland, increasing their impact.
- Insect pollinators can get out of sync with their plants and control of insect pests by natural enemies can fail when species respond differently to warming.

- Warmer winters can cause plants to break dormancy too early and be damaged by late spring frosts.

The following list contains the impacts of increased storms and flooding on Howard County systems and sectors with a high adaptive need:

People and Communities

- Increased risk of injury or death in flooded areas due to drowning, electrocution, or dangerous debris.
- Water damage to homes can produce long term health risks from mold.
- Power outages from storms that shut down air conditioning and refrigeration amplify heat stress.
- People may not be able to access medical care or obtain medications.
- Transport of pathogens in floodwaters increases illness through direct contact or contaminated food.
- Increased risk of disease transmission from mosquitoes when areas of still water remain after flooding.
- Potable water supplies can become contaminated by floodwaters.

Employment and Working Conditions

- Flood damage to commercial buildings can cause inability to access or open businesses.
- Rescue workers at risk in stormy or flooded conditions from flying debris and chemicals or pathogens in floodwater.

Infrastructure and Basic Services

- Flood damage to roads, bridge supports, and stormwater management systems can be severe.
- Power outages interfere with computational networks and information transfer between County offices and residents.
- Significant delays in normal operations and emergency response during flood damage and cleanup.
- Electric service restoration can be delayed in areas with significant flooding.
- Hospitals and medical centers can be damaged or inaccessible.
- Flooding can overwhelm water treatment plants, leading to discharge of contaminated water into streams or the Bay.

Economic Impacts

- Flooding can keep customers from accessing businesses, reducing sales.
- Cost of disaster recovery for businesses and County is increasing as climate change progresses.
- Cost of storm-related damage to infrastructure for businesses and County are increasing.
- Cost of upgrading stormwater management systems rises as damage increases.

Natural Systems

- Heavy rains contaminate waterways with increased litter and pollutants.
- Erosion from stormwater increases sedimentation in surface waters, causing negative impacts to plants, invertebrates, and fish.
- Increased runoff of agricultural chemicals and fertilizer during floods damage life in streams, rivers, and the Bay.

Agriculture and Gardening

- Flooding rains can interrupt planting or harvesting.
- Flooding increases erosion and loss of topsoil.
- Heavy rains may cause damage to crops from waterlogging.
- Flooding washes pollutants, litter, and toxins into waterways.
- Flooding and runoff can wash more agricultural and lawn chemicals into streams, rivers, and the Chesapeake Bay.

Differential Impacts

Overall, the climate in Howard County is getting hotter, with more frequent and intense extreme weather events. Notably, impacts from climate change are not felt uniformly across the County, in terms of both geography and populations. Some areas are more prone to flooding events, and some areas are expected to experience higher temperature increases than others due to local characteristics such as the urban heat island effect.

Although climate change impacts will be felt across all of Howard County, these impacts will not affect everyone equally. Extreme weather, heat, and flooding have the greatest potential to impact those who hold physiological, economic, and social characteristics that make them more vulnerable to climate.

Underserved populations may be less resilient to extreme weather. For example, they may be less able to absorb increased utility costs, may live in buildings with less weatherization to help keep homes comfortable, may lack air-conditioning, may be less able to afford amenities that make heat more tolerable (e.g., air conditioning, swimming pool access), and may have fewer transportation options to buildings, shaded parks, and other places that may offer relief. They may be less able to absorb the financial impacts of damage to homes and property or have fewer transportation options when a given roadway is temporarily impassible from a flood. The Baltimore Metropolitan Council, among many other agencies and organizations, has identified several characteristics that qualify individuals as being at greater risk to climate impacts.¹⁶ These characteristics are shown in Table 1.

Table 1: Vulnerability Characteristics

Vulnerability Characteristic	How Does this Increase Vulnerability to Climate Change Impacts?
Poverty	A lack of financial resources is correlated with lower abilities to gather supplies like food, water, and back-up generation to withstand natural disasters and climate impacts.
Non-Hispanic, Non-White, Hispanic	Individuals who classify as a race or ethnicity other than white are statistically more vulnerable to climate change impacts due to lower levels of access to community resources.
Limited English Proficiency	In general, communications materials and messaging are predominately presented in English. Individuals who cannot speak, read, or write English, experience limited access of resources.
Disabled	Individuals with mobility issues or impairments cannot access resources in the same way that non-disabled persons can, thus limiting their ability to deal with climate impacts.
Elderly	Elderly individuals are susceptible to extreme heat and often have impairments or mobility issues that prevent them from accessing resources.

Howard County used the Vulnerable Populations Index to help better understand potential differences in vulnerabilities of communities within the County. The Columbia Association’s Climate Vulnerability Assessment was also utilized for this purpose.

A Closer Look: Heat and Flooding Vulnerabilities

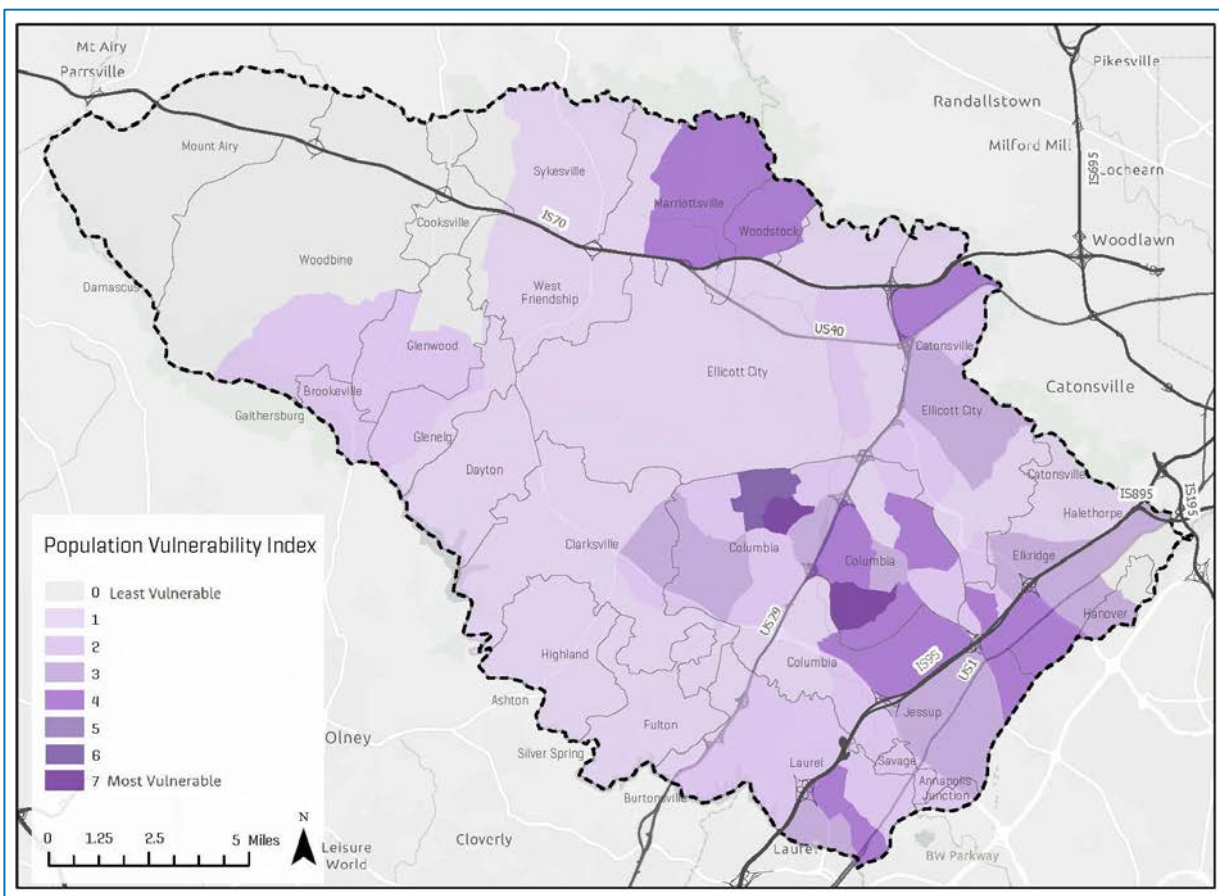
Flooding and heat are projected to increase in frequency and magnitude above historical baseline levels and will have significant impacts on people, infrastructure, and the environment. The present impacts of extreme heat across Howard County are represented in this assessment using land surface temperatures from available meteorological data sets. The present impacts of flooding across Howard County are represented in this assessment using FEMA 100-year and 500-year floodplain extents. To focus this climate vulnerability assessment further, the study team mapped both heat and flooding across Howard County to better understand how impacts will be felt across the County.

Vulnerabilities to Extreme Heat

Heat is anticipated to increase significantly in the future in Howard County, but the impacts will not be uniform across the County. Therefore, Howard County completed a spatial analysis that considered spatial variation in temperatures, alongside variations in population vulnerabilities.

The assessment first considered relative vulnerabilities of different communities, drawing on the Baltimore Metropolitan Council's Vulnerable Populations Index for each Census tract in Howard County. The BMC Vulnerable Populations Index considers the following characteristics that may make a community more vulnerable: poverty; non-Hispanic, non-white; Hispanic, Limited English Proficiency (LEP), disabled, elderly, and carless. Although this Index does not directly reflect vulnerability to heat, these characteristics are ones that could indicate either health or socio-economic situations that would make someone more vulnerable to extreme heat. For example, the elderly tends to be more sensitive to extreme temperatures. Poverty may be correlated with residences lacking sufficient cooling capabilities. Being carless may make it more difficult to travel without being exposed to high temperatures. Figure 5 shows the Population Vulnerability Index by Census tract.

Figure 5: Population Vulnerability Index



The assessment next considered geographic variations in heat. In this assessment, extreme heat across Howard County is represented by using land surface temperatures from meteorological data sets during a previous extreme heat event in Howard County which occurred on May 13, 2021. Temperatures were not uniform across the County due to variations in local characteristics such as the urban heat island effect. This index indicates that the eastern part of the County may experience hotter temperatures than the western part during extreme heat events.

Howard County combined this information on variations in heat and populations to create a Heat Vulnerability Index (Figure 6). The heat vulnerability index effectively surmises the vulnerability of that Census tract to increasingly extreme heat events due to the characteristics of that Census tract’s population, with darker areas of the map representing a higher vulnerability to heat and climate change impacts. Heat vulnerability across Howard County is most pronounced among southeastern portions of the County, which is primarily due to a greater portion of land area being covered by buildings, infrastructure assets, impervious surfaces, and a lack of tree cover. Jessup, Hanover, and Elkrige have a higher heat vulnerability than other areas. The Wilde Lake Village Center has the highest heat vulnerability in the County. Promoting more tree cover, shade structures, cooling surfaces, and cooling centers in these areas can help those who are more vulnerable to extreme heat.

Figure 6: Heat Vulnerability Index

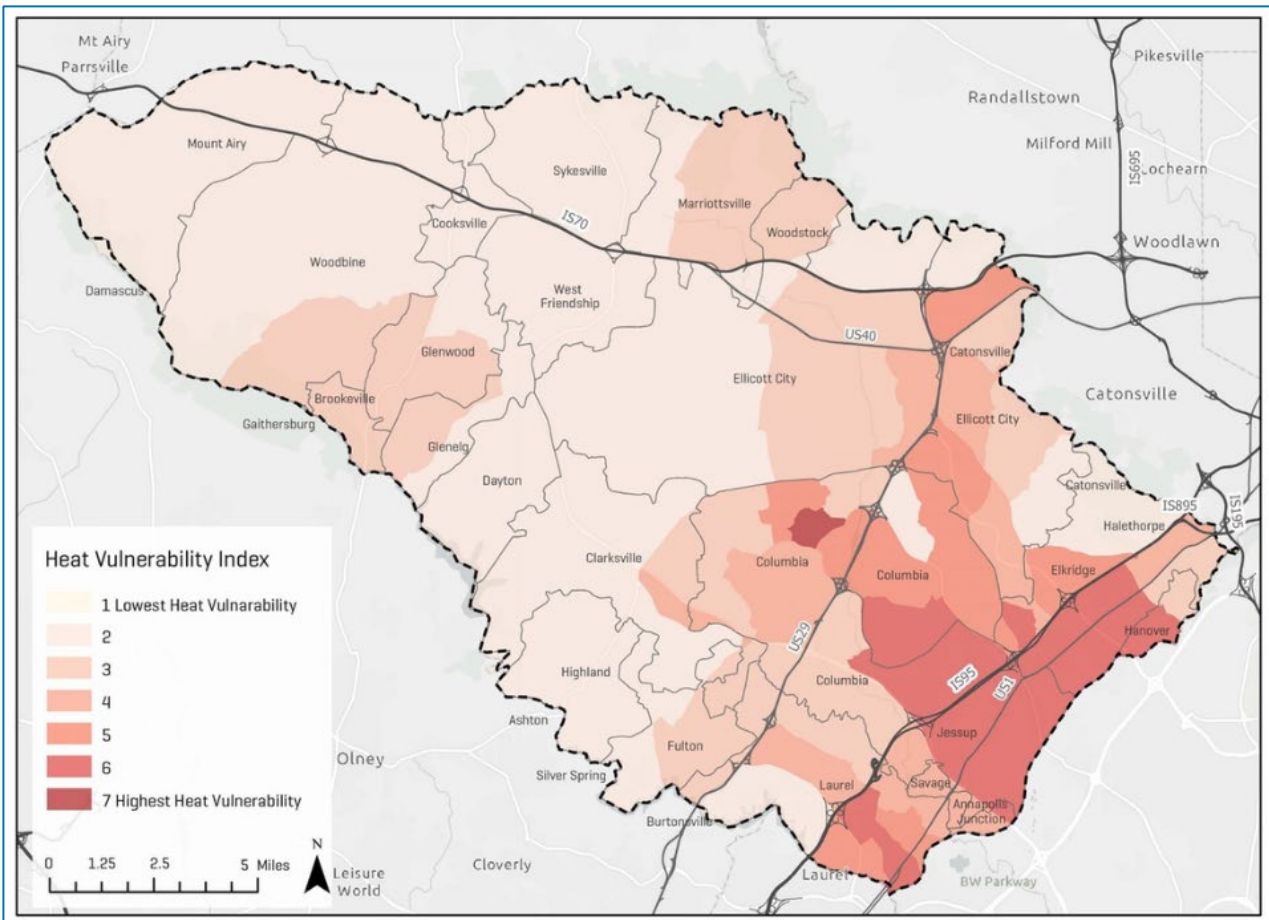


Figure 7 adds the location of the County’s current emergency cooling centers to the Heat Vulnerability Index map to show the locations of these centers relative to heat vulnerability. This information can help Howard County assess the need for additional emergency cooling centers. For example, the far eastern section of Howard County has a high overlap of urban heat islands and under-resourced populations, which may indicate a need for additional cooling centers in the area.

Figure 7: Heat Vulnerability Index and Cooling Center Locations

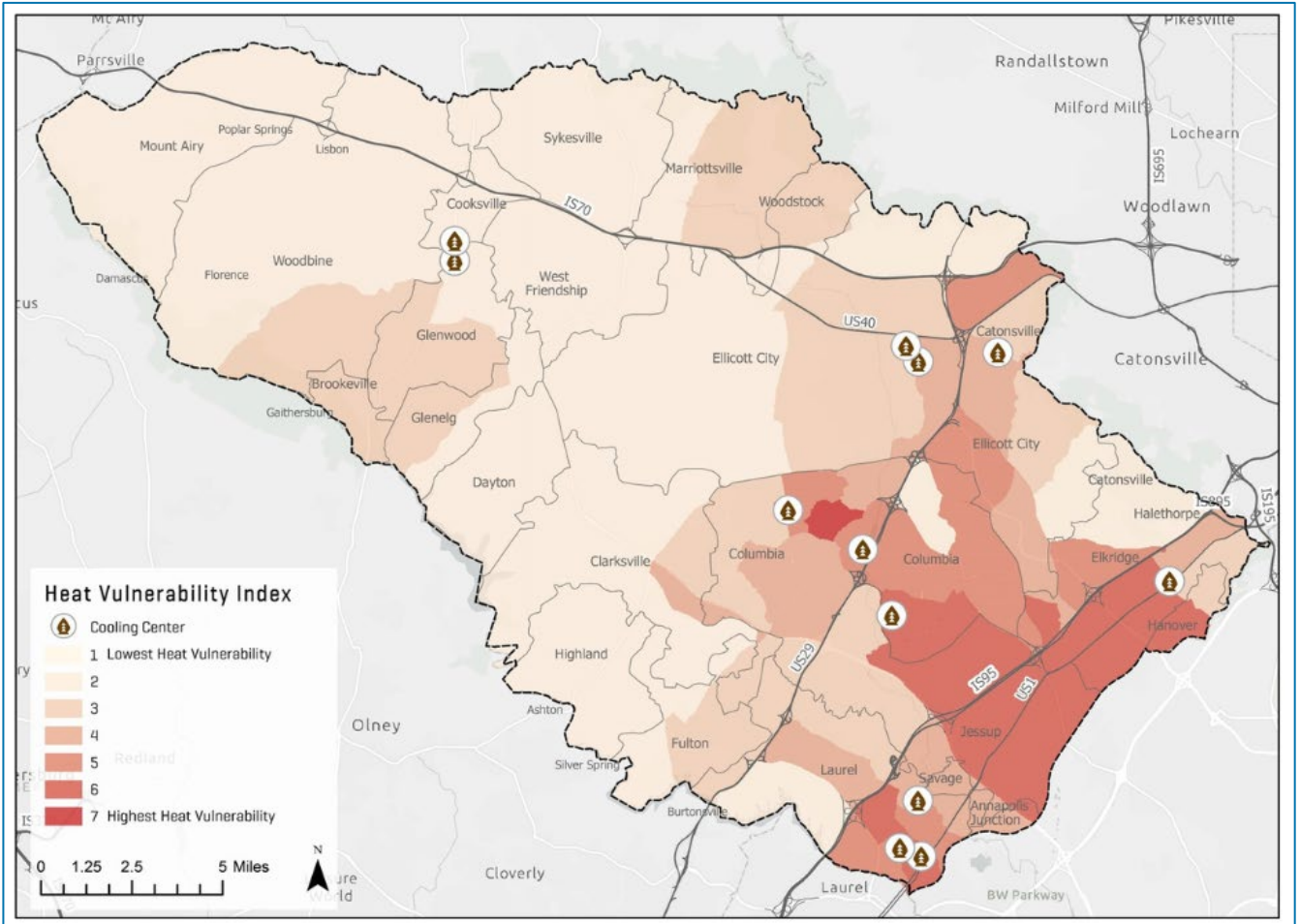


Figure 8 shows Howard County Tree Canopy data overlaid with the heat vulnerability index. Howard County should focus tree planting efforts on areas with higher heat vulnerability and less tree canopy. For example, southeastern Howard County has a high heat vulnerability and areas where tree canopy is lacking. Figure 9 shows tree canopy in an Elkridge neighborhood. Zooming in on interactive versions of these maps can help County staff identify neighborhoods that would benefit the most from tree plantings because they have a high heat vulnerability and low tree canopy.

Figure 8: Heat Vulnerability Index and Howard County Tree Canopy

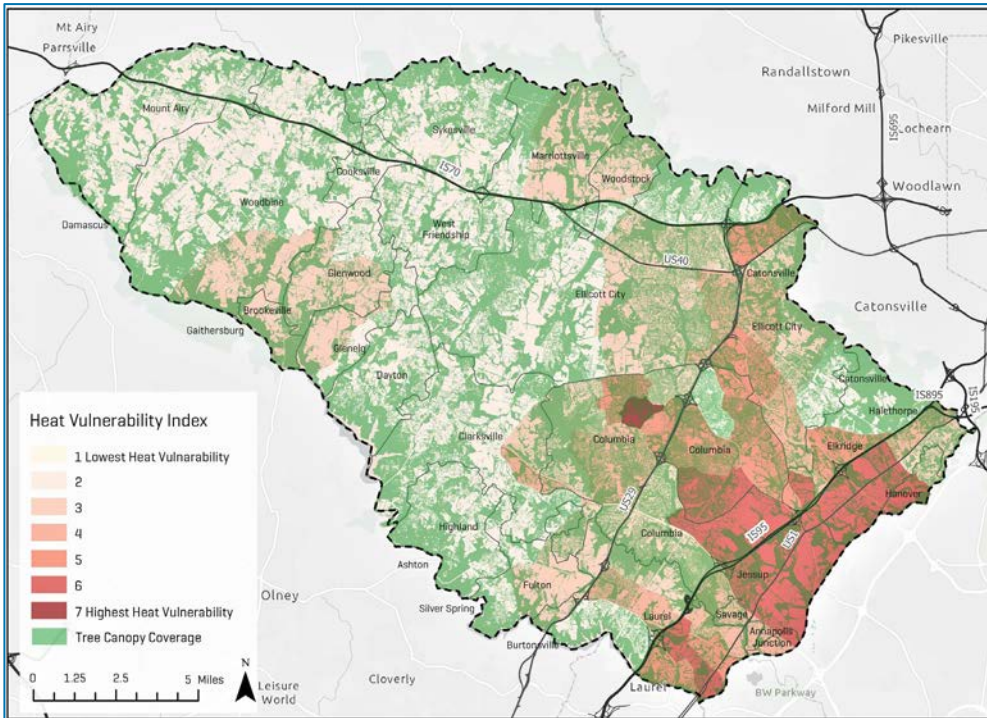


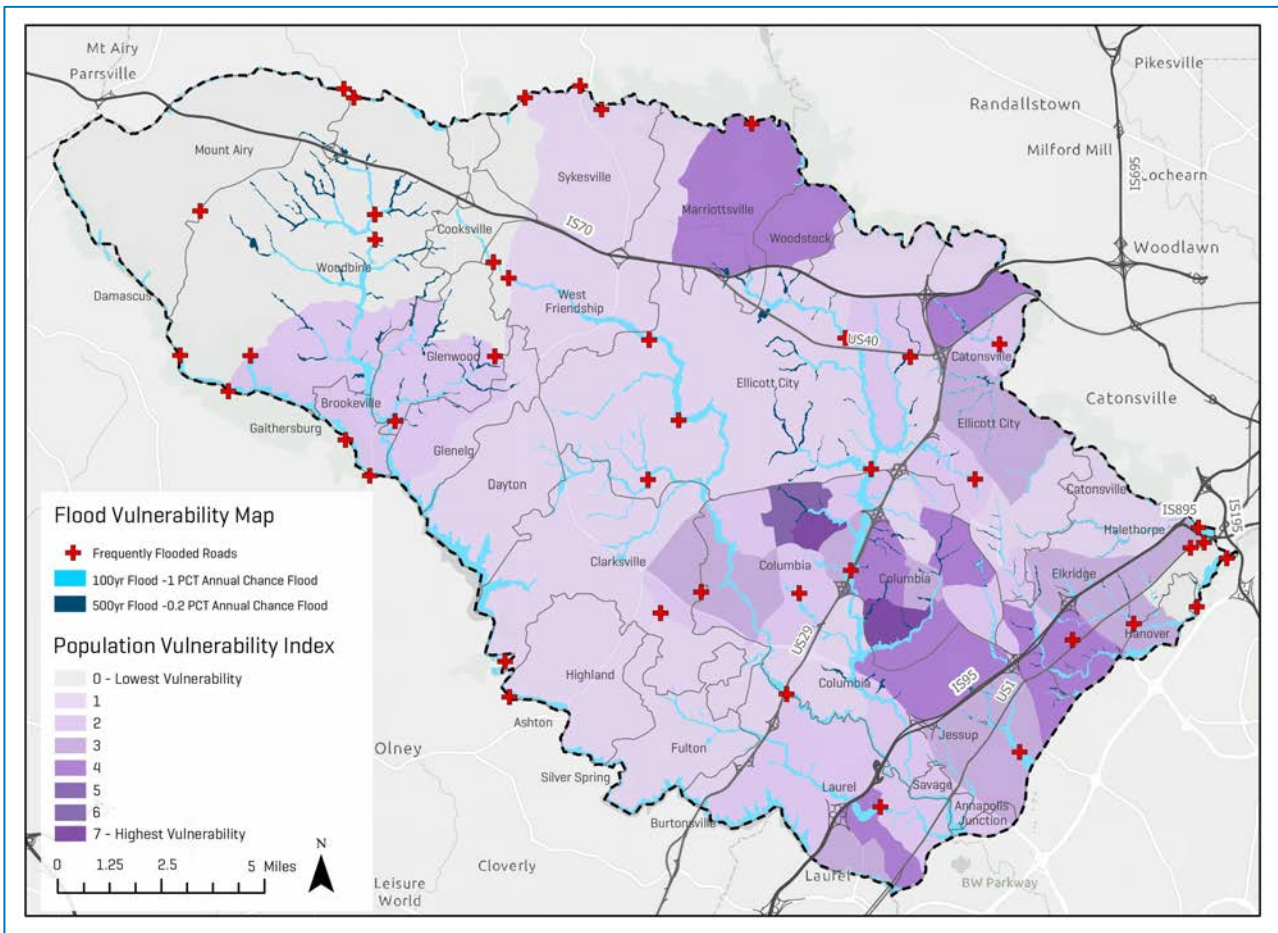
Figure 9: Tree Canopy Cover in an Elkridge Neighborhood



Vulnerabilities to Flooding

To better understand areas and communities at potential risk for flooding, Howard County has compiled spatial layers of the Federal Emergency Management Agency (FEMA) 100-year and 500-year flood zones, locations of frequently flooded roads, locations of County and critical facilities, and the BMC Vulnerable Populations Index. This information will help the County make informed decisions on where to prioritize investments to increase resiliency to flooding. To illustrate this information, Figure 10 below shows the flood zones, locations of frequently flooded roads, and the Vulnerable Populations Index. As this figure shows, there are flood zones and frequently flooded roadways throughout the County, including in communities scoring higher on the Vulnerable Populations Index.

Figure 10: Flood Zones, Vulnerable Populations Index, and Frequently Flooded Roads



Howard County faces significant flooding concerns within the 100-year and 500-year floodplains throughout the County, and particularly in and around central and eastern portions of Howard County. Importantly, there are several critical facilities— such as Howard County’s K-12 schools, fire stations, police stations— that are in or near floodplains. In addition to flooding concerns at these critical community resources and facilities, there are several roadways experiencing frequent flooding, which will further jeopardize access to and from these critical facilities. Columbia Association’s Climate Vulnerability Assessment revealed that high risk assets such as bridges and tot lots are in Harper’s Choice, Hickory Ridge, Kings Contrivance, Long Reach, and Owen Brown¹⁷. Areas showing higher vulnerability to climate change impacts that overlap with FEMA 100 and 500-year floodplains may be priority areas for the implementation of flood reduction and stormwater management strategies and actions.

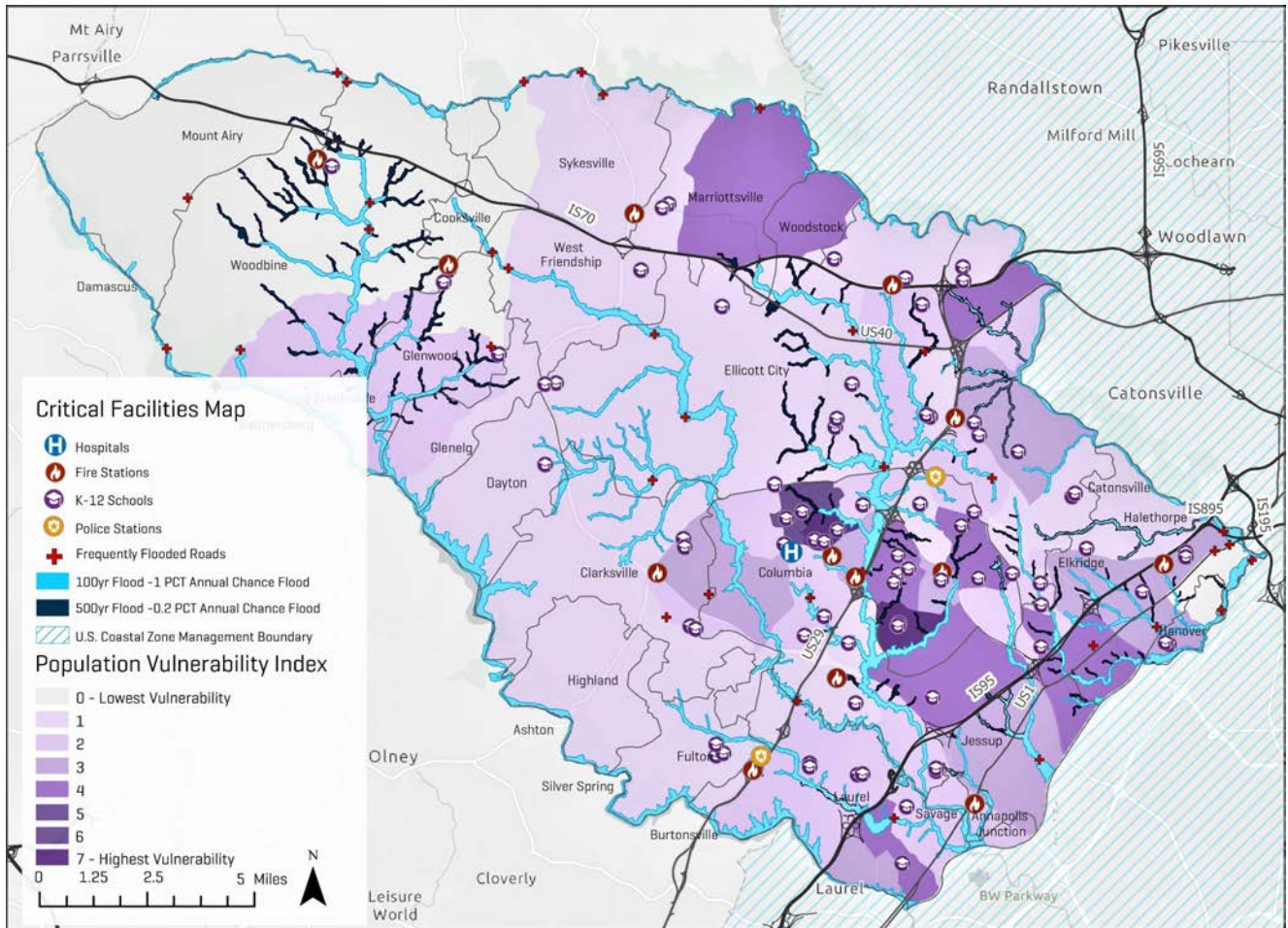
To help understand which important facilities could be affected by flooding in the future, Howard County conducted a spatial analysis to determine how close key facilities are to the current FEMA 100-year and 500-year flood zones. Table 2 summarizes some of the key facilities that are less than 1,000 feet from the flood zones. These facilities will not

necessarily be exposed to flooding, as local topography and hydrology will influence actual flooding. However, this assessment provides a general idea of the types of facilities that could be affected by flooding, either by being directly flooded or having key access roads flooded. Figure 11 shows the flood zones, critical facilities, and vulnerable populations index on a map.

Table 2: Important Facilities Near Flood Zones

Facility Type	# of Facilities <1,000 feet from the 100-year flood zone	# of Facilities <1,000 feet from the 500-year flood zone
Police Stations	2	2
Public K-12 schools	16	18
Fire Stations	3	3
Hospitals	0	0
State Facilities	9	3

Figure 11: Flood Zones, Vulnerable Populations Index, and Critical Facilities

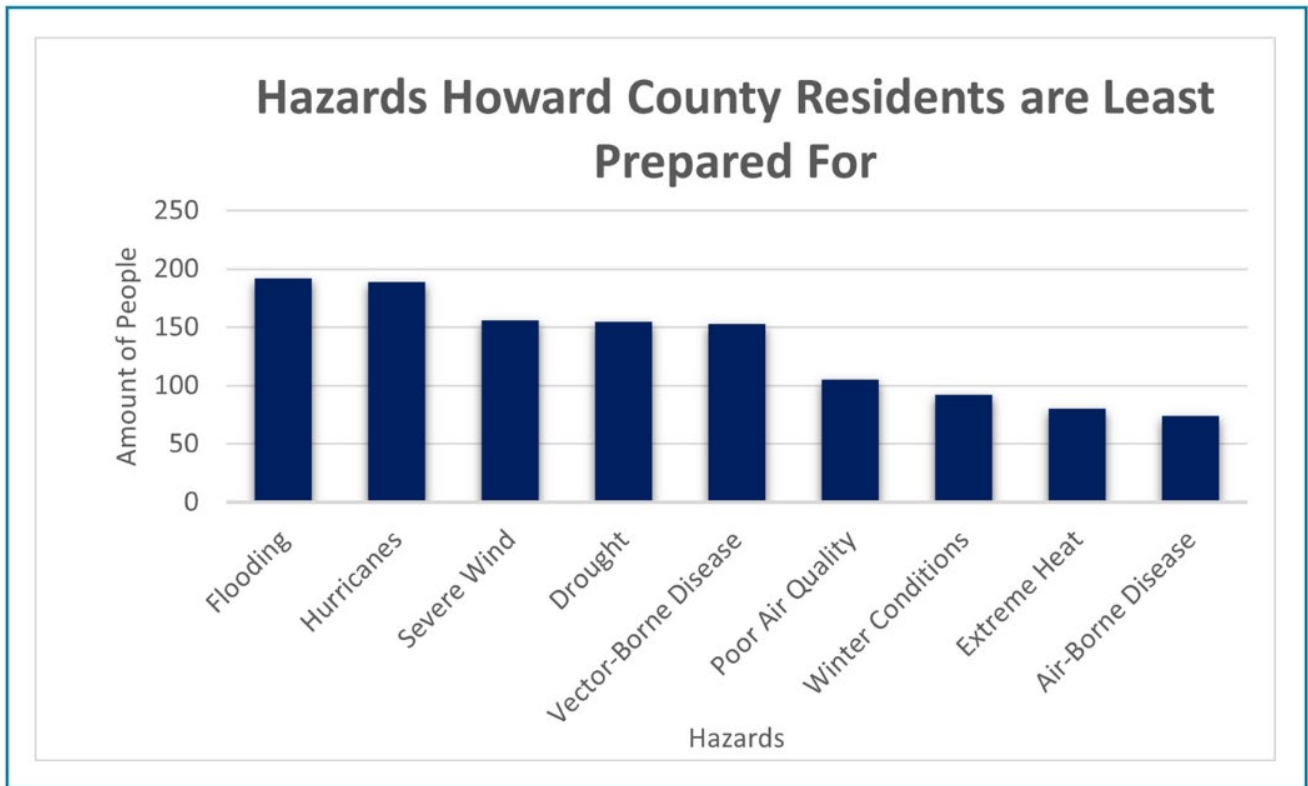


Climate Change Preparedness Survey

The 2022 Climate Change Preparedness Survey, administered by Howard County’s Office of Community Sustainability, was designed to get feedback from Howard County residents on how well they feel they are prepared for climate hazards that are expected to increase in intensity and/or frequency, what they need to feel better prepared, and what climate related hazards they have experienced. The survey was primarily distributed to underserved communities, such as individuals aged 65 and older, individuals with low or moderate income, people of color, and individuals with disability/access and functional needs.

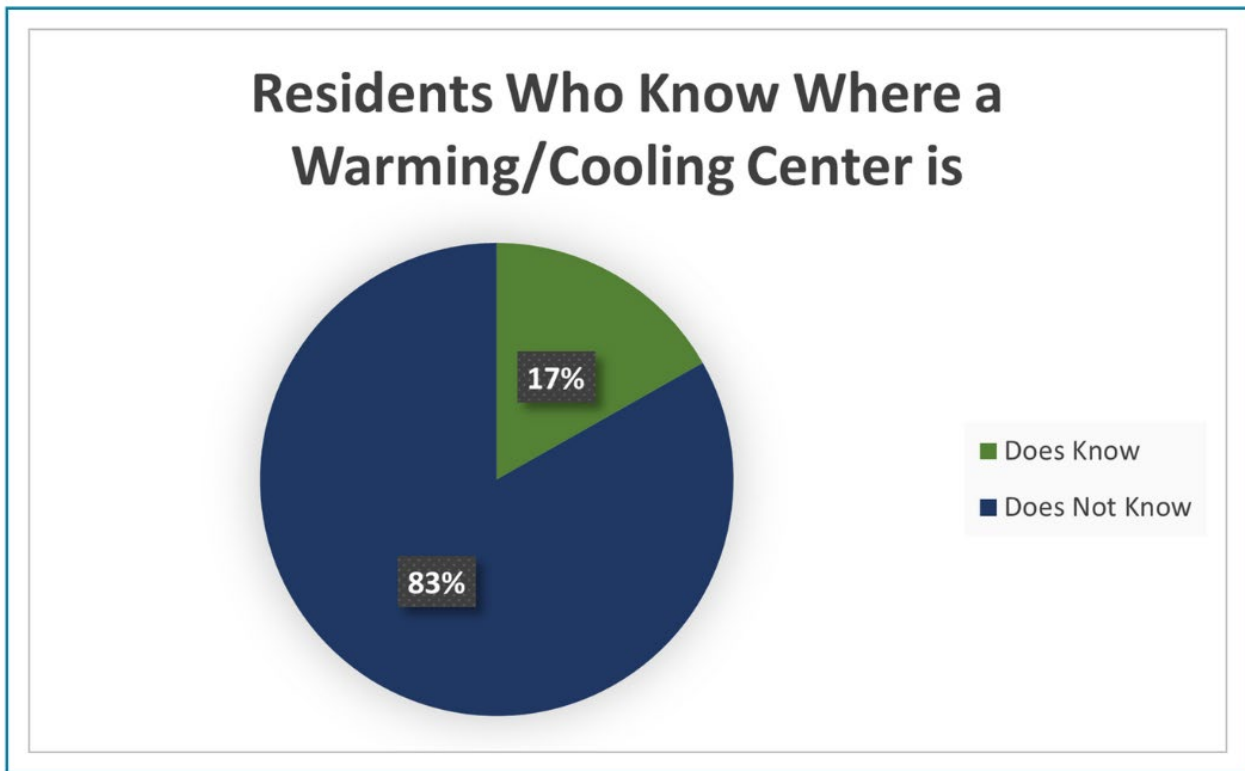
The results showed that citizens have already experienced weather-related disruptions in power and do not feel adequately prepared for flooding and major storm events (Figure 12). Citizens also expressed concern about how increasing temperatures could affect air quality and their health. The results also indicated communication gaps and suggested that community members are not aware of available resources and services, what heating/cooling centers are or where they are located (Figure 13), and where they can find information related to emergency preparedness. A total of 434 residents took the survey and their feedback played a crucial part in shaping the proposed resiliency strategies and actions to improve emergency preparedness.

Figure 12: Hazards Howard County Residents Feel Least Prepared For



Source: Howard County Climate Change Emergency Preparedness Survey

Figure 13: Howard County Residents Who Know the Location of a Heating/Cooling Center



Source: Howard County Climate Change Emergency Preparedness Survey

Other key findings from the Climate Change Emergency Preparedness Survey included:

- The four most common experiences faced by survey respondent in the last two years were: power outages, home or property damages after a storm, home or property damages from flooding and heavy rains, and no air conditioning in the house when needed.
- Nearly a quarter of respondents do not feel prepared if an emergency event were to occur.
- Nearly half of respondents feel generally that the community has resources and services to help them during an emergency event.
- Howard County residents listed airborne diseases as the number one hazard experienced in the last two years, most likely from Covid-19, followed by poor air quality and heat-related illnesses.

How Howard County Contributes to Climate Change

As a foundational element of this Climate Action Plan, Howard County developed a new greenhouse gas (GHG) emissions inventory and analyzed changes in current GHG emissions from its 2005 baseline. The County also estimated future GHG emissions through 2045 based on projected changes in the electricity grid, expected increases in the proportion of electric vehicles on the road, and anticipated population growth within the County. This information helps shape the strategies and action proposed to mitigate GHG emissions and to sequester carbon.

Overview of Greenhouse Gas Emissions Inventory Process

Howard County developed a community wide GHG emissions inventory based on 2019 data to identify current sources and drivers of emissions. The 2019 data set was the most recent and most complete data set that did not include anomalies in emissions caused by the COVID-19 pandemic. This inventory informed the GHG emissions reduction

strategies presented in this plan and provides a baseline for the County to track progress over time. Specifically, the GHG inventory estimates emissions from the following sectors:

Transportation (vehicle miles traveled) by on-road passenger vehicles, freight and service vehicles and transit vehicles operating within the County.

Built Environment (electricity use and stationary combustion of fossil fuels such as natural gas by residents, businesses, and government operations; refrigerant leakage from refrigeration and air conditioning equipment; and fugitive emissions from industrial oil and gas operations within the County. Fugitive emissions are emissions that escape from tanks, pipelines, and other pressurized equipment during typical operation.)

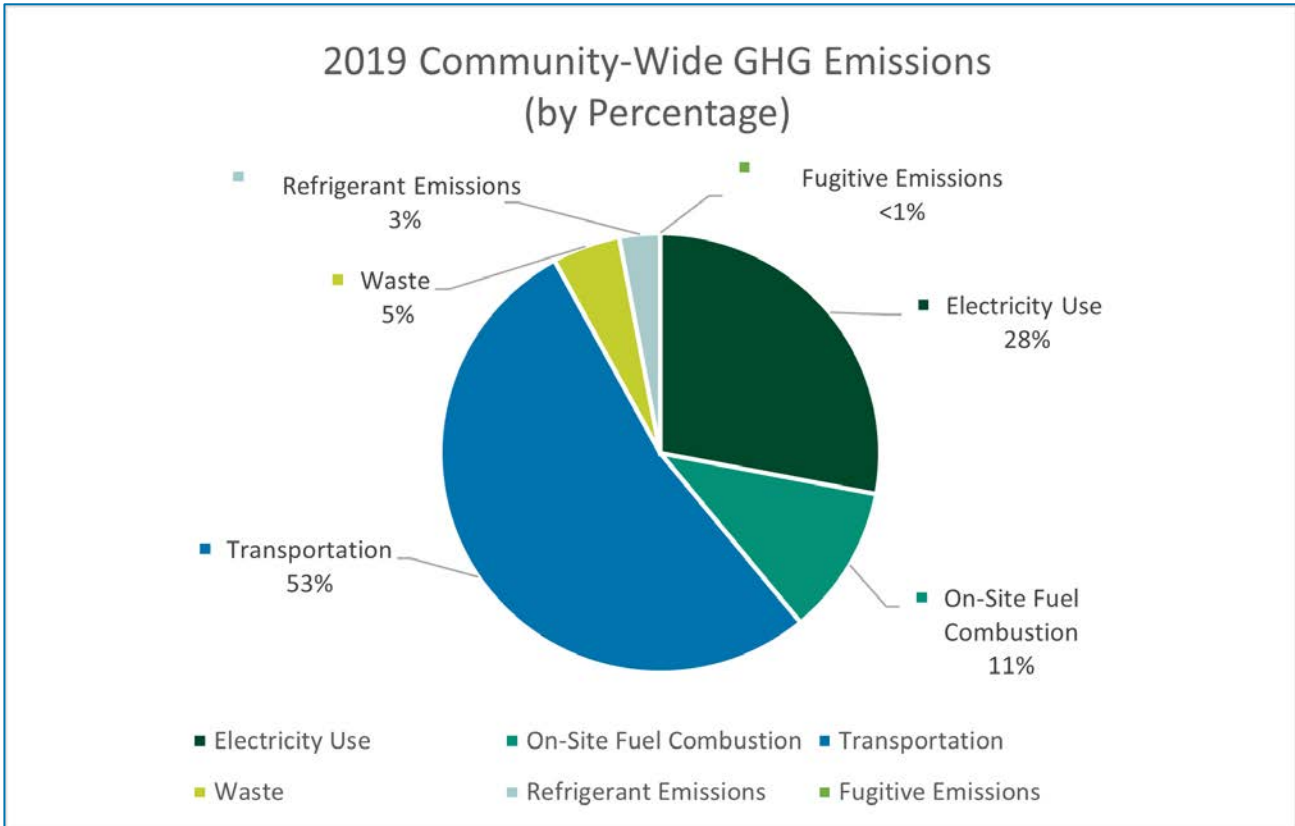
Solid Waste (waste disposal and composting) at the Alpha Ridge landfill and the disposal of waste generated by the community and landfilled outside of the County.

Howard County prepared this GHG inventory using the ICLEI ClearPath tool, which follows the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (developed by ICLEI). More details about the GHG Emissions Inventory, source data, and methods used to estimate or model emissions, are provided in Appendix E.

Current GHG Conditions in Howard County

In 2019, Howard County generated 3.9 million metric tons of carbon dioxide equivalent (MT CO₂e) community-wide, including the public and private sectors. Over half of these emissions were from the transportation sector (53%). Other emissions sources include electricity use at 28%, on-site fuel combustion at 11%, waste disposal (including waste generated in Howard County but disposed of outside of the County) at 5%, refrigerant emissions at 3%, and fugitive emissions such as leaks in fuel transportation pipes at less than 1%. Figure 14 shows the breakdown of emissions in 2019.

Figure 14: Howard County's 2019 Community-Wide GHG Emissions

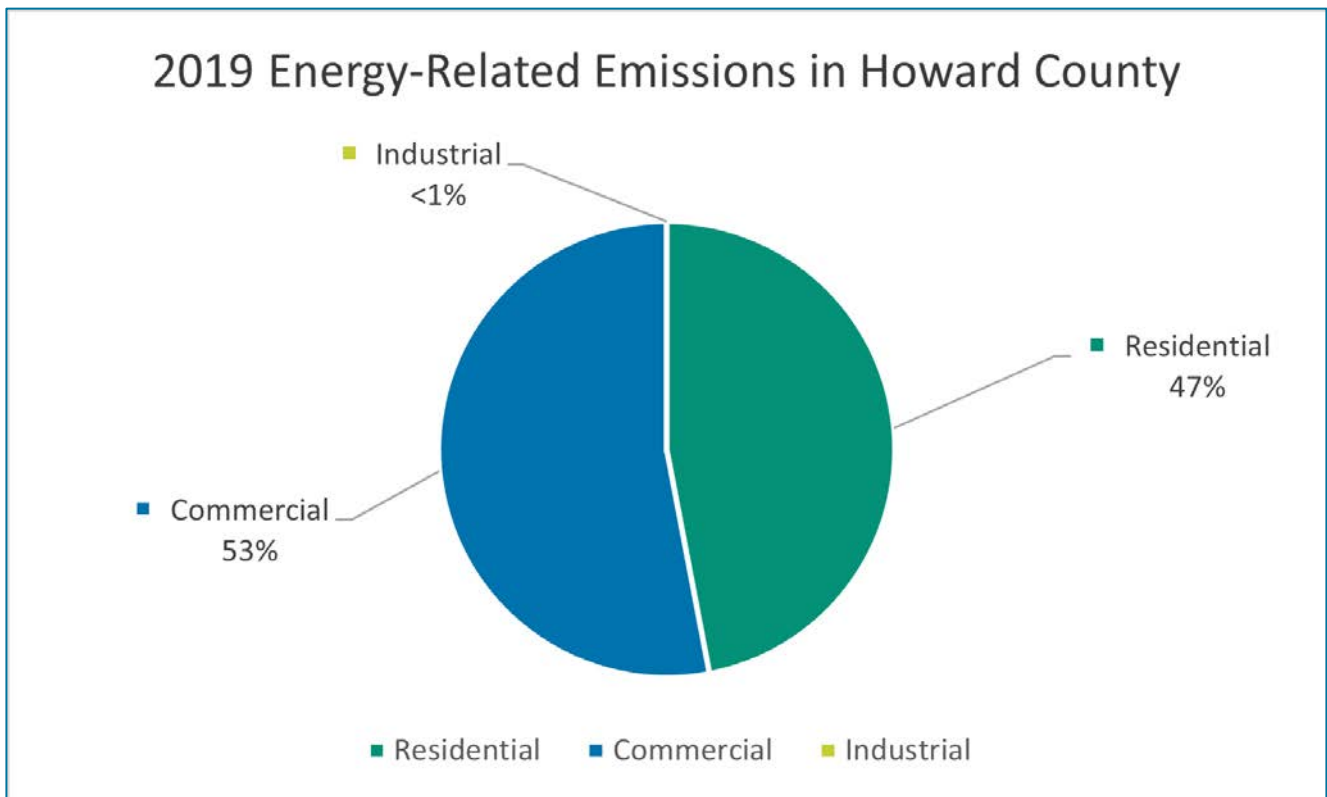


Built Environment

The built environment consists of man-made or modified structures that provide people with living, working, and recreational spaces. The built environment category includes emissions from the combustion of fossil fuels for energy and heat generation in buildings, as well as leakage from refrigeration equipment. Energy use includes on-site stationary fuel use (for example, natural gas boilers) and the use of purchased electricity in facilities. The Built Environment sources from Figure 14 above include electricity use (28% total emissions), on-site fuel combustion (11% total emissions) and refrigerant emissions (3% of total emissions). Adding these together, the built environment accounts for 42% of total emissions in Howard County in 2019.

The energy use portion of emissions in the County further can be allocated between residential (single and multi-family homes), commercial (businesses), and industrial end-users. Figure 15 shows a breakdown of energy sector emissions from Howard County in 2019 across commercial, residential, and industrial end-users. Emissions are close to evenly split between commercial and residential sectors, with 53% and 47% respectively. Industrial end users represent less than 1% of total electricity use. This includes emissions from both purchased electricity and on-site fuel combustion but does not include refrigerant leaks.

Figure 15: 2019 Energy-Related Emissions in Howard County



Refrigerant leaks, which account for 3% of Howard County's emissions, can be a significant contributor to climate change, as these chemicals typically have high global warming potentials (GWPs). These emissions occur as the charge in refrigeration and air conditioning (AC) equipment—such as window AC or commercial retail refrigeration units—leaks, either through normal operations or during maintenance. Currently, most equipment uses hydrofluorocarbons (HFCs) as a refrigerant, which can be more than 10,000 times as potent a greenhouse gas as CO₂.

Transportation and Other Mobile Sources

The combustion of fossil fuels in on-road transportation, including travel by passenger vehicles, freight and service vehicles, and transit vehicles, is the largest source of emissions in Howard County. Most vehicles in Howard County (79%)

are passenger cars.¹⁸ Within the County’s boundaries, on-road vehicles traveled about 4,362 million miles in 2019—the fifth highest County in state of Maryland. Of this, in 2019 1,462 million miles (33%) were pass-through miles on interstates including I-95.

Solid Waste

The Alpha Ridge Landfill is the only open landfill in Howard County. About 6% of the County’s municipal solid waste is disposed at this landfill, with the majority sent out-of-jurisdiction. The County also operates a composting operation at the Alpha Ridge Landfill, which processes organic waste from the County’s Green Bin program.

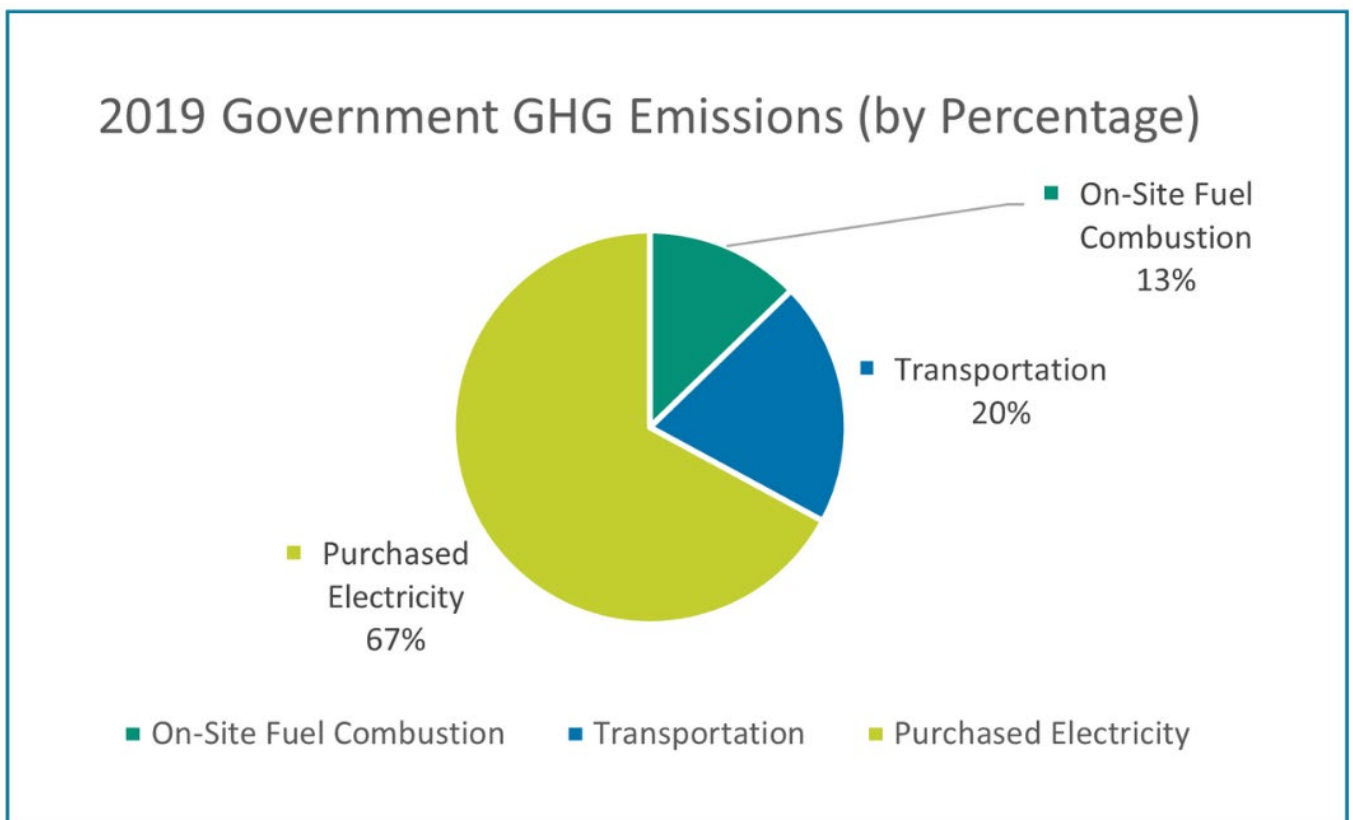
Wastewater and Water

The County operates water delivery and wastewater treatment facilities. These facilities use energy to operate and generate fugitive emissions from the decomposition of organic waste in wastewater. Energy-related emissions from water and wastewater treatment facilities are included in the Built Environment category; fugitive emissions are presented under this sector.

Emissions from Howard County Government Operations

Emissions from Howard County government operations have a different breakdown than the community-wide emissions. In 2019, Howard County government operations generated nearly 35,000 metric tons of carbon dioxide equivalent (MT CO₂e), representing only 1% of total community-wide emissions. The overwhelming majority of government operations emissions is from electricity use (67%), with County fleet fuel consumption contributing 20% of emissions and the remaining 13% coming from on-site fuel combustion.

Figure 16: Howard County’s 2019 Government Operations GHG Emissions



Progress to Date

Howard County has made significant progress already by reducing greenhouse gas emissions 15% from 2005 levels. This is demonstrated through a comparison of the County's most recent 2019 GHG emissions inventory to previous emissions estimates from the baseline year of 2005.

The 2005 GHG emissions inventory is in part directly taken from Howard County's 2010 Climate Action Plan, which also was a community-wide plan. The rest of the 2005 data were estimated based on 2007 data presented in the 2010 Climate Action Plan. To make the 2005 data as consistent and as comparable to the 2019 information as possible, this report applied global warming potentials (GWPs) from the IPCC's Fourth Assessment Report (2007) to each type of greenhouse gas. In addition, this report estimated emissions for certain sources that were excluded from the previous inventory based on other publicly available data and proxy methods.

While efforts were made to allow comparability between the two inventory years, the inventories rely on different sources of data and methods and are not always directly comparable or consistent. The comparison shown here is a useful starting point to understand how the distribution of emissions have shifted over the past 15 years.

Since 2005, Howard County's community wide GHG emissions have dropped by 15%. Figure 17 shows the total GHG emissions in Howard County in 2005 and 2019. Figure 18 shows the breakdown of emissions by sector in 2005 and 2019. In the County's base year (2005) inventory, the built environment was the primary source of emissions; in 2019, transportation-related sources are the largest contributors to County emissions. This is consistent with trends across the United States; transportation surpassed building energy use as the primary driver of U.S. emissions in 2018.

Figure 17: Community Wide Total GHG Emissions in 2005 and 2019

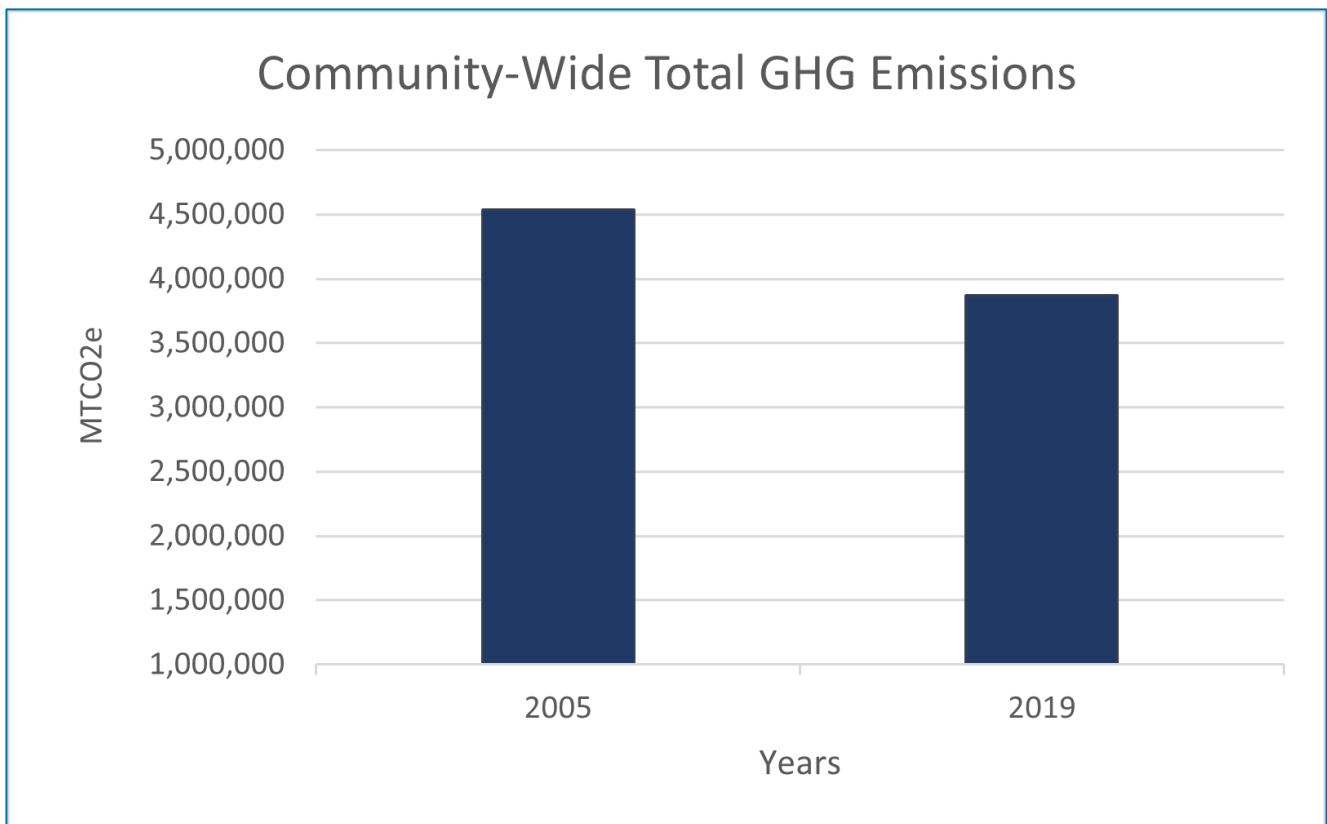


Figure 18: Estimated GHG Emissions by Sector in 2005 and 2019

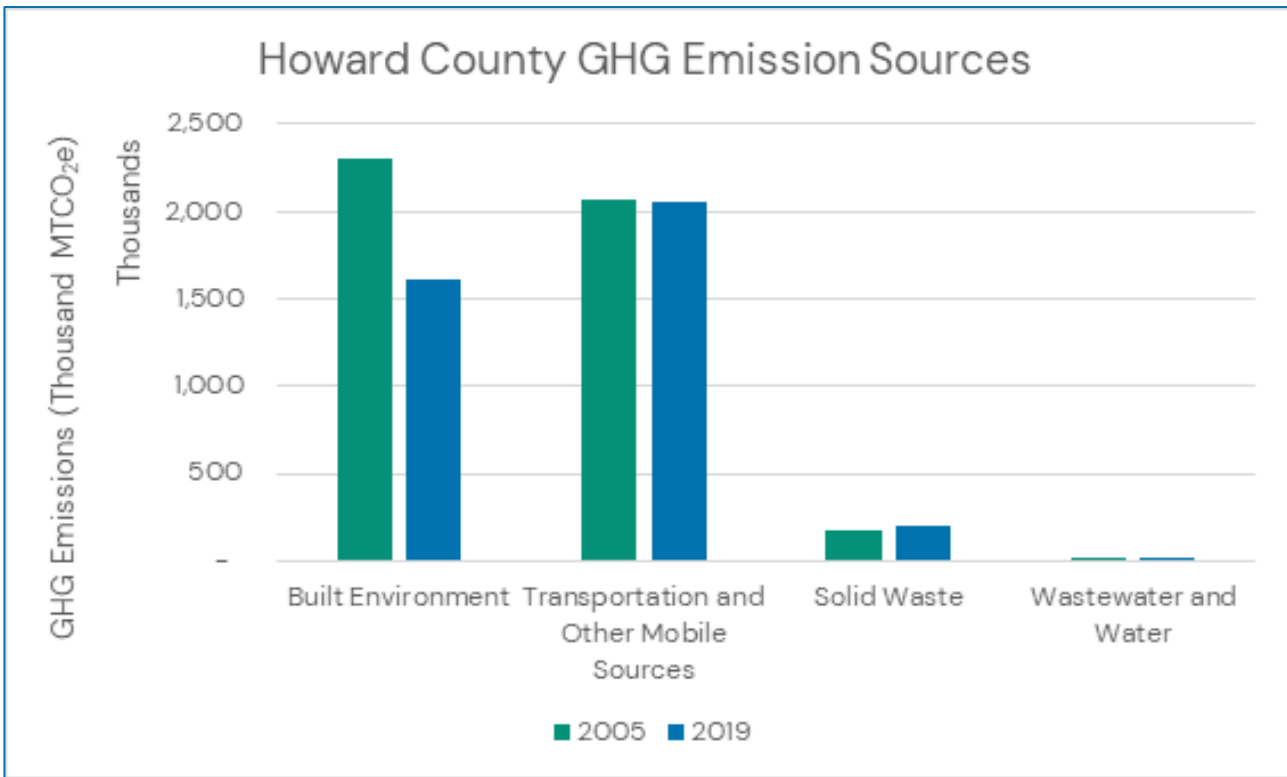


Table 3 below compares the County’s emissions in 2005 and 2019 by source.

Table 3: Change in Howard County’s GHG Emissions by Source from 2005 to 2019

GHG Emissions Source	2005 Emissions (MTCO _{2e})	2019 Emissions (MTCO _{2e})	Percent Change
Built Environment	2,300,887	1,607,068	-30%
Stationary Fuel Combustion*	555,774	410,564	-26%
Residential	376,022	224,764	
Commercial	179,752	185,800	
Industrial	-	-	
Electricity Use*	1,667,581	1,066,888	-36%
Residential	765,312	473,206	
Commercial	902,269	593,462	
Industrial	**	221	
Refrigerant Leakage	73,320	125,404	+71%
Industrial Emissions	4,212	4,212	0%
Transportation and Other Mobile Sources			
On-road transportation	2,063,842	2,057,172	<-1%
Solid Waste	167,855	205,013	+22%
In-County Disposal*	37,949	12,565	-67%
Out-of-County Disposal*	129,906	191,836	+48%
Composting	Not Estimated	613	N/A
Wastewater and Water			
Fugitive emissions	915	1,110	+21%
TOTAL	4,533,499	3,870,364	-15%

* Emissions are estimated based on 2007 values; 2005 data were unavailable.

** Included in commercial energy use.

The reduction in emissions from the built environment was driven by reductions in both on-site stationary energy use and electricity use. For electricity use, total reported kWh used in the County increased by about 1% between 2005 and 2019, but emissions decreased by 36% due to a less carbon-intensive grid electricity mix in 2019.

While the inventory includes County-wide emissions from the community, emissions from government operations were also estimated. These are included in the totals above and presented in Table 4.

Howard County is proud to report that GHG emissions from government operations have been reduced by 30 percent between 2005 and 2019, which is double the reduction achieved community wide.

Table 4: Change in GHG Emissions from Howard County Government Operations from 2005 to 2019

Emissions Source	2005 Emissions (MTCO ₂ e)	2019 Emissions (MTCO ₂ e)	Percent Change
Stationary Fuel Combustion	2,751	4,446	+62%
Electricity Use	36,221	23,405	-35%
Government Fleet	10,800	7,034	-35%
TOTAL	49,772	34,885	-30%

It is interesting to note that while government fleet petroleum fuel use and electricity use emissions both decreased by 35% each, stationary fuel combustion increased 62% in the same time period. There are several potential explanations for this increase. One is that there may have been new County government buildings built during this time that use natural gas or heating oil rather than electricity for heat. It’s also possible that additional diesel fuel was used for emergency generators during this time compared to 2005. Finally, it is possible that the data from 2005 did not include all of the stationary fuel sources due to lack of consolidated records, especially from purchases of heating oil and diesel fuel, which are not tracked by individual building in the same way that electricity and natural gas usage is tracked.

Future Business-As-Usual GHG Emissions Projections

Howard County anticipates that without additional action to reduce GHG emissions, the County’s emissions from all public and private sector sources will increase by 3% and 5% in 2030 and 2045, respectively, compared to 2019. This projected increase is primarily driven by changes in population. The County’s population is anticipated to grow by 13% between 2019 and 2045, which will result in increased energy use, vehicle miles traveled, and waste generation. During this time, there will also be a shift toward more renewable sources of grid electricity and increased use of electric vehicles, which offsets some of the increases in emissions due to population growth, so these changes have been factored into the projected emissions increases.

Emissions from transportation, the largest source of emissions in 2019, are expected to increase by 5% in 2030 and 4% in 2045 compared to 2019, and emissions from the built environment (the second largest source of emissions in 2019) will remain flat in 2030 and increase by 5% by 2045. Emissions from the other sectors are projected to increase roughly proportionally to population growth. See Figure 19 below.

Figure 19: Future GHG Emissions Projections in Business-as-Usual Scenario Including Changes in Electricity Generation Mix

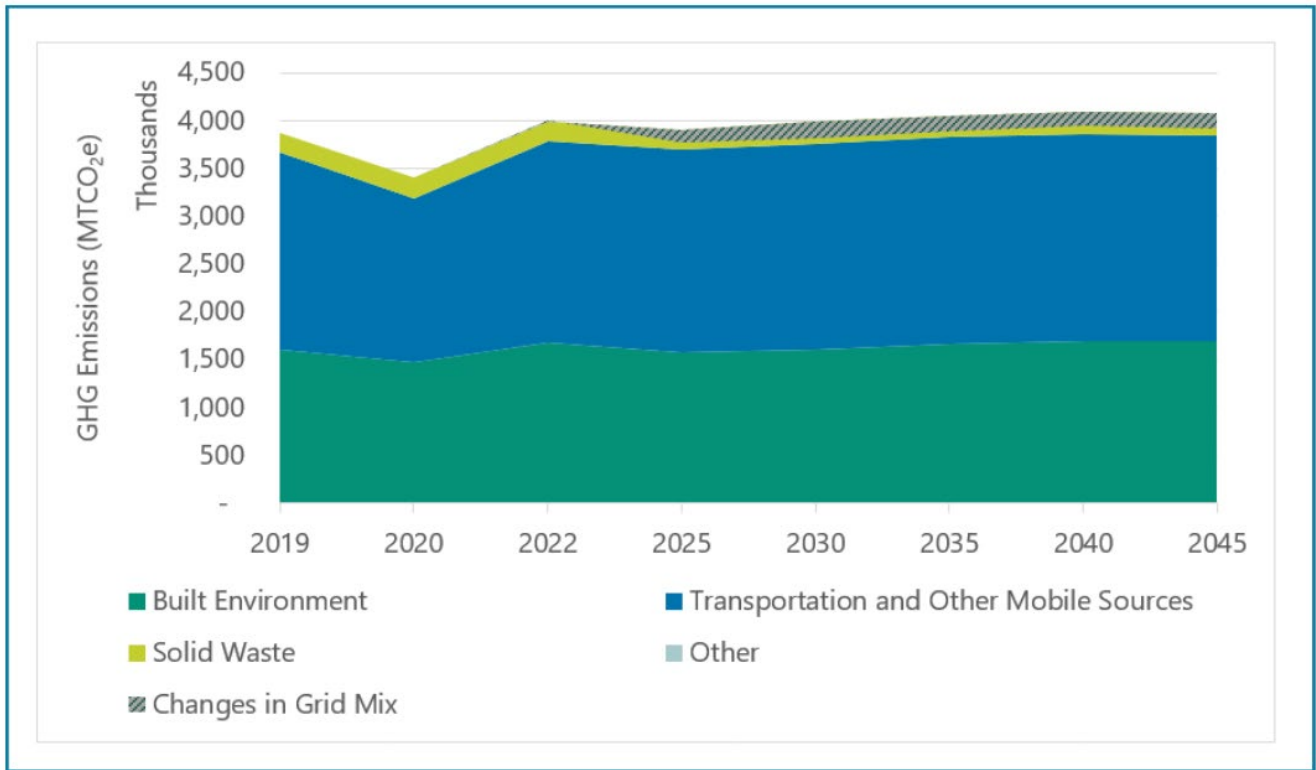
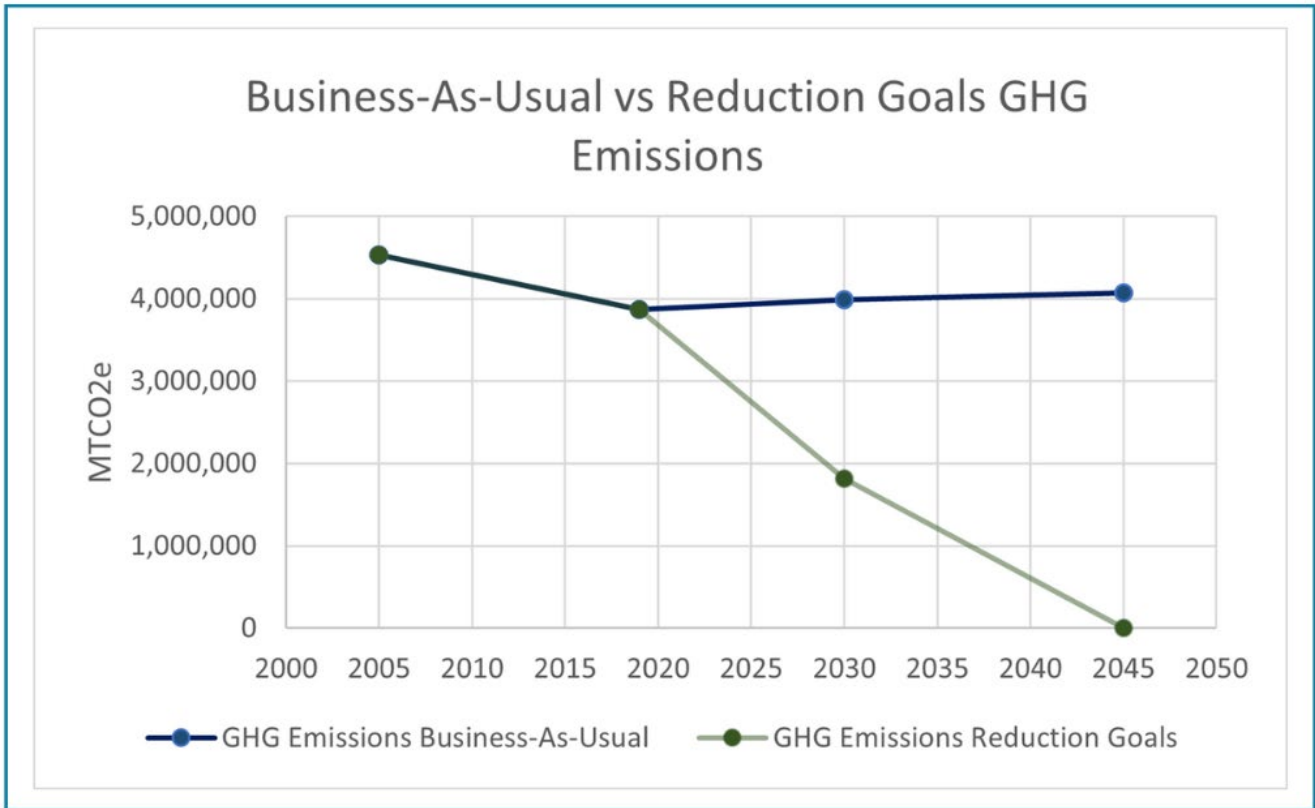


Table 5: Projected 2030 and 2045 Emissions under Business-As-Usual Scenario

Emissions Source	2019 Emissions (MTCO ₂ e)	Projected 2030 Emissions		Projected 2045 Emissions	
		(MTCO ₂ e)	%	(MTCO ₂ e)	%
Built Environment	1,607,068	1,609,411	+<1%	1,690,350	+5%
Stationary Fuel Combustion	410,564	449,857	+10%	465,438	+13%
Electricity Use	1,066,888	1,028,386	-4%	1,093,744	+3%
Refrigerant Leakage	125,404	125,404	-	125,404	-
Industrial Emissions	4,212	5,764	37%	5,764	37%
Transportation and Other Mobile Sources					
On-road transportation	2,057,172	2,150,309	+5%	2,148,926	+4%
Solid Waste	205,013	223,962	+10%	232,415	+13%
In-County Disposal	43,590	47,762	+10%	14,244	+13%
Out-of-County Disposal	160,810	176,200	+10%	217,476	+13%
Composting	613	671	+10%	695	+13%
Wastewater and Water					
Fugitive emissions	1,110	1,216	+10%	1,243	+13%
TOTAL	3,872,091	3,987,297	+3%	4,072,934	+5%

Figure 20: Comparison of expected GHG Emissions under Business as Usual and Howard County’s GHG Emissions Reduction Goals



As Figure 20 shows, there is a big difference between emissions expected under business-as-usual conditions and Howard County’s goals. To achieve Howard County’s GHG emissions reduction goals of 60% by 2030 and net zero by 2045, Climate Forward includes key strategies for reducing emissions and sequestering (storing) carbon. As transportation and building energy use are the largest sources of the County’s emissions, many of the strategies focus on the most impactful ways to reduce these emissions. This plan also includes strategies to reduce emissions from waste and to store carbon through nature-based climate solutions.

Federal and State Context

With proper attention and investment, County government can do a lot to reduce greenhouse gas emissions, sequester carbon, and improve resiliency to climate change. Howard County has already made great strides on sustainability and resiliency both within County operations and through education, outreach, and policy. As this report demonstrates, there are more actions the County can and must take to reduce greenhouse gas emissions, sequester carbon, and steward improved resiliency to climate hazards. However, County government alone is unable to solve the climate crisis. Many of the actions needed to reduce the impacts of and prepare for climate change are outside of the County’s jurisdiction, geographic boundaries, or ability to control. Meeting the ambitious and crucial goals set forth in this Climate Action Plan will require coordinated and sustained efforts by not just County government but also all members of the community, including federal and state government, neighboring jurisdictions, residents, businesses, organizations, and other partners.

Strong federal and state policies, programs, and financial commitments are critical to addressing climate change. Local governments have limited jurisdictions and are unable to affect the types of sweeping and far-reaching changes that are possible with state and federal engagement.

Fortunately, recent actions at the state and federal level will help support the ambitious changes that are needed. The federal government, under the Biden Administration, has rejoined the Paris Agreement on climate change and has set a national goal to reduce greenhouse gas emissions 50% over 2005 levels by 2030 and to achieve net zero emissions by 2050. In April 2022, the State of Maryland passed the Climate Solutions Now Act (CSNA), which sets an even more aggressive goal of achieving net zero greenhouse gas emissions by 2045. The CSNA also includes funding sources and policy support that will help achieve that target across the state. Meanwhile, Congress recently passed two major pieces of legislation—the Infrastructure Investment and Jobs Act (IIJA) in 2021 and the Inflation Reduction Act (IRA) in 2022—which will mobilize billions of dollars to support efforts to reduce greenhouse gas emissions and increase infrastructure resiliency. In addition, the recent passage of the American Innovation and Manufacturing Act (AIM) also has great potential to reduce greenhouse gas emissions. Some of the most impactful results expected from these state and federal policies are noted below.

Climate Solutions Now Act (Maryland)

In April 2022, Maryland adopted the Climate Solutions Now Act (CSNA). This act sets a statewide goal of reducing greenhouse gas emissions by 60% of 2006 levels by 2031 and achieving net-zero reductions by 2045. The CSNA does the following:

- Requires state agencies to develop code recommendations and energy performance standards to significantly reduce the energy consumption of buildings.
- Incorporates long-term electric distribution planning necessary to decarbonize the electricity supply.
- Directs climate-related funding and efforts to benefit overburdened and underserved communities.
- Pilots an electric school bus program.
- Establishes new funding for a variety of climate initiatives.^{19, 20}

Inflation Reduction Act (Federal)

In August 2022, Congress passed the Inflation Reduction Act (IRA), marking the largest federal clean energy and climate investment to date. The IRA does the following:

- Directs \$369 billion for addressing domestic energy security and climate change.
- Increases resiliency of electrical grids.
- Funds and promotes low-carbon technologies and materials for homes and other buildings.
- Provides tax credits and other support to increase electric vehicle adoption.
- Covers incremental costs of zero-emissions school buses, garbage trucks, and transit buses.
- Funds energy efficiency upgrades, climate resilience measures, and electrification of affordable housing.

Infrastructure Investment and Jobs Act (Federal)

In November 2021, Congress passed the Infrastructure Investment and Jobs Act (IIJA)—also known as the Bipartisan Infrastructure Law (BIL). The IIJA includes \$550 billion in federal funding to make our nation’s infrastructure and economy more sustainable and resilient. Notably, IIJA focuses on investments designed to create a more climate-friendly and resilient energy and transportation sector through the following goals, and the creation of a new Grid Development Authority for electrification of the power grid:

- Directs \$550 billion to make the nation’s infrastructure and economy more sustainable and resilient.
- Supports public transportation improvements.
- Expands EV charging infrastructure.
- Improvements to roads and bridges with a focus on climate resilience.

The Federal Highway Administration (FHWA) estimates that Maryland could receive the following resources because of the IIJA:

- \$4.7 billion to repair and rebuild roads and bridges with a focus on climate change mitigation, resilience, equity, and safety for all users, including cyclists and pedestrians.

- \$1.8 billion over five years to improve public transportation options across the state.
- \$63 million over five years to support expansion of an EV charging network in the state.

Finally, Howard County is eligible to compete for billions of dollars of competitive grants that cover topics like transportation system resilience, low- and zero-emission buses, and rehabilitating or replacing bridges and culverts.²¹

These and other state and federal initiatives go a long way toward curbing greenhouse gas emissions and improving climate resiliency in Howard County, Maryland, and the United States. However, more efforts will be needed at the state and federal level to reduce greenhouse gas emissions enough to avoid catastrophic climate change. Howard County will work with other local jurisdictions, activists, businesses, organizations, and other partners to advocate for additional positive change at the federal and state levels. For example, the County could support a 100% Renewable Portfolio Standard for Maryland because a carbon-free electricity grid is a foundational policy which unlocks the potential for lower emissions as transportation and building energy use continues to transition to electric power. The County also can push for additional financial investment at the state and federal level that can help accelerate a transition to carbon neutrality even more quickly.

Howard County Climate Solutions

Howard County, and the region at large, is positioned to experience increasing population growth and economic development at the same time its climate becomes more volatile due to climate change. Howard County must undertake strategies and actions to both mitigate GHG emissions across all sectors and increase the resilience of its underserved and under-resourced communities and its critical infrastructure.

To do so, Howard County has identified key strategies within three action areas:

- Governance strategies that address overarching governance within Howard County and are essential for successful implementation of the other strategies.
- Mitigation strategies whose primary focus is on reducing greenhouse gas emissions, although some may have co-benefits of increasing resilience as well.
- Resilience strategies whose primary focus is on enabling the County's infrastructure, population, and services to better withstand the challenges brought by climate change.

Within each strategy, the County also identified specific actions that should be implemented to achieve that strategy.

Howard County has chosen to focus on the strategies and actions that County government can take that have the greatest impacts in the near- and mid-term. These strategies and actions include updates to policies, plans, incentives, and regulations; education and outreach, working with partners; and making changes as needed to County facilities, fleet, and operations. The County identified priority governance, mitigation, and resiliency strategies based on:

1. Effectiveness in reducing GHG emissions or sequestering carbon.
2. Effectiveness in reducing identified climate risks.
3. Institutional and technical feasibility.
4. Alignment with climate goals and objectives.
5. Ability to reduce climate risks and impacts within underserved and under-resourced communities.

Howard County plans to periodically re-evaluate progress and adjust course if necessary and to tackle other important strategies once these top priority strategies are underway.

Climate and Equity Focused Governance

Everyday decisions and activities across nearly all elements of County operations impact greenhouse gas emissions and resiliency to the changing climate. From the equipment the County purchases to the types of vegetation it plants, to how it communicates internally and to the public, to how it manages information and data—all these actions can influence whether systems are set up to make smart climate decisions and create resiliency in the face of extreme weather events.

Therefore, it is crucial that climate action is not seen as something that is the responsibility of only one department. To truly tackle the challenges of climate change, climate-informed decisions must be made at every level, across all departments, on a routine basis.

Moreover, Howard County is committed to taking climate action in a way that is *equitable*. The impacts of climate change are not experienced uniformly across the County. Underserved and under-resourced communities can be more vulnerable to extreme weather events for a variety of reasons. For example, they may lack the resources to absorb higher utility bills or to pay for supplies, equipment, or upgrades that may make extreme weather events more tolerable. They may have fewer travel options to areas that provide resources during extreme weather events or have less access to critical resources. Populations that are more limited in mobility may be more greatly impacted if they cannot temporarily access safe facilities or other resources during climate hazard events. Populations with greater health concerns may be more vulnerable to the health impacts that accompany higher heat.

Similarly, the co-benefits of reducing greenhouse gas emissions are not necessarily uniformly distributed across populations. Improved weatherization of any building could reduce emissions, but weatherization may provide more co-benefits when it reduces utility bills for residents with lower incomes. Planting trees is a good thing to do throughout the County, but it may improve the quality of life more in areas that lack shade and trees.

Ensuring equity in climate action is a complex and nuanced endeavor—but it is achievable. Howard County believes that a single strategy or department focused on equity is not sufficient. Rather, equity must be woven into the overall approach to climate action to ensure that equity is accounted for in decision-making processes.

To achieve a successful and equitable implementation of this Climate Action Plan, Howard County will pursue the Climate and Equity Focused Governance Strategies listed below.

G-1: Establish a Climate Action Subcabinet

Working collaboratively with multiple agencies and departments during development of the Climate Action Plan fostered innovation and highlighted just how critical it is that all agencies and departments work together to tackle climate change. Through an Executive Order dated October 12, 2022, County Executive Calvin Ball established a Climate Action Subcabinet to ensure that implementation of this Climate Action Plan is a County-wide priority. The Climate Action Subcabinet will be a centralized committee of department heads and appointees who are responsible for coordinating across departments, establishing targets and milestones, and supporting County staff in implementing the strategies outlined in this plan.

The Subcabinet will also have topic-area committees to tackle strategies and actions that are most impactful and need the most cross-agency collaboration. The Climate Subcabinet will also be tasked with creating action items and timelines and overseeing Climate Forward implementation.

G-2: Prioritize Climate Action in all Aspects of Planning and Operations

This strategy will ensure that all levels of County government address climate change and will prioritize emissions reductions and climate resiliency in planning and operations. Climate change mitigation, carbon sequestration, and resiliency must be integrated into future codes, ordinances, and design manuals. County departments and offices need to adopt internal policies to prioritize climate action in purchasing, project management, community outreach, maintenance efforts and other aspects of operations.

G-3: Integrate Equity and Inclusivity into all Climate Action and Prioritize Communities Most Vulnerable to the Impacts of Climate Change

Climate change impacts underserved communities disproportionately. Climate mitigation and resiliency actions need to include measures to address and reduce these inequalities and disparities. This strategy will ensure that equity and inclusivity are integrated into every aspect of implementing climate action, including new or existing processes, projects, and programs. This Climate Action Plan will consider how greenhouse gas emission mitigation and resiliency strategies are implemented so that equity is maximized, and the communities most vulnerable to the impacts of climate change are prioritized.

G-4: Communicate Climate Action Progress Regularly and Transparently and Create Outreach that Engages the Community in Accomplishing Goals

Carrying out the strategies and actions in this Climate Action Plan will be a collaborative process involving the County, businesses, organizations, residents, and more. Transparent communication from the County will help ensure the community understands why these actions and strategies are being carried out and enlist their help in accomplishing goals. This strategy will ensure the community is aware of the Climate Action Plan's implementation process, progress, and successes.

G-5: Leverage State and Federal Programs and Funding Sources Whenever Possible to Advance Climate Action

Adequate and reliable funding is critical to the success of several of the strategies and actions outlined in this Plan. Significant state and federal legislation have been passed recently that increases resources available to combat and prepare for climate change. Maryland passed the Climate Solutions Now Act and the federal government passed the Infrastructure Investment and Jobs Act and the Inflation Reduction Act. In addition to new funding sources, there are many existing state, federal and non-governmental programs that provide funding, rebates, technical assistance, or other resources for climate initiatives. Under this strategy, the county will pursue state, federal, and non-governmental funding sources to support climate initiatives.

Mitigation Strategies: Reducing Emissions and Storing Carbon

Climate change mitigation means reducing or preventing greenhouse gas emissions. Substantial reductions in GHG emissions are required to prevent a rise in average global temperatures that could cause catastrophic impacts. It is impossible to eliminate all GHG emissions, however, as even natural processes contribute to these emissions. Therefore sequestration, or carbon storage, is equally important. Pulling carbon dioxide from the atmosphere and storing it in solid or liquid form is critical to reach Howard County's goal of net zero GHG emissions by 2045.

Howard County identified the most impactful, priority greenhouse gas mitigation and sequestration strategies. These strategies were selected as the most impactful, highest priority options because they reflect activities that the County has control or strong influence over, are feasible to implement from a technology or policy standpoint, and are expected to result in meaningful GHG emissions reductions and carbon sequestration.









The County was able to estimate the GHG emissions reduction potential for strategies in the Energy, Transportation, and Waste sectors, as shown in Table 6. The greatest reduction potential comes from the Energy and Transportation sectors, which makes sense as these are the largest sources of emissions found in Howard County.

The vast majority of the GHG emissions reductions needed to meet the County's 2045 net zero goal can be achieved through decarbonizing the grid, reducing energy use in buildings, increasing the adoption of electric vehicles, and reducing miles driven. This reduction potential reflects both the fact that such a large proportion of emissions are from building energy and transportation, and the large greenhouse gas benefits of moving toward cleaner energy sources.

While the Waste sector accounts for a smaller portion of the County’s emissions and therefore mitigation potential, strategies targeting this sector were also included because they have a relatively low implementation cost, have direct involvement of the County, and will reduce the County’s in-County waste emissions by at least one third. Finally, while waste is responsible for relatively low emissions in Howard County, it has a significant global impact on greenhouse gas emissions. Project Drawdown (2020), a comprehensive ranking of global climate solutions based on their potential for GHG reductions, ranks the reduction of food waste third out of all climate solutions.²²

Reductions from nature-based strategies were not quantified formally, but these strategies will still make an important contribution to lowering the County’s net greenhouse gas emissions, especially through carbon storage. Carbon storage benefits of nature-based strategies are expected to become easier to quantify in the future as new research and modeling tools are developed. In addition, these nature-based solutions also provide many co-benefits, including water quality improvement, flood reduction, pollinator habitat, and more. Page 40

Table 6: Summary of Howard County Mitigation Strategies

Mitigation Strategy	Mitigation Potential	GHG Reductions by 2030 (MTCO ₂ e)	% Reduction from 2005 totals by 2030	GHG Reductions by 2045 (MTCO ₂ e)	% Reduction from Business as Usual by 2045
E1: Reduce Greenhouse Gas Emissions from Existing Buildings	Moderate 	181,687	4%	434,410	11%
E2: Construct Efficient and Low-Carbon Buildings	Low 	7,805	<1%	35,537	1%
E3: Decarbonize the Energy Supply (includes emissions reductions from Maryland’s current Renewable Portfolio Standard of 50% by 2030)	High 	707,701	16%	968,597	24%
T1: Maximize the Use of Electric Vehicles	High 	207,367	5%	1,137,249	28%
T2: Reduce Vehicle Miles Traveled in Single Occupancy Vehicles	Moderate 	187,251	4%	253,840	6%
W1: Reduce Organic Waste Sent to Landfills and Manage Landfill Methane	Low 	1,000	<1%	4,200	<1%
W2: Expand the Use of Sustainable Materials and Reduce Waste Generation and Disposal		Not quantified	Not quantified	Not quantified	Not quantified
N1: Support Nature Based Climate Solutions to Improve Soil Health, Increase Carbon Sequestration, and Reduce Emissions	Moderate 	Not quantified	Not quantified	Not quantified	Not quantified
N2: Conserve Existing Forests and Expand the Tree Canopy	Moderate 	Not quantified	Not quantified	Not quantified	Not quantified

These strategies go a long way toward achieving County goals. By 2030, the quantified strategies in Table 6 are estimated to reduce GHG emissions an additional 29% on top of the 15% reduction already achieved between 2005 and 2019. With just these strategies, Howard County can expect to reduce emissions 44% over 2005 levels by 2030. In addition, these strategies can reduce emissions 70% over the Business as Usual (BAU) predictions by 2045.

To fully achieve Howard County's goal of 60% reduction from 2005 emissions and net zero emissions by 2045, Howard County will need to reduce emissions an additional 16% by 2030 and 30% by 2045. These remaining reductions can be achieved through a combination of broader community action, carbon-sequestering nature-based solutions, additional state and federal level legislation, and technological advancements.

One example of impactful state legislation that could close the gap to achieve County goals is to change Maryland's Renewable Portfolio Standard (RPS) to 100% renewable electricity. A carbon-free electricity grid is a foundational policy which unlocks the potential for lower emissions as transportation and building energy use transitions to electricity sources. The IRA provides significant incentives toward grid decarbonization. A Renewable Portfolio Standard of 100% for the State of Maryland could reduce emissions in the County by an additional 12% by 2045.

Another source of emissions reductions not included in the above estimates are the reductions in refrigerant emissions expected because of the federal American Innovation and Manufacturing (AIM) Act of 2020. The AIM Act phases out high global warming potential (GWP) refrigerants over time. By 2045, Howard County should see an additional 2% emissions reduction because of the AIM Act.

Further, achieving the County's net zero goals will require nature-based solutions that increase carbon sequestration. More detailed modeling is needed to accurately understand the current agricultural and land use emissions and sequestration levels as well as the additional sequestration potential of specific strategies. However, a preliminary analysis using ICLEI Land Emissions and Removals Navigator (LEARN) Tool, found that county forests and other trees can offset approximately 6% of emissions. Additional nature-based solutions, such as reforestation, farming practices that cultivate healthy soils, and replacing mowed turf grass with native plant gardens, can store even more carbon each year. Collectively, including the state and federal policies and nature-based climate solutions listed above with the strategies and actions outlined in this Climate Action and Resiliency Plan, Howard County can achieve 50% emissions reductions by 2030 and 90% emissions reductions by 2045.

In addition, emerging technologies can play a role in contributing to a lower emissions future. While a variety of established technologies exist today that reduce emissions, additional technologies can attain expanded commercial and economic viability through research and development. New and expanded technologies include sustainable refrigerants, fuel cells, advanced waste to energy, carbon capture utilization and sequestration, among many others. It is difficult to predict the role of future technologies, but future updates to this Plan will allow the County to adjust strategies to capture the potential of new technologies.

Also, Howard County plans to pursue the priority strategies identified in this plan over the next three to five years. After that, the County will likely add new priority strategies and actions that will ensure achievement of its ambitious climate goals. In addition, as Howard County begins to implement these strategies and actions and to evaluate their effectiveness, the County may adjust and modify the implementation steps, metrics, and priority actions as needed to best meet GHG emissions reduction goals.

Not only will Howard County government need to continue to commit to impactful climate actions, but there are many actions that can be undertaken by the community that can help reach and even surpass these goals. Recent federal and state legislation, including the Inflation Reduction Act, Infrastructure Investment and Jobs Act, and Maryland's Climate Solutions Now Act, include funding, rebates, tax incentives and other assistance to support mitigation actions by individuals, families, and businesses. Actions that individuals can take to help reach Howard County's climate goals are outlined in the Engaging the Community in Climate Action section.

Resiliency Strategies: Preparing for a Changing Climate

In addition to reducing GHG emissions and storing carbon, Howard County needs to ensure its citizens, plants, and wildlife are safe and healthy as the region experiences more frequent severe storms, flooding, and heat waves. As detailed in this report, Howard County has already experienced more extreme weather from climate change. These changes are expected to continue and to worsen, even if the world achieved global net zero GHG emissions within the next five or ten years. This report also details the vulnerabilities of the county's people, wildlife, agricultural resources, infrastructure and more.

The Resiliency Strategies included in this report are designed to help prepare for, recover from, and adapt to anticipated local climate impacts. Similarly to the Mitigation Strategies, Howard County has focused on the most critical priorities based on identified vulnerabilities as well as strategies that are within the County's ability to influence significantly.

Howard County's Resiliency Strategies will:

- Enhance emergency preparedness.
- Harden buildings, roads, and other infrastructure against extreme storms, flooding, and heat.
- Reduce heat islands and increase shade.
- Strengthen stormwater management on residential, commercial, and non-profit properties, treating both water quality and water quantity.
- Protect wetlands, forests, and streams.
- Direct resources toward underserved communities.

The report details several strategies and actions for each of these areas, including specific implementation steps, timeframes, and responsible parties.

Engaging the Community in Climate Action

Howard County government cannot meet the ambitious climate action goals outlined in Howard County Climate Forward without help from residents, businesses, and organizations. All of us can – and must – play an important role in mitigating the impacts of climate change. The individual choices made each day can significantly affect contributions to unwanted pollution and emissions. It's also critical that each of us is prepared for climate related emergencies and is aware of and has access to government and partner resources to survive and thrive in the changing climate. Together, we can achieve the needed GHG emissions reductions, carbon storage, and resiliency measures for our communities to survive and thrive now and in the future.

In Howard County Climate Forward, Howard County Government has outlined strategies, actions, and next steps to achieve climate goals. However, many of the next steps rely on outreach and education – and ultimately on behavior change resulting from education and outreach. To reach the maximum number of people, it will be most effective for government staff, local non-profits and concerned individuals to work together so that messaging can be reinforced and amplified.

There is so much work to be done that it can seem overwhelming. Therefore, prioritization is vital. For the next few years, it would be advisable to simplify and focus on a few topics. As progress is made, the messaging can be evaluated and modified to address new topics as needed. The following are key messages and actions to promote.

Maximize the Use of Electric Vehicles

Transportation accounts for 53% of GHG emissions in Howard County. To achieve emissions reduction goals, it is vital to reduce tail pipe emissions. This plan shows that electric vehicles have one of the largest potential impacts for reducing emissions. Currently, only 1% of personal vehicles in the county are electric. Increasing the percentage of EVs in Howard County to 50% can reduce GHG emissions 28% by 2045.

Action: Help family, friends, neighbors, and other community members purchase electric vehicles. Peer-to-peer ambassadors can share information and their personal experiences with EVs.

Information to share includes:

- Federal and State incentives.
- Local dealerships that are selling EVs.
- How to install home charging – create a list of local electricians that Howard County residents can recommend.
- Where to find charging stations – promote mobile apps and online mapping programs that provide this information.

Reduce Your Vehicle Miles Traveled

Not everyone will be able to convert to driving electric right away. Until EV's become more widely used, reducing the number of miles travelled alone in personal vehicles is another critical step in reducing GHG emissions. It's also one of the most cost-effective ways to do so since it doesn't require purchasing a new vehicle and can save individuals money on gas. Behavior change is hard to accomplish and measure but reducing the amount driven is crucial to reducing GHGs.

Action: Reduce vehicle miles traveled by driving less and helping others do the same.

- Combine trips by running errands on the way to other activities or running a series of errands at the same time. Google maps can be a great way to plan the most efficient driving routes for combined trips.
- Reduce idling. Idling is not necessary for vehicles, even in cold weather. Choose to park and go into restaurants, banks, and pharmacies rather than using the drive through option.
- Carpool with friends and neighbors to local activities.
- Telework whenever possible and encourage your employers to adopt flexible telework policies.
- Bike, walk, take the bus or train, and let your circle know how you are doing it. Invite friends and colleagues to join you, or post about it on social media. Make sure your friends, family, and colleagues know how to access trails and public transit.
- Encourage students to ride the bus to school or to walk or bike to school whenever possible. This helps reduce vehicle miles traveled and idling in the school drop off or pickup lines.

Use Less Energy in Homes and Community Spaces

Reducing GHG emissions from existing buildings is one of the most impactful climate actions since 42% of emissions come from the built environment.

Action: Help family, friends, neighbors, community spaces, and businesses conserve energy, make energy efficiency improvements, and electrify.

- Get an energy audit and implement the recommendations. Utility companies offer quick home energy check-ups at no additional cost and more detailed Home Performance with Energy Star audits for \$100 (a \$300 savings from the typical cost).

- Weatherize your home to reduce air leaks. Weatherization includes adding insulation, sealing leaks around windows, doors, switch plates, recessed lights, etc. If you are income-limited, you could qualify for free weatherization services from Community Action Council to save energy at home.
- Buy Energy STAR appliances with the highest energy efficiency ratings.
- Find out who oversees energy efficiency at your workplace and refer them to local programs, such as grants and loans through Maryland Energy Administration, C-PACE Energy Financing, and building tune up programs and rebates through BGE and Potomac Edison.
- Convert to heat pumps and other electric equipment whenever replacing a gas or oil heating system or appliance.
- Conserve energy at home and work by turning off lights when not in the room, connecting appliances to power strips and turning them off at the strip to avoid standby power, and by using a programmable thermostat. See livegreenhoward.com/energy for more tips.

Increase Use of Renewables

Decarbonizing the electricity supply is critical to reducing greenhouse gas emissions from buildings and from transportation, especially when moving toward greater adoption of electric vehicles and replacing natural gas and oil heat sources with electric ones. A great way individuals and organizations can make a difference is to help your family, workplace, and organizations you belong to make the switch to renewable power. This can include participating in community solar (a way to increase new, local solar projects and get the financial and environmental benefits of solar power without needing to own your home or have a shade-free roof), installing solar on your property, and even just switching your electricity provider to one that uses 100% wind or solar energy.

Action: Reduce barriers and decision fatigue around going renewable and increase participation in community solar, on-site solar, and renewable energy supply plans.

- If you have the means and appropriate location, add solar panels to your home. Build this into a scheduled roof replacement if that is needed.
- Become a solar ambassador by sharing information about your experience and recommended solar contractors to neighbors, friends, family, workplaces, and local organizations.
- Join a local community solar project and share information about your experiences with anyone with a local utility bill.
- Help increase awareness of community solar through your networks. Community solar has great potential but requires a lot of education so that more residents sign up. Consider holding a community solar webinar or promotion through a local non-profit. These sponsored sign-ups sometimes have an added bonus of a fundraising component for the organization.
- Direct people with questions to livegreenhoward.com and other sources of information.

Sequester Carbon with Trees, Plants and Healthy Soils

It is impossible to eliminate all sources of emissions, as even natural processes like decomposition of leaves and fallen tree trunks can release carbon into the atmosphere. Therefore, it is critical to do more to sequester or store carbon by taking good care of our land and natural areas. Most carbon storage from natural and working lands is achieved by plant roots and soil microbes, so it is critical to replace shallow rooted turf grass with deep rooted native flowers, grasses, and shrubs whenever possible. It's also very important to plant trees and to manage forests so they can be healthy and store more carbon than they release. In addition to storing carbon, healthy soils and native trees and plants also can reduce flooding, reduce urban heat islands, and provide habitat for pollinators and other wildlife. Seventy-three percent (73%) of land in Howard County is owned privately. Therefore, it is critical to help homeowners and other private landowners replace turf with trees and perennial plants.

Unfortunately, the social norm is to have overly manicured grass lawns in many residential and commercial properties – and even in our parks. This causes emissions from lawn-mowing in addition to reducing the carbon storage capacity of soils. However, studies have found that it only takes 25% of people in a group to adopt a new social norm to create a tipping point where the entire group follows suit.²³ This makes it even more critical for climate activists to adopt these land practices publicly and prominently.

Action: Plant more trees and native plant gardens. Work within neighborhoods to reach the tipping point to change social norms from turf grass to beautiful native plant meadows and gardens. Use signage, conversations, and other means to share information about these practices.

- Plant native plant gardens and native trees on your property prominently and include educational signage available from Howard County’s Bee City Program or National Wildlife Foundation’s Backyard Wildlife Habitat Certification Program.
- Use and promote programs that provide information and resources to help people convert turf grass to native plants and trees. Some of these include Howard County’s Bee City Program, Homegrown National Park, and Howard County Master Gardeners.
- Local groups and gardeners can continue to share their passion and knowledge on local Facebook groups such as Maryland Native Gardeners and Howard County Gardeners.
- Let local schools, parks, homeowner’s associations, and faith-based institutions know that native plants are welcome, beneficial, and beautiful. Help connect these organizations with funding and technical assistance from Howard County CleanScapes, Chesapeake Bay Trust, Howard County’s Bee City Program, and others.
- Promote and attend local native plant sales such as Native Plant Palooza at Robinson Nature Center or Howard County Greenfest at Howard Community College. Develop lists of recommended native plant retailers to share with family, friends, and colleagues.
- Organize a speaker series or informational workshop on native plants for your neighbors or local organizations.

Reduce Food Waste and Encourage Plant-Rich Diets

Global food systems have benefitted society tremendously through increased access to affordable, accessible food across the United States and in Howard County. However, there are significant opportunities for improvement of these systems to become less wasteful. About a third of food does not even make it to consumers, and after that, there is more waste by consumers themselves.²⁴ In higher-income areas, the reasons for consumer food waste may include unattractive produce rejection, improper planning of meals causing food to go bad, and imbalances between supply and demand at the grocery store.²⁵ This causes emissions because when food breaks down in a landfill, it generates methane, a potent greenhouse gas. Individuals should also make a conscious effort to eat more plants as part of a well-rounded diet, as raising livestock accounts for nearly 15% of direct global emissions each year. This high number is due to the clearing of land to house and feed livestock and the direct emissions livestock like beef produces. Eating a plant-rich diet can also provide an added benefit of improving your health.

All of this means that reducing food waste and encouraging plant-rich diets are two of the most impactful actions an individual can take to reduce global emissions. Project Drawdown, a comprehensive ranking of climate solutions based on their potential to reduce greenhouse gas emissions, rated these two actions third and fourth, respectively, out of the top 100 actions to reduce emissions worldwide.²⁶

Action: Reduce food waste at home and in the grocery store and switch to a more plant-based diet.

- Plan your meals ahead of time so that you only buy what you need at the grocery store. Consider keeping the foods that expire the quickest in the front of the refrigerator so they don’t get forgotten.
- Participate in Howard County’s curbside composting program or compost on your own property.
- Incorporate more plant-based meals into your routine. Even skipping meat-based meals once a week can make a big difference.

- Consider participating in an “ugly produce” program where less than perfect produce is sold directly to consumers.
- Support local farms to reduce the food waste produced during the shipping process. This can include buying food at local farmers’ markets and the Roving Radish Marketplace or signing up for a weekly box of produce from a local farm through a community supported agriculture (CSA) program.

Buy Less Stuff

Our hyper-convenient, disposable lifestyle is a very big challenge for the climate, wildlife, water quality, and even for our own health. Even though waste is a relatively small source of GHG emissions within the confines of Howard County, manufacturing and transporting goods result in high emissions in other places. These are considered indirect emissions and weren’t included in the GHG emissions inventory in this document because they can be very difficult to measure. However, the types and quantities of things bought and thrown away can have a big impact on the climate on a national and global scale.

Action: Reduce the amount of goods purchased and encourage others to do so as well.

- Practice and promote the five Rs: Refuse, Reduce, Reuse, Repurpose, and Recycle. Refuse means to not buy or take anything that you don’t really need, even if it’s offered for free. You can politely decline promotional freebies, single-use plastics, and anything else that isn’t truly essential.
- Promote simpler living and clutter-free gifts. Try to borrow items rather than buy them. Consider gifting food and other consumable items, experiences such as concert tickets, restaurant gift cards or subscriptions to museums.
- Participate in and promote the use of local groups, events, and resources that help people practice reuse and repurpose. These may include local “Buy Nothing” groups on social media, the Community Ecology Institute’s Repair Café to fix lamps and small appliances, DIY centers such as the tool lending center at Elkridge Branch Library, Habitat for Humanity’s ReStore for furniture and home project materials, and other consignment shops and thrift stores.

Mitigation Strategies

Energy

Strategy E1: Reduce Greenhouse Gas Emissions from Existing Buildings

Buildings continue to be a major source of greenhouse gas emissions in Howard County and throughout the region. These emissions come from a variety of sources, including on-site combustion of fuels in boilers and hot water heaters, electricity use, and leaking refrigerants. This strategy includes the implementation of building energy efficiency measures focused on lighting, HVAC, building control systems, and building envelope. This strategy also includes occupant education and behavior change programs to reduce the amount of electricity used. Actions from the County will build on existing work by the state including existing utility rebate programs and the state's Climate Solutions Now Act of 2022, which requires large buildings to meet direct emissions reductions through a building performance standard. Through this policy, buildings over 35,000 square feet must first report direct onsite emissions (for instance from boilers burning fossil fuels such as diesel, heating oil, or natural gas) by 2025, then reduce those emissions starting in 2030, eventually meet net zero direct onsite emissions by 2040, or face penalties. This strategy also builds on new incentives and rebates for electrification of home appliances through the federal Inflation Reduction Act. This strategy will:

- Focus on maximizing the effectiveness of residential retrofit programs and promoting and incentivizing efficient electric appliances including heat pumps, heat pump water heaters and induction stoves to improve residential and commercial energy efficiency.
- Develop educational materials and programs to encourage building occupants to reduce energy use by changing everyday behaviors.
- Pursue beneficial electrification to reduce natural gas, heating oil, and other high-emissions fuel use in existing buildings that meet specific criteria.
- Pursue strategies to use low-global-warming-potential refrigeration equipment to reduce fluorinated gas emissions from buildings.

Why These Actions?




Many energy efficiency improvements are cost-effective, and several existing programs can be leveraged for this effort, including EmPOWER Maryland and Community Action Council's weatherization assistance. One of the lowest cost methods to achieve significant energy savings is through occupant behavior, such as turning off lights and shutting down computers after use. Building electrification may seem to increase electricity use in buildings at first, as it typically replaces natural gas, heating oil, or other on-site fuel combustion. However, as the power grid is supplied by a greater percentage of renewable energy sources each year under Maryland's Renewable Portfolio Standard (RPS), beneficial electrification of existing buildings is an important pathway to decarbonization. New rebates expected through the Inflation Reduction Act will make electrification of home appliances more affordable to households making up to 150 percent of the median income in Howard County.

Addressing Equity

Increasing access to residential retrofits and rebates for underserved communities will improve occupant comfort and lower energy costs for residents. Electrification measures will reduce indoor air pollution from inefficient furnaces, water heaters, stoves, and other on-site combustion, which disproportionately impact disadvantaged communities.

Howard County Leading by Example

Howard County set a goal to reduce its energy use per square foot in government buildings 25% below 2019 levels by 2024. Howard County Government has already reduced energy use of government operations by converting traffic lights and streetlights to LEDs and implementing energy efficiency upgrades in its buildings.

GHG Emissions Reductions	Cost Considerations	Co-Benefits		
 <table border="1"> <tr> <td> 2030 182k MTCO₂e 4% reduction from 2005 baseline </td> <td> 2045 434k MTCO₂e 11% reduction from projected 2045 emissions </td> </tr> </table>	2030 182k MTCO ₂ e 4% reduction from 2005 baseline	2045 434k MTCO ₂ e 11% reduction from projected 2045 emissions	 <p> Upfront Capital Improvement Costs Reduced Energy Costs </p>	 <p> Improved efficiency will reduce energy costs for residents and businesses. Reduced onsite natural gas and heating oil use will reduce air pollution. </p>
2030 182k MTCO ₂ e 4% reduction from 2005 baseline	2045 434k MTCO ₂ e 11% reduction from projected 2045 emissions			

Action 1: Increase energy efficiency and conservation in all existing residential, commercial and government buildings.

This action will improve energy efficiency and conservation in existing buildings by leveraging and expanding upon existing utility and weatherization programs in the County and State. It also includes educating and incentivizing individuals and businesses to adopt cost-effective energy efficiency and conservation measures at home and at work. Residential energy efficiency measures may include weatherization, lighting upgrades, building envelope improvements, upgrades to more efficient appliances and HVAC equipment, and occupant behavior changes. Commercial measures may include lighting retrofits, more efficient HVAC equipment, building envelope improvements, retro-commissioning, and building automation, as well as occupant education and behavior change. Individual behavior changes at work and at home may include turning out lights or shutting down computers when not in use. Also under this action, Howard County government will continue to implement energy efficiency and conservation measures in its own buildings.

Overcoming Barriers

While a large variety of great energy efficiency and conservation options are available, many people have not yet adopted these practices, even with the inducements of rebates, incentives, and cost savings. Education on existing programs, funding opportunities, and co-benefits of energy efficiency and conservation can help increase adoption of energy saving measures in homes and businesses. In addition, partnerships and grants can help expand existing programs beyond their current reach.

Tracking Progress

This action will seek to achieve electricity savings of 0.5% per year initially, ramping up to 3% annual savings for residential and 2.5% for commercial by 2045. These annual electricity savings achieve a total savings of 30% for residential and 25% for commercial buildings over 2022 levels by 2045. Annual gas savings from energy efficiency measures will begin at 1.1%, ramping up to 2% by 2045. These annual gas savings achieve a total savings of 20% for all building types over 2022 levels by 2045. The metric table below shows electricity savings measured in megawatt hours (MWh) where each megawatt is 1,000 kilowatts (kWh). Natural gas savings are measured in MMBtu or one million British thermal units. The British thermal unit or Btu is a standard unit of measurement of the energy content in fuel.

Metric	Baseline	Goal
Cumulative residential electricity use savings	0 MWh	177,000 MWh (2030) 839,000 MWh (2045)
Cumulative commercial electricity use savings	0 MWh	233,000 MWh (2030) 945,000 MWh (2045)

Cumulative residential natural gas use savings	0 MMBtu	446,000 MMBtu (2030) 1,633,501 MMBtu (2045)
Cumulative commercial natural gas use savings	0 MMBtu	376,000 MMBtu (2030) 1,328,000 MMBtu (2045)

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from Department of Community Resources and Services (DCRS), Department of Public Works – Facilities (DPW – Facilities), Howard County Economic Development Authority (EDA) and Department of Finance (Finance).

Next Steps	Timeline	Responsibility
Work with local utilities and their partners to increase participation in existing commercial and residential energy efficiency incentive programs. Encourage homeowners, landlords, and contractors to take advantage of all new rebates that become available. Encourage businesses, organizations, and schools to apply for state energy efficiency grants and low-interest loans offered by Maryland Energy Administration.	2023-2024	OCS
Promote energy conservation at work and home through outreach and events. These may include LED light bulb exchanges, educational material development and distribution, contests such as Battle of the Buildings, and outreach through newsletters, blogs, social media, and websites.	2023-2024	OCS
Expand residential retrofit programs such as the Community Action Council's and Civic Works' weatherization efforts and Rebuilding Together's home repairs, with specific emphasis on underserved markets. Support these organizations in pursuing federal grant programs for this expansion including the upcoming energy efficiency block grant program. Educate residents about the availability of these programs and encourage them to reach out to these organizations to request energy and cost saving services, such as free energy audits and weatherization services.	2023-2024	OCS, DCRS
Expand the use of C-PACE for commercial properties. Work with the Chamber of Commerce and other partners to promote the program to local businesses. Commercial Property Assessed Clean Energy (C-PACE) is a clean energy loan program that allows property owners to pay back qualifying loans through their property tax bills. Howard County Council recently expanded C-PACE to include energy efficiency, renewables, resiliency improvements, and occupant health improvements. The Council legislation also encourages electrification by prohibiting the use of C-PACE loan funds for gas-powered boilers, furnaces, hot water heaters, or cooking appliances.	2023 and ongoing	OCS, Finance, EDA
Educate local businesses and nonprofits about opportunities for state grants and loans, as well as utility rebates through the EmPOWER Maryland program. These rebates include funding for building tune ups and for installation of energy efficient equipment.	2023-2024	OCS, EDA

Establish a benchmarking program to support compliance with the state’s planned Building Energy Performance Standard. In addition to benchmarking the direct emissions from on-site combustion, include options for benchmarking electricity use using Energy Star Portfolio Manager to raise awareness of energy efficiency gaps. Begin by benchmarking County buildings and publishing results to lead by example.	2023-2025	OCS
Explore requiring energy audits as part of commercial property sales, especially for larger buildings.	2023-2025	OCS
Include energy efficiency review at the beginning of systemic (existing building) projects at County government facilities as appropriate to maximize energy savings and grant opportunities. Consider replacement of equipment with the most energy efficient option available. OCS and Facilities to meet at the beginning of each fiscal year to review planned projects and discuss energy saving opportunities.	2023 and ongoing	DPW – Facilities, OCS
Identify needs for additional funding, staffing, and staff training for preventive maintenance in County government buildings.	2023-2024	DPW – Facilities
Increase funding, staffing, and staff training for building maintenance in Howard County government buildings to ensure all preventive maintenance is performed on schedule and that all building automation systems are monitored and adjusted for maximum energy savings.	2024-2025	DPW – Facilities
Provide regular reporting on energy consumption per square foot in County government buildings to upper management. Prioritize County government facilities for energy saving projects and implement those projects wherever possible with County and grant funding.	2023 and ongoing	OCS, DPW – Facilities

Action 2: Increase electrification in existing residential, commercial and government buildings.

Building electrification means replacing boilers, hot water heaters, and other equipment that use on-site combustion of fossil fuels (natural gas, heating oil, etc.) to high-efficiency equipment that runs on electricity, such as cold weather heat pumps or heat pump water heaters. Paired with grid decarbonization, electrification can significantly reduce emissions from buildings. Electrification not only reduces greenhouse gas emissions, but also can result in improved performance, reduced costs, or other added benefits. For example, when used in certain buildings electric heating and hot water can reduce energy costs as well as emissions. Replacing gas stoves with electric can improve indoor air quality and human health.

Overcoming Barriers

Many consumers have concerns about whether heat pumps will work as well as boilers and other more familiar technologies. While lifetime costs of heat pumps are typically lower than that of natural gas or oil boilers, upfront costs of heat pumps can be greater, which can be a barrier. Improved education on the efficiency, efficacy, and potential savings from using heat pumps, even in below-freezing temperatures, as well as education on the benefits of electrification may help bolster adoption. Most people are not yet aware of the new rebates and incentives for electrification of major home appliances that will be available through Inflation Reduction Act funds starting in 2023. Formulas to determine eligibility and allowable rebate amounts are complicated and individuals and contractors may need educational resources to fully understand how to make the best use of these new incentives. Additionally, installing new electric equipment in existing homes and commercial buildings may require electric panel upgrades or new electrical service depending upon existing capacity and use. Upgrading a building or home to electric requires a plan.

First, determine whether electrical upgrades are needed prior to the installation of the electric equipment. This will avoid a situation where the existing boilers and water heaters reach their end-of-life before the building is ready for the switch. Once existing equipment breaks, there is typically a need to replace equipment as quickly as possible, so it is more likely that building occupants will choose to replace gas and oil equipment with the same rather than add extra steps, time, and money to prepare for electric upgrades. Finally, education efforts focused on HVAC technicians and contractors also is key, as their clients often follow their recommendations when choosing new equipment.

Tracking Progress

This action focuses on replacement of boilers, hot water heaters, and other equipment that use on-site combustion of fossil fuels with electric equipment as the existing equipment breaks down and requires replacement. This action also encourages preparation for electrification prior to equipment breakdown. While some residents and businesses would switch to electric systems without additional incentives or education, the outreach and pilot programs outlined in this action have the potential to dramatically increase the rate of electrification. Under this action, the number of buildings that rely on on-site combustion of fossil fuels (described as eligible buildings in the chart below) will steadily decrease over time.

Metric	Baseline	Goal
Percent of eligible residential buildings that have implemented electrification	0%	20% (2030) 80% (2045)
Percent of eligible commercial and government buildings that have implemented electrification	0%	10% (2030) 59% (2045)

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from Howard County Economic Development Authority (EDA), and Office of Workforce Development (OWD).

Next Steps	Timeline	Responsibility
Support efforts to expand EmPOWER Maryland to include incentives for converting from oil and gas heat and appliances to electric. The Climate Solutions Now Act includes an initial step toward this work by changing utility programs for low-income customers and allowing utility programs to lower bills by switching to all electric heating rather than simply retrofitting to more efficient fossil fuel systems. Also seek inclusion of incentives for electric panel and/or electric service upgrades prior to electrification.	2023-2024	OCS
Educate the community, including residents and businesses, about state and federal incentives and programs promoting electric and efficient appliances, such as ENERGY STAR, EmPOWER Maryland, and new incentives available through the Inflation Reduction Act or other legislation. Provide educational materials as needed to help individuals and businesses understand their eligibility and how to maximize rebate and tax incentives for electrification.	2023-2025	OCS, EDA

Educate the community about the benefits of electrification, including lifetime cost savings, improved indoor air quality, and more. Include targeted education about the effectiveness of high efficiency heat pumps at cost-effectively and comfortably heating homes and smaller commercial buildings even in extreme cold temperatures. Also include education about the safety and time-saving benefits of electric induction ranges. Prioritize populations in buildings currently using oil heat for education programs.	2023-2025	OCS, EDA
Develop pilot programs as needed to test, demonstrate, fund, and implement electrification projects, especially in underserved communities and/or with small businesses. These pilot programs may include electric heat pumps and water heaters as well as electric stoves, electric dryers, and more. Prioritize buildings currently using oil heat whenever possible.	2023-2025	OCS, EDA
Reach out to HVAC and electrician professionals to discuss barriers they face in recommending and installing electric equipment. Partner with trade and professional associations, apprentice programs, community colleges, and others to develop and implement training as needed for current and future HVAC and electrician professionals.	2023-2025	OCS, OWD
Consider options for additional incentives and/or workforce development programs to help homeowners and commercial building owners to prepare for electrification with energy audits, electric infrastructure audits, and any needed upgrades to electrical panels and service. Prioritize income-restricted households and small businesses for any new incentives.	2025-2026	OCS, OWD
Explore requiring electric equipment audits and any needed panel and service upgrades as part of property sales.	2025-2026	OCS

Action 3: Accelerate the adoption of low GWP refrigeration and air conditioning equipment in commercial properties and reduce refrigerant leaks.

Refrigerant leaks can be a significant source of emissions as these chemicals typically are much more potent greenhouse gases than carbon dioxide and therefore have a high global warming potential (GWP) and contribute exponentially to climate change. Refrigerant leaks also can be costly because leaky systems need to be recharged more frequently. The American Innovation and Manufacturing Act (AIM) passed in 2020 phases down the consumption of hydrofluorocarbons (HFCs) currently used as refrigerants, by 85 percent over the next 15 years in favor of lower-GWP alternatives. AIM will result in significant GHG emissions reductions nationwide but will be slow to reach its fullest potential impacts because existing equipment using HFCs may still be in use for decades to come. In addition to waiting for commercial property owners to replace aging equipment with equipment containing lower-GWP refrigerants, this action supports proactive measures to reduce refrigerant leaks and begin replacing outdated equipment with low-GWP alternatives even before HFCs are mostly phased out. Howard County can lead by example through regular refrigerant system maintenance and replacing outdated equipment with low-GWP alternatives in County buildings. In addition, Howard County can help food retail and other businesses access available programs to help them follow best practices in refrigeration.

Overcoming Barriers

Commercial property owners may not be aware of the options for lower-GWP refrigerants. In addition, appliances with lower-GWP refrigerants may not be readily available, though the AIM Act will ensure greater availability in the future. Commercial property owners also may not be aware of opportunities for cost savings, technical support, and community recognition that can come from participation in partner programs such as the U.S. Environmental Protection Agency's GreenChill program.

Tracking Progress

This action seeks to reduce GHG emissions from HFCs used by commercial properties through supporting enrollment in existing programs, such as GreenChill, a voluntary U.S. Environmental Protection Agency partnership program that works

with the food retail industry to reduce refrigerant emissions. The GreenChill program can help educate businesses about their options for refrigerant systems and help them develop proactive plans for maintaining, retrofitting and/or upgrading systems.

Metric	Baseline	Goal
Store enrollment in EPA’s GreenChill program	1 store	34% of stores enrolled (2030) 83% of stores enrolled (2045)

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from Department of Public Works -Facilities (DPW – Facilities) and Department of Public Works -Environmental Services (DPW-ES), and Howard County Economic Development Authority (EDA).

Next Steps	Timeline	Responsibility
Identify existing programs focused on encouraging adoption of lower-GWP refrigerants (e.g., federal GreenChill program) and reach out to these programs regarding County-level partnership opportunities.	2023-2024	OCS, EDA
Educate the community about federal programs promoting lower-GWP appliances, refrigerant leak mitigation, and responsible appliance disposal (e.g., EPA’s Responsible Appliance Disposal Program).	2023-2024	OCS, DPW – ES
Ensure responsible recycling of HFC-containing equipment through community education.	2023-2025	OCS, DPW – ES
Continue to perform regular maintenance of refrigerant systems in County buildings. Increase funding and staffing for maintenance as novel lower-GWP systems are implemented.	Ongoing	DPW – Facilities

Strategy E2: Construct Efficient and Low-Carbon Buildings

New buildings should be highly efficient and emit the least carbon possible. By integrating green design principles, energy efficiency, and electrification in new buildings, the public and private sectors can avoid having to later retrofit these buildings to comply with Maryland’s Climate Solutions Now Action of 2022 and other regulations.

By implementing this strategy, Howard County will:

- Develop and implement more stringent green building standards to maximize energy efficiency and decarbonize new construction.
- Limit the use of high-global-warming potential refrigeration and air conditioning equipment in new construction.

Why These Actions?

Incorporating energy efficiency into new construction is one of the most cost-effective ways to limit future emissions. Adopting the International Green Construction Code overlay and/or another energy efficiency or green building standard would further increase energy efficiency in new construction. In addition, electrification of most new construction will be necessary to meet requirements under Maryland’s Climate Solutions Now Act, which gradually phases out onsite fuel combustion in buildings.




Addressing Equity

This strategy will incentivize highly efficient new construction, improving occupant comfort and lowering energy costs for residents. Electrification measures will reduce indoor air pollution from inefficient furnaces, water heaters, stoves, and other on-site combustion, which disproportionately impact underserved communities.

Howard County Leading by Example

New County government buildings greater than 10,000 square feet are required to achieve LEED Silver Certification to maximize efficiency and reduce the environmental impact of new construction, and in many cases, Howard County has achieved LEED Gold or LEED Platinum for new buildings. For example, the Howard County Circuit Courthouse, completed in 2021, achieved LEED Gold with many points achieved for energy efficiency and renewable energy.

Howard County’s Department of Inspections, Licenses and Permits staff are active participants in several International Code Council committees and workgroups that continuously revise and update codes to best protect people and property, as well as save energy and reduce life cycle building costs. As of 2022, Howard County has adopted all the most recent versions of international building codes, except for the International Green Construction Code overlay. The adoption of modern building codes is rare among local jurisdictions in the United States, with only about one-third of communities adopting the most modern codes. This prompted a new federal effort to increase adoption of modern building codes, called the National Initiative to Advance Building Codes.

GHG Emissions Reductions		Cost Considerations	Co-Benefits
			
2030 7.8k MTCO ₂ e <1% reduction from 2005 baseline	2045 35.5k MTCO ₂ e 1% reduction from projected 2045 emissions	Potential upfront costs for green building. Reduced energy and maintenance costs.	Improved efficiency will reduce energy costs for residents and businesses. Reduced onsite natural gas use will reduce air pollution and benefit public health.

Action 1: Implement more stringent green building standards for new residential, commercial, and government properties.

This action increases the energy efficiency of new construction and major renovations. To encourage compliance with green building codes, Howard County will work with the construction community to educate and train contractors and their workforce on green building benefits, new approaches and technology, and installation techniques. Howard County also will continue to actively engage with the state on the timing and process for adoption and implementation of new energy codes.

Overcoming Barriers

Barriers to new green and energy efficient buildings can come from a range of items including, education of project developers, access to construction materials and skilled laborers, and the higher cost of construction. In addition, code compliance is crucial for the benefits of a more energy-efficiency focused code to be realized. Further, a review of existing code requirements will be important to identify potential barriers to development of green buildings (e.g., fire code requirements and batteries). Howard County also needs to consider costs for home buyers and renters, particularly those with low and moderate incomes, when adopting and implementing code requirements. Finally, to adopt the International Green Construction Code overlay and/or other green building standards, Howard County Department of Inspections, Licenses and Permits will need additional funding and staff to conduct required inspections following building occupancy to ensure energy efficiency goals are met in each new building.

Tracking Progress

This action assumes that green building standards such as the International Green Construction Code (IgCC), Net Zero Energy code, or Green Globe, push new construction to reach energy efficiency levels above required International Construction Code (ICC) standards. New building codes are developed every three years and Howard County is one of the

earliest adopters of new codes across the country. Howard County has not yet adopted the IGCC or other green building standards, so there is good potential to reduce energy consumption and reduce GHG emissions through adoption of a green building standard. This Climate Action and Resilience Plan assumes a 95% compliance rate with a new green building or energy efficiency code.

Metric	Baseline	Goal
New Code Adoption	Existing Code Requirements	A new green building standard adopted for Howard County. (2027)

Implementation

The Department of Inspections, Licenses, and Permits (DILP) will be the lead implementer for this action, with support from the Office of Community Sustainability (OCS), Department of Planning and Zoning (DPZ), and Department of Public Works – Facilities (DPW – Facilities). Adoption of new codes is a responsibility of County Council.

Next Steps	Timeline	Responsibility
Research green building standards that support the construction of highly energy efficient new buildings and/or net zero emission buildings. Options may include IgCC, LEED, Green Globes, a variety of Net Zero energy standards, etc. Determine any resources needed to support new codes and ensure these resources are available before codes are adopted.	2023-2024	DILP, OCS
Adopt new green building standards and/or energy efficiency codes as appropriate through the standard three-year code adoption cycle.	2024-2027	DILP, County Council
Educate the construction community on the benefits of energy efficiency focused code, and brief them on the specific code updates, particularly on the residential side. This includes educating general contractors, but also trades people on quality and acceptable installation practices for things like insulation, weather resistant barriers, and other newer energy efficiency approaches.	2024-2027	DILP (and statewide partners)
Continue to conduct energy efficiency review for Howard County government building projects greater than 10,000 square feet with the goal to maximize energy efficiency and minimize carbon emissions in each new construction project. Encourage HCPSS to do the same.	Ongoing	DPW – Facilities, OCS, HCPSS
Explore options to modify local incentives (including monetary, zoning, building credits, etc.) and/or regulations to promote green buildings that provide additional energy efficiency beyond what is required by code. Also consider options to incentivize smaller residential units (houses, townhouses, apartments) and/or to disincentivize larger residential units.	2023-2025	DILP, OCS, Finance, DPZ
Adopt modifications to local incentives and/or regulations as needed to improve energy efficiency of new buildings beyond code requirements and/or to incentivize smaller building size.	2024-2026	DILP, OCS, Finance, DPZ

Action 2: Phase-in requirements for all-electric new construction for residential, commercial and government properties.

When paired with decarbonization of grid electricity, all-electric buildings reduce on-site fuel combustion and associated GHG emissions. This action considers phasing in requirements for all new residential and commercial construction to be all-electric, with an initial emphasis on buildings which are the most cost-effective to electrify. Howard County Council

also is considering including electrification in future construction code updates. In early 2023 the Council passed legislation (2023-CB5) requiring the County Executive to produce a report including recommendations on how to incorporate electrification into code for new construction. This action broadly aligns with Maryland’s Climate Solutions Now Act which requires net-zero on-site fuel combustion by 2040 for many buildings.

Overcoming Barriers

Public education about the cost effectiveness of electrification will be crucial as higher upfront costs can mask lifetime savings.

Tracking Progress

While Howard County’s exact path toward and timing of electrification is subject to future code changes, the modeling to determine GHG emission reduction potential for this action assumes 100% of new residential construction and 38% of new commercial buildings will be electric beginning in 2025. By 2035, the assumption changes to 100% electric new construction across residential, commercial, and government buildings.

Metric	Baseline	Goal
Percentage of new residential buildings that are all-electric	Unknown	100% (2030) 100% (2045)
Percentage of new commercial buildings that are all-electric	Unknown	38% (2030) 100% (2045)

Implementation

The Department of Inspections, Licenses and Permits (DILP) will be the lead implementer for this action, with support from the Office of Community Sustainability (OCS) and Howard County Economic Development Authority (EDA).

Next Steps	Timeline	Responsibility
Develop educational materials to address public concerns regarding electrification (utility infrastructure, grid carbon intensity, battery storage, etc.) and benefits of electrification (improved indoor air quality, life cycle cost savings, etc.).	2023	OCS
Research and report on options for including electrification requirements in construction code.	2023-2024	DILP, OCS
Implement electrification requirements as adopted in the code, which requires action by Howard County Council. International construction code updates typically take place every three years, with updates anticipated in 2024 and 2027.	TBD	DILP
Identify potential community partners to help support electrification efforts (e.g., coordination with Columbia Association, HCPSS, and Howard Community College to support electrification within their building portfolios).	2023-2025	OCS
Educate the construction and real estate community regarding the benefits of electrification and any grants, rebates, or other incentives to implement electrification of new construction.	2023-2025	DILP, OCS, EDA
Educate the construction and real estate community regarding the potential use of geothermal. Provide information on incentives and technical assistance opportunities for geothermal installation.	2023-2025	OCS, EDA

Incorporate requirements into building standards that promote the use of low-GWP refrigerant equipment in new buildings.	2024-2025	DILP
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Strategy E3: Decarbonize the Energy Supply

A clean energy grid with a carbon-free fuel mix is a foundational strategy because it enables both vehicle and building electrification to dramatically reduce emissions. Maryland’s Renewable Portfolio Standard requires half of the state’s electricity to come from renewable sources by 2030, with 14.5% carved out for solar. This state requirement is expected to reduce GHG emissions in Howard County 15% by 2045. Howard County can increase the emission reduction potential to 24% by supporting local renewable energy development and use through education, outreach, eliminating barriers, or considering new options for incentives.

Through implementing this strategy, Howard County will:

- Create outreach programs to increase the use of on-site solar, community solar, and third-party suppliers that offer 100 percent renewable energy options.
- Increase incentives for onsite solar development through codes, zoning, tax relief, or other options.
- Expand the development of onsite solar energy for residential, commercial and government properties.

Why These Actions?

These actions will help expand the local use of renewable energy and decarbonize electricity supply. Currently, 28% of the County’s greenhouse gas emissions come from electricity generation. Electrification of buildings and transportation will significantly increase electricity consumption in years to come, making this strategy critical to decarbonization.




Addressing Equity

This strategy encourages several efforts to remove barriers to local renewable energy development, including providing trusted information on renewable energy options and lowering upfront costs. Community solar and community choice aggregation can provide access to affordable renewable energy to all community members, including renters.

Howard County Leading by Example

Howard County has always been a leader in adopting solar on County-owned properties. In the last decade, Howard County installed solar on rooftops, canopies over parking, and even over a retired landfill. In 2020, Howard County government entered into the largest solar Power Purchase Agreement (PPA) in the state of Maryland. By aggregating rooftop, parking canopy, and ground-mount projects from public and private sites into one agreement, Howard County was able to meet multiple needs while keeping the cost of electricity down – even saving money compared to its already low group purchase rate. When complete, the combined projects are expected to generate a monumental 44 million kilowatt-hours of electricity each year. This will provide well over half of the total electricity needed for County government operations.

In addition, Howard County has made it easier for its residents and businesses to adopt solar. Following an investigation of solar policy through its 2020-21 Solar Energy Task Force, Howard County passed a comprehensive Zoning Regulation Amendment that opened more zoning districts to solar development, streamlined the zoning application process for personal and commercial use solar facilities, and better aligned the policy on commercial solar facilities on Agricultural Land Preservation Program properties to support farmland, farmers, and community solar projects. Howard County also began offering more Payment in Lieu of Taxes (PILOT) agreements to reduce the tax burden on solar developers and property owners.

GHG Emissions Reductions		Cost Considerations	Co-Benefits
			
2030 708k MTCO ₂ e 16% reduction from 2005 baseline	2045 969k MTCO ₂ e 24% reduction from projected 2045 emissions	High upfront costs; lower energy costs over time	This strategy will increase equity in the renewable energy marketplace by placing emphasis on access for underserved communities through a low income carve-out for community solar projects.

Action 1: Expand the development of solar energy for residential, commercial, and government properties.

This action aims to increase the development of local solar installations on residential, commercial, and government properties, leveraging both new and existing policies and programs. This action promotes the transition to local renewable energy and reduces stress on the electricity grid, improving local and regional resilience to power outages caused by high electricity use. Howard County can encourage and promote onsite solar deployment and can help ensure equitable access. The County also can provide unbiased solar information to homeowners and businesses and can help drive down the upfront costs of solar. For any situations where on-site solar is not possible, Howard County can promote community solar and 100% renewable third party electricity suppliers as another way to decarbonize the grid.

Overcoming Barriers

Upfront costs to property owners and knowledge about how to navigate onsite solar installations are major hurdles. Additionally, coordination across County departments will be crucial to create a more streamlined permitting process.

Tracking Progress

This action seeks to increase rooftop, carport, and ground mount solar capacity installed in Howard County. To determine the potential for local solar generation, Howard County estimated the maximum capacity of new solar that would be technologically feasible to add to residential and commercial rooftops within County boundaries. For a solar rooftop installation to be technologically feasible, the roof typically needs to be less than 5 years old, have the structural capacity to bear the weight of the solar array, and get adequate sunlight, among other factors. Other variables such as cost and consumer preferences were not considered relevant to technical feasibility. Understanding that costs and consumer preferences can also impact whether solar installations move forward and understanding that some property owners may choose to install solar canopies over parking or ground mount solar arrays, the County based its goals for solar installation on achieving 90% of the technologically feasible potential for rooftop solar. This means that in 2030, the technologically feasible potential for rooftop solar in Howard County will be 1,217 MW DC. The County's goal for that year is to reach 36% of that potential, which is 437 MW DC. In 2045, technologically feasible potential for rooftop solar was adjusted for population growth and associated new buildings, bringing the new rooftop solar potential to 1,259 MW DC. The County's goal for 2045 is to reach 90% of that potential, which is 1,133 MW DC. Although solar installations on 90% of the technologically feasible rooftop space available in Howard County in 2045 may seem like an aggressive goal, it assumes that while the actual rate of solar rooftop installations may be less than 90%, the MW DC capacity will be made up through installations of solar canopies over parking and ground-mounted solar arrays.

In the last three years, new solar installations in Howard County have averaged about 15 MW DC capacity each year. To put this action into perspective, it seeks to increase new solar installations by a factor of 3, reaching approximately 45-47 MW DC capacity of new solar installed in Howard County each year. However, it is likely that this increase will begin

gradually and then increase more exponentially in future years as new policies, education and outreach efforts, and incentives for solar become available.

In any cases where on-site solar isn't possible, Howard County seeks to increase participation in community solar, renewable electricity suppliers, and renewable energy credits. While a reliable baseline for the percentage of residential and commercial properties in Howard County that participate in these programs was not available at the time of this report, one of the implementation steps under this action is to establish a baseline and to continue measuring progress to reach the stated goals below.

Metric	Baseline	Goal
Installed solar capacity (combination of rooftop, ground-mount, and parking canopy)	108 MW DC	437 MW DC – enough to power 50,700 homes (2030) 1,133 MW DC – enough to power 131,500 homes (2045)
Participation in community solar and/or other renewable energy supply and Renewable Energy Credit options.	Unknown	50% of residential and commercial properties in Howard County (2030) 100% of residential and commercial properties in Howard County (2045)

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from Department of Planning and Zoning (DPZ), Department of Inspections, Licenses, and Permits (DILP), and Department of Public Works – Facilities (DPW Facilities).

Next Steps	Timeline	Responsibility
Continue to install solar on County government facilities whenever possible, especially for new construction, roof replacements, and in conjunction with parking lot and parking garage construction. Incorporate a solar feasibility review into new construction and renovation projects greater than 10,000 GSF for County government facilities. Pursue grants, incentives, power purchase agreements, and other opportunities to reduce costs of solar installation.	2023-onwards	DPW – Facilities, OCS
Purchase Renewable Energy Credits as needed, and as funding is available, to offset GHG emissions from electricity used to power County government operations.	2023-onwards	OCS
Work with community partners such as HCPSS, Howard Community College and others to encourage the installation of solar on rooftops, parking lots, and on suitable land wherever possible, especially during new construction. Provide information to these partners on grants, incentives, and other opportunities to reduce costs of solar installation.	2023-onwards	OCS
Explore options for a non-government organization, such as a green bank, to support the clean energy marketplace through financing, marketing, and technical support to help remove barriers to clean energy investments.	2023-2025	OCS
Research best practices and identify any additional needs to modify codes and/or permitting and zoning to maximize implementation of onsite solar and battery storage. Options may include requiring new residential construction to include solar ready roofs and south-facing roofs, for example.	2023-2025	DILP, OCS, DPZ

Ensure flexibility in zoning that promotes the installation of onsite solar by residents and businesses as part of future zoning code updates.	2023-2025	DPZ
Consider development of policy guidance on when and how Payment in Lieu of Taxes (PILOT) agreements may be offered to reduce costs of large solar installations.	2023-2024	OCS
Promote existing solar co-ops and or work with partners to create new solar co-ops as needed to reduce installation costs and increase the number of Howard County homes that have onsite solar power.	2023-2024	OCS
Determine current participation of Howard County residential and commercial properties in community solar, third-party electricity suppliers that provide 100% percent renewable energy, and/or that purchase Renewable Energy Credits to offset GHG emissions of their electricity use. Continue to monitor participation annually to track progress.	2023-onwards	OCS
Create educational materials and outreach programs for residents and businesses on technical assistance, incentives, and other useful information to promote the use of onsite solar, community solar, and purchases of 100% renewable energy from third party suppliers with special emphasis on underserved communities. Also provide information on Renewable Energy Credits as an option for businesses and nonprofits as another option to reduce GHG emissions from electricity use.	2023-2024	OCS
Consider additional options to increase renewable energy use in Howard County, such Community Choice Energy, which would provide a renewable energy supplier as the default for all residential and commercial electricity accounts, with the ability to opt out. (Currently, the default is the utility standard offer of service. Individual customers have the option choose a different supplier. However, each customer must conduct their own research to choose a supplier, typically with limited information. Renewable energy suppliers are included among many other, less climate-friendly options).	2024-2025	OCS

Transportation

Strategy T1: Maximize the Use of Electric Vehicles

Electric vehicle adoption should be increased in the public and private sector. This strategy works in tandem with grid decarbonization strategies, as the electricity used to charge EVs becomes cleaner over time.

Electric vehicles currently make up only 1% of vehicles registered in Howard County. In addition, only a few of Howard County’s government fleet and school buses are currently electric. Howard County has made progress with including hybrid vehicle and replacing *inefficient* vehicles with lower-emission ones, but there is still great potential to reduce GHG emissions through increased EV adoption and use. This strategy advances EV charging infrastructure, encourages private EV purchases, and converts school and transit vehicles to electric. Through implementation of this strategy, Howard County will:

- Accelerate the conversion of the government fleet to electric vehicles.
- Accelerate the conversion of the County’s transit and school bus fleets.
- Promote the adoption of electric vehicles among residents and businesses.

Why These Actions?




Transportation represents the largest source of GHG emissions within Howard County. Increasing the adoption of EVs in the public and private sector has the potential to reduce these emissions, both within the community at large and within government operations. This is the single most impactful action to reduce the County's footprint.

Addressing Equity

Although EVs have great potential to reduce emissions, they are currently more expensive than internal combustion engine vehicles and used EVs are not always available. Conscious effort must be made to design and promote incentive programs and charging infrastructure projects that directly benefit low-income residents.

Howard County Leading by Example

Howard County government has already taken steps toward addressing vehicle emissions by adopting a Green Fleet Policy in 2020. The policy addresses reducing idling, increasing fuel efficiency, right sizing the fleet, and purchasing electric vehicles. Approximately 25 percent of the Howard County government fleet already is either electric or hybrid, including public safety and administrative vehicles, with plans to continue replacing aging fleet vehicles with electric or hybrids whenever possible. Howard County also has significantly increased the availability of electric vehicle charging stations for fleet vehicles, employees, and the public by adding 62 new charging stations at more than a dozen County facilities over the past four years.

GHG Emissions Reductions		Cost Considerations	Co-Benefits
			
2030 207k MTCO ₂ e 5% reduction from 2005 baseline	2045 1,137k MTCO ₂ e 28% reduction from projected 2045 emissions	Upfront cost premium for electric vehicles. Ongoing fuel cost savings, as EVs are more efficient.	Increased EV adoption reduces air pollution and associated health impacts.

Action 1: Continue to develop a robust EV charging station infrastructure.

As of 2022, 62 chargers have been installed on Howard County government property, a 450% increase from the pre-2019 number of 12. When including chargers by the private sector, this total comes to 117, as indicated by the AFDC Electric Vehicle Charging Station Locations.²⁷ As of 2019, all new residential construction with driveways or garages are required to have the electric wiring to enable electric vehicle charging and new multi-family residential buildings must provide EV chargers.

This action supports even more robust expansion of charging stations in the County to encourage the adoption of electric vehicles. Modeling developed by Javid et al. 2019²⁸ shows that publicly available chargers are positively correlated with EV adoption. This model was applied to Howard County to estimate EV uptake from initiatives that increase publicly available chargers. The model considers demographics, home ownership, gas prices, electricity prices, average commute time, and the number of chargers per 10,000 residents to estimate EV uptake. Other studies also indicate that increasing the number of publicly available charging stations can lead to increases in electric vehicle adoption.^{29, 30} Publicly available chargers can include charging stations at Howard County government facilities such as parks, libraries, and offices as well as charging stations at workplaces, shopping centers, and along interstate corridors. While the modeling used for this document assumed level two charging stations with two charging ports per station, research also points to lower cost, yet also promising options, such as adding more level one charging stations and/or outdoor 120-volt outlets as workplace

charging.³¹ This slower charging option could work well for employees to plug in and charge throughout the workday and can even provide opportunities for nearby apartment or townhome dwellers to charge overnight.

Overcoming Barriers

Increasing the number of publicly available charging stations reduces “range anxiety”, a common barrier to electric vehicle adoption. Even with larger ranges in newer EV models, people feel more comfortable driving an EV if they know they have the option to charge the vehicle at multiple, convenient locations. As more people drive EVs, more charging stations will be needed to support these vehicles.

Tracking Progress

The objective of this action is to significantly increase the number of publicly accessible charging stations in Howard County. This in turn will encourage greater adoption of electric vehicles by County residents and commercial fleets.

Metric	Baseline	Goal
Number of EV Charging Stations in Howard County	117 charging stations (Countywide)	400 charging stations (2030) 2,600 charging stations (2045)

Implementation

The Office of Community Sustainability will lead on outreach, grants, and partnerships. Department of Public Works, Bureau of Facilities will lead on EV infrastructure installs. The two agencies will continue to coordinate on policy and planning. Additional planning assistance will come from the Office of Transportation, Office of Central Fleet Administration, and Department of Planning and Zoning.

Next Steps	Timeline	Responsibility
Implement programs to educate the public about home charging and public charging station information such as location, cost to charge, and how to use the stations. Leverage existing outreach materials and public charging locator mobile apps as well.	Ongoing	OCS
Evaluate the reliability of chargers installed on Howard County government property, report any reliability problems and work to get them fixed.	2023	OCS, DPW Facilities, BGE
Identify geographic areas with low charger density relative to population density and develop a plan for near-term charger deployment in those areas, including installation of charging stations on public and private property.	2023-2024	OCS, DPW Facilities, OCS
Identify barriers to installing EV charging in multi-family housing. HOAs and condos have cost barriers as well as permitting barriers. Continue to partner with BGE and support their multi-family pilot project.	2023-2025	DILP, OCS, DPZ
Prepare a short and long-term plan for charger deployment, estimating future needs. Work with state and regional planning agencies and seek funding for the next phase of chargers. State and Federal efforts currently focus more on highways and higher use roads. Local government, utilities, and the private sector can partner to address charging needs at the more local level.	2023-2024	OCS, OOT, DPW Facilities
Proactively address any power requirements for new charging stations, such as needs for new service lines from the utility or installation of transformers, to avoid any delays due to the significant lead times required to order and install this equipment.	2023-2025	DPW Facilities, BGE

Install additional chargers within the County. Support Howard County Public School System efforts to install chargers at school properties. Leverage partnerships such as the BGE EVSmart program and grants to fund new chargers, such as through MDOT, MDE, MEA and federal Inflation Reduction Act opportunities.	2023-2030	OCS, HCPSS, DPW Facilities, BGE
Work with non-government entities such as businesses and nonprofit organizations to identify appropriate charging station locations and help these entities apply for funding and rebates to subsidize the costs of new charging station installations. Also explore options for installing low-cost level one charging options where useful, such as at workplaces where employees can charge all day and nearby residents could charge at night.	2023-2030	OCS

Action 2: Accelerate the adoption of electric vehicles in the community and County government fleet.

With EVs at only 1% of vehicles registered in Howard County, there is a long way to go to achieve wide-spread EV use. This action seeks to increase the rate of EV adoption in the community and the County government fleet. Under this action, the County will pursue an accelerated schedule for replacing County vehicles with electric vehicles. Outreach programs will encourage EV adoption among the community by helping to reduce barriers to EV purchase and use.

Overcoming Barriers

Barriers to widespread adoption of EVs include their higher up-front cost, concerns about range and ability to charge easily when away from home, a lack of understanding about the benefits of EVs, and confusion about available rebates. Medium- and heavy-duty utility EVs have only recently entered the market and are not yet available for all vehicle types. Recently, there also have been challenges acquiring EVs due to supply chain issues and high demand.

Tracking Progress

Under this action, the County will pursue an accelerated schedule for replacing County vehicles with electric vehicles. Other County programs will seek to encourage additional EV adoption among the community by helping to reduce barriers to EV purchase and use. The metric is defined for passenger cars, including coupes, compacts, sedans, and station wagons. It is also defined for passenger trucks, which are light-duty trucks that include pickups, sport utility vehicles (SUVs), and vans. These vehicle types have separate metrics because of the differences in emissions and availability of EV models between the two.³²

Metric	Baseline	Goal
Number of all electric plug-in vehicles (EVs) in the government fleet	7	578 (2030) (42%) 1,336 (2045) (100%)
Percentage of EVs owned by people, businesses, and government in the County	1%	26% passenger cars, 8% passenger trucks (2030) 85.5% passenger cars, 73% passenger trucks (2045)

Implementation

The Office of Central Fleet will be the lead implementer for this action, with support from the Office of Community Sustainability.

Next Steps	Timeline	Responsibility
Promote federal, state and utility rebate programs for low/no-carbon fuel vehicle purchase by the public.	Ongoing	OCS
Implement an education and outreach program for the community about EVs, how they work, and their benefits. Conduct peer-to-peer and social marketing outreach.	2023-2025	OCS
Conduct outreach regarding installing home charging including rebates and vetted contractors if possible.	2023-2025	OCS
Seek technical assistance from Maryland Energy Administration toward development of a fleet electrification plan for Howard County government.	2023	Fleet, OCS
Make a short and long-term plan for EV fleet adoption, including funding needs to cover incremental costs of EV options over petroleum fuel vehicles. Pursue state and federal funding wherever possible and request funding in the County budget as needed to cover any gaps.	2023-2030	Fleet, OCS
Research electric and other low GHG emitting options for medium- and heavy-duty vehicles, including retrofit and add-on technology such as zero RPM battery systems to reduce engine idling in ambulances, snowplows, and other vehicles that need constant heat, air conditioning, and auxiliary power. These options can help reduce emissions from these vehicles while appropriate all electric alternatives are developed.	2025	Fleet, OCS

Action 3: Transition to a zero-emissions transit vehicle fleet.

This action will convert transit buses serving Howard County to a low/no-emission option, with a particular focus on EVs. Howard County will develop and implement a transition plan to zero emission buses. The transition plan will determine the feasibility, cost, and timeframe for a conversion of the fleet. To bridge the gap in the near term, other low-emission technologies, such as clean diesel, clean natural gas, and renewable natural gas, may be employed.

Approximately 15 bus routes operate within Howard County. Three Central Maryland Regional Transportation Agency (RTA) buses are fully electric, with plans for more in the future. As a near-term solution, Howard County also has had success in significantly reducing air pollution from transit buses through the use of clean diesel. While only moderately effective for GHG emissions reduction compared to electric buses, the clean diesel buses decrease particulate matter, NOx, and other air pollutants that impact human health, especially in underserved communities.

Overcoming Barriers

Careful planning and study of potential replacement vehicles must be conducted to ensure that they can match the endurance requirements for specific routes. Considerations also must be made to install appropriate charging and refueling infrastructure at strategic locations.

Tracking Progress

The objective of this action is to convert the Howard County RTA public transit fleet to electric buses by 2045.

Metric	Baseline	Goal
Number of EV buses, cutaways, and automobiles used for passenger services in RTA's fleet	3 (4%)	40 (48%) (2030) (FY25-FY30 plan) 82 (100%) (2045)

Implementation

The Office of Transportation will be the lead implementer for this action in conjunction with the RTA that serves as a Contractor to the County. Department of Public Works (DPW) also will assist.

Next Steps	Timeline	Responsibility
Develop a transition plan to zero emission buses. The transition plan will determine the feasibility, cost, and timeframe for a conversion of the fleet. Identify tradeoffs of several low/no emissions technologies, including renewable/biodiesel, CNG, hydrogen, and battery electric. Consider the medium term and long-term benefits of each solution and prioritize using a combination that moves towards no-emission vehicles.	2023-2025	OOT, RTA
Pursue State and Federal funding to support new transit vehicle purchases.	2024-2025	OOT, RTA
Identify and implement fast charging stations at locations along transit lines.	2025-2035	OOT, DPW
Deploy charging/fueling infrastructure at bus yards.	2025-2035	OOT, DPW
Purchase replacement transit vehicles following the transition plan.	2025-2045	OOT

Action 4: Transition to a zero-emissions school bus fleet.

Howard County Public School System (HCPSS) uses over 500 school buses to transport elementary, middle, and high school students to and from school. Replacing fossil fuel powered buses with electric buses as they reach the end of their useful life would result in significant GHG emissions reductions. Under this action, HCPSS will create and implement a plan to transition buses to electric.

Overcoming Barriers

Howard County Public School System (HCPSS) has significant obstacles to converting buses to electric since bus service is contracted out to private companies and the buses are not owned by the County. However, HCPSS is in the process of revising school bus policies and contracts and may be able to take this opportunity to push for school bus conversion. School buses usually make a minimum of 6 runs per day, two each for elementary, middle, and high school. Therefore, EV bus range and fast charging infrastructure will need to be carefully considered. Finally, electric buses currently cost significantly more than fossil fuel powered buses, and there will be costs for needed charging infrastructure as well. However, there are several federal and state grants available to assist school districts with school bus electrification that may help reduce this barrier. HCPSS will need very significant support and funding to make converting school buses to electric a reality.

Tracking Progress

The objective of this action is to reach 100% conversion to electric school buses by 2045 based on a 10-year replacement schedule.

Metric	Baseline	Goal
Number of electric school buses	2 (0.4%)	393 (73%) (2030) 535 (100%) (2045)

Implementation

Howard County Public Schools Transportation Department will be the lead implementer for this action, with support from Office of Community Sustainability. Budgets are determined by the School Board.

Nest Steps	Timeline	Responsibility
Develop a timeline for adoption of electric buses, taking into consideration that most school buses are contracted, not owned, by the school system.	2023-2024	HCPSS
Develop policies for contracting that incentivize EV adoption.	2023-2025	HCPSS, OCS
Investigate moving toward HCPSS owning and operating some portion of the bus fleet.	Ongoing	HCPSS
Request funding in the HCPSS budget and pursue grant funding and incentives for electric bus purchases.	2023-2030	HCPSS, School Board

Strategy T2: Reduce Vehicle Miles Traveled in Single Occupancy Vehicles

Howard County had the fifth highest vehicle miles traveled (VMT) in Maryland in 2019. High VMT contributes to transportation being the largest source of GHG emissions within Howard County. Opportunities to lower VMT include expanding transit options and reliability, increasing transportation connections from homes to jobs and amenities, expanding non-motorized transportation options, increasing telework opportunities, and encouraging behavior changes. Expanding transit access has the additional benefit of improving equitable access for those with few mobility options. Through this strategy, Howard County will:

- Expand transit coverage and increase the level of service across Howard County.
- Expand walking and biking infrastructure.
- Encourage alternatives to commuting and driving.
- Encourage behavior changes such as trip chaining, carpooling, and reduced idling.

Why These Actions?




Although EVs reduce emissions, they do not eliminate them. Increased use of public transportation and shifting to walking and biking will further reduce emissions from transportation. Safe, comfortable, and low-stress infrastructure is critical to encouraging more walking and biking. The pandemic has shown that teleworking is possible for many occupations. Even though telecommuters may run more errands during the day close to home than they did while commuting to the office daily, reductions in driving through teleworking can still lead to substantial net emissions benefits. Additional behavior changes, like reducing idling, carpooling, and grouping trips together can further reduce VMTs and related emissions.

Addressing Equity

Transportation disadvantaged communities should be prioritized for pedestrian infrastructure improvements. Microtransit service areas should be selected to benefit transportation disadvantaged communities wherever possible. Lastly, it is important to consider that many low-income occupations are not telework-capable, and these positions should not be disproportionately impacted by travel costs.

Howard County Leading by Example

Howard County offers free Regional Transit Agency (RTA) bus access to middle and high school and Howard Community College students. People who are age 60 or older or who have a disability can ride the bus for free. Howard County also offered free bus fares to all passengers in September and October 2022. Howard County government offers the majority of employees flexible telework options and has implemented extensive use of teleconferencing and remote work tools to reduce the need for transportation to in-person meetings.

GHG Emissions Reductions		Cost Considerations	Co-Benefits
			
2030 187k MTCO ₂ e 4% reduction from 20005 baseline	2045 254k MTCO ₂ e 6% reduction from projected 2045 emissions	<p>Upfront Costs: Infrastructure costs for microtransit and other infrastructure</p> <p>Ongoing Costs: Maintenance</p>	<p>Increased physical activity from walking and biking improves health and well- being. New transit services improve quality of life of community members by offering greater mobility.</p>

Action 1: Increase public transit ridership by enhancing the effectiveness and reliability of local and regional public transit.

Public transit can be an effective way to reduce vehicle trips. Opportunities to increase local and regional transit frequency and reliability should be evaluated and implemented where ridership has the best chance of being increased. Outreach about how to use public transit can also help to increase its use.

Overcoming Barriers

Howard County is a primarily suburban and rural county, with a few town center areas and other hubs of activity. This makes it very challenging to plan public transit routes that will serve the largest number of people in a cost-effective manner.

Tracking Progress

The objective of this action is to increase ridership on Howard County's public transit system.

Metric	Baseline	Goal
Number of local public transit trips taken each year	640,000 (demand-responsive and fixed-route)	1,000,000 (2030) 1,300,000 (2045)

Implementation

The Office of Transportation will be the lead implementer for this action in coordination with the Regional Transit Agency (RTA) and Maryland Transit Administration (MTA).

Next Steps	Timeline	Responsibility
Continue to plan and implement public transit service expansions and frequency improvements in the RTA service area and on the high priority corridors identified in the 2023 Transit Development Plan and the Regional Transit Plan, including extending Montgomery County's Flash Bus Service to Downtown Columbia	Ongoing	OOT, RTA
Increase reliability of RTA transit service	Ongoing	OOT, RTA
Work with MTA and other transit stakeholders on the MARC cornerstone plan to expand service and improve reliability on the CSX Camden Line	2023-2025	OOT, MTA

Explore creation of an autonomous Downtown Shuttle in partnership with Howard Hughes, DTC Partnership and others with funding to support such an initiative	2024-2030	OOT
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Action 2: Implement microtransit in less dense areas that have a demonstrated need of connection between homes, jobs, and services.

Microtransit is an on-demand, flexible transit mode that can provide a higher level of service than fixed route transit in certain contexts. Opportunities to apply this in Howard County should be examined. Through this action, Howard County seeks to implement a microtransit system by 2030. Microtransit enables more user-specific access and acts as a public and less expensive alternative to ride-hail services.

Overcoming Barriers

One of the biggest challenges to increasing public transit use and reducing vehicle miles traveled is what is known as the first mile/last mile problem. This refers to the distance a commuter needs to travel from a transit stop to their destination or vice versa. Transit stops typically provide transportation only to and from fixed, high traffic locations, which requires many commuters to walk a greater distance than feels comfortable to them to get to or from the transit stop. Adding enough transit stops to reduce the walk distance for most potential commuters isn't practical or affordable. Microtransit can offer these connections to scheduled transit in an affordable, flexible, on-demand manner that can meet the needs of many more potential transit riders. It also can offer more mobility options for people without personal vehicles, especially for shorter trips.

Tracking Progress

The objective of this action is to replace vehicle miles traveled (VMT) from single occupancy vehicles with on-demand, flexible microtransit. A pilot project will be implemented and assessed to determine goals and metrics.

Metric	Baseline	Goal
Microtransit ridership	0	TBD based on pilot (2030) TBD (2045)

Implementation

The Office of Transportation (OOT) will be the lead implementer for this action.

Step	Timeline	Responsibility
Research opportunities and regions within Howard County that could potentially benefit from microtransit.	2023-2025	OOT
Conduct microtransit pilot in the US Rt 1 corridor and assess ridership after one year of operation.	2024-2025	OOT
Based on results of the US Rt 1 pilot, expand microtransit service into areas with the greatest need for additional public transit options.	2025-2030	OOT

Action 3: Expand and improve sidewalks, crosswalks, pathways, and bike lanes and connect them to jobs, shopping, schools, and recreational amenities.

This action will improve and expand bike and pedestrian infrastructure to provide safe, comfortable, and effective walking and cycling options that can replace vehicle miles traveled, especially for shorter trips. This action also includes

education and outreach programs to raise awareness of existing and new sidewalks, crosswalks, pathways, and bike lanes, how to navigate them and plan trips using them, and how to use bicycles for commuting and recreational travel.

Overcoming Barriers

There currently are gaps in Howard County’s walking and cycling infrastructure network that make some trips challenging. In order to increase walking and cycling and to keep pedestrians and cyclists safe, it is important to close any gaps in the walking and cycling infrastructure network, taking equity into consideration. This can be accomplished by prioritizing projects in areas where a higher share of residents belong to racial and ethnic minorities, have lower incomes, have fewer cars per household, are disabled, have limited English proficiency, and are older. Traditionally, these communities have been left behind in the development of new pedestrian infrastructure.

Tracking Progress

The objective of this action is to reduce VMT by shifting short trips to walking, biking, and electrified micromobility modes, such as electric bicycles or scooters.

Metric	Baseline	Goal
Increase in bike lane miles	76 miles	Increase 20% by 2030 Increase 40% by 2045
Increase in sidewalk miles	1076 miles	Increase 2% by 2030 Increase 4% by 2045

Implementation

The Office of Transportation will be the lead implementer for this action. Department of Public Works (DPW), Howard County Police Department (HCPD) and Maryland Department of Transportation (MDOT), and Office of Community Sustainability (OCS) have support roles.

Next Steps	Timeline	Responsibility
Review and update existing plans to grow pedestrian/bicycle infrastructure and conduct outreach to identify new routes, improvements, and micromobility offerings.	2023-2025	OOT
Continue to integrate identified improvements into the design and construction of low stress pedestrian and bicycle infrastructure with an emphasis on the high-quality designs articulated in the County complete streets policy and design manual.	2023-2030	OOT, DPW, MDOT
Continue to advance and implement education and enforcement materials and programs to enhance and improve the safety of the transportation system for pedestrians and cyclists.	2023-2030	OOT, DPW, HCPD, MDOT
Incentivize the purchase and use of bikes, including electric bikes. Research state and federal and private funding opportunities.	2023-2025	OOT, OCS

Action 4: Increase and normalize teleworking options for employees whenever possible.

Telework reduces the number of commuters on the road, which can ease congestion and reduce overall VMT. For example, 950 Howard County government employees teleworking 77 working days during the first three months of the COVID-19 pandemic travelled 2 million fewer miles, saved 95,850 gallons of gasoline, and reduced GHG emissions by 852 metric tons CO_{2e}. Teleworking can have other benefits as well. According to the International Telework Association and Council, teleworking can increase employee productivity more than 20% and decreases employee absenteeism 60%.

Information from the Maryland Department of Labor and from the U.S. Census Bureau’s Longitudinal Employer-Household Dynamics indicate that more than half of the jobs in Howard County could be telework capable. However, only just over 20% of workers in Howard County currently work from home at least one day per week. This action will encourage the implementation and/or continuation of full or hybrid telework environments for all occupations that can support telework.

Overcoming Barriers

Not all jobs are work-from-home capable. Implementation of this action should be sensitive to the impact on jobs that do not allow for telework. While research³³ has shown that employees who telework tend to drive more miles for non-work-related purposes during telework days than during commute days, the increase in VMT from telework is minor in comparison to the VMT reductions achieved from even two or three days a week of telework for most or all telework capable jobs.

Tracking Progress

The objective of this action is to reduce VMT by eliminating commute trips.

Metric	Baseline	Goal
Number of employees Countywide who work from home at least one day per week and percentage of total workforce.	38,000 (23%)	70,800 (40%) (2030)
		105,000 (52%) (2045)
Avoided commuter trips in miles, assuming 3 days worked from home per week	143.2 million mi	266.7 million mi (2030)
		395.6 million mi (2045)

Implementation

Howard County Administration (County Admin) will be the lead implementer for this action, with support from Human Resources (HR), Economic Development Authority (EDA), Office of Transportation (OOT) and Office of Community Sustainability (OCS).

Next Steps	Timeline	Responsibility
Support telework adoption by providing guidance and carbon emissions impact to employers. Guidance can include draft telework policies, case studies of effective programs, and networking opportunities among human resources personnel to facilitate sharing of best practices.	2023-2024	County Admin, HR, EDA
Connect businesses in Howard County with existing federal and state grant opportunities to purchase equipment, software, and access technical assistance and other resources to initiate or expand telework programs.	2023-onward	OCS, EDA
Consider new tax incentives, grants, and/or recognition programs for local employers with workers that offer a hybrid work schedule and report to the County on person days of telework and/or avoided commuter miles.	2025	EDA, OOT, OCS

Action 5: Implement policies, outreach programs, and incentives to promote individual behavior changes to reduce emissions from personal vehicles.

Individual behavior change can be difficult, but since transportation is the largest source of GHG emissions in Howard County, we must use all the options available to us to reduce vehicle miles traveled. Behavior changes such as trip chaining, carpooling, and reducing idling are very low-cost ways to reduce VMT and to reduce costs for individual drivers.

Overcoming Barriers

Many drivers may be unaware of how much gasoline they can waste idling or through poor trip planning. Howard County can address this lack of awareness through public outreach efforts. In addition, there are tools to assist with trip planning to optimize routes and optimize fuel efficiency. Such information often is readily available through popular mapping apps. While finding people to carpool with can be a challenge for individual drivers, there are regional programs that pair commuters with others going to and from the same places. Howard County’s outreach efforts can help drive additional participation in these carpool matching programs.

Tracking Progress

The objective of this action is to increase positive driver behaviors that reduce VMT and GHG emissions. Progress will be tracked through the number of people reached through webpages, social media posts, newsletter opens, webinar attendance, and other outreach methods.

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from the Office of Transportation (OOT), Department of Public Works (DPW) and Howard County Public School System.

Next Steps	Timeline	Responsibility
Work with schools to increase the ability to walk and bike to school and reduce the number of parents driving students to school. Increase infrastructure such as paths and bike racks.	2023-2025	HCPSS, OOT, DPW
Conduct outreach campaigns to encourage behavior changes like trip chaining, carpooling, and reduced idling.	2023-2025	OCS, OOT
Research coordinated carpooling options and rides home from work programs and increase awareness about them. Promote existing apps and tools to connect carpool partners and/or research options for developing new tools as needed.	2023-2025	OCS, OOT

Waste

Strategy W1: Reduce Organic Waste Sent to Landfills and Manage Landfill Methane

Organic waste in landfills is a significant source of methane generation and subsequent emissions. Diversion techniques such as composting organic waste can reduce methane generation. Ensuring that methane generated in landfills is captured and managed using best practices is also very important.

Methane has more than 25 times the global warming potential of carbon dioxide. Therefore, it is critical to reduce methane emissions wherever possible. A Howard County study showed that organic waste makes up 30 percent of the local municipal solid waste stream. Diversion techniques such as composting organic waste can reduce methane generation in landfills. Howard County only has one active landfill, so most of its municipal solid waste is sent out of County. Although many GHG emissions inventories would not count emissions generated outside of the jurisdiction, Howard County did include all landfill emissions in our inventory, including those generated from out of County landfills that accept Howard County waste. Through implementing this strategy, Howard County will:

- Expand composting programs for the residential sector and increase participation where the Feed the Green Bin program already exists.

- Increase composting by schools and other public sources of organic waste and decrease the amount of food waste created.
- Increase knowledge and use of home composting through outreach and working with community partners.
- Promote existing commercial composting options and investigate the long-term capacity needed to compost organic matter from private companies.
- Ensure that Howard County’s Alpha Ridge Landfill and closed landfills meet or exceed the state and federal methane requirements.

Why These Actions?




Efforts to reduce the generation and disposal of organic wastes, such as food waste and yard waste, reduces methane generation. Further, composting local waste creates a circular economy – repurposing organic waste into useful products such as high-quality compost and soil amendments. Howard County has a composting facility at its Alpha Ridge Landfill. In 2019, more than 8,000 tons of organic waste was picked up from Howard County residents through curbside service and composted at this facility, reducing emissions by more than 4,000 metric tons of carbon dioxide equivalent (MTCO₂e) Ensuring that methane generated in landfills is captured and managed using best practices is also very important, as this minimizes the amount of methane gases escaping into the atmosphere from landfills.

Addressing Equity

Not all residents currently have access to composting, although the highest-density neighborhoods were chosen first to participate in residential curbside composting collection. Expansion of the Feed the Green Bin program will allow more residents to have easy access to more composting options. Multi-family homes do not currently have the same composting options as single-family homes. New waste reduction efforts need to be applied more equitably to all residents.

Howard County Leading by Example

Howard County currently has a yard trim collection composting program that serves half of the homes in the County and focuses on food and yard waste. The “Feed the Green Bin” program expands on the yard trim collection by providing optional bins to add food waste collection. Feed the Green Bin is available to 35,653 homes—53% of the County’s households with County service for yard trim collections. Alpha Ridge Landfill has a very high-tech and effective composting operation that produces high-quality products and has received certification of the U.S. Composting Council’s “Seal of Testing Assurance.” Howard County has a Feed the Green Bin website, a home composting education program, and gives out free home compost bins every year.

GHG Emissions Reductions		Cost Considerations	Co-Benefits
			
2030 1.0k MTCO ₂ e <1% reduction from 2005 baseline	2045 4.2kMTCO ₂ e <1% reduction from projected 2045 emissions	<p>Upfront Costs: Bin infrastructure, potential expansion of composting facility</p> <p>Ongoing Costs: Waste collection, additional processing time</p>	<p>Produces a beneficial soil amendment that can reduce fertilizer application.</p>

Action 1: Reduce organic waste and expand composting in the residential sector.

Howard County has a yard trim collection for most homes and an innovative Feed the Green Bin food waste collection program. This action will increase residential organic waste diversion by expanding residential access to the Feed the Green Bin program, increasing participation within existing collection areas, and promoting home composting and waste reduction.

Overcoming Barriers

Cost and composting facility capacity are barriers that currently prevent Howard County from offering the Feed the Green Bin curbside food waste collection program to all households. Howard County is working to expand capacity in order to offer curbside food waste collection to more households in the future. In the meantime, Howard County can increase participation in existing service areas through education and outreach activities. Some residences may be too remote for efficient pickup and these properties may be better suited for increased outreach and participation in home composting. Outreach programs can help individuals who are unsure about how to start home composting.

Tracking Progress

The objective of this action is to increase participation in curbside food waste collection and to maximize diversion of food and other organic waste from landfills.

Metric	Baseline	Goal
Households with access to the Feed the Green Bin program	35,653 (53%)	66,916 100% of County collection areas by 2030
Percentage eligible households participating in the Green Bin program (based on number of carts requested by households)	17,234 (48%)	75% participation of eligible households by 2030 90% participation of eligible households by 2045
Tons of food composted in the Feed the Green Bin program	660 tons (per year)	1,000 (2030) 2,600 (2045)
Residential yard trim composted	10,000 tons (per year)	Move towards more source reduction, less composting

Implementation

The Department of Public Works, Bureau of Environmental Services (BES) will be the lead implementer for this action.

Next Steps	Timeline	Responsibility
Increase education and outreach on reducing food waste, mulching leaves and grass on-site, and other methods of reducing the amount of organic waste created.	2023-2025	BES, OCS
Expand "Feed the Green Bin" service area to collect food waste from all residential areas that have yard trim collection.	Ongoing, expected completion 2026	BES
Investigate increased access by multi-family residences to composting pickup services. These homes are currently considered commercial and are not part of the County's waste collection service.	Ongoing	BES
Increase education and outreach on composting including in multiple languages.	Ongoing	BES

Consider adding drop-off areas for residents outside of pick-up areas so they can participate. Residents can already bring organic materials to Alpha Ridge Landfill at no cost, but some residents may consider it too far from their home.	Ongoing, needs resources	BES
Continue to partner with local non-profit organizations and neighborhoods to increase participation in the Feed the Green Bin program and home composting.	Ongoing	BES
Continue educating the public on Food Waste Prevention. Increase awareness of the Food Waste Prevention website's resources such as food rescue apps, grocery planning, storage tips, and food donation. Consider adding more food waste challenges and other similar programs.	Ongoing	BES

Action 2: Incentivize businesses and schools to reduce organic waste and participate in composting.

Food waste can be a large portion of the waste stream for businesses and schools. This action encourages more local businesses and schools to reduce the creation of organic waste and increase composting. Currently seven schools in Howard County participate in the Feed the Green Bin program and Howard County has an online signup schools can use to be considered for the program. Some businesses and communities have had success with food donation and improving operations to avoid food waste. Howard County can build on these successes through education and outreach efforts, expanding composting services, and developing partnerships among businesses, schools, farms, and other key players in composting operations.

Overcoming Barriers

The main barriers to commercial composting are the lack of businesses accepting and processing these materials and the cost. The County's planned improvements to its composting facility will help increase capacity to manage organic waste in-County. Howard County's Feed the Green Bin website lists private companies that offer commercial composting. However, there is not currently enough capacity at this time to handle all the organic waste created. Howard County has a privately-owned biodigester that effectively manages commercial organic waste and creates marketable products. More local partnerships for the source material and end users of the products could make this a very viable option for increasing Howard County's organic waste recycling capacity. Composting efforts at schools and businesses are limited by cost, access to collection and training, and resistance to changing existing waste management practices. Increasing outreach and education to schools in particular and making it as easy as possible to join in can improve participation. While composting is very beneficial, more emphasis is needed on reducing waste before it becomes waste that needs to be managed.

Tracking Progress

The objective of this action is to increase the number of businesses and schools that participate in composting and food waste reduction programs.

Metric	Baseline	Goal
Schools participating in composting programs	7	30 (40% by 2030) All (2045)
School organic waste composted	36 tons per year	1080 (2030) 2880 (2045)

Number of commercial composting operations	1	2 (2030) 10 (2045)
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Implementation

The Department of Department of Public Works, Bureau of Environmental Services will be the lead implementer for this action.

Next Steps	Timeline	Responsibility
Consider adding a composting certification category to the Work Green Howard program.	2024	BES
Investigate commercial composting by private businesses to find opportunities for the County to promote them and to help them expand.	Ongoing	EDA, BES, DPZ
Explore partnerships with farms to expand composting capacity for certain waste streams (e.g., wood debris from emergency weather events).	2023-2025	EDA, DPZ
Increase outreach to schools about the Green Bin program, encouraging them to sign up and participate.	2023-2025	BES, OCS

Action 3: Ensure that Howard County’s Alpha Ridge Landfill and closed landfills meet or exceed the state and federal methane requirements.

This action reinforces that Howard County will continue to meet or exceed the state and federal landfill gas requirements. Howard County will also pursue innovative methane reduction technologies for landfills such as biofilters.

The state of Maryland is fairly aggressive in the proposal of new regulations to control methane from municipal solid waste landfills. As of February 2023, new regulations have been proposed and are receiving public comments. Howard County’s Bureau of Environmental Services is following it closely.

Overcoming Barriers

Innovation can be a challenge in this very regulated area. In order to use new technologies, it must be approved by the State. Howard County will continue to pursue the latest technology in landfill gas management. Staff time and financial resources are needed to achieve these objectives.

Tracking Progress

Howard County is currently upgrading its enclosed landfill gas flare. The County monitors landfill gas, performs emissions testing, and submits compliance reports.

Implementation

The Department of Department of Public Works, Bureau of Environmental Services (BES) will be the lead implementer for this action.

Next Steps	Timeline	Responsibility
DPW-BES proposed an innovative treatment for landfill gas at New Cut Landfill to MDE in 2022 and received positive response from MDE. The landfill gas would be routed to a biofilter for treatment rather than the flare, which is currently more than 20 years old and operating on a timer. Construction of this treatment system could be done at relatively low cost and serve as model for other closed and small landfills in MD.	2023-2025	BES
Ensure that the methane collection system at Alpha Ridge Landfill meets or exceeds state laws and regulations.	Ongoing	BES

Strategy W2: Expand the Use of Sustainable Materials and Reduce Waste Generation and Disposal

This strategy focuses on identifying opportunities to reduce non-organic waste from Howard County sent to landfills. Adoption of sustainable government procurement practices can help Howard County government lead the way for the community to similarly identify opportunities to reduce waste.

Why These Actions?

Although difficult to quantify in a local GHG inventory, national and global GHG accounting shows that the amount of waste created per capita in the US contributes significantly to overall GHG emissions. Reducing waste at the source is the most cost efficient and impactful step we can take to reduce emissions from non-organic waste. In addition, this strategy focuses on reducing consumption of waste-heavy products like single-use plastics that generate GHG emissions in their production, transportation, and disposal.

Howard County excels in many environmental areas, as demonstrated by receiving LEED Platinum in 2022 in the LEED for Cities and Communities program. However, during the LEED certification process, gaps were also uncovered. The amount of waste generated per capita is high. (The other gaps revolved around transportation, another hugely important aspect of climate action).

Addressing Equity

Waste reduction efforts need to consider that alternatives to disposal products often have a higher upfront cost than their disposable counterparts. Howard County can address equity in this strategy by ensuring opportunities for people with lower incomes to obtain reusable alternatives at low or no cost. Limiting the use of plastic bags, cups, bottles, and other disposable products also helps reduce litter that often disproportionately impacts underserved communities. In addition to reducing these waste products at the source, Howard County also can sponsor cleanups in underserved communities.

Howard County Leading by Example

Howard County has implemented a plastic bag fee and a plastic reduction law that dis-incentivize using single-use plastic. Howard County also created the Plastic Reduction and Environmental Protection grant program that funds source reduction projects and education.

Action 1: Improve sustainable procurement in government operations.

This action will establish or expand the County government environmental procurement policy to encourage the purchase of sustainable materials and products and to minimize waste. Howard County should also consider life-cycle analysis and long-term benefits when evaluating procurements.

Overcoming Barriers

Government procurement is understandably risk-averse, so it can be difficult to change practices. Procurement may be an area of Howard County government that has not traditionally been included in sustainability discussions, but this needs to change. There also can be health concerns when hosting large public events outdoors on hot days without providing sources of water, which typically have been bottled water in the past due to lack of infrastructure such as water bottle filling stations.

Tracking Progress

The objective of this action is to reduce waste through County procurement policies. Howard County government has regulations about recycled content purchasing and environmentally preferable purchasing (EPP) but does not have formal, county-wide procurement policies that address waste reduction. The new goal should be to Implement waste reduction focused procurement policies for County construction activities, government events, and other purchases by 2025 as outlined in the Next Steps.

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer, coordinating closely with the Office of Procurement & Contract Administration (Procurement) and the Department of Public Works (DPW).

Next Steps	Timeline	Responsibility
Evaluate the procurement rules for construction to require construction waste recycling and reuse. This is currently done for LEED projects, but not others.	2023-2025	DPW, Procurement OCS
Evaluate construction rules and policies to allow greater re-use of construction waste such as asphalt and concrete.	2023	DPW, OCS
Research recognized procurement standards such as Forest Stewardship Council, GreenSeal, and Terracycle and adopt those that reduce waste.	2023-2024	Procurement, OCS
Have all departments use fewer single-use plastics in give-away items, plastic food ware, and plastic water bottles. Take a hard look at whether the expense and environmental cost are worth the disposable items commonly distributed.	2023-2024	Howard County Admin, Procurement
Invest in infrastructure to support the reduction of single-use plastic such as the installation of water bottle refilling stations.	Ongoing	DPW, DRP, HCPSS

Action 2: Reduce the use of single-use items, particularly plastics and promote waste reduction and reuse throughout Howard County.

Community outreach should increase focus on waste reduction, repair, and buying less. Howard County agencies should evaluate their operations looking for waste reduction possibilities and engage local partners to amplify waste reduction efforts and messaging. Howard County should seek to be a model in reducing waste, starting with events such as GreenFest.

Overcoming Barriers

Behavior change away from hyper-convenient, single-use products is a difficult challenge, but there is a large potential for improvement.

Tracking Progress

The objective of this action is to reduce single-use plastics through outreach and partnerships that compliment and amplify Howard County’s enforcement of current laws. Howard County will continue to leverage and track progress made through the Disposable Plastic Bag fee initiatives.

Implementation

The Bureau of Environmental Services has an extensive outreach program for recycling. They can leverage these efforts to increase emphasis on waste reduction. All agencies should evaluate their operations looking for waste reduction possibilities. Howard County should engage local partners to amplify waste reduction efforts and messaging.

Next Steps	Timeline	Responsibility
Continue to implement and track source reduction practices as outlined in the Maryland municipal solid waste and recycling program.	Ongoing	BES
Continue to invest in infrastructure to support the reduction of single-use plastic such as the installation of water bottle refilling stations.	2023-2025	DRP, DPW, HCPSS
Increase education and outreach on reducing waste and its economic and climate action benefits.	2023-2025	BES, OCS
Support community partners such as the Community Ecology Institute, Repair Café, HC Library DIY center, Upcycled, and others that promote re-use.	Ongoing	OCS, BES

Nature Based

Strategy N1: Support Nature Based Climate Solutions to Improve Soil Health, Increase Carbon Sequestration, and Reduce Emissions

Conservation-focused practices that improve soil health reduce emissions to the atmosphere and increase carbon sequestration by minimizing soil disturbance while maximizing soil cover, biodiversity, and the presence of living roots. By focusing on soil health as a climate solution, we also gain co-benefits such as reduced soil erosion, improved water infiltration, increased nutrient cycling, decreased money spent on inputs like fertilizer, and more resilient soils over time.

Why These Actions?

Healthy soils sequester and retain greenhouse gases. Improving soil health also has many co-benefits.

Addressing Equity

Healthy, diverse ecosystems can improve climate resiliency across the community. Reduced mowing will lead to reduced noise pollution and improved air quality. Air pollution is often concentrated in underserved communities.

Howard County Leading by Example

Howard County has programs that address soil conservation, no-mow areas, meadows, and replacing turf with native plants and trees. These can be leveraged and expanded to have more climate action impact.

GHG Impacts

Achieving Howard County’s GHG emissions reduction goals will require both reducing GHG emissions and sequestering more carbon. This strategy has components that do both. The actions under this strategy also have several economic and health co-benefits which should also be considered.

Action 1: Incentivize adoption of Natural Resources Conservation Service (NRCS) conservation practices that reduce GHG’s and sequester carbon

Howard County provides agricultural technical assistance as well as cost sharing assistance from federal, state, and local sources for conservation practices. Under this action, the County will increase outreach and technical and financial assistance to farmers about practices that reduce soil erosion and create healthy soil.

Overcoming Barriers

Potential barriers to this action may include a lack of awareness about these conservation practices, a need for additional technical assistance, or a lack of funds to implement them.

Tracking Progress

As we begin to implement this strategy, we will gather baseline information and begin tracking metrics. We will track carbon sequestration from NRCS conservation practices, and we will work with the relevant County Departments to track the number of farms participating in incentive and financing options, Howard Soil Conservation District (HSCD) grants, and implementing agroforestry practices.

Implementation

Howard Soil Conservation District (HSCD) will be the lead implementer with outreach assistance from the Office of Community Sustainability (OCS), Department of Planning and Zoning (DPZ), and Department of Recreation and Parks (DRP).

Next Steps	Timeline	Responsibility
Utilize COMET-Planner to determine baseline carbon sequestration numbers and develop new incentive programs, or reevaluate existing incentives, to increase conservation practices.	2023- 2025	HSCD, OCS
Work with the relevant County Departments to get baseline number of farms participating in incentive and financing options, HSCD grants, and implementing agroforestry practices	2023-2025	OCS, HSCD, DPZ
Support grants to emphasize healthy soils practices implemented by farmers.	2023-2025	HSCD
Continue to work with farmers on healthy soils practices and implementing innovative solutions while promoting the financial, social, and environmental benefits of healthy soils.	2023-2025	HSCD
Work with farmers to better utilize and identify existing incentive programs and financing options.	2023-2025	HSCD
Research Climate Smart Agriculture to determine which practices can be better incorporated locally and pursue associated U.S. Department of Agriculture and associated financial incentives where appropriate.	2023-2025	HSCD, OCS
Research programs for farmers to sell carbon credits for best management practices.	2024-2026	HSCD, OCS

Work with farmers on implementing agroforestry practices such as silvopasture, riparian buffers, alley cropping, and windbreaks to increase tree plantings and forest cover. Develop educational materials for related best practices.	2023-2025	HSCD, DPZ, OCS
Consider utilizing DRP leased properties to serve as pilots for best management practices.	2023-2025	DRP

Action 2: Improve soil health on private lands through outreach and program expansion.

Native and deep-rooted plants sequester carbon and decompact soil to increase water infiltration and retention. Native plants are more adaptable to local weather patterns without additional water or fertilizer and they provide habitat. This action will encourage improving soil health through planting native plants and increasing sustainable landscaping practices on private lands.

Overcoming Barriers

Barriers to this action may include a lack of public awareness about the benefits of native plants and sustainable landscaping, stigmas for untidy looking landscapes based on social norms around mowed lawns, regulations and policies at the County and homeowner association level that discourage these practices, and lack of funds for implementation and maintenance of these practices.

Tracking Progress

As we implement this strategy, we will continue to track habitat registered through the Howard County Bee City Pollinator Habitat Registration as well as water quality practices installed that improve soil health.

Implementation

The Office of Community Sustainability (OCS) will lead the private property stormwater items and the Department of Planning and Zoning will lead on the Landscape Manual and Green Neighborhoods. The Department of Recreation and Parks (DRP) and Department of Public Works (DPW) are included for technical guidance and outreach assistance.

Next Steps	Timeline	Responsibility
Update the Howard County Landscape Manual to prioritize or mandate native plants and eliminate invasive plant species.	2023-2025	DPZ, OCS, DRP
Increase funding and staffing for private property stormwater programs to expand the installation of natural stormwater features on residential, commercial, and nonprofit properties that provide native habitats, soil retention, stormwater infiltration, and carbon sequestration.	2023-2025	OCS, DPW
Increase outreach to raise awareness about the private property stormwater programs and their reimbursement incentives, especially to low-income residents, and sites in vulnerable watersheds and underserved communities.	2023-2025	OCS, DPW
Reevaluate the Green Neighborhoods program to develop new incentives, reassess program potential and accessibility, and renew support. Or consider other programs to incentivize environmentally friendly, sustainable development.	2023-2025	DPZ, OCS

Establish a County-wide outreach campaign to educate the public about the value of soil health, native plants, no-mow areas, meadows, pollinator-friendly yards, using lawn mimics instead of traditional lawns, reduced chemical applications, and sustainable landscaping practices. Continue recognizing pollinator-friendly yards through the Bee City Campaign.	2023-2025	OCS, DRP
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Action 3: Increase sustainable landscaping practices on public lands to improve soil health and reduce GHG emissions.

This action will encourage improving soil health through increased use of native plants and other sustainable landscaping practices on public lands. Additionally, reduced mowing on County land can reduce GHG emissions from lawn maintenance equipment. Howard County government should lead by example in their landscape practices, pilot new methods, and provide education to the public to implement them as well. Traditional landscaping equipment emits many GHGs. Reducing gas-powered equipment use, either through increased native plant gardens or meadow areas, low-mow areas, or shifting to electric equipment will not only aid in improving air quality, but also reduce noise and water pollution, and increase habitat and soil health. Additionally, conversion of turf grass to native plants through reduced mowing provides the co-benefits of increased carbon sequestration in the soil and reduced stormwater runoff.

Overcoming Barriers

Electric landscaping equipment has a high startup cost so determining the return on investment (ROI) will be important. Education, outreach, and demonstration areas can help overcome any community concerns associated with transitioning from traditional landscaping to sustainable landscaping practices.

Tracking Progress

As we implement this strategy, we will track acres of turf converted to low-mow or native plantings, amount of gas-powered equipment converted to electric, as well as all associated GHG emissions reductions.

Implementation

The Department of Recreation and Parks (DRP) will be the lead implementer in collaboration with the Office of Community Sustainability (OCS), Department of Public Works -Highpage 81ways (DPW), and the Howard County Public School System (HCPSS).

Next Steps	Timeline	Responsibility
Identify parks and other public open space that could be converted to low-and no-mow areas. Consider incorporating compost as a soil amendment (suburban subsoiling) in these areas to increase infiltration through decompaction and encourage deep-rooted plant growth for carbon sequestration and soil retention. Plan for management of invasives in these areas. Hire new staff and increase funding where necessary.	2023-2024	DRP, OCS
Establish a County-wide outreach campaign to raise awareness, acceptance, and appreciation for the value of soil health, native plants, reduced mow areas, and meadows. Consider partnering with Howard County Bee City on these efforts.	2023-2025	OCS, DRP, HCPSS
Coordinate with HCPSS to expand existing no-mow efforts and incorporate compost soil amendments (suburban subsoiling) and deep-rooted plants requiring minimal mowing into field spaces or little used turf areas.	2024	HCPSS, OCS

Continue to reduce chemical fertilizer and pesticide applications on County property, while also educating private property owners about the benefits of sustainable landscape maintenance.	2023-2025	DRP, OCS, DPW Highways, HCPSS
Pilot an electric landscaping equipment conversion program to begin phasing out gas-powered equipment where possible.	2023-2024	OCS, DRP
Continue to seek innovative nature-based climate solution methods and opportunities to lead by example in improving soil health and GHG emission reductions on County land.	Ongoing	OCS, HCPSS
Determine baseline GHG emissions from mowing County land and set reduction goals.	2023-2025	DRP, OCS, DPW Highways, HCPSS

Strategy N2: Conserve Existing Forests and Expand the Tree Canopy

Healthy forests hold significant potential for carbon sequestration. Trees outside of forests sequester carbon as well, but less so than those within forests. Planting and maintaining native tree species also preserves biodiversity and improves climate resiliency. This strategy builds on the County’s ongoing work to increase tree cover and sequester carbon by identifying priority areas for forest conservation and new tree planting.

Why These Actions?

Forests and their soils, as well as trees outside of forests, are Howard County’s most obvious carbon stocks. As we strive to reach net zero emissions, increasing or at least maintaining the carbon stocks in our forest and canopy resources will be essential for offsetting emission sources difficult to eliminate entirely. Most trees in Howard County’s largest forests are of a prime age for sequestering carbon and will be for decades to come. Still, as old trees die naturally or succumb to vines, insects, clearing, or changes in climate, new forests will need to take their place to maintain Howard County’s carbon stocks and sequestration potential. To that end, existing forests will need to be managed to ensure regeneration, and new forest will need to be planned and protected into the future.

Addressing Equity

Tree canopy is especially critical in areas where populations are most vulnerable to heat waves and high temperatures, which tend to include people with lower incomes, people of color, people with disabilities and people who are 65 and older. Tree planting in underserved areas provides co-benefits such as reducing heat island impacts, storing carbon, and providing habitat for wildlife.

Howard County Leading by Example

Howard County has already begun work on preserving and growing forest and tree canopy. The updated Forest Conservation Act increased replanting requirements for tree clearing, strengthened protections for “champion” and “specimen” trees, and increased the required maintenance period for Forest Conservation Easements. Howard County manages and promotes a variety of tree planting initiatives and protects existing forests through deer management and invasive species management where possible.

GHG Impacts

Forests and urban trees sequester carbon from the atmosphere, while the conversion of forests to other land uses results in a net carbon release. Initial investigations begun by the Office of Community Sustainability in 2022 suggest that the County’s forested lands and tree canopy offset roughly 7% of all County emissions in 2019, at an estimated net 252,960 MTCO₂e (metric tons of carbon dioxide equivalent) removed from the atmosphere per year. This number was generated using the International Council for Local Environmental Initiatives’ Land Emissions and Removals Navigator, or “LEARN

Tool,” an online application designed to help local governments quantify the carbon stocks of their forests and trees outside of forests. Changes from forest to other land use, and other canopy loss emitted an estimated 26,263 MTCO_{2e}, which was accounted for and subtracted from a larger carbon sequestration estimate, to provide the net 252,960 MTCO_{2e} figure. While the estimate provided with this tool notes that the MTCO_{2e} values may be up to 45% greater or less in reality than indicated through the model, the model can reliably indicate the directionality of sequestration over time; that is, whether the forested and treed parts of the landscape are increasing or decreasing their carbon stocks and sequestration ability.

Action 1: Protect and restore forest and non-forest tree canopy

This action seeks to protect and conserve existing forests and trees, restore degraded forests, and increase the planting of native trees throughout the County on public and private lands. This will increase carbon sequestration and offer many resiliency co-benefits.

Overcoming Barriers

The County government owns a small portion of Howard County land and therefore significant planting on private property will need to occur to achieve and maintain forest and tree canopy goals, as well as GHG emissions reduction goals. The County will need to attract more willing landowners to preserve and plant forest acreage. Additional staff, equipment, and funding is needed to maintain current forest and canopy resources, and funding for long term management needs to be in place when planning new planting projects. Invasive species, particularly vines, pose a threat to maintaining tree canopy, and the overpopulation of white-tailed deer has minimized natural forest regeneration across the County.

Tracking Progress

Metric	Baseline	Goal
MTCO _{2e} removed by forests and trees outside of forests	252,960 (7% of 2019 combined emissions from all sectors offset)	275,000 (7.3% offset of 2019 emissions) 300,000 (8% offset of 2019 emissions) (2045)
Achieve and sustain 50% tree canopy.	49.1 % (2018)	49.5% (2030) 50% (2045)

Implementation

The Department of Recreation and Parks will be the lead implementer for this action, with support from the Office of Community Sustainability, the Department of Planning and Zoning, and the Department of Public Works.

Next Steps	Timeline	Responsibility
Expand tree planting efforts across land uses, both public and private.	Ongoing	DRP, OCS
Evaluate the effects of recent updates to the County and State Forest Conservation Acts and consider updates to the County Forest Conservation Act and Forest Conservation Manual to address any gaps in tree protection during the development process.	2023-2030	DPZ, DRP, OCS
Expand existing invasive species management programs with a focus on forest canopy preservation. Plan for maintenance and long-term management in budgets and with each tree planting in the future.	2023	DRP, OCS

Evaluate new methods of reducing the deer population to allow for forest regeneration.	2024	DRP, OCS
Account for CO2 sequestration in County forests and tree canopy, as well as emissions from forest and canopy losses. Update the inventory as new land cover maps and CO2 accounting tools are made available.	Ongoing	OCS

Resiliency Strategies

Strategy R1: Become a model for excellent communication, education, and outreach about climate hazards, emergency preparedness, and available resources

Risks and impacts of climate hazards can be reduced if the public is well informed of resources and best practices in managing risks and impacts. Howard County already facilitates conversations and disseminates information on emergency preparedness via departments working within emergency management, public health, and citizen services departments. Going forward, Howard County will take communication, outreach, and education to the next level, ensuring highly accessible and relevant information is disseminated in the most effective means possible, and that all residents, businesses, and County employees are aware of how to prepare, what resources are available to them and where to go for more information. Howard County will provide a cohesive and prioritized suite of communication, education, and outreach resources to the public to become a model in the climate resilience communications space.

Why These Actions?

These actions were chosen to increase communication around climate preparedness, emergency management, and other related information. While there is a lot of information available to residents, Howard County can work more on making sure that this information reaches everyone in an effective and equitable way. The following actions will increase the effectiveness of distributing information and making sure the information is available in many formats. Howard County will work on consolidating climate information for residents. Additionally, Howard County will improve outreach and communications to the County's diverse community. The 2022 Climate Change Emergency Preparedness Survey informed these actions.

Addressing Equity

Increasing and improving communication, outreach, and education to all Howard County residents will ensure that underserved communities have access to critical emergency preparedness information. Incorporating new outreach techniques and tools will help the County reach underserved communities with this information.

Howard County Leading by Example

Howard County has one of the highest COVID-19 vaccination rates in the country. Its Health Department's robust outreach plan reached underserved populations through mobile vaccine clinics and COVID-19 testing sites. Department of Fire and Rescue Services, Mobile Integrated Community Health team, Howard County Health Department, and other departments who assisted in this effort made vaccines and testing accessible for seniors, individuals with Disabilities/Access and Functional Needs (D/AFN), and those who may not have the access or resources to get vaccinated/tested at traditional sites. Many lessons were learned about reaching new populations and this knowledge can be used to enhance climate resiliency outreach efforts.

Action 1A: Create a one stop shop for all resources and services relating to climate hazards

Consolidate all relevant emergency management, public health, and state and local resources related to preparing for and dealing with climate-related and non-climate related emergencies to one single online portal and physical document. Simplify the most important information for the front pages of the online portal and add links that redirect residents to Howard County resources. Explore options in communicating information through an easy-to-remember phone number such as the 211 Maryland United Way Helpline. Increasing public and employee awareness of resources and services and where to go to find this information and ensuring information is easily accessible.

Overcoming Barriers

This action was chosen because information regarding how to prepare for and deal with climate hazards are distributed in multiple online webpages, making it difficult for users to find relevant information quickly and efficiently. Creating one place for all relevant state and local resources can decrease the amount of time spent looking for this information and makes it more likely the information will be available when needed.

Implementation

The Office of Emergency Management (OEM) and Office of Community Sustainability (OCS) will be the lead implementers for this action, with support from The Office of Public Information (PIO) and Department of Technology and Communication Services (DTCS).

Next Steps	Timeframe	Responsibility
Collaborate with relevant departments to collect all information regarding climate hazards, other non-climate emergencies, and climate action.	2024-ongoing	OEM, OCS
Create an organized webpage and document to store relevant information. This webpage should contain relevant information in multiple languages, and it should be made accessible for individuals with disabilities.	2024-ongoing	OEM, OCS, DTCS, PIO
Create summary page with the most critical information using information provided by OEM and OCS. Other pages can include events, weather tracking, plans, and resources on preparation and resiliency.	2024-ongoing	OEM, OCS, DTCS, PIO
Explore whether this information can be incorporated into an existing number like 211. Create an easy-to-remember and easy-to-use local phone number for residents to call to get the most critical information.	2024-ongoing	OEM, DTCS, PIO
Provide public-facing employees with informational guides on how to help residents find critical information. Train all public-facing employees on how to access the webpage, summary page, and phone number.	2023-ongoing	All applicable departments in Howard County
Conduct a user-study to determine if “one-stop-shop” webpage and phone number is easy to use and findable and improve as needed.	2024-2025	DQRS, PIO, DTCS
Develop promotional material, taglines or graphics for all County communications and websites, etc. to help get the word out about it, outreach to news organizations to get their help getting the word out, etc.	2023-ongoing	PIO, OEM
Continue to collaborate with departments and update webpage with relevant information.	Ongoing	OEM, OCS, PIO, DTCS, All applicable Howard County departments

Action 1B: Improve existing communication, education, and outreach methods and research best practices to reach communities.

Howard County departments that interface with the public use a variety of communication, education, and outreach methods. Internal stakeholders should collaborate with other departments to identify and bolster methods that are successful and identify methods that can be improved. Stakeholders should incorporate new or improved communication, education, and outreach practices into messaging specific to emergency preparedness, climate resiliency, and other climate-related information. Additionally, the County should work with non-profits, community

organizations, and other partners to build trustworthy relationships with different communities where additional or unique outreach approaches need to be considered.

Overcoming Barriers

Despite Howard County already having communication, education, and outreach methods used to reach the public, the 2022 Climate Change Emergency Preparedness Survey shows that there are some gaps in communication regarding how well the community feels they are prepared for disasters and where they can find information related to emergency preparedness. Additionally, results show that many Howard County residents are not aware of disaster/emergency preparedness resources and services that may be available to them following a disaster. It is important that the County can effectively disseminate information through communication and outreach methods regarding emergency preparedness and climate resiliency in the community to help residents know more about climate hazards, emergency preparedness, and available resources and services.

Tracking Progress

Metric	Baseline (2022)	Goal (2024)
Percentage of people who know where to find emergency preparedness resources (Based off the 2022 Climate Change Emergency Preparedness Survey).	54.8%	80%
Percentage of people who feel prepared if an emergency event were to occur (Based off the 2022 Climate Change Emergency Preparedness Survey).	37.2%	60%

Implementation

Department of Community Resources and Services (DCRS), Office of Human Rights Equity (OHRE), and Office of Emergency Management (OEM) will be the lead implementers of this action, with the support from the Office of Public Information (PIO), the Office of Community Sustainability (OCS), and all applicable departments.

Next Steps	Timeframe	Responsibility
Conduct an audit of existing methods of communication, education, and outreach to identify gaps.	2023-2024	DCRS, OHRE, OEM
Conduct a user study to determine the best methods of communication and distributing information through education and outreach.	2023-2024	OHRE, PIO, DCRS
Research new methods of communication, education, and outreach to ensure modes of communication are equitable.	2023-2024	DCRS, OHRE, PIO
Take research, results from user study, and feedback from departments to implement new strategies, build upon and/or improve existing strategies. Those who do a lot of outreach and education with the community should follow new strategies, especially with information regarding emergency preparedness and climate resiliency.	2024-2025	OEM, OCS, OHRE, DCRS
Publish a resource guide with best methods to communicate, educate, and conduct outreach for other departments and communities to follow.	2024-2025	OHRE, DCRS

Subject Matter Experts on emergency preparedness, recovery, and resiliency should reach out to external partners and educate them on climate information, available resources and services, and the best ways to educate and communicate with their own members.	2024-ongoing	OEM, OCS, All Applicable Departments
Work with internal and external partners, with a focus on nontraditional partners, to distribute emergency preparedness, climate-specific, and resiliency information as widely as possible.	Ongoing	All applicable departments
Create and distribute a 2024 Climate Change Emergency Preparedness survey that contains similar questions to the 2022 Climate Change Emergency Preparedness survey. Survey residents to see if communication and outreach of County resources has improved. The survey should be expanded and include questions about climate resiliency to see if residents know about energy efficiency, stormwater practices, agriculture, land, and other programs.	2024-2025	OCS, OEM

Action 1C: Ensure equitable access to information.

Emergency preparedness information should be accessible for those who may struggle to gain information through traditional communication modes (i.e., social media, internet-based news, television, etc.). The information the County publishes should be easy to understand and made available in languages other than English and in alternate formats that are more accessible to individuals with Disabilities/Access and Functional Needs (D/AFN). The County should evaluate its current structure/modes for disseminating information to include the inclusiveness, accessibility, and effectiveness of existing channels to access information. Based on that evaluation, the County should then determine the best methods of distributing equitable accurate information and determine any communication gaps. The County should consider incorporating a phone number for residents to call to be able to access the information in alternate formats.

Overcoming Barriers

This action is chosen because being able to access information quickly post-emergency is vital to community resiliency. Although the County does provide information to the public that can be accessed equitably for individuals with Disabilities/Access and Functional Needs (D/AFN), there is still a lot of information that cannot be accessed in an accessible way. Residents should feel confident that they are able to access information in alternate formats and different languages to fit their needs.

Implementation

Department of Community Resources and Services (DCRS) and Office of Human Rights and Equity (OHRE) will be the lead implementers for this action, with support from the Office of Emergency Management (OEM) and the Office of Public Information (PIO).

Next Steps	Timeframe	Responsibility
Conduct a user study to determine accessibility of current information. This user study can be combined with determining the best methods of communicating and distributing information through education and outreach.	2023-2024	OHRE, DCRS
Meet with departments and Subject Matter Experts (SMEs) who incorporate accessibility into their messaging and discuss the best ways to distribute information regarding climate resiliency	2023-2024	OHRE, DCRS, PIO, OEM

Incorporate accessibility into all relevant outreach methods and communication modes, especially any media or websites that contain climate resiliency, preparedness information, and the “one-stop-shop” website/landing page.	2024-ongoing	All applicable departments
Develop a list of nontraditional communications channels and update no less than annually. Make sure all departments communicating about emergencies and emergency preparedness have access to this list and are using it.	ongoing	OHRE, PIO

Action 1D: Maximize outreach opportunities by layering emergency preparedness information into County communication tools.

Outreach opportunities should be utilized to their fullest potential to make sure people are aware and know how to access available emergency resources and services, emergency preparedness information, and climate-specific preparedness information. Howard County should continue to take advantage of any opportunity to disseminate this information through press releases, newsletters, social media pages, County employee signatures, and other potential opportunities. This action encourages other County departments, including departments with a lot of interaction with the public and a lot of opportunities for public outreach, to push out emergency preparedness information and become informed on emergency preparedness. Additionally, this action should encourage departments to improve internal communication with each other to increase the County’s awareness of emergency preparedness to better assist residents. The County should continue to collaborate with partner organizations, including schools, businesses, and nonprofits to share information regularly with their members and explore paid media.

Overcoming Barriers

At times, communication can be misunderstood and/or need improvements. This action is chosen because maximizing outreach opportunities into all County communications can help increase the number of people who are prepared for climate emergencies by increasing awareness of available resources and services. Information can be most effectively disseminated when using the greatest variety of channels of communication.

Implementation

Office of Public Information (PIO), Public Information Officers (PIO’s) and Office of Emergency Management (OEM) will be the lead implementers for this action, with support from the Department of Community Resources and Services (DCRS) and from all applicable departments who have a lot of interaction with the public.

Next Steps	Timeframe	Responsibility
Develop standardized templates for County departments to use on their social media posts/sites, employee signatures, newsletters, and other communications to direct the public toward the best sources of emergency preparedness information.	2023-ongoing	PIO, All applicable departmental PIOs, OEM
Expand list of internal County contacts and external partner contacts that can be used to easily disseminate information broadly. Update regularly.	Ongoing	OEM, All applicable departments
Ensure County departments are communicating and distributing the necessary information to their external partners so that they can push out information with their members when appropriate	2024-ongoing	OEM, PIO, DCRS, All applicable departments

Strategy R2: Improve emergency preparedness of Howard County citizens

Making sure that the public is prepared and well-equipped to deal with a variety of climate hazards can help reduce the impacts of those climate hazards. Howard County's Office of Emergency Management, the Department of Community Resource Services, and the Howard County Health Department already have emergency resources and services that can help people prepare for extreme temperature, flooding, and other emergency/disaster events. However, the County can increase the amount of people who know how to respond to climate disasters, what emergency supplies to have, and where to access emergency resources and services.

Why These Actions?

Emergency preparedness can help people know what to expect during extreme temperature events, extended power-outages, and other climate risks and impacts. Providing the public with the information and resources most needed following a climate emergency is critical. These actions help increase the number of Howard County residents who are prepared for climate emergencies, through outreach and ensuring organizations have adequate resources. Having specific materials and resources readily available will help Howard County's population recover effectively and swiftly from climate hazard impacts. The County is aware there are many factors to consider when increasing education and outreach efforts for emergency preparedness. The County will conduct targeted outreach to individuals residing in the County who may be more vulnerable to extreme heat, flooding, and other hazards because of their geographical location, socioeconomic situation, and other factors. This action was chosen because Howard County wants to ensure that residents are more resilient, specifically for extreme temperature events. Overall, this strategy will increase emergency preparedness of residents.

Addressing Equity

This strategy ensures that underserved communities are prepared for emergency events by ensuring equitable distribution of and providing affordable emergency preparedness and climate action resources and services across the County.

Howard County Leading by Example

There are several plans published by the Office of Emergency Management that address climate hazards and how the County responds to disasters, such as Howard County Hazard Identification Risk Assessment (HIRA) Plan, Howard County Hazard Mitigation Plan, The 2020-2025 Office of Emergency Management Strategic Plan, Howard County Comprehensive Emergency Response and Recovery Plan (CERRP), and an Animal Disaster Preparedness Packet. Additionally, they provide digestible resource packets such as the Community Hazard Handbook. The Office of Community Sustainability has many resources about climate actions that residents can partake in to be more resilient to hazards in their own home and backyard such as stormwater and energy related solutions. To help residents find available resources and services near them, Howard County has partnered with the CAREAPP service that connects Howard County residents with resources and services that assist with or provide transportation, housing, food, education, and more. The County developed two different centers, the Family Assistance Center (FAC) and Disaster Assistance Center (DAC), that are activated after an emergency to provide people with emergency support resources such as case management support for food, water, and shelter. These centers may provide similar services but are activated depending on the type of recovery services are needed.

Action 2A: Increase number of individual citizens with emergency kits and emergency plans.

Emergency kits contain supplies that will last for several days following an emergency, including food, water, and other resources that fit an individual's or families' specific needs. The Office of Emergency Management and the Howard County Health Department distribute and encourage individuals (via outreach events, social media posts, etc.) to build

emergency kit(s). Increasing the number of individuals with emergency supply kits or information on what goes in an emergency supply kit can help increase community preparedness and resiliency.

Overcoming Barriers

This action is chosen because emergency kits are a necessity following a disaster incident(s). People can use emergency kits to address acute and immediate needs instead of relying on outside resources and/or services. The 2022 Climate Change Emergency Preparedness survey results highlight that many individuals do not have emergency supplies.

Implementation

Office of Emergency Management (OEM) and the Office of Community Sustainability (OCS) will be the lead implementer for this action, with support from the Department of Community Resources Services (DCRS) and all applicable departments/organizations.

Next Steps	Timeframe	Responsibility
Use communication and outreach methods developed under Strategy R1 to increase public awareness about the importance of emergency supply kits and how to put together a kit.	Ongoing	OEM, OCS
Promote the usage of emergency plans and kits at tabling events across the County, giveaway information on what goes in an emergency kit and the usage of emergency plans, kits, etc. right before an extreme weather event like a hurricane or extreme temperature events.	Ongoing	OEM, OCS
Consider holding a contest for the most creative and effective emergency kit to raise awareness.	2024-ongoing	OEM
Find sources of funding to provide departments and partners with basic emergency kit supplies or giveaway items. Consider partnering with Community Action Council (CAC) of Howard County and other organizations to provide emergency kits to those with qualifying incomes in communities most vulnerable to flooding, heat, or other impacts of storms.	2024-ongoing	OEM, DCRS, all applicable departments/organizations

Action 2B: Increase capacity of organizations that can provide emergency services before and during an emergency.

Howard County is fortunate to have several organizations that provide needed supplies and services before and during emergency events. Increasing support and resources available to these partner organizations can help reduce supply shortages, reduce over-crowding of shelters and supply distribution locations, and distribute more resources across the County. This action helps ensure that organizations who already provide food, water, shelter, and other resources have adequate supplies to give out during an emergency by helping them secure additional funding for resources and services. Howard County also can further promote these partners and raise community awareness of available services by including these organizations and their services on the “one-stop-shop” webpage.

Overcoming Barriers

This action is chosen because more emergencies are expected to occur, and the number of resources and services will have to increase. More resources should be made available to residents. Well-prepared and amply resourced nongovernmental service organizations can help with this effort.

Implementation

Department of Community Resources and Services (DCRS) will be the lead implementers of this action, with support from the Office of Emergency Management (OEM).

Next Steps	Timeframe	Responsibility
Ensure CAREAPP, "One-Stop-Shop", and other sources that share information on resources and services provided by organizations and departments are up to date. Determine if there are gaps or missing existing community services and resources.	2023-ongoing	DCRS, OEM
Increase the number of residents who are aware of the CAREAPP and existing resources and services. Assist organizations in promoting their resources and services, especially during and after an emergency event.	2023-ongoing	DCRS, OEM
Reach out to existing organizations to determine if additional funding for resources and services is needed to fill in gaps.	2024-ongoing	DCRS
Seek funding to assist organizations in providing more robust emergency services to Howard County residents.	2024-ongoing	DCRS, OEM

Action 2C: Target more education and outreach efforts about emergency preparedness and climate action to communities most vulnerable to heat and flooding impacts.

Targeted education and outreach efforts to increase emergency preparedness should be directed toward individuals living in parts of the County that are expected to be most impacted by extreme temperature and flooding, as well as individuals with higher health risks when exposed to these conditions. The Department of Public Works has disseminated information on flooding hazards to residents living in areas susceptible to flooding, however, these efforts could be expanded. For example, extreme temperature preparedness outreach and education efforts can target those living in urban areas and populations that are more susceptible to extreme temperature exposure (i.e., individuals with Disabilities/Access and Functional Needs (D/AFN)). The Howard County Office of Emergency Management already provides County residents with emergency preparedness and public health related information, however, expanding on the County's reach to the public and promoting more climate specific emergency preparedness would be beneficial. County stakeholders could help expand education and outreach efforts. Education and outreach relating to emergency preparedness for extreme temperature events and extreme weather impacts should continue to be expanded to underserved communities. Relevant partners should continue educating the public on climate and general emergency preparedness ahead of a disaster through workshops, videos, social media, newsletters, mail, and other methods of effective outreach identified in Strategy R1.

Overcoming Barriers

The County is aware there are many factors to consider when increasing education and outreach efforts for emergency preparedness. Individuals residing in the County may be more vulnerable to extreme heat, flooding, and other hazards because of their geographical location, socioeconomic situation, and other factors. This action was chosen because Howard County wants to ensure that residents are more resilient, specifically for extreme temperature events.

Implementation

Office of Emergency Management (OEM), Department of Community Resources and Services (DCRS), and Office of Community Sustainability (OCS) are the lead implementers for this action, with support from Economic Development Authority (EDA), Office of Human Rights and Equity (OHRE), the Office of Public Information (PIO), Department of Public Works - Bureau of Environmental Services (BES) and all applicable departments.

Next Steps	Timeframe	Responsibility
Determine where and what kind of targeted outreach is needed using heat and flood, equity maps and other tools. This action should be updated every year as climate hazards are expected to increase and residents may be more susceptible to the impacts of climate hazards.	2023-ongoing	OEM, OCS, DCRS, PIO, OHRE
Work with OEM and other relevant departments to improve the preparedness of Howard County residents and/or business owners for specific hazards relevant to their area.	2023-ongoing	OEM, OCS, EDA, DCRS, OCS
Implement improved or new education and outreach efforts targeting relevant areas, communities, etc.	2024-ongoing	DCRS, OEM, BES, PIO, all applicable departments
Assess if education and outreach has improved Howard County's preparedness levels and get feedback on targeted education and outreach efforts and adjust as needed.	2024-ongoing	OEM, DCRS

Strategy R3: Improve access to emergency shelters, cooling centers, and resources during climate hazard events, especially for underserved and under-resourced communities

This strategy will explore options to improve access to emergency shelters, warming/cooling centers, and other resiliency and recovery resources. The County should explore additional opportunities to add more emergency shelters and warming/cooling centers throughout the County in feasible locations. Additionally, the County may need to increase transportation options to get people to and from emergency shelters and warming/cooling centers.

Why These Actions?

Ensuring that adequate access to transportation and to County resources and services is secured ahead of climate hazard events, such as extreme heat/cold events, will ease operations of the County's emergency response and public health processes.

Addressing Equity

Howard County will ensure that community members with specific mobility needs have access to affordable and accessible public transportation options by improving Americans with Disabilities Act (ADA) compliance. Additionally, the County will offer no- cost and low-cost transportation options. This will ensure that equitable preparation and recovery efforts are offered before, during, and after climate hazard events.

Howard County Leading by Example

Howard County has pre-established sheltering and amenity capabilities for disaster and non-disaster incidents. These resources can provide the public with warming/cooling centers during extreme weather events, amenity centers for charging electrical devices during power outages, and overnight sheltering following an emergency/disaster incident. These different types of resources are activated upon specific triggers, such as the type and severity of the weather, or as needed by the community. Howard County's mobility services include General Paratransit (GPT) which offers free rides on fixed routes and trips to senior centers, medical appointments, social service agencies, employment, and education, and select hospitals. Regional Transit Agency's (RTA) Complementary ADA Paratransit complements RTA services a large area of 128 square miles and provides services to certified ADA persons, including free rides on fixed routes.

Action 3A: Raise awareness of and add new warming/cooling centers, emergency shelters, and comfort centers as needed, prioritizing underserved areas

Extreme weather events, such as flooding, extreme heat, and winter storms may require the County to establish more cooling/warming centers in existing buildings. It is important that residents know what options are available to fit their needs. Additionally, it’s important that residents know the differences between warming and cooling centers and emergency over-night shelters as they each provide different services and functions. The County should work with housing complexes, schools, and community organizations to identify areas where additional warming/cooling centers are feasible and useful to the public, especially for those who lack viable transportation options to the nearest center. Consider adding warming/cooling centers in places where vulnerable populations are more impacted by extreme temperature events and in more accessible and equitable locations (i.e., near bus stations, within walking distance of residential areas, etc.).

Overcoming Barriers

This action is chosen because new warming/cooling centers may need to be considered to help areas with a high-volume of underserved residents and/or residents who are in areas that are vulnerable to extreme temperature events and flooding. Currently, Howard County has 15 locations established as warming/cooling centers for extreme weather events and those centers are not utilized to their full potential. However, the County’s 2022 Climate Emergency Preparedness Survey indicated that a large sector of the public would use warming and cooling centers if they knew it was an option. We can expect the use of these services to increase as the County improves education and awareness of these services. In addition, survey respondents indicated that lack of transportation is one of the largest barriers preventing their use of existing heating and cooling centers. Increasing the number of centers in places where people can easily access them by walking or public transit improves accessibility.

Implementation

Office of Emergency Management (OEM), Office of Community Sustainability (OCS), and the Department of Public Works (DPW) will be the lead implementers of this action, with support from Howard County Public School System (HCPSS), Department of Technology and Community Services (DTCS), Office of Public Information (PIO), Department of Community Resources and Services (DCRS), and all applicable departments.

Next Steps	Timeframe	Responsibility
Use extreme temperature vulnerability maps, flood vulnerability maps, and demographic data (such as EJ Screen), to identify priority geographic areas where new centers are most needed.	2023-ongoing	OEM, DCRS
Review the list of critical facilities within Howard County to identify existing facilities within these priority areas that could serve as new warming and cooling centers. Meet with stakeholders and community groups to further refine the list of existing facilities to assess for suitability as warming and cooling centers.	2024-2025	OEM, DPW- Facilities, OCS, DCRS, All applicable departments
Utilizing existing criteria, implement new centers as needed and feasible.	2024-2026	OEM, DPW-Facilities, HCPSS
Map new centers and include center locations in the “one-stop-shop” webpage.	2024-ongoing	OEM, OCS, DTCS, PIO
Conduct targeted outreach in neighborhoods within walking distance of new and existing warming and cooling centers to raise awareness of shelter availability and locations.	Ongoing	OEM, OCS

Survey target populations to determine whether new placements of warming/cooling centers are accessible and adjust locations as needed.	Ongoing	OEM, DCRS, OCS
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Action 3B: Maximize transportation options to get to and from emergency centers during climate hazard emergencies

During extreme weather events, people need to be able to access various transportation modes and options to get to safety. An ADA-compliant transportation plan during large and localized climate emergency events should be developed. Affordable transportation options focused on getting people to and from emergency centers should be considered a priority during extreme weather events.

Overcoming Barriers

Affordable and accessible transportation for residents is crucial especially during emergency situations. Initial research of the 2022 Climate Change Emergency Preparedness survey shows that lack of transportation is a barrier residents face when accessing community resources and services.

Implementation

The Office of Transportation (OOT), Department of Community Resources and Services (DCRS), and Office of Community Sustainability (OCS) are the lead implementers for this action, with support from Howard County Public School System (HCPSS) and Department of Recreation and Parks (DRP).

Next Steps	Timeframe	Responsibility
Identify emergency events that could trigger acute transit needs for individuals with D/AFN, lack of access to personal vehicles, or other reasons.	2024-2025	OEM, DCRS
Identify and prioritize neighborhoods with greatest need for emergency transportation to shelter and recovery resource locations based on demographic information and vulnerabilities to flooding, extreme temperature events, and other climate hazards.	2024-2025	DCRS, OCS
Identify stakeholders and community groups that can provide new resources to address transit needs.	2024-2025	DCRS, OOT
Explore options for diverting public transit buses, rideshare services, school buses, and vans to serve emergency needs.	2024-2025	OOT, HCPSS
Generate a list of new resources that fill gaps in transit needs during climate hazard events.	2024-2025	OOT
Incorporate new local funding initiatives to support these new transit resources.	2024-ongoing	OCS, OOT
Conduct education and outreach campaigns in targeted neighborhoods to raise awareness of the availability of new emergency transit options.	2024-ongoing	OCS, OEM, DCRS, DRP
Survey target populations to determine whether new emergency transit services meet communities needs and adjust program as needed.	2025-ongoing	DCRS, OCS, OEM, OOT

Strategy R4: Increase resiliency of buildings, infrastructure, and communities to match anticipated climate hazards

Commercial and residential buildings, roads, bridges, and other built infrastructure may be ill-equipped to withstand the stress of more intense heat waves, extreme storms, flooding, and other anticipated climate hazards. Building codes, design standards, and best practices that improve resiliency of these structures can include energy efficiency practices, climate-resilient construction materials, weatherization techniques, flood resistance measures, a highly trained workforce to repair critical equipment in emergencies, and on-site energy generation (including solar and battery storage) to better withstand extreme weather, flooding, and extended power outages. Promoting climate resilient building codes, infrastructure design manuals, and best practices that are co-beneficial with energy efficiency initiatives and climate resilience can foster effective improvements to buildings, roads, bridges, and other built infrastructure throughout Howard County.

Why These Actions?

Howard County needs to prepare for the increase in severe storms, intense heat, and increased flooding expected because of climate change. Most the County's existing buildings and other infrastructure were not designed to withstand these increases in extreme weather. Proactive decision-making to harden critical facilities and shelters will prepare these locations to withstand climate hazard impacts and can prevent the worst impacts of climate hazards from occurring.

Intense heatwaves and related prolonged power outages are likely to become more frequent due to climate-related extreme weather and associated increased demand on the electric utility grid. At the same time, climate change hazards such as heat waves and flooding make uninterrupted access to public safety and community resources even more critical. Power outages and extreme temperatures also put increased demand on highly skilled technicians who can install, repair, and maintain HVAC systems, generators, and microgrids.

Howard County, as a recognized leader in the development and adoption of modern international building codes, is in a unique position to pilot and advocate for code improvements targeted toward specific needs for building stock resiliency and public safety concerns resulting from climate hazards.

Addressing Equity

Extreme heat due to climate change is expected to be worse in some areas than others due to urban heat island effects. In addition, extreme heat can disproportionately impact highly sensitive groups such as people with breathing issues and the elderly. People with lower incomes also can suffer more from extreme heat because they often occupy older buildings and may not have adequate cooling systems or options for backup power in case of outages. There are many best practices that can reduce heat island effects and protect heat-sensitive groups from extreme heat. Retrofits of existing buildings and other infrastructure to reduce energy demand and improve resiliency to heat and flooding should prioritize buildings, roads, bridges, and other infrastructure critical to public health and safety and that provide services to under-resourced communities. Increasing the ability of Howard County's community centers to provide services and resources during emergencies also benefits surrounding underserved communities.

Howard County Leading by Example

Howard County has already demonstrated leadership in many of the areas critical to successfully implement this strategy. Howard County's Department of Inspections, Licenses and Permits staff are active participants in several International Code Council committees and workgroups that continuously revise and update codes to best protect people and property, as well as saving energy and reducing life cycle building costs. Howard County has the highest Insurance Services Office (ISO) Rating in the state of Maryland for Commercial and Residential. This rating is based on the ratio of inspectors to buildings, enforcement of existing codes, and certifications and expertise of inspectors. Howard County also has led the state with climate-forward code. For example, Howard County first required electric vehicle charging stations for new multi-family dwelling units in 2019, which is now included in the 2021 International Energy Conservation Code. As of 2022, Howard County has adopted all the most recent versions of international building codes, except for the

International Green Construction Code overlay. The adoption of modern building codes is rare among local jurisdictions in the United States, prompting a new federal effort to increase adoption of modern building codes, called the National Initiative to Advance Building Codes.

In addition, Maryland was the first state in the nation to require that nursing homes and assisted living facilities provide emergency backup power. Maryland Code 10.07.14.46 requires that assisted living facilities serving more than 50 people have an emergency electrical power generator on the premises and that certain areas specified in the rule and law are covered. System tests are required once per month and the generators must be at full speed within 10 seconds of activation.

Action 4A: Continue to lead nationally on building safety and resiliency by researching and piloting building code updates to increase resiliency to severe storms, flooding and heat beyond life safety

Strong, modern building codes help keep people safe and reduce damage to buildings from extreme storms, heat waves and other climate hazards. While building codes have begun to address energy efficiency and other climate change mitigation measures in the last decade, building codes traditionally focus on life safety, ensuring buildings operate long enough to safely evacuate people in a disaster, rather than ensuring people can continue to safely live in those buildings during and after emergency events. Targeted building code updates can improve long term building resiliency in a changing climate. For example, higher standards for storm resistant siding, windows, and doorways in buildings can prevent damage during storms. Building codes related to the location of internal systems and utilities can also improve the overall resilience by shifting sensitive assets away from potential flooding or overheating due to extreme weather. Code and other policy also can protect against building flooding and resulting mold hazards. Targeted code updates also can help reduce heat islands by using reflective building materials and including more shade plantings and other heat mitigation measures on site.

Overcoming Barriers

Successful adoption of new building codes requires education of contractors and developers to ensure they fully understand and can implement the new code. In addition, code compliance relies on adequate code enforcement, so Howard County needs to make sure it has the required staff and resources available before code changes are adopted.

Implementation

The Department of Inspections, Licenses, and Permits (DILP) will be the lead implementor for this action, with support from the Office of Community Sustainability (OCS).

Next Steps	Timeframe	Responsibility
Continue to participate actively in International Code Council committees and in state and regional code working as they evaluate additional resiliency measures in code updates.	Ongoing, quarterly	DILP

Investigate the latest research and innovations in building codes to promote climate resiliency and evaluate these for inclusion in Howard County code. Focus on research and innovations that directly address Howard County’s priority climate hazards: flooding, heat, and severe storms as well as resulting power outages. Consider adopting a climate-ready building standard. For example, revise codes to achieve more floodproofing, location of mechanical and electrical equipment above projected flood elevations, etc.	2024 (updated every three years through the code adoption cycle)	DILP
Investigate options to protect tenants from health impacts of climate hazards and update regulations as needed. For example, this could include requiring landlords to install measures to protect against flooding in their properties, especially in basements, and to inspect for mold and remediate as needed within a specified timeframe after flooding events to protect occupant health.	2024 (updated every three years through the code adoption cycle)	DILP
Synthesize the findings of the above research and suggest ways to incorporate these findings into building codes and best practices, including details about any additional staff, budget, partnerships, or other resources needed to implement any recommended code updates effectively.	2024 (updated every three years through the code adoption cycle)	DILP
Actively pursue adoption of the International Green Construction Code and funding for the additional DILP staff needed to implement and enforce the code effectively. Consider including requirements that non-critical facilities install measures to reduce energy use during extreme weather events to conserve available electricity supply for critical services such as ventilators, oxygen compressors, medication refrigeration, and cooling to maintain safe indoor temperatures for sensitive groups.	2024-2027	DILP, OCS
Assist efforts by existing commercial building owners to improve building resiliency by expanding C-PACE through new council legislation to meet the new options allowed by the state. Promote the use of C-PACE financing for improving building resiliency to flooding, heat, and other climate hazards.	2023	OCS

Action 4B: Promote existing programs to protect underserved populations from extreme heat and explore opportunities to expand eligibility for these programs to more people

Weatherization programs funded by federal and state grants provide free energy audits and energy efficiency upgrades, including new air conditioning units or air conditioning upgrades, to income-qualified individuals. Nonprofit organizations and contractors that manage these programs have expressed a need for additional outreach in Howard County to maximize use of the program. In addition, generators are critical resources to protect people during heat waves, but many people with lower incomes do not have access to them. It also is important to ensure that generators or other backup power sources have the lowest possible carbon footprint.

Overcoming Barriers

Not all income-limited populations may currently qualify for free weatherization assistance based on state guidelines, especially in Howard County where cost of living may be higher than in other parts of the state. In addition, many underserved populations are not able to access some of the County’s quickest and easiest communications and outreach methods. County staff may need to work with partner organizations and employ new strategies to reach the populations that can most benefit from weatherization and related assistance.

Implementation

The Department of Community Resources and Services (DCRS) will be the lead implementer for this action, with support from the Howard County Health Department (Health), Office of Community Sustainability (OCS), and nonprofit partners such as the Community Action Council of Howard County and Civic Works.

Next Steps	Timeline	Responsibility
Review eligibility guidelines for weatherization programs and develop Howard County – specific educational materials as needed.	2023	DCRS
Review data documenting weatherization efforts in Howard County to date to determine any gaps in target populations or geographic areas that can be prioritized for focused outreach efforts.	2023-2024	DCRS, nonprofit partners
Reach out to service providers, companies, nonprofits, and other community leaders with influence in prioritized areas and targeted populations to request assistance with outreach and to coordinate efforts.	2023-2024	DCRS, Health
Conduct education and outreach campaigns for landlords, tenants, and homeowners, particularly in underserved and heat vulnerable communities, to promote existing weatherization programs, rebate programs, and grant programs to improve home comfort, energy efficiency, and adequate cooling systems.	Ongoing	DCRS, Health
Track participation in weatherization efforts and compare data collected before and after outreach campaigns to determine success.	Ongoing	DCRS, nonprofit partners
Explore opportunities to expand eligibility for people who do not currently qualify for weatherization services, but who have limited resources to take advantage of rebates and other available programs.	Ongoing	DCRS, OCS
Consider new incentives to reduce costs of energy audits, especially for low- and moderate- income households. Seek grant funding to cover the portion of energy audits not already covered by utility rebates.	Ongoing	DCRS, OCS, nonprofit partners
Explore opportunities to expand requirements for nursing homes and assisted living facilities to require smaller facilities to have emergency backup power that includes air conditioning as well as other critical health equipment.	Ongoing	OCS, Health
Assess the need for generators within under-resourced and heat vulnerable communities.	Ongoing	DCRS, OCS
Consider options to incentivize use of low carbon sources of backup power to make these options more affordable to residents and businesses. Low carbon backup power may include on-site solar with battery backup or renewable natural gas generators in place of diesel or gasoline generators.	Ongoing	DCRS, OCS

Action 4C: Promote and incentivize building best practices that protect people from impacts of extreme heat

Building best practices such as cool rooftops, green roofs, cool pavements, and shade plantings, can reduce heat island effects and protect heat-prone areas from increased intensity and duration of heat waves. However, these practices are not yet widely adopted. Incentives, case study projects, and improvements to regulations and design manuals can help increase the benefits of these practices relative to their costs.

Overcoming Barriers

Cost can be a significant barrier to some of these practices. Others of these practices may require frequent and/or complex maintenance. The County also needs to consider and address how to balance different possible uses for rooftops and parking lots and their benefits, such as solar panels and shade trees.

Implementation

The Department of Inspections, Licenses, and Permits (DILP) and the Office of Community Sustainability (OCS) will be the lead implementers for this action, with support from Department of Planning & Zoning (DPZ), Howard County Economic Development Authority (EDA), Department of Finance (Finance), and Department of Public Works (DPW).

Next Steps	Timeline	Responsibility
Research creative incentive programs, new requirements, and other options to increase the resiliency of new developments. Consider including resiliency-focused elements into any revisions of the Green Neighborhood Program.	2023-2024	OCS, DPZ, DILP, Finance
Convene a meeting with property developers in Howard County to discuss building practices and possible incentives that will successfully increase the resilience of new developments.	2024	OCS, DPZ, EDA, Finance
Consider adopting specific code revisions that may include green roofs, cool roofs, or solar photovoltaic roofs and cool and/or permeable pavements on driveways, paths, and other private roads, particularly in heat vulnerable areas. Determine whether additional inspectors or funding is needed to inspect these site components prior to issuing Use and Occupancy Permits. Obtain additional inspectors and/or funding as needed prior to implementing these code revisions.	2024-2025	DILP, DPZ, OCS
Consider updates to the Design Manual and/or Landscape Manual that include best management practices for heat resiliency.	2024-2025	DPW – Engineering, DPZ, DILP, OCS
Following any Design Manual and/or Landscape Manual updates, implement pilot projects on public properties owned and maintained by Howard County to serve as a model to private developments and property owners for how to incorporate heat resiliency best management practices into their projects. Promote these pilot projects and lessons learned through videos, websites, printed brochures, and tours.	2025-2027	DPW – Facilities, OCS

Action 4D: Improve resilience of critical infrastructure to flooding, heat and other climate hazards

Roads, bridges, dams, public water and wastewater utilities, and other critical infrastructure may experience additional stress from more extreme heat, flooding, and other climate hazards. Mapping flood risks to roads, dams, bridges, and other infrastructure can help the County identify and prioritize any needed improvements to existing infrastructure. Evaluating and considering updates to design requirements for infrastructure and critical facilities can help ensure resiliency to climate hazards. Retrofits of existing infrastructure to improve resiliency should prioritize buildings, roads, bridges, and other infrastructure critical to public health and safety and that provide services to under-resourced communities.

Overcoming Barriers

Retrofits of existing infrastructure can have a high cost, making prioritization critical. The County may need to identify outside sources of funding before pursuing some of these projects.

Implementation

Office of Emergency Management (OEM) and Department of Public Works (DPW) will be the lead implementers for this action, with support from Office of Community Sustainability (OCS).

Next Steps	Timeline	Responsibility
Continue to identify, map, and track critical infrastructure such as roads, bridges, dams, and public water and wastewater utilities that may experience stress from climate hazards.	Ongoing	OEM, DPW – Engineering, DPW – Utilities
Evaluate risks to infrastructure from climate hazards such as flooding, extreme heat, and severe storms. Create a priority list of infrastructure to target for resiliency upgrades. Priority should be given to at-risk critical infrastructure that provides services to under-resourced communities.	2023-2024	OEM, DPW – Engineering, DPW – Utilities, OCS
Apply for grants, loans, incentives, and other funding sources to implement priority resiliency upgrades to infrastructure.	2024-2027	OEM, DPW – Engineering, DPW – Utilities, OCS
Implement priority resiliency upgrades to infrastructure as funding becomes available.	2025-2030	DPW – Engineering, DPW – Highways, DPW – Utilities
Review Design Manual and consider updates to ensure new critical infrastructure is constructed to best withstand additional stress of current and future climate hazards.	2024-2025	DPW – Engineering, DPW – Highways, DPW – Utilities

Action 4E: Implement microgrids throughout Howard County where feasible, prioritizing areas that meet critical community needs

A microgrid is a local power generation system that can operate independently of the utility grid. Microgrids often include a combination of solar panels, battery storage, natural gas generators, and system controls that work together to provide on-site power. Microgrids can improve electric grid resiliency by reducing demand on the grid during high energy use days. Careful siting of microgrids and other local energy generation and storage can ensure critical public safety functions and vital community services are available even during extreme heat, severe storms, and associated power outages.

Overcoming Barriers

Costs for microgrid projects can be significant, making prioritization critical. The County may need to identify outside sources of funding before pursuing some of these projects.

Implementation

The Office of Emergency Management (OEM) and the Department of Public Works (DPW) will be the lead implementers for this action, with support from the Office of Community Sustainability (OCS).

Next Steps	Timeline	Responsibility
Pursue federal and state grant funds to support the Howard County Government Campus microgrid in Ellicott City. This project would ensure uninterrupted public services in the case of emergencies, including police services, 911 and emergency operations, emergency recovery, and local emergency shelter capabilities. Include matching funds for grants in the County’s FY24 capital budget and beyond as necessary.	2023-2024	OEM, DPW – Facilities, OCS
If federal and or state funding is granted and matching funds in the Howard County budget are approved, design and install the Howard County Government Campus microgrid.	2025-2028	DPW – Facilities
Convene meetings with relevant stakeholders to understand where additional microgrid systems would be most beneficial for emergency operations and community services.	2023-2024	OEM, DPW – Facilities
Using feedback from stakeholder meetings and critical facilities mapping tools, establish a priority list of facilities for microgrid implementation. These may include facilities responsible for emergency communications, hospitals, public schools, and resource centers. Potential microgrid sites also should be prioritized to favor traditionally underserved communities.	2024-2025	OEM, DPW – Facilities
Apply for federal and state funding and explore other financing options such as public-private partnerships and energy-as-a-service to design and implement microgrids in priority order.	2025-2028	OEM, DPW – Facilities, OCS
Design and install priority microgrids whenever feasible and when outside funding is available to match any County investments	2026-2030	DPW - Facilities, external partners

Action 4F: Implement resiliency hubs to meet critical emergency needs for the community

A resiliency hub provides community services during emergencies, including heating and cooling, medication refrigeration, device charging, and assistance with accessing additional emergency preparedness and recovery resources. During emergencies, community members may have needs for services beyond what is available at typical heating and cooling centers. Residents can benefit from in-person support accessing resources to help with longer term emergency recovery, such as completing flood insurance claim forms and researching options for temporary housing, accessing emergency repair services, and more. Resiliency hubs provide safe places for the public to gather, meet critical needs, and gain information and assistance with emergency recovery. Resiliency hub services can include temporary access to heating and cooling, medication refrigeration, device charging, and assistance with accessing additional emergency preparedness and recovery resources. After a climate hazard event occurs with widespread power outages, having locations that residents can utilize for electricity, Wi-Fi, phone services, and emergency assistance will aid in recovery efforts.

Howard County’s Community Centers are well-situated to serve as resiliency hubs, as they already provide many services to the surrounding communities and have great potential to develop into more robust resiliency hubs for disaster recovery. Howard County currently has four Community Centers managed by the Department of Recreation and Parks: Roger Carter Community Center in Ellicott City, North Laurel Community Center in Laurel, Harriet Tubman Cultural Center in Columbia, and Gary J. Arthur Community Center in Glenwood. These locations currently serve as emergency heating and cooling centers and have emergency backup power through diesel generators.

Overcoming Barriers

There are several different definitions for resiliency hubs, so coming up with a clear definition and criteria will be critical. Increasing functionality of existing County facilities is a cost-effective way to start providing resiliency hubs. However, outside funding sources will be required if the County identifies a need for facilities to provide additional resiliency hubs.

Implementation

The Office of Emergency Management (OEM) will be the lead implementer for this action, with support from Department of Recreation and Parks (DRP), Department of Public Works (DPW), and Office of Community Sustainability (OCS).

Next Steps	Timeline	Responsibility
Develop criteria for what is most needed for resiliency hubs in Howard County.	2024	OEM, DCRS, OCS
Evaluate current capacity of Howard County’s Community Centers to meet the resiliency hub criteria and identify gaps in current services.	2025	OEM, DRP
Develop plans, budgets, and timeframes for each Community Center to add services and upgrade facilities and staffing services as needed to meet the criteria for resiliency hubs.	2025-2026	OEM, DRP, DPW – Facilities
Pursue grant funding wherever possible to make any desired upgrades to Community Center facilities and staffing.	2025-2026	OEM, OCS
Implement facility enhancements and hire/train new staff as needed to support resiliency hub functions of Community Centers.	2027-2028	DPW, DRP

Action 4G: Expand recruitment and training for technicians to support HVAC, microgrids, and emergency generators

The implementation of microgrid systems and other on-site energy generation and storage will require technicians to learn new skill sets. At the same time, extreme storms and heat will place greater stress on HVAC systems and could trigger more power outages, increasing the need for experts who can install, repair, and maintain HVAC systems and generators. In addition, well-educated HVAC technicians can recommend the best options for energy efficiency and preventive maintenance that will extend the life of equipment and reduce stress on the grid. Workforce development programs can create a talent pipeline for trained and qualified staff to fill future roles in these fields in the public and private sectors.

Howard County’s Office of Workforce Development and the Howard County Workforce Development Board work with business leaders and workforce development providers within Howard County to provide opportunities including apprenticeships and jobs skills programs. Howard County Department of Public Works also has an apprenticeship program for trades and is interested in continuing to train and develop the local workforce as Howard County Community College currently runs a Heating, Ventilation, Air Conditioning and Refrigeration Apprenticeship Program in partnership with Heating and Air Conditioning contractors of Maryland. The College is looking to expand this program and add additional programming on solar and battery storage and other resiliency and energy efficiency training programs through its new Center for Sustainable Excellence.

Through this action, Howard County will assess current and future demand for HVAC, emergency generator, microgrid, and solar with battery storage technicians and work with Howard County Office of Workforce Development, Howard Community College, Lincoln College of Technology, HCPSS Applied Research Lab, Howard County Economic Development Authority, Chamber of Commerce, relevant trade associations, and other partners to develop recruitment programs, trainings, education materials, and apprenticeship programs especially related to preventative maintenance, emergency repair, energy efficiency, and grid resilience.

Overcoming Barriers

Coordination between multiple partners will be critical to ensure maximum reach without duplication of efforts.

Implementation

The Howard County Office of Workforce Development (OWD) will be the lead implementer of this action, with assistance from the Howard County Economic Development Authority (EDA), the Department of Public Works (DPW), and other nonprofit and training partners.

Next Steps	Timeline	Responsibility
Research and compile current and future demands for HVAC, microgrid, solar with battery storage, and emergency generator technicians.	2023-2024	OWD
Convene stakeholders and potential partners to discuss research results, share information about existing training programs, identify any gaps or opportunities to enhance existing programs or develop new programs.	2024-2025	OWD, nonprofit and training partners
Connect stakeholders with partners, resources, technical experts, and promotional opportunities to enhance and promote existing training programs or development of new programs.	2025-2028	OWD, nonprofit and training partners
Assist partners with budgeting, identifying funding sources, and pursuing funding for new programs as needed.	2025-2028	OWD
Connect trained technicians with apprenticeships and job opportunities with local businesses.	2025-2028	OWD, EDA, DPW, nonprofit and training partners
Continue to evaluate programs, improve and evolve educational materials and trainings as technologies change, and set new goals.	2025-2028	OWD, nonprofit and training partners

Strategy R5: Reduce heat islands and increase shade in heat vulnerable areas

Heat is one of the most dangerous climate hazards to human health. Urban heat islands, the result of dark, heat-absorbing surfaces like asphalt streets and parking lots can add anywhere from 6°F to 12°F of additional heat. Reducing heat islands will have important health co-benefits as well, as heat can exacerbate other health issues such as COPD and asthma.

Thoughtfully planting native drought- and heat-resistant trees will also reduce watering needs and maintenance costs as average temperatures climb and extreme heat events become more prevalent. Shade structures and cool surface products are other methods that should be researched and utilized, particularly where trees are not feasible. Parking lot solar canopies can serve the dual purpose of creating shade and renewable energy. More about solar can be found in the energy strategies.

Why These Actions?

Taking strategic action in heat vulnerable areas should be data driven. Research into heat islands and the connection with underserved populations has begun during the creation of this plan, but a cross-department effort to refine these targets would be very beneficial. Using this data as a starting point, these actions will increase tree planting and the use of shade structures and cool surface technologies and inform planning policy.

Addressing Equity

Underserved populations will be the most affected by extreme heat. Increasing shade trees, shade structures and cool surfaces within heat vulnerable areas will bring equity into this implementation process. Increased tree canopy also has other physical and mental health benefits which should be equitable among communities.

Howard County Leading by Example

Howard County Government has a robust street tree program that maintains existing trees and replaces trees as needed. In 2022, 1,000 street trees were planted. The Department of Public Works, Division of Highways responds to public input about street trees through the TellHoCo app which creates data that can be geo-located. Howard County Government has also built some shade structures in parks and installed solar canopies. Parking lot solar canopies have been installed at the Little Patuxent Wastewater Treatment Plant and two more are underway, one at the Ken Ulman building and one at the East Columbia Library.

Howard County Recreation and Parks has several tree planting projects that involve the public, including Turf to Trees, Stream ReLeaf, the Annual Tree Giveaway, and Students Branching Out. As of 2023, Howard County Department of Recreation and Parks is starting a new Tree Canopy program that prioritizes underserved and lower tree canopy areas. The Office of Community Sustainability assists these efforts and has also planted trees on Howard County Housing Commission property and created the Trees for Bees program.

Action 5A: Research and map heat vulnerable areas with a focus on underserved populations

To be the most impactful and efficient, Howard County needs to set criteria and delineate heat vulnerable areas so that tree planting and maintenance can be targeted to these prioritized areas. This Climate Action and Resiliency Plan's heat vulnerability mapping correlates high heat areas with underserved populations specific to Howard County. Using this data, existing mapping resources and mapped tree canopy data as starting points, this action will clearly delineate which geographic areas the County should prioritize for reducing heat. Incorporating defining heat vulnerable neighborhoods and streets will enable County programs to have the most impact on increasing shade and decreasing heat islands.

Overcoming Barriers

There are many tools and resources that map underserved populations and tree canopy, so much so that they can be overlapping and overwhelming. Howard County has GIS specialists and an impressive collection of interactive maps that are available to the public. Howard County has also completed a study of tree canopy using the most advanced and most recent high-quality data available. This action will use existing research and mapping as a springboard to sort through the data and create a mapping resource for use across departments and by the wider community.

Tracking Progress

Progress will be tracked by the creation of heat-vulnerability mapping and its use.

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer and collaborate with the Department of Technology and Communication Services (DTCS), Department of Planning and Zoning (DPZ), and Department of Public Works (DPW-Highways).

Next Steps	Timeframe	Responsibility
Convene a working group across departments that is tasked with refining the heat vulnerability mapping started in this plan and incorporating it into the County's Geographic Information Systems used by departments.	2023	DTCS, OCS

Share research, criteria, and maps across departments with the intention of using the heat vulnerable areas to prioritize tree programs.	2023-2024	OCS, DTCS, DPZ, DPW – Highways
Once refined, consider using identified heat vulnerable areas in plan review. Consider that tree canopy and other native vegetation should be required at higher levels in heat vulnerable areas.	2023-2025	DPZ

Action 5B: Strategically increase tree planting in heat vulnerable areas on both public and private land

Howard County is projected to see increases in extreme heat due to climate change. There are several geographic areas throughout Howard County, that would benefit most from shade to reduce the impact of heat. This action will prioritize high heat risk areas for shade trees, especially in the locations identified under Action 5A. High heat risk areas correspond with underserved populations and areas within Howard County that typically see the most pronounced impacts of urban heat island effect and extreme heat events.

Many trees planted now will be full size by climate target years such as 2030 and 2050. Howard County has a 73.2% homeownership rate, and the majority of available planting space is on private property, so working with the public will be crucial to these efforts.

Overcoming Barriers

Budget and staff resources are the main barriers to increasing tree planting. Dedicating resources to tree maintenance is a particular challenge.

Tracking Progress

Progress can be tracked by the number of trees planted in heat vulnerable areas by Howard County Government and our non-profit and resident partners.

Implementation

The Office of Community Sustainability (OCS) will coordinate these efforts with the Department of Public Works (DPW) Facilities and Highways Divisions, and the Department of Recreation and Parks (DRP).

Next Steps	Timeframe	Responsibility
Leverage the Street Tree program to prioritize heat vulnerable areas. Seek grants such as Maryland’s Urban Trees initiative to support this work.	2023-2025	DPW – Highways, OCS
Increase tree planting on private property in underserved communities. Howard County started a new Tree Canopy program in 2023 to work with homeowners to plant native shade trees on private property. Heat vulnerable, low tree canopy areas will continue to be prioritized.	2023-2025	DRP
Integrate shade trees into any new County facilities such as parks, playgrounds, and facilities. Maximize tree canopy in projects that fall within the heat vulnerable areas outlined in Action 5A.	2023-2024	DRP, DPW – Facilities
Include consideration for heat resiliency and underserved communities when evaluating and awarding County environmental grants.	Ongoing	OCS
Integrate shade trees and drought resistant vegetation into roadway construction projects such as Complete Streets.	2023-2024	DPW

Increase tree planting by homeowners through outreach, education, and connecting homeowners with tree planting incentives such as the Marylanders Plant Trees coupon, County tree planting programs, and giveaways. Continue to work with non-profits and schools on tree planting.	Ongoing	OCS, DRP
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Action 5C: Research and incorporate use of shade structures and cool surface technologies in public amenities and spaces

Nature-based solutions have the most co-benefits, but as annual average temperatures and extreme heat waves continue to increase across the country, structural cooling practices and products also need to be used. Prioritize high heat risk areas for shade structures and cool surfaces in amenities such as playgrounds and other high use paved surfaces.

Overcoming Barriers

Prioritizing projects based on heat vulnerable areas is a new concept that will take some time to research and incorporate into policy. It needs to be balanced with other priorities and brought to the attention of County staff.

Tracking Progress

Progress can be tracked by the number of shade structures, solar canopies, and other cooling technologies.

Implementation

The Department of Recreation and Parks (DRP) will be the lead implementer in coordination with the Department of Public Works (DPW) and the Department of Planning and Zoning (DPZ).

Next Steps	Timeframe	Responsibility
Document the use of shade and surface cooling technology that is already used in Howard County and share this information across departments.	2023-2024	DRP, DPW
Based on existing practices and new research, incorporate the use of shade structures and surface cooling technology into newly built public amenities and when older amenities are upgraded. Prioritize amenities in heat vulnerable areas.	2024-ongoing	DRP
Update or create regulations, policies, and standard operating procedures to ensure that these heat-reducing practices are formally incorporated into County projects.	2024-2027	DRP, DPZ, DPW

Strategy R6: Increase installation and facilitate maintenance of stormwater best management practices on residential, commercial, and non-profit properties

Increase the installation and long-term maintenance of small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics, preserve natural features, and minimize the impact of land development on water resources. These best practices may include bioretentions, rain gardens, conservation landscapes, and tree canopy expansion. Howard County already promotes many of these practices through existing programs. At a residential scale the impact may be small when looking at a single example, however widescale adoption of these practices can help reduce stormwater load as the frequency and intensity of rain events

increases. On commercial and non-profit properties, opportunities for larger projects can provide for larger scale treatment, as well as demonstration projects for the community. Additional outreach and education can generate further support and widespread adoption of these practices, including focused efforts toward demonstration sites. There is a need for ongoing support and resources to ensure proper maintenance of smaller-scale stormwater practices as part of post 2003 development. Providing outreach and educational materials to private property owners will assist in effectively installing and maintaining climate resilient stormwater management practices and ensure longevity of projects. Pairing these materials with financial incentives will foster rapid and effective stormwater management of Howard County's private property.

Why These Actions?

These actions expand upon existing programs, increase equity, provide greater incentives and thereby more participation, and promote the resilience of existing best management practices (BMPs) through maintenance. These program partnerships provide opportunities for educating large numbers of residents, as well as implementing larger-scale stormwater projects on private property, which are not addressed through capital projects.

Addressing Equity

Prioritizing projects within underserved and under-resourced communities imparts equity to this strategy. Identifying underserved communities and neighborhoods within vulnerable watersheds can help guide the prioritization of this strategy. Increasing the installation of stormwater BMPs will benefit existing stormwater infrastructure and add resiliency to communities by reducing the impact of stormwater runoff on properties during frequent smaller storms.

Howard County Leading by Example

Howard County provides multiple programs to incentivize stormwater management through all sectors of the built community. CleanScapes, Howard County's existing residential stormwater incentive program, installs stormwater BMPs in areas that pre-date modern stormwater development regulations. Howard County convened a Commercial Stormwater Solutions Work Group in 2016 with final recommendations for developing incentives and increasing participation in stormwater projects within the commercial sector. Based on this work group, Howard County developed a Commercial Stormwater Partnership Program to work with property owners to implement and retrofit stormwater practices while recognizing various financial strategies to make participation realistic. The Nonprofit Watershed Protection Partnership strives to maximize stormwater treatment on nonprofit properties, as well as community outreach, while providing a credit to the Nonprofit Partners' annual Watershed Protection Fee. Howard County piloted the Community Stormwater Partnership Grant program in 2022. This grant provides a funding source for Nonprofit Watershed Protection Partners to install stormwater solutions on their properties as part of their Partnership requirements, as well as provides much needed financial support to HOAs looking to install stormwater practices on shared common space.

Action 6A: Expand the CleanScapes program to increase installation and maintenance of stormwater practices on residential properties, with a focus on areas of high flood risk as well as underserved communities

Expand the CleanScapes program and related initiatives that increase the use of stormwater BMPs on residential properties. Broaden CleanScapes outreach efforts to target vulnerable watersheds and underserved communities; incorporate flood education resources into residential site visits by all Departments. Provide funding support for reconstructing BMPs that have reached the end of their life cycle.

Overcoming Barriers

Small-scale stormwater practices have the potential to make a big impact in terms of reducing stormwater runoff from frequent small storms, with the biggest potential coming from aggregating BMPs in areas where there is frequent flooding from lot-to-lot drainage. This approach to installation is challenging because not all homeowners will be willing

or able to participate, and focused outreach and education will be needed to make an impact, including increasing equity through new incentive programs.

Tracking Progress

The CleanScapes program will continue to be tracked through the number of BMPs installed and impervious surface reduction credits.

Implementation

The Office of Community Sustainability (OCS) will lead these actions and coordinate with the Department of Public Works (DPW).

Next Steps	Timeframe	Responsibility
Refine CleanScapes education and outreach materials to expand on the ecological and flood prevention benefits of these best practices, including maintenance information and resources.	Ongoing	OCS
Disseminate educational and outreach materials to property owners and community organizations, including those situated in vulnerable watersheds and underserved communities.	2023	OCS, DPW
Revise budgets as needed to account for program expansion. Hire/train new staff as needed to support program expansion.	Ongoing	OCS
Conduct workshops for landlords, tenants, realtors, and homeowners, particularly in underserved, flood-prone communities, and vulnerable watersheds to promote CleanScapes program.	Ongoing	OCS, DPW
Conduct ongoing research of new or innovative BMPs that can be included in the program and analysis of how to allow for increasing BMP quantity treatment.	Ongoing	OCS, DPW
Develop a BMP maintenance and reconstruction component of the CleanScapes program. Include considerations for post-2003 BMP installations that have reached the end of their life cycle.	2024-2025	OCS, DPW
Connect contractors to resources and technical experts to enhance and promote existing training programs or develop new programs.	Ongoing	OCS
Explore opportunities to expand eligibility for residents with varying income levels.	Ongoing	OCS

Action 6B: Enhance the Community Stormwater Partnership Grant program to further support stormwater best management practices in flood-prone areas, vulnerable watersheds, and underserved communities

Non-profits and HOAs are private landowners that tend to have large open space areas available for installation of stormwater practices. These sites also offer the potential for larger projects that are predominantly in shared spaces and provide an opportunity for educational signage to further community acceptance of nature-based stormwater solutions.

Overcoming Barriers

Stormwater solutions for nonprofits and HOAs are not currently provided through other means. This grant will aid these groups looking to treat stormwater runoff but struggling to fund projects. The effort will increase awareness and education to garner greater community support for stormwater treatment.

Tracking Progress

The number and dollar amount of grants awarded will be tracked each year.

Implementation

The Office of Community Sustainability (OCS) will implement these actions.

Next Steps	Timeline	Responsibility
Expand outreach and funding for the grant program to encourage new participation.	Ongoing	OCS
Incentivize or require Nonprofit Watershed Protection Partners to participate in the grant program.	Ongoing	OCS
Connect stakeholders with partners, resources, and technical experts to enhance and promote stormwater implementation.	Ongoing	OCS
Continue to include scoring for underserved communities and vulnerable watersheds in the grant review process.	Ongoing	OCS

Action 6C: Expand Commercial Stormwater Solutions Program to provide flexibility in program structure and account for the financial impacts of BMP installation and retrofits to property owners

Commercial properties have large areas of impervious surfaces and therefore can contribute significantly to stormwater runoff. Working with commercial properties also offers the opportunity for innovative projects, as seen through previous partnerships.

Overcoming Barriers

In most cases, stormwater treatment is not the focus of commercial property owners. Further, the current structure of the Watershed Protection and Restoration Fee and affiliated credit opportunities are rarely enough of an incentive for commercial properties to install or retrofit stormwater practices. Because of this, providing education and a variety of incentive options will encourage partnerships with the County.

Tracking Progress

The number of commercial partners and the impervious acre treatment credits provided through stormwater management installations or retrofits will continue to be tracked.

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer with assistance from the Department of Public Works (DPW).

Next Steps	Timeline	Responsibility
Research creative incentive programs, new requirements, and other options for commercial properties.	2024	OCS
Consider reconvening Commercial Stormwater Task Force to discuss incentives that will successfully increase the participation in the program.	2024-2025	OCS
Develop plans, budgets, and timeframes required for implementing participation incentives.	Ongoing	OCS

Consider implementing new incentives for properties that implement stormwater best practices.	Ongoing	OCS,
Continue to implement pilot projects on public properties owned and maintained by Howard County to serve as a model to private developments and property owners. Promote these pilot projects and lessons learned through videos, websites, printed brochures, and tours.	Ongoing	OCS, DPW

Action 6D: Provide BMP maintenance support and resources that ensure long term success of BMPs installed as part of new development

Providing resources and maintenance support to property owners, especially residential properties, who have BMPs installed on their property as part of the development process will address the long-term functionality of these systems. This is critical to ensuring that stormwater runoff from new developments is not negatively impacting local waterways and existing stormwater infrastructure. Howard County’s existing Watershed Protection and Restoration Fund needs to provide for an increased maintenance component for both large and smaller stormwater practices.

Overcoming Barriers

Property owners often struggle with BMP maintenance typically because of lack of understanding or available resources and funds to support the maintenance efforts. Unmaintained BMPs neglect to provide water quality treatment and can exacerbate water quality concerns if left to erode.

Implementation

The Office of Community Sustainability (OCS) will coordinate this effort with the Department of Public Works (DPW) and the Department of Planning and Zoning (DPZ).

Next Steps	Timeline	Responsibility
Develop criteria for what is most needed; BMP types, maintenance frequency, new install vs. long-term maintenance.	Ongoing	DPW, OCS
Hire/train new staff as needed to support action.	Ongoing	OCS, DPW
Connect contractors to sustainable landscaping resources and technical experts to enhance and promote existing training programs or develop new programs.	2023-Ongoing	OCS, DPW
Convene meetings with developers to determine the best way to disseminate BMP maintenance information.	2024	OCS, DPZ
Create a guide for developers to integrate BMP maintenance information into their sales.	2024-2025	OCS, DPZ
Develop a real estate outreach campaign for property owners purchasing sites with existing stormwater facilities.	2024-2025	OCS, DPW

Action 6E: Leverage existing Nonprofit Watershed Protection Partners to implement stormwater management and outreach

The existing Nonprofit Watershed Partnership should be reevaluated to be more effective. Nonprofit Partners are currently very inactive, and few have installed or retrofit practices on their properties. This Partnership provides an opportunity to work with nonprofits and utilize their lands to provide greater stormwater management.

Overcoming Barriers

Howard County’s existing Watershed Protection and Restoration Fund provides a credit of 100% to nonprofits joining the Partnership, however more parameters and requirements would make the Partnership more effective.

Tracking Progress

The Nonprofit partnership will be tracked by number of participants and their project implementation.

Implementation

The Office of Community Sustainability (OCS) will implement these steps.

Next Steps	Timeline	Responsibility
Research and propose additional parameters and requirements for the Partnership.	2023-2024	OCS
Develop criteria for what is most needed to increase participation in nonprofit stormwater implementation efforts.	2023-2024	OCS
Hire/train new staff to support the Partnership and assist in securing additional funding for projects.	Ongoing	OCS
Develop an outreach and assistance program for Partners.	2024-2025	OCS

Strategy R7: Prioritize stormwater management by strengthening regulations, policies, and innovation

Implement climate resilient stormwater management regulations, policies, and programs utilizing the best available climate science and best practices to design stormwater systems for forecasted future climate conditions. Strengthen existing initiatives, update infrastructure, incorporate new maintenance efforts, and ensure adequate funding.

Why These Actions?

As weather events continue to become more severe and intense, greater stormwater management is needed throughout the County, especially in flood prone areas. These actions will promote a synchronized approach to future policy and regulation changes. Improving infrastructure, and adjusting design guidelines to incorporate climate change projections, will restore and create new functionality within the stormwater management system and effectively prepare Howard County to withstand increased climate impacts. This will reduce the need for service repairs and the impacts of flooding on homes, business operations, utility infrastructure, and buildings.

Utilizing innovative and nature-based systems to maximize stormwater treatment options will increase co-benefits and added resiliency. Additional funding is needed to be able to provide necessary maintenance, upgrades, and additional infrastructure and treatment facilities.

Addressing Equity

Prioritizing stormwater improvements in underserved and under-resourced communities who are simultaneously situated within floodplains or frequently flooded areas will bring equity to this implementation process. Prioritizing these locations ahead of well-resourced areas increases the overall equity of this strategy.

Howard County Leading by Example

A Stormwater Subcabinet previously met to discuss issues and ideas and established the precedent to work across agencies on stormwater management issues, policies, and practices. Howard County continues to work across departments on stormwater projects regularly to ensure the greatest outcome and co-benefits.

Action 7A: Develop a Howard County specific stormwater management guide

Develop an understanding of what presently works well to combat issues related to stormwater management and what perceived gaps might be filled by innovative and new strategies. Package the findings of pilot projects, past experiences, priorities, funding options, and policies for Howard County staff into a guidance document. The document should also include forecasting for future weather events and how our stormwater management can adapt and be prepared, as well as any associated policy or regulation adjustments needed for resiliency. Fund a study of possible innovative solutions and strategies, including examples of what has worked and failed elsewhere.

Overcoming Barriers

The Maryland Stormwater Design Manual, prepared by MDE, provides performance criteria and design specifications for a variety of stormwater infrastructure throughout Maryland. A Howard County specific guide could provide insight into the most successful project types and applications, areas where our regulations differ from the state, and priorities for implementation both in terms of locations and types of practices. The guide can provide an overview of the operations and maintenance costs and protocols for new stormwater management techniques or strategies not outlined in detail by MDE.

Implementation

The Office of Community Sustainability (OCS) will be the lead implementer in close coordination with the Department of Public Works (DPW) and with input from the Department of Planning & Zoning (DPZ).

Next Steps	Timeline	Responsibility
Strategize on funding sources to secure a consultant team to assist in creating a Howard County Stormwater Guide.	2023	OCS, DPW
If funding is secured, procure a scope that requests the creation of a guide with specific attention on innovative stormwater management practices and climate resilience.	2024-2025	OCS, DPW
Produce the guide and include best practices using consultant expertise and stakeholder engagement with operations and maintenance departments and any departments working within the stormwater management space.	2025	OCS, DPW, DPZ
Continue to adjust and update the guide and keep staff aware of new projects and techniques.	2025-ongoing	OCS

Action 7B: Consider adjusting and strengthening stormwater management regulations based on climate change predictions

Consider increasing stormwater management regulations for redevelopment, as well as expanding special stormwater management zones requiring higher treatment levels for watersheds with known or predicted flooding. Also consider increasing stormwater treatment requirements based on scientific predictions for future weather events.

Overcoming Barriers

Howard County currently follows MDE guidance for water quality and quantity for stormwater management, however greater regulations may be needed with increasing storm events and flooding areas.

Implementation

The Office of Community Sustainability (OCS), Department of Public Works (DPW), and Department of Planning & Zoning (DPZ) will coordinate on this effort.

Next Steps	Timeline	Responsibility
Coordinate between agencies to determine realistic options for strengthening regulations.	Ongoing	OCS, DPZ, DPW
Develop policy or legislation as needed to update regulations in coordination with Maryland Department of the Environment's Advancing Stormwater Resiliency in Maryland (A-StoRM) report.	Ongoing	DPW, OCS, DPZ

Action 7C: Increase support for maintenance and infrastructure updates

Provide funding dedicated to maintenance of existing stormwater management infrastructure, including storm drains, environmental site design practices, and stormwater ponds. Prioritize funding and action based on climate predictions and proximity to vulnerable watersheds and underserved populations.

Overcoming Barriers

Currently very little funding is available for maintenance and inspections of facilities and storm drain system upgrades. Storm drain systems are reaching end of life and will continue to fail without replacements causing severe damage and safety concerns. New Environmental Site Design (ESD) practices installed will fail without proper maintenance leading to poor water quality and increased runoff impacts. The large quantity of required ESD practices requires an increase in funding for inspections as well.

Tracking Progress

All facilities will continue to be inspected triennially and the status and expected life span of each will be tracked to ensure maintenance is occurring and being prioritized on critical facilities.

Implementation

The Department of Public Works (DPW) will be the lead implementer with assistance from the Office of Community Sustainability (OCS) and Howard County Public School System (HCPSS).

Next Steps	Timeframe	Responsibility
Research funding needs to provide critical inspections, maintenance, and upgrades of infrastructure.	2023 - Ongoing	DPW
Research and pilot additional workforce development opportunities and employment efforts to increase labor available for needed maintenance and inspections.	Ongoing	DPW
Coordinate with HCPSS to provide training for grounds staff who maintain stormwater BMP's on HCPSS property.	2023-Ongoing	OCS, DPW, HCPSS
Continue to implement innovative strategies that may reduce maintenance needs.	Ongoing	DPW, OCS
Establish inclusion of additional funding and a long-term funding strategy to be adopted through the annual County budget process.	2023-Ongoing	DPW, OCS

Action 7D: Employ innovation and natural solutions in stormwater management

Seek opportunities to employ innovative best practices to maximize stormwater quantity and quality control within existing stormwater management infrastructure and/or for creating new stormwater storage capacity on already developed land. Consider natural solutions prior to structural solutions in all cases and only select structural solutions after careful analysis and elimination of alternatives.

Overcoming Barriers

While structural and engineered solutions are more commonplace and familiar, innovative and natural practices often have a greater potential for providing multi-benefit solutions, such as water quantity and quality treatment, while also providing habitat or carbon sequestration and should be chosen over structural solutions in all possible opportunities.

Implementation

The Office of Community Sustainability (OCS) will coordinate these efforts with the Department of Public Works (DPW).

Next Steps	Timeframe	Responsibility
Research best practices and innovative ideas that have been piloted in other communities and look to pilot or adapt them in Howard County.	Ongoing	OCS, DPW
Develop a checklist, SOP, or policy to assess the practicality of nature-based solutions for each project and prioritize these practices over structural whenever appropriate.	2024	OCS, DPW
Continue to look for new opportunities to incorporate stormwater management and nature-based solutions in other County projects (such as road work, complete streets, and development) or including additional stormwater management above what is required.	Ongoing	OCS, DPW
Provide increased support (staff and funding) for the commercial stormwater partnership program and nonprofit partnership program to allow new partnerships and innovative implementation options on private property.	Ongoing	OCS

Action 7E: Establish a fund for pilot projects to encourage innovation

Establish a fund to support pilot projects that test new solutions on a small scale. Establish baseline performance of pilot projects and develop scalable plans to implement successful pilot projects throughout Howard County. Simultaneously, begin to identify local, state, and federal public and private resources that can fund large scale implementation programs. Pilot projects are an effective initiative to understand the benefits of innovative stormwater management practices, while also piloting the cost, operations, and maintenance required to steward such stormwater management infrastructure.

Overcoming Barriers

Pilot projects and new partnerships can sometimes be overlooked if clear funding isn't available to test new solutions and innovation. Dedicated funding for pilot projects allows for new partnership development and testing of innovative solutions.

Implementation

The Office of Community Sustainability (OCS) will lead this effort in close coordination with the Department of Public Works (DPW).

Next Steps	Timeframe	Responsibility
Establish a fund for the engineering design and construction of pilot projects in Howard County's annual budget cycle.	2024-2025	DPW, OCS
Utilize funds to implement and test innovative practices and partnerships.	Ongoing	OCS, DPW
If pilot projects are successful, integrate these stormwater management practices into large scale implementation programs.	Ongoing	OCS, DPW

Action 7F: Explore increasing the Watershed Protection and Restoration Fee, as well as alternative funding solutions

Consider a variety of fee increase structures and explore funding opportunities from private, state, and federal sources, as well as additional funding structures such as public private partnerships and cost share programs.

Overcoming Barriers

Current fee rates do not provide an incentive for larger private property owners to participate in stormwater treatment installation or upgrades. Howard County instituted a Watershed Protection and Restoration Fee in 2013, however it has yet to be updated to reflect inflation, maintenance needs, and impending greater treatment requirements because of severe weather.

Tracking Progress

The impervious surface treatment provided utilizing Watershed Fee revenue will continue to be tracked and reported to the State and County.

Implementation

The Office of Community Sustainability (OCS) will lead this effort in coordination with the Department of Public Works (DPW) and Department of County Administration (DCA).

Next Steps	Timeline	Responsibility
Work with consultant to provide various Fee structures to increase the revenue into the Watershed Protection and Restoration Fund.	2023	OCS
Provide outreach and education to residents and property owners regarding potential Fee changes.	2023-2024	OCS, DPW
Provide a proposal to the County Administration for Fee restructuring and introduce associated legislation.	2023	OCS, DCA, DPW
Explore other funding opportunities from various sources.	Ongoing	OCS, DPW

Action 7G: Improve reclaimed water capacity and usage

Rainwater and reclaimed water can be valuable resources during climate change. Howard County currently purchases all potable water from outside sources. Capturing and reutilizing rainwater greatly improves County-wide resiliency and reduces dependence on other sources for non-potable water needs. This will also reduce our demand on the regional water supply should neighboring jurisdictions face a water shortage or threat. Capturing rainwater and reclaimed treatment plant water to be repurposed, reduces stormwater flows as well as demand on infrastructure and potable water resources. This water can be utilized for a multitude of applications and be essential during severe storm or emergency events, drought, or if water systems are compromised.

Overcoming Barriers

Howard County piloted a few small-scale rainwater collection systems (cisterns) with mixed success, including at fire stations for truck washing. Learning from these efforts can improve our ability to be more water independent moving forward.

Tracking Progress

The amount of rainwater and reclaimed water redirected for other uses will be tracked.

Implementation

The Office of Community Sustainability will lead implementation of these actions in collaboration with Department of Public Works (DPW), Department of Inspections, Licenses, and Permits (DILP), and Department of Fire and Rescue Services (DFRS).

Next Steps	Timeline	Responsibility
Assess existing cistern systems and determine successes, failures, and use restrictions.	2024	OCS, DPW, DFRS, DILP
Where possible provide maintenance plans, repairs, or enhancements for existing systems.	2024-Ongoing	OCS, DPW, DFRS
Review current code language regarding water reuse (currently optional for Howard County) and explore expanding the County’s reclaimed water systems for non-potable water requirements and potential future needs related to climate change, water independence, and community resiliency.	2024	OCS, DPW, DILP
Establish funding to support the expansion of reclaimed water usage and consider funding opportunities from various sources.	Ongoing	OCS, DPW

Strategy R8: Determine vulnerable watersheds and prioritize recommended stormwater solutions

Create a program focused entirely on Vulnerable Watersheds, defined as areas within the County subject to flooding both from overflowing streams and from local drainage systems inadequate to convey runoff from large storm events. As weather events continue to intensify, prioritize identifying, assessing, and implementing actions to aid these communities. Long term sustainability and maintenance of installed projects must be carefully considered and planned, including dedicated funding. Utilizing innovative and nature-based systems to maximize stormwater treatment options in these Vulnerable Watersheds will increase co-benefits and resiliency.

Why These Actions?

This action was chosen because increasing weather events will only exacerbate existing flooding concerns in certain areas of the County, and possibly cause flooding in new areas. Working to identify and reduce flooding by watershed will maximize the impact in the community.

Addressing Equity

To address flooding issues in vulnerable communities, we must first identify locations and potential solutions. This strategy calls for short and long-term planning and will include prioritizing stormwater improvements in underserved and under-resourced communities where frequent or severe flooding occurs.

Howard County Leading by Example

Howard County’s existing small watershed plans and known past flooding experiences will help guide efforts in this program.

Action 8A: Establish a new program designed to aid Vulnerable Watersheds

Create a Vulnerable Watershed Restoration and Resiliency Program to assist communities with flooding issues, including severe erosion. Utilize a set of criteria to locate, assess, and implement recommendations to assist in flooding and its associated impacts. Prioritize recommended stormwater enhancements and maintenance in these areas of the County to create more resilient neighborhoods.

Overcoming Barriers

Proactive rehabilitation and improvements to stormwater infrastructure can reduce the impacts of heavy precipitation and flooding instances. Improving the functionality of these systems before a storm hits will effectively prepare Howard County to withstand these climate impacts. Ensuring dedicated funding is critical to creating an effective difference in these vulnerable watersheds.

Implementation

The Department of Public Works (DPW) will lead these actions with close coordination with the Office of Community Sustainability (OCS).

Next Steps	Timeline	Responsibility
Establish a fund for the Vulnerable Watershed Restoration and Resiliency Program through a budget request each year.	Ongoing	DPW
Seek outside funding opportunities such as grants and partnerships.	Ongoing	DPW, OCS
Develop criteria utilizing best available data and science to define and prioritize Vulnerable Watersheds.	2023	DPW, OCS
Provide a comprehensive analysis for each Vulnerable Watershed, including existing storm drainage and stormwater controls, noted concerns, predictions for future impacts due to increased weather events, and generate a list of strategies and projects to combat the drainage and flooding issues in each watershed.	2023-ongoing	DPW, OCS
Utilize the analysis to methodically implement effective projects that will increase stormwater management and reduce flooding. Each project should have a long-term plan for maintenance to ensure the sustainability of these efforts and maximize neighborhood resiliency.	2024-ongoing	DPW, OCS
Focus solutions on employing tools that work with natural systems and the existing land, and reducing gray infrastructure, when possible, to maximize co-benefits within the neighborhood.	Ongoing	DPW, OCS
Increase staffing or contractual awards as needed to continue progress.	Ongoing	DPW, OCS

Strategy R9: Maximize the resiliency benefits derived from ecosystem services by improving protections for wetlands, forests, and streams and increasing the acreage of these resources through restoration or creation

Ensure that the resiliency benefits provided by ecosystems are valued and protected. Healthy wetlands, forests, and streams mitigate environmental conditions more cost effectively than engineered systems and have greater co-benefits. These ecosystems absorb water and wind, mitigate heat, treat pollution, and perform many other ecosystem services essential to human health. These services are increasing in value as we prepare for a changing climate.

Why These Actions?

Wetlands, forests, and streams act as natural sponges and filters in the landscape. They absorb water and the energy that carries it during storms. They sequester carbon and remove or breakdown various pollutants from the air, ground, and water. These ecosystems provide countless additional services which need to be better understood and supported as we prepare for increased community stressors associated with climate change.

Addressing Equity

At risk and underserved populations often have fewer resources available to prepare for, and respond to, environmental hazards and disasters. As a result, these communities are more reliant on ecosystem services to mitigate conditions after an extreme weather event, and for maintaining quality of life in general as our climate continues to change.

Howard County Leading by Example

Howard County protects its natural resources through a combination of zoning and land development regulations, comprehensive plans, implementation manuals, habitat management plans, incentive programs and educational efforts. Together, these tools provide a system for protecting natural resources and the goods and services they provide, greatly contributing to Howard County's high quality of life. In preparation for the increased stressors from climate change, Howard County is always looking at new and improved measures for natural resource management, to improve the resiliency and mitigation capacity of our landscape and provide a healthy environment to the next generations.

Action 9A: Improve the protection of existing wetlands, restore degraded wetlands, and investigate wetland creation opportunities

Consider increasing buffers or other protections for wetlands, especially in vulnerable watersheds and near underserved populations. Investigate options for wetland preservation, restoration, and creation.

Overcoming Barriers

Many wetlands are on private land, but stormwater management and farm management practices lend themselves to opportunities to address the concerns of multiple stakeholders through wetland stewardship.

Implementation

Department of Planning and Zoning (DPZ) will manage buffer width assessments and other regulatory aspects of this action. The Office of Community Sustainability (OCS) will lead on researching sites for wetland preservation, restoration, and creation. The Department of Recreation and Parks (DRP) and Department of Public Works (DPW) will lead on implementation projects occurring on County property. Howard Soil Conservation District (HSCD) and Howard County Economic Development Authority (EDA) will assist with any implementation steps involving agricultural properties.

Next Steps	Timeframe	Responsibility
Consider increasing buffer widths for wetlands in flood vulnerable areas.	2025-2027	DPZ, OCS
Investigate opportunities for mitigation requirements to proposed impacts to wetlands or wetland buffers.	2025-2027	DPZ, OCS
Continue to work with developers to evaluate more environmentally friendly site design options when considering requests for alternative compliance to wetland regulations.	Ongoing	DPZ, OCS
Investigate opportunities for wetland protection, restoration, expansion, and creation across land uses. Partner with universities, nonprofits, agricultural property owners, and the environmental restoration industry.	Ongoing	OCS, DPZ, HSCD, EDA

Prioritize and begin implementation of the projects discovered in the investigation described above.	2025-2027	OCS, DRP, DPW, DPZ, HSCD, EDA
Explore new funding sources for implementation of wetland protection, restoration, and creation projects.	Ongoing	OCS, DRP, DPZ, DPW
Encourage developers to remove existing culverts, bridges, and structures within wetlands and their buffers, restore onsite wetlands, and maintain natural hydrology as part of site development.	Ongoing	DPZ, OCS, DPW
Consider creating a resource protection goal for wetlands and their buffers for each of the County's major watersheds.	2025-2027	DPZ, DRP, OCS

Action 9B: Improve the protection of existing forests, restore degraded forests, and increase forest acreage where possible. Retain and expand non-forest tree canopy

Use a variety of tools to protect and enhance the County's forest and tree canopy resources. Further research our forest needs. Look at different types of forests and tree canopy and how they might merit different levels of protection in preparation for climate change. Periodic updates of the Forest Conservation Act and Forest Conservation Manual, and funding for the upkeep of Forest Conservation Easements and other County owned, forested lands are all essential to successful forest protection in Howard County.

Overcoming Barriers

Much of the county's forest and tree canopy is located on property which is not owned by the County, but by private or Maryland state entities, limiting the County's influence over those properties. Forest fragmentation, prolific invasive species, and an overpopulation of deer are major threats to the long-term health of forest and tree canopy resources. Howard County's land holdings have increased considerably in the last 20 years and additional staff and funding is needed to manage the extensive forested lands owned by the County.

Implementation

The Department of Recreation and Parks (DRP) and the Department of Planning and Zoning (DPZ) are the lead departments responsible for the protection of forest resources. The Office of Community Sustainability (OCS) and Department of Public Works (DPW) play a supporting role in many of the departmental forest management efforts.

Next Steps	Timeframe	Responsibility
Increase the maintenance of existing forest resources on County land.	Ongoing	DRP, OCS
Provide incentives for maintenance of existing forests on private property.	2026	OCS, DRP
Prioritize opportunities to protect and expand forests in climate vulnerable and underserved communities.	Ongoing	OCS, DRP, DPZ
Develop partnerships with state and federal agencies to manage forests on public, non-county property.	2025	OCS, DPW, DRP
Continue to work with developers to evaluate more environmentally friendly site design when considering requests for alternative compliance to the Forest Conservation Act.	Ongoing	DPZ, OCS, DRP
Evaluate the effects of recent updates to the County and State Forest Conservation Acts and consider updates to the County Forest Conservation Act and Forest Conservation Manual to address any gaps in tree protection during the development process.	2023-2030	DPZ, DRP, OCS
Keep abreast of and advocate for state and federal programs that offer incentives for preserving forests such as forest banking and carbon credits.	Ongoing	OCS, DPZ, DRP
Increase non-forest canopy.	Ongoing	DRP, OCS, DPW

Develop funding avenues to hire additional natural resource focused staff for Forest Conservation Easement inspections, forest maintenance, public outreach, and other emerging needs.	Ongoing	OCS, DRP, DPZ
Investigate new methods of controlling the overpopulation of white-tailed deer.	2024	DRP, OCS, DPZ
Encourage the removal of invasive species in development projects.	Ongoing	DPZ, DRP, OCS
Investigate measures to improve the onsite retention of higher quality forests and connections between larger forest patches.	Ongoing	DPZ, OCS, DRP
Consider creating a resource protection goal for forests and tree canopy for each of the County's major watersheds.	2025-2027	DPW, DPZ, DRP, OCS

Action 9C: Improve the protection of streams, restore degraded streams, and increase stream buffers where possible

Improving stream resiliency benefits to developed areas and ecosystems. The ability of stream systems to absorb and retain water volume and dissipate erosive energy is reliant on the health of the stream prior to a severe weather event. Streams that are connected to their floodplains and streams with forested banks and buffers are more resilient to extreme weather and provide greater resiliency benefits to surrounding developments.

Overcoming Barriers

Watersheds comprise large areas with many different property owners and land uses, which contribute to or detract from stream health. Many stakeholders prefer to be able to utilize streams and stream buffers in ways that may complicate their protection, including commercial development, farming, and residential uses.

Implementation

The Department of Planning and Zoning (DPZ) will lead on regulatory aspects of stream protection. The Department of Public Works (DPW), Department of Recreation and Parks (DRP), and Office of Community Sustainability (OCS) play various implementation roles in stream protection and restoration.

Next Steps	Timeframe	Responsibility
Consider increasing buffer widths for streams in flood vulnerable watersheds, underserved populations, or other defined areas as a part of any future code updates.	2025-2027	DPZ, OCS
Continue to work with developers to evaluate more environmentally friendly site design when considering requests for alternative compliance to stream and stream buffer regulations.	Ongoing	DPZ, DRP, OCS
Research streams with potential for improved buffers and floodplain connections, particularly in flood vulnerable and underserved communities. Partner in this effort with nonprofits, environmental restoration companies, universities, and other private entities as appropriate.	Ongoing	OCS, DPW, DRP, DPZ
Increase outreach to landowners with potential to improve stream buffers and connect landowners with resources to incentivize buffer planting.	2025-2026	OCS, DRP
Increase funding available for this action by expanding existing funding sources and exploring and applying for new funding sources.	Ongoing	OCS, DPZ, DRP
Encourage the removal of invasive species within stream buffers.	Ongoing	DPZ, OCS, DRP

Encourage developers to remove existing culverts, bridges, and structures within streams and their buffers, and restore streams as part of site development.	Ongoing	DPZ, OCS, DPW, DRP
Prioritize forest retention and native planting in floodplains and riparian areas.	Ongoing	DPZ, DRP, OCS
Investigate opportunities for mitigation requirements to proposed impacts to streams and stream buffers.	2025-2027	DPZ, OCS, DRP
Consider creating a resource protection goal for stream buffers for each of the County's major watersheds.	2025-2027	DPZ, DPW, OCS
Consider expanding the scope of watershed management plans to set priorities and guide efforts to protect, restore, and improve the County's environmental resources.	2025-2027	DPW, DPZ, OCS

Action 9D: Protect and enhance the natural resources in the Green Infrastructure Network

Connectivity between ecosystems is critical for their health and function, especially in the wake of a natural disaster or with shifting climate patterns. After a major disturbance such as fire, flood, or an insect invasion, ecosystems which are connected to healthy ecosystems will recover more quickly than areas without those connections. Similarly, if shifting weather patterns degrade an ecosystem in one location, such as the long-term drying of a wetland, the Green Infrastructure Network (GIN) provides potential routes for species to emigrate to other locations. The plant and animal species in the GIN rely on its connectivity for their long-term vitality, and human populations rely on the ecosystem services provided by these species and their associated ecosystems.

Overcoming Barriers

Much of the land in the GIN is privately owned, limiting the County's influence over those properties. The GIN does not currently have any specific legal protection; however, most of the land in the GIN is already protected.

Implementation

The Department of Planning and Zoning (DPZ) leads the overall management of the GIN Program including updating the GIN Map and GIN Plan. The Department of Recreation and Parks (DRP) manages the natural resources present on County owned properties as well as the acquisition of properties for conservation purposes. The Office of Community Sustainability (OCS) supports the GIN Plan by exploring new funding and stewardship opportunities for GIN related projects and educating the public about the GIN.

Next Steps	Timeframe	Responsibility
Use the guidance in the GIN Plan to determine the most desirable land or easement purchases in the GIN.	Ongoing	DPZ, OCS, DRP
Purchase easements or land in the GIN.	Ongoing	DPZ, OCS, DRP
Continue to implement the GIN Plan using the tools of stewardship, financial incentives, regulatory protection, easements, and acquisition.	Ongoing	DPZ, OCS, DRP
Research additional implementation options and regulatory measures to those presented in the GIN Plan.	Ongoing	DPZ, OCS, DRP
Increase funding available for this action by expanding existing funding sources and exploring and applying for new funding sources.	Ongoing	OCS, DPZ, DRP

Action 9E: Ensure that planting practices evolve to be resilient to climate change

Assess planting pallets across County programs, including the development of new County facilities, land development regulations, tree planting programs and other environmental incentive programs such as CleanScapes.

Overcoming Barriers

Guidance regarding which plants to use in projects ranging from forestation to landscaping, with respect to a changing climate, is limited but emerging as land managers predict the need to reevaluate planting plans and management methods moving forward.

Implementation

The Department of Recreation and Parks (DRP), Department of Public Works (DPW), Department of Planning and Zoning (DPZ), and Office of Community Sustainability (OCS) will share knowledge gained while considering updates to the plants recommended or accepted for use in their programs.

Next Steps	Timeframe	Responsibility
Research the latest science on the best trees and landscape plants that are adaptable to a changing climate and incorporate these findings into existing County programs. Increased heat, drought, and intense rain events are specific concerns.	2023-2025	DRP, OCS, DPZ
Update the Landscape Manual and include considerations for heat, drought, and intense rain events. Increase requirements for native plants and prohibit the use of invasive species.	2023-2025	DPZ, OCS, DRP
Provide resources to educate and guide County staff, developers, landscape professionals, and other stakeholders about updated best practices, new landscaping requirements, and the reasons for their use.	2025-2026	DPZ, OCS, DPW
Determine if updates are needed for required and recommended planting guidelines that are not covered in the Landscape Manual.	2025-2026	DRP, DPZ, OCS

Appendices

- **Appendix A: Strategy and Action Summary**
- **Appendix B: Glossary**
- **Appendix C: Climate Vulnerability Assessment Methodology**
- **Appendix D: Climate Emergency Preparedness Survey Summary**
- **Appendix E: Greenhouse Gas Emissions Inventory Methods**
- **Appendix F: Mitigation Analysis Assumptions and Methods**
- **Appendix G: Current Howard County Climate Initiatives**

¹ Baltimore Metropolitan Council and Baltimore Regional Transportation Board. Planning, Designing, Operating, and Maintaining Local Infrastructure in a Changing Climate. 2021. https://www.baltometro.org/sites/default/files/bmc_documents/general/transportation/climate-change/Climate%20Change%20Resource%20Guide.pdf

² The Columbia Association. *Climate Vulnerability Assessment Columbia, Maryland*. 2021. <https://www.columbiaassociation.org/wp-content/uploads/2022/01/CA-Climate-Vulnerability-Assessment-121021.pdf>

³ The climate projections cited from the BMC study assume RCP 8.5. For more information about their analysis assumptions, please refer directly to that report.

⁴ BMC (2021) defines *heatwaves* as 3 consecutive days above the 98th percentile temperature.

⁵ Data from the Climate Toolbox (<https://climatetoolbox.org/tool/Climate-Mapper>) indicates Howard County's minimum relative humidity during the summer to be around the mid-40s, averaged over the time period 1971-2000; maximum relative humidity can climb into the 90s. Relative humidity tends to fall as temperatures climb, so the minimum relative humidity levels would more likely occur during the maximum temperatures in a day. There is variation across the County and across days and years, but suffice to say, Howard County often experiences high humidity levels during the summer, and that these levels are sufficient to create heat index levels of Dangerous or Extremely Dangerous.

⁶ National Weather Service. What is the heat index? <https://www.weather.gov/ama/heatindex>

⁷ BMC (2021) defines *extremely heavy precipitation* event as 95th percentile of days with precipitation. In more simple terms, when looking at all of the days in a given year that had some precipitation, it is the amount of precipitation that the 5% of the highest precipitation days exceed. So, if 100 days in a year had at least some precipitation, the 5 rainiest (or snowiest) days would be considered *extremely heavy precipitation* events.

⁸ U.S. Geological Survey, Water Science School. The 100-Year Flood. (2018) <https://www.usgs.gov/special-topics/water-science-school/science/100-year-flood#:~:text=The%20100%2Dyear%20recurrence%20interval,year%20is%201%20in%20100.>

⁹ National Weather Service. Ellicott City Historic Rain and Flash Flood – July 30, 2016. <https://www.weather.gov/lwx/EllicottCityFlood2016>

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¹¹ U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service. *The Historic Derecho of June 29, 2012*. 2013. <https://www.weather.gov/media/publications/assessments/derecho12.pdf>

¹² Kretschmer M, et al. More-Persistent Weak Stratospheric Polar Vortex States Linked to Cold Extremes. *Bulletin of the American Meteorological Society*. 99 (1): 49-60. 2018. <https://doi.org/10.1175/BAMS-D-16-0259.1>

¹³ Zhang P, et al. Prolonged Effect of the Stratospheric Pathway in Linking Barents–Kara Sea Ice Variability to the Midlatitude Circulation in a Simplified Model. *Climate Dynamics*. 50: 527-539. 2018. <https://doi.org/10.1007/s00382-017-3624-y>

¹⁴ Overland J, et al. The Melting Arctic and Midlatitude Weather Patterns: Are They Connected? *Journal of Climate*. 28 (20): 7917-7932. 2015. <https://doi.org/10.1175/JCLI-D-14-00822.1>

¹⁵ Kim B, et al. Weakening of the Stratospheric Polar Vortex by Arctic Sea-ice Loss. *Nature Communications*. 5, 4646. 2014. <https://doi.org/10.1038/ncomms5646>

¹⁶ Baltimore Metropolitan Council. 2022. "Vulnerable Populations Index". <https://www.baltometro.org/transportation/data-maps/vulnerable-populations-index>. Accessed August 2022.

¹⁷ The Columbia Association. *Climate Vulnerability Assessment Columbia, Maryland*. 2021. <https://www.columbiaassociation.org/wp-content/uploads/2022/01/CA-Climate-Vulnerability-Assessment-121021.pdf>

¹⁸ State Highway Administration of Maryland. https://www.roads.maryland.gov/OPPEN/annual_vehicle_Class.pdf

¹⁹ National Caucus of Environmental Legislators (NCEL). Maryland Passes the Climate Solutions Now Act. April 11, 2022. <https://www.ncelenviro.org/articles/maryland-passes-the-climate-solutions-now-act/>

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- ²¹ U.S. Department of Transportation. The Bipartisan Infrastructure Law Will Deliver for Maryland. April 13, 2022. <https://www.transportation.gov/briefing-room/bipartisan-infrastructure-law-will-deliver-maryland#:~:text=Under%20the%20Bipartisan%20Infrastructure%20Law%2C%20Maryland%20would%20expect%20to%20receive,billion%20available%20for%20EV%20charging.>
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Appendix A: Strategy and Action Summary

Climate and Equity Focused Governance Strategies

Strategy G-1: Establish a Climate Action Subcabinet

Strategy G-2: Prioritize Climate Action in all Aspects of Planning and Operations

Strategy G-3: Integrate Equity and Inclusivity into All Climate Action and Prioritize Communities Most Vulnerable to the Impacts of Climate Change

Strategy G-4: Communicate Climate Action Progress Regularly and Transparently and Create Outreach That Engages the Community in Accomplishing Goals

Strategy G-5: Leverage State and Federal Programs and Funding Sources Whenever Possible to Advance Climate Action

Mitigation Strategies: Energy

Strategy E1: Reduce Greenhouse Gas Emissions from Existing Buildings

- Action 1: Increase energy efficiency and conservation in all existing residential, commercial and government buildings
- Action 2: Increase electrification in existing residential, commercial and government buildings
- Action 3: Accelerate the adoption of low GWP refrigeration and air conditioning equipment in commercial properties and reduce refrigerant leaks

Strategy E2: Construct Efficient and Low-Carbon Buildings

- Action 1: Implement more stringent green building standards for new residential, commercial, and government properties
- Action 2: Phase-in requirements for all-electric new construction for residential, commercial and government properties

Strategy E3: Decarbonize the Energy Supply

- Action 1: Expand the development of solar energy for residential, commercial, and government properties

Mitigation Strategies: Transportation

Strategy T1: Maximize the Use of Electric Vehicles

- Action 1: Continue to develop a robust EV charging station infrastructure
- Action 2: Accelerate the adoption of electric vehicles in the community and County government fleet
- Action 3: Transition to a zero-emissions transit vehicle fleet
- Action 4: Transition to a zero-emissions school bus fleet

Strategy T2: Reduce Vehicle Miles Traveled in Single Occupancy Vehicles

- Action 1: Increase public transit ridership by enhancing the effectiveness and reliability of local and regional public transit
- Action 2: Implement microtransit in less dense areas that have a demonstrated need of connection between homes, jobs, and services
- Action 3: Expand and improve sidewalks, crosswalks, pathways and bike lanes and connect them to jobs, shopping, schools, and recreational amenities
- Action 4: Increase and normalize teleworking options for employees whenever possible
- Action 5: Implement policies, outreach programs, and incentives to promote individual behavior changes to reduce emissions from personal vehicles

Mitigation Strategies: Waste

Strategy W1: Reduce Organic Waste Sent to Landfills and Manage Landfill Methane

- Action 1: Reduce organic waste and expand composting in the residential sector
- Action 2: Incentivize businesses and schools to reduce organic waste and participate in composting
- Action 3: Ensure that Howard County's Alpha Ridge Landfill and closed landfills meet or exceed the state and federal methane requirements.

Strategy W2: Expand the Use of Sustainable Materials and Reduce Waste Generation and Disposal

- Action 1: Improve sustainable procurement in government operations
- Action 2: Reduce the use of single-use items, particularly plastics and promote waste reduction and reuse throughout Howard County

Mitigation Strategies: Nature-Based

Strategy N1: Support Nature Based Climate Solutions to Improve Soil Health, Increase Carbon Sequestration, and Reduce Emissions

- Action 1: Incentivize adoption of Natural Resources Conservation Service (NRCS) conservation practices that reduce GHG's and sequester carbon
- Action 2: Improve soil health on private lands through outreach and program expansion
- Action 3: Increase sustainable landscaping practices on public lands to improve soil health and reduce GHG emissions

Strategy N2: Conserve Existing Forests and Expand the Tree Canopy

- Action 1: Protect and restore forest and non-forest tree canopy

Resiliency Strategies

Strategy R-1: Become a model for excellent communication, education, and outreach about climate hazards, emergency preparedness, and available resources

- Action 1A: Create a one stop shop for all resources and services relating to climate hazards
- Action 1B: Improve existing communication, education, and outreach methods and research best practices to reach communities
- Action 1C: Ensure equitable access to information
- Action 1D: Maximize outreach opportunities by layering emergency preparedness information into County communication tools

Strategy R-2: Improve emergency preparedness of Howard County citizens

- Action 2A: Increase number of individual citizens with emergency kits and emergency plans
- Action 2B: Increase capacity of organizations that can provide emergency services before and during an emergency
- Action 2C: Target more education and outreach efforts about emergency preparedness and climate action to communities most vulnerable to heat and flooding impacts

Strategy R-3: Improve access to emergency shelters, cooling centers, and resources during climate hazard events, especially for underserved and under-resourced communities

- Action 3A: Raise awareness of and add new warming/cooling centers, emergency shelters, and comfort centers as needed, prioritizing underserved areas
- Action 3B: Maximize transportation options to get to and from emergency centers during climate hazard emergencies

Strategy R-4: Increase resiliency of buildings, infrastructure and communities to match anticipated climate hazards

- Action 4A: Continue to lead nationally on building safety and resiliency by researching and piloting building code updates to increase resiliency to severe storms, flooding and heat beyond life safety
- Action 4B: Promote existing programs to protect underserved populations from extreme heat and explore opportunities to expand eligibility for these programs to more people
- Action 4C: Promote and incentivize building best practices that protect people from impacts of extreme heat
- Action 4D: Improve resilience of critical infrastructure to flooding, heat and other climate hazards
- Action 4E: Implement microgrids throughout Howard County where feasible, prioritizing areas that meet critical community needs
- Action 4F: Implement resiliency hubs to meet critical emergency needs for the community
- Action 4G: Expand recruitment and training for technicians to support HVAC, microgrids, and emergency generators

Strategy R-5: Reduce heat islands and increase shade in heat vulnerable areas

- Action 5A: Research and map heat vulnerable areas with a focus on underserved populations
- Action 5B: Strategically increase tree planting in heat vulnerable areas on both public and private land

- Action 5C: Research and incorporate use of shade structures and cool surface technologies in public amenities and spaces

Strategy R-6: Increase installation and facilitate maintenance of stormwater best management practices on residential, commercial, and non-profit properties

- Action 6A: Expand the CleanScapes program to increase installation and maintenance of stormwater practices on residential properties, with a focus on areas of high flood risk as well as underserved communities
- Action 6B: Enhance the Community Stormwater Partnership Grant program to further support stormwater best management practices in flood-prone areas, vulnerable watersheds, and underserved communities
- Action 6C: Expand Commercial Stormwater Solutions Program to provide flexibility in program structure and account for the financial impacts of BMP installation and retrofits to property owners
- Action 6D: Provide BMP maintenance support and resources that ensure long term success of BMPs installed as part of new development
- Action 6E: Leverage existing Nonprofit Watershed Protection Partners to implement stormwater management and outreach

Strategy R-7: Prioritize stormwater management by strengthening regulations, policies, and innovation

- Action 7A: Develop a Howard County specific stormwater management guide
- Action 7B: Consider adjusting and strengthening stormwater management regulations based on climate change predictions
- Action 7C: Increase support for maintenance and infrastructure updates
- Action 7D: Employ innovation and natural solutions in stormwater management
- Action 7E: Establish a fund for pilot projects to encourage innovation
- Action 7F: Explore increasing the Watershed Protection and Restoration Fee, as well as alternative funding solutions
- Action 7G: Improve reclaimed water capacity and usage

Strategy R-8: Determine vulnerable watersheds and prioritize recommended stormwater solutions

- Action 8A: Establish a new program designed to aid Vulnerable Watersheds

Strategy R-9: Maximize the resiliency benefits derived from ecosystem services by improving protections for wetlands, forests, and streams and increasing the acreage of these resources through restoration or creation

- Action 9A: Improve the protection of existing wetlands, restore degraded wetlands, and investigate wetland creation opportunities
- Action 9B: Improve the protection of existing forests, restore degraded forests, and increase forest acreage where possible. Retain and expand non-forest tree canopy
- Action 9C: Improve the protection of streams, restore degraded streams, and increase stream buffers where possible
- Action 9D: Protect and enhance the natural resources in the Green Infrastructure Network
- Action 9E: Ensure that planting practices evolve to be resilient to climate change

Appendix B: Glossary

100-year Flood: A flood or storm that has a 1% probability of occurring in any given year. The 100year flood zone is the extent of the area of a flood that has a 1% chance of occurring or being exceeded in a given year.

500-year Flood: A flood or storm that has a 0.2% probability of occurring in any given year. The 500year flood zone is the extent of the area of a flood that has a 0.2% chance of occurring or being exceeded in a given year.

Action: A specific activity that supports achieving a broader strategy.

Adaptation: Adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects. Adaptation can lead to greater resilience.

Alley Cropping: An agroforestry practice that places trees within agricultural cropland systems.

Baltimore Metropolitan Council (BMC): A nonprofit organization that works collaboratively with the chief elected officials in the region to create initiatives to improve our quality of life and economic vitality. The BMC region includes Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County, Howard County, and Queen Anne's County.

Benchmarking: The practice of comparing the measured performance of a device, process, facility, or organization to itself, its peers, or established norms, with the goal of informing and motivating performance improvement.

Best Management Practices (BMPs): Effective methods used to treat, prevent, or reduce water pollution.

Biodiesel: A renewable, biodegradable fuel manufactured domestically from vegetable oils, animal fats, or recycled restaurant grease.

Bioretention: A soil bed planted with suitable non-invasive (preferably native) vegetation. Stormwater runoff entering the bioretention system is filtered through the soil planting bed before being either conveyed downstream by an underdrain system or infiltrated into the existing subsoil below the soil bed.

Building Envelope: Includes the walls, windows, roof, and foundation, forms the primary thermal barrier between the interior and exterior environments.

Built Environment: The man-made or modified structures that provide people with living, working, and recreational spaces.

Carbon Dioxide: An important heat-trapping gas, or greenhouse gas, that comes from the extraction and burning of fossil fuels (such as coal, oil, and natural gas), from wildfires, and from natural processes like volcanic eruptions.

Carbon Dioxide Equivalent: A metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

Carbon Sequestration: The process of capturing and storing carbon dioxide from the atmosphere through soils, trees, and other systems.

Carbon Storage: The building of plant structures (biomass) by converting glucose into cellulose and lignin. Most carbon in a forest is stored in the soil and the above-ground living biomass (e.g., trees and other plants).

Census Tract: Small, relatively permanent statistical subdivisions of a county as determined by the U.S. Census Bureau.

Chemical Fertilizer: Any inorganic material of wholly or partially synthetic origin that is added to soil to sustain plant growth.

Climate Change: Any change in climate over time, whether due to natural variability or as a result of human activity. Climate refers to long-term trends in weather over decades.

Climate Impact: A consequence of climate change, usually expressed as consequences on human health and well-being, the local economy, general quality-of-life, or similar terms.

Climate Vulnerability: Climate vulnerability describes the degree to which natural, built, and human systems are at risk of exposure to climate change impacts.

Commercial Property Assessed Clean Energy (C-PACE): A type of clean energy loan program that uses borrowed capital to pay for the upfront costs associated with energy efficiency or renewable energy improvements. Unlike other project financing, the borrowed capital is repaid over time via a property tax assessment. This allows the repayments of the loan to be transferred to a new owner if the property is sold.

Community Solar: Local solar facilities shared by multiple community subscribers such as individuals, businesses, nonprofits, and other groups, who receive credit on their electricity bills for their share of the power produced. This model helps solar developers secure financing for projects and allows community subscribers to benefit from the solar project with costs savings similar to those they would experience from installing solar on their own property.

Composting: A controlled, aerobic (oxygen-required) process that converts organic materials into a nutrient-rich soil amendment or mulch through natural decomposition. The end product is compost – a dark, crumbly, earthy-smelling material that is used to amend soil and provide nutrients for plant growth.

Critical Facility: Those structures from which essential services and functions for public safety and disaster recovery are performed or provided.

Decarbonization: The process of replacing fossil fuels with fuel that is less harmful to the environment.

Derechos: A long band of windstorms that stretch across a large area of land with winds similar in strength as a tornado or hurricanes. These storms produce heavy winds, thunderstorms, and rain.

Electrical Grid: A network of transmission lines, substations, transformers and more that deliver electricity from the power plant to homes, businesses and other electricity users.

Electric Vehicle: A vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source. An EV includes both a vehicle that can only be powered by an electric motor that draws electricity from a battery (all-electric vehicle) and a vehicle that can be powered by an electric motor that

draws electricity from a battery and by an internal combustion engine (plug-in hybrid electric vehicle). The use of EV in Howard County Climate Forward refers to all-electric vehicles unless otherwise stated.

Electrification: The process of replacing building systems and appliances that burn fossil fuels such as oil and gas onsite with building systems and appliances that use electricity to reduce overall greenhouse gas emissions.

Emergency Kit: A kit that has all of the things an individual or family may need during an emergency in which people may have to stay inside for longer than usual or the electricity could go out.

Energy Audit: An assessment that can help determine how much energy a building uses, where the building is inefficient, and which problem areas and fixes to prioritize to save energy and improve the comfort of your building.

Energy Efficiency: The use of less energy to perform the same task or produce the same result. Energy-efficient homes and buildings use less energy to heat, cool, and run appliances and electronics, and energy-efficient manufacturing facilities use less energy to produce goods.

Energy STAR: A joint program of the Environmental Protection Agency (EPA) and the Department of Energy (DOE). Its goal is to help consumers, businesses, and industry save money and protect the environment through the adoption of energy-efficient products and practices. The ENERGY STAR label identifies top-performing, cost-effective products, homes, and buildings.

Equity: The act of fairness and justice, creating equal outcomes by allocating resources and opportunities to meet individual needs of specific communities.

Extreme Weather: A weather event that is rare at a particular place and time of year or is more intense or severe than is typically experienced in that location, including heatwaves, cold waves, heavy rains, periods of drought and flooding, and severe storms.

Fuel Cell: Technology that uses the chemical energy of hydrogen or other fuels to cleanly and efficiently produce electricity.

Fugitive Emissions: The unintentional and undesirable emission, leakage, or discharge of gases or vapors from pressure-containing equipment or facilities, and from components inside an industrial plant such as valves, piping flanges, pumps, storage tanks, compressors, etc. These emissions also may include leaks from transmission pipes.

Fluorinated Gas (F-gas): Gases that have no significant natural sources and come almost entirely from human-related activities. They are emitted through their use as substitutes for ozone-depleting substances (e.g., as refrigerants) and through a variety of industrial processes such as aluminum and semiconductor manufacturing. Many fluorinated gases have very high global warming potentials (GWPs) relative to other greenhouse gases, so small atmospheric concentrations can have disproportionately large effects on global temperatures.

Forest Fragmentation: A loss of forest and the division of the remaining forest into smaller blocks.

Generator: A machine by which mechanical energy is changed into electrical energy. Generators often are used to provide a backup source of power for an individual house or building during electrical grid outages and are typically fueled with diesel, gasoline, natural gas, propane, or other fossil fuels.

Geothermal Energy: Heat energy from the earth. Wells, ranging from a few feet to several miles deep, can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications, including electricity generation, direct use, and heating and cooling. Geothermal also can use the steady ground temperature of about 55°F to heat or cool water that is then circulated through buildings to provide energy efficient heating or air conditioning.

Global Warming Potential (GWP): A measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO₂).

Governance: All processes of governing, the institutions, processes and practices through which issues of common concern are decided upon and regulated.

Graywater: Used water that contains low levels of contaminants from household, commercial, or industrial activities such as showering, bathing, doing laundry, doing dishes etc.

Greenhouse Gas: Gases that trap heat in the atmosphere.

Greenhouse Gas Inventory: A list of greenhouse gas emission sources and the associated emissions quantified using standardized methods.

Hazard: The occurrence of a natural event or trend that can have impacts on human health and infrastructure; for example: heat, precipitation, flooding, extreme storms.

Heat Index: What the temperature feels like to the human body when relative humidity is combined with the air temperature.

Heat Island: An area where temperatures are higher than surrounding areas due to impervious heat-absorbing surfaces such as asphalt and concrete.

Heat Pump: An energy-efficient alternative to furnaces and air conditioners that uses electricity to transfer heat from a cool space to a warm space, making the cool space cooler and the warm space warmer.

Heatwave: A prolonged period of abnormally hot weather.

Hydrofluorocarbons (HFCs): Greenhouse gases (GHGs) commonly used in a wide variety of applications, including refrigeration, air-conditioning (AC), building insulation, fire extinguishing systems, and aerosols. HFCs have high global warming potential (GWP), raising concern about their impacts as they become increasingly used as replacements for ozone-depleting substances (ODS), and as economic growth spurs demand for new equipment, especially in the refrigeration/AC sector.

ICLEI's ClearPath Tool: An online software platform for completing greenhouse gas inventories, forecasts, climate action plans, and monitoring at the community-wide or government-operations scales.

Impervious Surface: All hard surfaces like paved roads, parking lots, roofs, and even highly compacted soils like sports fields. Rain and other precipitation cannot penetrate and soak down into these surfaces and instead runs off these surfaces, picking up heat and pollutants, and running off into storm drains and streams.

Induction Stove: Induction cooking tops consist of an electromagnetic coil that creates a magnetic field when supplied with an electric current. When brought into this field, compatible cookware is warmed internally, transferring energy with approximately 85% efficiency. These stovetops run on electricity, not on natural gas.

Infrastructure: The basic systems and services that are necessary for a country or an organization to run smoothly, for example buildings, transport and water and power supplies.

Intergovernmental Panel on Climate Change (IPCC): The United Nations body for assessing the science related to climate change.

International Green Construction Code (IGCC): A model building code that provides minimum requirements to safeguard the environment, public health, safety and general welfare through the establishment of requirements that are intended to reduce the negative impacts and increase the positive impacts of the built environment on the natural environment and building occupants.

Invasive Species: An organism that causes ecological or economic harm in a new environment where it is not native.

Leadership in Energy and Environmental Design (LEED): The most widely used green building rating system in the world. Available for virtually all building types, LEED provides a framework for healthy, efficient, and cost-saving green buildings. LEED certification is a globally recognized symbol of sustainability achievement and leadership.

LEDs: Light emitting diode, a highly energy-efficient lighting technology

Life-Cycle Analysis: A comprehensive form of analysis that utilizes the principles of Life Cycle Assessment, Life Cycle Cost Analysis, and various other methods to evaluate the environmental, economic, and social attributes of energy systems ranging from the extraction of raw materials from the ground to the use of the energy carrier to perform work.

Life-Cycle Costing: Considering all the costs that will be incurred during the lifetime of a product, work or service: Purchase price and all associated costs (delivery, installation, insurance, etc.) Operating costs, including energy, fuel and water use, maintenance and end-of-life disposal.

Methane: An odorless, colorless, flammable greenhouse gas emitted from energy, industry, agriculture, land use, and waste management activities. Methane has been determined to have a global warming potential of 27 to 30 times that of carbon dioxide.

Microgrid: An on-site power generation system for one or more buildings that can tie to the utility grid but also can operate independently of the grid during power outages including major outages of long duration.

Micromobility: Any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles, electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.

Microtransit: Flexible, on-demand transit system that is conceptually in between private individual transportation and public mass transit. For example, microtransit may use vans or other small, multi-passenger vehicles to provide shared, on-demand transit that is more flexible than the typical public transit model of fixed routes and timetables.

Mitigation: Measures to reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing carbon dioxide from the atmosphere.

Native Plant: The indigenous species that have evolved and occur naturally in a particular region, ecosystem, and habitat. Species native to North America are generally recognized as those occurring on the continent prior to European settlement.

Natural Gas: An odorless, gaseous mixture of hydrocarbons—predominantly made up of methane (CH₄).

Nature-Based: Actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, providing human well-being and biodiversity benefits.

Net Zero: Reducing amount of greenhouse gas emissions to zero, or close to zero, by balancing the amount released into the atmosphere with the amount removed from the atmosphere.

Organic Waste: All waste of biological origin (which was once alive or part of a living thing).

Paratransit: "Origin to destination" services for people with disabilities who are not able to ride fixed-route public transportation.

Pesticide: A substance that kills, repels, or controls forms of animal and plant life considered to damage or be a nuisance in agriculture and domestic life.

Polar Vortex: A large area of low pressure and cold air surrounding both of the Earth's poles. It ALWAYS exists near the poles, but weakens in summer and strengthens in winter. The term "vortex" refers to the counter-clockwise flow of air that helps keep the colder air near the Poles. Many times during winter in the northern hemisphere, the polar vortex will expand, sending cold air southward with the jet stream.

Pollinator: Anything that helps carry pollen from the male part of the flower (stamen) to the female part of the same or another flower (stigma). Typical pollinators include bees, butterflies, and some species of birds.

Pollution: The presence of substances and heat in environmental media (air, water, land) whose nature, location, or quantity produces undesirable environmental effects; activity that generates pollutants.

Rain Garden: A low lying area created to absorb and filter runoff from roofs, driveways and parking lots. Rain gardens are generally planted with native plants adapted for high levels of water, which help to hold the runoff and filter pollutants while the runoff water slowly soaks into the ground.

Rebate: A return of a part of a payment.

Reclaimed Water: Wastewater from a municipal sewage treatment facility that has been treated to be suitable for beneficial use.

Refrigerant: A chemical that produces a cooling effect while expanding or vaporizing. Refrigerants are typically used in refrigeration and air conditioning.

Renewable Energy: Energy produced from sources like the sun and wind that are naturally replenished and do not run out.

Resilience: Capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.

Retrocommissioning: A building systems tune-up that applies the commissioning process to a building that has been commissioned previously (either during construction or as an existing building); it is normally done every three to five years to maintain top levels of building performance and/or after other stages of the upgrade process to identify new opportunities for improvement. Retrocommissioning is a low cost measure that can result in big energy savings in buildings.

Retrofit: Involves the modifications to existing buildings that may improve energy efficiency or decrease energy demand.

Riparian Buffer: An area adjacent to a stream, lake, or wetland that contains a combination of trees, shrubs, and/or other perennial plants and is managed differently from the surrounding landscape, primarily to provide conservation benefits.

Silvopasture: The deliberate integration of trees and grazing livestock operations on the same land. These systems are intensively managed for both forest products and forage, providing both short- and long-term income sources.

Single-use Plastic: Items intended to be used only once before they are thrown away or recycled. These include, among other items, grocery bags, food packaging, bottles, straws, containers, cups and cutlery.

Solar Power: Solar technologies convert sunlight into electrical energy either through photovoltaic (PV) panels or through mirrors that concentrate solar radiation. This energy can be used to generate electricity or be stored in batteries or thermal storage.

Stakeholder: One who is involved in or affected by a course of action.

Stationary Fuel Combustion: Devices that combust solid, liquid, or gaseous fuel, generally for the purposes of producing electricity, generating steam, or providing useful heat or energy for industrial, commercial, or institutional use, or reducing the volume of waste by removing combustible matter. Stationary fuel combustion sources include, but are not limited to, boilers, simple and combined-cycle combustion turbines, engines, incinerators, and process heaters.

Stormwater: Falling precipitation that can't be absorbed by pervious surfaces or runs off impervious surfaces and enters water ways, picking up pollutants along the way.

Strategy: An overarching policy or approach designed to achieve a specific climate goal, like reducing greenhouse gas emissions or increasing County resilience. Strategies often are comprised of one or more actions.

Sustainability: To create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations.

Tree Canopy: The layer of leaves, branches and stems of trees that shelter the ground when viewed from above. This measurement is expressed as a percentage of ground area that is covered by tree crowns and relates to the branching spread of the trees.

Under-Resourced Population: Populations that lack adequate access to community resources. These populations tend to be economically disadvantaged and may also include people who are disabled, people whose primary language is not English, people of color, and people ages 65 and over.

Underserved Population: Populations that face health, financial, educational, and/or housing disparities. These populations tend to receive fewer health care services, encounter barriers to services such as economic, cultural or linguistic barriers, or have a lack of familiarity with available services.

Vulnerable Population Index: The data and the analyses undertaken to identify a region's vulnerable people and groups. The index developed by the Baltimore Metropolitan Council includes maps showing concentrations of groups that have low income, limited English proficiency, disabilities, no car, and/or are elderly.

Waste to Energy: The conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, anaerobic digestion and landfill gas recovery.

Watershed: A land area that drains rainfall and snowmelt into a specific waterbody, which could include a creek, stream, river, bay, lake, or ocean. Every body of water has a watershed. Activities on the land within a watershed can impact water quality and quantity of the water body into which it drains.

Weatherization: The act of protecting a structure, such as a house or building, from the elements of weather by installing energy efficient measures such as air sealing, insulation, moisture control, ventilation, heating and air conditioning. Weatherization often starts with an energy audit to determine energy uses and potential energy saving opportunities in a building. Weatherization assistance is available to low-income households and can result in greater comfort and in lower utility bills.

Wet bulb temperature: This is a way to measure the combination of dry air temperature and humidity. A wet cloth over the bulb of a thermometer cools the temperature, but if the humidity in the air is high, less evaporation occurs so the wet-bulb temperature is closer to the dry air temperature. The wet-bulb temperature measures how well humans will be able to cool themselves through sweating.

Wetland: Areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Some types of wetlands include marshes, bogs and swamps.

Windbreaks: Linear plantings of trees and shrubs designed to provide economic, environmental and community benefits. The primary purpose of most windbreaks is to slow the wind which creates a more beneficial condition for soils, crops, livestock, wildlife and people.

Appendix C: Climate Vulnerability Assessment Methodology

Methodology

Howard County conducted a preliminary Climate Vulnerability Assessment to assess its vulnerability to climate change. Howard County used ICLEI's Temperate tool and Climate Vulnerability Assessment framework to assess a variety of potential hazards and the risks they pose to natural resources, economic systems, human health, and infrastructure within the county.

The Temperate tool, designed by Azavea Inc. and ICLEI – Local Governments for Sustainability, is an adaptation planning application that helps counties identify their risks to hazards. The tool recommends a list of potential hazards that are likely to worsen due to the changing climate using historical data and future projection trends of hazards in the area.

The Temperate tool uses findings from the 2014 National Climate Assessment to identify potential future climate hazards that are specific to Howard County. The tool also uses climate change indicator data under two emission scenarios from both NASA Earth Exchange Global Daily Downscaled Projections (NASA NEX-GDDP) and Localized Constructed Analogs (LOCA) datasets.

Using Temperate data, Howard County's Hazard Identification Risk Assessment, and subject matter expert assessments, Howard County's Office of Community Sustainability (OCS) identified eight hazards that are applicable to Howard County. The hazards evaluated are Air-Borne Disease, Hurricanes, Drought, Extreme Heat Days, Extreme Winter Conditions, Flooding, Severe Wind, and Vector-borne disease. OCS then evaluated the risks these hazards could pose to nine community systems: Agriculture, Ecological Function, Emergency Management, Energy Delivery, Internet and Communications, Public Health, Public Safety, Quality of Life, Tourism, Highways/Transportation, Stormwater, and Utilities.

Howard County's Temperate findings and the Baltimore Metropolitan Council (BMC) report indicates a moderate- high risk probability, and increasing frequency and intensity, for flash and surface flooding. They also report extreme heat to be a moderate- to high-risk probability and increasing frequency and intensity of extreme hot days with moderate to high impacts across community systems.

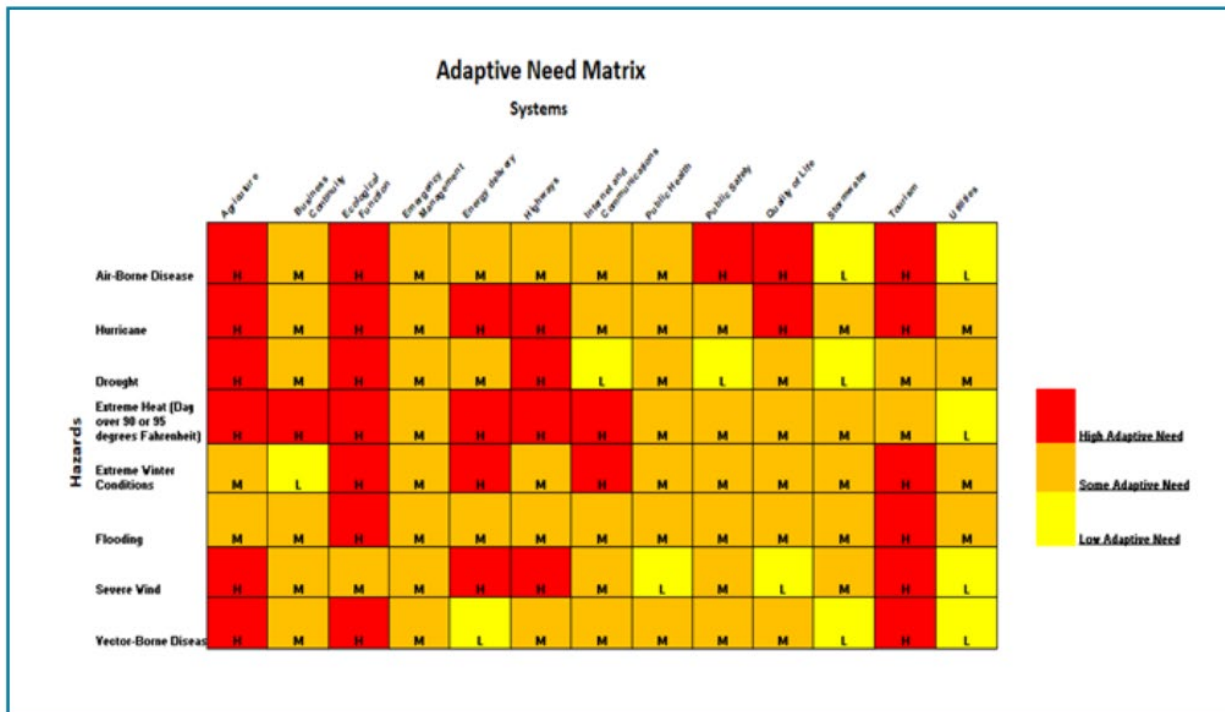
Subject Matter Experts across several county departments and agencies helped OCS evaluate the vulnerability of each system to each climate hazard. Through a survey, Subject Matter Experts ranked both the potential impact on the system from each hazard and the community's adaptive capacity to react to and rebound from the hazard. Subject Matter Experts also had the option to further describe impacts the hazards would have on their operations and the community. This information was entered into the Temperate tool, which calculated an adaptive need score based on the average values of the impact magnitude and the adaptive capacity score selected by Subject Matter Experts. The adaptive need score is illustrated using a color scale, ranging from yellow to red. Yellow represents a low adaptive need score, red represents a high adaptive need score, and orange represents some adaptive need. A low adaptive need score is the combination of a low impact ranking and a high adaptive capacity ranking, while a high adaptive need score is the combination of a high impact ranking and low adaptive capacity ranking. Systems with a higher adaptive need score, represented by the color red, tells us that these systems have a higher vulnerability to hazards and will need to be made more resilient by the County.

Subject Matter Experts include representatives from the Office of Community Sustainability, Department of Health, Department of Public Works – Highways, Environmental Services, and Utilities, Department of Police, Howard County Tourism, Inc., Howard County Economic Development Authority, Department of Fire and Rescue, Department of Technology and Community Services, and BGE. Additional expertise was provided by Dr. Sara Via who is a Climate Expert with the University of Maryland Cooperative Extension.

Results

Extreme Heat and Flooding were identified as the top two hazards for Howard County. Extreme Heat has a moderate- to high-risk probability and moderate to high impacts on agriculture, business continuity, ecological function, energy delivery, highways and internet and communications. Flooding has a moderate- to high-risk probability and moderate impacts on systems. While the County has some adaptive capacity to deal with the impacts of flooding, the BMC report shows that inland flooding will have significant impacts on transportation, stormwater, wastewater, facilities and solid waste service areas. Howard County’s Temperate results show that flooding will have high impacts on tourism and ecological function. The combination of high-risk probabilities increasing frequency and intensity of these hazards and the impacts of hazards on systems is how these hazards were chosen.

The table below lists the potential impacts of extreme heat, flooding/increased precipitation, extreme weather (hurricanes, severe wind, storms), and other (air-borne disease, vector-borne disease, extreme winter conditions, and drought) on community systems and ability of community systems to mitigate or adapt to the potential future impacts.



CVA Methodology (Adaptive Need Matrix) Figure 1.

Appendix D: Climate Change Emergency Preparedness Survey

Background

Howard County Government's Climate Change Emergency Preparedness Survey was designed to understand how residents are being impacted by climate change now and how prepared residents are for climate hazards. It also helped identify barriers to information and access to emergency preparedness resources experienced by underserved communities. The survey was administered by Howard County's Office of Community Sustainability and conducted in June 2022 as part of the County's Climate Action Plan update. The survey includes questions about preparedness for various climate hazards and the impacts of these hazards. The climate hazards were chosen based on Howard County's Climate Vulnerability Assessment, nearby jurisdictions' Climate Vulnerability Assessments, and regional climate data. Vector-borne disease, airborne disease, extreme heat, extreme winter conditions, flooding, poor air-quality, drought, flooding, hurricanes, and severe wind are expected to increase in frequency and/or intensity in the region and have the potential to cause disruption to daily life.

This primary target audience of the survey was Howard County residents who are part of underserved communities. The County defined underserved communities as people of color, people ages 65 and older, people with disabilities, people with low-income, and people with limited English language ability. According to a recent Environmental Protection Agency report titled *Climate Change and Social Vulnerability in the United States*, underserved communities are disproportionately vulnerable to the impacts of climate change. These groups may not have the same ability as other groups to prepare for, adapt to, and recover from the impacts of climate change due to a combination of social, economic, political, and environmental factors. Systemic inequities and an unequal distribution of wealth and resources cause barriers for these groups.

Questionnaire Design

The survey consisted of 27 questions including multiple choice and free form responses. The survey was divided into four sections: Health and Well-Being, Emergency Preparedness, Emergency Preparedness Awareness and Knowledge, and Demographics.

The Health and Well-Being section included three questions that asked residents about their concerns and experiences with climate-related hazards. This section asked for residents to reflect on how the selected climate hazards have affected their day-to-day functions. The responses were used to understand what residents most are concerned about and what they have already experienced.

The Emergency Preparedness section was composed of twelve questions that asked residents about preparation, services and resources, and disabilities that may impact one's ability to access emergency services and resources.

The Emergency Preparedness Awareness and Knowledge section consisted of seven questions on how residents feel about various statements, and what residents would like to learn more about.

The Demographics section collected information about gender, age, race, ethnicity, and total household income. This section allowed the County to get a better understanding of the representative population of survey respondents. By analyzing the data and using cross-tabulation, the County has the potential to spot trends in responses by groups. The data collected from the surveys will be used to improve climate action, resiliency, and adaptation in the community.

Survey Distribution Method

To reach these populations, staff asked organizations that provide services and resources to our target groups to distribute surveys through email lists and newsletters. Newsletters contained a link that directed respondents to the survey page on the LiveGreenHoward website. In coordination with the Howard County Health Department, staff distributed printed fliers with QR codes that directed respondents to the survey at clinics and other health-related events including Glen Mar Church Community Health Fair, Owen Brown Clinic, and the Health Department's Family Wellness Event. Fliers also were distributed to multiple service centers such as the Columbia Food Bank, Hopeworks, Community Action Council, Dancel YMCA, the County's Multiservice Center, and various 50+ centers, community centers, and libraries. While most of the respondents chose to fill the survey out online, there were options for the respondents to fill out the survey over the phone or on paper.

In addition, the County contracted with the Clean Water Fund to send canvassers door-to-door to several communities to distribute surveys directly to residents or to leave doorhangers with survey information on resident's doors. The locations canvassed by Clean Water Fund were Columbia Landing, Columbia Commons, Monarch Mills, and houses off Tamar Drive in Columbia, MD. The locations were strategically chosen by County staff using EJ Screen's demographic indicators to identify communities of the target populations.

Results

- Airborne Disease, Poor Air Quality, and Extreme Heat are the top three hazards that Howard County survey respondents are most concerned about.
- Power outages and damage to home or property after a storm are the two most common experiences faced in the last two years.
- Survey respondents identified flooding, hurricanes, and drought as hazards that they are least prepared for.
- The majority of survey respondents (83%) do not know where a heating/cooling center is, and the majority of survey respondents (81%) would use a heating/cooling center if needed. The most common reason for not using a heating/cooling center is because the respondent did not know there was an option to go to a heating/cooling center.
- The majority of respondents aged 65 or older (85%) would use a cooling center if needed. 65+ respondents who wouldn't use a heating/cooling center listed not knowing heating/cooling centers were an option and not having access to transportation as reasons they would not use one.
- Approximately 75% of respondents do not know where to get food/water in an emergency event.
- More than 75% of respondents feel they know about the impacts of climate change.
- Nearly a quarter of respondents do not feel prepared if an emergency event were to occur.
- Nearly 50% of respondents feel generally that the community has resources and services to help them during an emergency event.
- 38% of respondents feel they do not know how to easily access community resources and services. There is a difference in responses from individuals of an underserved community versus responses from individuals not of an underserved community. 34% of those respondents not underserved feel they cannot easily access community resources and services, whereas 40% of underserved respondents feel they cannot easily access community resources and services.
- Approximately 75% of survey respondents feel the community keeps them informed about severe weather.
- Nearly 70% of respondents are interested in learning more about disaster preparedness.

Appendix E: Greenhouse Gas Emissions Inventory

As part of its 2023 Climate Action Plan, Howard County developed a County-wide greenhouse gas (GHG) emissions inventory to identify and quantify private and public sector sources and drivers of emissions. To develop this inventory, Howard County used 2019 data, the most recent and most complete set of data available for all sectors at the time this Climate Action Plan was developed. Howard County used the ClearPath emissions management software suite from ICLEI-USA as a basis for the County-wide 2019 GHG inventory. ClearPath was developed by ICLEI to help local governments inventory community and government GHG emissions. Users can input activity data where available or use default settings provided by ClearPath to reach a rough estimation of GHG emissions within the community or local government operations.

The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, developed by ICLEI, establishes requirements for creating community and government operation inventories of GHG emissions. This protocol focuses on calculating emissions based on the activity from which they originate. At a minimum, inclusion of five basic emissions generating activities is required in all protocol-compliant GHG inventory reports. These activities were selected by ICLEI because they represent activities over which local governments typically have significant control, data to estimate emissions are reasonably available, emissions associated with the activity are significant, and the activities are common.¹ These five categories, at a high level, include:

- Use of electricity by the community.
- Use of fuel in residential and commercial stationary combustion equipment.
- On-road passenger and freight motor vehicle travel.
- Use of energy in potable water and wastewater treatment and distribution.²
- Generation of solid waste by the community.

GHG emissions are commonly grouped into three categories, or scopes. Scope 1 emissions are direct emissions generated locally, including on-site energy combustion like natural gas or other fuels, refrigerants, and vehicle emissions. Scope 2 emissions are indirect emissions from purchased energy, typically electricity. This includes the GHG emissions from energy generated off-site but purchased and used on-site for activities such as powering home and commercial buildings. Scope 3 emissions are indirect emissions generated outside of the County from the production of goods or services used in-County. This includes off-site emissions from the production, transportation, distribution, and disposal of products used on-site. Scope 3 emissions are much more difficult to measure and typically are not included in a local government GHG inventory.

The Howard County GHG inventory includes primarily scope 1 and 2 emissions. Howard County's scope 1 emissions include on-site fuel combustion, transportation, waste generated and landfilled in Howard County, refrigerant emissions, fugitive emissions (emissions from leaks in oil and gas pipelines), and soil nitrogen dioxide emissions from agricultural activities. Howard County's scope 2 emissions include all purchased electricity used by residents, businesses, and government within the County. Howard County also felt it was important to include scope 3 emissions specifically from waste generated in Howard County but landfilled outside of Howard County, as most waste is transported out of County for disposal.

Howard County's 2019 GHG inventory includes sources in the built environment; transportation and other mobile sources; solid waste; and wastewater and water sectors. These emissions are documented at the community level and include any emissions generated from County government operations.

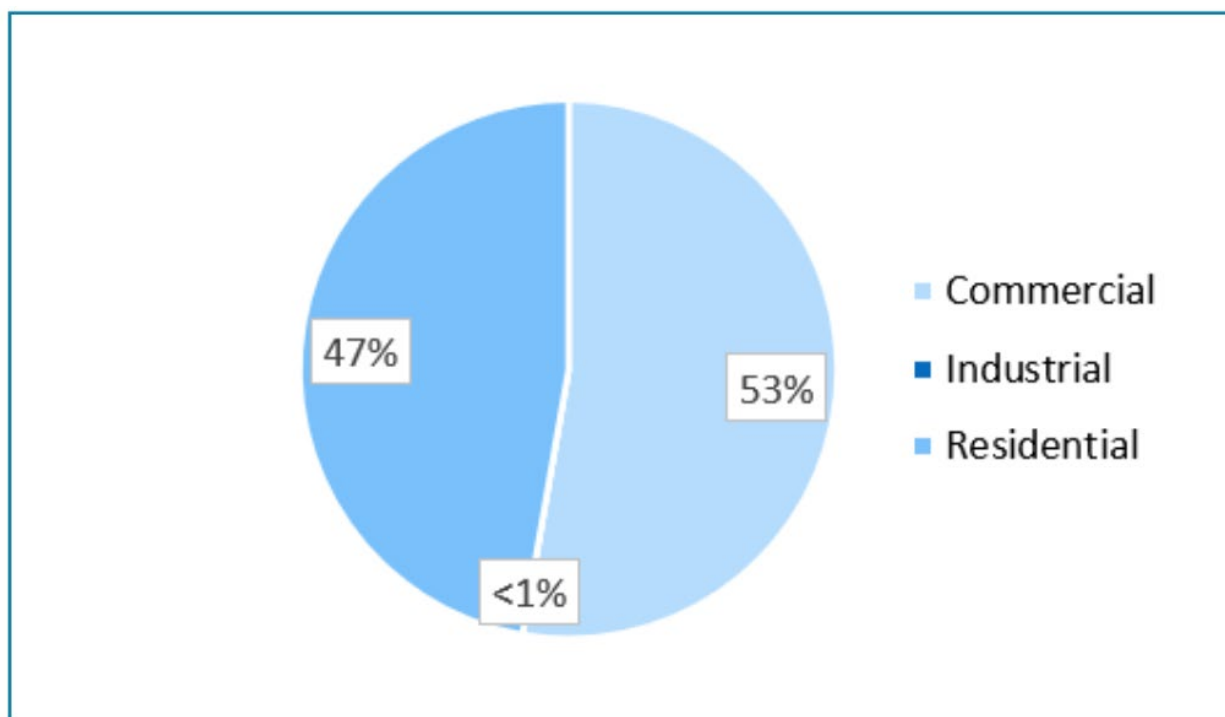
Built Environment

Electricity and natural gas use data for the built environment was provided by utilities for residential, commercial, and industrial end users. Electricity data is included from utilities Baltimore Gas and Electric (BGE) and Potomac Edison for the households and businesses they service. BGE accounted for 98% of the electricity used in Howard County in 2019. Natural gas data from BGE has been included. Research into the natural gas utility providers in the service area of Potomac Edison did not yield results, thus natural gas utilities data for a portion of the County is not accounted for. Assuming BGE provides natural gas and electricity for the same residential households, this gap represents 2% of households not covered.³

Emissions from purchased electricity and on-site fuel combustion account for 72% and 28% of the energy sector emissions total, respectively.

Default electricity emission factors from the 2019 RFC East eGRID subregion were used to estimate GHG emissions from electricity use.⁴ Figure 1 shows a breakdown of energy sector emissions from Howard County in 2019 across commercial, residential, and industrial end-users. Emissions are close to evenly split between commercial and residential sectors, with 53% and 47% respectively.⁵ Industrial end users represent less than 1% of total electricity use. This data includes emissions from both purchased electricity and on-site fuel combustion.

Figure 1. Energy Sector Emissions by Type of End-User



Transportation and Other Mobile Sources

Estimates of transportation sector emissions were derived using the vehicle miles traveled (VMT) for gasoline and diesel vehicles in Howard County and relevant emission factors. VMT data was taken from the 2019 mileage report developed by the Maryland Department of Transportation (MDOT) State Highway Administration (SHA) and included annual vehicle miles of travel by highway functional class. Functional classifications included are interstate, principal arterial other freeways and expressways, principal arterial other, minor arterial, major collector, minor collector, and local. Total VMT for Howard County in 2019 was estimated to be 4,362 million miles. According to the MDOT data used in the inventory, 1,462 million

miles of the total Howard County VMT were on interstates. Howard County government has limited control over the VMT associated with interstates, but decided to keep these miles in the total intra-County VMT to best represent actual emissions taking place within County borders.

As different types of vehicles have different fuel efficiencies and may even use different fuel types, converting VMT into GHG emissions requires information regarding the percentages of each vehicle type that make up the total vehicles driving in or through Howard County.

Table 1 provides a breakdown by vehicle and fuel types using the default values provided by ClearPath, which were derived from the EPA State Inventory Tool.⁶

Table 1. 2019 Percentage Breakdown of Vehicle Types (ClearPath)

Vehicle Type	Fuel Type		Percent of Total
	Gasoline	Diesel	
Motorcycles	0.0	0.0	0.0
Passenger Vehicles	60.6	0.3	60.9
Light Trucks	32.4	1.3	33.7
Heavy Trucks	0.0	5.4	5.4
Totals	93.0	7.0	100.0

When comparing this breakdown with the vehicle types in Howard County tracked by the State Highway Administration of Maryland for 2019, displayed in Table 2,⁷ the ratio of passenger cars to light trucks differs significantly. Therefore, Howard County used the state data instead of ClearPath nationwide defaults to achieve more accurate results. The assumption made is that the ratio of passenger cars to light trucks in Howard County will be more similar to the ratio across the state of Maryland than to the ratio found nationwide.

Table 2. 2019 Percentage Breakdown of Vehicle Types (State Highway Administration of Maryland)

Vehicle Type	Percentage
Motorcycles	0.2
Passenger cars	79.4
Light trucks and other	13.4
Buses	0.8
Single unit trucks	3.3
Single trailer trucks	2.9
Multi trailer trucks	0.1

Howard County specific data also allows for the inclusion of electric vehicles in the breakdown. At the end of fiscal year in 2021, 278,885 vehicles were registered in Howard County.⁸ Of these registered vehicles 3,698 were electric vehicles (EVs) and 1,794 were plug-in hybrid electric vehicles (PHEVs). As this data was not available for 2019, the assumption is made that the fraction of electric vehicles was approximately the same in 2019 as it was in 2021.

Using the percentages by vehicle type from the State Highway Administration of Maryland, ratio of gasoline to diesel vehicles by class provided by ClearPath, and excluding the electric vehicles, the inputs were updated as shown in Table 3.

Table 3. Proposed New percentage Breakdown of Vehicle Types

Vehicle Type	Gasoline	Diesel	Electric
Motorcycles	0.2	0	
Passenger Vehicles	79.0	0.4	0.02
Light Trucks	12.8	0.5	
Heavy Trucks	0.0	7.0	

Emission factors for each vehicle type were derived from data within ClearPath for 2019 U.S. National Defaults from the US Community Protocol developed by ICLEI (updated 2021).

Solid Waste

Estimates of emissions from the solid waste sector were derived from data provided by the County’s Bureau of Environmental Services. This data includes all facilities that have Howard County waste in 2019. Data for 18 facilities in total are included, with three located within Howard County.⁹ Total waste generated in 2019 is estimated at 312,930 tons including residential, commercial, industrial, and mixed. Residential waste is estimated to be 40% of total and commercial represents 60%, based on reporting from Howard County Bureau of Environmental Services to Maryland Department of the Environment. Within ClearPath, defaults were selected estimating the landfill methane collection scenario to be “typical”, landfill moisture content to be “wet”,¹⁰ all waste types included.

Refrigerant Emissions

Refrigerant leaks can be an important source of emissions as these chemicals typically have high global warming potentials (GWPs). These emissions were estimated by scaling Maryland state refrigerant emissions for 2019 by the population of Howard County. Annual state level estimates can be found using the EPA’s State Inventory Tool (SIT) and, for Maryland in 2019, are estimated to be 2,327,841 MT CO₂e.¹¹ The Howard County population was 5.4% of the state total, and thus County refrigerant emissions are estimated to be 125,404 MT CO₂e.

Wastewater and Water

Electricity used for wastewater collection and treatment was included within data provided by BGE. Associated emissions are thus accounted for in the built environment. Howard County did not include process emissions from operation of wastewater treatment facilities and operation of septic systems to allow for more consistent comparisons between the 2019 GHG emissions inventory and past inventories that did not include these emissions.

Fugitive Emissions

Research into industrial emissions was conducted using the EPA Greenhouse Gas Reporting Program (GHGRP). Certain industrial emitters above a threshold are required to report emissions to the GHGRP. Only two reporters for 2019 were identified: the Transcontinental Gas Pipe Line Corporation (Transco) Natural Gas Pumping Station 190 and Alpha Ridge Landfill. Emissions associated with the landfill are already accounted for within the inventory. Transco Station 190 reported emitted 71,694 MT CO₂e from stationary combustion and 4,212 MT CO₂e from petroleum and natural gas systems in 2019.^{12, 13} Fugitive GHG emissions reported to EPA's GHGRP were included in the County's inventory.

Howard County Government GHG Emissions Inventory 2019

Although Howard County government operations are included in the overall communitywide GHG inventory, Howard County also calculated the emissions resulting solely from government operations.

The Local Government Operations Protocol developed by ICLEI states that all sources of emissions within government operations should be included and provides additional guidance on how to define an organizational boundary based on operational or financial control.¹⁴ Under this accounting framework, the county government should not include GHG emissions from operations in which it has an interest, but no control. For example, emissions from the manufacture of products used in the county are not included in this accounting framework. The protocol indicates the criteria for operational control includes either: wholly owning an operation, facility or source; or having the full authority to introduce and implement operational and health, safety, and environmental policies. Autonomous departments (e.g., municipal utilities) may be managed by a board, but if county government has control over appointments to this board or oversight, then these departments are considered within government operational control and associated emissions should thus be included.

Data provided by Howard County estimate all government electricity usage in 2019 to have been 75.9 million kWh. Howard County provided data for purchased natural gas and diesel in 2019. Based on purchased natural gas, the County estimates that 709,995 therms of natural gas and 77,236 gallons of #2 ULS Heating Oil Dyed were consumed. This fuel was used for facilities such as Police, Fire and Rescue, Public Works, and Utilities.

To estimate County government fleet emissions, Howard County provided 2019 fleet data including make, model, type of fuel, daily consumption, and fuel efficiency. Total annual gasoline consumption was assumed to be 527,857 gallons and total diesel consumption 235,079 gallons. Vehicle classes (by gross vehicle weight) were grouped into the vehicle categories used in ClearPath, and the percentage of each vehicle type using gasoline or diesel was calculated (see Table 4). A rough estimate of County fleet emissions was made by summing daily consumption by fuel type and class, and then multiplying by an assumed number of working days (260 days). Knowing the fuel type and class is important to determining emissions because different types of vehicles have different average fuel consumption in miles per gallon and different emissions factors based on fuel efficiency and fuel type used.

Table 4. Percent of Vehicles Using Gasoline or Diesel Fuel by Functional Class for the Howard County fleet in 2019

ClearPath Vehicle Types	Class (Gross Vehicle Weight or GVW in tons)	Gasoline	Diesel
Motorcycles		0%	0%
Passenger Vehicles	<8,500 GVW	79%	2%
Light Trucks	8,501- 10,000 GVW; 10, 001- 14,000 GVW; 14,001- 16,000 GVW;	20%	17%
Heavy Trucks	16,001- 19,500 GVW; 19,501- 26,000 GVW; 26,001- 33,000 GVW; >33,000 GVW	1%	81%

Updates to 2005 Baseline GHG Inventory

Howard County’s first Climate Action Plan, published in 2010, was based on 2007 and 2005 data. In order to best compare GHG emissions progress between our 2005 baseline and our 2019 inventory, Howard County made several modifications to the data from the 2010 CAP. These changes included:

- Used 2005 VMT numbers instead of 2007 numbers. 2007 estimates were interpolated between 2005 and 2009 values.
- Proxied sources that were not included in the original inventory based on available data (e.g., County population, state-wide estimates scaled to the County).
- Removed sources that were not included in the 2019 inventory (e.g., livestock)
- Updated global warming potentials to use IPCC’s Fourth Assessment Report for consistency with the 2019 inventory

GHG Inventory Future Business as Usual (BAU) Projections

Future businesses as usual (BAU) GHG projections were developed using 2019 as a base year. For scopes 1 and 3, estimates were developed based on the emissions calculated within ClearPath. BAU assumptions for the electricity grid followed the predicted changes to grid mix following the Annual Energy Outlook 2021 (AEO) developed by EIA. 15 Sector-specific assumptions are described below.

Most emission sources were assumed to increase proportionately with population growth, with a few exceptions. Population projections for all years from 2020 – 2050 were calculated using the historical and projected population data of Howard County. Data on the historical population from 2010-2019 was collected from the U.S. Census Annual Estimates of the Resident Population for Counties in Maryland.¹⁶ Population projections for 2015-2045 were developed in 5-year intervals from the Maryland Department of Planning. Historical and projected population for Howard County is shown below in Table 5.¹⁷

Table 5. Howard County Population Projections 2015 – 2045

	2015	2020	2025	2030	2035	2040	2045
Population	313,350	327,990	344,150	356,860	364,640	368,830	369,220

On-Site Combustion

On-site fuel combustion was calculated separately for both the residential, commercial, and government¹⁸ sectors. On-site fuel combustion was assumed to grow at the same rate as Howard County population for all years except 2020. 2020 fuel consumption was adjusted based on analysis from the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020.¹⁹ This analysis showed that commercial sector emissions due to natural gas combustion shrank by 9.9% compared with 2019, while residential usage shrank by 6.9%. Years post-2020 were projected based on 2019 data.

Transportation

For all years after 2021, transportation emissions were assumed to grow at the same rate as Howard County population growth for both the County and government inventories. Activity data for both 2020 and 2021, across both inventories, were adjusted due to the COVID-19 pandemic. Annual VMT data was found from the Maryland Department of Transportation (MDOT), shown in Table 6.²⁰ Transportation emissions for both inventories for 2020 and 2021 was determined using the ratio of 2019 annual VMT compared with the desired year multiplied by 2019 emissions.

Table 6. Howard County Annual VMT for 2019-2021

	Annual VMT in Howard County (millions)	Percent of 2019 VMT
2019	4,362	
2020	3,640	83%
2021	4,044	93%

Starting in 2022, the “avoided” on-road emissions due to assumed EV uptake in the County is subtracted from the baseline projection scenarios.

Waste

Both scope 1 and scope 3 waste emissions were assumed to grow at the same rate as Howard County population growth.

Refrigerant Emissions

Refrigerant emissions were assumed to remain constant over the calculated time period, due to competing factors of population growth, potential building stock changes, refrigeration equipment stock turnover, and the impact of policies such as the AIM Act to phase down high-GWP refrigerants in the coming years for new equipment.

Purchased Electricity

Calculations for scope 2 emissions were based on the electricity usage data provided by Howard County. Purchased electricity was assumed to grow at the same rate as Howard County population for all years except 2020. 2020 electricity usage was adjusted based on analysis from the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020.²¹ This analysis showed that commercial sector electricity usage shrank by 9.6% compared with 2019, while residential usage grew

by 1.7%. Government electricity usage was assumed to decrease at the same rate as commercial. Years post-2020 were projected based on 2019 data. Based on the purchased electricity data, the U.S. Energy Information Administration's Annual Energy Outlook (AEO) projection scenario was used to estimate future electricity grid mix. Both scenarios are built using emission factors calculated from RFC East eGRID data.²² The AEO projection scenario scales 2019 grid factors based on policies currently "on the books", across future years. The impact of the Maryland Renewable Portfolio Standard (RPS) was included in the mitigation scenario. The RPS provides a minimum percentage of the electricity used in Maryland that needs to come from renewable sources by specific years.

Following 2022, additional load from EVs is added to baseline projections of electricity consumption. 80% of this additional load is assumed to take place at residential locations with 20% at commercial- locations.²³

Fugitive Emissions

Fugitive emissions from GHGRP reporter Transco Station 190 were assumed to remain constant over the calculated time period and are based on a 3-year average of data.

Suggestions for Inclusion in Future Inventories

- Include emissions from other stationary fuels (e.g., fuel oil, kerosene). Government operations emissions calculations included fuel oil, diesel, natural gas, and other stationary fuels, but this information wasn't as widely available for the rest of the community in the 2005 and 2019 inventories. Approximately 2% of the County's population is not serviced by the main natural gas provider (BG&E), and natural gas use in that area was assumed to be minimal or non-existent. Future inventories could include this information from other natural gas providers to Howard County.
- Include emissions from off-road mobile equipment (e.g., lawnmowers, construction equipment)
- Confirm no additional sources of industrial emissions occur in the County, and that the TransCo stationary combustion emissions are included in the commercial sector estimates.
- Include freight rail and other sources that were not included in the current inventory, as listed in the ICLEI Protocol
- Expand on scope 3 waste estimates based on destinations of landfill (i.e., the County could improve the accuracy of its estimate by reflecting specific landfill characteristics of the landfills receiving its waste)
- Consider estimating emissions of Sulphur hexafluoride (SF₆) from electricity transmission and distribution lines within the County's boundaries. SF₆ is a greenhouse gas with a high global warming potential (GWP) of 22,800, compared to a GWP of 1 for carbon dioxide.
- Confirm electricity emission factors with any in-County electricity generating units.
- Explore the feasibility of estimating emissions from other wastewater treatment methods (e.g., septic systems)
- Consider adding other upstream/downstream sources of emissions
- Agriculture and land use-related sources and sinks (carbon storage) could include:
 - o Livestock-related emissions, including both enteric fermentation and manure management
 - o Soil N₂O emissions
 - o Sequestration and C flux changes from land use and land use conversions for forestland, grassland, agricultural land, etc.
 - o Sequestration from urban trees
 - o Emissions from forest fires and agricultural residue burning

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- ¹ ICLEI U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Version 1.2, July 2019. Accessed online at: <https://icleiusa.org/us-community-protocol/>
- ² ICLEI notes that the energy use associated with water and wastewater infrastructure may also partially or fully be included in the use of purchased electricity and stationary combustion equipment.
- ³ U.S. Census data from 2016 -2020 estimates Howard County has 116,457 households. Data provided by Howard County indicates that 114,170 households receive electricity from BGE, or 98% of Howard County households. U.S. Census Bureau. Retrieved from <https://www.census.gov/quickfacts/fact/table/howardcountymaryland/AFN120217>
- ⁴ Environmental Protection Agency. eGRID Summary Tables 2019. https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf
- ⁵ Industrial emissions total 220 MT CO₂e in 2019.
- ⁶ Environmental Protection Agency. State Greenhouse Gas Inventory and Projection Tool. <https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool>
- ⁷ State Highway Administration of Maryland. https://www.roads.maryland.gov/OPPEN/annual_vehicle_Class.pdf
- ⁸ MVA Vehicle Registration by County from 2010 to 2022. <https://opendata.maryland.gov/Transportation/MVA-VEHICLE-REGISTRATION-by-COUNTY-FY-2010-to-FY-2/kqkd-4fx8>
- ⁹ Facilities located within Howard County include Alpha Ridge Municipal Landfill, AmeriWaste Processing & Transfer Station, and Citron Hygiene Transfer Station.
- ¹⁰ ClearPath indicates “wet” should be selected for annual precipitation of greater than 40 inches per year.
- ¹¹ Environmental Protection Agency. State Greenhouse Gas Inventory and Projection Tool. <https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool>
- ¹² Environmental Protection Agency. GHGRP Data for Transco Station 190 in 2019. Accessed online at: <https://ghgdata.epa.gov/ghgp/service/facilityDetail/2019?id=1006953&ds=E&et=&popup=true>
- ¹³ “Petroleum and natural gas systems” includes fugitive emissions.
- ¹⁴ Local Government Operations Protocol, Version 1.1, May 2010. Accessed online at: https://s3.amazonaws.com/icleiusesources/lgo_protocol_v1_1_2010-05-03.pdf
- ¹⁵ Energy Information Administration. Annual Energy Outlook 2021. Table 54. Electric Power Projections by Electricity Market Module Region; <https://www.eia.gov/outlooks/archive/aeo21/>
- ¹⁶ U.S. Census Bureau. County Population Totals: 2010-2019. <https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html>
- ¹⁷ Maryland Department of Planning, Projections and State Data Center (December 2020). Historical and Projected Total Population for Maryland’s Jurisdictions. <https://planning.maryland.gov/MSDC/Documents/popproj/TotalPopProj.pdf>
- ¹⁸ Community-scale commercial and residential on-site combustion only included natural gas. Government emissions include both natural gas and #2 ULS Heating Oil Dyed. In 2021 approximately 83% of on-site fuel combustion government emissions were due to natural gas.
- ¹⁹ Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020. Chapter 3: Energy. <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-chapter-3-energy.pdf>
- ²⁰ Maryland Department of Transportation – State Highway Administration. Vehicle Miles of Travel. https://www.roads.maryland.gov/oppen/Vehicle_Miles_of_Travel.pdf
- ²¹ Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020. Chapter 3: Energy. <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-chapter-3-energy.pdf>
- ²² Environmental Protection Agency. eGRID2019 Unit, Generator, Plant, State, Balancing Authority Area, eGRID Subregion, NERC Region, U.S., and Grid Gross Loss (%) Data Files. February 23, 2021. https://www.epa.gov/sites/default/files/2021-02/egrid2019_data.xlsx
- ²³ Blonsky, Michael, Prateek Munankarmi, Sivasathya Balamurugan. 2021. Incorporating Residential Smart Electric Vehicle Charging in Home Energy Management Systems: Preprint. Golden, CO: National Renewable Energy Laboratory. NREL/CP-5D00-78540. <https://www.nrel.gov/docs/fy21osti/78540.pdf>

Appendix F: Mitigation Analysis Assumptions and Methods

Buildings and Energy Use Strategies

In the Energy Strategies section, there are three major ways in which emissions are reduced. First, by using less energy than anticipated from the business as usual (BAU) projection through the implementation of energy efficiency or green building techniques. Second, by switching equipment out from one energy source to a cleaner energy source (as is the case with electrification). Third, by cleaning the energy supply through the integration of low and no carbon resources (this happens from new carbon free sources on the electricity grid, such as solar or wind energy, or by the addition of renewable natural gas into the gas system).

The modeling took a simplistic approach to costs, pricing all equipment without cost changes over the life of the technology and holding utility rates at current utility rates for the range of years studied. This approach provides for a highly replicable and transparent methodology. Methodology assumptions below include a base mitigation modeling methodology and an enhanced mitigation modeling methodology, with all modeling for the base mitigation modeling unless noted otherwise.

Strategy E1: Reduce Greenhouse Gas Emissions from Existing Buildings

Action 1: Increase energy efficiency and conservation in all existing residential, commercial and government buildings

Methodology

ICF begins by taking cost-effective energy efficiency potentials for residential, commercial and government buildings. For electricity, we assume 30% residential savings and 25% for commercial and government buildings. For gas, we assume 20% savings across all buildings. We then phase in these reductions annually until 100% of the building stock realizes these reductions by 2045. It is assumed a suite of technical and behavioral measures are used to reach these savings – technical measures could include air sealing, insulation, high-efficiency appliances, and smart thermostats, among others. Behavioral measures could include providing education information, leveraging social norms, and other techniques that encourage building occupants to use less energy. All equipment changes in the model are “replaced on burnout” in alignment with cost effective energy efficiency values outlined below. This means that the modeling assumes new equipment is only installed when equipment reaches the end of its useful life (at which time the equipment is replaced with a more efficient piece of equipment). As a result of this approach, modeled costs represent only the incremental cost between more and less efficient new equipment and the costs of any other energy efficiency measures that are not replacing old equipment, not the total anticipated costs which would be inclusive of maintaining all equipment, as equipment maintenance costs are likely to be similar between old and new equipment.

Key Assumptions

- Targets existing residential, commercial and government buildings
- Cost-effective electricity energy efficiency potential of 30% in residential buildings¹² and 25% in commercial and government buildings.³ Annual building stock-wide electricity savings begin at 0.5%, ramping up to 3% for residential and 2.5% for commercial and government by 2045. The changes within these rates were chosen based on the expectation that energy efficient equipment will become more widely available and cost effective over time.

- Cost-effective gas efficiency savings of 20% across all buildings. Annual gas savings begin at 1.1% ramping up to 2% by 2045.
- 20-year measure life, with replacement by like measures at end of life.
- Replacement on burnout for measures, capturing only incremental cost of efficient vs. conventional equipment. This is because it is unlikely residents and businesses will upgrade equipment before it breaks.
 - o \$3,500/household for residential measures⁴
 - o \$1.91/sq. ft. for commercial measures⁵
- Electricity price of \$0.125 /kWh, natural gas price of \$14.00/MCF⁶
- No additional operations and maintenance costs since new equipment is assumed to have similar operations and maintenance costs as existing equipment.

Action 2: Increase electrification in existing residential, commercial and government buildings

Methodology

The strategy takes BAU natural gas and fuel oil consumption and converts it to electricity, gaining efficiency via beneficial electrification measures. By 2030, it is assumed that 20% of residential homes and 10% of commercial and government will be electrified.⁷ By 2045, 80% of residential and 59% of commercial and government buildings will be electrified. Linear interpolation is used between these targets for a steady adoption rate. These adoption values are considered realistic due to the aggressive legislation that has passed in Maryland and the relative cost effectiveness of electrification in the residential marketplace. In its Maryland Building Energy Transition Plan⁸, the Maryland Climate Change Commission recommended the State include rebates and incentives to support fuel switching and beneficial electrification programs through their EmPOWER program starting in 2024. In the commercial space, The Climate Solutions Now Act of 2022 mandated a pathway of zero carbon commercial buildings including broad electrification of existing buildings to achieve net-zero emissions by 2040. Residential gas use is converted to electricity via 8.2 Heating Seasonal Performance Factor (HSPF) air source heat pump (which aligns with ENERGYSTAR’s current efficient heat pump equipment). Commercial and government gas use is converted to electricity using a conservative 18% efficiency gain (based on a 2020 national study of electrification in commercial buildings). This value is considered conservative due to Maryland’s average air temperatures, which should allow more efficient and effective electric heating than can be expected in areas with colder climates. All equipment is “replaced on burnout,” and therefore only incur incremental costs, as described in the energy efficiency strategy above. At the end of measure life, new equipment replaces existing equipment.

Key Assumptions

- Targets existing residential, commercial and government buildings
- By 2030, 20% residential buildings using gas or oil are converted to electric and 10% of commercial and government buildings using oil or gas are converted to electric. By 2045, 80% of residential buildings using gas or oil are converted to electric and 59% of commercial and government buildings using oil or gas are converted to electric.
- Electrification GHG reductions are based on using an 8.2 HSPF heat pump for residential buildings⁹ and applying 18% efficiency gain for commercial and government buildings.¹⁰ Although electrification can include appliances such as dryers and stovetops, heating, ventilation, and air conditioning (HVAC) tends to be one of the largest electric loads in a building. Therefore, the modeled GHG emissions reductions are based on energy savings from electrifying heating systems.
- 15-year equipment measure life, with replacement by like equipment at end of life.

- Replace on burnout for measures, capturing only incremental cost:
 - o \$3,500/house incremental capital cost for residential,¹¹
 - o \$18.48/sq. ft. capital cost for electrification of commercial and government buildings. Costs ranged from \$8.48 - \$23.68 in the study referenced, so this was calculated as the average incremental capital cost for commercial and government buildings.¹² Over time as electrification technologies are more broadly adopted, costs are anticipated to come down through contractor familiarity and technology improvements.
- Electricity price of \$0.125 \$/kWh, natural gas price of \$14.00/MCF.¹³
- No additional operations and maintenance costs for energy efficient equipment.

Action 3: Accelerate the adoption of low GWP refrigeration and air conditioning equipment in commercial properties and reduce refrigerant leaks.

Refrigerant leaks can be an important source of emissions as these chemicals typically have a high global warming potential (GWP). The AIM Act passed in 2020 phases out hydrofluorocarbons (HFCs) over time in favor of lower-GWP alternatives. Howard County can create a program promoting the use of low GWP refrigerant equipment and performing frequent maintenance to reduce refrigerant leaks in commercial properties (e.g., encourage local businesses to enroll in the federal GreenChill program).

Methodology

Refrigerant emissions from the food retail sector was estimated using a total count of food retail stores in Howard County, estimated square footage for each type of store, and an assumed refrigerant leakage rate per 1,000 sq. ft. The model assumes enrollment of retail food stores in GreenChill (or a similar program), results in a drop in emissions.

Key Assumptions

- BAU projections assume that HFC refrigerant emissions remain flat through 2045. Retail food locations are expected to grow at the same rate as population.
- As of 2022, Howard County has 152 food retail stores. These include: 83 convenience stores; 37 supermarkets; and 32 small grocery/corner stores.¹⁴
- An estimate of emissions due to refrigerant leakage per 1,000 sq. ft. for supermarkets was developed using analysis conducted by the GreenChill Program.¹⁵ The average 46,000 sq. ft. supermarket emits 1,556 metric tons of carbon dioxide equivalent (MT CO₂e) of refrigerant per year.
- An average square footage for each category of food retail store is assumed. Convenience store – 2,450 sq. ft.;¹⁶ small grocery/corner store – 12,000 sq. ft.;⁵ supermarket – 46,000 sq. ft.¹⁷
- The GreenChill program helps participating retailers improve their refrigerant management practices, transition to alternative refrigerants, and set and track progress toward GHG reduction goals.¹⁸ GreenChill Partners in the food retail industry have refrigerant emissions rates nearly 50% lower than the EPA-estimated industry average. This model assumes that as food retail locations enroll in GreenChill (or a similar program) emissions reduce by half.¹⁹
 - o Currently only 1 store in Howard County is enrolled in the GreenChill program (Sprouts in Ellicott City, MD).²⁰
- By 2030, 34% of Howard County retail food stores are enrolled in GreenChill (or a similar program).
- By 2045, 83% of Howard County retail food stores are enrolled in GreenChill (or a similar program).

Strategy E-2: Construct Efficient and Low-Carbon Buildings

Action 1: Implement more stringent green building standards for new residential, commercial and government properties.

Methodology

Historic Howard County building permit records were used to project forward new construction. The average residential growth rate from 2006-2022 was applied to future years, and the average commercial growth rate from 2018-2022 was applied to future years. Commercial growth intentionally weighted COVID-19 impacted years to reflect a presumed decrease in demand for new commercial office space.

Once growth projections were determined, new IECC (residential) and ASHRAE 90.1 (commercial and government) codes were applied to new construction. Based on historical improvements to codes, ICF estimated energy efficiency expected due to new code improvements. ICF also worked to define through modeling a green building standard or overlay code. Modeling accounts for codes to be updated every 3 years and above code standards (green building standards or overlay code) to stay one code cycle ahead of current version of IECC/ASHRAE code, with each subsequent code version resulting in a 5% reduction in energy use intensity (EUI) which is the energy use including electricity and any other fuel sources per square foot. Howard County assumed a 95% compliance rate with new energy –efficiency-focused code.

Only incremental capital costs are included in the model. Incremental cost is the additional cost of constructing a building to the new green building code standard compared to the cost of constructing the same building under the International Construction Code. Commercial capital costs are negative because even though there may be a small added cost from tighter, better insulated building envelopes, these energy efficiency improvements also allow the building to use smaller, less expensive heating and cooling equipment, which results in a slight overall cost savings over construction under the International Construction Code. At the end of measure life, like equipment replaces existing equipment.

Key Assumptions

- Targets new residential, commercial and government buildings
- Average annual new construction rate from 2006-2022 for residential, 2018-2022 for commercial.
- 5% efficiency gain with each subsequent code cycle.²¹
- 95% compliance rate with new energy-efficiency focused code.
- Incremental cost of code adoption (including electrification):
 - o \$3,687/house incremental capital cost for residential,²²
 - o -\$1.50/sq. ft. incremental capital cost for commercial and government buildings (due to equipment downsizing)²³
- Electricity price of \$0.125 \$/kWh, natural gas price of \$14.00/MCF²⁴
- No additional operations and maintenance costs

Action 2: Phase-in requirements for all-electric new construction for residential, commercial and government properties.

Methodology

All-electric new construction is assumed to begin in 2025 for 100% of residential properties and 38% of commercial and government properties. All-electric commercial construction is implemented beginning in 2035. Both assumptions align

broadly with Maryland's plans for a Building Emissions Standard and associated updated building codes as outlined in recent planning documents.²⁵ Residential gas use is converted to electricity via 8.2 HSPF air source heat pump. Commercial and government gas use is converted to electricity using a conservative 18% efficiency gain.

Only incremental capital costs are included in the model. Incremental cost is the additional cost of constructing a building to the new green building code standard compared to the cost of constructing the same building under the International Construction Code. Commercial capital costs are negative because even though there may be a small added cost from better insulated building envelopes, these improvements also allow the building to use smaller, less expensive heating and cooling equipment. This results in a slight overall cost savings over construction under the International Construction Code. At the end of measure life, like equipment replaces existing equipment.

Key Assumptions

- Targets new residential, commercial and government buildings
- Average annual new construction rate from 2006-2022 for residential, 2018-2022 for commercial.
- 5% efficiency gain with each subsequent code cycle.²⁶
- 95% compliance rate with new energy-efficiency focused code.
- 2025: 100% residential electrification, 38% commercial and government electrification
- 2035: 100% building electrification across residential, commercial and government
- 8.2 HSPF heat pump for residential buildings,²⁷ 18% efficiency gain for commercial and government buildings²⁸
- 15-year equipment measure life, with replacement by like equipment at end of life.
- Incremental cost of code adoption (including electrification):
 - o \$3,687/house incremental capital cost for residential,²⁹
 - o -\$1.50/sq. ft. incremental capital cost for commercial and government buildings³⁰ (due to equipment downsizing)
- Electricity price of \$0.125 \$/kWh, natural gas price of \$14.00/MCF³¹
- No additional operations and maintenance costs

Strategy E3: Decarbonize the Energy Supply

Anticipated Grid changes from MD Renewable Portfolio Standard (RPS), etc. without specific Howard County government action (not a named or numbered strategy in Howard County Climate Forward)

Methodology

This strategy explored two possibilities for changes to the electricity grid carbon intensity in addition to the base case for the grid.

- The base case grid assumes that the grid carbon intensity matches recent regional grid emissions rates from EPA's eGRID³² (RFC East) and follows the same carbon intensity trends from the 2022 Annual Energy Outlook (AEO)³³. The emissions for the BAU were calculated using in grid emissions factors from this base case grid.
- The existing policy methodology aimed to align with Maryland's current RPS of 50% of electricity from regional renewable energy sources by 2030.
- The enhanced policy methodology implements the existing Maryland RPS and expands it to a proposed 100% carbon-free electricity statewide by 2035 in alignment with the Biden Administration's electricity grid carbon reduction goals. This would require new state legislation.

In both cases, emissions from renewable electricity were set at zero and implementation of the renewable energy was seen as a change from the planned AEO base case grid policy scenario. Emissions reductions are above and beyond AEO Grid Policy Scenario which serves as the baseline for reductions. This is not the result of a Howard County government action but can demonstrate the GHG impact of a zero-carbon grid.

Howard County included Maryland's current RPS of 50% of electricity from regional renewable energy sources by 2030 in emissions reduction calculations for Strategy E3 because even though this isn't a County action, it is something that is currently happening and was not reflected in the emissions outlook for 2030 or 2045 in any other way in the mitigation analysis.

Action 1: Expand the development of solar energy for residential, commercial, and government properties

Methodology

A 2018 rooftop solar technical potential of 1,100 MW DC was calculated using Project Sunroof information.³⁴ Project Sunroof estimates rooftop based on aerial mapping, which estimates technical potential constraints such as shading, roof angle as well as a regional solar resource.³⁵ The Technical potential represents the achievable capacity (MW) of rooftop solar photovoltaic (PV) given existing system performance as well as rooftop constraints. Technical potential does not account for economic barriers or market considerations. Future rooftop solar technical potential was tied to population growth rates (and the associated increase in new construction and new roofs available for solar), resulting in a maximum achievable potential of 1,259 MW DC of rooftop solar by 2045. A phase-in factor implements linear interpolation (straight line of growth) towards achieving 90% of technical potential in 2045, or 1,133 MW DC.

Howard County solar permitting data was then analyzed to derive the existing installed capacity of 82 MW on rooftops in 2022. A BAU growth in new rooftop solar installations of 6.9 MW was forecasted annually through 2050 based on the median growth in these installations from 2018-2022. Electric grid kWh reductions and associated CO₂e reductions from the actions in this strategy do not include this BAU growth as doing so would double count the impact and show it both in the BAU and the post-strategy-implementation calculations.

Key Assumptions

- Targets existing and new residential, commercial and government buildings.
- Uses a high rate of implementation of rooftop solar (90 percent of technical capacity by 2045) as a proxy to account for the fact that actual rooftop solar installation may be less than 90 percent of technical capacity, but that parking canopy solar and ground mount solar also will be installed and isn't otherwise accounted for in this model.
- 2018 solar technical potential of 1,100 MW DC. Adjusting for population growth and associated new construction and new roofs, the solar technical potential in 2045 is projected to be 1,259 MW DC.
- 82 MW existing solar capacity and 6.9 MW BAU growth³⁶
- 1379.5 kWh AC/year from a 1 kW DC array in Howard County which is used to scale kWh production per kW DC installed³⁷
- 30-year measure life
- Cost per kW was set at \$1624/kW for weighted cost of residential and commercial solar³⁸
- Electricity price of \$0.125 \$/kWh
- No additional operations and maintenance costs since studies show actual O&M costs to be very small (less than 2% of capital costs annually) and they would have an extremely small impact on the results.

Transportation Strategies

Strategy T1: Maximize the Use of Electric Vehicles

Action 1: Continue to develop a robust EV charging station infrastructure

Methodology

ICF obtained the total number of existing publicly-accessible chargers within Howard County using raw data from the AFDC Electric Vehicle (EV) Charging Station Locations map. Next, we applied the regression model developed by Javid et al. 2019³⁹ to estimate EV adoption rates in Howard County using Howard County demographics, energy costs, and home ownership data in addition to assumed numbers of chargers in 2030 and 2050. In order to achieve an EV penetration of 74% of all passenger vehicles, ICF assumed that the number of chargers would double every 5 years through 2042 and increase by 1,000 every 5 years through 2050. Baseline projected EV adoption rates by vehicle class developed by NREL⁴⁰ was subtracted from the regression model projected adoption rate. The change in adoption rate over baseline for each vehicle class was multiplied by non-interstate vehicle miles traveled (VMT) by vehicle class to calculate the increase in EV VMT and decrease in ICE VMT. Non-interstate was chosen because EV chargers in Howard County are anticipated to have little effect on pass-through vehicle propulsion type choice. AEO (or BAU) grid emissions assumptions applied throughout the analysis were used to calculate the anticipated additional emissions from additional grid load from EVs. As described in strategy E3, AEO scenario electricity grid factors were used to determine the electricity emissions changes as a result of this activity. Net emissions change was the difference of emissions reductions from reduced ICE VMT and additional emissions from additional grid load from electric vehicles.

Key Assumptions

- Regression model coefficients used to estimate electric vehicle adoption rate based on charging infrastructure deployment were developed by Javid et al. 2019⁴¹
- Regression model data:
 - o Age⁴²
 - o Gender⁴³
 - o Number of vehicles per household⁴⁴
 - o Maximum education level in household⁴⁵
 - o Home ownership⁴⁶
 - o Gas Price⁴⁷
 - o Electricity Price⁴⁸
 - o Average travel time to work (min)
- 2022 number of chargers found by using the AFDC Electric Vehicle Charging Station Locations map data and filtering for chargers located within Howard County. Data accessed on August 30, 2022.
https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC
- 400 publicly available chargers by 2030 and 2,600 by 2045. This estimate is in line with industry recommendations.⁴⁹
- Gas prices, at \$0.16/mi, and electricity prices, at \$0.04/mi, held constant

- Electric vehicle efficiency values (kWh/mi) based on AFLEET 2020⁵⁰ defaults with a 15% efficiency improvement by 2050

Assumed EV Energy Economy (kWh / mi)				
	2018	2022	2030	2050
Pass. Cars	0.30	0.29	0.28	0.26
Pass. Trucks	0.600	0.59	0.57	0.51

Please note that although the above methodology shows that installing additional EV charging stations throughout the County is a critical step to encourage the adoption of EVs by members of the community, Howard County did not use this methodology to estimate the GHG emissions reductions expected from increased adoption of EVs. Instead, this methodology was used to determine a target number of publicly available EV charging stations in Howard County on public and private property. The emissions reductions from EV adoption by the community was captured through analysis used for T1 – Action 2 below. In order to avoid double counting emission reductions, Howard County only used emissions reduction numbers calculated for one of the actions related to increasing EV adoption in the community.

Action 2: Accelerate the adoption of electric vehicles in the community and County government fleet.

Methodology for County Fleet

Baseline fuel consumption is estimated for one year by summing the product of annual work days and the daily consumption for each vehicle in the Howard County government fleet.

Scenario fuel consumption is estimated for each year by replacing vehicles once they reach 15 years of age with an electric vehicle of the same class. Assumed efficiencies of replacement electric vehicles vary by class and by procurement year, and are based on AFLEET 2020 defaults. Once an electric vehicle reaches 15 years of age, it is replaced with another electric vehicle of the same class but has an updated efficiency.

Change in total fuel use and associated emissions between the baseline and scenario fleets is calculated. Next, total additional grid load from new electric vehicles is summed by using the product of efficiency (kWh/mi) and annual VMT derived from the provided daily fuel use and fuel economy. AEO grid emissions assumptions applied throughout the analysis were used to calculate the anticipated additional emissions from additional grid load from electric vehicles. Net emissions change was the difference of emissions reductions from reduced ICE fuel usage and additional emissions from additional grid load from electric vehicles.

With these assumptions, a 100% EV fleet will be reached by 2037.

Key Assumptions

- 260 work days per year
- Analysis based on existing fleet and fuel use information from Howard County
- All county fleet vehicles (across all vehicle classes) are replaced with electric vehicles once they reach 15 years of age. This assumes that all vehicle classes will have an EV option by the time of vehicle replacement.
- County vehicle driving profiles remain the same, and the fleet does not change in size.
- Vehicle efficiency values (kWh/mi) based on AFLEET 2020⁵¹ defaults with a 15% efficiency improvement by 2050

- When electric vehicles reach 15 years of age, they are replaced with another vehicle with the latest efficiency value.
- We anticipate that supply chain and scaling issues impacting EV availability will resolve in the next few years as the technology matures and should not impact long-term EV needs.

Methodology for Community Fleet

This action focuses on increasing the rate of EV adoption by the community through a combination of adding new EV charging infrastructure, educating community members about EVs and new rebates available from the state and federal government, as well as anticipated adoption of EVs as the market trends toward EVs in the future.

The adoption rate was assumed to be 50% of new light-duty passenger car and truck sales are EVs in 2030 and that by 2040, 100% of new vehicle sales are EVs. The adoption rate for each vehicle class was multiplied by non-interstate vehicle miles traveled (VMT) by vehicle class to calculate the increase in EV VMT and decrease in ICE VMT. Non-interstate was chosen because EV chargers in Howard County are anticipated to have little effect on pass-through vehicle propulsion type choice. AEO (or BAU) grid emissions assumptions applied throughout the analysis were used to calculate the anticipated additional emissions from additional grid load from EVs. As described in strategy E3, AEO scenario electricity grid factors were used to determine the electricity emissions changes as a result of this activity. Net emissions change was the difference of emissions reductions from reduced ICE VMT and additional emissions from additional grid load from electric vehicles.

Key Assumptions

- 50% of new light-duty passenger car and truck sales are EVs in 2030; 100% of new vehicle sales are EVs by 2040.
- Assumed vehicle efficiency values (kWh/mi) based on AFLEET 2020 defaults
- When electric vehicles reach 15 years of age, they are replaced with another vehicle with the latest efficiency value.

Action 3: Transition to a zero-emissions transit vehicle fleet.

Methodology

We retrieved information about Howard County’s transit fleet from the Bureau of Transportation Statistics’ (BTS) National Transit Database (NTD). This fleet includes buses, cutaways, and automobiles used for fixed route and demand responsive service types. Numbers were then verified and adjusted as needed by Howard County’s Office of Transportation.

Baseline average annual miles per vehicle was calculated by dividing the VMT by fuel type from “Fuel and Energy Static” NTD 2019 table and the “Vehicles Static” NTD 2019 table number of buses, cutaways, and automobiles used for fixed route and on demand transit. By doing this, an average annual VMT was calculated for each vehicle type.

Baseline fuel use and emissions were calculated by using the NTD 2019 fuel use totals and assumed fuel emissions rates.

Scenario fuel use was calculated by linearly interpolating the number of EVs such that 100% EV transit fleet is achieved by 2040. Average annual miles per vehicle was multiplied by each vehicle and each fuel type in each year to obtain miles traveled on each fuel. The NTD 2019 mpg and kWh/mi were multiplied by the total VMT by fuel type to obtain fuel use in each year. Fuel used was multiplied by assumed emissions factors or grid emissions factors to obtain total emissions.

The difference between baseline fleet emissions and scenario fleet emissions was the emissions reduction.

Key Assumptions

- Conversion to EV buses only (i.e., no hybrid, hydrogen fuel cell, or catenary wire buses)

- Based on 2019 NTD data
- Transit service stays the same as 2019 in all modeled years
- Only Howard County RTA modeled, MTA not modeled
- kWh/mi projected to decrease over time as more efficient electric propulsion systems are developed

Action 4: Transition to a zero-emissions school bus fleet

Methodology

Annual VMT for the existing school bus fleet is estimated by calculating an average annual mileage for each vehicle (total mileage divided by the number of years in service) and summing.

Baseline emissions were calculated by multiplying this VMT by an assumed school bus emissions factor and fuel economy. Scenario emissions are estimated for each year by replacing school buses once they reach 12 years of age with an electric school bus. Assumed efficiencies of replacement school buses are based on AFLEET 2020 defaults. Once an electric school bus reaches 12 years of age, it is replaced with another electric school bus but has an updated efficiency. Total additional grid load was summed by multiplying the average annual VMT by the fuel efficiency (kWh/mi). Grid emissions assumptions applied throughout the analysis were used to calculate the anticipated additional emissions from additional grid load from electric school buses. Net emissions change was the difference of emissions reductions from reduced ICE school bus fuel usage and additional emissions from additional grid load from electric school buses.

Key Assumptions

- 180 school days per year
- All school buses are replaced with electric vehicles once they reach 12 years of age. The fleet will consist of 393 (73%) electric school buses by 2030 and 535 (100%) electric school buses by 2045.

Assumed EV Energy Economy (kWh / mi)				
	2018	2022	2030	2050
School Buses	1.5	1.47	1.42	1.28

- Vehicle efficiency values (kWh/mi) based on AFLEET 2020 defaults with a 15% efficiency improvement by 2050
- ICE school bus MPG provided by US AFDC⁵²
- When school buses reach 12 years of age, they are replaced with another vehicle with the latest efficiency value.
- Each school bus maintains a constant annual average VMT.

Strategy T2: Reduce Vehicle Miles Traveled in Single Occupancy Vehicles

Action 1: Increase public transit ridership by enhancing the effectiveness and reliability of local and regional public transit.

This action was not independently modeled.

Action 2: Implement microtransit in less dense areas that have a demonstrated need of connection between homes, jobs, and services.

Methodology

Baseline tailpipe emissions for passenger vehicles were calculated through 2045. This total was reduced by 3.8% per year to account for the addition of microtransit service in the county. The difference between baseline and the adjusted emissions totals was the emissions reductions due to the action.

Although these emissions reductions may be a bit high because Howard County microtransit is likely to take place on a smaller scale than it did in the studies cited in the assumptions below, several of the actions that are intended to reduce VMT were not modeled and therefore have no emissions reduction numbers assigned to them. Therefore, having an action where emissions reduction estimates may be slightly high can make up for the actions under T2 that do not have modeled reductions assigned to them.

Key Assumptions

- 3.8% VMT and proportional emissions reduction on baseline emissions in Howard County due to microtransit, based on research in Canada.⁵³ In the Canadian study, baseline GHG levels were calculated based on vehicle occupancy rate, emissions rates, and inefficiency assumptions (e.g. 20% inefficiency for paratransit trips). For projected GHG reductions, total number of journeys and distance travelled were kept the same. Interviews and expert input informed the likely switching rate by consumers to microtransit, the inefficiencies involved with empty vehicles between pickups, and the emissions rates of the microtransit vehicles themselves. The 3.8% figure, calculated for Montreal, was the more conservative of the two regions studied. The other value was 5% for Toronto.
- The 3.8% reduction in emissions is applied to the emissions anticipated under a BAU scenario that also includes some reductions in vehicle emissions due to expected increases in adoption of electric vehicles that will likely occur without any County actions.

Action 3: Expand and improve sidewalks, crosswalks, pathways and bike lanes and connect them to jobs, shopping, schools, and recreational amenities.

Methodology

An outcome-based approach was used to model walkable path and bike lane networks. Baseline tailpipe emissions for all types of passenger vehicles were calculated through 2045. This total was discounted by 2% per year by 2030 and 4% per year by 2045. This was to account for the reduction in VMT and associated tailpipe emissions from all passenger vehicle types that result from the increase in pedestrian infrastructure in the County.

Although these emissions reductions may be a bit high because the modeling is not based directly on emission reductions from sidewalks, paths, and bike lanes, several of the actions that are intended to reduce VMT were not modeled and therefore have no emissions reduction numbers assigned to them. Therefore, having an action where emissions reduction estimates may be slightly high can make up for the actions under T2 that do not have modeled reductions assigned to them.

Key Assumptions

- 2% passenger VMT reduction by 2030 and 4% passenger VMT reduction by 2045, which is consistent with other analyses conducted by ICF in the metropolitan Washington, D.C. region on increased land use density. These VMT

reductions found from increased land use density were then applied as a proxy for VMT reductions that may result from increased biking and walking infrastructure in Howard County.

- The reductions in emissions from the assumed reductions in VMT listed above is applied to the emissions anticipated under a BAU scenario. The BAU scenario includes some reductions in vehicle emissions due to expected increases in adoption of electric vehicles that will likely occur without any County actions.

Action 4: Increase and normalize teleworking options for employees whenever possible.

Methodology

Estimates for growth in number of jobs by NAICS industry for Maryland, provided by the Maryland Department of Labor and Industry, was applied to the actual number of jobs by industry in Howard County from 2019. The actual number was obtained from Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) data and extrapolated to 2030 and 2045.

The percentage of employees by NAICS industry that can telecommute was estimated by Dingle and Neimen 2020.⁵⁴ In this study, researchers assessed occupational surveys to determine which occupations within different industries were telework capable.

Dey et al. 2020⁵⁵ estimated pre-COVID-19 telecommute uptake by NAICS industry using two different surveys.

The Dingle and Neimen 2020 industry telework capable percentages were discounted by the Dey et al. pre-COVID-19 uptake percentages. The resulting “delta” percent was multiplied by the projected number of jobs by industry in the county to obtain total new telecommute capable jobs in the county on top of the baseline telecommute rates from before COVID-19.

Based on the sources above, we found that the percentage of Howard County employees in 2022 who telework at least one day per week is about 23% of the total workforce, or 38,000 people. Projections were made for number of employees teleworking in 2030 and 2045 based on projections for total workers in those years and on our goals of getting 40% of the total workforce telecommuting by 2030 (70,800 people) and the maximum, based on the percentage of all jobs that are telework-compatible, of 52% of the workforce (105,000 people) in 2045.

Next, average work trip length for Maryland was obtained from the Baltimore Metropolitan Council’s Travel Demand Forecasting.⁵⁶ Additionally, passenger vehicle mode share, that is, the percent of commuters using personal vehicles for commuting on work trips, was obtained from the National Household Travel Survey (NHTS) 2017. The number of new remote workers was multiplied by the passenger vehicle mode share percentage and the average work trip distance to determine total maximum work VMT avoided. The average work trip distance for Howard County for all workers is 14.62 miles each way, or 29.24 miles round trip.

A 17.4% induced VMT discount can be determined from Zhu and Mason 2014,⁵⁷ who compared the VMT trends of telecommuters and non-telecommuters in the 2009 National Household Travel Survey. They showed a mean non-work trip VMT of 31.5 miles for non-telecommuters, 28.2 mile mean work trip VMT for non-telecommuters, and a 36.4 non-work trip VMT for telecommuters. The total work VMT avoided in the previous step is discounted by 17.4%, calculated as

$$\frac{\text{telecommuter mean non-work trip VMT} - \text{non-telecommuter mean non-work trip VMT}}{\text{non-telecommuter mean work trip VMT}} = \frac{36.4 - 31.5}{28.2} = 17.4\%$$

Thus, for every 28.2 miles of work trip VMT avoided by a previously non-telecommuter beginning to telecommute, 4.9 miles of non-work trip VMT are added. This reflects additional VMT added when a worker is not commuting to the office. 4.9 miles divided by 28.2 miles is 17.4%. This percentage is subtracted from the VMT reductions achieved by telework. We

applied the 17.4% discount to the 29.24 mile average round trip commute for Howard County and to determine the VMT avoided each day by Howard County commuters teleworking is 24.15 miles ($29.24 \times 0.174 = 5.09$ miles; $29.24 - 5.09 = 24.15$).

Hybrid work schedules are likely to be the reality in coming years instead of pure work from home schedule. Reducing VMT is critical to lowering GHG emissions in Howard County, with transportation as the largest source of emissions. Therefore, our goal is for all employees with telework capable jobs (about 52% of total County workforce) to telework 3 days per week by 2045. We multiplied the total number of workdays per year of 260 by 3/5 to reflect 3 days spent at home and 2 days in the office). This results in 156 work days per year spent at home.

Daily VMT avoided by telework of 24.15 miles is multiplied by 156 days per year and then multiplied by the number of Howard County workers with telework capable jobs in each of our target years of 2030 and 2045. Although we show a baseline of 38,000 people telecommuting in 2022, we are assuming no reductions for teleworking from VMT emissions calculated for our GHG emissions reduction baseline year of 2005 because teleworking was rare at that time.

Expected VMT avoided in 2030 is 266.7 million VMT and in 2045 is 395.6 million VMT.

The resulting VMT reduction is converted to GHG emissions by using baseline ICE (internal combustion engine) emissions rates and EV efficiencies and uptake in future years. The resulting emissions reductions from reduced VMT is 90,600 MTCO_{2e} in 2030 and 124,049 MTCO_{2e} in 2045.

Key Assumptions

- Teleworking is available to all workers in the county (government and public) whose occupation is telework capable
- Share of telework capable jobs by industry was developed by Dingle & Neimen 2020
- Job total projections by industry for 2030 and 2050 are based on a constant average annual rate of change calculated from the 2020-2030 Maryland Department of Labor and Industry statewide projections⁵⁸
- Starting jobs by industry in Howard County obtained from 2019 LEHD/LODES data⁵⁹
- Average commute mileage for Howard County workers came from Baltimore Metropolitan Council's Travel Demand Forecasting.⁶⁰
- A discount of 17.4% induced VMT was applied to telecommute miles to simulate increased VMT at home (Zhu & Mason 2014)
- Pre-COVID-19 telecommute uptake by industry was assumed and applied as a discount in the calculations (Dey et al. 2020)
- Hybrid work environment was simulated by assuming 2 days in the office per week, with 3 days at home.
- Discounted benefits by a baseline uptake of EVs in future years, as EVs will produce fewer emissions than ICE vehicles so the reductions in emissions between commuting with EVs and teleworking will be less than they would be for ICE vehicles.

Action 5: Implement policies, outreach programs, and incentives to promote individual behavior changes to reduce emissions from personal vehicles.

This action was not independently modeled.

Waste Strategies

Strategy W1: Reduce Organic Waste Sent to Landfills and Manage Landfill Methane (all actions)

Methodology

This action increases the number of households participating in the Green Bin program each year, diverting organic waste from landfilling to composting operations, which results in a net GHG reduction. A Howard County website references a waste study that indicated that approximately 30% of waste in the County is composed of organic material, which could be diverted from landfills.⁶¹ This action focuses on residential organic waste, for which an existing composting program is available. Commercial organic waste could be another way to expand the impact of this action.

The number of new households participating in the program was multiplied by the average compost produced per household to estimate additional quantities of organic waste composted instead of landfilled.

Key Assumptions

- Approximately 15,000 people and 5,800 households are estimated to currently participate in the program⁶²
- Current participation results in approximately 1,200 tons of compost diverted from landfills, which is about 0.2 tons per participating household
- The number of households participating in the program is increased by 5% per year under this action
- This amount of organic waste was reduced from in-County landfilling quantities and increased baseline composting quantities. To estimate the associated GHG savings, the same emission factors used for the GHG inventory (from the ClearPath software) were used, which include direct CH₄ and N₂O emissions associated with each waste management practice from EPA's Waste Reduction Model (WARM.)

Additional Strategies Estimated but Not Included in Formal Modeling

Land Use Potential

Methodology 1

This action reviewed how changes in land use could impact GHG emissions. Two specific changes to land use were reviewed: One to review how the tree canopy could be expanded, the other estimated how changes to agricultural practices (specifically no till farming) could change soil carbon. These analyses were done to provide the rough potential for emissions reductions or carbon storage for these two strategies and relied on multiplying potential land use acreage changes with the change in carbon (from either new tree canopy or new no till farming practices on land). Based on this preliminary analysis, the County could reduce approximately 162,000 MTCO_{2e} through sequestration and improved practices.

Key Assumptions

- Existing Tree Canopy and potential tree canopy acreage values were derived from 2018 Howard County Tree Canopy Report. The possible tree canopy acreage value (excluding any agricultural uses) was considered as the potential land area for new tree canopy

- Total Existing Agricultural Land and Potential No Till Agricultural Land were derived from 2018 Howard County Tree Canopy Report. Potential Tree Canopy from Agricultural Land acreage value was considered as the Potential No Till Agricultural Land
- Net and Gross Tree carbon sequestration rates were used from a relevant study⁶³
- Conventional Tillage and No Till Carbon Dioxide and Nitrous Oxide values were used from a relevant study⁶⁴
- Changes in land use were phased in from 2023 through 2045 using a straight growth rate

Methodology 2

Howard County used the carbon storage estimate found through Methodology 2 because it is more specific to Howard County conditions. This methodology looks only at the carbon sequestration potential of forests and other trees that are outside of forests. Forests and urban trees sequester carbon from the atmosphere, while the conversion of forests to other land uses results in a net carbon release.

Initial investigations begun by the Office of Community Sustainability in 2022 suggest that the County's forested lands and tree canopy removed an estimated net 252,960 MTCO₂e (metric tons of carbon dioxide equivalent) from the atmosphere per year. This number was generated using the International Council for Local Environmental Initiatives' Land Emissions and Removals Navigator, or "LEARN Tool," an online application designed to help local governments quantify the carbon stocks of their forests and trees outside of forests.⁶⁵ Changes from forest to other land use, and other canopy loss emitted an estimated 26,263 MTCO₂e, which was accounted for and subtracted from a larger carbon sequestration estimate, to provide the net 252,960 MTCO₂e figure. While the estimate provided with this tool notes that the MTCO₂e values may be up to 45% greater or less in reality than indicated through the model, the model can reliably indicate the directionality of sequestration over time; that is, whether the forested and treed parts of the landscape are increasing or decreasing their carbon stocks and sequestration ability. In addition, Howard County used the GHG emissions sequestered by forests and urban trees to represent all carbon sequestration potential of natural and working lands in the County. Therefore, if the estimate for carbon storage potential of forests and trees alone is higher than the reality, other lands such as farms, native plant meadows, wetlands, etc. likely make up the difference.

Refrigerant Emission Changes (AIM Act)

Methodology

This action reviewed how changes in refrigerant types over time could reduce greenhouse gas emissions. It was modeled based on the recently passed federal AIM Act which directs the EPA to address HFC pollutants (which are many of the common refrigerants). Modeling was completed before regulations were provided and estimated drawdown of HFCs was largely modeled based on values from the Kigali Amendment (an international amendment to the Montreal Protocol from which the AIM act was based on). This was included as part of the enhanced modeling methodology. This could achieve emission reductions of approximately 96,000 MTCO₂e in 2045.

Key Assumptions

- 20-year stock turnover
- The AIM Act will require an 85% phasedown of HFC production and consumption from a set baseline over 15 years (by 2036), starting in 2025
- Model assumes that the drawdown will follow the Kigali Amendment schedule (35% reduction by 2025, 70% in 2029, 80% in 2034, 85% in 2035)
- The AIM Act will require an 85% phasedown of HFC production and consumption from a set baseline over 15 years (by 2036), starting in 2025

- Model assumes that the drawdown will follow the Kigali Amendment schedule (35% reduction by 2025, 70% in 2029, 80% in 2034, 85% in 2035)
- No change in refrigerant use
- 5% of HFC using equipment turnover annually with new equipment lowering emissions along the set schedule
- Provides for an 82.5% reduction in total emissions from HFCs by 2050 given the 20-year life of equipment (total of turnover from previous 20 years)

¹ National Renewable Energy Laboratory (NREL). MD Cost -Effective Energy Efficiency Potential, NREL ResStock: <https://resstock.nrel.gov/factsheets/MD>

² EmPOWER Maryland 2018 & 2019 Annual Reports, BG&E

³ Srivastava, R., and J. Mah. 2022. Moving the Needle on Comprehensive Commercial Retrofits. Washington, DC: American Council for an Energy-Efficient Economy. aceee.org/research-report/b2203.

⁴ Lawrence Berkeley National Laboratory (LBL). Home Energy Saver. <https://homeenergysaver.lbl.gov/consumer/>

⁵ ICF Analysis of regional costs (Based on Case Studies - Building Energy Performance Standards Development – Technical Analysis. Montgomery County, Maryland) <https://www.montgomerycountymd.gov/green/Resources/Files/energy/Case%20Studies%20-%20Building%20Energy%20Performance%20Standards%20Report.pdf>

⁶ Energy Information Administration (IEA). Maryland Price of Natural Gas Delivered to Residential Customers. <https://www.eia.gov/dnav/ng/hist/n3010md3m.htm>

⁷ Completed Commercial Permits, Howard County Permitting, 2006-2022

⁸ Maryland Commission on Climate Change. Building Energy Transition Plan: A Roadmap for Decarbonizing the Residential and Commercial Building Sectors in Maryland. 2021.

<https://mde.maryland.gov/programs/air/ClimateChange/MCCC/Commission/Building%20Energy%20Transition%20Plan%20-%20MCCC%20approved.pdf>

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¹⁹ Environmental Protection Agency (EPA) - GreenChill. GreenChill Store Certification Program. https://www.epa.gov/sites/default/files/2020-11/documents/gc_storecertprogram_11.12.20.pdf

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Appendix G: Current Howard County Climate Initiatives

Energy Conservation and Energy Efficiency

Building Codes

As of January 11, 2019, new home construction in Howard County is required to be “EV-Ready,” meaning that it must include infrastructure for plug-in electric vehicles. Installing EV infrastructure during construction is much more cost-effective than adding wiring later. Howard County is the first jurisdiction in Maryland and one of the first in the U.S. to require that new residential construction with driveways or garages have the electric wiring to enable electric vehicle charging. Even more innovative, new multi-family residential building will be required to provide one EV charging station for every twenty-five residential units.

Implementing targeted building code updates can be beneficial to the community in Howard County because those updates can improve long-term building resiliency in a changing climate. Increasing the number of targeted building code updates can help to reduce the number of heat islands by using reflective building materials and including more shade plantings and other heat mitigation measures on site.

Due to Howard County’s Department of Inspections, Licenses and Permits staff being active participants in several International Code Council committees and workgroups, the staff are constantly working to revise and update building codes that will not only protect property but also people. As of 2022, Howard County has adopted all of the modern international building codes, with the exception of the International Green Construction Code overlay.

<https://www.howardcountymd.gov/inspections-licenses-permits/adopted-codes>

Energy Performance Contracts

In 2009, Howard County’s EPC energy upgrades in seven County facilities resulted in \$238,000 of annual energy savings. In 2015, Howard County’s follow-on EPC efforts included energy audits at all 200-plus County-owned facilities and proposed energy conservation measures in 67 buildings. The installation of the measures in all buildings was completed in 2018 and the energy performance contract guarantees \$900,000 in annual cost savings.

Energy Conservation and Efficiency Education

Howard County provides information to the public on how to save energy and how access rebates, incentives and technical assistance, and use the most energy efficient equipment at work and at home.

LED Light Bulb Exchanges

Howard County offers residents free LED light bulbs at light bulb exchange events at Greenfest, 50+ Centers, and Community Centers. In 2023, Howard County began a partnership with the Howard County Public Library System. Through this program, residents can exchange their old, inefficient bulbs for new LED bulbs at the Elkridge Branch and East Columbia Branch circulation desks.

LEED Certified Buildings

New publicly funding buildings which consists of 30% or more County funding and are larger than 10,000 square feet must attain a LEED Silver rating. Most new private buildings larger than 50,000 square feet must attain a LEED Certified rating.

Howard County provides tax credits for these high-performance buildings. These commercial and residential buildings that qualify will receive tax credits when the buildings are fully built to the certain LEED and equivalent standards.

LEED for Cities and Communities

In August 2022, Howard County became the first county in the U.S. to obtain the LEED Platinum certification in the current Cities and Communities Program.

Little Patuxent Water Reclamation Plant

Howard County's Water Reclamation Plant uses a state-of-the-art technology Enhanced Nutrient Removal system to make it more energy efficient and reduce the amount of nitrogen that is released into the environment. There are two backup generators at this plant that protect the plant from power loss. Additionally, the plant has installed a solar energy array to completely offset the carbon of the generators and partially offset the carbon emissions of the plant.

Planning and Zoning

Howard County is planning to incorporate climate action throughout the new general plan, HoCo By Design, which is expected to be completed in 2023. This new General Plan will set the vision for the County's future growth, development and conservation policies over the next 20 years and reflect the shift in demographics and changes to the communities' priorities and goals. <https://www.hocobydesign.com/>

Green Neighborhoods: The Green Neighborhoods program is a voluntary program that uses housing allocations as an incentive to encourage development that conserves and protects natural resources, while providing sustainable communities that are energy and water efficient. The Green Neighborhoods Program consists of a Sites and a Home's component.

Watershed Planning: Watershed planning provides steps and feedback so environmental planning is better coordinated throughout the County. Watershed planning and management includes all of the activities related to preserving, protecting and restoring the streams, wetlands, forests and other natural resources that can be found in a watershed.

Retro commissioning

Howard County has received grants and rebates to "retro commission" seven buildings. Retro commissioning involves building tune-ups that will maximize energy efficiency and cost savings. The building tune-ups include making sure heating and cooling systems are working and are calibrated and programmed correctly. As of 2022, retro commissioning has been completed at the East Columbia Library, Ellicott City Senior Center, North Laurel Community Center, Gateway Building, Glenwood Public Library, Scaggsville Public Safety Complex, and the Charles E. Miller Library. Howard County is planning additional retro commissioning in 2023 at the George Howard Building, Warfield Building, and Carroll/Ligon Buildings in Ellicott City. On average, retro commissioning reduces building energy use by about 10 percent.

Street Light Conversion Program

As of July 2022, Howard County has converted all streetlights to LED (10,000 streetlights). This conversion resulted in a reduction of electricity use by over 225,000 kWh per year and a reduction of GHG emissions by 3,045 metric tons CO₂e.

Weatherization for Underserved Populations

Howard County promotes the nonprofit Community Action Council's (CAC) Weatherization Assistance Program, which permanently reduces energy bills by making the home more energy efficient. Funds for this work comes from federal and state energy efficiency grants. <https://cac-hc.org/weatherization-assistance/>

Renewable Energy

Solar Education and Outreach

Howard County and its partners educate residents and businesses about how to go solar through websites, social media, events, and newsletters. Howard County also hosts and promotes residential solar and community solar workshops both in person and online. <https://livegreenhoward.com/energy/renewable-energy/>

Solar Power Purchase Agreement (PPA)

In 2020, the County signed a Power Purchase Agreement (PPA) to install solar on County-owned and privately-owned sites. These solar projects will power more than 50 percent of County operations and result in more than \$1.5 million in cost benefits over 25 years, with no up-front capital costs to the County. The combined projects will generate a monumental 44 million kilowatt hours of electricity each year from solar on rooftops, canopies over parking lots, and ground mounts on County and private properties. Ground mount solar arrays on private properties will showcase innovative practices such as pollinator plantings around the panels as well as sheep-grazing and beekeeping. <https://livegreenhoward.com/howard-county-solar-projects/>

Solar Zoning Regulation Amendment

Council Bill (CB) 17-2021, passed in May 2021, was transformative legislation that expanded solar opportunities in the County to all zones including on agriculturally preserved land. The bill also requires that ground mount solar facilities on Agricultural Land Preservation Program (ALPP) properties provide pollinator or native grass habitats, grazing for livestock, or other ecologically enhancing alternative under the solar array.

Transportation

Bus/Transportation Routes

Howard County provides fixed route and paratransit services via the Regional Transit Agency (RTA), which operates 15 local fixed bus routes in Howard County, Prince George's County, Anne Arundel County, and the City of Laurel. RTA connects with MTA Commuter Bus services, the MARC Train, Metrorail, and other local transit systems. RTA Mobility is a curb-to-curb, shared ride transportation service for passengers who are unable to ride fixed route buses due to a disability or age.

Howard County offers unlimited free rides on its fixed bus routes for people ages 60 and up, and reduced rates for students. <https://www.howardcountymd.gov/transportation/public-transportation>

Complete Streets

Howard County adopted a Complete Streets Policy in 2019 establishing safety and access for all modes as the priorities for our streets. The Howard County Complete Streets Design Manual was adopted in 2022 as technical design guidance to implement the Complete Streets Policy.

Electric Scooter Pilot

The Howard County Office of Transportation oversees the permitting process for shared electric scooters. One vendor, SPIN, was granted a permit to operate up to 200 shared electric scooters in Howard County from March 23, 2022 to March 22, 2023. At the end of the pilot, adjustments to the permit requirements will be considered and advertising will begin for applications for 2023 permitting.

Electric Buses

Howard County received a federal grant to add three full-size, lightweight electric buses to the Howard Transit fleet for use in and around Columbia. These new buses are powered by an inductive charger that provides energy to the bus batteries through electromagnetic induction. In other words, the batteries are reenergized without having to be plugged in. The buses operate on Howard Transit's Green Route which is the most heavily used line.

EV Charging Stations

Howard County has dramatically increased the number of EV charging stations available to the public through a variety of partnerships, which include BGE, Maryland Energy Administration, and private businesses. There are several Apps people can use to find the EV charging stations, such as Liberty Plugins and PlugShare. <https://livegreenhoward.com/electric-vehicles/>

Green Fleet

Howard County has implemented a Green Fleet policy that includes reducing unnecessary idling, limiting the use of take-home vehicles, and replacing older petroleum-fuel administrative vehicles with electric vehicles. Other petroleum-only vehicles are replaced with hybrids when due for replacement when that option exists. The goal of the Green Fleet Policy is to reduce petroleum fuel consumption in the fleet by 20% by 2024. To date, Howard County has eight electric vehicles, six electric motorcycles, and 177 hybrid vehicles. Howard County has partnered with the Maryland Energy Administration to receive grants towards several of these electric vehicles. Howard County also incorporated two diesel-electric hybrid buses into the Howard Transit service. These hybrid buses reduce fuel consumption by about 35% and reduce maintenance and repair costs compared to similar diesel buses.

Transportation Planning

Bike Howard

BikeHoward is the Howard County Bicycle Master Plan. Adopted in 2016, BikeHoward includes recommendations for infrastructure improvements that create a network on bike friendly routes throughout Howard County. <https://bikehoward.com/>

Walk Howard

The *WalkHoward* plan is an update of the 2007 Pedestrian Master Plan. The new Pedestrian Plan that was adopted in 2020, *WalkHoward: Moving Forward*, continues efforts to improve walkability in Howard County. This new plan includes recommendations for infrastructure improvements, with a focus on access to transit and school zones. Our community is happier, healthier, safer and more efficient when we have a system of sidewalks, pathways, bus stops and roadway crossings that make it easy to get around on two feet and in a wheelchair. <https://walkhoward.org/>

Go Howard

Go Howard is the county's Transportation Demand Management (TDM) program. TDM refers to a group of strategies used to manage the demand for travel to create the most efficient use of our existing roadways. These strategies encourage people to utilize alternatives to the single-occupancy vehicle (SOV) such as transit, rideshare, walk, bike, and telework, thereby reducing the number of vehicles using the road network. <https://gohoward.org/>

Stormwater

Stormwater Regulations and Permits

Howard County follows Maryland Department of the Environment (MDE) most current regulations and strives to meet or exceed our Municipal Separate Storm Sewer System (MS4) permit requirements. Howard County collaborates with regional jurisdictions and other permit holders as well as MDE to explore opportunities and innovation in stormwater management.

Stormwater Management Facilities and Departments

Stormwater management crosses many departments throughout Howard County. Howard County Department of Public Works implements stormwater management largely on public property while Office of Community Sustainability focuses on private partnerships to increase stormwater treatment. Department of Planning and Zoning works to ensure stormwater regulations are followed for new and redevelopment.

CleanScapes Program

The [CleanScapes Program](#) provides funding to residential property owners who aid the County in meeting water quality goals by installing stormwater best management practices (BMPs), such as rain gardens, on their properties. Residents can receive a one-time reimbursement for the cost of installing a stormwater BMP, as well as an annual credit towards their [Watershed Protection Fee](#). In addition, an opportunity for a 100% reimbursement of BMP costs is available to residents demonstrating a hardship.

Ellicott City Safe and Sound

The Ellicott City Safe and Sound plan is a multi-phase plan built around the need for public safety, supporting business and property owners, preparing the county for a changing climate, and creating a more inclusive, community driven process for decisions regarding Ellicott City's future. There are four main focus areas of the plan: ensuring public safety, supporting business and property owners, maintaining Ellicott City's historic charm, and developing a more inclusive, community-driven process. <https://www.ecsafeandsound.org/>

Innovative Stormwater Management

Howard County continually looks to innovate practices and partnerships to further our stormwater management and meet permit regulations. Utilizing public private partnerships and alternative funding strategies, the County successfully implemented both water quality and quantity treatment with the commercial and agricultural sectors.

Nature-Based Climate Solutions

Bee City

In 2019, County Executive Ball named Howard County a Bee City USA. The Bee City Committee works to implement new pollinator habitat areas, provide outreach, design pollinator garden templates for public use, and give away plants to promote pollinator gardening at home.

Forest Conservation Act

On December 6, 2019 Howard County Executive Calvin Ball signed the updated and improved Howard County Forest Conservation Act (FCA), which had not been updated since the 1990s. This brought Howard County into compliance with the Maryland Forest Conservation Act and made our County's FCA the strongest of any county in Maryland. The update strives to protect forest resources in every neighborhood by requiring 75% of tree planting obligations generated through the residential development process to be planted on the development site. The updated FCA also incentivizes meeting planting obligations in the watershed where development occurs, further protecting trees throughout the County. The updated FCA also raised the fee-in-lieu of planting by over 50%, strengthened the waiver process by requiring additional justification and proof of alternatives considered, and included the Green Infrastructure Network as a priority planting and retention area.

Green Infrastructure Network (GIN)

Maps the most ecologically valuable forests, wetlands, meadows, waterways, and other natural areas as well as the lands that connect them together. Green Infrastructure helps support native plant and animal species while helping human populations by cleaning air and water resources, maintaining natural ecological processes, and contributing to everyday quality of life. The GIN provides six (although there are more) ecosystem services: recreation, pollination, air purification, flood control, water treatment, and pest control. The use of hubs and corridors is important for a green infrastructure network and fit together to create a successful GIN for Howard County. Howard County's Green Infrastructure Network Plan (GIN Plan) refines and expands on the State of Maryland's Green Infrastructure Network to include areas of local ecological significance. The GI Plan will enable planners to consider important resources when preparing the General Plan, transportation plans, watershed plans, and community plans; making decisions about zoning and development proposals; acquiring land for parks and public facilities; and obtaining agricultural, environmental, and other land preservation easements. <https://livegreenhoward.com/land/green-infrastructure-network/>

Meadows on County Properties

Howard County plants and maintains native plant meadows in its parks and natural areas to provide habitat for pollinators and ground nesting birds, as well as to showcase the beauty of these low-maintenance natural habitats. Howard County's Department of Recreation and Parks maintains well over 30 acres of meadows across the county.

No Mow Areas

Howard County is studying alternative lawn mimics and pollinator plantings in collaboration with Columbia Association and the University of MD. The research includes a variety of sites for the alternative lawn trials and is studying which seed mixes provide the most weed resistance, least maintenance, greatest drought tolerance, and most aesthetic match to lawns. Howard County expects the pollinator plot trials to reveal the best weed control strategy to use when installing pollinator gardens.

Pesticide Reduction

Howard County updated its Pesticide Policy in 2019, eliminating the use of chlorpyrifos and drastically restricting the use of glyphosate and neonicotinoids on County owned property. The policy stresses integrated pest management and alternative solutions.

Tree Planting Programs

Howard County offers free trees to residents through several tree giveaways, including Trees for Bees. Since 2019, Howard County has given away more than 10,000 trees to residents and local nonprofits. The trees are all native species, meaning that they are adapted to our climate and conditions. Native species generally live longer and require less care. They are also co-adapted with native pollinators, birds, and other wildlife.

Stream ReLeaf: The Stream ReLeaf program helps property owners plant riparian buffers. Riparian buffers are protective strips of trees, shrubs, and other vegetation along a stream which help prevent erosion, provide vegetative cover, and trap nutrients such as nitrogen and phosphorus – two major pollutants of the Chesapeake Bay.

Turf to Trees: The Turf to Trees program was created to help alleviate the damaging effects of stormwater runoff by increasing tree coverage throughout the County. The program provides trees and planting services to Howard County property owners with lots of 1.5 to 10 acres in size, free of cost. Since the project started in 2015, over 3,100 trees have been planted.

Students Branching Out: Students Branching Out engages Howard County students in local tree planting efforts. Students have participated in tree planting volunteer days and field trips, planted trees on school property, and promoted existing County tree planting programs. Over 6,500 trees have been planted with thousands of students so far.

Information on all tree programs can be found at <https://livegreenhoward.com/land/tree-programs/>.

Solid Waste & Recycling

Composting

The Bureau of Environmental Services operates a facility to compost food waste and yard waste. Seasonal yard waste curbside collection is available to all County residents. About half of County residents are currently eligible to participate in year-round curbside food waste and yard waste collection through the Feed the Green Bin program. Public schools also can participate in food waste collection by request. In addition, Howard County provides free backyard compost bins upon request and the Residents' Convenience Center at Alpha Ridge Landfill also accepts food scraps.

<https://www.howardcountymd.gov/public-works/feed-green-bin>

Plastics Reduction

Plastic bag fee: As of October 1, 2020, all stores in Howard County who provide customers a disposable plastic bag at the point of sale are required to charge 5 cents per bag. Businesses keep one cent from every fee and the remainder goes to funding the Plastics Reduction and Environmental Protection (PREP) grant program, providing reusable bags predominantly to vulnerable communities and for other environmental purposes. <https://livegreenhoward.com/recycling-waste/plastic-bag-fee/>

Single use plastics ban: As of January 1, 2022, food service facilities can longer sell or distribute single-use plastic straws, stirrers, utensils, condiment packets, and other food ware to customers unless specifically requested, with certain exceptions for self-service areas and drive through. Retail businesses cannot sell or distribute single use plastic straws or stirrers unless paper or reusable straws or stirrers are also available for purchase in the same location.

<https://livegreenhoward.com/plastic-reduction-law/>

Plastics Reduction and Environmental Protection (PREP) Grants

Using funds from the plastic bag reduction fee, Howard County introduced the Plastics Reduction and Environmental Protection (PREP) grant. This grant program provides funding to local organizations working to reduce litter, improve water quality, and provide education to the public regarding pollution and our environment. The County received great interest in the first request for grant applications in 2021 from a wide variety of organizations with a diversity of project ideas.

<https://livegreenhoward.com/recycling-waste/plastic-bag-fee/prep-grants/>

Recycling

Single Stream Recycling: Howard County residents with County-provided collection can place recyclables all together in the same container. Acceptable recyclables include metal cans, plastics, glass bottles and jars, mixed paper and cardboard. Waste Management Recycle America (WMRA) is under contract to Howard County for the processing and marketing of recyclables. WMRA operates a state-of-the-art recyclables processing facility near Elkrige, which has the necessary equipment to sort recyclables in preparation for sale to individual material markets. The Residents' Convenience Area at Alpha Ridge Landfill is a great resource for additional recycling opportunities for all Howard County Residents. Items ranging from scrap metal to reusable building materials to used cooking oil can be brought in for recycling.

<https://www.howardcountymd.gov/public-works/recycling>

Howard County also provides a comprehensive online list of harder to recycle items with suggestions on how to properly recycle, donate, or reuse these items. <https://www.howardcountymd.gov/knowbeforeyouthrow>

Emergency Management

Emergency Management Plans

Howard County has a 2018 Natural Hazard Mitigation Plan which includes a Flood Mitigation Plan update. These plans suggest several actions to reduce or eliminate risk to people or property from future natural hazards. They include hazard mitigation, preparedness, emergency response, and recovery actions. These plans are reassessed and updated every five years in conjunction.

Additionally, Howard County has a Comprehensive Emergency Response and Recovery Plan (CERRP) which defines the responsibilities and roles of local, state, and federal entities during an emergency event for a coordinated response and recovery.

Other resources include the Community Hazard Handbook and the Hazard Identification & Risk Assessment (HIRA).

<https://www.howardcountymd.gov/emergency-management>

Cooling Centers

There are several facilities people can utilize when they are in need of a place to cool off on a hot day. These include Howard County Library System Branches, Howard County 50+ Centers, Howard County Recreation & Parks Community Centers, and The Mall in Columbia.

Agriculture

Roving Radish

The Roving Radish is a Howard County Government program dedicated to promoting healthy farm to table eating habits to our community, while creating sustainable markets for our local and regional farms. We achieve this by selling healthy meal kits, sourced from local and regional farms to our community. The meal kits are made available to all Howard County residents and are offered at a discounted price to those in need. The Roving Radish also operates a store at Long Reach Village Center that offers meats, dairy projects, eggs, and fresh produce from local farms. <https://rovingradish.com/>

HoCo Fresh

HOCO Fresh is a Howard County Government program to encourage restaurants and businesses to buy produce and proteins from our Howard County Farms.

HOWARD Soil Conservation District (HSCD)

The HSCD has staff that are trained specialists who help landowners make the best land use decisions for their properties. There are cost sharing options through federal, state and/or local sources that may be available for conservation practices that control erosion and improve water quality.

The HSCD is solely authorized to review sediment and erosion control plans and small pond designs for all proposed developments. Their trained specialists and engineers actively participate on Howard County's weekly subdivision Review Committee with other state and county agencies.

Technical experts provide direct one-on-one assistance to homeowners, community associations and county departments with natural resource problems and questions.

HOWARD County Economic Development Authority (HCEDA)

HCEDA offers the Agricultural Marketing Program that works with the farming community as their constant advocate on agriculture-related legislation and business development. There are five main ways to delve into what this program does: Start A Farm, Diversify My Farm, Grants & Financing, Farms & Markets, and Fall Fun on The Farm. <https://hceda.org/>

Start A Farm offers tools for the farming community by providing information on licensing, permits, regulations, resources, and training & education. Diversify My Farm provides the farming community with options to expand on their options they provide to the public, such as Agri-Tourism, Solar or Wind Energy Collection, or Value-Added Processing. The Grants & Financing aspect allows the farming community to gather information about County Grants, State Loans & Grants, Regional Loans & Grants, and Federal Loans & Grants. The Farms & Markets part of the program offers two options for the farming community: Farm to Table and Farm Search. Lastly, the Fall Fun on The Farm offers a variety of different events occurring at farms throughout the Fall.