

Appendix 1: Background Memorandum



Prepared for the
Baltimore Office of Sustainability
Prepared by
AECOM

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Abbreviation List

Abbreviation	Definition
CAP	Climate Action Plan
TAC	Technical Advisory Committee
RAC	Resident Advisory Committee

Introduction

The Baltimore Office of Sustainability is in the process of updating the City's 2012 Climate Action Plan (CAP) with a roadmap to carbon neutrality by 2045. The 2012 CAP set a goal of 15% reduction by 2020 relative to a 2010 baseline. Baltimore's 2019 Sustainability Plan strengthened the greenhouse gas reduction goals, committing the City to achieve a 25% reduction by 2020 and 30% by 2025 relative to 2007, and carbon neutrality by 2045. In January 2022, Baltimore Mayor Brandon M. Scott reaffirmed these goals and announced the Baltimore City's 2023 Climate Action Plan update (CAP update) process. The CAP update will utilize robust technical analyses and community engagement to develop an actionable and inclusive plan.

This Background Review memo provides an overview of Baltimore's existing policy and planning documents related to greenhouse gas (GHG) emissions reductions and reviews the City's progress in implementing previous plans and goals related to GHG emissions. The memo is intended to serve as an annotated bibliography for the Office of Sustainability and AECOM consultant team and will help to frame Technical Advisory Committee (TAC) and Resident Advisory Committee (RAC) discussions & interview questions for City staff. The final CAP update document will draw on this memo to summarize how the CAP relates to the City's previous planning documents.

To complete the Background Review, AECOM conducted a high-level scan of Baltimore's existing policy and planning documents to identify goals and actions aimed at GHG reductions that the City has identified, beginning with the 2012 CAP. The memo also describes the progress made in implementing the actions in the 2012 CAP and 2019 Sustainability Plan, based on the City's internal progress tracking spreadsheet.

The remainder of the memo is organized as follows:

- Summary of relevant plans, studies, and legislation
- Status of 2012 Climate Action Plan Actions
- Status of 2019 Sustainability Plan Actions (GHG emissions reduction)
- Next steps and discussion questions

Summary of Documents Reviewed

Table 1 summarizes Plans and Studies related to the goals of the CAP update and reducing GHG emissions and how the CAP update relates to these efforts. Table 2 summarizes relevant state and local legislation.

Table 1. Plans and Studies Related to the CAP

Document (Year)	Description	Relevance to CAP Update
<u>Climate Action Plan (2012)</u>	The 2012 Climate Action Plan builds on the 2009 Sustainability Plan to outline strategies toward Baltimore's target of reducing GHG emissions by 15% by 2015.	<ul style="list-style-type: none">• The CAP update will provide a roadmap for implementing the vision of carbon neutrality established in 2012.
<u>Sustainability Plan (2019)</u>	The 2019 Sustainability Plan is a citywide umbrella plan concerning Baltimore's environment, economy, and social equity that was adopted as part of the City's Comprehensive Master Plan. It features a robust equity lens to incorporate racial equity considerations into policy development.	<ul style="list-style-type: none">• The CAP update will build upon 2019 GHG reduction Strategies and Actions (summarized later in the document) and carry forward the equity lens established in the Sustainability Plan.
<u>Less Waste, Better Baltimore Plan Task 9 Report (2020)</u>	The City of Baltimore Recycling and Solid Waste Management Plan outlines strategies/initiatives and options for	<ul style="list-style-type: none">• The CAP update will build on key GHG reduction and community health initiatives outlined in the LWBBP such as diverting

	improving Baltimore City's solid waste and recycling system. Includes estimates of CAPEX, annual OPEX, and annual revenues associated with strategies.	waste from landfills, composting, and improving incinerator efficiency.
Baltimore Food Waste and Recovery Strategy (2018)	Developed as a partnership between the Baltimore Office of Sustainability and the Institute for Local Self-Reliance (ISLR) which sets 2040 goals for food waste diversion by sector.	<ul style="list-style-type: none"> • Implementation of key measures in the BFWRS can support GHG emissions reduction by about 305,000 MTCO2E annually. This is the equivalent of taking 64,700 passenger vehicles off the road or reducing gasoline consumption by 34.3 million gallons (per the Less Waste, Better Baltimore plan).
Disaster Preparedness Plan (2018)	Baltimore's Disaster Preparedness and Planning Project (DP3) – which also serves as the City's Hazard Mitigation Plan (HMP) – seeks to increase the city's capacity to adapt to both current hazards and predicted future climate change impacts. The plan's strategies and implementation actions address both risk mitigation and climate adaptation. The City is planning to update the HMP in late 2023.	<ul style="list-style-type: none"> • The CAP update can coordinate/carry forward relevant strategies with the Disaster Preparedness Plan: <ul style="list-style-type: none"> – IN-2: Increase energy conservation efforts. – B-8: Improve resource conservation practices in all City owned buildings – NS-3: Create an interconnected network of green spaces to support biodiversity and watershed-based water quality management • The CAP Update can identify actions that have co-benefits related to increasing broader community resilience.
Green Network Plan (2018)	The Green Network Plan outlines proposed projects and action steps for expanding and improving green space in Baltimore, with emphasis on projects in four Focus Areas, clusters of 2-3 neighborhoods selected based on high vacancy levels and opportunities for economic development. In addition to city parks, the plan includes projects aimed at nature corridors and "anchor institutions" that provide opportunities to spearhead neighborhood economic development.	<ul style="list-style-type: none"> • The CAP update will coordinate relevant strategies with the Green Network Plan <ul style="list-style-type: none"> – Goal 4 - Provide safe access to both green spaces and economic hubs throughout the city. • The CAP Update can identify actions that support the Baltimore Green Network by making safe connections for residents to walk or bike to schools, stores, parks, recreation centers to help improve quality of life and reduce dependence on personal vehicles.

<u>The Complete Streets Manual (2021)</u>	Following the passage of Baltimore's Complete Streets ordinance in 2018, the Complete Streets Manual provides guidelines for the design of Complete Streets that prioritize safety for all users. The Manual includes a project prioritization process that ensures equity is a consideration in street design.	<ul style="list-style-type: none"> • Guidance from the Complete Streets Manual promotes active, carbon free modes of transit, discourage personal vehicle use, and reduce GHG emissions.
<u>Nuisance Flood Plan 2020</u>	The Nuisance Flood Plan inventories known tidal nuisance flood hazard areas, identifies thresholds that lead to tidal nuisance flooding, and establishes a procedure to document tidal nuisance flood events. The plan outlines the current response approach and brief recommendations for risk mitigation, which touch on transportation and stormwater infrastructure.	<ul style="list-style-type: none"> • The CAP Update can identify actions that have co-benefits related to increasing broader community resilience.
<u>Homegrown Baltimore Plan 2013</u>	This report covers the Grow Local component of Homegrown Baltimore Plan. It documents the history, benefits, and types of urban agriculture in Baltimore; lays out current local urban agricultural efforts and the policies that affect them; and identifies challenges and provides recommendations for creating a more robust urban agriculture sector.	<ul style="list-style-type: none"> • The CAP update can highlight ways that local food movements reduce GHG emissions and support community health.
<u>Baltimore City Strategic Management Energy Plan 2015</u>	The Baltimore City Strategic Management Energy Plan outlines 7 strategic goals for the Office of Sustainable Energy (OSE) which were designed to incorporate the City's goals identified in other plans. The document lists strategies to achieve results and provides a framework for measurement and reporting to manage energy and greenhouse gas emissions reduction for City government facilities and fleet.	<ul style="list-style-type: none"> • The CAP Update sets more ambitious goals and commitments than the 2015 OSE Plan. The CAP update can highlight progress made on OSE Plan implementation since 2015 as provided by the City.

<u>Baltimore Together Plan 2022</u>	The Baltimore Together Plan highlights seven key economic development goals and four key strategies to guide the city's work over the next 5 years, focusing on diversity, inclusion, and resilience.	<ul style="list-style-type: none"> • The CAP update will integrate key ideas from the Baltimore Together Plan, such as the recognition that failure to act on climate change is a threat to economic development.
<u>ACEE Energy Burden Study 2020</u>	This is a two-page summary outlining energy burden (i.e., percentage of income spent on home energy bills) statistics for Baltimore and four locally led strategies to address high energy burdens. The ACEE Energy Burden Study also highlights the disproportionately high energy burden faced by Baltimoreans compared to the national average, and specifically by Black, Hispanic, Native American, older adults, renters, and low-income multifamily building residents.	<ul style="list-style-type: none"> • CAP Update can identify co-benefits associated with reducing energy cost burden and other household costs. • The ACEE study identifies strategies to reduce energy burden that can be carried forward in the CAP Update: <ul style="list-style-type: none"> – Set energy burden goals and track progress – Increase funding for low-income weatherization – Improve program design, delivery, and evaluation through best practices and community-driven planning • Integrate energy, health, and housing funding and resources
<u>Baltimore Smart Surfaces Study 2021</u>	The Baltimore Smart Surfaces Study, developed by the Smart Surfaces Coalition, summarizes the full costs and benefits, including health benefits, of Smart Surfaces adoption for Baltimore and further quantifies the costs and benefits for a multitude of Smart Surface solutions. Smart Surfaces are technologies that are applied to surfaces including roofs, roads, parking lots, sidewalks, etc. such as cool roofs, solar PV, permeable pavements, green roofs, urban trees, and reflective pavements. The report concludes with the implications of key findings and a discussion of next steps.	<ul style="list-style-type: none"> • Smart Surfaces have benefits that relate to the goals of the CAP update: <ul style="list-style-type: none"> – Reducing GHG emissions (e.g., using solar PV, reduces need for air conditioning) • Increasing quality of life (e.g., through reduced heat island effects and increased urban tree canopy)

<u>BNIA Vital Signs Report 2021</u>	The BNIA Vital Signs Report highlights over 150 indicators for each of Baltimore City's 55 communities. Each section of the report describes an issue or area that is central to the quality of life in Baltimore City. The data within each of the sections provide a picture of the conditions within Baltimore City's neighborhoods and their progress over time.	<ul style="list-style-type: none"> • The project team can utilize the BNIA report to develop an overview of Baltimore and to better understand Baltimore residents' lived experience.
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Source: AECOM Review

Table 2. State and Local Legislation Related to the CAP Update

Legislation (Year)	Description
<u>Maryland Greenhouse Gas Emissions Reduction Act 2021</u>	<p>The Maryland Greenhouse Gas Emissions Reduction Act sets forth a set of measures to reduce and sequester GHGs for Maryland. This 2030 GGRA Plan continues progress from previous updates to the GGRA Plan with the goal of achieving 50% reductions of GHG by 2030. The plan advances this goal with an environmental equity and racial injustice lens. Core programs include:</p> <ul style="list-style-type: none"> – Maryland Renewable Energy Portfolio Standard (RPS) – Clean and Renewable Energy Standard (CARES) – Regional Greenhouse Gas Initiative (RGGI) – Public Transportation, Bike and Ped initiatives • Innovative Volunteer Initiatives
<u>Maryland Climate Solutions Now Act of 2022 (enrolled bill)</u>	<ul style="list-style-type: none"> • Senate Bill 528, the Climate Solutions Now Act of 2022, requires the State to reduce GHG emissions by altering statewide greenhouse gas emissions goals, establishing of a net-zero statewide greenhouse gas emissions goal, developing certain energy efficiency and emissions reduction requirements for certain buildings, requiring electric companies to increase their annual incremental gross energy savings, etc.

Council Bill 21-0159 (under consideration)	<ul style="list-style-type: none"> Council Bill 21-0159 Procurement Zero-Emission Vehicles is related to converting the City fleet of vehicles, subject to certain exceptions, to zero-emission vehicles; defining certain terms; authorizing rules and regulations; and generally related to the City's procurement of vehicles.
Council Bill 21-0160 (under consideration)	<ul style="list-style-type: none"> Council Bill 21-060 Building Code - Cool Roofs is related to requiring newly constructed buildings and additions to existing buildings partly financed using City funds to adhere to specified roofing requirements; authorizing certain exceptions; and generally relating to the installation of Cool Roofs.
Council Bill 21-0161 (adopted)	<ul style="list-style-type: none"> Council Bill 21-0161 City Operations - Net-Zero Emissions of Greenhouse Gases seeks to make City operations achieve net-zero emissions of greenhouse gases by 2050; defining certain terms; authorizing rules and regulations; and generally related to the City's emission of greenhouse gasses.
Council Bill 21-0175 (under consideration)	<ul style="list-style-type: none"> Zero Waste Commission For the purpose of establishing the Zero Waste Commission; providing for the Commission's composition, terms of office, officers, meetings, quorum, and rules of procedure; establishing the general purposes and specific duties of the Zero Waste Commission; defining certain terms; and generally relating to the Zero Waste Commission.
Council Bill 21-0075R (adopted)	<ul style="list-style-type: none"> Council Bill 21-0175 Global Warming Solutions - Carbon Neutral City calls on the Mayor, the Baltimore City Council, the Baltimore City Administrator, the Baltimore Office of Sustainability, and the Baltimore Commission on Sustainability to take all necessary actions to make Baltimore a carbon neutral city by 2050.
Council Resolution 17-022 R (adopted)	<ul style="list-style-type: none"> For the purpose of establishing the Zero Waste Commission; providing for the Commission's composition, terms of office, officers, meetings, quorum, and rules of procedure; establishing the general purposes and specific duties of the Zero Waste Commission; defining certain terms; and generally relating to the Zero Waste Commission.
Expanded Polystyrene Foam Ban, 2018 (adopted)	<ul style="list-style-type: none"> The Baltimore City Council passed an ordinance in April 2018 banning expanded polystyrene foam food containers in Baltimore City. The Baltimore City Foam Ban goes into effect 10/19/19 and applies to all food service businesses.
Single-Use Plastic Bag Bill 2020 (adopted)	<ul style="list-style-type: none"> In January 2020, the Baltimore City Comprehensive Bag Reduction Act was signed into law, which bans single-use plastic bags at the point of sale, pickup, or delivery, and sets a fee for other types of bags. Originally set to take effect in January 2021, Mayor Scott signed an executive order to delay implementation until October 1, 2021, due to the Covid-19 pandemic.
Maryland Greenhouse Gas Emissions Reduction Act 2021	<p>The Maryland Greenhouse Gas Emissions Reduction Act sets forth a set of measures to reduce and sequester GHGs for Maryland. This 2030 GGRA Plan continues progress from previous updates to the GGRA Plan with the goal of achieving 50% reductions of GHG by 2030. The plan advances this goal with an environmental equity and racial injustice lens. Core programs include:</p> <ul style="list-style-type: none"> – Maryland Renewable Energy Portfolio Standard (RPS)

	<ul style="list-style-type: none">- Clean and Renewable Energy Standard (CARES)- Regional Greenhouse Gas Initiative (RGGI)- Public Transportation, Bike and Ped initiatives• Innovative Volunteer Initiatives
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Source: AECOM Review

2012 Climate Action Plan

The 2012 Baltimore Climate Action Plan (CAP) set a goal to reduce greenhouse gas (GHG) emissions 30% by 2025, 60% by 2030, and to achieve full carbon neutrality by 2045, compared to 2007 baselines. The CAP includes a variety of Measures (also referred to as Actions) to define the programs, policies, and projects that the city will undertake to accomplish its GHG emission reduction goals. These Measures/Actions are organized into three Topic/Action Areas -- Energy Savings and Supply (ESS), Growing a Green City (GGC) and Land Use and Transportation (LUT) -- and by Strategy. CAP Strategies are intended to be implemented through a combination of voluntary actions, incentives, mandates, infrastructure projects, outreach efforts, strategic plans, and zoning code changes. Each measure includes a time frame for implementation (short-term, mid-term, or long-term), a performance indicator, and an estimated GHG reduction potential and participation rate.

Table 3 show the status of 2012 CAP Actions in 2022 using recent data from the City's FY 22 tracking spreadsheet.

Table 3. 2022 Status of Actions from the 2012 CAP

Topic/Action Area + Strategy	Still Pending	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
ESS 1 Reduce energy consumption of existing buildings	<ul style="list-style-type: none">1.A Disclose residential energy bills and energy efficiency improvements at the beginning of the sale or rental processRequire energy	<ul style="list-style-type: none">1.E Encourage model green lease provisions	<ul style="list-style-type: none">1.B Benchmark and disclose energy performance and improvements of city -owned and privately-owned	<ul style="list-style-type: none">1.i Promote cool roof installations and other roofing technologies1.G Retrofit Baltimore's streetlights for	<ul style="list-style-type: none">1.H Encourage switch from heating oil to natural gas1.F Conduct outreach programs in schools

	<p>audits for city-owned and privately-owned, commercial, industrial, and institutional buildings over 10,000 sq. ft.</p> <ul style="list-style-type: none"> • 1.C.b Require retro-commissioning for city-owned and privately-owned, commercial, industrial, and institutional buildings over 10,000 sq. ft. 		commercial, industrial, and institutional buildings	more efficient energy usage	<ul style="list-style-type: none"> • 1.D Conduct commercial and residential energy efficiency outreach
ESS 2 Promote generation of renewable energy					<ul style="list-style-type: none"> • 2.A Standardize permitting for renewable energy installations • 2.B Conduct outreach for solar installations, to achieve 30 MW of PV installed in total, across all sectors (government, commercial, institutional, multifamily, and

					residential) by 2020 <ul style="list-style-type: none"> 2.C Encourage State to increase Renewable Portfolio Standard to 26% by 2022
ESS 3 Expand and upgrade energy performance for major renovation and new construction		<ul style="list-style-type: none"> 3.A Adopt green building standards for new residential construction and major renovation 3.B Modify existing new homeowner and rehabilitation tax credit to include energy efficiency standards based on the Energy Star home certification program 			
ESS 4 Promote efficient community energy districts		<ul style="list-style-type: none"> 4.A Encourage new facilities to consider connecting to existing, proximate, cogeneration facilities 	<ul style="list-style-type: none"> 4.B Encourage co-generation installation for replacing inefficient boiler plants 		

GCC 1 Divert waste from landfills				<ul style="list-style-type: none"> 1.B Reduce construction and demolition waste 	<ul style="list-style-type: none"> 1.A Develop a comprehensive recycling plan
GCC 2 Improve water efficiency		<ul style="list-style-type: none"> 2.B Improve water efficiency in existing small residential buildings 	<ul style="list-style-type: none"> 2.A Repair water supply infrastructure 2.C Improve water efficiency for new construction and major renovations of small residential buildings 		
LUT 1 Promote mixed-use development near transit					<ul style="list-style-type: none"> 1.A Create high-quality pedestrian- and transit-oriented neighborhoods 1.B Support mixed-use neighborhoods to increase access to goods and services
LUT 2 Support alternative commutes			<ul style="list-style-type: none"> 2.A Develop and promote incentives for individual transportation choices 2.B Promote establishment of qualified 		

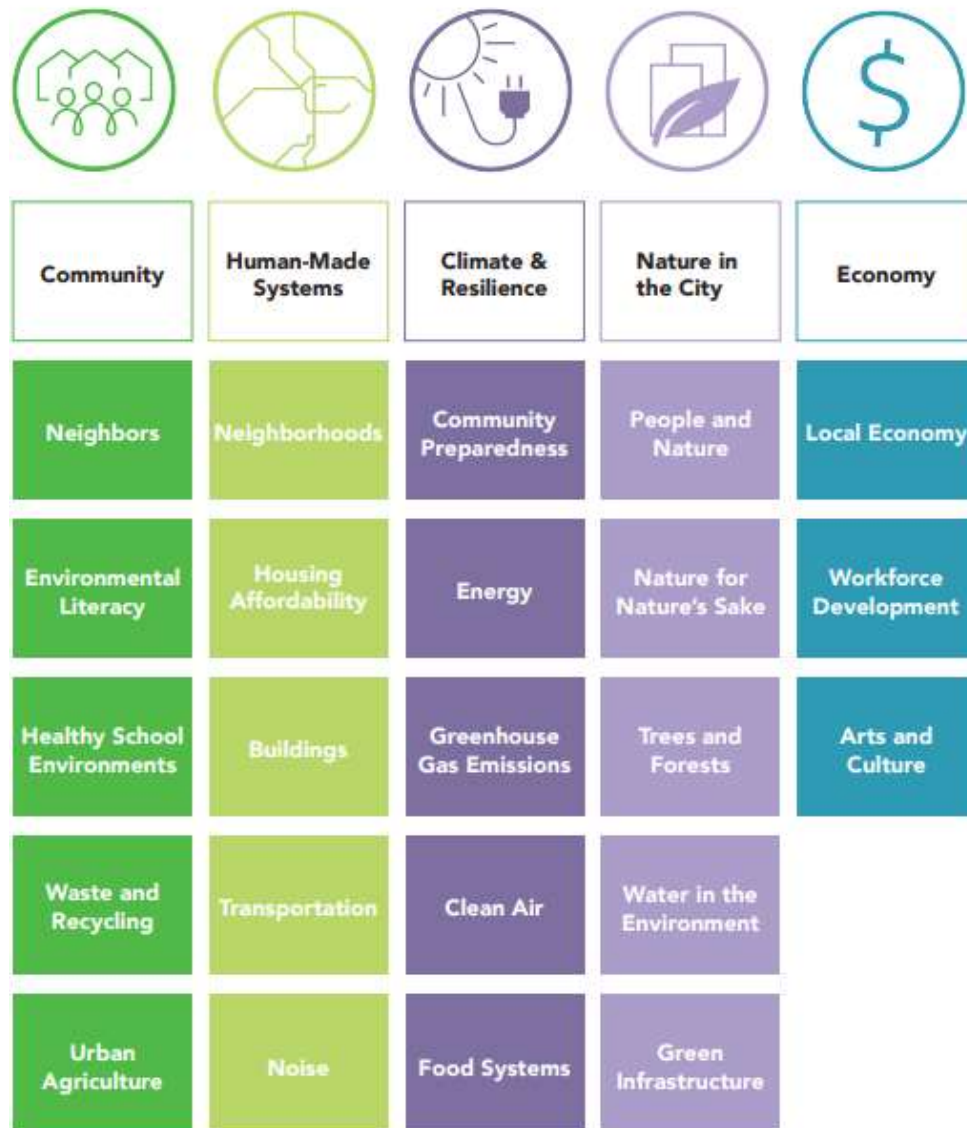
			bike commute reimbursement programs		
LUT 3 Explore parking strategy options			<ul style="list-style-type: none"> 3.A Explore the creation of a parking plan for city-owned parking 		<ul style="list-style-type: none"> 3.C Reduce off-street parking requirements 3.B Provide alternatives to monthly parking passes
LUT 4 Increase walking and biking			<ul style="list-style-type: none"> 4.B Support Safe Routes to Schools 	<ul style="list-style-type: none"> 4.A Develop a pedestrian master plan. 4.C Expand and improve bicycle infrastructure 	
LUT 5 Increase efficiency in city fleet			<ul style="list-style-type: none"> 5.A Implement a centralized fueling program and route optimization software 		
LUT 6 Support cleaner vehicles			<ul style="list-style-type: none"> 6.A Support alternative-fuel infrastructure and encourage adoption of alternative-fuel vehicles 		<ul style="list-style-type: none"> 6.B Promote Fuel Efficient cargo handling in the Port of Baltimore

Source: City of Baltimore Office of Sustainability, 2022

2019 Sustainability Plan

The 2019 Sustainability Plan strengthened Baltimore's greenhouse gas reduction goals, seeking to reduce greenhouse gas (GHG) emissions 30% by 2025, 60% by 2030, and to achieve full carbon neutrality by 2045, compared to 2007 baselines. The Sustainability Plan developed Strategies and Actions organized across 5 Core Themes and 23 Topic Areas (see Framework diagram below). The values and actions laid out in the 2019 Sustainability Plan focus on a broad range of sustainability priorities. Many of the topic areas are directly relevant to GHG reduction and the CAP Update including actions related to Greenhouse Gas Emissions, Energy, Clean Air, Food Systems and Waste and Recycling. Other values (e.g., Environmental Literacy, People and Nature, Local Economy) are less directly related to GHG reduction but support equitable implementation. The CAP Update can build upon the overall values and equity lens established by the 2019 Sustainability Plan.

We reviewed all the Actions in the Sustainability Plan and extracted those that are most directly related to GHG emissions reductions. These Actions and their status are summarized below, in Table 4, organized by Topic Area and Strategy.



Sustainability Plan Framework

Table 4. Summary of 2022 Status of GHG-Related Actions from the 2019 Sustainability Plan

Topic Area	Strategy Description	Still Pending	Early Stages	Mid-Stages	Advanced Stages	Implemented/ Ongoing
Buildings	Advance building energy and water efficiency, as well as education and outreach, in all sectors—residential, commercial, municipal, and institutional—to reduce long-term costs and increase the health of occupants.	2 Develop a financing toolkit to assist building owners to understand available energy and water efficiency financing options.		3 Promote Property Assessed Clean Energy (P.A.C.E.) financing.		
Buildings	Create and adopt programs and codes for promoting occupant health and comfort as well as efficiency	2 Create systematic approaches to building designs that integrate and restore the natural environment. 3 Support the development of holistic, neighborhood-wide, deep energy retrofit projects. 4 Explore requiring development plans to include operational efficiency cost-benefit analyses.	1 Review the City's existing green building code and amend.			

		5 Integrate energy- and water-savings strategies and promote gray-water harvesting and stormwater capture.				
Buildings	Create policies to promote awareness and transparency of energy and water use and reduction.	3 Evaluate existing utility and city-wide energy- and water-savers programs to further advance incentives and efficiency				
Buildings	Increase energy and water efficiency retrofits in affordable and low-income housing markets to reduce greenhouse gas emissions, expand local sector jobs, and improve the long-term viability of affordable housing.	3 Analyze long-term return on investment opportunities for deep energy and water retrofits in the low-income housing market.		2 Develop programs to retrofit affordable housing units into energy- and water-efficient units. 4 Increase workforce programs in energy efficiency, renewable energy, and healthy upgrades, emphasizing local hiring.		
Clean Air	Reduce emissions from industrial operations to reduce harm to people living nearby	3 Work with the Port of Baltimore. 4 Enact and enforce strong anti-idling regulations for	1 Encourage state-of-the-art pollution controls. 2 Work with federal, state, and regional agencies to reduce toxic air			

		commercial cars, buses, and trucks.	emissions from transportation.			
Energy	Expand awareness of and funding models for energy efficiency and renewable energy.	2 Seek increased financing for energy programs.	1 Expand energy efficiency, conservation, and renewable energy education programming. 3 Expand solar job training programs and job placement opportunities.			
Energy	Speed the path to decarbonization through increased deployment of renewable energy and electric vehicles.	1 Increase the supply of clean, renewable electricity.	2 Advocate for a higher State of Maryland renewable portfolio standard. 3 Increase electric vehicle adoption.	4 Adopt a goal for electric vehicle charging stations.		
Energy	Support and deploy innovative technologies and programs to reduce energy use in buildings and transportation.	3 Increase installation of cool roofs and green roofs and plant more shade trees. 4 Promote and expand installation of energy-efficient combined heat and power and district energy systems which capture and reuse waste heat. 5 Set a goal to	1 Review current building codes and regulations and adopt a residential green building code.	2 Complete the conversion of streetlights to LEDs.		

		reduce petroleum consumption and increase use of alternative fuel vehicles and equipment in the city government fleet.				
Greenhouse Gas Emissions	Create new programs to reduce greenhouse gas emissions.	3 Reduce short-term pollutants.	1 Develop outreach campaigns focused on actions to reduce emissions.			2 Commit to being a "Carbon Neutral City".
Greenhouse Gas Emissions	Improve efforts to reduce greenhouse gas emissions.			2 Establish a Climate Change Advisory Committee.	1 Update the Climate Action Plan.	
Greenhouse Gas Emissions	Modify operations and policies in City government to reduce emissions.		2 Require a life-cycle evaluation of energy savings and emission reduction options. 3 Update codes.	4 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.		1 Set an ambitious reduction target.
Healthy school environments	Conserve resources.		2 Green the school system's fleet of vehicles.	1 Reduce waste and increase recycling. 3 Follow green design and construction practices.		

Transportation	Enact policies that promote city and regional priorities for pedestrians, transit, and alternative forms of transportation.			5 Seek opportunities to implement more pedestrian-only spaces.		
Transportation	Improve reliability, accessibility, safety, and efficiency of transit while reducing the environmental impacts of vehicles.		4 Encourage green commutes to work and school.			
Transportation	Prioritize local and regional transportation coordination and investments, ensuring equity.		2 Support a dedicated funding source for public transportation and safety improvements.			1 Advance the Central Maryland Regional Transit Plan.
Waste and Recycling	Expand Baltimore's Waste to Wealth initiative.		2 Site a local composting facility.	3 Investigate revising codes and creating ordinances to eliminate waste and maximize reuse of materials; Establish businesses that reuse products and marketplaces for selling them.	1 Implement the City's Food Waste and Recovery Strategy.	
Waste and Recycling	Increase the amount of trash that is diverted from the landfill and incinerator to				1 Provide free recycling bins.	

	recycling programs.					
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Source: City of Baltimore Office of Sustainability, 2022

Appendix 2A: Community Engagement Summary



Prepared for the
Baltimore Office of Sustainability
Prepared by
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Abbreviation List

Abbreviation	Definition
CAP	Climate Action Plan
RAC	Resident Advisory Council
OS	Office of Sustainability

Overview

Equitable outreach and engagement are at the core of the Baltimore City Office of Sustainability's (Office of Sustainability's) approach to the City's Climate Action Plan Update (CAP). The CAP Community Engagement Strategy sought to achieve four overarching goals:

1. Ensure that community priorities shape every part of the process.
2. Make climate change an accessible issue through strong communication and collaboration.
3. Move from engagement to empowerment.
4. Engage anchor institutions and private sector entities to promote cross-sector, city-wide buy-in to the actions created in the Climate Action Plan.

The Office of Sustainability designed the CAP Community Engagement Strategy to be flexible and responsive to community needs as feedback was shared from various stakeholders. This document summarizes the Office of Sustainability's engagement process and approach and reflects on successes and challenges in achieving the CAP Community Engagement Strategy goals.

Engagement Strategy

Process

The Office of Sustainability's (OS) CAP Community Engagement Strategy began in October 2021 with the hiring of a CAP Community Engagement Fellow and the formation of the CAP Resident Advisory Council (RAC). The OS led the development of the engagement strategy in close collaboration with the RAC. The OS worked with the RAC and Points North Studio, a Baltimore-based women and minority-owned graphic design firm, to draft and finalize CAP branding for engagement including a custom logo and banner image. In Fall 2022, two consulting firms, AECOM and Assedo Consulting, were added to the team to provide much needed capacity for the planning and engagement process. Along with the OS, Assedo and AECOM created the CAP Project Team that has worked diligently to support and adapt the CAP Update process. The CAP Community Engagement Strategy included the following methodologies and tools:

Groups	Events	Tools
<p><i>Engage with Existing Groups</i></p> <ul style="list-style-type: none"> • Mayor's Sustainability and Resiliency Subcabinet • Sustainability Commission • Planning Commission • Community Resiliency Hubs • Community Organizations <p><i>Regularly hold CAP Advisory Council meetings</i></p> <ul style="list-style-type: none"> • Technical Advisory Council (TAC) 	<ul style="list-style-type: none"> • In-person community Events (farmer's markets, festivals, GROW Center pop-ups, etc.) • Office of Sustainability Open House (2022 and 2023) • Community Workshops <ul style="list-style-type: none"> ◦ In-Person Workshop ◦ Virtual Workshops (3) • Plan Launch Event (to be completed when CAP is in draft form) 	<ul style="list-style-type: none"> • 3 CAP Outreach Interns • Email list-servs • Monthly Newsletter • Flyers • Social Media • Surveys (online and hardcopy) <ul style="list-style-type: none"> ◦ Public Survey ◦ Youth Survey • Participation payments to incentivize participation and compensate residents for their contributions • CAP Update Website • Creative engagement strategy (to be

Resident Advisory Council (RAC)		completed when CAP is in draft form)
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Approach & Results

This section discusses the Office of Sustainability’s approach to engaging existing groups and CAP Advisory Councils and implementing other engagement activities. At the beginning of this process, the CAP Project Team set an internal goal of achieving a minimum of 6,000 high-quality, unique engagements during the process where people that were engaged either directly contributed or walked away having learned something new. Another objective of the engagement process was to reach a population that was as the population demographically representative of Baltimore City, as possible. Overall, the Office of Sustainability has engaged with over 2,500 Baltimore City residents, businesses, non-profits, and other institutions in over 50 neighborhoods as of June 2023. From June – December 2023, there will be additional opportunities to increase engagement around the Draft CAP Public Comment Period and the rollout of the Final CAP.

Engagement with Existing Groups

The Office of Sustainability engaged with the Mayor’s Sustainability and Resiliency Subcabinet, Sustainability Commission, and Community Resiliency Hubs throughout the CAP process.

Mayor’s Sustainability and Resiliency Subcabinet

The Mayor’s Sustainability and Resiliency Subcabinet is an interdepartmental group chaired by the Chief Administrative Officer (CAO) that includes representation of all city agencies that can play a role in advancing sustainability in Baltimore. The Subcabinet first met in the Fall of 2021 and included a Climate Working Group that was to be focused on garnering internal support for the CAP Update. The Climate Working Group met numerous times between Fall 2021 and Fall 2022. The Climate Working Group supported the development of the CAP Community Engagement Strategy, the CAP Public Survey (including the demographic questions), as well as CAP logo and banner design. As the TAC was being developed in Fall 2022, it was

determined that membership would be duplicative of the Climate Working Group of the Subcabinet and the TAC became the main mechanism for working with City agencies and other key institutional stakeholders with a stake in climate action.

Sustainability Commission

The Sustainability Commission is comprised of 20 residents appointed by the Mayor as well as one City Council representative that oversee the implementation of the 2019 Baltimore Sustainability Plan. The Sustainability Commission holds monthly public meetings which often include presentations by local experts to elevate sustainability work happening in the city that support the Sustainability Plan. The Sustainability Commission's role was to contribute feedback on the formation of the engagement strategy and provide strategic support throughout the CAP Update process. The OS presented the CAP Community Engagement Strategy and engagement timeline at the January 2022 Sustainability Commission Meeting. Four members of the Commission also joined the CAP Technical Advisory Council.

Community Resiliency Hubs

Surveys and other CAP-related information were shared with 17 Community Resiliency Hub partner organizations. Resiliency Hub partners were encouraged to take the surveys and share with their community members, provided feedback on engagement materials, and spread the word of engagement opportunities to other community groups. At a meeting with Resiliency Hub leaders early in the process, the OS presented Climate Action Plan Update background information and held a group discussion to get feedback on the types of community engagement strategies that are most successful for reaching community members.

Engagement with CAP Advisory Councils

The Office of Sustainability formed a Technical Advisory Council (TAC) and a Resident Advisory Council (RAC) for targeted advising on the CAP Update process.

Technical Advisory Council

The Technical Advisory Council (TAC) members were invited by the Baltimore Office of Sustainability to support the CAP Update process. The Office of Sustainability brought together approximately 28 technical experts from a diverse range of City and partner agencies, community-based organizations, and civic groups to discuss the findings of the city's Greenhouse Gas Emissions Inventory and advise on climate action implementation as it relates to reducing emissions in key sectors: transportation, waste, energy, and buildings. The purpose of the TAC meetings was to facilitate cross-city collaboration and elicit subject matter expertise to inform the

CAP update. TAC members shared their expertise on various policies, barriers, solutions, and equity considerations when implementing key CAP Actions. The input provided by TAC members will help shape the actions and implementation roadmaps outlined in the Climate Action Plan.

The first TAC Meeting in February 2023 focused on setting the stage and understanding Baltimore's existing GHG emissions. The second TAC meeting involved a discussion of action prioritization and evaluation, as well as roadblocks and opportunities for implementing key actions. Two additional TAC meetings planned for the summer and fall of 2023 will provide additional opportunities for members to discuss strategies and approaches to effectively put the CAP into action and review the draft plan.

Resident Advisory Council

A 14-member resident advisory council (RAC) was formed to provide feedback on the CAP Community Engagement Strategy and CAP development to encourage equitable processes and outcomes. OS led an RAC application process and selected a diverse group of candidates across a broad spectrum of ages, races, genders, neighborhoods, incomes, and lived experiences to become RAC members. The opportunity to apply was amplified broadly through the OS newsletter, community outreach, and promoted by partners. RAC members were selected by a small team of reviewers that included OS team members to ensure a variety of personal and professional backgrounds. RAC members work with the Office of Sustainability and the CAP Project Team to drive an equity and community-centered engagement process. Two youth are included in the RAC to elevate concerns and considerations for younger generations. Two Sustainability Commissioners also served as RAC members to increase coordination between the two bodies. RAC members had the option to volunteer or to be compensated for their time. Those who opted for compensation received \$25/hour for their time and participation if they filled out and submitted a W9 to the OS.

The Office of Sustainability held ten RAC meetings from November 2021 to June 2023. One additional meeting will be held in the fall of 2023 to review the draft plan. To date, RAC members have provided direct input on the engagement strategy, CAP branding, specific outreach tools for reaching hard-to-reach populations, messaging strategies, ways to elevate and increase awareness of the CAP, and key promotional opportunities such as community events. The RAC was also kept up to date and able to provide feedback on the results and outcomes from the engagement activities and technical analyses. They also provided feedback on proposed prioritization criteria for actions to be included in the CAP. The RAC was essential in keeping the CAP Engagement Strategy on track and helped the CAP Project Team pivot and rethink our approach when needed.

Events

Community Events

The OS attended 93 community gatherings and events through the project (see map in the Appendix). The OS tabled at these events with the goal to engage with residents about their communities and climate change as well as distribute and collect surveys. Events included GROW Center pop-ups, farmer's markets, food giveaways, and various community and organizational meetings.

Office of Sustainability Open House

The Office of Sustainability hosted its annual Open House on June 14, 2022, at the Shake & Bake Fun Center. The theme was “The Art of Climate Action” and included food*, roller skating*, giveaways, and learning opportunities about CAP. Local artists showcased their climate-related artwork and were compensated for their time and labor, also at a rate of \$25/hr.* Local environmental justice-focused, community-based organizations were also in attendance to share their efforts to make a more sustainable, equitable, and resilient Baltimore City. 299 community stakeholders attended the event.

Virtual Community Workshops

The Office of Sustainability hosted three virtual community workshops in March 2023. The workshops saw a total of 131 participants with 44 participants attending the first workshop, 33 participants in the second, and 54 participants in the third. Participants were compensated \$25 for their time if they filled out and submitted W9 to the OS. The workshops had three goals:

1. Learn how climate solutions can improve residents' quality of life and increase community well-being;
2. Gather input on barriers and solutions surrounding different climate topic areas; and
3. Discuss how solutions may amplify benefits and mitigate negative outcomes for vulnerable communities.

The workshops covered the four broad topics below. Participants had the opportunity to rank their interest in the four topics on the sign-in sheet form to encourage assignments to topics of interest.

1. Adoption of/transition to renewable energy;
2. Reduction of energy use in buildings and efficiency standards for new buildings;
3. Sustainable transportation option; and
4. Reduction of emissions associated with waste.

The three workshops followed the same format, including: a high-level presentation on Baltimore City’s current greenhouse gas emissions and trends, breakouts into small group discussions via topic areas, and a report back wrap-up to summarize takeaways. Each breakout room focused on one of the four topics with one facilitator and one note-taker.

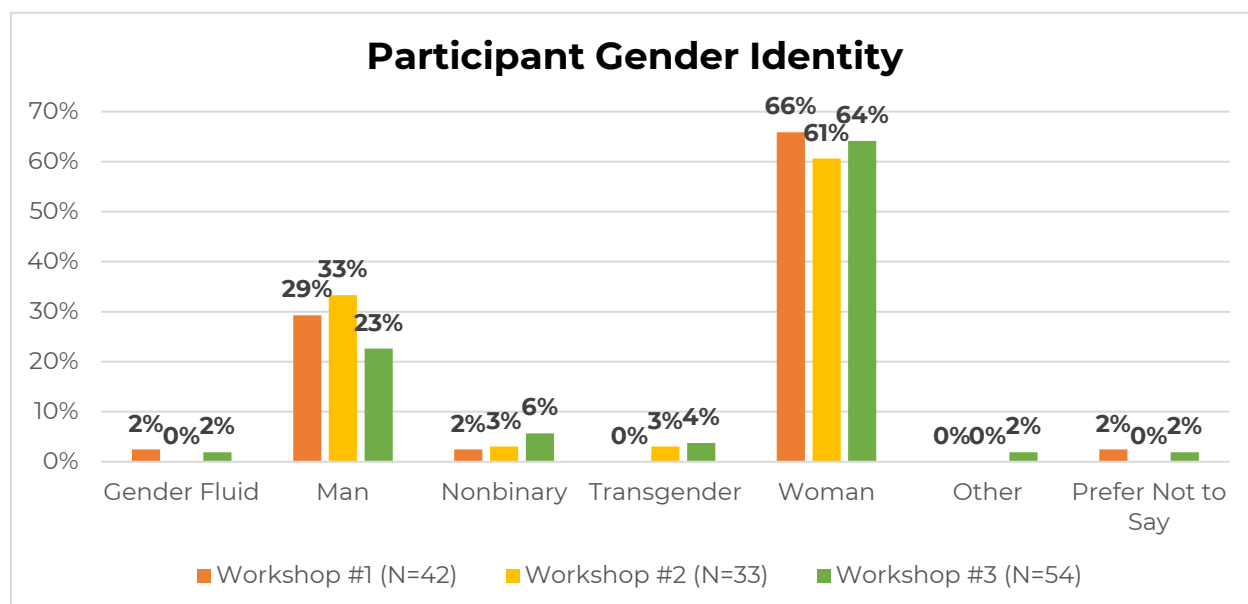
The live engagement visualization tool, Mural™, was used to collate and discuss ideas, concerns, barriers, and solutions to various climate action prompts. Facilitators asked participants the following questions to hear their examples and solutions for the respective topic areas:

- How can these solutions improve quality of life and community livability?
- How can the implementation of these solutions lead to equitable outcomes?
- What are some barriers you anticipate while implementing these solutions?
- Ensure equitable outcomes! *[Prompt to help ensure outcomes are equitable to the community]*
- Any last thoughts?

Participant Demographics

On average, 64 percent of workshop participants identified as women, and 29 percent identified as men (see figure 1). According to the 2021 ACS- 5 Year Estimate,¹ 53 percent of Baltimore City residents identify as women, and 47 percent identify as men.

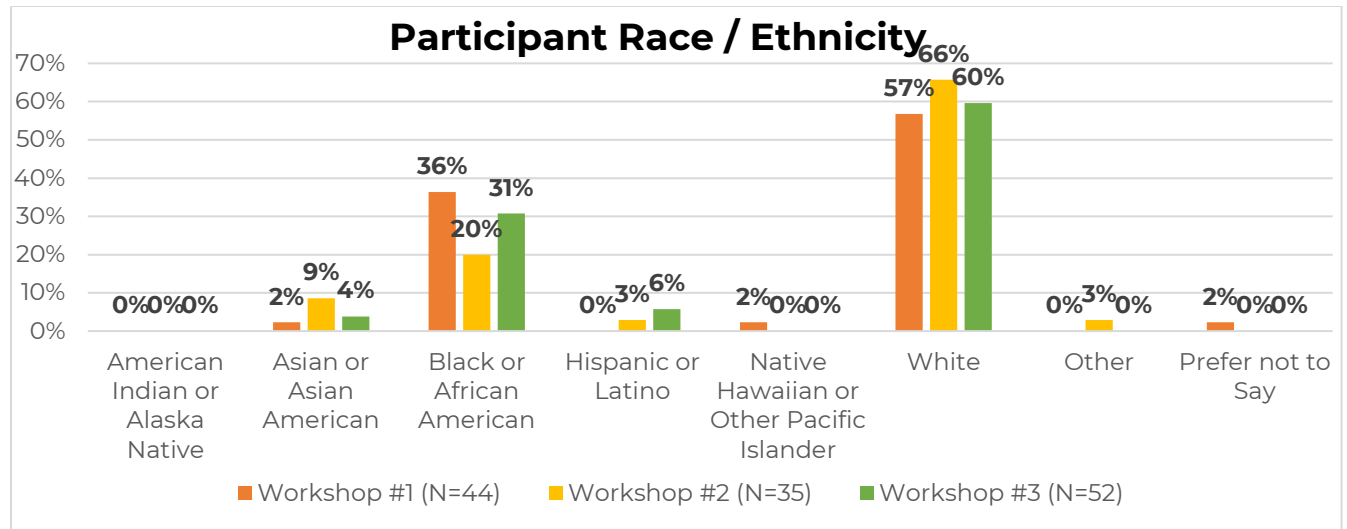
Figure 1. Gender Identity of Participants across the Virtual Workshops.



¹ <https://data.census.gov/table?q=baltimore+city&t=Age+and+Sex&tid=ACSDP5Y2021.DP05>

On average, 61 percent of participants identified as White, and 29 percent identified as Black or African American (see figure 2). According to Census data,² 29 percent of Baltimore City residents identified as White, while 62 percent identified as Black or African American.

Figure 2. Ethnic and Racial Composition of Participants across the Virtual Workshops



² <https://data.census.gov/table?q=baltimore+city&t=Age+and+Sex&tid=ACSDP5Y2021.DP05>

On average, 38 percent of residents indicated that they earned over \$100K/ year, while the average median income in Baltimore in 2021 was approximately \$54K³ (see figure 3).

Figure 3. Income Distribution of Participants Across all the Virtual Workshops

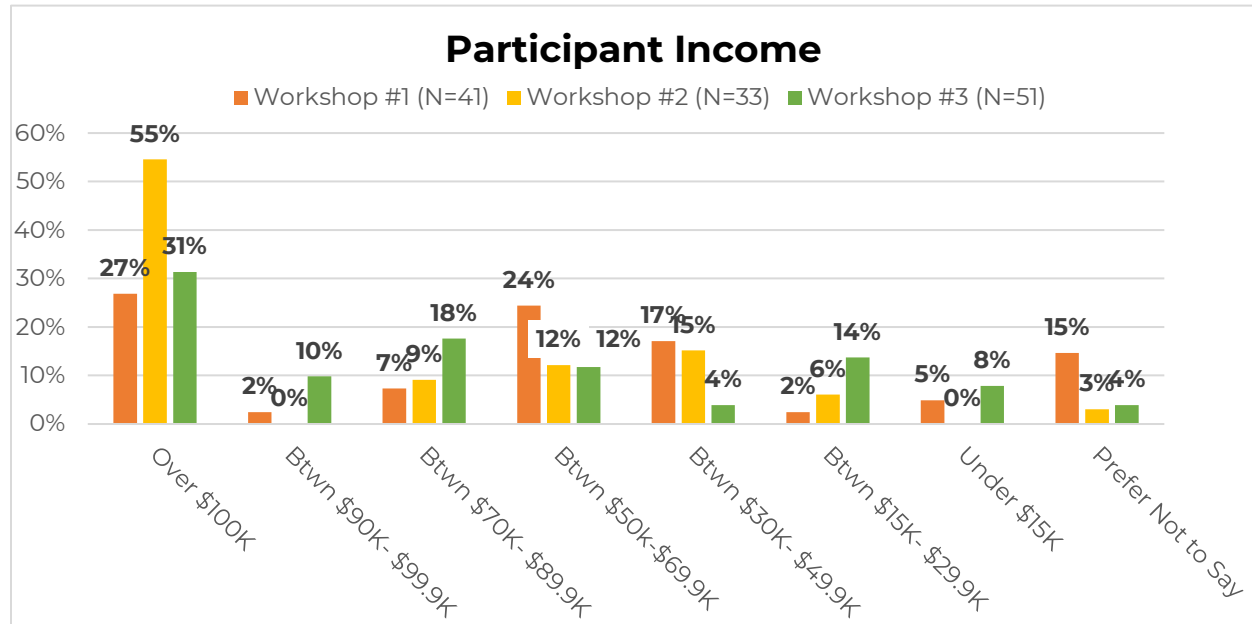
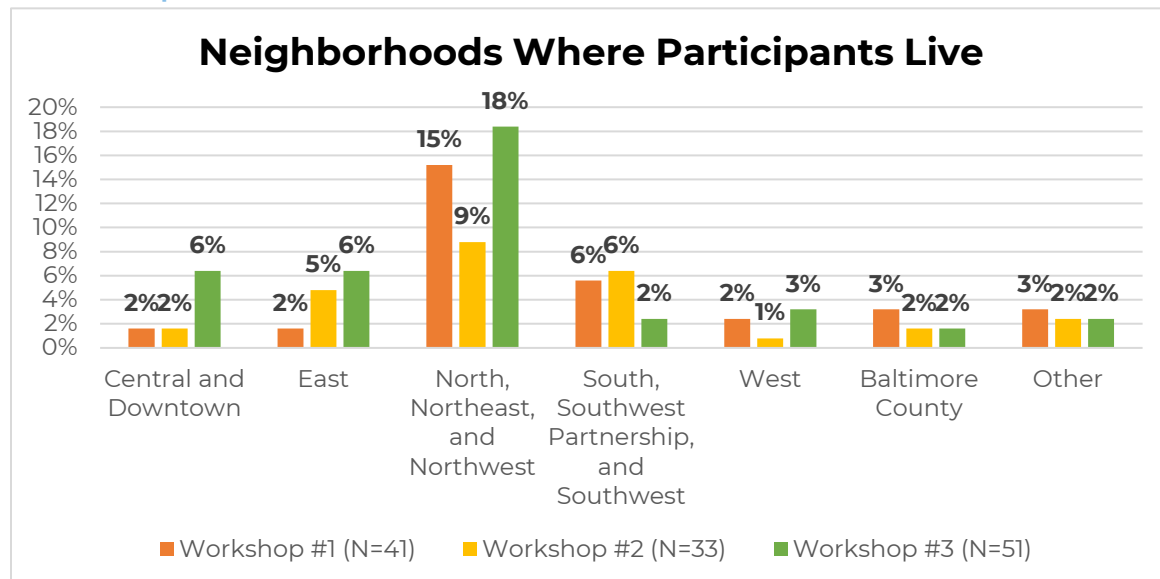


Figure 4. Resident Participation by Neighborhood Across the Virtual Workshops



³[https://data.census.gov/table?q=baltimore+city&t=Income+\(Households,+Families,+Individuals\)&tid=ACSSTIY2021.S1903](https://data.census.gov/table?q=baltimore+city&t=Income+(Households,+Families,+Individuals)&tid=ACSSTIY2021.S1903)

Approximately 42 percent of residents were from the Northern neighborhoods in Baltimore City, with 14 percent of residents coming from Southern Baltimore neighborhoods.

In-Person Workshop

The Office of Sustainability, in collaboration with Johns Hopkins University and the University of Houston, hosted an in-person workshop on Saturday, April 22, 2023. The workshop took place at the Vollmer Center at Clyburn Arboretum in northern Baltimore City. The 4-hour event brought residents together to deliberate on climate issues the City identified based on data gathered from other engagement efforts. At sign-in, residents were given two different colored stickers that represented the main topic areas they were assigned to (renewable energy, buildings, sustainable transportation, and waste management). Residents were asked to discuss proposed solutions to the main topic as well as tradeoffs, ideas, and any general questions or feelings they had about the proposed solution. Sample proposed solutions included:

- Implement an opt-out community choice energy program to acquire 100 percent clean electricity for the community.
- Expand public electric vehicle charging infrastructure, especially along main routes and in popular destinations.
- Standardize alternatives to single-use items such as straws, cups, utensils, packaging, and similar items.
- Require all new construction to be electric.

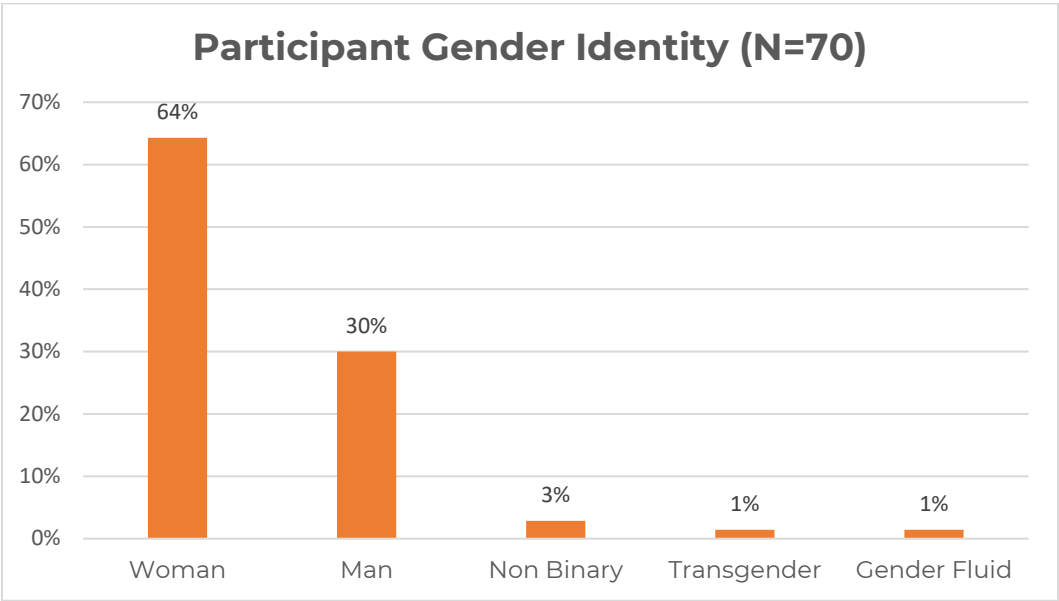
There was a total of three breakout sessions, two assigned, and one that allowed residents to choose which topic interested them. There were two breakout groups per topic with 8-12 residents per breakout group. Each group had one note-taker to capture ideas and sentiments from residents, one facilitator to help guide and prompt the group for discussion, and one subject-matter expert to answer technical questions from residents. Facilitators were given a Workshop Issue Guide and a Facilitator Cheat Sheet (see the appendix) to help lead the group.

Participant Demographics

The in-person workshop brought approximately 70 residents together, with the option to be compensated \$100 for their time if they filled out and submitted a W9 to the OS.

As shown in Figure 6, 64 percent of participants identified as women, while 30 percent identified as men.

Figure 5. Gender Breakdown of In-Person Workshop Participants



As shown in Figure 7, 41 percent of participants identifying as white, 33 percent identified as Black or African American, 4 percent Hispanic or Latinx and 14 percent as other. The ‘other’ category was comprised of individuals who self-identified as Middle Eastern or as two or more races.

Figure 6. Racial and Ethnic Breakdown of In-Person Workshop Participants

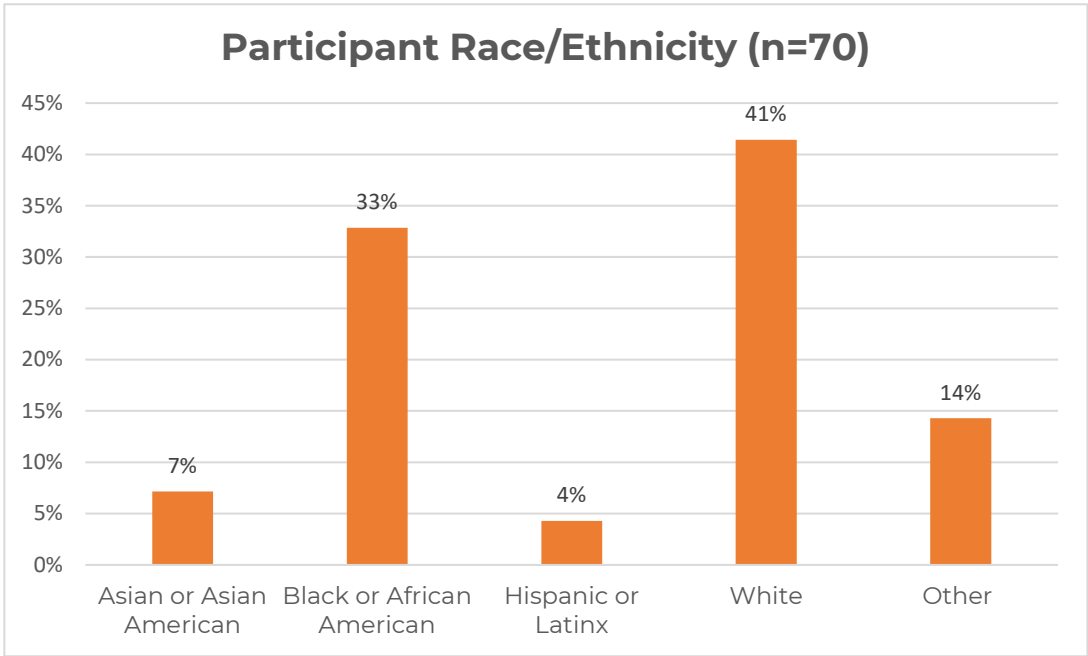
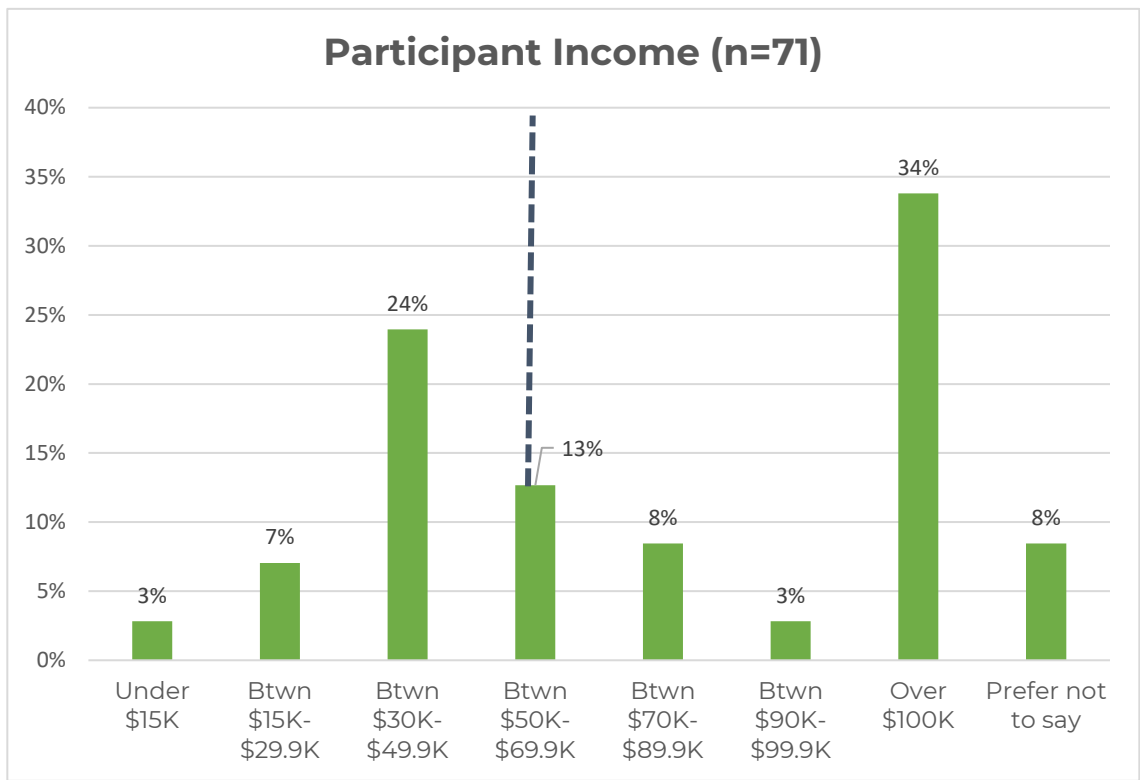
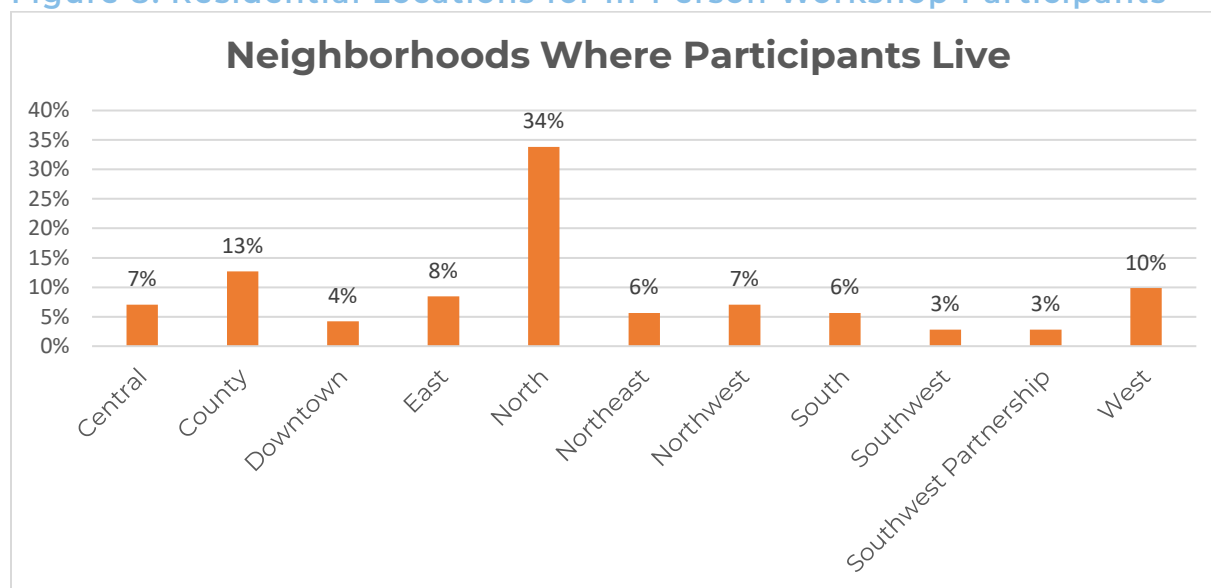


Figure 7. Reported Income of In-Person Workshop Participants



34 percent of residents who attended reported an income of \$100k or higher, while only 13 percent of residents reported income between \$50K-\$69K (Figure 8). Residents came from both Baltimore City and County. Overall, 34 percent of participants indicated that they lived in the Northern planning districts of Baltimore City, 13 percent of participants lived outside of the Baltimore City, and 10 percent of participants were from neighborhoods in the Western planning district (see appendix for map).

Figure 8. Residential Locations for In-Person Workshop Participants



Tools

Community Organization Outreach

The Office of Sustainability created a shared list of community organizations by neighborhood. These organizations were asked to distribute information about opportunities for CAP engagement participation to community organizations.

Flyers Distribution

The Office of Sustainability distributed flyers and survey drop boxes at community centers and other accessible locations across the city, targeting neighborhoods that are often underrepresented in engagement activities, have limited access to the internet, or lack of resources.

Social Media

The Office of Sustainability leveraged its Instagram ([sustainbmore](#)), Facebook ([baltimoresustainability](#)), Twitter ([SustainBmore](#)), and LinkedIn ([Baltimore City Office of Sustainability](#)), to implement its CAP Social Media Campaign. Posts, stories, and polls were used on the respective five platforms. The campaign had three goals:

1. Engage with Baltimore City and get their input for the CAP update.
2. Educate followers/connections on all things CAP-related, from climate change to other sustainability efforts in Baltimore City.
3. Direct users, specifically Baltimore City residents, to our surveys, forms, and CAP website.

Six types of posts were published on the platforms:

1. Promotions for/links to the CAP Surveys
2. Promotions for/links to the Workshop Interest Forms
3. Survey “call and responses” – a series of questions related to CAP topics, such as energy/utilities, health, transportation, and more.
4. “Do You Know?” facts
5. Polls

CAP process update: Content Type	Frequency (during peak times to communicate about action items)
Survey response solicitation	1-3x/week
Surveys and Forms stories	1/week
“Call and Responses”	1/week
“Do You Know?”	1/week
Polls	1/week
CAP process update	Every 3 weeks

Surveys

The Office of Sustainability created and administered a Public Survey and a Youth Survey as primary tools for collecting data for the CAP. The 41-question Public Survey, open from April 2022 – March 2023, received 412 responses from individuals representing 18 different neighborhoods. It included open-ended and multiple-choice questions on how climate change impacts people at the individual, household, and neighborhood scale, what solutions could help reduce climate impacts, and what their climate change priorities are. The Public Survey was intentionally written using inclusive language at a 5th grade reading level and minimized climate jargon.

The 21-question youth survey, geared toward ages 10-20, targeted questions to the younger generation’s experiences with sustainability and climate topics based on six categories, health, disaster resiliency, weather, energy, transportation, and demographic information. It received 19 responses.

Analysis of the survey results is forthcoming.

Engagement Impact Reflection

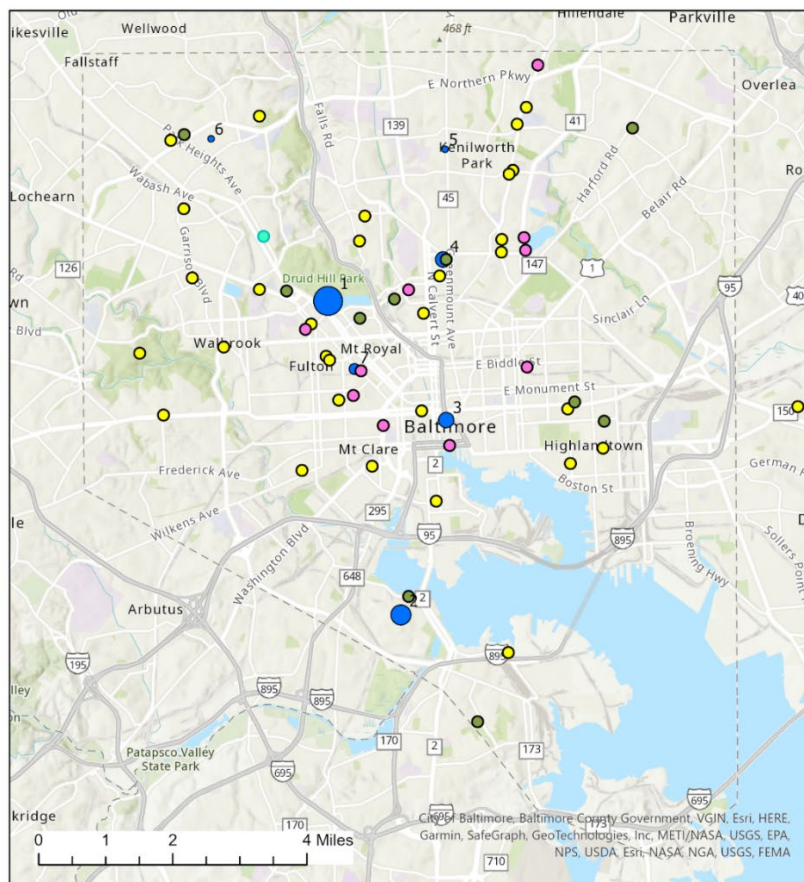
Overall, the Office of Sustainability facilitated approximately 2,300 unique engagements⁴ throughout the CAP Engagement process. As a whole, developing and implementing a community-driven engagement process has provided extensive insight on the local context of CAP actions, helped develop localized solutions for addressing emissions, and generated buy-in for the CAP process. It also increased community knowledge and awareness of the impacts of climate change and emissions, as well as set a precedent for Baltimore in fairly compensating residents for their participation and input in public processes. Specifically, public engagement helped identify:

1. Action gaps and barriers
2. New actions
3. Action implementation steps
4. Equity considerations
5. Important action evaluation criteria

This feedback helped inform the development of the draft CAP actions, the action evaluation and prioritization process, and the development of the action implementation roadmaps. Though the process wasn't perfect and the demographic breakdown of individuals engaged throughout the process was not completely representative of the city, it was an informative and useful process that will, most importantly, complement and focus the technical analysis components of CAP. As intended, the Draft and Final CAP document will demonstrate exactly where and how community input was incorporated into the CAP narrative, actions, and ultimately - the outcomes.

⁴ "unique engagements" refers to the number of individuals.

Figure 9. Community Events Attended and Locations of Survey Distribution Events

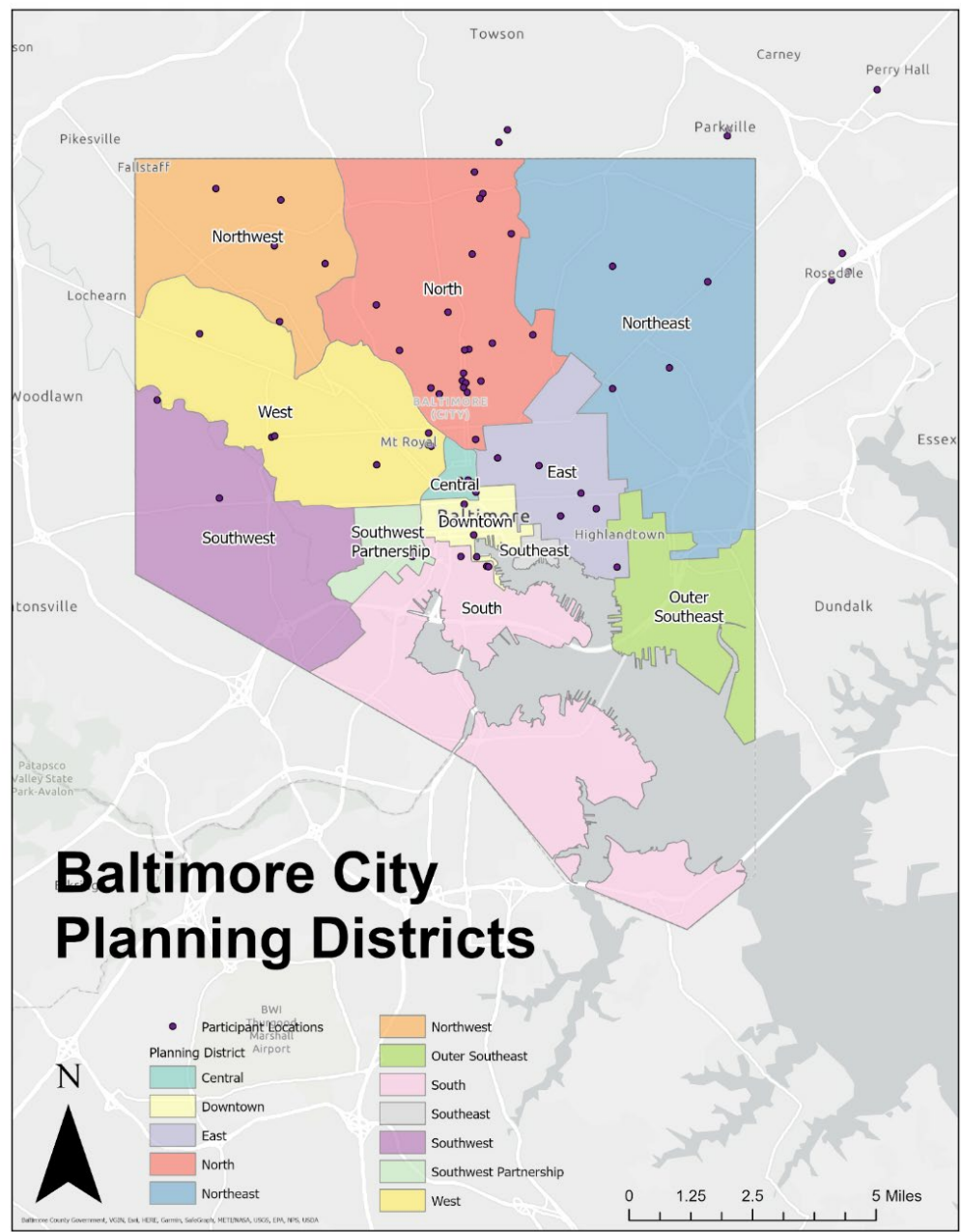


- Legend**
- Engagement Locations
 - Grow Center Engagement
 - Survey Locations
 - Farmers Market Locations (Visits)
 - 1
 - 3
 - 6
 - 8
 - 11

Survey/ Engagement Effort Locations



Figure 10. Residential Locations for Participants of In-Person Workshop



Appendix 2B: Community Survey Summary



Prepared for the
Baltimore Office of Sustainability

Prepared by
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Abbreviation List

Abbreviation	Definition
CAP	Climate Action Plan

Executive summary

The community survey, conducted as part of Baltimore's Climate Action Plan update, asked residents about a range of topics, from how extreme weather effects them, to the modes of transportation they use, how they feel in their home and in their neighborhood, and how they want Baltimore City to respond to climate change. Overall, 504 people responded to the survey. We note, however, that there is a higher prevalence of wealthy residents, Caucasian residents, and women in the survey responses compared to the demographics of Baltimore City writ large. Hampden and Charles Village are also disproportionately represented compared to other City neighborhoods. These demographic caveats notwithstanding, respondents report being most affected by heat relative to other extreme weather events and weather-related emergencies. In fact, just under half of all respondents say they are able to keep their homes at reasonable temperatures, while just under half say "It Depends/Sometimes" and 7% say "No." Cost is the most commonly-cited barrier to adequate heating and cooling. Survey participants further cite a desire for more shade as the number one resource that would help them deal with extreme weather events. Most respondents (64%) are interested in choosing renewable or clean energy for their home (if offered), though 22% have concerns about the associated cost. For context, most survey participants have central heat from a gas or oil-fueled furnace (51%), while a much smaller number have an electric furnace (25%) or radiators (22%). For cooling, most have central air conditioning (62%), while a smaller number use fans (52%) and open windows (40%). Cars and motorcycles are the most reported modes of transportation (76%). By contrast, 65% report walking while a smaller number report cycling (20%) or using public transit (32%) as primary modes of transportation. Respondents say that more reliable/convenient public transportation options would be most effective in convincing them to use alternative modes of transportation. Survey participants indicate varying levels of satisfaction with their homes and neighborhoods. Respondents report that safety, drug use, the overall condition of their neighborhood are the primary barriers to their physical and mental well-being in their neighborhood and in their housing. Furthermore, survey participants report that safer streets (e.g., traffic calming, better lighting); cleaner, more vibrant streets; and more street trees/shade are the neighborhood improvements that would be most effective in improving their physical/mental health.

Overall, most survey participants want Baltimore City to act on climate change -- by investing in more renewable and eco-friendly resources, by creating better trash disposal policies, planting more trees, and making public transit more reliable.

Survey Demographics

Approximately 504 people participated in the Climate Action Plan (CAP) survey. The figures below summarize the geographic distribution and demographics of survey respondents, compared to the demographics of Baltimore City. Note that in a few instances, the demographics questions on the survey provide slightly different information than is available from the US Census, making it challenging to compare the demographics of survey respondents against the demographics of the City writ large. For example, the age categories available on the survey are slightly different than the age categories available from US Census data.

Figure 1. Race distribution of Baltimore City residents by percentage.
Data received from the 2021 Vital Signs of the Baltimore Neighborhood Indicators Alliance.

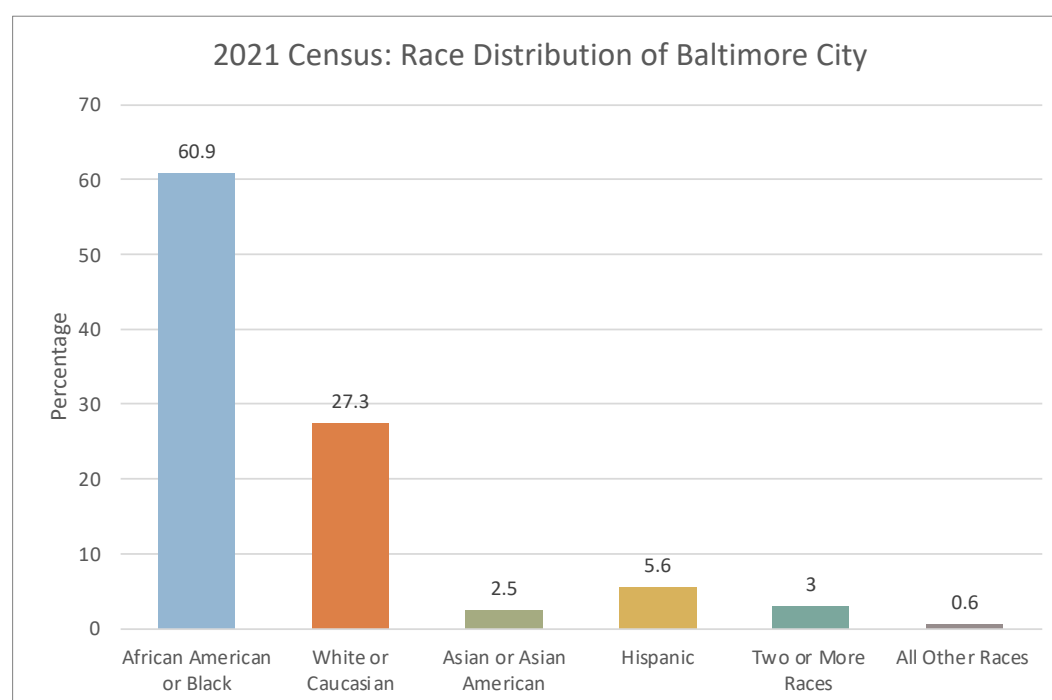


Figure 2 Race distribution of CAP Survey by percentage.

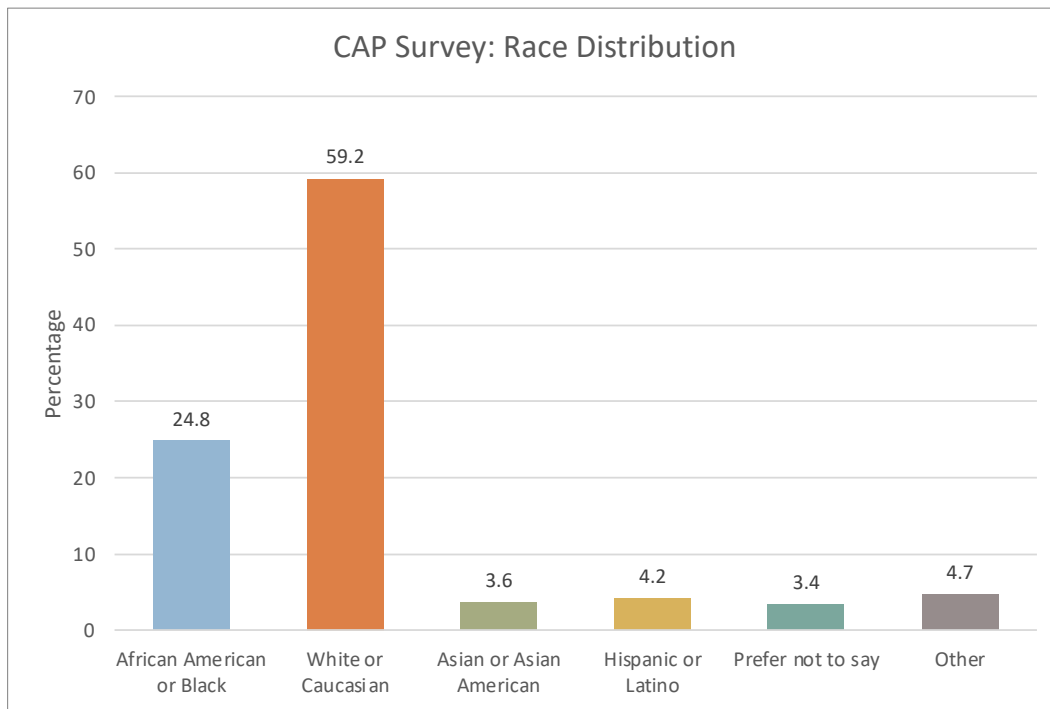


Figure 3. Map of Baltimore City showing the distribution of population (in %) among different Baltimore City zip codes. Source: 2020 US Census.

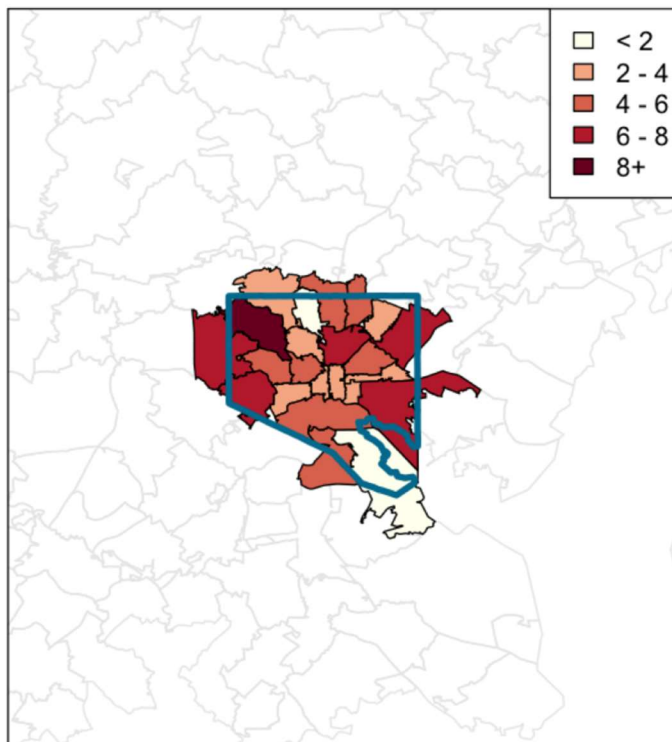


Figure 4. Map of Baltimore City showing the distribution (in %) of CAP responses among different zip codes. Note that there are a small number of survey responses from Baltimore County residents, and we include these responses in the analysis.

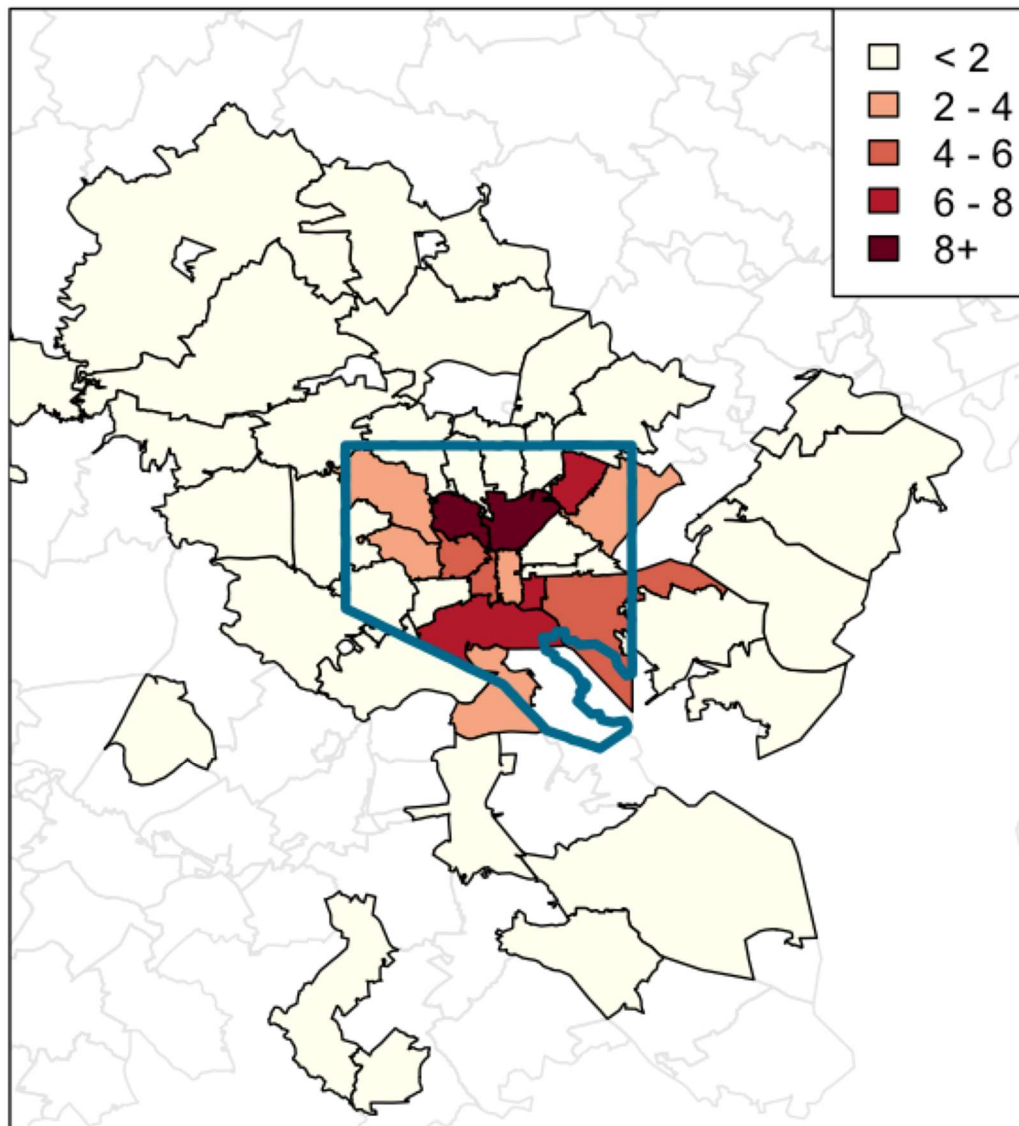


Figure 5. Age distribution of Baltimore City residents by percentage. Data received from the 2021 Vital Signs of the Baltimore Neighborhood Indicators Alliance.

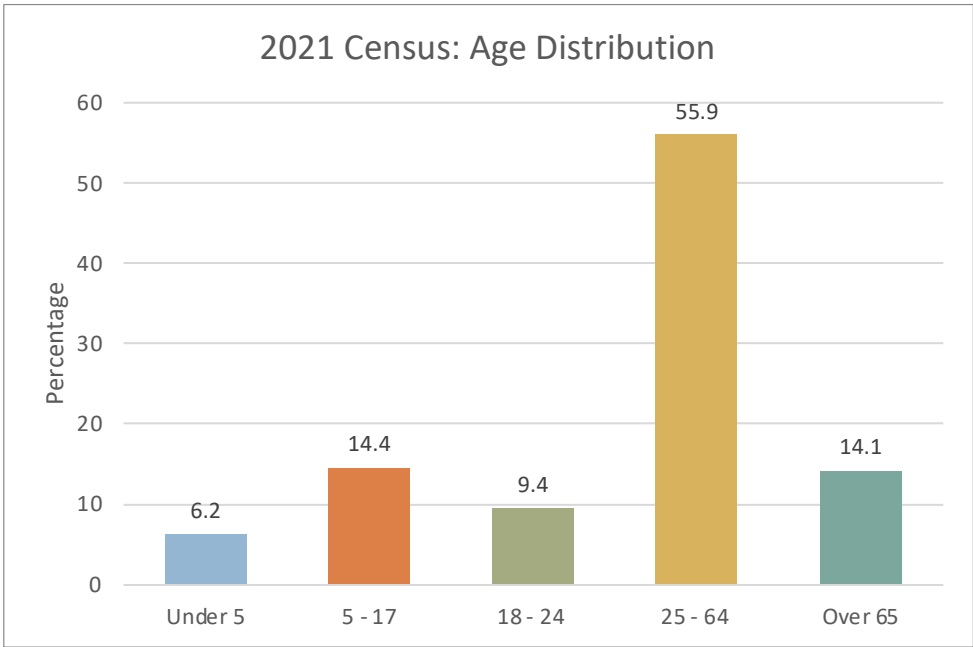


Figure 6. Age distribution of CAP Survey respondents by percentage.

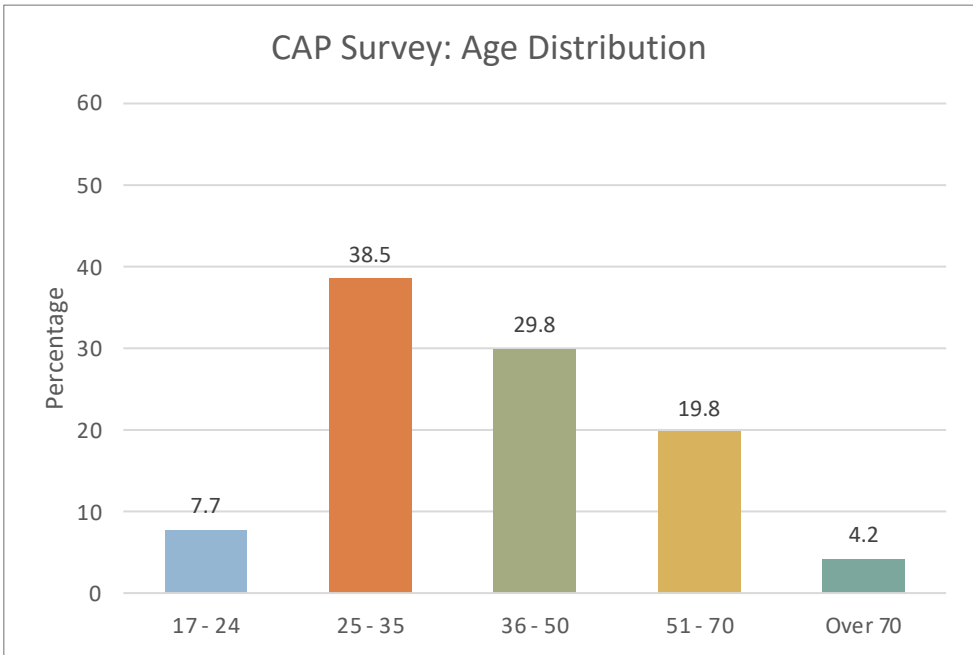


Figure 7. Gender Distribution of CAP Survey participants

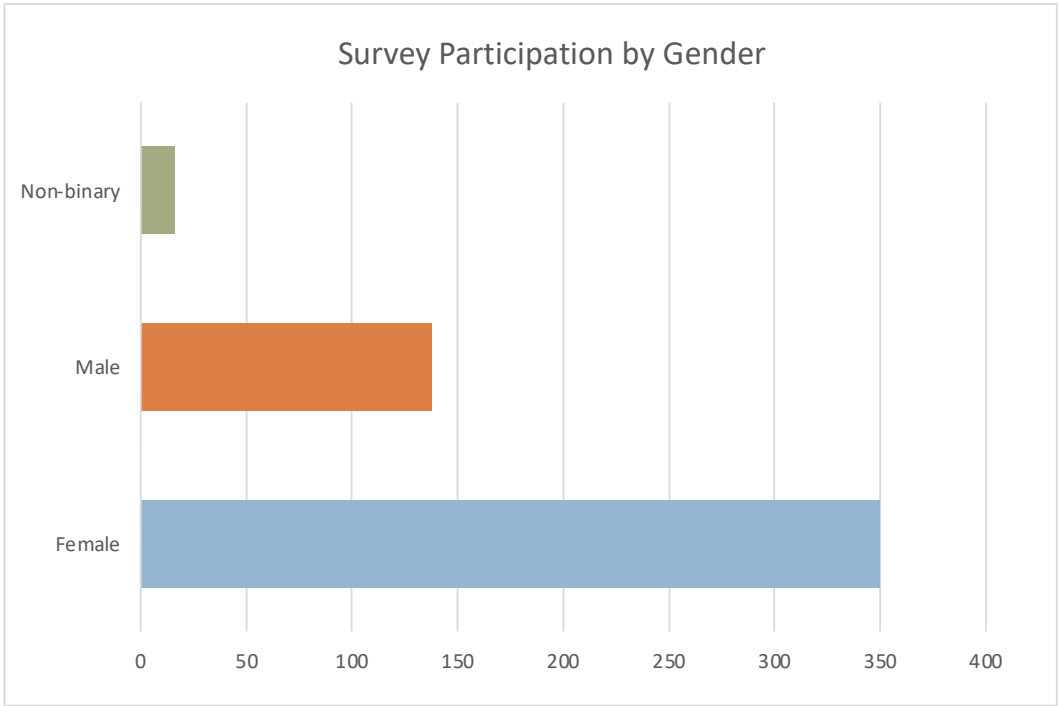


Figure 8. Educational distribution of CAP Survey participants.

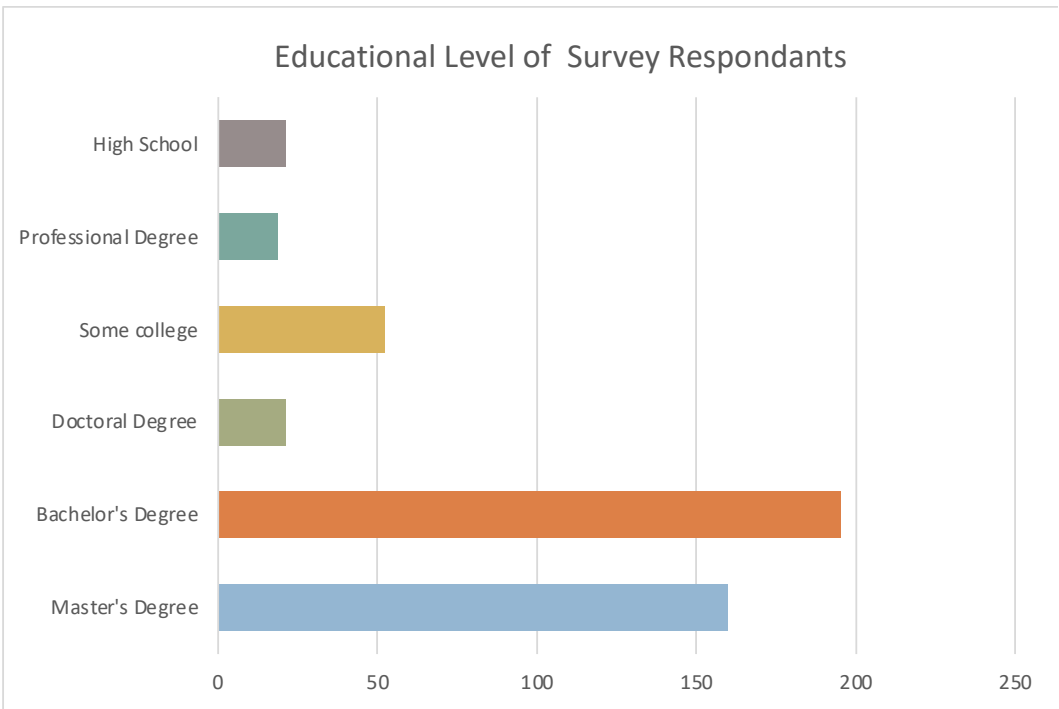


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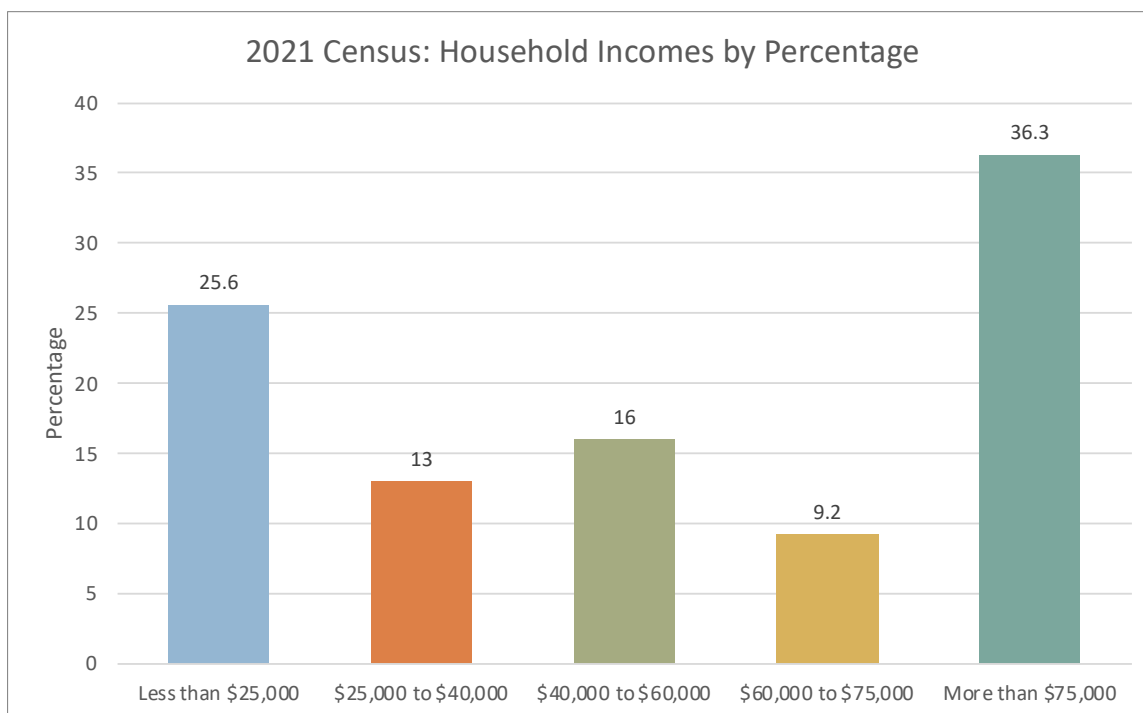
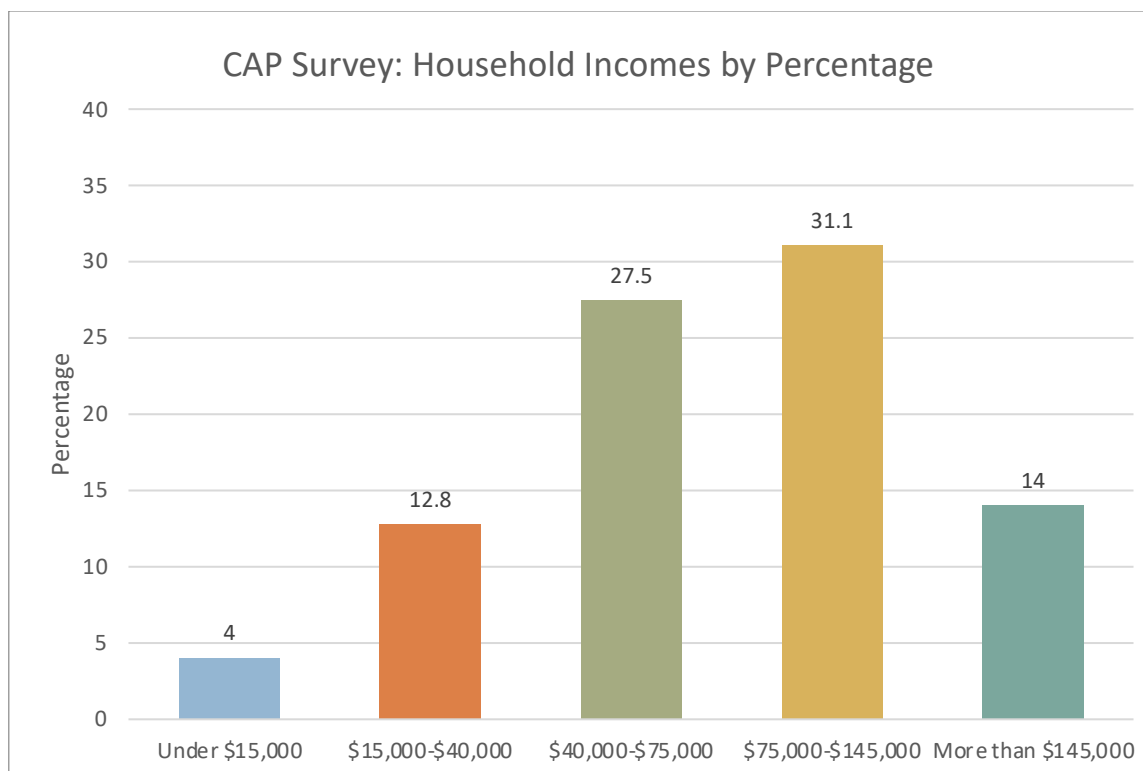


Figure 10. Household earnings of CAP Survey participants.



The comparison of the CAP Survey demographics vs. the 2021 census of Baltimore City residents reveal that survey responses reflect the opinions of Caucasian women more than any other demographic. While Baltimore City only has a 27.3% white population, 59.2% of survey respondents are white. Additionally, 69.4% of respondents are women. This means out of 504 respondents, 350 are women, 138 are men, and 16 are non-binary. The highest represented races are “White” with 327 responses and “African American or Black” with 137 responses. The most represented demographic are white women with 211 total respondents.

Another dominant survey demographic includes having a higher estimated household income. In comparison to the 2021 Census, the household incomes of respondents are skewed on a higher scale than the average Baltimorean. Majority of respondents are college educated with 195 having a Bachelor’s Degree and 160 having a Master’s Degree.

A fairly distributed demographic of the CAP survey is the spread of age. Out of 494 responses, 190 are between the ages of 25 – 35; 147 are between ages 36 -50; and 98 are between ages 51 – 70.

Extreme Weather Challenges

Figure 11. Holistic representation of CAP respondents on how they feel affected by extreme weather challenges.

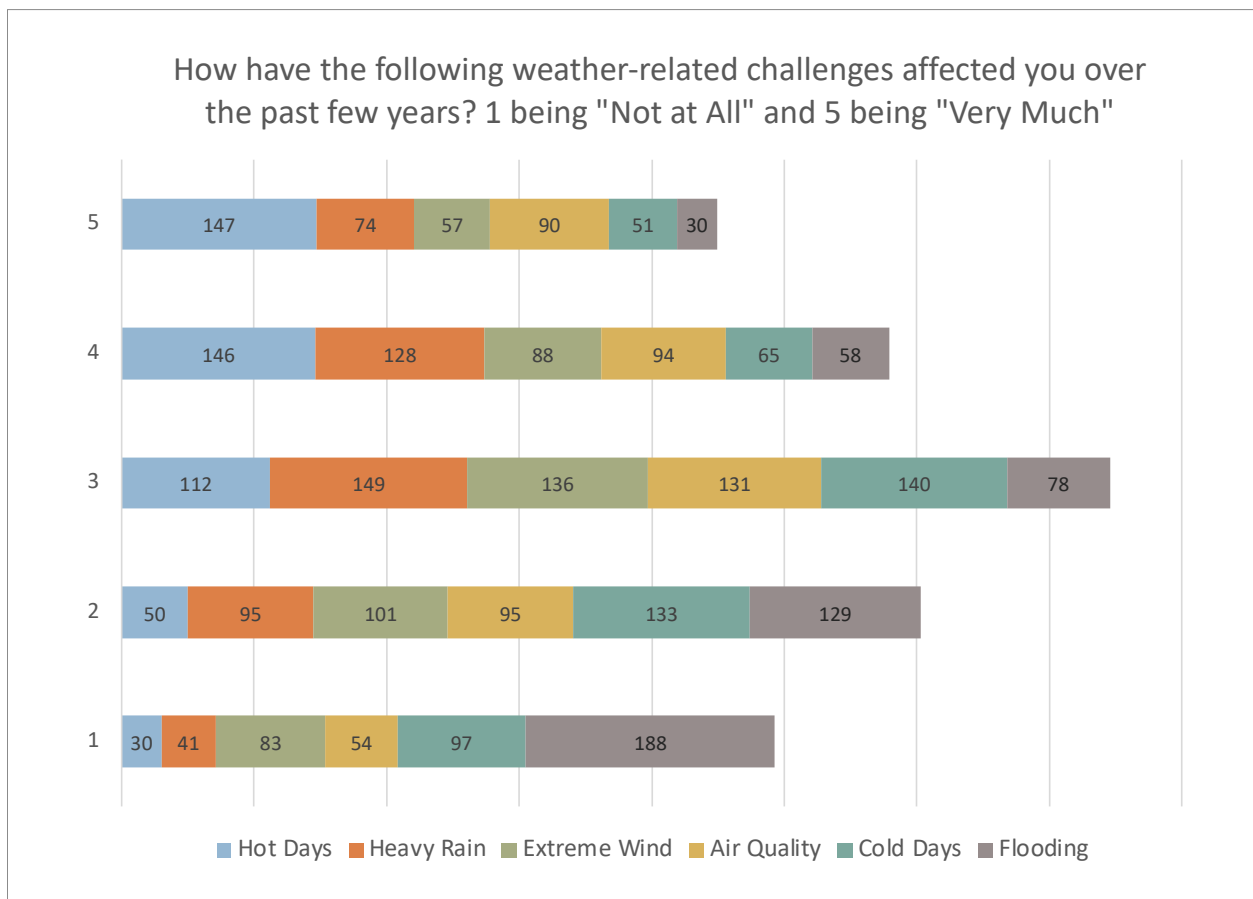


Figure 12. Holistic representation of CAP respondents on types of weather emergencies that most affect their neighborhood and home.

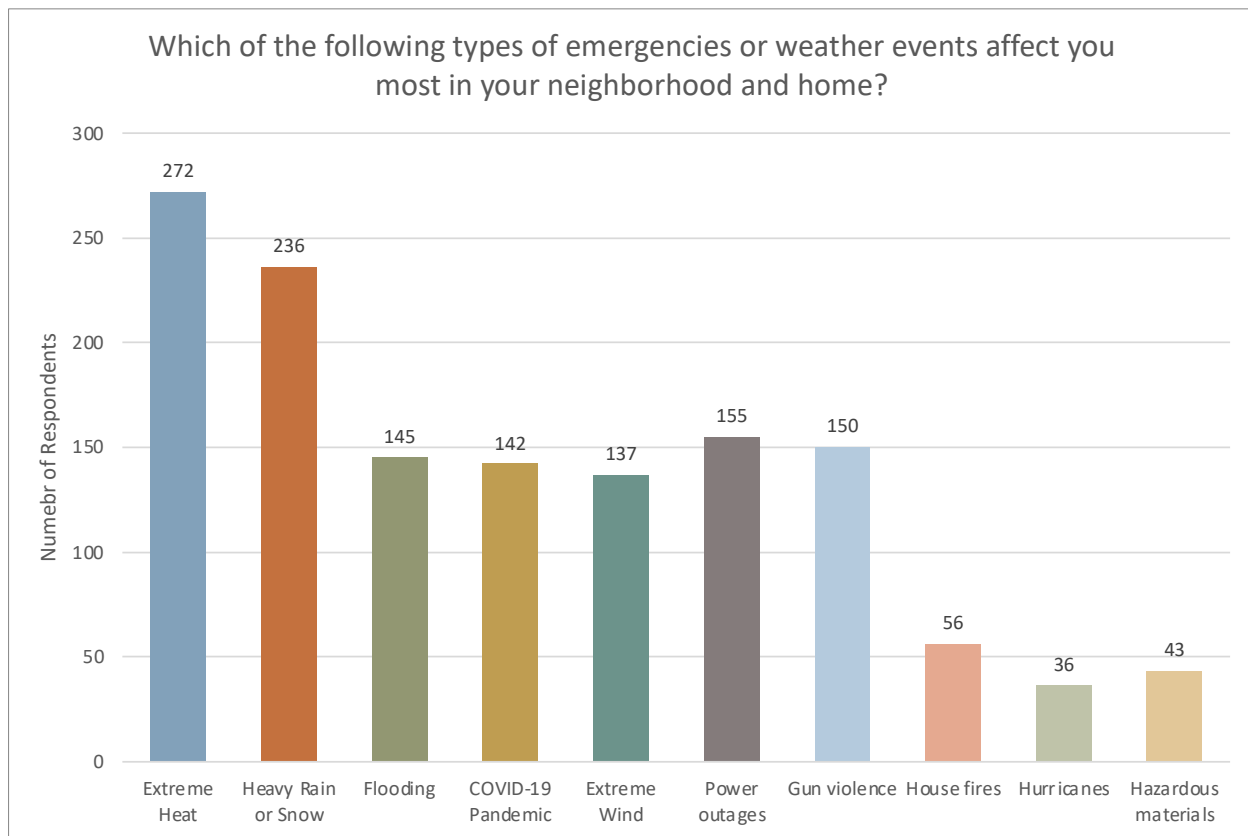


Figure 10 displays the popularity of ten pre-generated responses created by the Baltimore Office of Sustainability. For the question addressed in Fig. 10, respondents were given the chance to write-in their own answers. Aside from the fixed responses, the next most common environmental emergencies cited were air pollution, noise pollution, and trash accumulation. The issues with air and noise pollution are often expressed from residents who are closer to highways and inner-city neighborhoods.

Another concern involves possible gas leaks with resident homes and in adjacent houses. One resident says, “Gas leaks and overall poor air quality from gas appliances concerns me greatly - our air filter goes to red for almost an hour every time we turn on the stove. Long-term this is terrible for our health. We need incentives to help people convert to induction ranges and reduce concerns about gas leaks.”

Lastly, survey responders have concerns about reckless driving and loud traffic. One person writes, “Speeding cars and lack of safe driving enforcement paired with lack of safe places for pedestrians and cyclists to get around.”

Figure 13. CAP respondents on their access to comfortable temperatures at home.

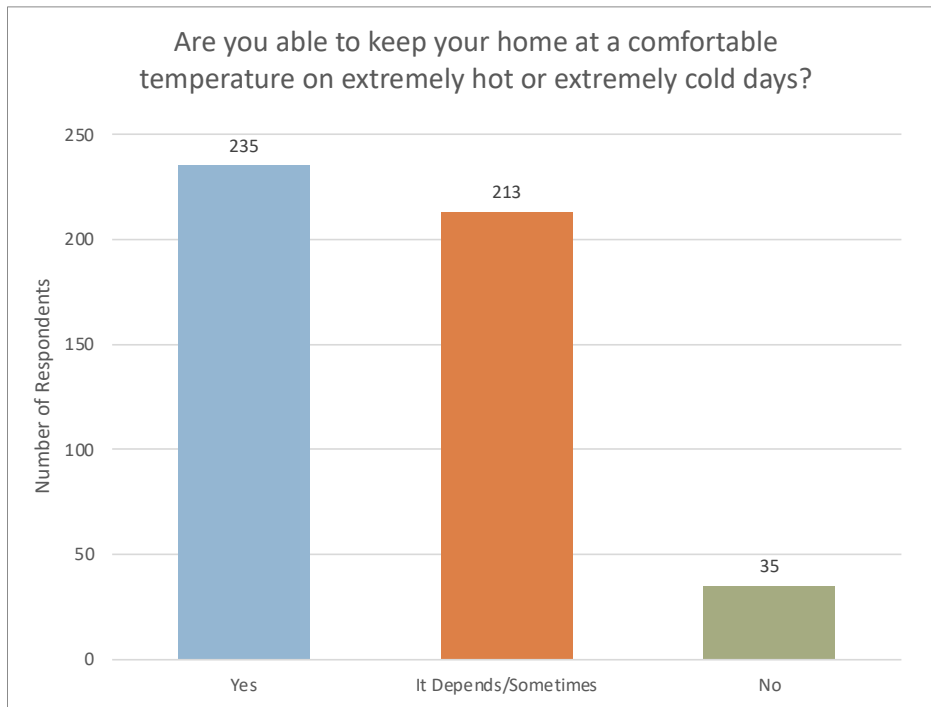


Figure 14. CAP respondents on their problems facing comfortable temperatures at home.

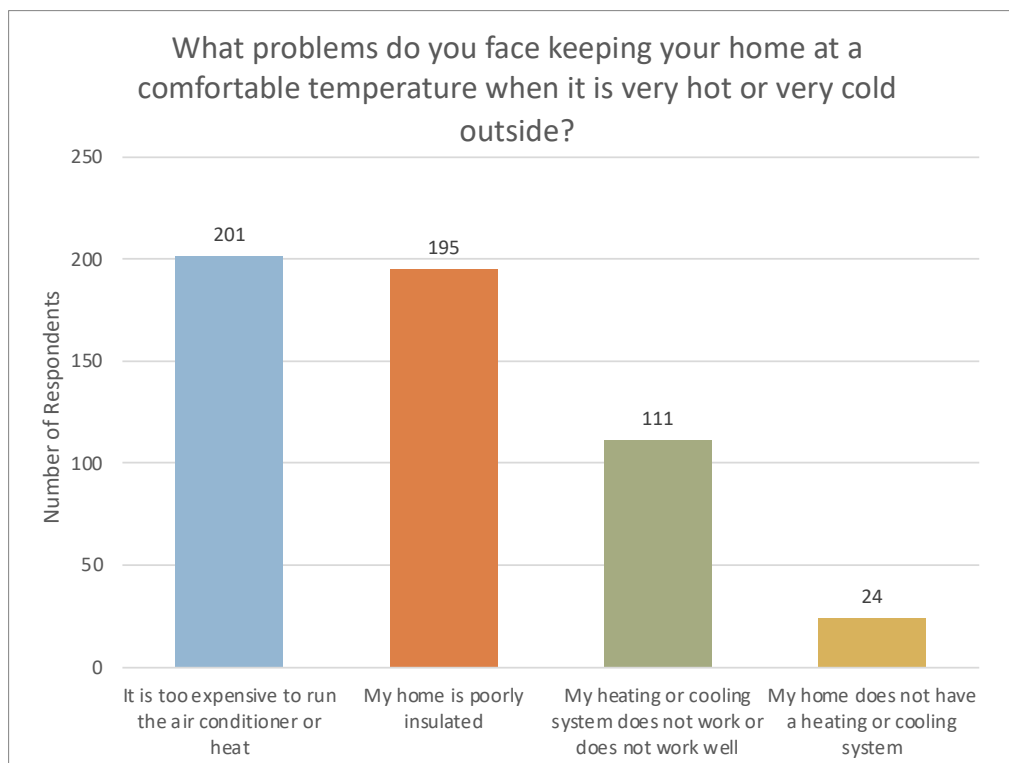


Figure 15. CAP respondents on home resources that would help them in extreme weather events.

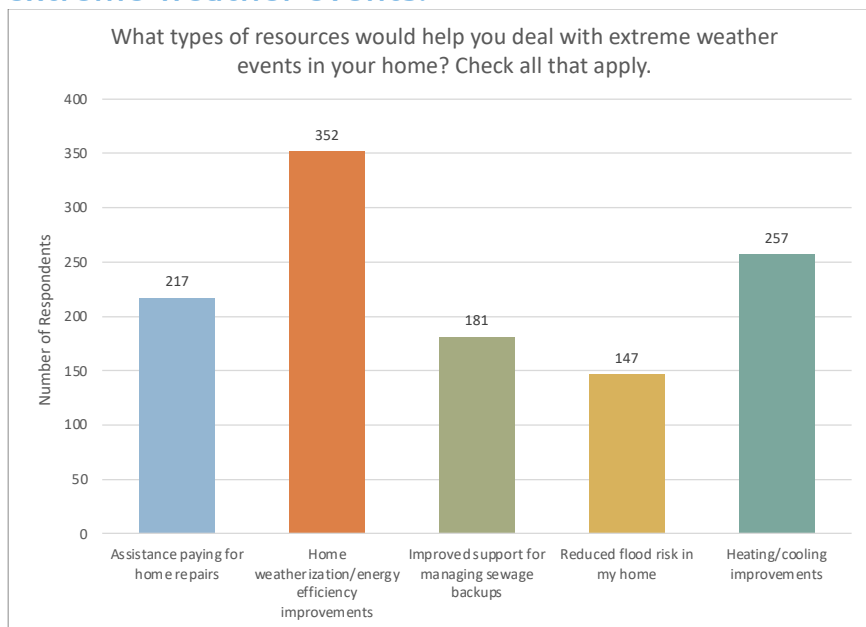


Figure 16. CAP respondents on neighborhood resources that would help them in extreme weather events.

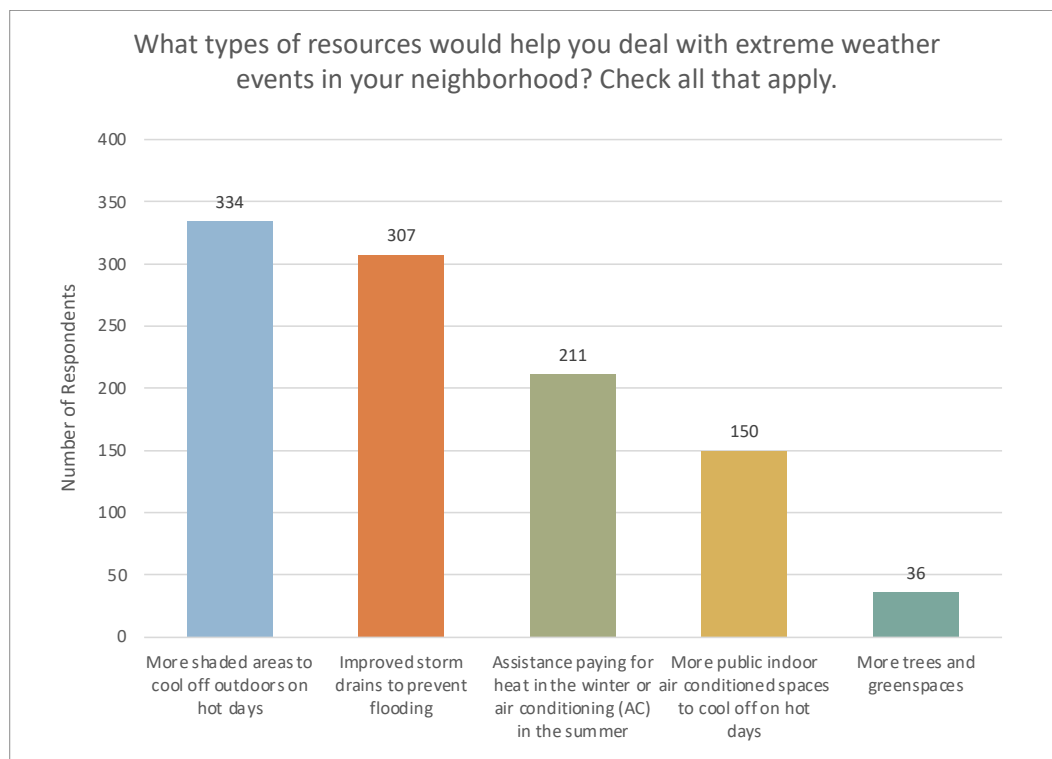


Figure 17. CAP respondents on types of resources that feel the safest in the case of a climate emergency.

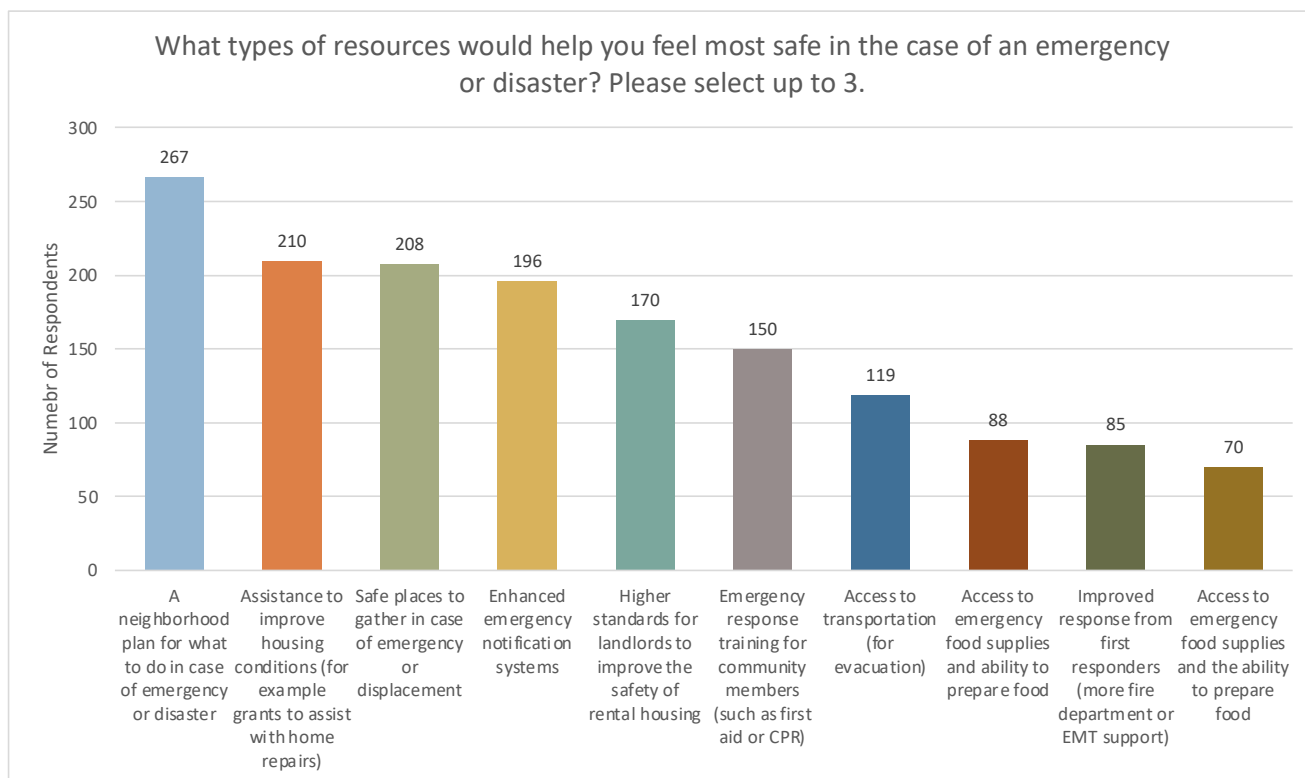


Figure 15 displays the popularity of ten pre-generated responses created by the Baltimore Office of Sustainability. Aside from these ten options, many respondents feel that the next best available resource would be to have more reliability on first responders to arrive and assess emergencies.

One respondent says, “there keep being car accidents at the bottom of my street and traffic control was installed but often it takes 15-20 or more minutes for emergency response to arrive, and the accidents almost cause more accidents during the waiting period.”

Another popular open-ended response expressed for Fig. 15 was for there to be improved communication between neighborhoods and the local government during a climate crisis. To the question asked in Figure 15, a person says, “Public Health Crisis Communication! CERC principles go a long way. Establishing trust is a must!” Another suggestion was for “Information to assess personal/neighborhood readiness.” Residents are interested in learning about ways to be better prepared for extreme weather.

Home Resources and Savings Programs

Figure 18. CAP respondents on methods they use to heat their homes.

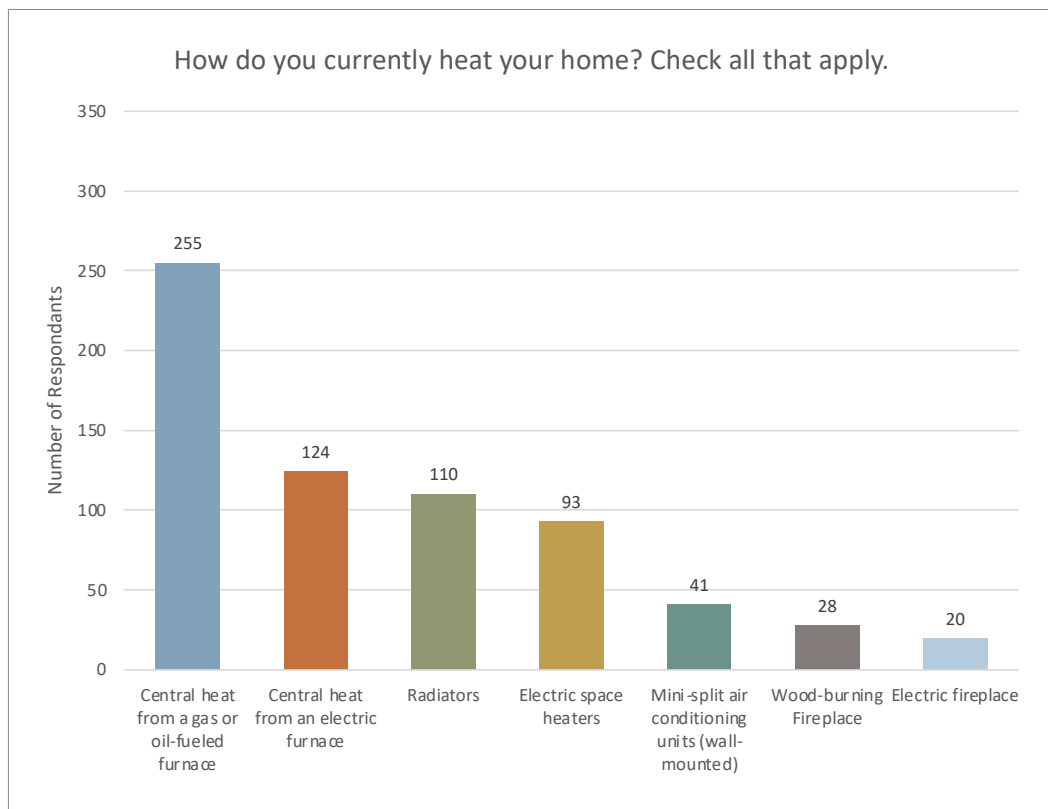


Figure 19. CAP respondents on their interest in cost savings programs for utilities.

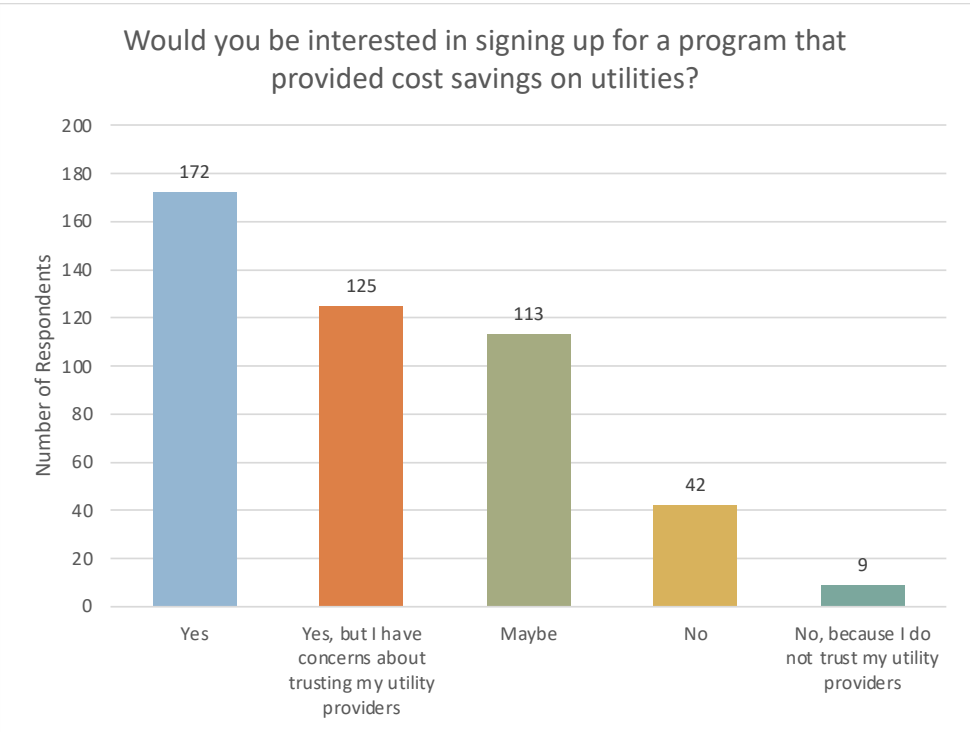


Figure 20. CAP respondents on methods they use to cool their homes.

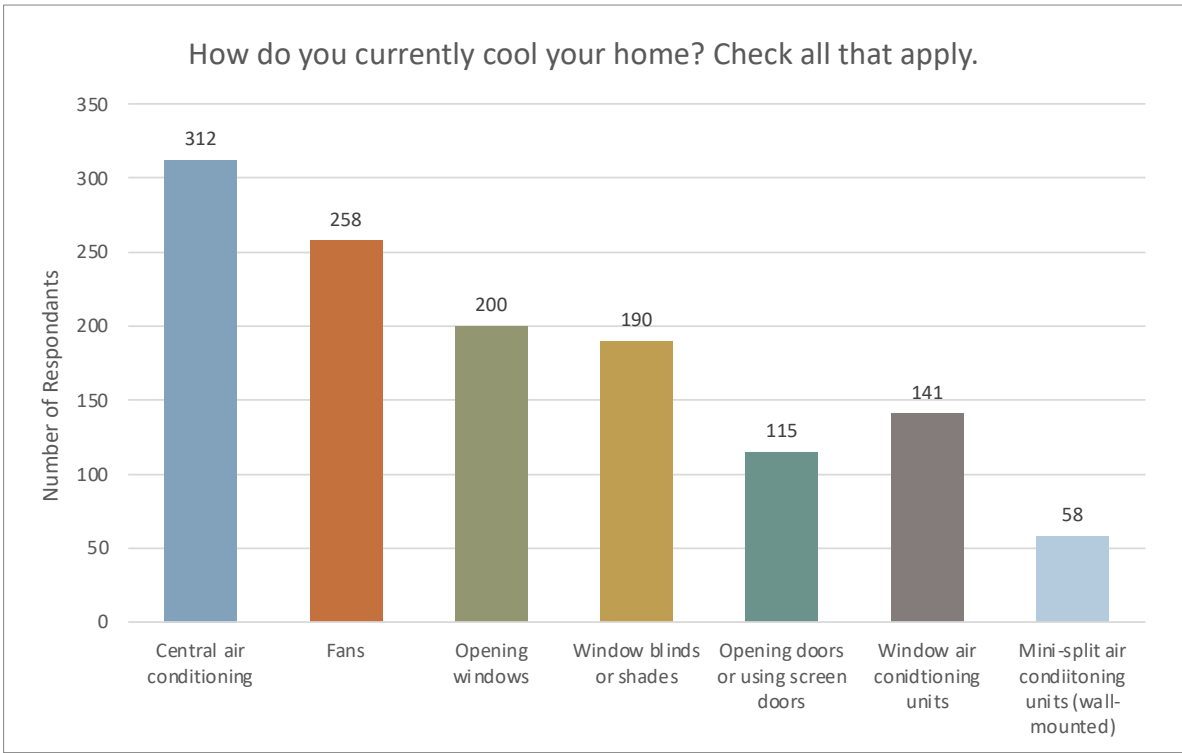


Figure 21. CAP respondents on their interest in clean or renewable energy for their home.

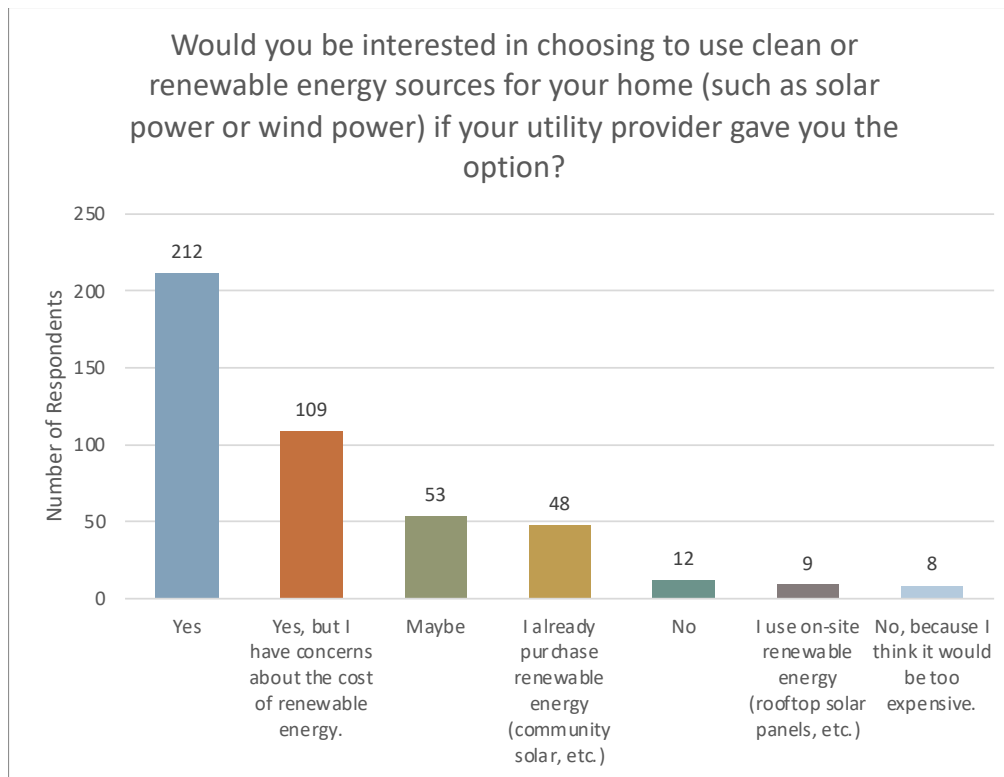
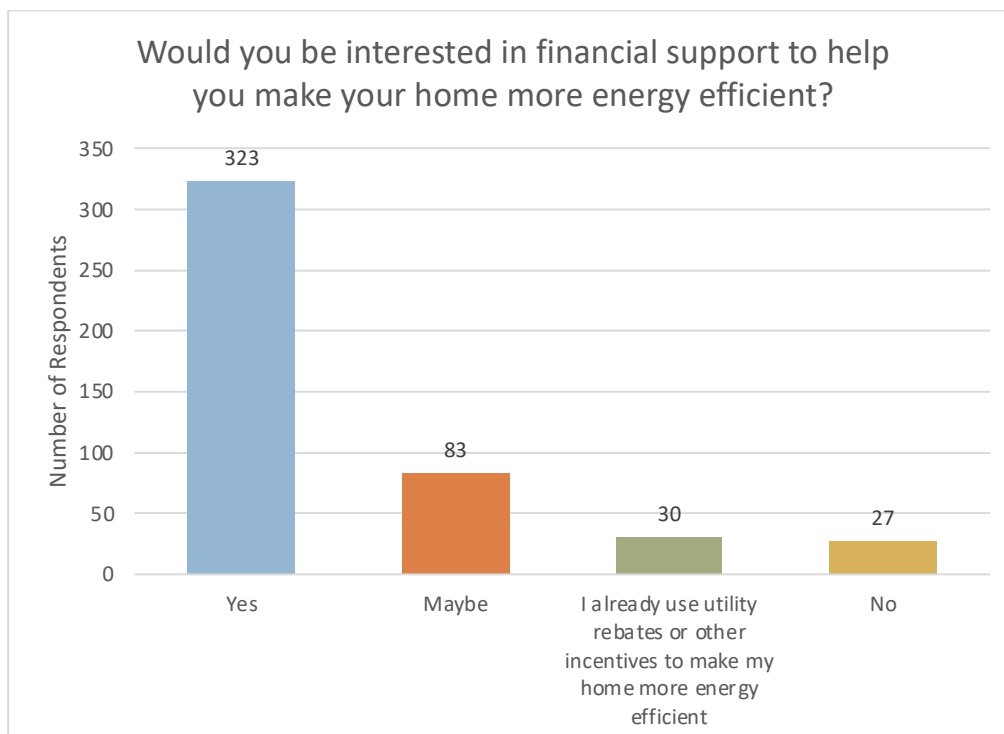


Figure 22. CAP respondents on their interest in financial support to make their homes more energy efficient.



Transportation

Figure 23. CAP respondents on their primary resource for transportation.

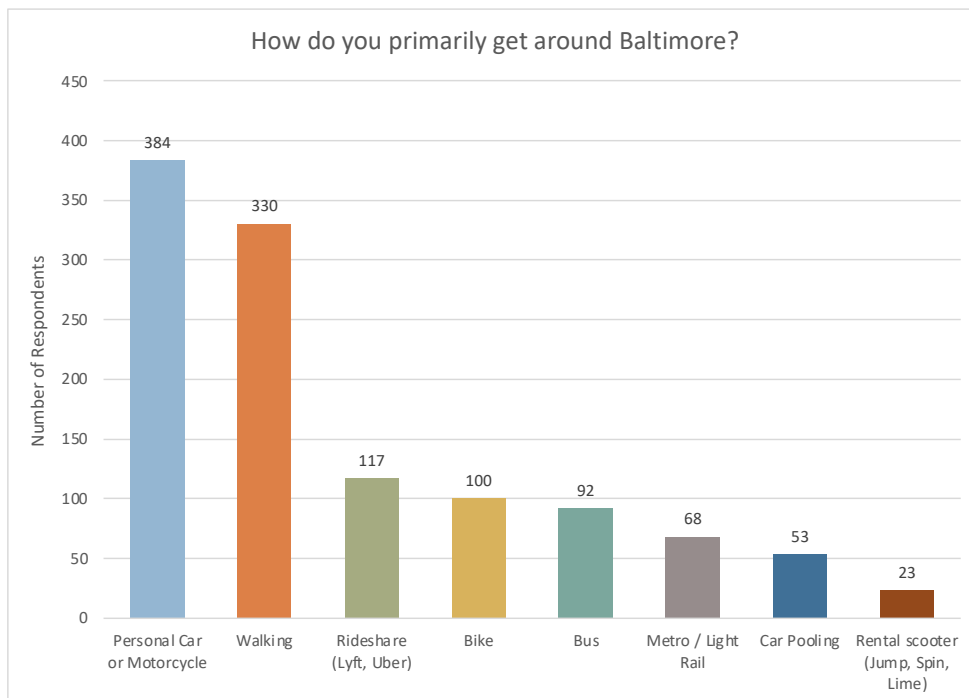
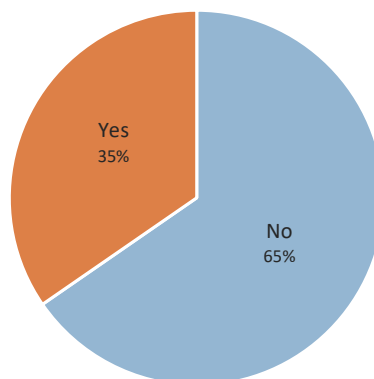


Figure 24. CAP responses to whether or not transportation payments are challenging. The question references the modes of transportation.

Is paying for transportation a challenge?



Open-ended responses on transportation costs

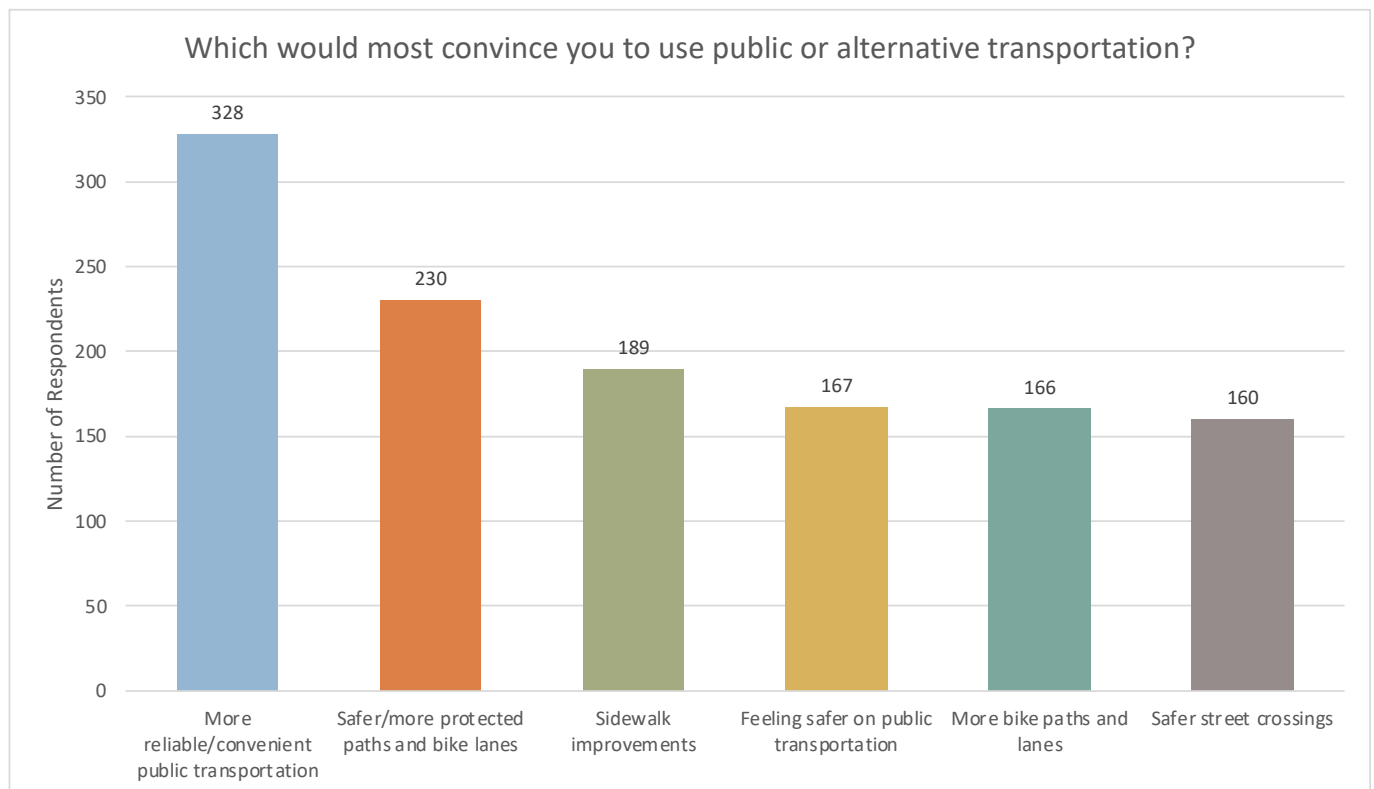
Many survey respondents cite the high cost of owning a car. The most common complaint was the rising cost of gasoline, followed by the high cost of auto insurance in Baltimore City. In fact, multiple respondents point out that auto insurance costs are higher in the City than in surrounding counties. One resident of Cameron Village explains, “Having a car, with insurance/gas/repairs, the convenience of having it sit for most of the week when it could be used if there weren't the insurance liability issues should an accident occur.” Another resident of Cameron Village makes a similar comment: “Car insurance rates for the few miles I drive, horrible! I am aware of people who could use my car while it sits idle and I won't volunteer due to insurance risks.” An Irvington resident further writes, “Gas and car maintenance are difficult to maintain. Having bus fare for the entire family is also hard.” A respondent from Fells Point also points out, “due to random vehicle violence repairs are more frequent.” Similarly, a respondent from Westport notes, “Car insurance is very expensive living in the city, and with constantly changing parking restrictions and car break ins there's a lot of fees that add up over time.”

After automobile costs, the second most common topic is the high cost and unreliability of rideshares (e.g., Uber and Lyft). Several people note that rideshare costs have increased in recent years, and the unpredictable cost of rideshares makes affordability a challenge. For example, a Patterson Park resident explains, “Ride share, the price fluctuations at different times of day. Can't budget a ride for the day.” A Pigtown resident further notes, “Ride shares are extremely expensive. Almost double the price than a ride share in DC...” Several residents explain that they have cut back on rideshare usage due to the cost. A respondent from Hoes Heights explains, “I used to take Lyft or Uber occasionally when needed but the cost has increased significantly during COVID so now I only take in emergencies.”

City residents also cite challenges with the reliability of public transportation and the availability of bike lanes. A respondent from Butchers Hill sums up many of these concerns: “Parking is always a challenge & driving here is a nightmare. Baltimore needs better public transportation to help with this issue and I believe having less cars could help reduce pollution in the city too. Baltimore is also not bike friendly at all and needs more bike lines that aren't also bus/scooter/parking lanes.” A resident of Northwood laments, “The bus is expensive given the service. Also I have an EV, but there are no chargers in our neighborhood.” Another City resident (no neighborhood specified) explains, “Bus service is a problem, which is why I purchased a car.”

Furthermore, a resident of Baltimore County who responded to the survey points out, “The bus is a challenge a lot of the time because it is a specific route, I would have to take multiple public transportation for a place that is 20 min away by car and then sometimes they do not show up or they are late.”

Figure 25. CAP respondents on improvements that could increase the appeal of alternative or public transportation.



Some less common responses for Fig. 23 include 29 respondents saying they only feel comfortable driving their personal car for transportation. 27 respondents said improvements with rental scooter access and rideshare options would most convince them to use alternative transportation.

In written explanations of what the city could improve for public or alternative transportation, many respondents have expressed that public transportation isn't very reliable. Apart from the reliability of public transit, there is also a desire for more bus stop locations.

One respondent wrote, “More convenient public transportation would be a big help because there is some bus routes that do not extend to some areas which is

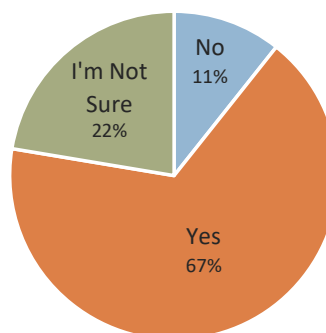
inconvenient. On the weekends public transportation shows up every other hour or not at all.” Another person said, “Buses don't always show up when they are scheduled to. They can be very unreliable and have led me to not trust the bus system and to use Lyft/Zipcar more.” Respondents also want to safe while taking public transportation. One respondent wrote, “I have heard of many negative safety experiences on the rail and bus from my coworkers.”

There were also concerns from bicyclists that Baltimore drivers are too aggressive, and it is difficult to share the road with them. One respondent wrote, “Baltimore drivers often don’t pay as much attention to bicyclists as they should, so it makes it stressful to share the road with cars.” Another person said, “Don't feel safe riding my bike on City streets due to aggressive and distracted drivers. Would happily use the bus if it were reliable, clean, and felt safe.”

Health and Well-Being

Figure 26. CAP responses on the effect of weather on their health or wellbeing

Do you think your health or wellbeing is affected by the weather in your neighborhood?



heat

air_quality

harsh_weather

flooding

trees

heavy_rain

drought

water_quality

volatile_climate

trash

infrastructure

mold

falling_trees

stay_inside

heavy_rain

trees_falling

food_selection

insects

no_problems

soil_quality

humid

green_spaces

invasive_species

damages

health_condition

incinerator

police

damping

allergies

heavy_rains

cold

Many of the survey respondents note that extreme weather impacts their physical well-being. For example, several residents cite problems with asthma. An Edmonson Village resident explains that, “Extreme hot or cold makes it hard for me to breathe.” Several respondents also note a connection with allergies. Specifically, a Hollins Market resident points out that “Higher temperatures leading to earlier blooming of trees and flowers leads to an earlier and longer allergy season for me.” Other noted physical impacts include fatigue and difficulty sleeping. According to one respondent from Seton Hill, “I have dysautonomia which causes me fatigue and dizziness. This is worse when it's extremely hot or cold. When the temperature is in the high 80s or above, I can't spend more than 10-15 minutes outside without feeling fatigued.” Another resident of Charles Village says “When it's too hot, it's hard to complete daily tasks and activities, or even sleep. This can affect my mood or basic needs and responsibilities.” Hot weather and other climate changes have also been associated with air quality problems, and several survey respondents express concern about the resulting health problems. A Locust Point resident writes, “As someone who likes to garden, hike, bike, and enjoy the outdoors, air quality can keep me inside or heavily dependent on my inhaler.”

Changing weather can also affect mental well-being. For example, numerous respondents explain that extreme hot or cold negatively affects mood. Several respondents also find it difficult to focus during very hot weather, particularly when the availability of air conditioning is scarce.

Several respondents explain that extreme heat, cold, and intense storms make it difficult to complete necessary day-to-day activities. For example, public City schools are occasionally cancelled when temperatures are hot or cold, and the lack of adequate heating and cooling makes it difficult for students to focus. Hot weather also affects peoples' commute, particularly for people who must wait outdoors for public transit, people who walk, or people who cycle. One Patterson Park resident laments, "Lack of trees and shade on extremely hot days make me feel weak. I walk and travel by bus. Not all bus stops have protection from the sun." Other respondents note that hot weather can make some parts of a building unlivable or unusable. A Hoes Heights resident explains, "Our apartment does not have central AC, so on days when it is very hot, we huddle in the one bedroom that has a good window unit and hang out in there most of the day with our young children."

Many residents note that extreme weather limits access to the outdoors. Hot weather is exhausting and puts a limit on the activities one can do outside. A Highlandtown resident explains, "The community doesn't have many green spaces. While we have access to Patterson Park, Residents east of S. Conkling Street have to walk several blocks to access green spaces. For me, this means that I am limited to outside exercise based on the weather. This limits my outside exercise to either early morning or dusk." Relatedly, an Oakenshawe resident says, "Now, I stay indoors in the summer as much or even more than I do in winter. I never had issues with heat exhaustion and trouble staying hydrated before the last few years." Heat can also make it difficult to exercise. An Old Goucher resident writes, "The heat and the air quality affect my ability to be outside, which has impacts in my mental and physical health."

Several respondents point to the interactions between weather, the built environment, and well-being. Intense storms cause water damage and mold, which impact well-being; these impacts are geographically widespread across the city. For example, a Hampden resident explains, "Heavy rains are causing leaks in my home; likely because my gutters are overcapacity when the volume of rain is too high, so the water is getting into the building envelope." A Westport resident says, "My room is the basement and constantly floods, so I have to sleep in a musty, molding room." A Govans resident notes, "When we have strong storms, the sewer/storm drains on our street back up into our house as well as the other 3 houses in our row house group," and a Hamilton resident writes "More extreme weather, like rain, has impacted the foundation of my house and is causing financial and mental distress to

repair.” Numerous respondents note high electricity bills in summer due to increased cooling needs. Neighborhood trees are also mentioned several times. Respondents in neighborhoods with few trees explain that the lack of trees exacerbates heat. Still other residents who live in neighborhoods with large trees express concerns that these trees could cause damage during intense storms. A City resident (no neighborhood listed) states, “Severe thunderstorms are becoming more common and because I live in a forested neighborhood it causes trees to fall and we often have to shelter in the basement. It can be very anxiety inducing.” A Hamilton resident further explains, “More violent storms have led my neighbors to fear what ‘might’ happen to trees, and they’ve removed canopy trees over that fear.” A Hanlon resident also laments, “Almost all of the street trees on my street and nearby ones have been cut down and no new trees have been planted. We spend less time outside because its hot and there’s less shade. The big trees brought more birds to the neighborhood too - I miss seeing more types of birds in the neighborhood and more birdsongs in the morning.”

Figure 28. CAP responses to the negative effect of housing on physical health

Do you think your physical health is negatively affected by the neighborhood or housing you live in?

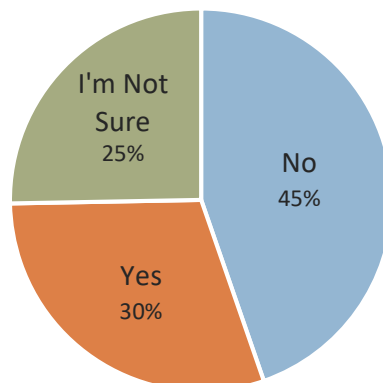


Figure 29. A word bubble summarizing the most common words in the survey question: “Please explain if or how you think your physical health is negatively affected by your housing or neighborhood.”



Open-ended responses on housing, neighborhood, and physical health:

Several respondents noted that they love their house or their neighborhood and many survey respondents did not record a response to this question. With that said, many residents do cite problems with their house or neighborhood. Crime and safety are common themes. For example, an Edmonson Village resident explains, “Very stressful hearing gun shots, worrying about reckless drivers hitting my vehicle.” A Union Square resident writes, “Every once in a while when there is a murder or shooting, you simply don't feel safe going for an early morning or late night jog.” According to a Reservoir Hill resident, “Neighborhood tensions can make it challenging to leave my home. I get less exercise outdoors than I use to because of being nervous about a recent increase of violent crime in my neighborhood.” Similarly, a resident of Butchers Hill reflects, “The crime and gun violence in Baltimore City and our neighborhood has given me anxiety and I don't feel safe walking alone as a woman sometimes.” A Greenmount West resident further summarizes a common sentiment, “Concentrating poverty in a neighborhood makes for a miserable experience. There is no upward mobility for people trapped in

this system.” In addition to concerns about violence, several respondents note concerns about open-air drug use and drug markets in their neighborhood. Greater access to parks, better pedestrian infrastructure, and improved cycling infrastructure are also common themes. A Hampden resident writes, “Cars speed on my street regularly, and there isn't a crosswalk at the complicated intersection next to my house. Pedestrians and cyclists are hit by cars regularly. The DOT infrastructure doesn't meet ADA and it is unsafe to be a pedestrian in my home, which is adjacent to TWO parks.” A Hardwood resident also notes, “If streets were safer for cyclists and pedestrians, I would use those modes more often and be more active.” A Roland Park resident explains, “We need to improve walkability in our neighborhoods because it will improve our community health in the long-term.”

Several residents express a strong desire for better air quality and note concerns about the Wheelabrator Trash incinerator and air pollution emissions from traffic. Several respondents also note a desire for more tree cover. Furthermore, a handful of survey respondents note a lack of food options in their neighborhood. A few also point to problems with mold in their house or apartment, usually caused by flooding and sewer backups.

Figure 30. CAP responses to the effect of housing on mental health

Do you think your mental health is
negatively affected by the
neighborhood or housing you live in?

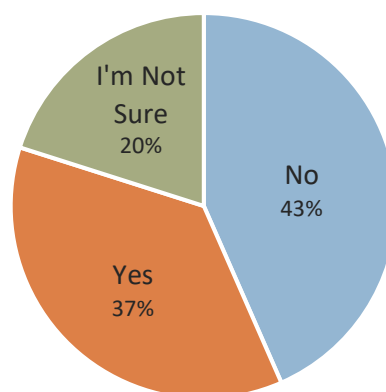


Figure 31. A word bubble summarizing the most common words in the survey question: " Please explain if or how you think your mental health is negatively affected by your neighborhood or housing."



Open-ended responses on housing, neighborhood, and mental health:

Survey respondents most commonly cite stress and anxiety over crime, particularly violent crime, robberies, and drugs. One Franklinton resident explains, "Open air drug market. Having this activity in my community makes me feel unsafe and not willing to support community businesses that cannot control this activity on their property." A Fells Point resident notes, "We were involved in 3 house break-ins. We have an alarm system, but I still have anxiety about leaving my animals/house." Furthermore, a resident in Bridgeview-Greenlawn writes, "There is a stress-inducing issue in my neighborhood concerning the growing presence of violent drug gangs. They are robbing pedestrians who walking around in the neighborhood, and there have been several shootings over the last few years. It makes me frightened about stepping out of my house."

Some respondents also noted stress and anxiety about the overall condition of their neighborhood. A Hanlon resident writes, "Frankly, my immediate neighborhood looks ugly - lots of rental housing that the landlords had removed bushes and trees from their properties. I remember how it used to look - big trees and actual plantings in yards, it was really nice." Several respondents also note that trash is a source of stress. A Hampden resident writes, "It's the little everyday things. For example, I see people drive through some neighborhoods and throw trash out the

windows of their cars. What message does that send to the people living in these neighborhoods?”

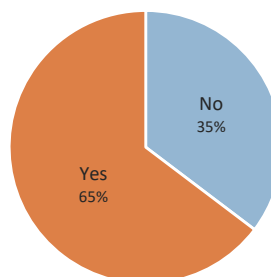
A handful of respondents want a stronger feeling of community. A Hampden resident notes, “The COVID-19 pandemic has been a challenge. It's harder for everyone to socialize and build community.” A Hollins Market resident says, “I wish there were a stronger sense of community here.

Table 1. CAP responses on neighborhood changes that could improve their overall well-being.

Which of the following changes to your neighborhood do you think might improve your physical and mental health?	Number of Respondents
Safer streets (traffic calming, better lighting)	257
Cleaner, more vibrant streets	253
More street trees/shade	228
More community-managed green spaces (community garden, pocket park)	221
Cleaner air	188
Improved parks and nature trails	184
More small businesses	183
Increased access to healthy food options	163
Fewer vacant lots/abandoned housing	144
Increased police presence	103
Access to healthcare resources	84

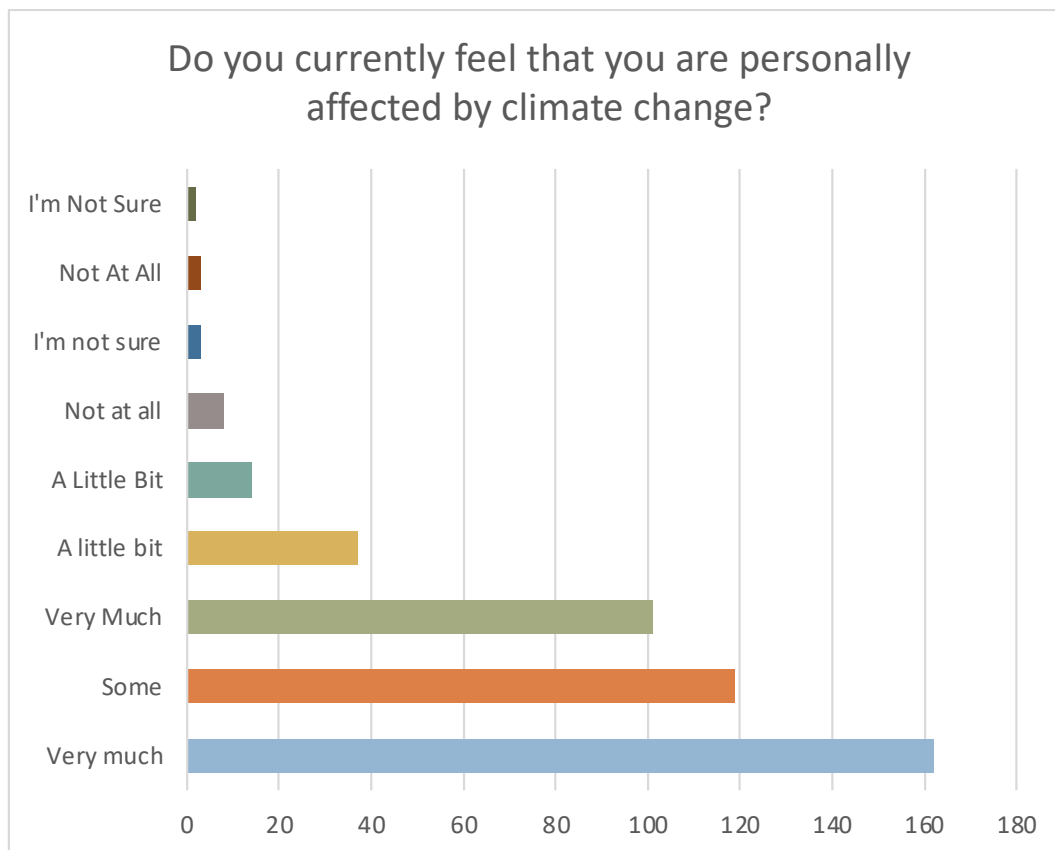
Figure 32. CAP interest in future opportunities for paid workshops by the Baltimore Office of Sustainability

Would you be interested in participating in paid workshop opportunities?



Climate Change

Figure 33. CAP responses, given the definition, "Climate change is the long-term increase in global temperatures which is leading to more extreme weather, sea level rise, and other related negative impacts, including flooding and poor air quality."



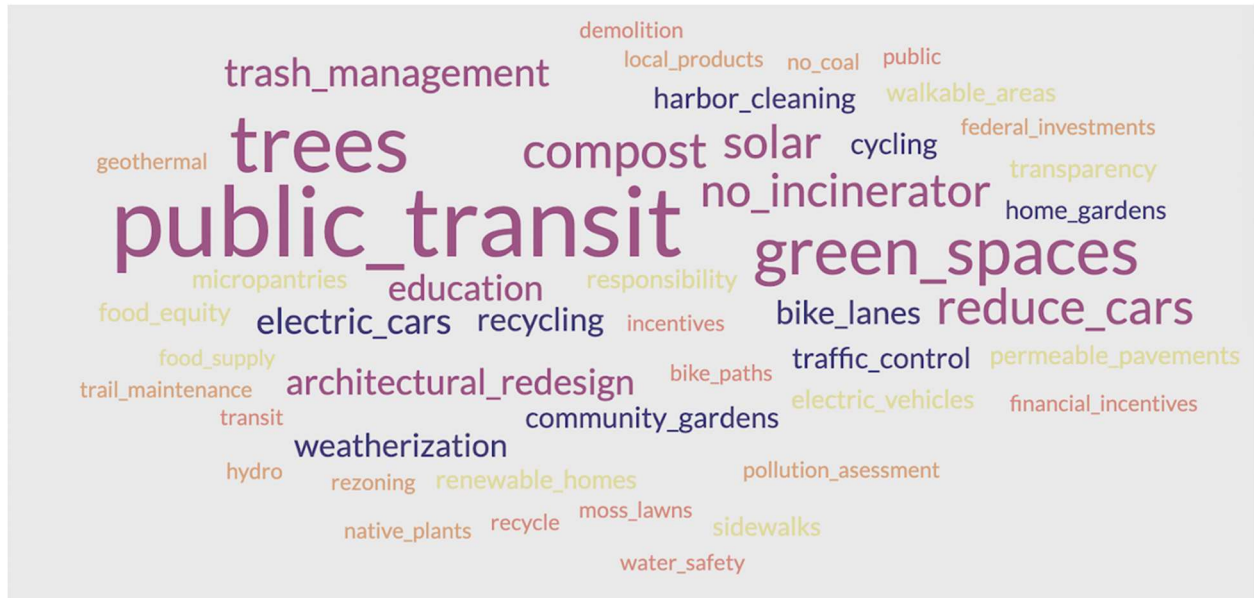
government_aid
volatile_climate
storms
drought
heat
cold
heavy_rain
water_quality
runoff
health_condition
existential_crises
trees
damping
shorter_winters
fires
food_shortage
infrastructure
heavy_rains
habitat_loss
incinerator
green_spaces
government_aid
volatile_climate
gas_prices
rising_prices
anxiety
insects
community_segregation
sea_levels
plant_growth
stress
allergies
mold
volatilization

Do you feel that you understand what climate change is and how it might affect you?

A bar chart with the y-axis labeled 'Number of Respondents' ranging from 0 to 450 in increments of 50. The x-axis shows five categories of understanding: 'Yes', 'Kind of', 'Somewhat', 'No', and 'not at all'. The bars are colored blue, orange, green, yellow, and teal respectively. The values for each bar are 382, 39, 19, 8, and 8.

Understanding Level	Number of Respondents
Yes	382
Kind of	39
Somewhat	19
No	8
not at all	8

Figure 36. A word bubble summarizing the most common words in the survey question: "If you have opinions on climate change in Baltimore and thoughts about actions that the city should take to achieve carbon neutrality, please share here."



Open-ended responses on climate change and further city action:

Most residents feel like they will be more affected by climate change in future years, making note of rising temperatures and sporadic weather. When extreme weather strikes, residents notice the jarring differences of infrastructure quality and green spaces available across different neighborhoods.

One resident says, "Quality of air, water, and life in general have been depreciated. Because of our countries 100+ year initiative to have racist policies, communities like mine have been designed to have bad infrastructure, limited access to green spaces, and deteriorating quality of life. As a Black man, I have personally seen the difference in how communities in majority 'White or Caucasian' neighborhoods are invested in versus the communities that I live and my people (ADOS) can afford to live in. This design of our community generally leads to worse outcomes for life and general progress, which predictably means, my community is more susceptible to climate change issues."

Climate change has also begun to dictate whether it's safe for residents to enjoy outdoor activities. Poor air quality, thunderstorms, and extreme heat have all contributed to keeping residents indoors, where they might not have the resources to mitigate the effects. One person says, "On poor air quality days me and my children have to stay in. Moving around outdoors can be uncomfortable. Flooding basements smell bad and are had to clean because some don't have sump pumps or doors to push the water out."

The unpredictability of the weather has also affected the mental health of respondents. One Federal Hill resident writes, "The anxiety of anticipating impending tragedies as a result of climate inaction takes a significant toll on my mental health and inner peace." Those respondents who have a greater understanding of environmental health have expressed more anxiety surrounding our future with climate change. Another respondent says, "I am a young person working in the environmental space and am worried about how climate change will affect me and younger generations."

Regarding the question in Fig. 36, respondents want the City to take action by investing in more renewable and eco-friendly resources. Additionally, they want the city to create better trash disposal policies, plant more trees, and make public transit more reliable. One respondent created a list of suggestions saying, "Complete the Baltimore Greenway Trails Network. Fully fund parks and forestry. Make a sustainability focused cabinet position with direct access to the mayor. Use federal infrastructure dollars to build a robust transit network. Create job training programs to rehab houses make the city ready to accept an influx of new residents."

Another person suggests, "Improve public transit, more public food gardens, more free cover in low-income areas, convert parking lots of unused retail/industrial centers into green space to absorb run off, increase amount of protected bike lanes & connect lanes." While residents understand that these changes can't be made overnight, their message to the Baltimore City government is to prioritize environmental health.

Appendix

The tables and figures in this appendix are meant to represent the breakdown of CAP responses by race. As mentioned in the survey demographics, the racial background of survey respondents is different from that of the City writ large. Please keep this in mind when looking at the data.

Table 2. Number of CAP respondents and their educational attainment by race.

Race	Bachelor's Degree	Master's Degree	Doctoral Degree	Professional Degree	Some College	Associate degree	High School
White	64	4	14	13	11	4	6
Black	31	19	4	4	30	3	14
Asian	3	3	0	0	0	0	0
Native American or Alaskan	0	1	1	0	2	0	0
Latino or Hispanic	2	2	0	1	0	1	1
Middle Eastern or North African	3	0	1	0	0	0	0
Native Hawaiian or Pacific Islander	0	1	0	0	0	0	0

Table 3. Number of CAP respondents and their household income by race.

Race	Under \$15,000	\$15,000-\$40,000	\$40,000-\$75, 000	\$75,000-\$145,000	\$145,000-\$200,000	Over \$200	Prefer Not to Say
White	7	24	81	109	29	26	23
Black	8	24	37	18	3	3	21
Asian	0	1	0	4	0	1	0
Native American or Alaskan	1	0	1	0	2	0	0
Latino or Hispanic	0	3	1	3	1	0	0
Middle Eastern or North African	0	0	0	4	0	0	0
Native Hawaiian or Pacific Islander	0	0	0	1	0	0	0

Figure 37. CAP response breakdown of Fig. 26 by race.

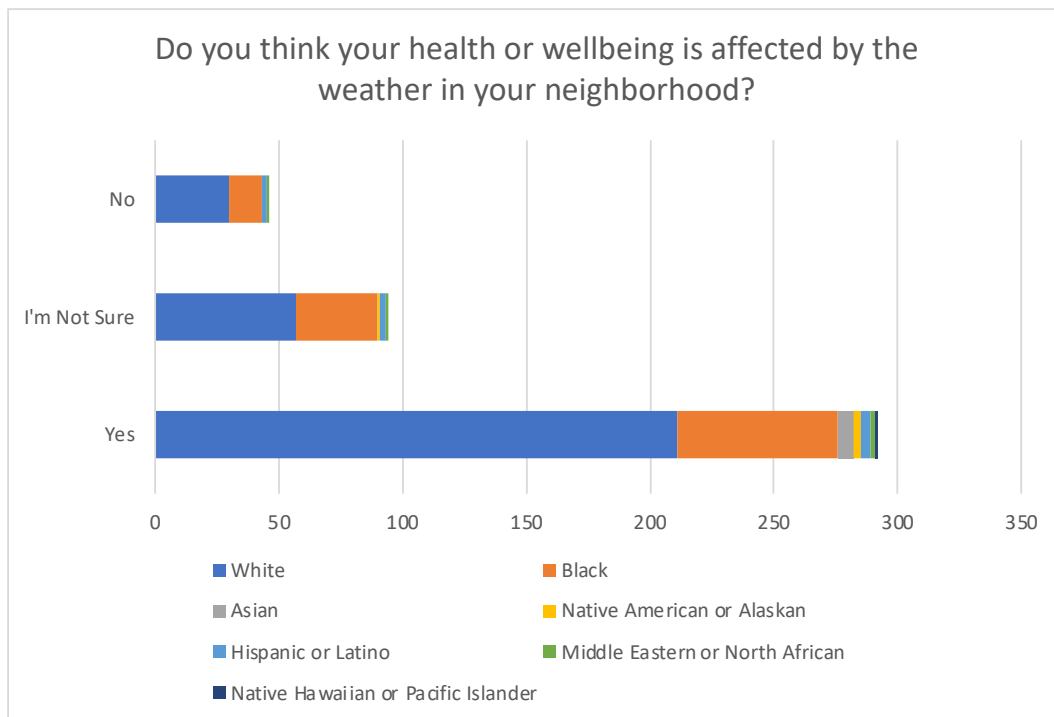


Figure 38. CAP response breakdown of Fig. 16 by race.

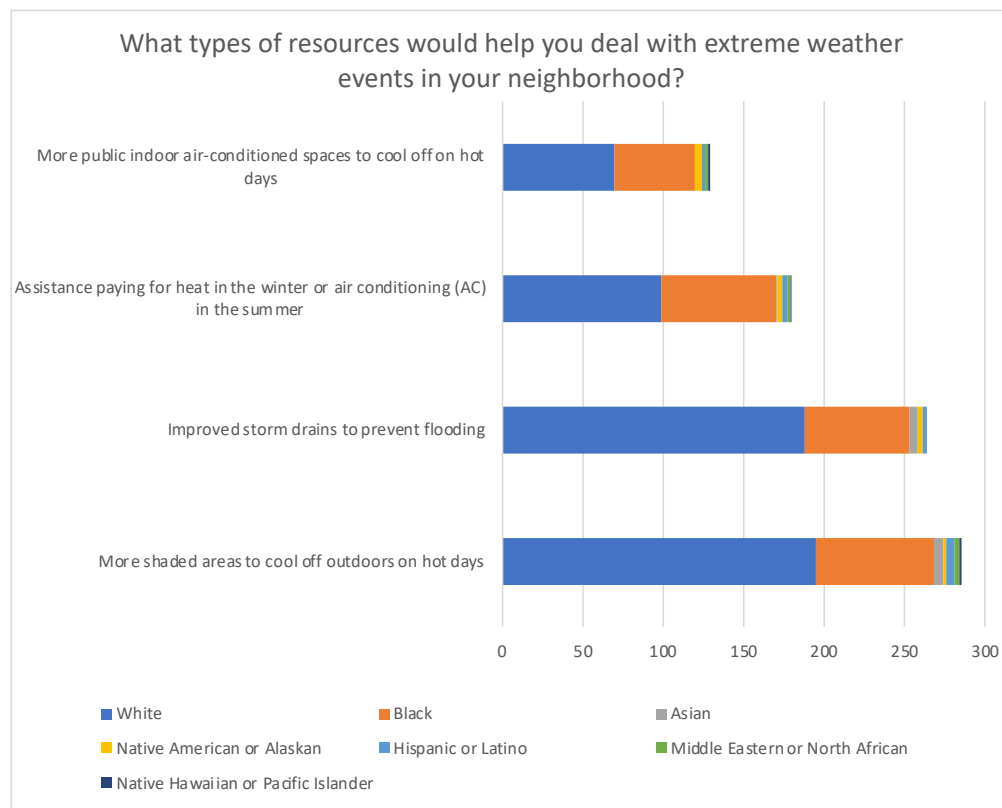


Figure 39. CAP response breakdown of Fig. 15 by race.

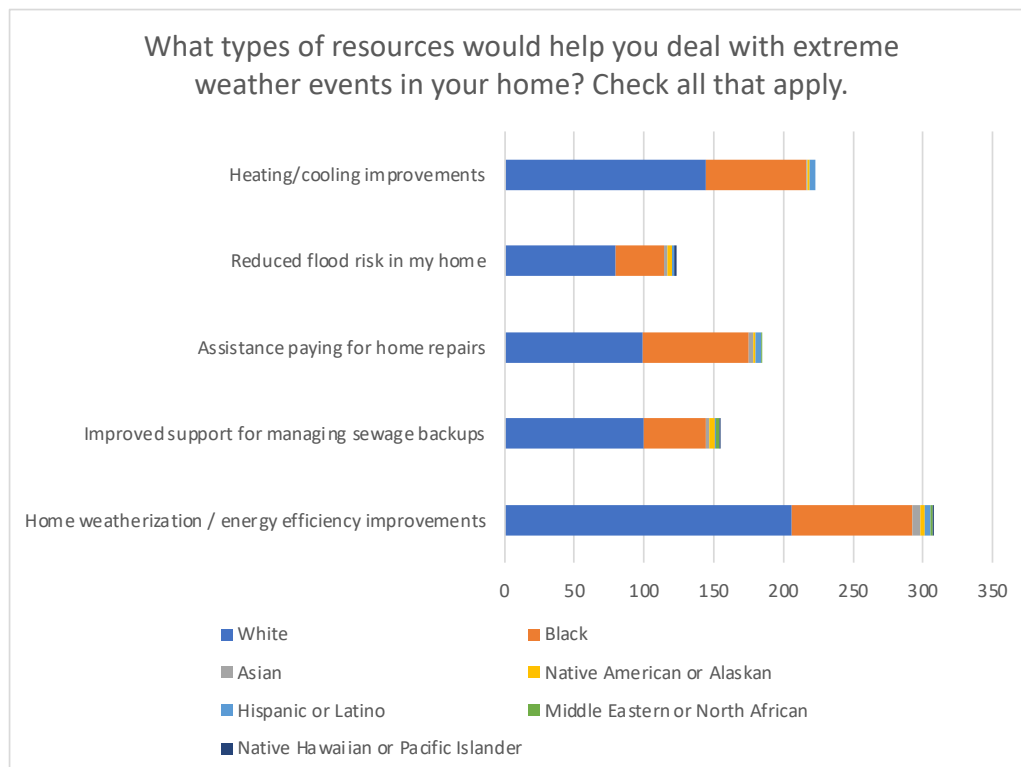


Figure 40. CAP response breakdown of Fig. 18 by race.

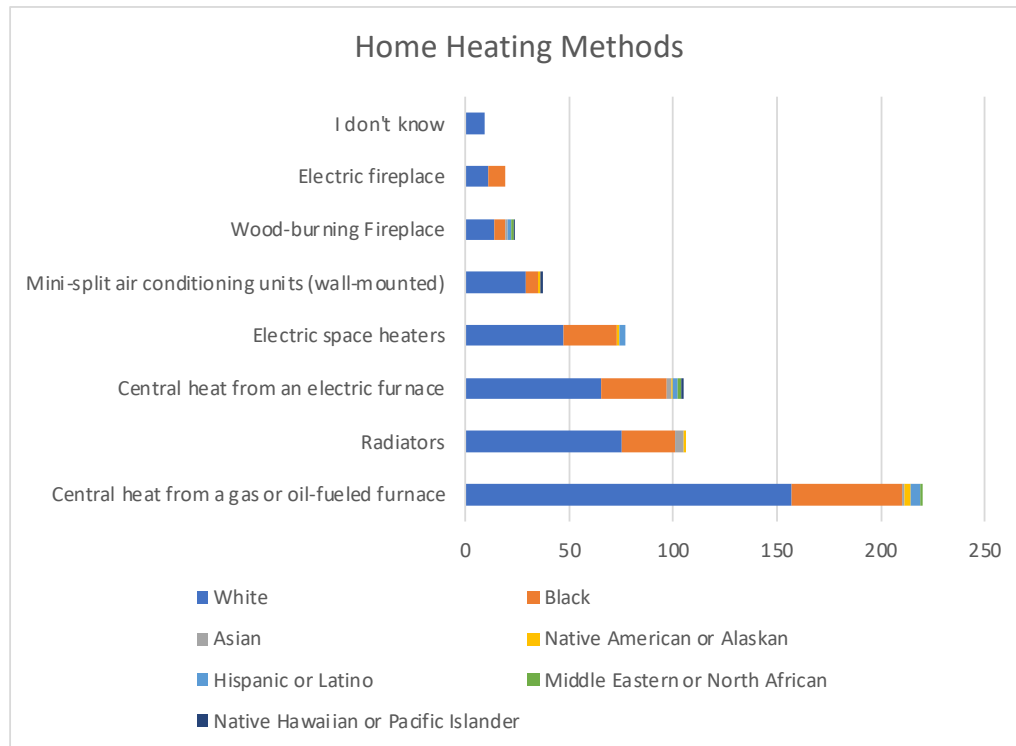


Figure 41. CAP response breakdown of Fig. 19 by race.

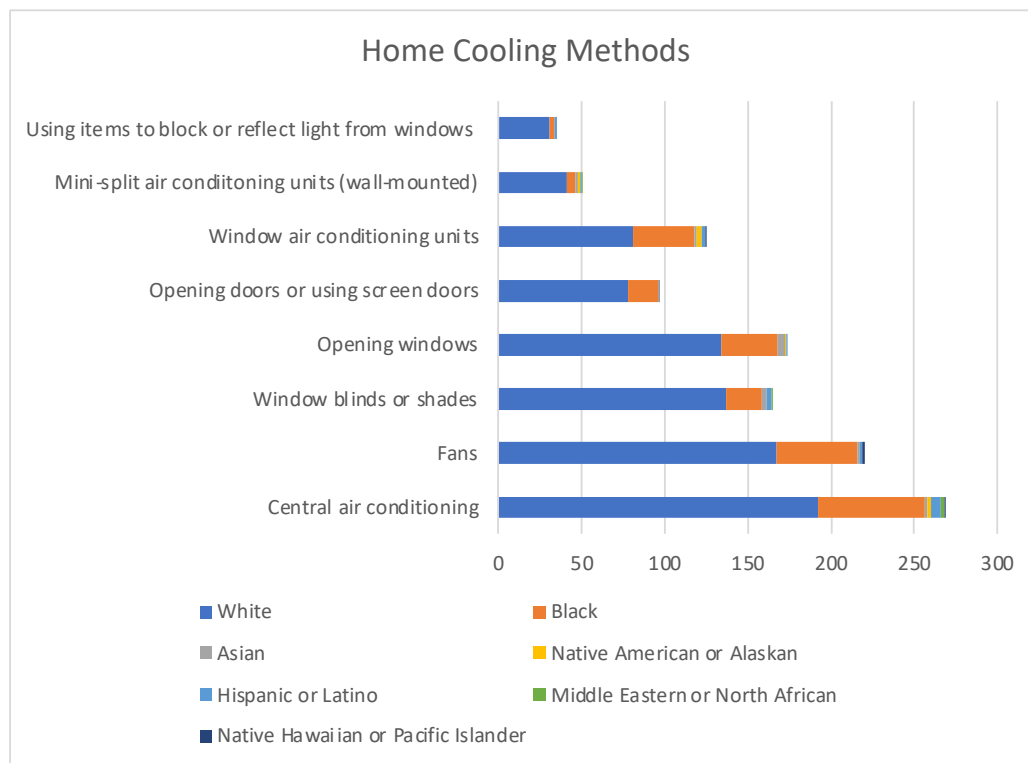


Figure 42. CAP response breakdown of Fig. 13 by race.

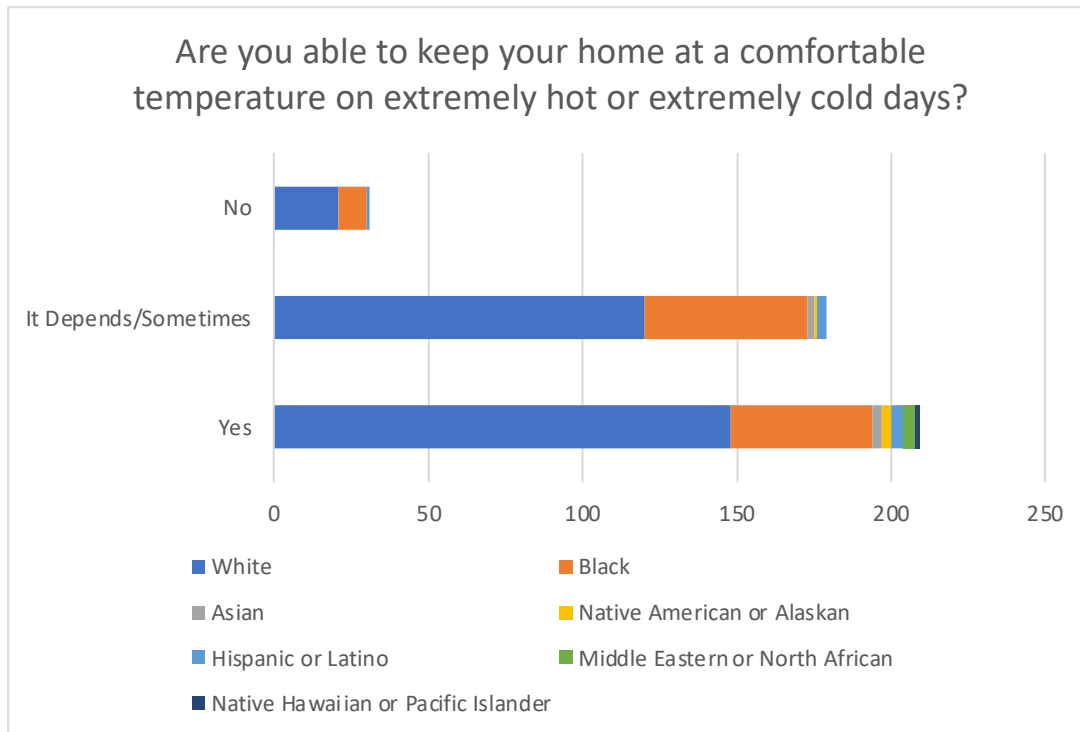


Figure 43. CAP response breakdown of Fig. 14 by race.

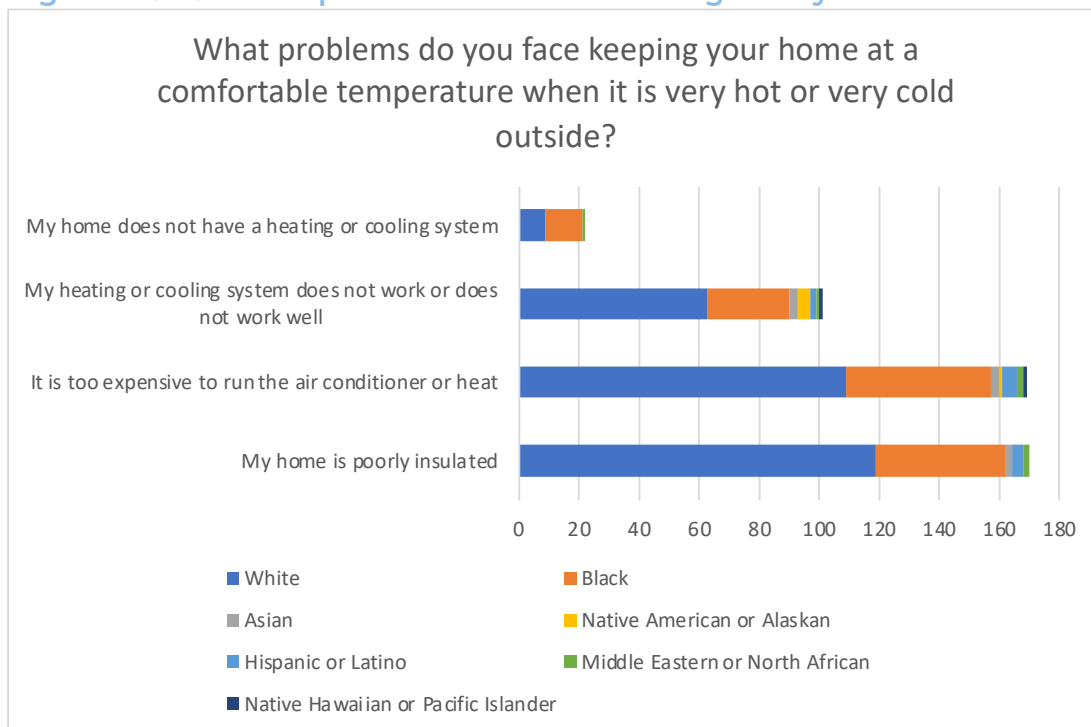


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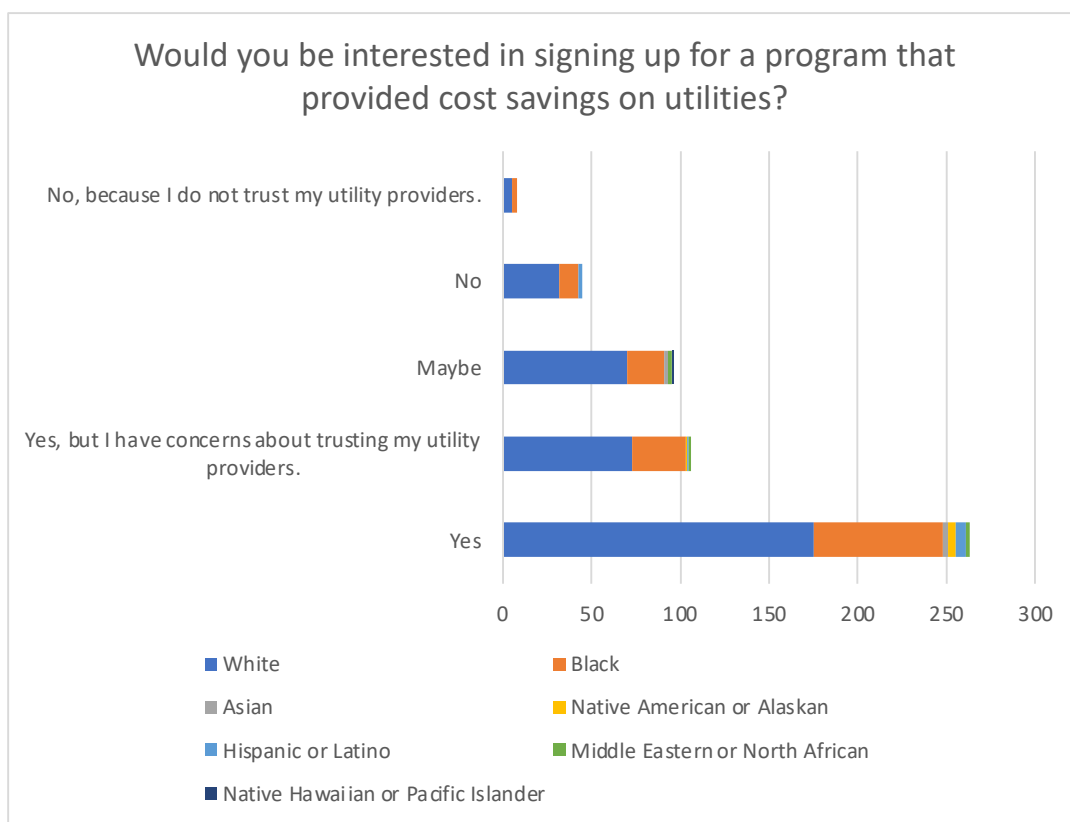


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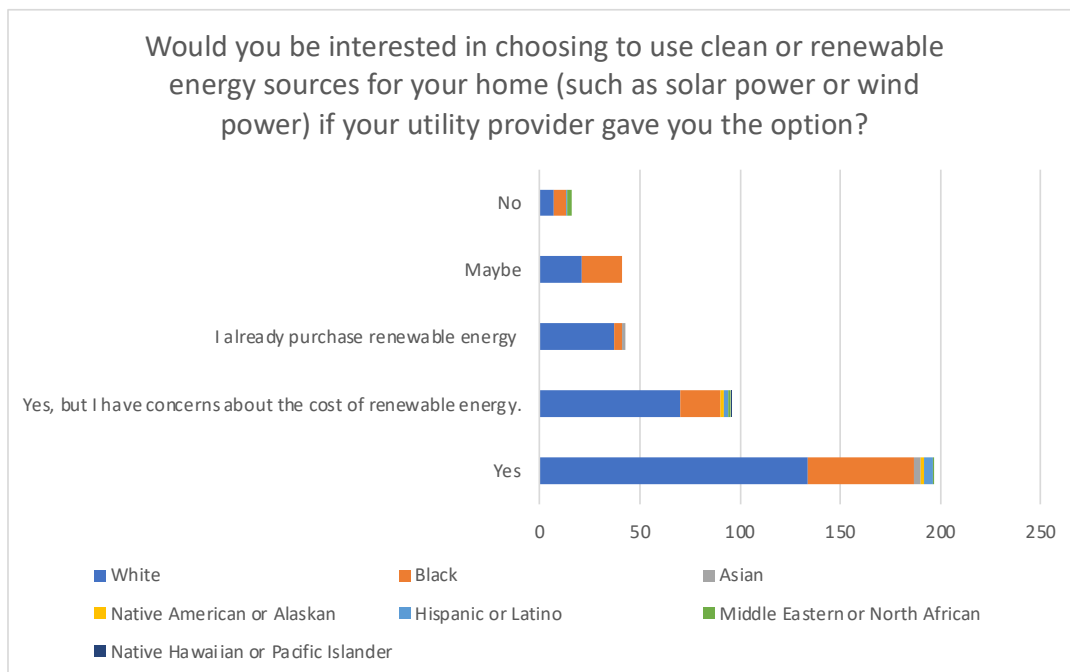


Figure 46. CAP response breakdown of Fig. 22 by race.

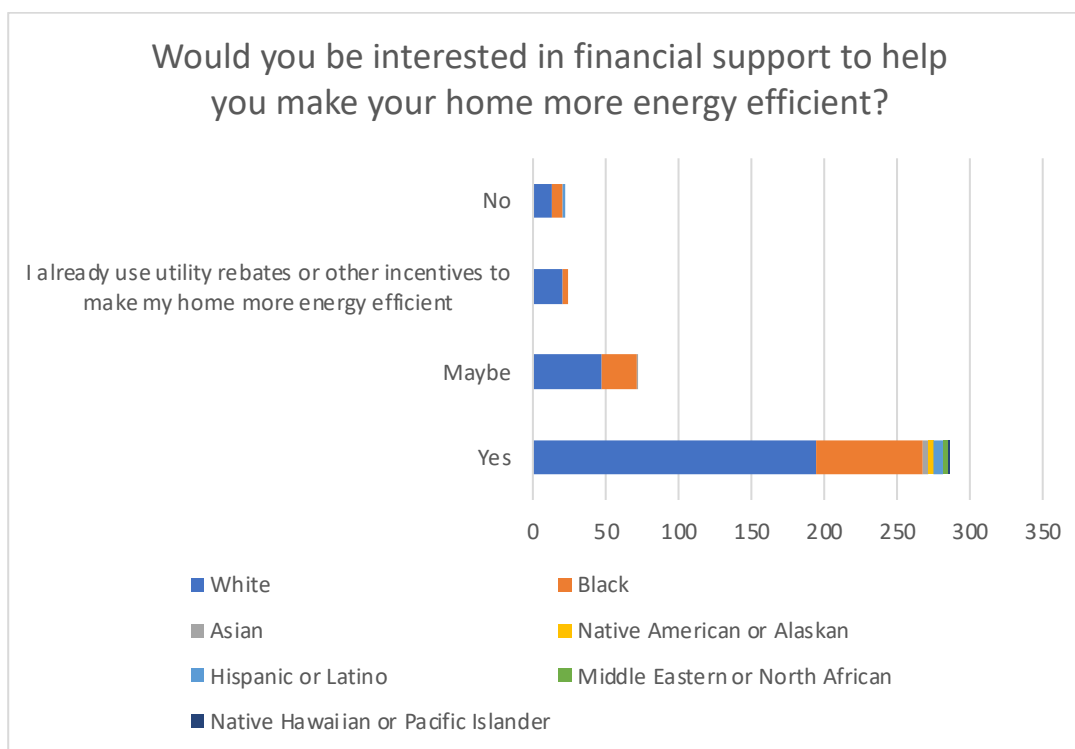


Figure 47. CAP response breakdown of Fig. 12 by race.

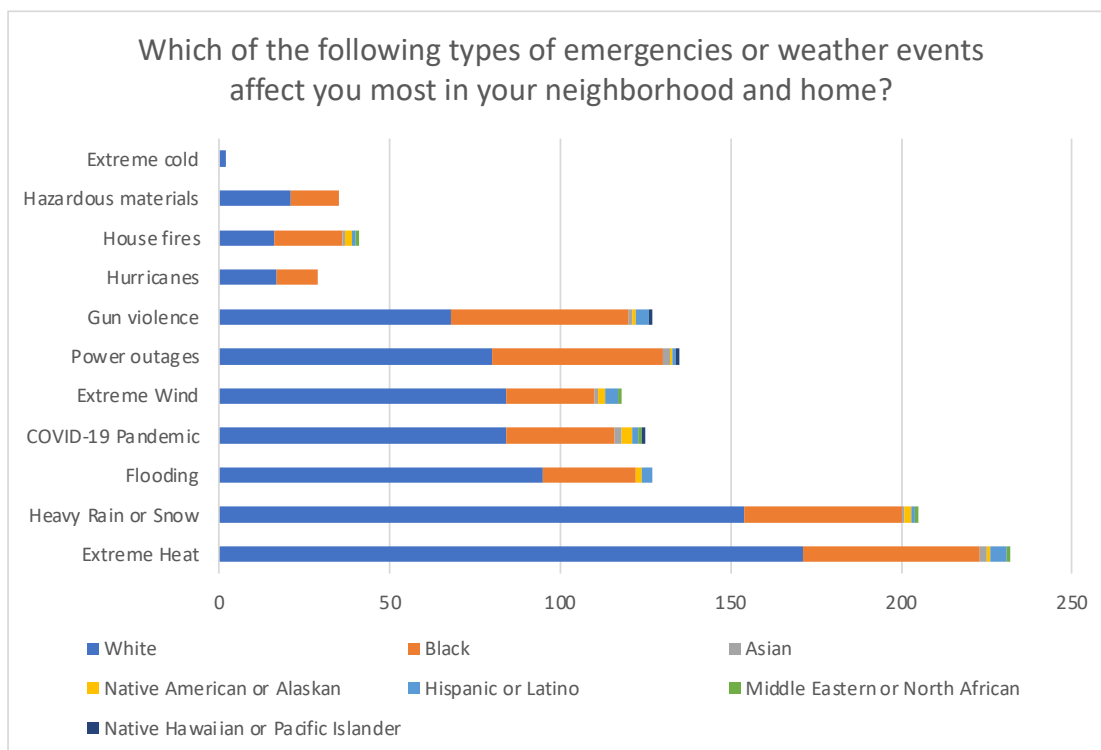


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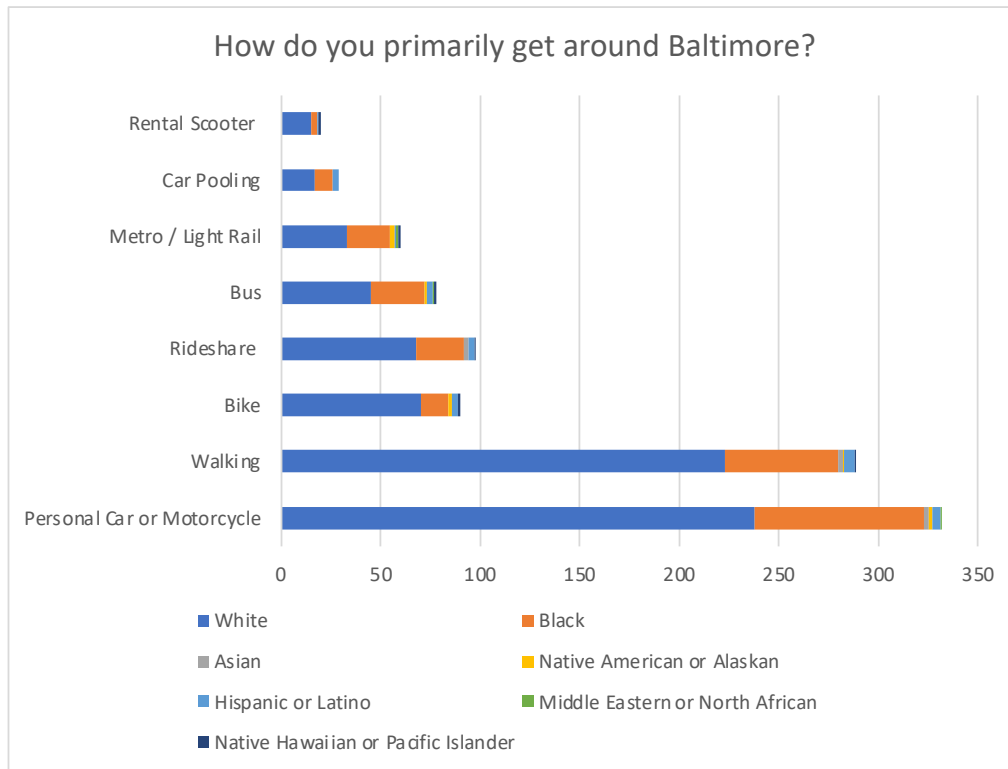


Figure 49. CAP response breakdown of Fig. 17 by race.

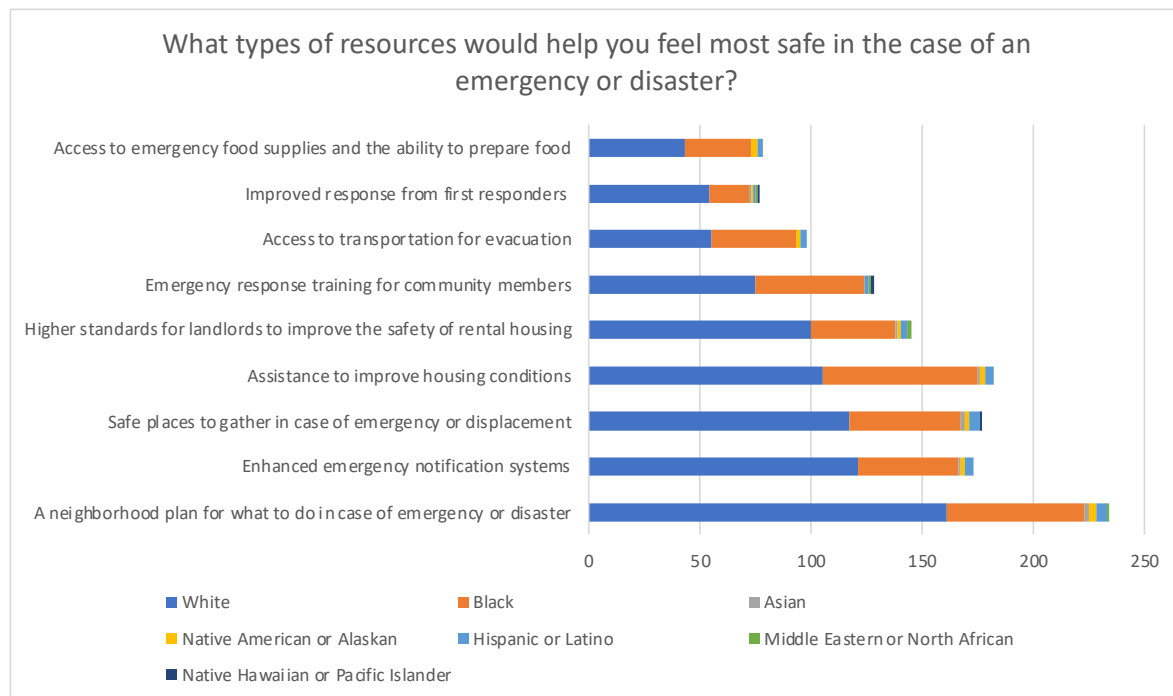


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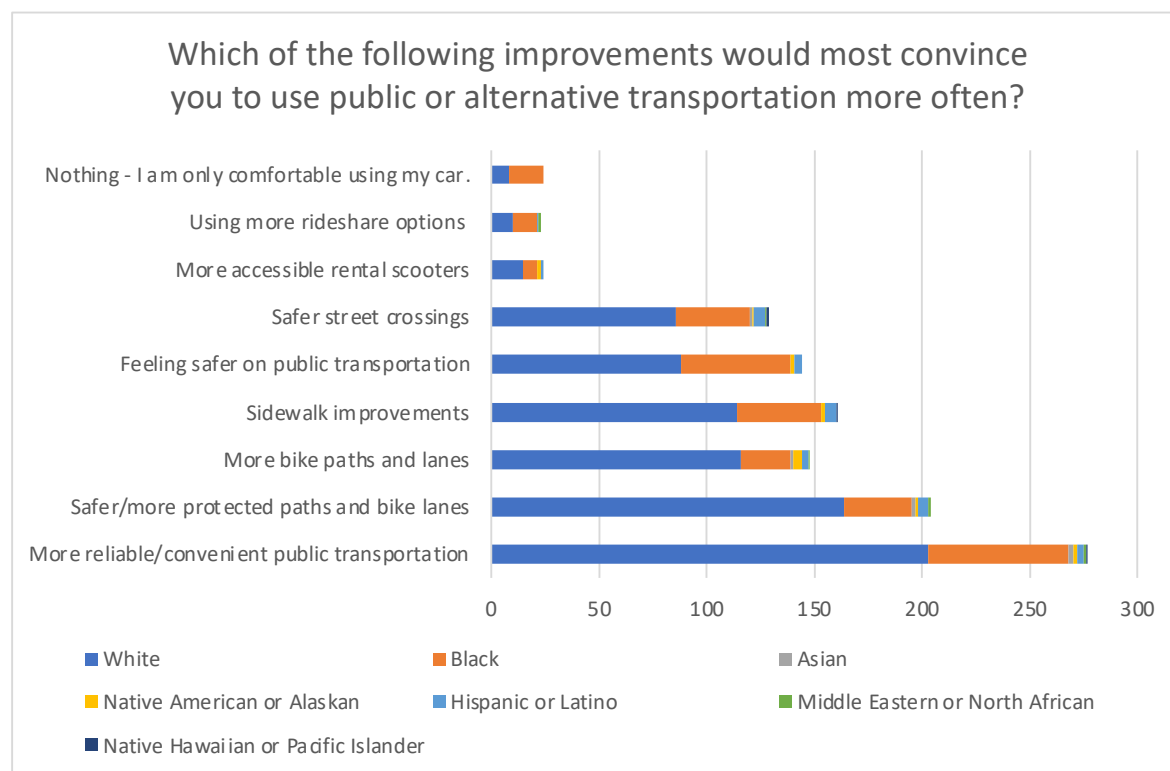


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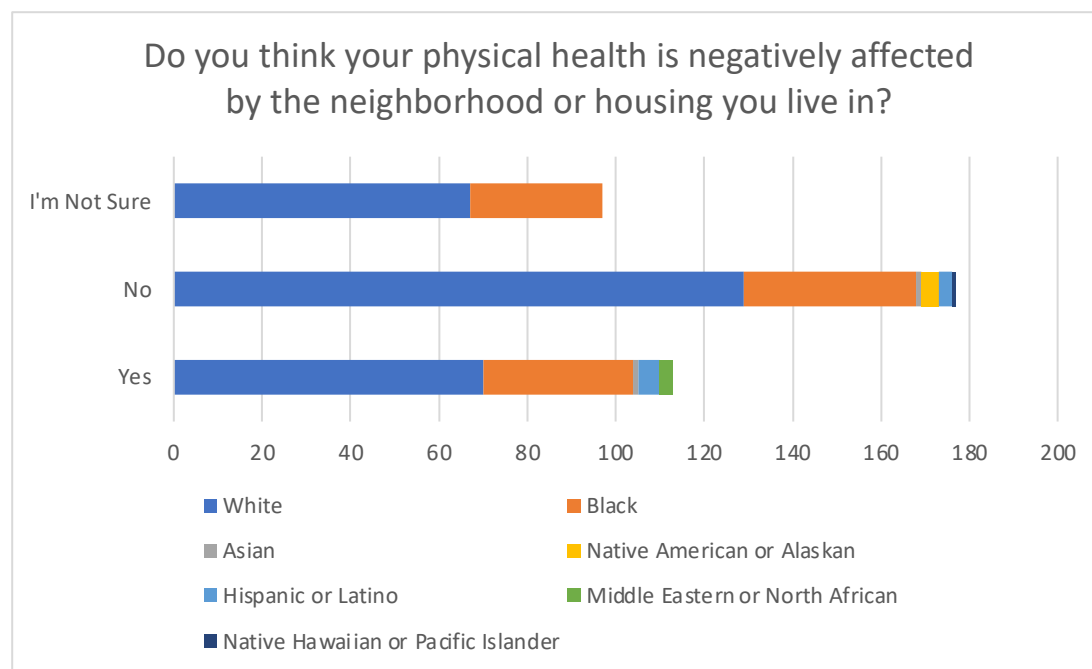


Figure 52. CAP response breakdown of Fig. 30 by race.

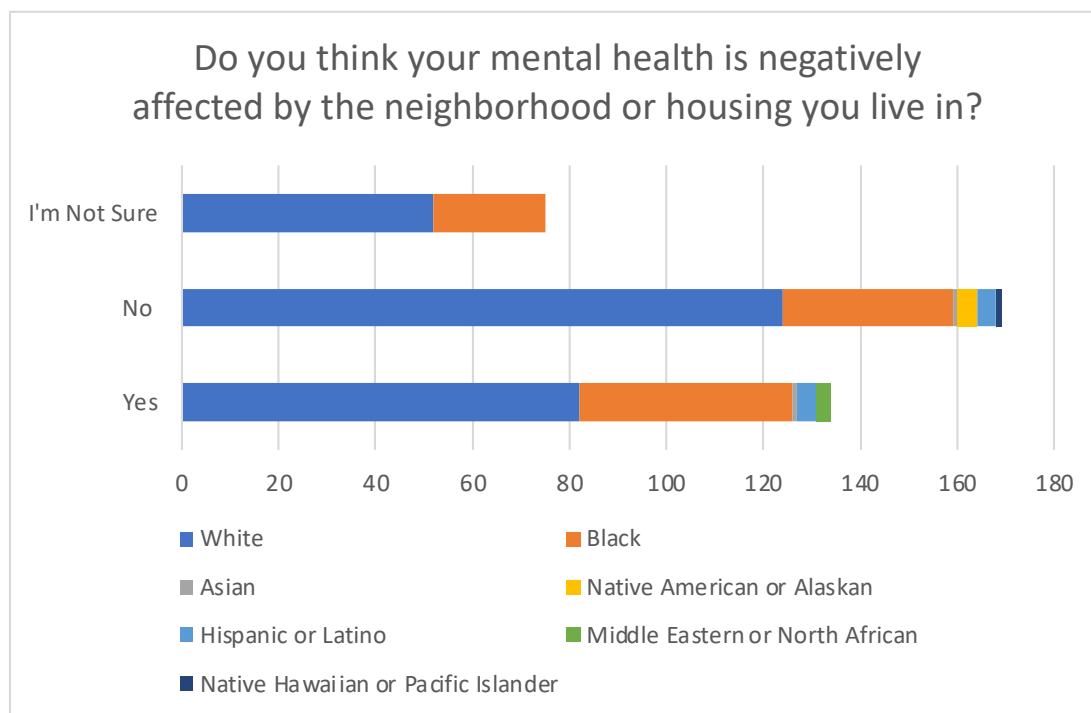


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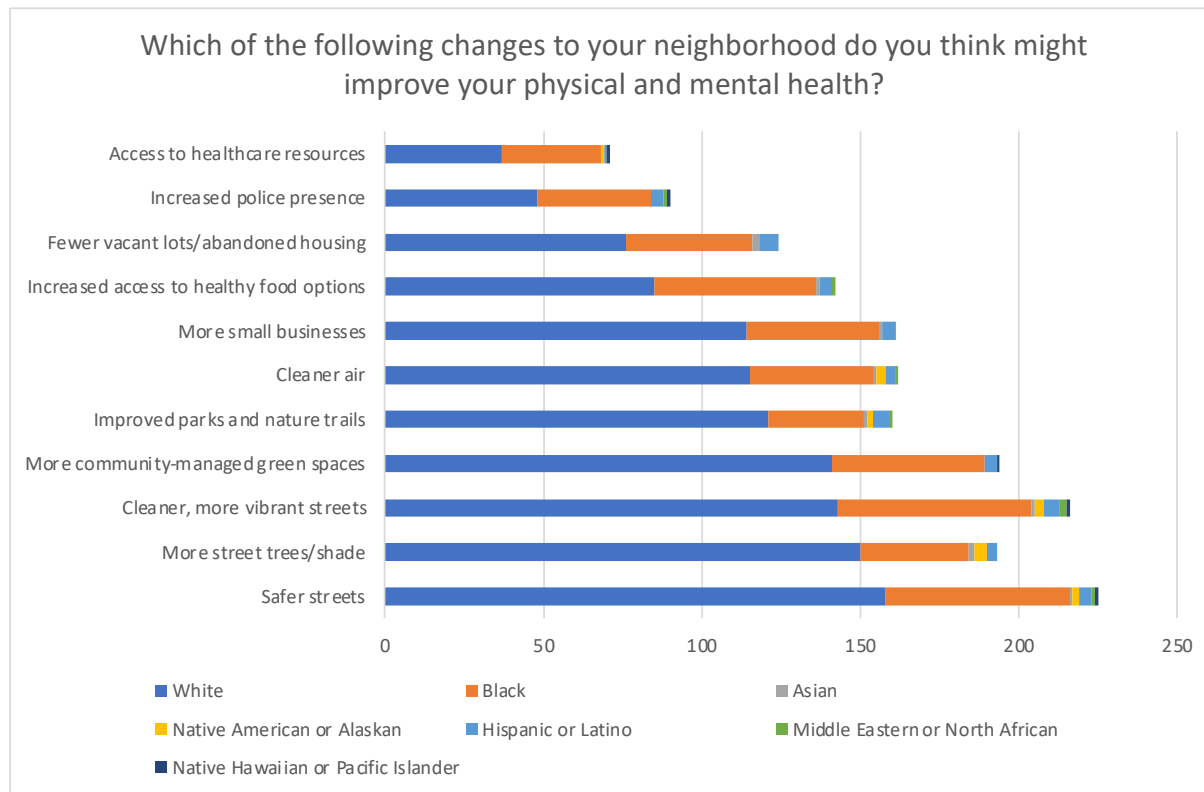


Figure 54. CAP response breakdown of Fig. 33 by race.

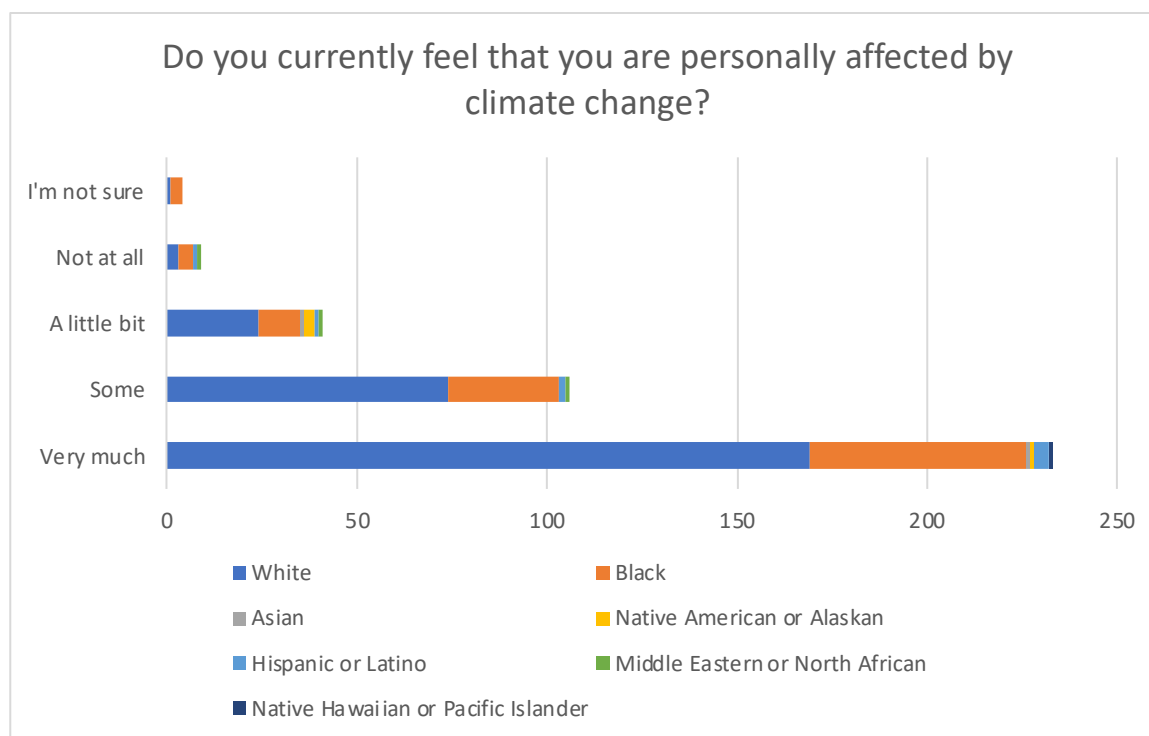


Figure 55. CAP response breakdown of Fig. 32 by race.



Figure 56. CAP response breakdown of Fig. 35 by race.

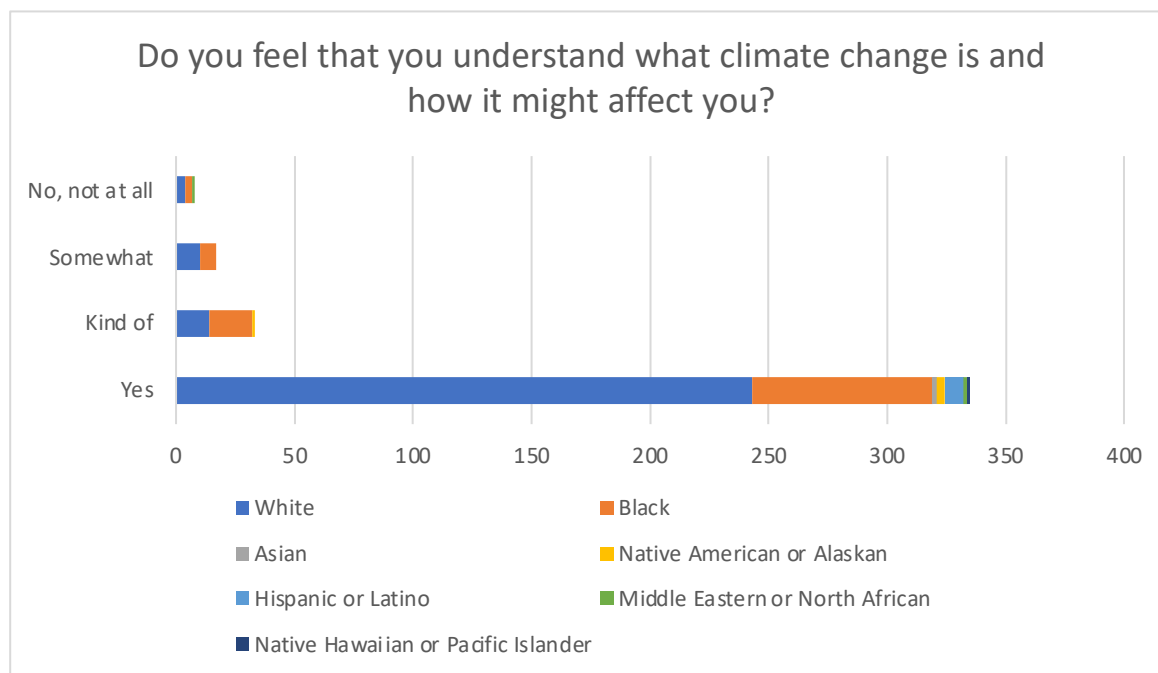


Figure 57. Response breakdown of Fig. 11 by white respondents.

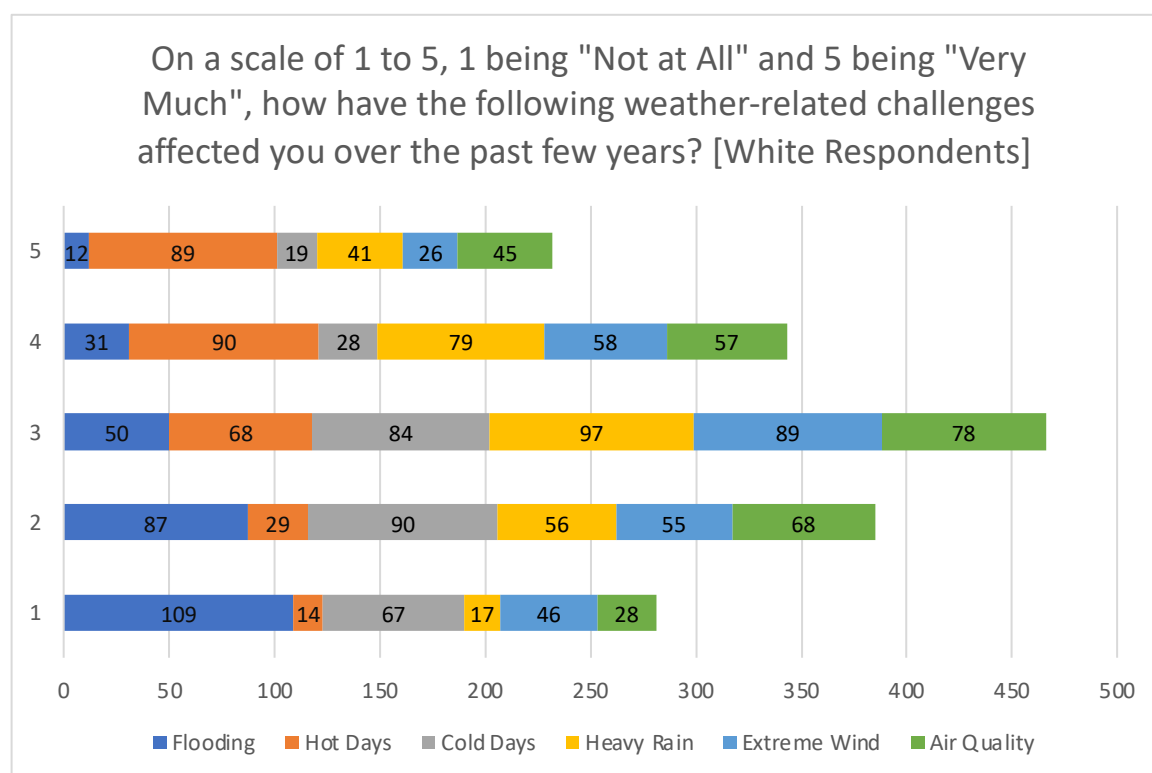


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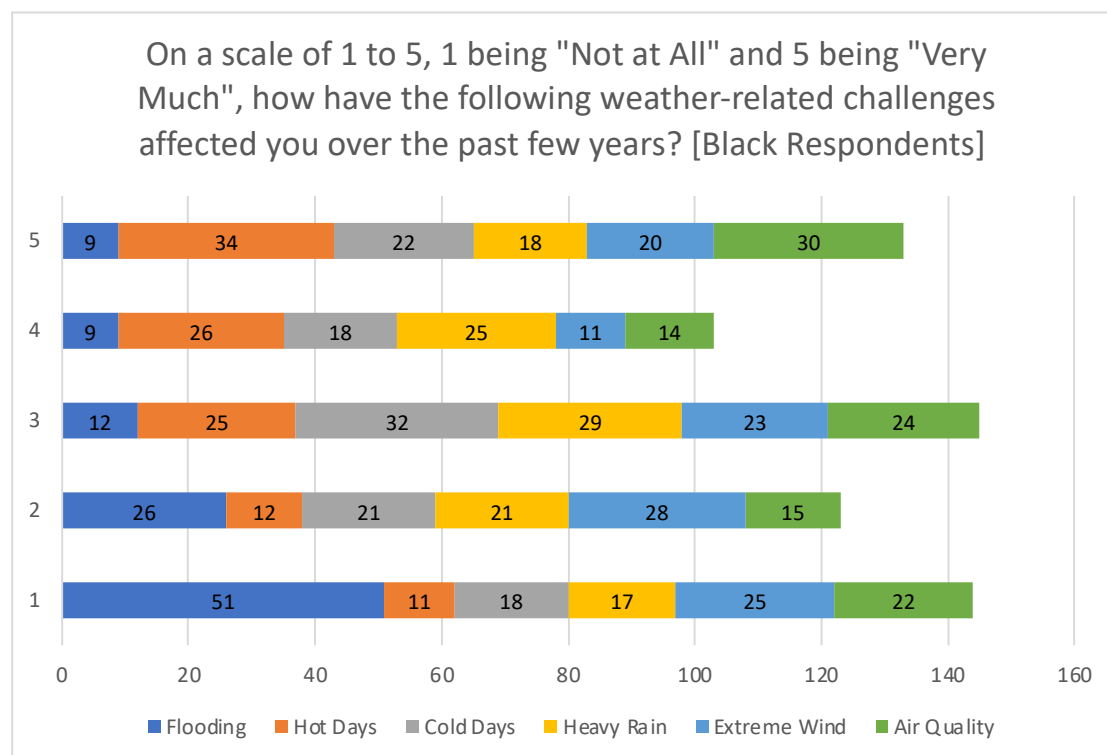


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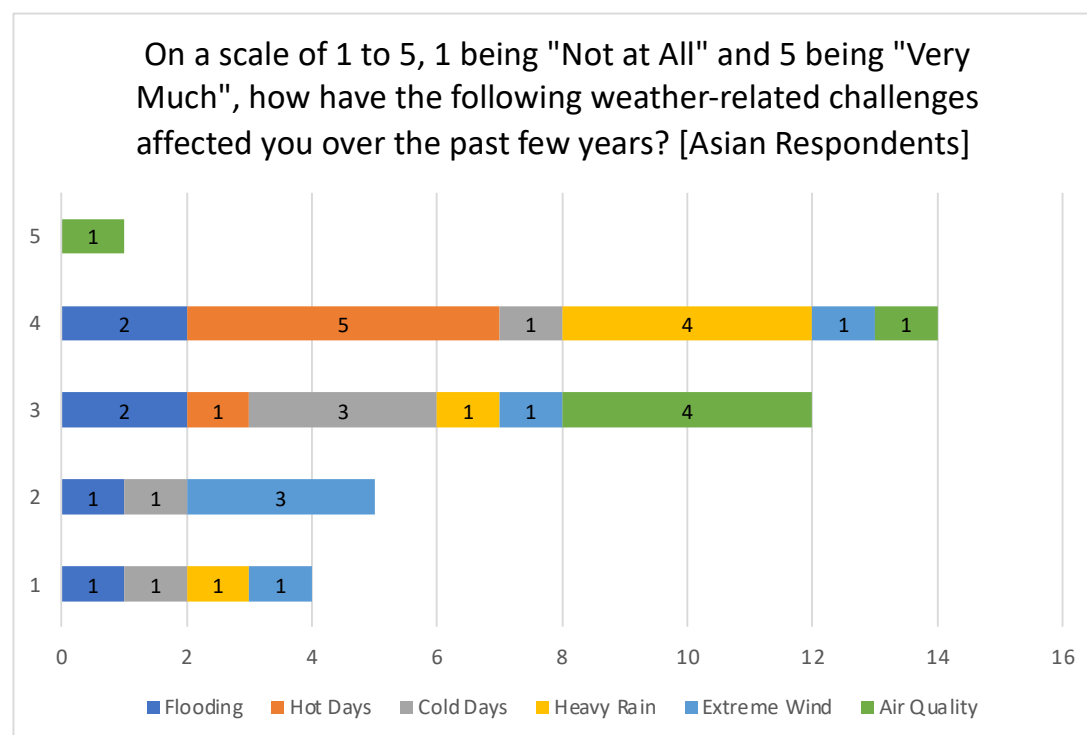


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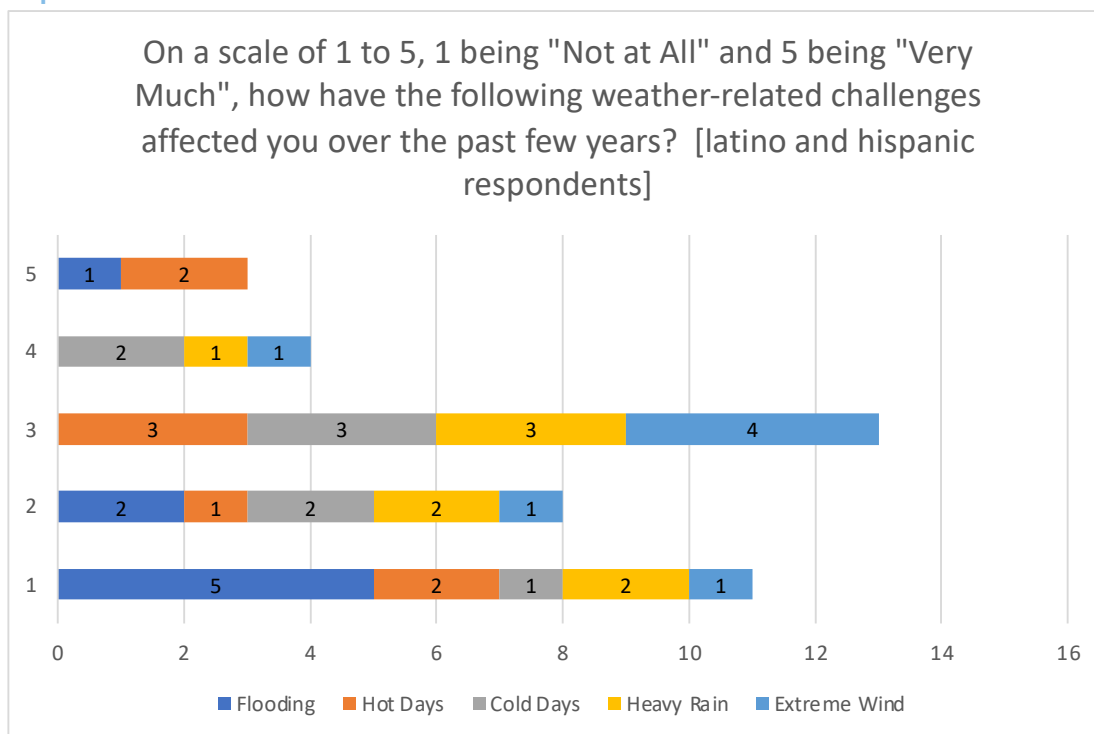


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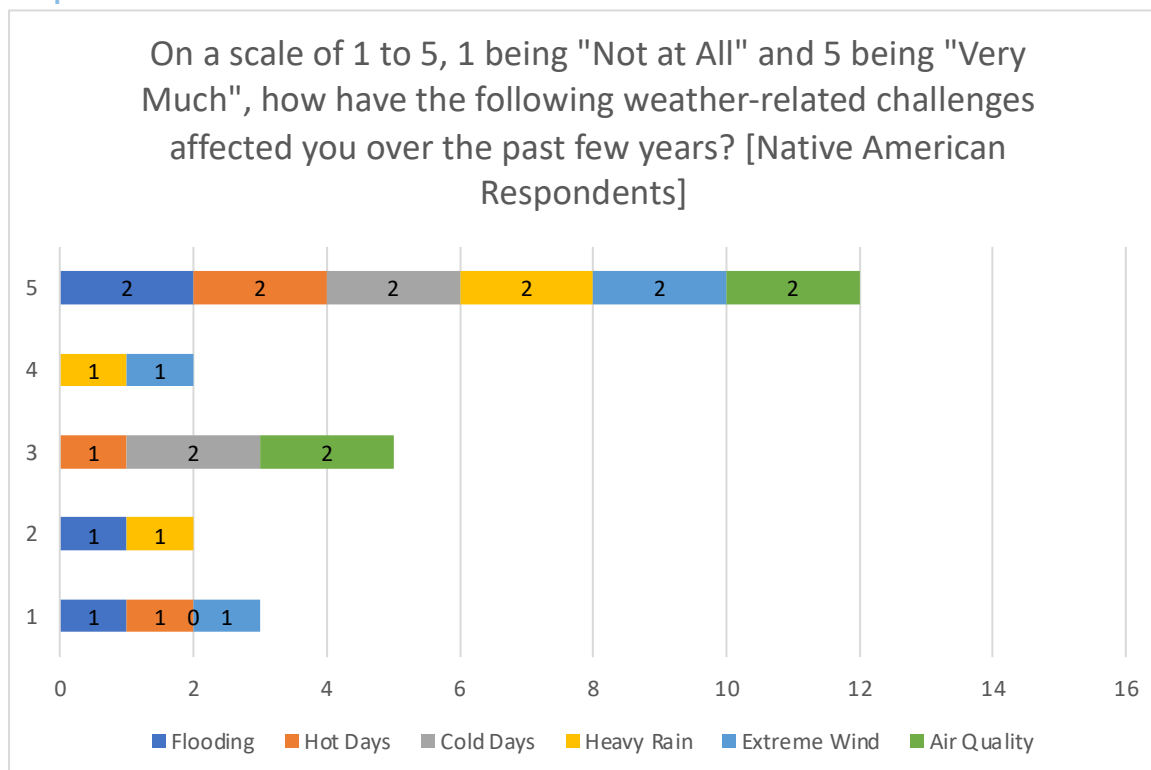


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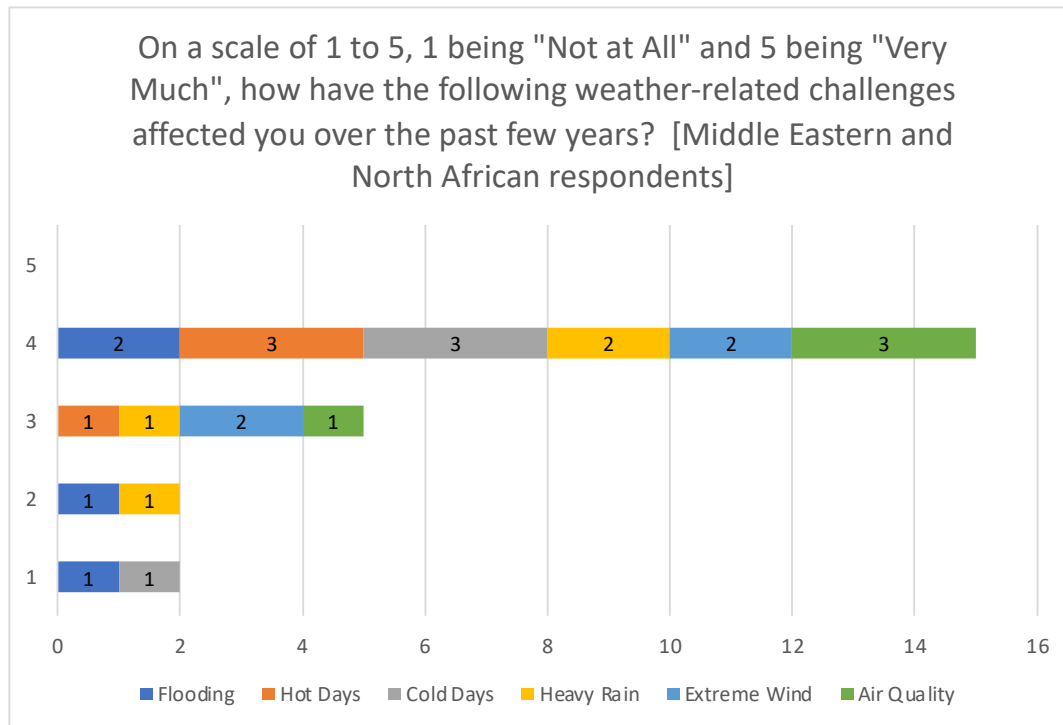
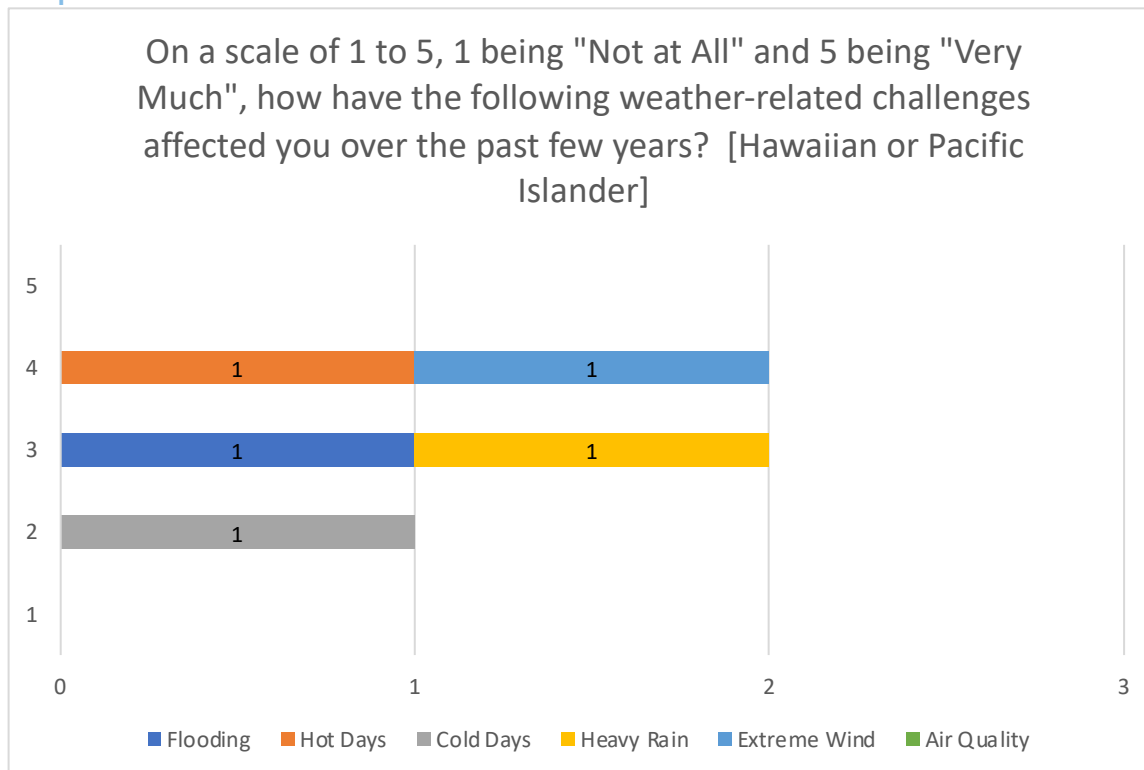


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Appendix 3: Municipal Greenhouse Gas Inventory and Reduction Pathway



Prepared for the
Baltimore Office of Sustainability
Prepared By
AECOM

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Figure 1. 2019 Municipal GHG Inventory (MTCO₂e)

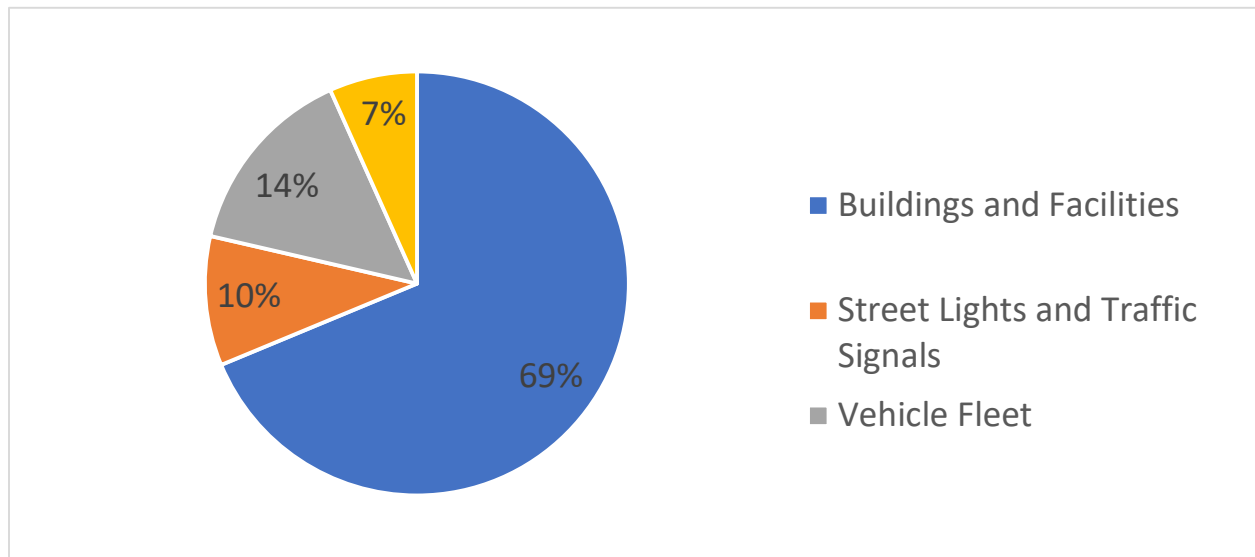


Figure 2. Municipal GHG Emissions Forecast and Targets

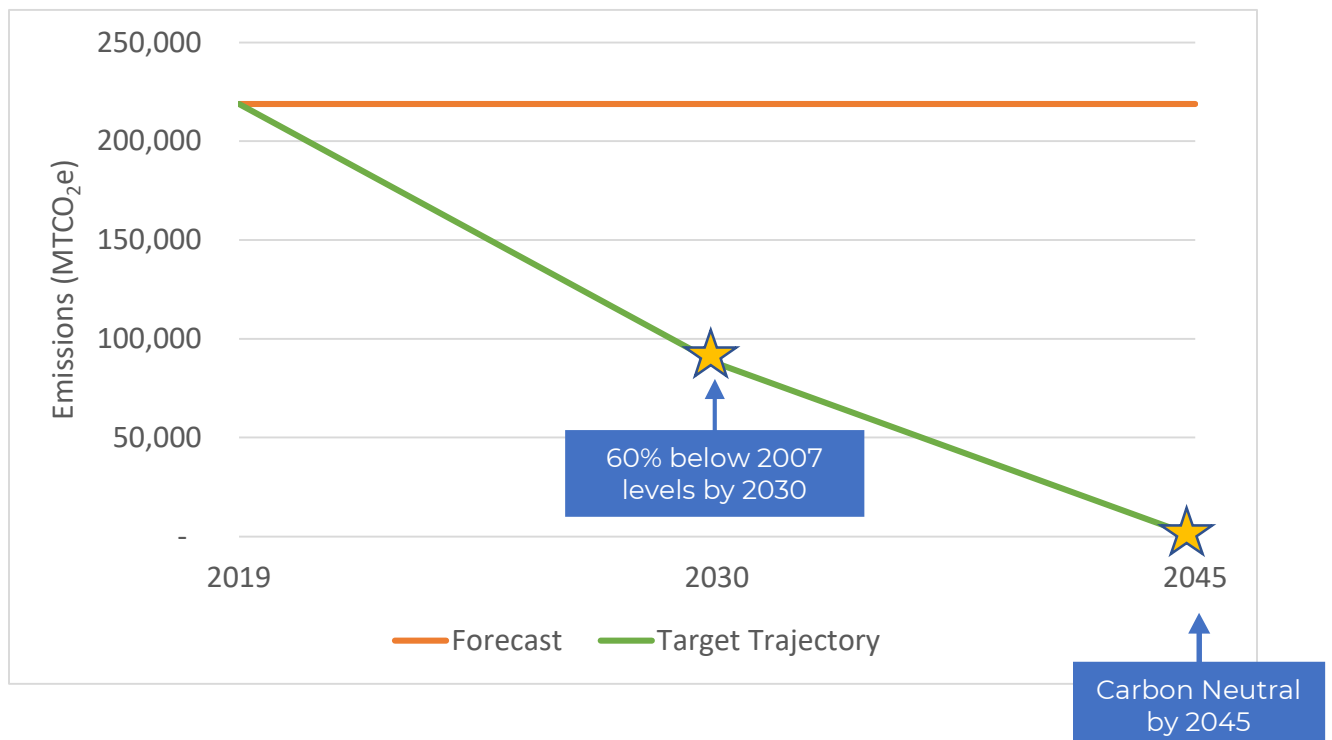


Table 1. Municipal 2030 GHG Reduction Pathway Strategies

Municipal Sector	Municipal 2030 GHG Reduction Pathway Strategies
Buildings, Facilities, Street Lights and Traffic Signals	100% clean electricity
	25% of building equipment and appliances converted to highly efficient and electric options (60% conversion at end of life)
	35% district heating emissions reduction, 85% district cooling emissions reduction
Vehicle Fleet	40% of passenger vehicles are zero-emissions (78% conversion at end of life)
	15% of medium- and heavy-duty vehicles are zero-emissions (30% conversion at end of life)
	5% vehicle miles traveled reduction from vehicle route optimization
Wastewater Treatment Facilities	15% of off-road equipment are zero-emissions
	5% reduction in wastewater emissions

Appendix 4:

Action Evaluation and Prioritization Process Memorandum



Prepared for the
Baltimore Office of Sustainability
Prepared by
AECOM

*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

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Introduction

The Baltimore City Climate Action Plan (CAP) update is intended to identify local actions that will help the City reach its interim greenhouse gas (GHG) emissions reduction target of 60% by 2030 compared to 2007 levels and set the city on a pathway to carbon neutrality by 2045. Because there is a wide variety of actions a city can pursue to reduce emissions, and municipalities typically have limited time and resources to implement these actions, action prioritization is a crucial step in creating an implementable and effective CAP. An action prioritization process that reflects the city's priorities is more likely to be embraced by the plan's users, and therefore to enable the City and community to meet their ambitious GHG emissions reduction goals.

Beyond GHG emissions reduction, implementation of climate actions often provides additional community benefits that may not be accounted for in a typical GHG analysis. For example, actions designed to address climate change can also improve local air quality, bolster the local economy, and enhance community cohesion and resilience. Additionally, many actions will vary in their levels of feasibility. Factors influencing feasibility include the level of City authority to implement the action, cost of implementation, and available funding. Assessing the impact of actions, whether positive or negative, against a customized set of evaluation criteria helps ensure a community's priorities and preferences are considered during the CAP development process.

The CAP project team used the [Action Selection and Prioritization \(ASAP\) tool](#) (a freely available tool created by the C40 Cities Climate Leadership Group for city climate action planning) to evaluate actions for their impact on multiple evaluation criteria and prioritize actions in near-, medium-, and long-term categories for the CAP update. To enhance the evaluation process, the Baltimore Office of Sustainability selected specific community benefit and feasibility criteria that it determined would best represent community priorities and municipal decision-making considerations.

Action Evaluation Process

Draft Action Development

Baltimore City recognizes that achieving carbon neutrality by 2045 requires multi-faceted strategies that involve all people, businesses, institutions and communities in Baltimore. Climate actions must be broad, diverse, and target different stakeholders, while the prioritization process must highlight equity and climate justice. Different actions will more directly impact specific groups. For instance, some actions target municipal operations or businesses while others call for policies that would have a greater effect on individuals. Careful consideration was given to ensure that no single group or community is disproportionately affected and that actions could be implemented in a way that meaningfully improves access to benefits and resources for people who need them due to income or other factors. The following steps were taken to ensure that the draft actions were developed through an equity and environmental justice lens:

- An intentional engagement strategy (Technical Advisory Committee [TAC] and Residential Advisory Committee [RAC], broad outreach, combination of virtual and in person meetings, surveys, etc.) with targeted outreach to neighborhoods was employed to elicit broad and diverse feedback on CAP actions.
- Actions were vetted at public meetings, with the TAC and other stakeholders using common ground and trade-off analysis. This analysis included discussions of equity and environmental justice issues and solutions to help identify potential unintentional consequences and to seek better, more equitable solutions to problems.
- Action development and filtering involved consideration and prioritization of actions that would provide positive community benefits and the burden on the people most vulnerable to the negative effects of climate change.

The initial draft action development process resulted in 58 draft actions. Using the feedback and guidance on equity considerations above, the City narrowed this list of actions to 45, which were then evaluated for their impact on the evaluation criteria and prioritized into near-, medium-, and long-term categories.

Primary Evaluation Criteria

GHG emissions reduction is the primary goal of a CAP, and GHG reductions are a primary evaluation criterion in ASAP. The ASAP tool provides a framework to estimate the relative GHG emissions reductions for actions, based on their relationship to the City's inventory and using some high-level implementation assumptions. The tool assigns each action a score that can be used to compare the GHG reduction potential of each action to other actions, and to allow GHG reduction potential to be considered alongside the actions' community benefits and feasibility. The project team assessed actions for their GHG emissions reduction potential using city data, relevant studies, and results from similar actions.

GHG Emissions Reduction

To estimate an action's relative GHG emissions reduction potential, each action was rated in ASAP for the following:

- **Extent of Reach:** the proportion of GHG emitters within the subsector that will be targeted by this action.
- **Reduction Potential:** the potential for the technology, behavior change, or other change encouraged by the action to reduce emissions.
- **Uptake Potential:** the proportion of targeted GHG emitters that will likely implement the technology/behavior change that the action promotes.

Estimates of GHG mitigation impact typically result in a range of emissions reductions that vary according to the anticipated extent of reach (e.g., number of targeted emitters) and uptake potential (e.g., likelihood of action adoption) of each action. Considering this variability, the ASAP tool estimates emissions reduction scores using a specific set of tiered inputs for each impact (for example, 0-19% or 80-100%) to account for unknowns and variability in emissions impact. This results in an

overall GHG Reduction Score, which is a relative measure of an action's potential to reduce emissions based on its relationship to the City's GHG emissions inventory.

The CAP team established GHG reduction rating rules and assumptions to ensure consistency when applying action ratings to similar action types. Examples of these rules include:

- The maximum feasible Uptake Potential of the actions were considered (voluntary actions are typically less than 20%, while mandatory actions are up to 100%).
- New construction actions represent a small amount of additional emission growth from the base year to the interim and carbon neutrality years (2030 and 2045), and therefore receive low Extent ratings and result in low Emissions Reduction Scores.
- To estimate maximum emissions reduction potential from electrification actions, the team assumed that the electric grid would be powered by 100% clean energy. Therefore, building or vehicle electrification actions will have an 80-100% Reduction Potential rating.
- EV charging actions will support additional electric vehicle purchases, so they have an indirect emissions reduction impact, and are therefore rated for Emissions Reductions.
- Water conservation actions reduce water conveyance emissions but not wastewater emissions, and therefore do not have an Emissions Reduction Score.
- Actions that included developing tools, providing outreach and education, or improving electric infrastructure were not rated for Emissions Reductions.
- Municipal actions that did not address an emissions source in the municipal inventory, such as employee commuting, contracted operations, or upstream emissions from material purchasing, were not rated for Emissions Reductions.

Table below shows how an active transportation infrastructure action was rated in ASAP, and its resulting Emissions Reduction Score:

Rror!

Table 1. Electrification Action Evaluation Example

Action	Emissions Sector Addressed	Extent	Reduction Potential	Uptake Potential	Emissions Reduction Score
Improve Active Transportation Infrastructure	On-Road Transportation	0-19% <ul style="list-style-type: none"> (only a small portion of on-road car travel could switch to active transportation) 	80-100% <ul style="list-style-type: none"> (switching from cars to active transportation could reduce the emitter's on-road emissions by 100%) 	0-19% <ul style="list-style-type: none"> (only a small portion of car travelers that could switch to active travel will switch as this action is voluntary in nature) 	<ul style="list-style-type: none"> 0.9

Secondary Evaluation Criteria: Community Benefits & Feasibility

Secondary evaluation criteria include community benefits and implementation feasibility. The Office of Sustainability selected five community benefit and two feasibility criteria that reflect community values and primary municipal concerns that would apply to multiple CAP areas (e.g., Building Energy as well as Transportation). In developing the criteria, the Office of Sustainability consulted the CAP Resident Advisory Committee (RAC) and Technical Advisory Committee (TAC), and considered the community priorities that were discussed in public workshops and surveys conducted as part of the planning process.

Community Benefits

Community benefits are generated by actions beyond the primary benefit of GHG reductions. Table 2 summarizes the community benefit criteria selected by the City of Baltimore.

Table 2. Community Benefit Criteria Definitions

Evaluation Criteria	Definition
Public Health	Impact on life expectancy and/or incidents of diseases or deaths (e.g., increased life expectancy due to decreased criteria air pollutants).
Economic Prosperity	Impact on the city's economy, such as revenue for businesses, number of green jobs or employment rate, or access to new technologies or knowledge.
Savings to Residents and Businesses	Cost savings (e.g., utility costs, travel costs, future repairs/maintenance, etc.) for residents or businesses.
Resilience	Impact on the capability to prepare for, adapt, withstand, and recover from climate change impacts, hazards, and stressors.
Social Cohesion	Impact on strengthening social relationships, interactions, and ties.

For a given action, each of the chosen community benefits was rated on a qualitative ranking scale based on the degree to which implementation of the action will positively or negatively impact the community benefit. Each action and community benefit criterion pair received one of the five impact ratings: Very Positive, Somewhat Positive, Neutral, Somewhat Negative, or Very Negative. Using a five-point rating scale allows numerous potential actions to be evaluated in a consistent and comparative manner. As shown in Table 3, each criterion has a different definition for each rating.

Table 3. Community Benefit Criteria Scoring Rubric

Criteria	Action Impact Rating				
	Very Positive (Score=2)	Somewhat Positive (Score=1)	Neutral (Score=0)	Somewhat Negative (Score= -1)	Very Negative (Score= -2)
Public Health	The action positively impacts more than one aspect of public health (e.g., indoor air pollution, outdoor air pollution, physical activity)	The action positively impacts one aspect of public health	The action has no impact, the impact is unknown, or the positive and negative impacts may negate each other	The action negatively impacts one aspect of public health	The action negatively impacts more than one aspect of public health
Economic Prosperity	The action creates a	The action creates a	The action has no	The action creates a	The action creates a

Criteria	Action Impact Rating				
	Very Positive (Score=2)	Somewhat Positive (Score=1)	Neutral (Score=0)	Somewhat Negative (Score= -1)	Very Negative (Score= -2)
	large positive impact on the local economy (e.g., many new jobs created)	moderate positive impact on the local economy (e.g., a few new jobs created)	impact, the impact is unknown, or the positive and negative impacts may negate each other	moderate negative impact on the local economy	large negative impact on the local economy
Savings to Residents and Businesses	The action provides savings across a large portion of the community	The action provides savings across a small portion of the community	The action has no impact, the impact is unknown, or the positive and negative impacts may negate each other	The action increases costs across a small portion of the community	The action increases costs across a large portion of the community
Resilience	The action has a positive impact across a large portion of the community	The action has a positive impact across a small portion of the community	The action has no impact, the impact is unknown, or the positive and negative impacts may negate each other	The action has a negative impact across a small portion of the community	The action has a negative impact across a large portion of the community
Social Cohesion	The action increases interaction across a large portion of the community	The action increases interaction across a small portion of the community	The action has no impact, the impact is unknown, or the positive and negative impacts may negate each other	The action decreases interaction across a small portion of the community	The action decreases interaction across a large portion of the community

The CAP team established evaluation criteria rules and assumptions to ensure consistency when applying action ratings to similar action types. Examples of these rules are shown in Table 4:

Table 4 Criteria Rating Rules

Evaluation Criteria	Rating Rules
Public Health	Actions with Very Positive ratings improve more than one aspect of public health, such as indoor air pollution, outdoor air pollution, physical activity, etc. Actions with Somewhat Positive ratings impact one aspect of public health.
Economic Prosperity	Actions with Very Positive ratings include extensive new programs that would generate many new jobs and significant revenue, or hyper-local programs that would create localized economic benefits. Actions with Somewhat Positive ratings include building new smaller scale infrastructure/assets, creating small programs, or expanding existing programs.
Savings to Residents and Businesses	Actions with positive ratings reduce operation costs or travel costs. Municipal actions do not provide any savings or increase costs to residents.
Resilience	Actions with positive ratings directly address resources or assets that would be most impacted by climate change or would help to respond to climate change impacts. Actions with Neutral ratings do not address resources or assets that would be most impacted by climate change or would not help respond to climate change impacts.
Social Cohesion	Actions with Very Positive ratings promote intentional physical or verbal interactions. Actions with Somewhat Positive ratings indirectly encourage interaction. Actions with Neutral ratings result in no or limited community interaction.

Table 5 shows how an example action's community benefit impact was rated and its corresponding Community Benefit Score.

Table 5. Example of Impact Rating and Corresponding Community Benefit Score

Action	Public Health	Economic Prosperity	Savings to Residents and Businesses	Resilience	Social Cohesion	Community Benefit Score
Incentivize Micromobility	Very Positive (2)	Neutral (0)	Somewhat Positive (1)	Somewhat Positive (1)	Somewhat Positive (1)	5

No actions scored negatively for their impact on Resilience, Public Health, Social Cohesion, or Economic Prosperity. Only one action (Require Residential Energy/Emissions Disclosure) scored Somewhat Negative for Savings to Residents and Businesses criterion. This demonstrates that the initial action filter was highly successful in filtering out actions with negative community impacts.

Feasibility Criteria

Feasibility criteria describe how easy or difficult it will be to implement an action. Assessing action feasibility provides important context for decision-makers as they contemplate things like optimal launch timing, the need to pursue funding, and gauging capacity. These feasibility criteria will influence the likelihood of successful implementation. The City of Baltimore selected feasibility criteria that reflect its primary concerns regarding implementation. Each feasibility criterion has specific rating options that were defined by the project team. The feasibility and criteria rating options are listed in Table 6.

Table 6. Feasibility Criteria Scoring Rubric

Evaluation Criteria	Definition	Rating Guide	Rating Definition	Score
City Authority to Implement	The City's level of authority to implement the action.	Full Authority – Administrative	City has full authority to implement a required action administratively	2
		Full Authority – Legislative	City has full authority to implement an action, but it would need to be accomplished through legislation	1
		Partnership	City must partner with another entity to implement action	0
		No Authority	Action is under full control of another entity	-1
Savings to the City¹	Action is expected to provide operational savings to the City over time.	Very Positive	Action provides a large amount of operational savings	2
		Somewhat Positive	Actions provides some operational savings	1
		Neutral	Action does not provide operational savings, or the potential for savings is unknown based on current information	0

¹ Only applies to municipal actions. Does not include upfront capital cost considerations.

The Savings to the City criterion only applies to municipal actions. This criterion was selected because the Savings to Residents and Businesses criterion did not apply to any of the municipal actions.

Other feasibility criteria will be assessed when creating implementation roadmaps for 10 selected actions. These criteria include cost estimates (for capital projects), timeframe, regulatory requirements, and fiscal considerations. Additionally, the following feasibility criteria will be assessed for select municipal actions through a fiscal impact analysis: rough order of magnitude (ROM) costs, the extent to which external funding might be available to pay for the projects, potential operational savings and/or co-benefits the actions could provide, likelihood that external resources (e.g., grants) may be available to assist with implementation, and key funding opportunities that could help the City advance implementation.

Table 7 shows how an example action's feasibility impact was rated and its corresponding Feasibility Score.

Table 7. Example of Feasibility Impact and Corresponding Feasibility Score

Action	City Authority to Implement	Savings to the City	Feasibility Score
Require Solar Ready for City Government Facilities	Full Authority – Administrative (2)	Somewhat Positive (1)	3

No actions scored negatively (i.e., “No Authority”) for City Authority to Implement, demonstrating that the initial action filter was successful in filtering out actions that are out of the City’s control.

Action Prioritization Process

The goal of the prioritization process was to prioritize all actions into near-, medium-, and long-term categories with a roughly equal number of actions in each category. There is no “correct” way to prioritize actions – cities can define their local priorities in many different ways. To help with this process, the CAP team defined the three priority levels as shown in Table 8.

Table 8. Priority Category Definitions

Priority Category	Definition
Near-term	Actions to be implemented in 1-3 years
Medium-term	Actions to be implemented in 4-7 years
Long-term	Actions to be implemented in 8-10 years

During workshops with the RAC, TAC, and the general public, the CAP team received feedback on stakeholder priority actions. These comments were consolidated and shared with the City team during an action prioritization workshop. The goal of this

workshop was to prioritize roughly 10 community actions and 5 municipal actions in each priority category. To determine which actions would be assigned to the near-term category, the City considered the following (action definitions can be found in Table 9):

1. Low-hanging fruit actions that are partially underway or could be implemented immediately (e.g., Community Action #s 3, A3, 37, Municipal Action #s 4, 10, B2)¹.
2. Top scoring across evaluation categories, or balancing between actions that are high priorities to communities and those that have the greatest GHG emissions reduction (e.g., Community Action #s 10, 18, 32, Municipal Action #s 3, 5, 12).
3. Enabling actions that would help in implementing or must precede other actions (e.g., Community Action #s A4, 6, 8, Municipal Action #s 3, 4).
4. Including actions across emissions sectors (e.g., electricity, buildings, transportation, waste).

The City also considered the following when prioritizing actions into each category:

- The need for consultation with implementing agencies to determine when they could reasonably expect to take action.
- If new policy or legislation is required to mobilize action.
- The action's potential to inform the public or targeted stakeholders about the CAP and its goals (e.g., awareness or education communications will begin early and continue throughout the plan).

This action prioritization process resulted in a list of 18 near-term actions (12 community and 6 municipal), 14 medium-term actions (12 community and 2 municipal), and 10 long-term actions (6 community and 4 municipal), as shown in Table 9 and Table 10 (during this process, municipal action “B3. Establish and Offset Goal” was merged into action 3. “Create Net-Zero Plan City Government Facilities”, municipal action 15. “Adopt City Government Zero-Emissions Off-Road Policy” was merged into action 14. “Support City Government Contracting of Zero- or Low-Emissions Off-Road Equipment”, and municipal action 9. “Offer Discounted Transit Passes” was merged into action 8: “Incentivize Programs for Sustainable Commuters”, so there are 42 final actions).

¹ Note that during the action development process, new action ideas were included in the original numbered action list based on stakeholder input, and these new action ideas were identified alphanumerically (e.g., A3 instead of 3)

Table 9. Prioritized Community Action List

Priority Category	Actions* **
Near-term	<p>3. Promote Existing Renewable Energy Incentive Programs: Provide outreach and education on available programs and incentives for residents and businesses to install solar (e.g., tax credits, rebates, net metering, solar renewable energy certificates (SRECs)).</p> <p>6. Partner with Utility to Improve Electric Infrastructure: Work with BGE to understand future electrification and infrastructure needs and work with them to target infrastructure upgrades in the most vulnerable communities.</p> <p>8. Develop a Centralized Tool for Climate Actions: Provide a centralized tool that provides 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> <p>10. Incentivize Energy Efficiency and Electrification Retrofits: Provide incentives and/or discounts to encourage existing building energy efficiency and electrification retrofits and ensure maximum accessibility to lower income residents.</p> <p>18. Improve Active Transportation Infrastructure: Implement the Bikeways and Complete Streets Plans to improve active transportation infrastructure and connectivity and protect infrastructure from vehicles.</p> <p>19. Support Transit-Oriented Communities: Support transit-oriented communities, ensure that land uses close to transit stations are oriented toward people and not auto uses, require inclusion of affordable housing in transit oriented development, and enhance access to amenities by active and transit modes</p> <p>23. Promote and Expand Existing Commute Trip Reduction Programs: Promote and expand existing commute trip reduction programs such as the MTA Commuter Connections Program and iRide Baltimore.</p> <p>32. Expand Public EV Charging Network: Expand publicly accessible EV charging infrastructure, ensuring that resources are equitably distributed and available along main routes and in popular destinations.</p> <p>33. Promote Zero-Emission Bus Transition: Support the transition to electric vehicles for public transit.</p> <p>37. Enhance Existing Organic Waste Diversion Policy: Enhance existing organic waste diversion policy awareness, compliance and enforcement.</p>

Priority Category	Actions* **
	<p>A3. Encourage Water Savings Program: Encourage water conservation program.</p> <p>A4. Create an Education and Outreach Program: Develop a comprehensive promotions strategy to advance all CAP priority actions and provide resources to help people take action.</p>
Medium-term	<p>11. Propose Green Zoning Regulations: Propose green zoning regulations to incentivize or offer bonuses for efficient buildings, zero-energy ready, multifamily and mixed use areas, and transit oriented developments.</p> <p>20. Revise Parking Standards: Eliminate minimum parking standards for additional zoning/use categories and establish firm parking maximums and stronger variance standards for parking requirements.</p> <p>24. Incentivize Micromobility: Provide incentives for residents to purchase micromobility vehicles (escooters, ebikes, bikes, etc.).</p> <p>29. Partner with Rideshares to Improve Paratransit: Partner with rideshare providers to improve paratransit and carpool service options.</p> <p>31. Promote EV Sharing: Promote the creation of EV sharing programs at a hyper-local level to offer greater access to EVs to more community members.</p> <p>34. Promote Electric Car Share and Ride Share: Promote and raise awareness of programs support the transition of ride share companies to using electric vehicles.</p> <p>38. Develop Waste Diversion Incentives: Develop financial incentives for reducing waste and increasing recycling such as save as you throw programs, waste bin capacity upgrades and bottle return programs.</p> <p>A1. Require or Incentivize Active Transport-Friendly Development: Require or incentivize more pedestrian, bike and scooter friendly development.</p> <p>A2. Work with Gas Stations to Install EV Chargers: Work with new or significantly renovated gas stations to install EV chargers.</p> <p>40. Partner with Circular-Economy Local Business: Promote/partner with local businesses that use local recycled materials or avoid single-use materials.</p> <p>42. Establish Waste Community Leaders: Establish or expand programs where community leaders or block captains promote waste management at a neighborhood level.</p>

Priority Category	Actions* **
	43. Coordinate Citywide Food Rescue Program: Coordinate regional food rescue capacity and logistics with nonprofits that have expertise in food rescue programs.
Long-term	<p>5. Implement Solar-Ready Requirements on New Construction: Require all new developments to install solar or meet solar-ready requirements through a code amendment.</p> <p>13. Adopt Residential Green Building Standard: Adopt green building standards for new residential construction and major renovation.</p> <p>17. Require Residential Emissions / Energy Disclosure / Improvements: Implement a Residential Emissions/Energy Conservation Ordinance to disclose energy performance and/or require energy or emissions improvements at time of sale or lease.</p> <p>26. Establish Car-Free Zones: Require inclusion of car-free zones in transit-oriented development areas.</p> <p>28. Expand Transit for Low-Income Neighborhoods: Increase public transit operations for low-income neighborhoods, including micro transit options.</p> <p>36. Implement Citywide Composting: Implement organic food waste composting and provide compost for free to residents and businesses.</p>

*Some action titles were changed in Table 9 after prioritization so they may not exactly match the action titles in the ASAP outputs.

**Action 14: “Require Fossil Fuel Free New Construction” was added after the prioritization process.

Table 10. Prioritized Municipal Action List

Priority Category	Actions*
Near-term	<p>2. Require Solar Ready for City Government Facilities: Require all new construction or major renovation to be solar ready and evaluate existing roofs for additional solar opportunities.</p> <p>3. Create Net-Zero Plan for City Government Facilities: Evaluate how to transition City municipal buildings to net-zero emissions buildings and establish a maximum offset goal.</p> <p>4. Create Energy Benchmarking Policy for City Government Facilities: Create an energy benchmarking policy for municipal facilities.</p> <p>8. Incentivize Programs for Sustainable Commuters: Incentivize sustainable commuting programs, such as discounted transit passes or parking cash out programs for City employees.</p> <p>10. Enhance Awareness of Alternative Transport for Staff: Enhance awareness among city staff of alternative transportation options.</p> <p>B2. Establish Sustainable Procurement Protocol: Establish sustainable procurement protocol and incentives system.</p>
Medium-term	<p>5. Implement Energy Audits and Retro-Commissioning for City Government Facilities: Implement an energy audit and retro-commissioning program of for city-owned buildings and target buildings with opportunities for improvement.</p> <p>14. Develop a Plan to Transition City to Low- or Zero-Emission Off-Road Vehicles and Tools: Develop a Plan to transition City and City contractor use to low- or -zero-emissions off-road vehicles and tools.</p>
Long-term	<p>1. Purchase Clean Electricity for City Government Operations: Increase power purchase agreements by 10% by 2030 to promote creation of new, regional clean energy projects.</p> <p>7. Require Fossil Fuel Free New Construction for City Government Facilities: Develop fossil fuel free requirement for all new construction and major renovations for municipal buildings.</p> <p>12. Transition to Zero- or Low-Emissions Fleet: Expand municipal EV charging infrastructure and transition City fleet to zero-/low-emission vehicles.</p> <p>B1. Establish Emissions Plan for Wastewater Facilities: DPW to develop and begin implementing an emissions reduction plan for at least one of its wastewater treatment facilities.</p>

*Some action titles were changed in Table 9 after prioritization so they may not exactly match the action titles in the ASAP outputs.

The series of figures on the following pages provide graphic outputs from the ASAP tool that were referenced during the prioritization process, illustrating the action evaluation results for community and municipal GHG reduction potential matrices that compare community and municipal primary benefits versus community benefits and matrices comparing community and municipal feasibility versus primary benefits.

list community and municipal actions that scored highly across the three evaluation criteria categories. Note that some action titles were changed in Table 9 after prioritization so they may not exactly match the action titles in the ASAP figures. Action names and description may be updated further post-prioritization process.

Figure 1. Community Actions – Emissions Reduction Score

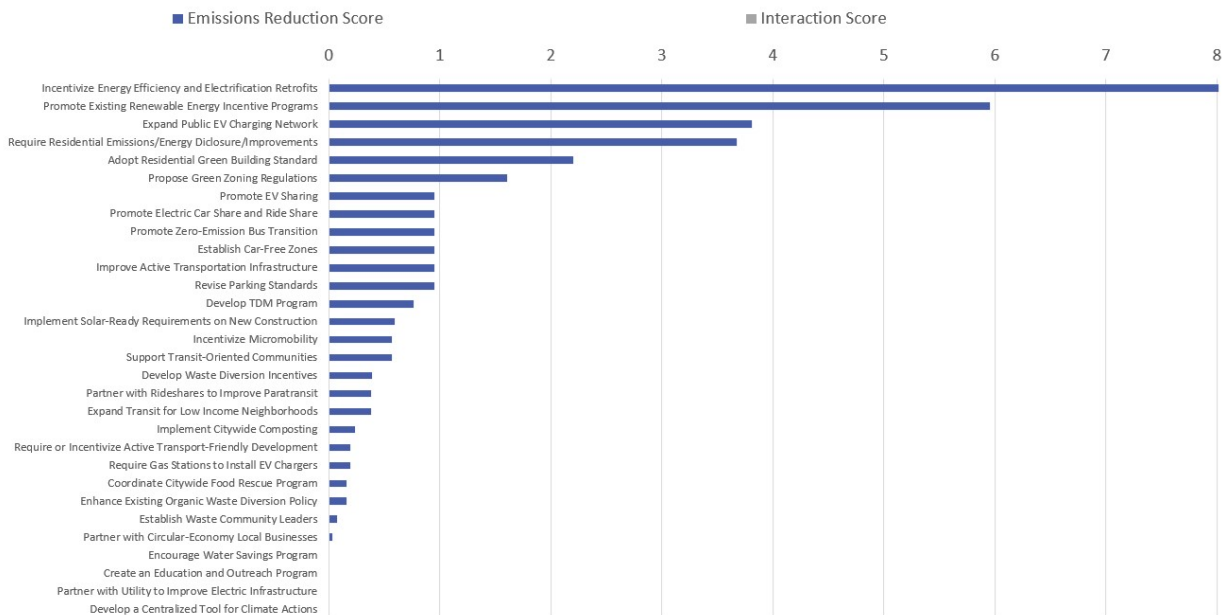


Figure 2. Community Action – Community Benefits Score

Public Health
Economic Prosperity and Savings
to Residents and Businesses



Figure 3. Community Action – Feasibility Score

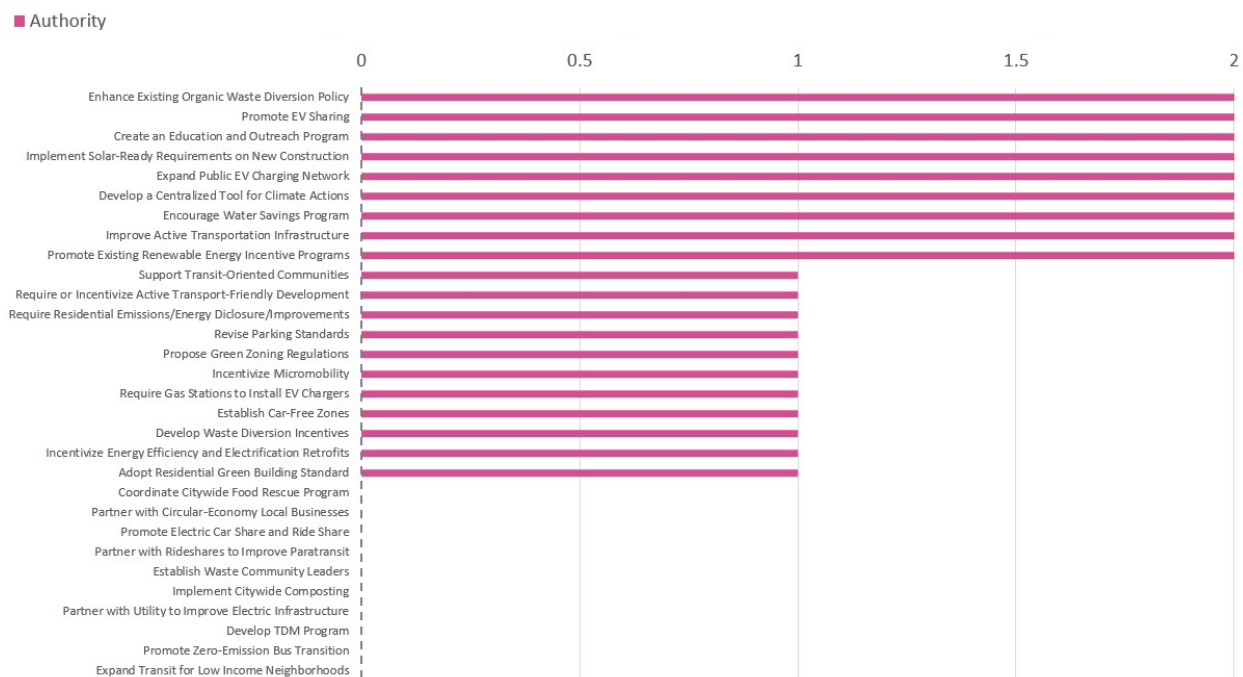
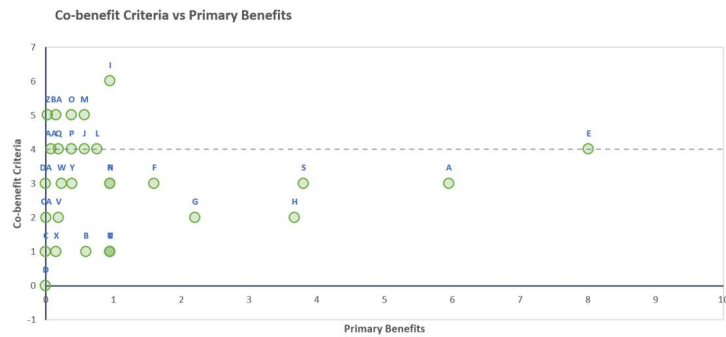
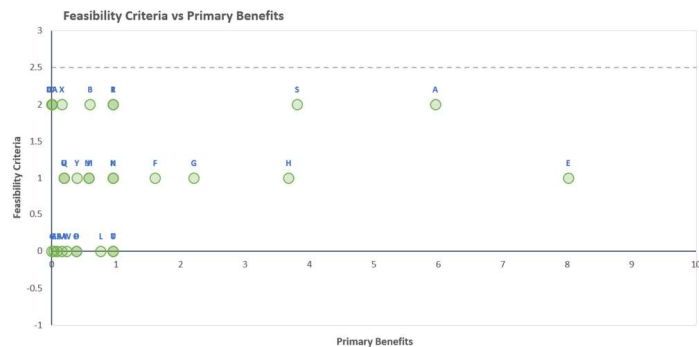


Figure 4. Community Actions – Community Benefits vs Primary Benefits



Action ID	Action Title
A	Promote Existing Renewable Energy Incentive Programs
B	Implement Solar-Ready Requirements on New Construction
C	Partner with Utility to Improve Electric Infrastructure
D	Develop a Centralized Tool for Climate Actions
E	Incentivize Energy Efficiency and Electrification Retrofits
F	Propose Green Zoning Regulations
G	Adopt Residential Green Building Standard
H	Require Residential Emissions/Energy Disclosure/Improvements
I	Improve Active Transportation Infrastructure
J	Support Transit-Oriented Communities
K	Revise Parking Standards
L	Develop TDM Program
M	Incentivize Micromobility
N	Establish Car-Free Zones
O	Expand Transit for Low Income Neighborhoods
P	Partner with Rideshares to Improve Paratransit
Q	Require or Incentivize Active Transport-Friendly Development
R	Promote EV Sharing
S	Expand Public EV Charging Network
T	Promote Zero-Emission Bus Transition
U	Promote Electric Car Share and Ride Share
V	Require Gas Stations to Install EV Chargers
W	Implement Citywide Composting
X	Enhance Existing Organic Waste Diversion Policy
Y	Develop Waste Diversion Incentives
Z	Partner with Circular-Economy Local Businesses
AA	Establish Waste Community Leaders
BA	Coordinate Citywide Food Rescue Program
CA	Encourage Water Savings Program
DA	Create an Education and Outreach Program

Figure 5. Community Actions – Feasibility vs Primary Benefits



Action ID	Action Title
A	Promote Existing Renewable Energy Incentive Programs
B	Implement Solar-Ready Requirements on New Construction
C	Partner with Utility to Improve Electric Infrastructure
D	Develop a Centralized Tool for Climate Actions
E	Incentivize Energy Efficiency and Electrification Retrofits
F	Propose Green Zoning Regulations
G	Adopt Residential Green Building Standard
H	Require Residential Emissions/Energy Disclosure/Improvements
I	Improve Active Transportation Infrastructure
J	Support Transit-Oriented Communities
K	Revise Parking Standards
L	Develop TDM Program
M	Incentivize Micromobility
N	Establish Car-Free Zones
O	Expand Transit for Low Income Neighborhoods
P	Partner with Rideshares to Improve Paratransit
Q	Require or Incentivize Active Transport-Friendly Development
R	Promote EV Sharing
S	Expand Public EV Charging Network
T	Promote Zero-Emission Bus Transition
U	Promote Electric Car Share and Ride Share
V	Require Gas Stations to Install EV Chargers
W	Implement Citywide Composting
X	Enhance Existing Organic Waste Diversion Policy
Y	Develop Waste Diversion Incentives
Z	Partner with Circular-Economy Local Businesses
AA	Establish Waste Community Leaders
BA	Coordinate Citywide Food Rescue Program
CA	Encourage Water Savings Program
DA	Create an Education and Outreach Program

Figure 6. Municipal Actions – Emissions Reduction Score

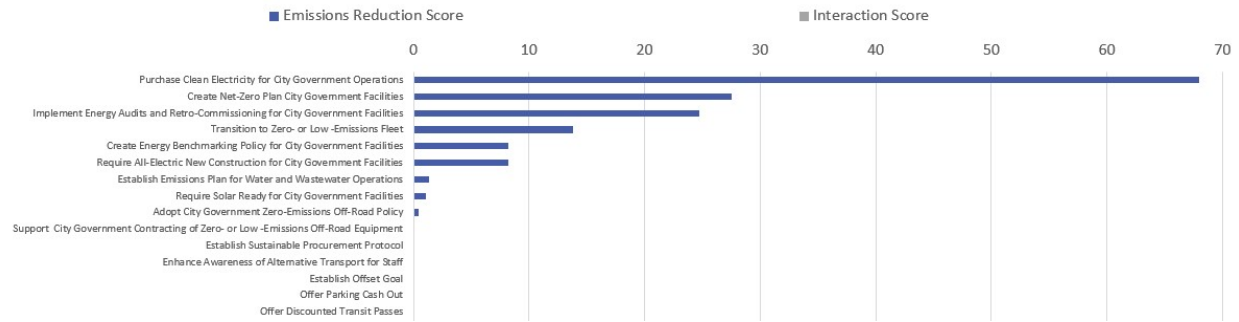


Figure 7. Municipal Actions – Community Benefits Score



Figure 8. Municipal Actions – Feasibility Score

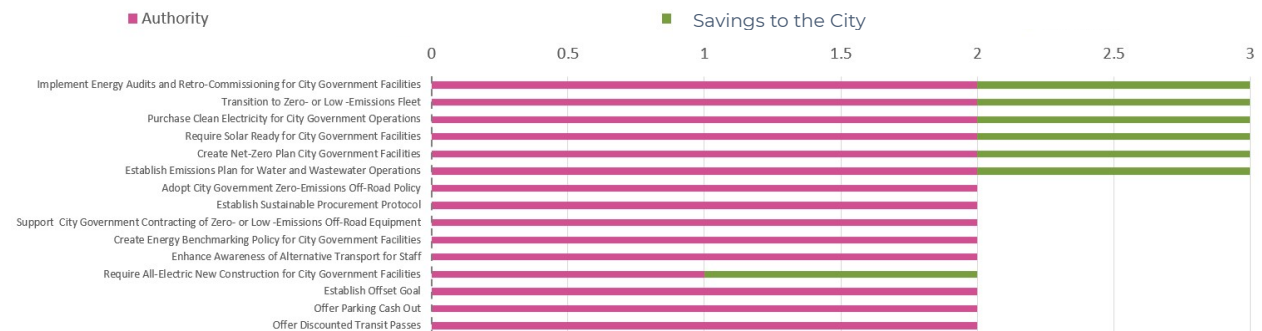


Figure 9. Municipal Actions – Community Benefits vs Primary Benefits

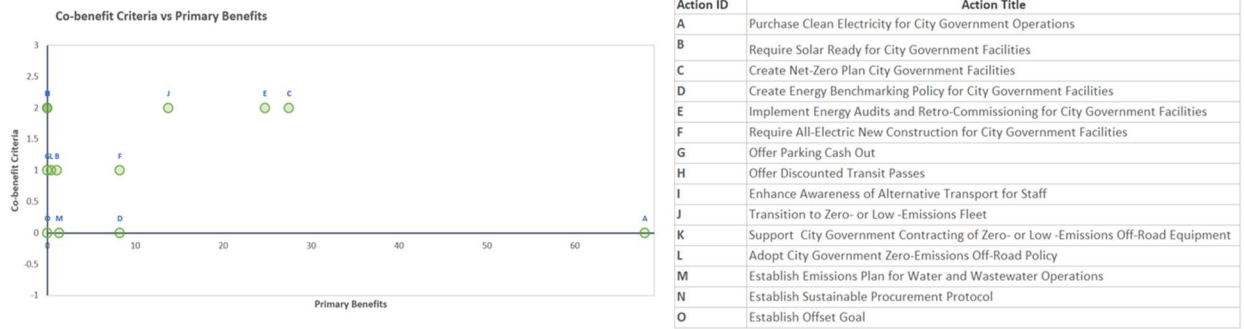


Figure 10. Municipal Actions – Feasibility vs Primary Benefits



Figure 11. Community Actions - Top Scoring Actions

* Green actions score highly across 2 categories.

GHG Reduction (Scored Above a 1)	Co-Benefits (Scored Above a 3)	Feasibility (Full Authority-Admin)
10. Incentivize Energy Efficiency and Electrification Retrofits	18. Improve Active Transportation Infrastructure	18. Improve Active Transportation Infrastructure
3. Promote Existing Renewable Energy Incentive Programs	24. Incentivize Micromobility	3. Promote Existing Renewable Energy Incentive Programs
32. Expand Public EV Charging Network	28. Expand Transit for Low Income Neighborhoods	32. Expand Public EV Charging Network
17. Require Residential Emissions/Energy Disclosure/Improvements	43. Coordinate Citywide Food Rescue Program	31. Promote EV sharing
13. Adopt Residential Green Building Standard	40. Partner with Circular-Economy Local Businesses	A4. Create an Education and Outreach Program
11. Propose Green Zoning Regulations	10. Incentivize Energy Efficiency and Electrification Retrofits	5. Implement Solar-Ready Requirements on New Construction
	23. Develop TMD Program	37. Enhance Existing Organic Waste Diversion Policy
	19. Support Transit-Oriented Development	8. Develop a Centralized Tool for Climate Actions
	29. Partner with Rideshares to Improve Paratransit	
	A1. Require or Incentivize Active Transport-Friendly Development	
	42. Establish Waste Community Leaders	

Figure 12. Municipal Actions - Top Scoring Actions

* Green actions score highly across 2-3 categories.

GHG Reduction (Scored Above a 1)	Co-Benefits (Scored Above a 3)	Feasibility (Full Authority-Admin)
1. Purchase Clean Electricity for City Government Operations	3. Create Net-Zero Plan City Government Facilities	1. Purchase Clean Electricity for City Government Operations
3. Create Net-Zero Plan City Government Facilities	5. Implement Energy Audits and Retro-Commissioning for City Government Facilities	3. Promote Existing Renewable Energy Incentive Programs
5. Implement Energy Audits and Retro-Commissioning for City Government Facilities	12. Transition to Zero- or Low-Emissions Fleet	5. Implement Energy Audits and Retro-Commissioning for City Government Facilities
12. Transition to Zero- or Low-Emissions Fleet	9. Offer Discounted Transit Passes	12. Transition to Zero- or Low-Emissions Fleet
	10. Enhance Awareness of Alternative Transport for Staff	B1. Establish Emissions Plan for Water and Wastewater Operations
	14. Support City Government Contracting of Zero- or Low-Emissions Off-Road Equipment	2. Require Solar Ready for City Government Facilities
	B2. Establish Sustainable Procurement Protocol	

Appendix 5: Implementation Roadmaps



Prepared for the
Baltimore Office of Sustainability
Prepared by
AECOM

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Abbreviation List

Abbreviation	Definition
BGE	Baltimore Gas and Electric
BMC	Baltimore Metropolitan Council
CCC	Charm City Circulator
CHAP	Commission for Historical and Architectural Preservation
DGS	Department of General Services
DPW	Department of Public Works
MTA	Maryland Transit Administration
SWMP	Solid Waste Management Plan
TDP	Transit Development Plan
TOD	Transit-Oriented Development
ZEV	Zero Emission Vehicle

Introduction

The City of Baltimore prioritized ten complex climate actions to receive additional guidance in the form of implementation roadmaps. The implementation roadmaps show how to approach these actions over the next ten years. Using their practical experience, expertise, and knowledge, City of Baltimore employees from different departments conferred with the City's consultant to identify next steps for each action, 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 actions outlined in the implementation roadmaps benefit frontline communities. This was done through the identification of equity considerations, or the positive and negative equity impacts the action could cause, and potential solutions to address any negative impacts. The actions selected for implementation roadmaps include the following::

- B6: Require Fossil Fuel Free and Solar-Ready New Construction
- B8: Expand Access to the Weatherization Assistance Program and Retrofitting Services
- B2: Create Net Zero Plan for City Government Facilities
- T3: Support Transit-Oriented Communities
- T13: Implement Re.vised Parking Standards and Encourage Developers to Reduce Parking
- T14: Promote and Expand Existing Commute Trip Reduction Programs
- T5: Improve Transit for Low-Income Neighborhoods and Other Communities in Need of Transit Options
- T2: Require or Incentivize Active Transport-Friendly Programs and Infrastructure

- T10: Expand Public EV Charging Network
- W4: Develop Waste Diversion Incentives

Please note that the action names and descriptions have changed since the roadmaps were first developed. The action names and descriptions in this document reflect the newest actions in the Baltimore CAP Update.

How to Read an Implementation Roadmap

The table below describes each element of an implementation roadmap.

Action # and Name	Action # and title
Action Description	Action description
Lead Implementor	Department(s) that will be leading action implementation. Government offices and departments listed refer to City of Baltimore agencies unless otherwise indicated.
Supporting Partners	Department(s) or other entities that can support action implementation. Government offices and departments listed refer to City of Baltimore agencies unless otherwise indicated.
Implementation Steps and Timeline	High-level steps to implement the action with the number of years it will take to implement each step. Year ranges are as follows: <ul style="list-style-type: none"> • 0-3 years (near-term) • 3-7 years (medium-term) • 7+ years (long-term)
Equity Considerations	The positive or negative equity impacts the action could cause, and potential solutions to address any negative equity impacts
Other Implementation Considerations	Implementation considerations that are not discrete steps, but are factors the implementors or those impacted by the action should be aware of during implementation
Potential Fiscal Implications	General City cost or saving implications from implementing the action, such as capital investments, staff time, operating savings, etc.
Metrics to Track Progress	<ul style="list-style-type: none"> • Output Indicators: Measurable result of action (i.e., miles of bike lanes built, kilowatts of renewable energy installed) • Outcome Indicators: Outcomes needed to achieve the greenhouse gas reduction strategies and targets (i.e., increase in bicycle mode share, electricity emissions reduced)

Community Benefits	Additional benefits the action provides beyond greenhouse gas emissions reductions
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Action B6. Require Fossil Fuel Free and Solar-Ready New Construction

Action # and Name	B6: Require Fossil Fuel Free and Solar-Ready New Construction
Action Description	Make a rule that new buildings cannot use fossil fuels for power and are 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.
Lead Implementor	<ul style="list-style-type: none"> • Department of Housing and Community Development • Department of Planning
Supporting Partners	<ul style="list-style-type: none"> • Baltimore Development Corporation • Baltimore Gas and Electric (BGE) • Colleges and Universities
Implementation Steps and Timeline	<p>Review feasibility and develop bill (3-7 Years)</p> <ul style="list-style-type: none"> • Develop Council bill language that would require new construction to be solar-ready and use fossil-fuel free equipment that is also highly energy efficient <ul style="list-style-type: none"> • Develop a phased implementation approach that requires new construction to comply first, followed by major rehabilitations/renovations • Consider the needs of specific establishments where fossil-fuel construction may not be economically or technologically feasible in the near-term, such as commercial food businesses and manufacturing facilities • Develop guidelines for back-up generator fuel use where there are no other feasible options

	<ul style="list-style-type: none"> • See New York City example of a similar local law • Partner with BGE to evaluate electric grid capacity impacts/feasibility • Partner with electrification-focused nonprofits, community-based organizations, and stakeholders to understand lessons learned from their building electrification pilot(s) including the Green & Healthy Homes Initiative, the Climate Access Fund, and others <p>Conduct education and outreach (3-7 Years)</p> <ul style="list-style-type: none"> • Create separate educational campaigns for developers/builders and residents/landlords: <ul style="list-style-type: none"> • For developers/builders: Provide tools with information on new standards such as the Buildings Energy Performance Standards (BEPS) law, best practices, and recommended technologies/systems. Develop separate residential and commercial guidance/tools • For residents/landlords: Ensure educational campaign focuses on how to use electric equipment, such as stoves and heat pumps, and the benefits, such as cost savings, state/federal rebates, and positive health impacts • Provide communications to neighborhood associations about the standards new buildings are meeting
<p>Equity Considerations</p>	<p>Potential Positive Equity Impacts:</p> <ul style="list-style-type: none"> • Depending on equipment type, high-efficiency electric equipment (e.g., heat pumps) is cheaper to operate than gas equipment or electric resistance heating • All-electric housing is often cheaper to develop than mixed fuel housing because gas distribution hookups do not need to be provided, potentially reducing the cost of new housing development • All-electric buildings can improve indoor air quality/occupant health by eliminating indoor air pollutants from combustion equipment such as gas stoves and heaters • Natural gas costs will most likely continue to increase as more buildings transition towards all-electric; requiring that all new buildings are built as all-electric will reduce utility costs for future tenants • With energy transitioning away from natural gas, all-electric standards will help prevent customers from being stranded with old equipment and/or exorbitant energy costs

Other Implementation Considerations	<ul style="list-style-type: none"> Action could potentially disincentivize development by adding more regulatory hurdles Gas delivery rate increases are currently being considered along with major replacement of gas infrastructure in the city. The City could work with BGE to conduct thorough, ongoing reviews of state/utility/Public Service Commission plans for natural gas investments and advocate to halt unnecessary investments both statewide and at the city-level while pushing for investments in electrification
Potential Fiscal Implications	<ul style="list-style-type: none"> Staff time needed to implement action Potential incentives or tax credits to ease the transition to electrification in new construction Potential increased capital with reduced operating costs of municipal construction
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> % of new developments that are all-electric (can be determined by gathering data on the # of new gas inspections for new developments and square footage of new developments) <p>Outcome:</p> <ul style="list-style-type: none"> Reduced community natural gas use Reduced emissions from utility natural gas use Reduced emissions per household
Community Benefits	Public Health, Savings to Residents and Businesses, Resilience

Action B8: Expand Access to the Weatherization Assistance Program and Retrofitting Services

Action # and Name	B8: Expand Access to the Weatherization Assistance Program and Retrofitting Services
Action Description	Enhance city's existing Weatherization Assistance Program (WAP) to 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.
Lead Implementor	<ul style="list-style-type: none"> Office of Sustainability Department of Housing & Community Development
Supporting Partners	<ul style="list-style-type: none"> Baltimore Gas and Electric (BGE) Civic Works, Green and Health Homes Initiative (GHHI), Maryland Department of Housing and Community Development
Implementation Steps and Timeline	<p>Develop targeted education and outreach program for homeowners and landlords (0-3 years):</p> <ul style="list-style-type: none"> Provide home counseling and investment education on financing tools and mechanisms for upgrades Coordinate with BGE to promote their offerings, such as the Home Energy Assessments program and incentives for lighting, refrigeration, appliances, etc. Promote awareness of Home Energy Audits and incentives for full weatherization to be performed by Baltimore City energy auditors Raise awareness of State and Federal rebates and City tax credits Develop a public list of recommended efficient equipment/appliances for homes that includes considerations for upfront and operational costs <p>Create voluntary reporting and recognition program for “green” rental units (0-3):</p> <ul style="list-style-type: none"> Create program for landlords to voluntarily report on their units’ fuel types, equipment types, or other energy- and sustainability-related features to the City, who could then provide a public list of these rental units and their features to help inform renters Offer a City-created green certification if the rental units meet certain requirements (e.g., only have highly-efficient electric equipment)
Equity Considerations	Potential Positive Equity Impacts:

	<ul style="list-style-type: none"> Prospective purchasers and tenants are generally unaware of energy efficiency and utility cost implications when considering a property; a disclosure and/or education program would increase energy efficiency transparency when residents are looking to rent or buy <p>Other Considerations:</p> <ul style="list-style-type: none"> Ensure educational materials are multilingual and culturally appropriate
Other Implementation Considerations	<ul style="list-style-type: none"> Consider the need for consistent, clear communications across educational materials produced by the City, BGE, nonprofit partners, and state or federal entities on energy efficiency and electrification Consider the need for qualified, trusted contractors who are able to support residential electrification needs Inflation Reduction Act incentives are available for building upgrades for low-income households
Potential Fiscal Implications	<ul style="list-style-type: none"> Funding for receiving weatherization or retrofitting services from these programs Staff time needed to progress citywide communications, coordination and outreach efforts
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> # of housing units reporting to program <p>Outcome:</p> <ul style="list-style-type: none"> Reduced residential building energy use per square foot (kWh/sq.ft., therms/sq.ft) Reduced community-wide residential building energy use (kWh, therms) Reduced residential building energy costs per square foot (\$/sq.ft.)
Community Benefits	Public Health, Economic Prosperity, Savings to Residents and Businesses, Resilience

Action B2. Create Net Zero Plan for City Government Facilities

Action # and Name	B2: Create Net Zero Plan for City Government Facilities
Action Description	Evaluate how to transition City municipal buildings from fossil fuel energy to low or no emission energy sources and establish a maximum offset goal.
Lead Implementor	Department of General Services (DGS)
Supporting Partners	<ul style="list-style-type: none"> • Capital and facilities maintenance teams for: * <ul style="list-style-type: none"> ○ Recreation & Parks ○ Department of Public Works ○ Department of Transportation • Bureau of the Budget and Management Research • Department of Planning
Implementation Steps and Timeline	<p>Develop the Plan (0-3 Years):</p> <ul style="list-style-type: none"> • Develop a net-zero plan and potentially hire a consultant to assist • Develop a plan that outlines the following elements of a net-zero buildings transition: <ul style="list-style-type: none"> • Feasibility Study and Prioritization: <ul style="list-style-type: none"> ▪ Conduct feasibility study for targeted buildings which includes energy audits to understand existing systems and efficiencies ▪ Prioritize buildings for net-zero transition, including identifying buildings that would be exempt from electrification requirements (e.g., industrial processes/buildings) • Electrification and energy efficiency: <ul style="list-style-type: none"> ▪ Identify a timeline for transitioning fossil fuel equipment to efficient electric systems • Clean Energy Sources: <ul style="list-style-type: none"> ▪ Conduct a feasibility study for on-site solar on City government facilities/properties ▪ Conduct green energy purchasing cost analysis • Offsets: <ul style="list-style-type: none"> ▪ Establish an acceptable level and type of carbon offsets and analyze potential cost impacts • End of Life Options <ul style="list-style-type: none"> ▪ Include sustainable end of life options for solar panels, batteries, and other building materials • Outline new specifications for buildings • Update the City Design Standards to align with and reference the municipal net-zero plan

	Implement the Plan (3-7 Years): <ul style="list-style-type: none"> Conduct staff training for new technologies or processes, such as heat pumps or HVAC controls Develop guidelines or regulations necessary to execute on the plan, such as requirements for equipment replacement
Equity Considerations	Potential Positive Equity Impacts: <ul style="list-style-type: none"> Electrifying public buildings may positively impact public health due to reduced local air pollutants from natural gas equipment use Increasing the efficiency of libraries/recreation centers can directly benefit disadvantaged communities as these facilities also serve as cooling/heating centers and essential community assets Other Considerations: <ul style="list-style-type: none"> Any funds spent on purchasing offsets could be spent on other programs that directly benefit residents City buildings can be examples of best-in-class processes and technology for broader education
Other Implementation Considerations	<ul style="list-style-type: none"> Some fossil fuel systems and older facilities may be difficult to electrify (e.g., natural gas systems used for processes at manufacturing and DPW industrial facilities) Substantial electrical upgrades will be required to electrify all municipal buildings Next steps should consider net positive energy buildings that produce more energy than they consume on an annual basis
Potential Fiscal Implications	<ul style="list-style-type: none"> Removal of existing systems Upgrading equipment, and electrical paneling/infrastructure Training staff Purchasing offsets Operational savings due to more efficient equipment
Metrics to Track Progress	Output: <ul style="list-style-type: none"> % of net zero emissions buildings (out of all eligible buildings) kBTU/square foot of buildings (also known as energy use intensity or EUI) % of kWh used that are from clean or renewable sources Outcome: <ul style="list-style-type: none"> Municipal natural gas, heating oil, utility steam and utility chilled water consumption
Community Benefits	Public Health, Resiliency, Savings to the City OTHER: Employee Comfort and Productivity

* DGS does not have decision-making authority for all municipal facilities and this measure will rely on cooperation with large agencies such as Recreation and Parks, Department of Public Works, and Department of Transportation, as well as smaller agencies.

Action T3: Support Transit-Oriented Communities

Action # and Name	T3: Support Transit-Oriented Communities
Action Description	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.
Lead Implementor	<ul style="list-style-type: none"> Department of Planning
Supporting Partners	<ul style="list-style-type: none"> Department of Transportation Department of Housing and Community Development Baltimore Development Corporation Maryland Transit Administration Maryland Department of Housing and Community Development
Implementation Steps and Timeline	<p>Update zoning code to reflect changes for location of TODs in alignment with the Comprehensive Plan (0-3 years):</p> <ul style="list-style-type: none"> There are four types of TOD Districts for areas around existing and anticipated transit stations in the current zoning code. Review the zoning code and update it if needed in alignment with the Comprehensive Plan update. Allow conversion of single-family homes to multi-family units. Encourage elimination of single-family zoning Standardize a site plan review process that allows the City more authority to enforce Complete Streets design guidelines and/or MTA recommendations for development projects impacting the right of way (ROW), projects that impact bus lanes, bus stops, bike infrastructure or other elements in the ROW Expand TOD zones to be in alignment with other future plans, such as the Red Line, Rebuilding American Infrastructure with Sustainability and Equity (RAISE) corridors, and MTA's transit priority corridors identified in their Regional Transportation Plan (RTP) and Complete Streets design guidelines. Consider also aligning with Department of Transportation's separated bike network plan and/or greenway trails network plan Expand TOD zones around transit corridors in addition to light rail, subway or BaltimoreLink bus access. Enact upzoning near transit stations to incentivize long-term investment in those areas

	<ul style="list-style-type: none"> • TOD zones can be within walking and biking distance of key transit stops. Expand TOD zones to two miles around rail stops, and then 0.5 miles on both sides of RTP corridors. Incentivize bike shops and bike repair stations around TOD areas • Increase bike parking requirements and require micro-mobility corral placement in TODs • Consider compensatory mechanism for existing residents in TOD areas such as free one-year micromobility memberships and transit passes • Consider code update for inclusion of affordable housing in TODs • Consider rent control/caps of existing rents to preserve affordable and low-income housing and protect communities from gentrification. Additionally, consider alternative housing stabilization mechanisms such as community land trusts that are implemented preemptive to area transformations <p>Make transportation and land use decisions that enable a 15-minute City (3-7 years):</p> <ul style="list-style-type: none"> • The City's Sustainability and Resiliency Subcabinet's Transportation Working Group recommends identifying pathways to transform Baltimore into a 15-minute city • As a start, audit TOD areas and other high-density commercial zones for connectivity to amenities, land uses and infrastructure investments required to support the 15-minute city concept • Provide for pedestrian, bicycle, and scooter first and last mile connections • Align existing and future transportation and land use plans with this goal. Consider adopting the 15-minute city goal formally through an executive order or legislation • Evaluate empty occupancy in the post-COVID 19 landscape. Incentivize conversion of empty offices to housing, retail, restaurants, other services, and amenities
Equity Considerations	<p>Potential Positive Equity Impacts:</p> <ul style="list-style-type: none"> • Providing affordable housing near high-quality transit, or high-resourced communities as part of a transit-oriented community can reduce resident household and transportation costs, improve household access to jobs and services, and reduce reliance on personal vehicles • Rent control and other housing stabilization mechanisms will protect communities from gentrification • Ensuring amenities, either within the area or within easy access (15-minute city) will line up both with existing neighborhood needs and desires as well as supporting the needs and desires of future residents
Other Implementation Considerations	<ul style="list-style-type: none"> • Consider how amenities which foster co-benefits are incorporated into city planning efforts

Potential Fiscal Implications	<ul style="list-style-type: none"> • Staff time for studies and implementation • Reduced on-road vehicle travel will lower maintenance costs for roadways • Reduced car crashes, noise pollution, and improved air quality from lower VMT and multi-modal roadways results in fewer acute and chronic health issues which takes the burden off the healthcare system • Improved access to employment opportunities and cultural amenities can result in higher spending power within the city
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> • # of projects built to TOD design standards • # of affordable units built in TODs • # of housing units in TOD designated areas • # of new TOD designated areas • Ratio of housing units/off-street parking in TOD designated areas • # of new businesses in TOD designated areas (track type) • # of traffic crashes <p>Outcomes:</p> <ul style="list-style-type: none"> • Reduced vehicle miles traveled • Increased transit ridership • Improved safety • Increased bike and pedestrian volumes • Improved air quality
Community Benefits	<p>Public Health, Savings to Residents and Businesses, Resilience, Social Cohesion</p>

Action T13: Implement Revised Parking Standards and Encourage Developers to Reduce Parking

Action # and Name	T13: Implement Revised Parking Standards and Encourage Developers to Reduce Parking
Action Description	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.
Lead Implementor	<ul style="list-style-type: none"> Department of Planning Department of Housing and Community Development (Zoning Office)
Supporting Partners	<ul style="list-style-type: none"> Parking Authority of Baltimore City Department of Transportation Baltimore Gas and Electric (BGE)
Implementation Steps and Timeline	<p>Implement actions to reduce oversupply of parking for new development (0-3 years):</p> <ul style="list-style-type: none"> Encourage developers to leverage shared parking provisions in the zoning code Educate or inform developers of parking lots or facilities in the vicinity of the site during Pre-Development Meeting of site plan review phase to encourage shared parking agreements Work with Business Improvement Districts to identify and formalize shared parking opportunities Encourage developers/property owners to unbundle parking costs for residents/employees Research and publish a transportation demand management policy to provide developers with concrete steps to reduce parking demand for new development <p>Identify ways to right-size parking requirements (3-7 years):</p> <ul style="list-style-type: none"> Evaluate changes to parking standards over time through a parking study and identify if further reduction in required number of parking spots can be recommended to right-size parking requirements as people shift to using other modes of transportation Mandate strict requirements for developers to provide justification when they submit variance requests to provide more parking spots than what is required by the zoning code

	<ul style="list-style-type: none"> When a new development is proposed, educate community members on how parking needs were right-sized to mitigate concerns of increased traffic and parking within the neighborhoods Discourage new surface parking lots and right-size existing surface parking <p>Prepare parking facilities for ZEV needs (3-7 years):</p> <ul style="list-style-type: none"> Evaluate weight load and charging infrastructure needs for new off-street parking facilities. Require a certain percentage of EV charger spaces or potential EV charger spaces in new facilities Encourage parking areas for e-bikes and e-scooters that incorporates charging infrastructure in commercial areas and parks
Equity Considerations	<p>Potential Positive Equity Impacts:</p> <ul style="list-style-type: none"> Reducing the required number of parking spots can lower costs for builders and increase affordability of new housing units, while freeing up room in new development for more residential, common, and/or green space Reducing stormwater runoff <p>Potential Negative Equity Impact and Solutions:</p> <ul style="list-style-type: none"> Loss of parking or increased parking costs will negatively impact low-income families that are dependent on cars for their transportation needs. This can be compensated through offering transit passes, micromobility share memberships, and/or car share memberships to offset costs.
Other Implementation Considerations	<ul style="list-style-type: none"> High-quality transit options along with walking and bicycling infrastructure are needed in order to reduce parking demand Parking standards should also align with Complete Streets guidelines to enhance green space, permeability and avoid impervious surfaces
Potential Fiscal Implications	<ul style="list-style-type: none"> Staff time to implement action and resources to complete studies
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> # of new developments providing more than required number of off-street parking spaces # of shared parking arrangements created for new development Square footage of new asphalt surface area/reduced asphalt surface area # of new public e-bike and e-scooter parking spaces <p>Outcome:</p> <ul style="list-style-type: none"> Reduced single-occupancy-vehicle miles traveled Reduced congestion Increased bike and pedestrian traffic

	<ul style="list-style-type: none"> • Reduced car ownership rates • Increased transit ridership • Reduced paved surfaces
Community Benefits	Public Health, Savings to Residents and Businesses

Action T14: Promote and Expand Existing Commute Trip Reduction Programs

Action # and Name	T14: Promote and Expand Existing Commute Trip Reduction Programs
Action Description	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.
Lead Implementor	<ul style="list-style-type: none"> • Department of Transportation (DoT) • Maryland Transportation Authority (MTA)
Supporting Partners	<ul style="list-style-type: none"> • Mayor's Office of Employment Development • Greater Baltimore Committee • Baltimore Development Corporation • Employee Development Office • Baltimore Metropolitan Council • Business community • Community organizations
Implementation Steps and Timeline	<p>Launch an information and education program to promote the use of MTA Commuter Connections Program and iRide Baltimore (0 – 3 years):</p> <ul style="list-style-type: none"> • Encourage employers to allow flexible telework policies and provide incentives for 'car free' days among workforce • Make information on these programs accessible and available to diverse audiences • Update the webpage and app to be more streamlined and user-friendly • Conduct a study, in partnership with MTA, to audit the Commuter Connections and other commuter programs, evaluate staffing and funding needs, and recommend ways to increase accessibility and expand services <p>Promote employer shuttle systems that are open to all residents (0 – 3 years):</p> <ul style="list-style-type: none"> • Work with large employers or institutions to sponsor their own shuttles in partnership with other nearby employers and ensure that anyone can ride them regardless of affiliation (similar to the John Hopkins Medicine model) • Alternatively, encourage employers or institutions to collaborate with MTA for increased services along their preferred routes.

	<p>Encourage merging employer/institution shuttles with MTA. Either make those lines free or the employers/institutions can give their employees/students free transit passes</p> <p>Evaluate offering free or discounted public transit to low-income residents (0 – 3 years):</p> <ul style="list-style-type: none"> • Partner with MTA and conduct a study to explore funding structures for offering free or discounted public transit to low-income residents • Passes could be effective at certain times or be geography-based • Evaluate how the City can provide free bikes and e-bikes to low-income citizens, incentivize bike and e-bike purchase for others
Equity Considerations	<p>Potential Equity Impacts and Solutions:</p> <ul style="list-style-type: none"> • Ensure transit and incentive information is relayed in an equitable manner by using multiple languages, clear signage/wayfinding, obvious ways of getting information for the non-digital community (such as signage/wayfinding, real time information at stations) • People also need to feel safe when using transit – provide adequate pedestrian lighting at stops and within walking distance of major transit lines/hubs
Other Implementation Considerations	<ul style="list-style-type: none"> • The action needs to be implemented in parallel to increasing transit service through the Red Line Project and expanding the bike network or providing incentives for shared workspaces or telecommuting • In addition to making improvements to infrastructure that allows for more efficient service, such as a network of buses with transit priority signals, connect the bike network and ensure it lines up with commuter needs • High-quality transit options along with walking and bicycling infrastructure are needed along with commute trip reduction programs to reduce vehicle reliance
Potential Fiscal Implications	<ul style="list-style-type: none"> • Staff time
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> • Participation in MTA Commuter Connections Program and iRide Baltimore programs • Engagement with websites • # of employer shuttle system programs • Ridership of employer shuttle system programs • Transit ridership • % of people who commute by transit, bike, walking, carpool, single occupancy vehicle <p>Outcome:</p> <ul style="list-style-type: none"> • Reduction of vehicle miles traveled in single-occupancy vehicles

Community Benefits

Public Health, Savings to Residents and Businesses, Resilience, Social Cohesion

Action T5: Improve Transit for Low-Income Neighborhoods and Other Communities in Need of Transit Options

Action # and Name	T5: Improve Transit for Low-Income Neighborhoods and Other Communities in Need of Transit Options
Action Description	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.
Lead Implementor	<ul style="list-style-type: none"> • Department of Transportation (DoT) • Maryland Transportation Authority (MTA)
Supporting Partners	<ul style="list-style-type: none"> • Department of Housing • Mayor Office of Employment Development • Department of Health • Department of Planning
Implementation Steps and Timeline	<p>Implement recommendations from the Baltimore City Transit Development Plan (TDP) and MTA's Regional Transit Priorities (0-3 years):</p> <ul style="list-style-type: none"> • The TDP, completed in 2022, recommends improvements to current routes as well as operations improvements for the Charm City Circulator (CCC). The routes proposed in the TDP prioritize neighborhoods with the highest percentage of households who do not own cars and include expanding the CCC service area to close gaps in the current MTA service <p>Identify first and last-mile solutions (0-3 years):</p> <ul style="list-style-type: none"> • First and last mile connectivity refers to the beginning or end of a trip. The "first mile" is the distance between public transport and the end destination, and the "last mile" is the distance between the residence and public transport. For example, people often walk to transit if it is close enough. They might also drive or use another method to get to and from the nearest station or stop. Identify first and last-mile gaps to and from transit facilities and supplement with micro-transit options in transit-dependent communities • Align existing transit plans, priorities and actions with transit equity needs, identified in the forthcoming Baltimore City Transit Equity Gaps Study • In parallel, expand neighborhood shuttles (can be fixed route), micromobility, improve bike and pedestrian infrastructure

	<ul style="list-style-type: none"> • Require sufficient scooter and e-bike placements in these first and last mile key locations • Explore funding mechanisms for implementation <p>Improve accessibility and safety to transit facilities (0-3 years):</p> <ul style="list-style-type: none"> • Conduct a walking/biking/scooter audit to identify infrastructure improvements required for safe access to transit facilities and recommend improvements • Conduct a survey to identify barriers to access of MTA's Call and Ride services, especially for paratransit users, and identify solutions • Create an information campaign to promote the use of public transit and consider including multi-lingual wayfinding elements, a designated hotline for elderly users, and multi-lingual hotline operators • Incorporate designs elements at transit stops to protect transit users from temperature extremes including extreme heat <p>Consider an alternate governance structure for the CCC (0-3 years):</p> <ul style="list-style-type: none"> • Audit CCC's governance structure for operational efficiencies • Consider an alternate operation structure for the CCC, including incorporating it into MTA's operations to leverage regional resources • When considering alternative structures, look at regional resources and evaluate whether the CCC should be operated under the umbrella of MTA to simplify transit for riders, allowing all transit information to be in one source and consolidating bus stops. Under this structure, Baltimore City would pay MTA to run free transit that serves the downtown core. • Consider repurposing public safety funds collected from speed camera funds towards transit operations through legislation
Equity Considerations	<p>Other considerations:</p> <ul style="list-style-type: none"> • Ensure transit is accessible to elderly users and those with disabilities • Make information accessible to non-English speaking communities
Other Implementation Considerations	<ul style="list-style-type: none"> • Improve safety for transit users (e.g., improve pedestrian safety, lighting, protection from weather extremes around stops) • Identify appropriate funding structure and required staffing capacity to implement the infrastructure improvements and expanded transit operations. This could include public-private partnerships and grants
Potential Fiscal Implications	<ul style="list-style-type: none"> • Staff time to complete planning studies • Expanding CCC operations will require a new and dedicated funding source • Hire staff or consultants to implement recommendations • Hire a dedicated grant writer for DoT who can support pursuing upcoming federal or state grants

Metrics to Track Progress	Output: <ul style="list-style-type: none"> • # of trips by origin and destination • # of riders • % of people who commute by transit, bike, walking, carpool, single occupancy vehicle (modal commute percentages) Outcome: <ul style="list-style-type: none"> • CCC ridership • Frequency of service
Community Benefits	Public Health, Economic Prosperity, Savings to Residents and Businesses, Resilience, Social Cohesion

Action T2: Require or Incentivize Active Transport-Friendly Programs and Infrastructure

Action # and Name	T2: Require or Incentivize Active Transport-Friendly Programs and Infrastructure
Action Description	Create more pedestrian, bike and scooter friendly programs and infrastructure throughout Baltimore, particularly in frontline communities.
Lead Implementor	<ul style="list-style-type: none"> Department of Housing & Community Development (Zoning Office)
Supporting Partners	<ul style="list-style-type: none"> Department of Transportation (DoT) Department of Planning (DoP)
Implementation Steps and Timeline	<p>Require developers to meet standards set by Baltimore Complete Streets Manual (0-3 years):</p> <ul style="list-style-type: none"> DoT and DoP to coordinate through site plan review process to require developers to meet complete street requirements, for developments above a certain size <ul style="list-style-type: none"> Set specific requirements for developers to meet beyond those required in the zoning code Establish an inter-departmental review process to ensure compliance For developments that would normally trigger traffic mitigation, developers should be implementing Complete Streets designs. Set parameters around the amount of roadway segment related to development size Require showers, indoor bike parking, other amenities in buildings that people may want to encourage active transportation trips <p>Consider a policy that allows developers to contribute to an active mobility fund or build on-street multimodal infrastructure, in lieu of constructing parking lots or parking facilities (0-3 years):</p> <ul style="list-style-type: none"> The City could repurpose these funds for encouraging other active transportation modes (e.g., giving out free bikes to community members and community outreach/education for micro-mobility) The City could incentivize developers to build on-street multimodal infrastructure instead of adding parking <p>Build partnerships with bike share, micro-mobility, and car share companies (0-3 years):</p> <ul style="list-style-type: none"> During the site plan review process, the City can work with developers to include parking spots for car share or bike share services on site and/or a designated parking coral for scooters.

	Include parking for car share services in prominent locations (near handicapped parking or EV charger/parking)
Equity Considerations	<p>Potential Positive Equity Impacts:</p> <ul style="list-style-type: none"> • Access to active transportation options and facilities will improve public health • The City can incentivize facilities in areas that need them the most as identified in the Baltimore Complete Streets Manual. Communities within the City that qualify as historically underserved were identified based on a combination of indicators including race, household income, household vehicle access, rates of public transportation utilization and median age of residents <p>Other Considerations:</p> <ul style="list-style-type: none"> • Additional requirements may increase development costs. This can be offset by phasing implementation for public/affordable housing projects or identifying other sources of funding to offset additional costs • Rent control and other housing stabilization mechanisms will protect communities from gentrification • Large parts of the city have aging infrastructure and housing stock. Redevelopment costs are higher in underserved communities that need active transportation facilities. The City can consider providing subsidies to offset costs in these areas
Other Implementation Considerations	None identified
Potential Fiscal Implications	<ul style="list-style-type: none"> • Staff time to review, enforce, and implement the program • Staff time and resources resource for studies and zoning code update
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> • Miles of bike lane constructed and maintained • Miles of sidewalk constructed and maintained • # of new bike or scooter facilities such as parking or repair shops • # of intersections redesigned for increased pedestrian and micromobility safety and accessibility • # of All Ages & Abilities micromobility facilities • Miles of sidewalk constructed, and widened • # of new ADA ramps <p>Outcome:</p> <ul style="list-style-type: none"> • Commute mode share • Public space infrastructure (parklets or outdoor dining spaces added, design for distancing projects, slow streets)
Community Benefits	Public Health, Savings to Residents and Businesses, Social Cohesion

Action T10: Expand Public EV Charging Network

Action # and Name	T10: Expand Public EV Charging Network
Action Description	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.
Lead Implementor	Parking Authority
Supporting Partners	<ul style="list-style-type: none"> • Department of Transportation • Maryland Department of Transportation • Maryland Zero Emission Electric Vehicle Council • Baltimore Gas and Electric (BGE) • Recreation and Parks • Commission for Historical and Architectural Preservation (CHAP) • Baltimore Metropolitan Council (BMC)
Implementation Steps and Timeline	<p>Expand public EV charging (0-3 Years)</p> <ul style="list-style-type: none"> • Work with BGE on their existing program to install on-street and parking lot chargers • Coordinate with BMC study on equitable expansion of charging infrastructure in the region • Develop an initial internal EV Charging Plan as basis for comprehensive plan • Develop a comprehensive EV Charging Plan and potentially hire a consultant to assist • Develop policies for residents without dedicated parking spots • Install EV chargers in remaining public parking garages (most garages currently have EV chargers) • Identify a charging vendor that the City can partner with to continue installing on-street chargers • Install chargers in public surface lots • Develop regulations around EV charging, such as fines for non-EVs parking in EV charging spaces or idling fees for fully charged EVs using charging stations • Provide education on location of existing charging ports and how to use them • Study potential for using lamp post chargers (some lamp posts can support lower-level EV charging while others cannot) • Develop maintenance plan for EV chargers located on city property or right-of-way to ensure chargers remain in working condition • Integrate e-bike and e-scooter charging stations

	Address EV charging pricing (3-7 Years): <ul style="list-style-type: none"> Shift from free public charging to priced charging as demand increases, to help pay for the program and ensure charging resources are used efficiently
Equity Considerations	Potential Positive Equity Impacts: <ul style="list-style-type: none"> City Goal is to provide 30% of chargers in equity zones (defined as census tracts in the lowest quartile of median income) Rideshare/taxi/other fleet services that frequently service low-income communities could more feasibly transition fleets to EV if there were publicly accessible chargers in these neighborhoods
Other Implementation Considerations	<ul style="list-style-type: none"> Consider the floodplain when siting EV chargers and infrastructure Balance EV infrastructure with active/public transit infrastructure and prioritize mode shifting There are no current federal ADA requirements for EV charging, so ensure local EV charging is as accessible as possible Level 3 chargers/superchargers are much more expensive, have lower reliability, and not suited for on-street parking spaces – therefore, the City is prioritizing Level 2 chargers for public charging The City cannot offer free public parking in garages or rent out public spaces – therefore, neither of these tactics can be used to offer EV charging spaces The City’s goal is to provide a comprehensive EV network with only 1-2 charging vendors to streamline administration
Potential Fiscal Implications	<ul style="list-style-type: none"> Hiring consultant to develop EV Charging Study/Plan Purchasing/installing and maintaining EVSE infrastructure Staff time to implement action Hiring new staff to implement action Revenue generated from City-owned chargers Federal grants usually require 20% match from City (Parking Authority typically contributes that match, City would need to be more involved with larger-scale projects)
Metrics to Track Progress	Output: <ul style="list-style-type: none"> # of public EV chargers/charging ports % of chargers/charging ports in equity zones % of chargers currently working (i.e. uptime) Monthly usage of BGE chargers (minutes at chargers, electricity use, etc.) Outcome: <ul style="list-style-type: none"> On-road transportation emissions # of registered EV/ZEVs in City
Community Benefits	Public Health, Economic Prosperity, Savings to Residents and Businesses

Action W4: Develop Waste Diversion Incentives

Action # and Name	W4: Develop Waste Diversion Incentives
Action Description	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.
Lead Implementor	Department of Public Works (DPW)
Supporting Partners	<ul style="list-style-type: none"> • Community Leaders • Businesses • Private commercial waste handling companies • Restaurant owners • Community benefits districts • Nonprofits • Schools • City Council
Implementation Steps and Timeline	<ul style="list-style-type: none"> • Align action implementation steps with zero waste planning goals and previous city efforts (0-3 years) • Partner with local organizations to offer convenient residential drop-off diversion locations (0-3 years) • Develop consistent and sustainable funding for Waste Diversion through a combination of public private partnership, general funding, and enterprise funding for waste diversion (7+ years) • Create a plan to connect supply chains and create local markets for reusing materials that DPW handles (3-7 years) <p>Continue education and outreach program (0-3 years):</p> <ul style="list-style-type: none"> • Follow the 10-year Solid Waste Management Plan (SWMP) recommendations on education and outreach <p>Develop financial incentives (3-7 years):</p> <ul style="list-style-type: none"> • Develop a strategy to expand and leverage funding for Solid Waste through financially incentivized legislation such as bottle bills, bag taxes, and diversion mandates • Assess disposal fee restructuring to ensure that sustainable resource management strategies are more affordable than disposal options • Enhance compliance with existing waste reduction and diversion laws, policies or procedures such as the Comprehensive Bag Reduction Act and the Maryland Recycling Act Support compliance with the State of Maryland's Organics

	<p>Recycling and Waste Diversion - Food Residuals legislation (HB264) which requires producers to divert food waste from waste streams through prevention, donation, food rescue or food scrap diversion</p> <p>Develop non-financial incentives (3-7 years):</p> <ul style="list-style-type: none"> • Participate in Zero Waste Coalition – engage regularly in collaborative planning and programming • Improve and expand food recovery programming • Support for food waste audits and waste characterization studies at schools, universities, and other large institutions • Improve overall data tracking for city-managed and privately-managed waste to inform waste diversion strategy • Support the revision or implementation of local legislation and zoning code to eliminate barriers to zero waste like reuse, bring your own (BYO) containers, organics collection, and more. • Explore other waste reduction policies and programs including: <ul style="list-style-type: none"> • Right to Repair laws that allow consumers access to the necessary technical information to repair consumer goods, oppose to disposal • Extended Producer Responsibility (EPR) which passes the cost for managing waste back to the private sector, alleviating the financial burden post-consumer waste places on taxpayers • Leveraging Sustainable Business Guidelines to educate businesses about waste reduction and diversion approaches <p><i>*Note: Though all strategies and actions listed in the 10-Year SWMP are not detailed in the CAP, the goals outlined in the SWMP are fully supported, endorsed and in alignment with CAP goals</i></p>
<p>Equity Considerations</p>	<p>Potential Positive Equity Impacts:</p> <ul style="list-style-type: none"> • Reducing local waste generation can also reduce local air pollutants/health impacts as waste is burned at the WinWaste waste-to-energy facility <p>Other Considerations:</p> <ul style="list-style-type: none"> • DPW is interested in pursuing a diversified and distributed approach to expanding solid waste service funding to avoid placing financial burden on any one sector.
<p>Other Implementation Considerations</p>	<ul style="list-style-type: none"> • Action could require City code or legislative changes • The City manages <50% total city waste and would need heavy coordination and partnerships across the private sector to meet goals • A lot of waste disposed of in the city is not generated in city. Waste generation locations are difficult to track and require legislative action to require waste hauler reporting on waste

	<p>generation locations. Tracking waste generation locations could help inform out-of-city disposal fees</p> <ul style="list-style-type: none"> • Waste composition studies could be conducted to track waste diversion behavioral change
Potential Fiscal Implications	<ul style="list-style-type: none"> • Staff time • Waste cost savings • Job creation • Program costs for incentives (e.g., workshops, consultants) • Capital costs for a bottle return program, collection stations, staffing • Revenue from expanded services
Metrics to Track Progress	<p>Output:</p> <ul style="list-style-type: none"> • Participation rate in programs • Engagement in outreach and education materials/programs • Percent of recyclable/compostable material in waste stream sent to landfill/incinerator (tracked through waste composition studies) • Changes in waste characterization with increased participation in diversion across sectors <p>Outcome:</p> <ul style="list-style-type: none"> • Waste diversion rate
Community Benefits	<p>Public Health, Economic Prosperity, Savings to Residents and Businesses</p> <p>OTHER: City beautification, environmental restoration and preservation, environmental awareness</p>

Appendix 6: Fiscal Analysis of Selected Municipal Actions



Prepared for the
Baltimore Office of Sustainability
Prepared by
AECOM

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Introduction

The Baltimore City Climate Action Plan (CAP) provides targeted community actions and municipal actions that will reduce the City's greenhouse gas (GHG) emissions. To understand the near-term budgetary implications of implementing municipal actions, the AECOM consultant team worked with City staff to select the following three actions for a fiscal analysis:

1. Develop a plan to transition the City to low- or zero-emission off-road vehicles and tools. (Action T18)
2. Require solar ready for government facilities. (Action E5)
3. Create net-zero plan for city government facilities. (Action B6)

All of these actions are categorized as near-term in the plan, defined as actions which can be implemented in the next 1-3 years. They were selected because while the immediate focus is on plan development, ultimate implementation of the actions will be capital-intensive. In other words, they will eventually require significant upfront investment from the City. At the same time, implementation will create the opportunity for the City to achieve significant cost savings, such as through reduced energy and operating costs.¹

For this analysis, AECOM calculated the costs and potential savings from replacing GHG-emitting fuel-based systems with zero-carbon alternatives over a ten-year timeframe. Note that for equipment with a lifecycle greater than ten years (e.g., solar panels which generate energy cost savings for 25 years), the full life cycle was taken into account to assess the total cost savings associated with each municipal climate action.

Approach

This analysis calculates the costs and potential savings from transitioning the City's off-road fleet to zero-emission vehicles, requiring that new roofs on government facilities be solar ready, and transitioning to net-zero government facilities. For each of these actions, AECOM selected assets for analysis based on their potential to reduce GHG emissions considering the City's equipment usage patterns and the equipment lifecycle; and City staff input. The key outputs of the task include financial performance metrics such as the Return on Investment (ROI) and asset-level payback period to inform the City's near-term climate investment decisions.²

¹ Note that municipal action T17, "transition to zero- or low-emissions fleet", was not selected for the fiscal analysis because a preliminary fiscal analysis on municipal fleets has already been conducted by the City.

² Based on City input, the fiscal analysis assumed an inflation rate of 2.5% and a nominal discount rate of 4.35% across all three municipal actions.

In addition to the potential fiscal benefits of implementing each action, environmental and social benefits are qualitatively discussed to evaluate the overall impact of municipal actions. Note that while these municipal actions are expected to yield various potential nonmonetary benefits such as improved public health, public education, and air quality, the magnitude of those benefits may not be as significant as those of community actions which have the potential to be implemented at a much larger scale.

Lastly, the fiscal analysis identifies key funding opportunities that can potentially fund and finance the proposed municipal actions. Note that most of the identified funding programs are from the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA).

Summary of Results

Table 1 summarizes the range of costs and savings associated with each municipal action at the asset level. The cost savings through electric transition is from the savings in maintenance and repair costs and fuel costs over the entire asset lifecycle. The asset-level ROI for municipal action T18 is 75%, demonstrating the substantial lifecycle cost saving potential through the adoption of electric mowers. Municipal action E5 has an ROI of 40% for both buildings. Lastly, municipal action B6's ROI ranges from 26% to 55%, with the Health Department Headquarters having the highest return on replacing gas-fired heaters with rooftop heat pumps.

Table 1. Summary Results for Municipal Actions

All numbers are rounded up to the nearest thousand.

	Municipal Action T18	Municipal Action E5	Municipal Action B6
Description	Replacing 87 aged-out fuel-based mowers with electric substitutes.	Installing rooftop solar on two City-owned buildings: Govans Multipurpose Center and the War Memorial Building.	Replacing gas-fired boilers and heating and cooling systems with electric alternatives in three City-owned buildings.
Asset-level Capital Cost	\$3,261,000	\$326,000 - \$648,000	\$67,000 - \$352,000
Cost Savings through Electric Transition	\$3,746,000	\$402,000 - \$800,000	\$42,000 - \$197,000
Annual Cost Savings through Electric Transition	\$374,600	\$16,000 - \$32,000	\$2,000 - \$15,000
Asset-level ROI*	75%	40%	26% - 55%

**The ROI of electric equipment was calculated by dividing total savings by the lifecycle cost of the electric equipment.*

Fiscal Analyses and Results

Municipal Action 1: Develop a Plan to Transition City to Low- or Zero-Emission Off-Road Vehicles and Tools

Action Description

This action in the CAP reads as follows:

“Develop a Plan to transition City and City contractors to low- or -zero-emissions off-road vehicles and tools. This could include developing a contracting policy that encourages the City to contract with businesses operating low- or zero-emission fleets of off-road equipment; or adopting a zero-emission off-road vehicles and equipment policy that requires or encourages low- or -zero-emission replacements depending on categories of vehicles and equipment.”

While the municipal action is focused on a transition plan development for off-road vehicles and equipment, **the fiscal analysis evaluated the costs, operational savings, and net fiscal implications of the actual transition of City-owned mowers.**

Data and Methodology

Dataset

The off-road fleets dataset was provided by the Baltimore Department of General Services (DGS). The dataset contains information on 500+ City-owned off-road equipment, with key datapoints such as acquisition cost, equipment age, equipment life cycle, annual fuel usage, and annual maintenance and repair cost. The assets are owned by multiple city departments and detailed data is available from 2013 through present. The dataset includes 28 city-owned equipment categories, valued at approximately \$30 million.

Asset Selection for Fiscal Analysis

The City of Baltimore’s equipment inventory encompasses over 30 equipment categories, ranging from light towers to excavators. AECOM worked closely with City Staff to evaluate the current commercial availability of electric alternatives as well as their emissions reduction potential. Equipment categories without commercially available electric alternatives, or those with electric substitutes of limited capacity, were excluded from the analysis. For instance, light towers are heavily used by the City, yielding significant emissions reduction potential, but due to the lack of electric alternatives currently available in the market, they were not selected for the analysis. Based on market availability of electric alternatives, City staff selected mowers for a fiscal analysis. Due to the city's extensive fleet of gas-powered mowers and their frequent use, transitioning to electric mowers could significantly reduce the city's greenhouse gas emissions.

Methodology

1. Identification of Electric Alternatives

AECOM focused on 87 mowers that required replacement in the next ten years based on their useful life.³ AECOM then grouped mowers into smaller equipment classes using the City’s existing class definitions to identify electric substitutes with similar properties and assessed the acquisition cost of zero-emission alternatives. AECOM researched the best commercially available models as of September 2023 and identified the “Mean Green EVO” to be the electric replacement for mowers. The electric alternative and marginal cost of acquisition are listed in Table 2. The average replacement cost of fuel-based mowers was found in the city's fleets dataset, and the cost of electric alternatives was from AECOM's cost research.

Table 2. Electric Alternatives for Mowers

Unit Count for Replacement	Average Replacement Cost (2023) of Fuel-Based Mower	Electric Equipment Alternative	Replacement Cost (2023) of Electric Mower	Marginal Replacement Cost of Electric Mower
87	\$15,000	Mean Green EVO	\$38,000	\$23,000

³ One mower category was excluded from the analysis despite requiring replacement due to its significantly high capacity, which precluded the availability of electric substitutes.

2. Calculation of Financial Metrics

Table 3 summarizes the information on cost inputs for replacing fuel-based mowers with electric alternatives.

- **Capital Cost:** AECOM calculated the total acquisition cost of replacing aged out mowers in a ten-year timeframe (2023-2033) using City-provided equipment data. Capital costs were discounted based on the year in which the equipment would be replaced, to reflect all costs in present terms.
- **Maintenance and Repair(M&R) Cost:** Average annual maintenance and repair cost per mower was calculated using the City's historical M&R data (2013-2023). According to current industry benchmarks, there is an average of a 65% difference in M&R costs between fuel-based offroad equipment and electric alternatives on the mechanical side, based on past AECOM projects; this is because electric alternatives have fewer moving parts than their gas-powered counterparts.⁴ M&R cost for electric equipment was calculated by multiplying 65% by the annual average M&R cost of fuel-based equipment.
- **Total Electricity Cost:** To calculate the electricity spending per unit, AECOM estimated annual electricity usage based on City staff input on fuel usage assumptions. An average annual fuel consumption of 1,260 gallons per mower was estimated based on the assumption that each mower operates from May to November, five days per week, for six hours per day, consuming 1.5 gallons per hour. Using this annual rate of fuel consumption, AECOM converted the fuel usage rate (gallons per acre) to electricity usage rate (kWh per acre).⁵ Lastly, the City's fuel and electricity unit costs were inflated annually using the forecasted increase in fuel and electricity prices from the Energy Information Administration (EIA) to account for increasing costs over time.
- **Total Savings:** The total savings from transitioning from fuel-based mowers to electric alternatives were calculated by summing the marginal savings in both M&R cost and the difference between fuel costs. Note that the cost savings were primarily driven by the significant reduction in fuel costs.

Table 3. Fiscal Analysis Inputs for Mowers

All numbers are rounded up to the nearest thousand.

		City-Owned Mowers
Equipment Overview	Number of Equipment	87
	Average Cost of Fuel-based Equipment (per unit)	\$15,000
	Average Cost of Electric Equipment (per unit)	\$38,000

⁴ "The Future of Electric Off-Road Cars: What you need to know", August 2023, <https://energy5.com/the-future-of-electric-off-road-cars-what-you-need-to-know>

⁵ For Fuel Consumption: "Fuel Expense & Emissions Calculator for Commercial Mowing Equipment", Grasshopper Mower, <https://www.grasshoppermower.com/fuel-calculator/>; For Electricity Usage and Consumption: "Greenworks Commercial ride-On Zero Turn Mower – 16kW", Woods Machinery, <https://woodsmachinery.com/listings/cz-52r-82v-52-commercial-ride-on-turn-mower-16kw/>; "How to Calculate Electrical Load Capacity for Safe Usage", The Spruce, <https://www.thespruce.com/calculate-safe-electrical-load-capacities-1152361>

Financial Metrics for Electric Alternatives	Total Capital Cost	\$3,261,000
	Total M&R Cost	\$1,716,000
	Total Electricity Cost	\$30,000
	Total Savings (from M&R and fuel cost reduction)	\$3,746,000

3. Calculation of Financial Returns Metrics

Table 4 summarizes the financial performance metrics in a ten-year timeframe. To evaluate the financial implications of transitioning to electric mowers, AECOM calculated the following metrics:

- **Annual Cost Savings:** The annual cost savings is calculated by dividing the total savings (from M&R and fuel cost reduction) by ten.
- **Return on Investment (ROI):** The ROI of electric mowers was calculated by dividing total savings by the lifecycle cost of 87 electric mowers which is the sum of capital cost, M&R cost, and electricity cost.
- **Payback Period:** The payback period for mowers was estimated by dividing the total lifecycle cost differential by the annual cost savings. This metric measures the number of years required for the accumulated cost savings benefits to exceed the additional investment associated with electric mowers compared to replacement with fuel-based mowers. In other words, a shorter payback period indicates that the investment will yield a positive ROI in a shorter period of time.

Limitations and Future Considerations

- **Electric Equipment Availability:** The electric substitute chosen for this analysis was identified based on research on commercially available models as of September 2023. Given that the electric vehicle market is rapidly evolving, commercially available options at cheaper prices might become available at the time of action implementation. As a result, the fiscal analysis may need to be updated depending on the timing of implementation.
- **Exclusion of Training Costs:** The cost of skills training and supportive services to prepare current city workers for the transition to electric equipment was omitted from the fiscal analysis due to the limited information on the city's maintenance and repair workforce. Additionally, the methodology for estimating the number of workers required for mowers was unclear when the current staff manages more than twenty equipment categories.
- **Electric Equipment Charging Schedule:** Electricity cost assumptions in the analysis did not account for cost differentials between charging during on-peak vs. off-peak hours. According to EIA, on-peak hours generally refer to 7:00 AM to 11:00 PM on weekdays, and off-peak hours refer to 11:00 PM and 7:00 AM on

weekdays, and all day on weekends and holidays.⁶ To avoid surcharge during peak times it would be necessary to develop a detailed operations plans to charge electric equipment during off-peak periods.

- **Exclusion of Charging Infrastructure:** Although the transition to zero-or low-emissions fleet will necessitate the expansion of municipal EV charging infrastructure, this infrastructure is outside the scope of this analysis and was not included in the financial model. Additional analysis will be required to evaluate charging needs associated with the electrification of off-road equipment and establish an installation plan. However, it is worth noting that multiple types of vehicles and equipment, including both on-road and off-road varieties, can generally share charging infrastructure, resulting in economies of scale as the City expands its electric fleet. For example, New York City, as part of its plan to electrify the municipal fleet, has installed over 1,600 charging ports in city-owned garages and parking locations, all administered under the Department of Citywide Administrative Services since 2015.⁷ In addition, some of these charging ports can also be publicly accessible, making the pricing structure and return on investment for their installation unpredictable and dependent on many assumptions. In Baltimore, the Parking Authority has already been collaborating with other city agencies to expand publicly accessible charging infrastructure on city-owned properties. Currently, across 26 city-owned locations, the Parking Authority has already installed 110 Level 2 charging plugs and 16 fast charging plugs, with plans to install 40 more Level-2 charging plugs in 10 new locations.⁸ Thus, while additional investment will be required for the City to provide and maintain adequate charging infrastructure for fleet electrification, the marginal cost and return of providing charging infrastructure for fleet expansion will require additional analysis.

Summary Results

Table 4 summarizes the fiscal analysis results for transitioning to electric mowers. Based on this analysis, mowers yield significant cost savings and have an ROI of 75% despite the capital cost of replacing 87 mowers with electric substitutes cost \$2.2 million more in the ten-year analysis timeframe.

Because of the significant fuel savings as well as the lower M&R cost of electric equipment, mowers yield positive returns from electrification.

⁶ "Day or Night: When is the Best Time to Charge your EV?", Blink Charging, <https://blinkcharging.com/day-or-night-when-is-the-best-time-to-charge-your-ev/>

⁷ "Fleet Sustainability", New York Department of Citywide Administrative Services, <https://www.nyc.gov/site/dcas/agencies/fleet-sustainability.page>

⁸ "Publicly Accessible EV Chargers", Parking Authority of Baltimore City, <https://parking.baltimorecity.gov/electric-vehicle-charging-program/publicly-accessible-ev-chargers%C2%A0>

Table 4. Fiscal Analysis Results

All numbers are rounded up to the nearest thousand.

Financial Returns Metrics	City-Owned Mowers
Annual Cost Savings	\$375,000
Return on Investment (ROI)	75%
Payback Years	<1 years

Co-Benefits

The EPA assumes that a gallon of diesel fuel emits around 22 pounds of CO₂, and the EIA estimates that a gallon of gasoline emits about 19 pounds of CO₂.^{9,10} By transitioning to electric mowers, the City can avoid emitting 194,000 pounds of CO₂ from diesel fuel, and 1,915,000 pounds of CO₂ from gasoline. Off-road vehicles and equipment contribute heavily to pollution due to the sector's reliance on diesel engines, which emit particulate matter and criteria pollutants.¹¹ The solid material in diesel exhaust known as diesel particulate matter is known to be composed of carbon particles and other organic compounds, including over 40 cancer-causing organic substances.¹² As such, the City's transition towards low-or-zero-emissions off-road equipment provides direct financial benefits in terms of lower operating costs, as well as significant co-benefits, such as improved air quality, reduced health risks for equipment operators and surrounding communities, and reduced healthcare costs. Additionally, electric equipment is generally quieter, which reduces noise pollution in operating environments and can mitigate the risk of occupational illnesses related to work-related noise exposure for operators.¹³

Potential Federal Funding Opportunities

Table 5 includes a variety of federal funding opportunities for the electrification of off-road fleets. The funding opportunities below can be awarded directly to local governments. Although this table focuses on funding for vehicle and equipment replacements, there are also other state and federal funding opportunities for the purchase and installation of electric vehicle charging infrastructure.

⁹Greenhouse Gases Equivalencies Calculator, EPA, <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>

¹⁰ Gasoline explained: gasoline and the environment, EIA, <https://www.eia.gov/energyexplained/gasoline/gasoline-and-the-environment.php>

¹¹ "Overview: Diesel Exhaust & Health", California Air Resources Board (CARB), <https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health>

¹² "Overview: Diesel Exhaust & Health", California Air Resources Board (CARB), <https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health>

¹³ "Lawn and Garden Equipment Sound: A comparison of Gas and Battery Electric Equipment", December 2018, Arup and Quiet Communities, https://www.researchgate.net/publication/332893521_Lawn_and_Garden_Equipment_Sound_A_Comparison_of_Gas_and_Battery_Electric_Equipment

Table 5. Funding Table

Department	Program	Description	Link
Environmental Protection Agency	Diesel Emissions Reduction Act (DERA) National Program	EPA is offering funding assistance to accelerate the retrofit or replace existing diesel engines, vehicles, and equipment including off-road vehicles used in construction, handling of cargo, agriculture, mining, or energy production, with EPA-certified engine configurations and verified retrofit and idle reduction technologies.	Diesel Emissions Reduction Act (DERA)
US Department of Transportation (Federal Highway Administration)	Congestion Mitigation and Air Quality Improvement (CMAQ) Program ¹⁴	CMAQ provides funding for State and local governments to fund projects to help meet the requirements of the Clean Air Act. Eligible projects include diesel engine replacements and retrofits.	Congestion Mitigation and Air Quality Improvement (CMAQ)
US Department of Energy	Vehicle Technologies Office (VTO) Program ¹⁵	DOE's Vehicle Technologies Office (VTO) release funding opportunities every year (based on program priorities) –many of these opportunities supported transportation electrification projects including the planning and installation of charging infrastructure, electric vehicle deployment/data collection/analysis.	DEP Vehicles Funding Opportunities

¹⁴ Eligible applicants for CMAQ are Transportation Management Associations (TMAs) and Metropolitan Planning Organizations (MPOs).

¹⁵ Note that the VTO program primarily focuses on research and development, and deployment of advanced technologies to reduce emissions in the transportation sector. Therefore, the City can partner with manufacturers and higher education institutions for the funding program.

Municipal Action 2: Require Solar Ready for City Government Facilities

Action Description

This action in the CAP reads as follows:

“Require all new construction or major renovation to be solar ready and evaluate existing roofs for additional solar opportunities.”

While the municipal action focuses on making City -owned buildings ready for solar panels, the fiscal analysis assumed the full installation of a rooftop solar panels. This is because roof replacement and rooftop solar installation are typically done at the same time since solar panels and commercial roofs having a similar lifespan of 25 to 30 years. **To estimate the incremental fiscal impacts of making City roofs solar-ready alongside a rooftop solar installation, AECOM conducted a fiscal analysis on two scenarios: 1) rooftop solar installation with roof replacement; and 2) rooftop solar installation without roof replacement.** City-owned assets were selected based on factors such as potential energy generation capacity, data availability, and roof age. The following two buildings were assessed for a fiscal analysis of rooftop solar installation: Govans Multipurpose Center, and the War Memorial Building.

Data and Methodology

Dataset

AECOM used the building portfolio database provided by DGS. The dataset contains 120 City-owned buildings with granular system-level information such as installation year, system end of life, system life cycle, system replacement cost, and detailed system description based on maintenance reports. The building portfolio data was matched to the energy use dataset provided by DGS to identify each building's annual energy consumption. This information was incorporated when sizing and costing the rooftop solar units.

Related Study on Roof Readiness

This analysis builds on a 2023 report prepared by the SEMCAS group, which evaluated the feasibility of installing rooftop solar on 25 City-owned buildings. This analysis incorporated some of the selection criteria from the study such as the generation-to-use ratio and roof age (prioritizing roofs with less than 10 years of remaining roof life). Additionally, AECOM used the National Renewable Energy Laboratory ([NREL](https://pvwatts.nrel.gov/pvwatts.php)) [PVWatts Calculator](https://pvwatts.nrel.gov/pvwatts.php) to estimate the capital cost and energy production capacity of each building's PV systems, following the methodology outlined in the 2023 roof readiness report.¹⁶

Asset Selection for Fiscal Analysis

¹⁶ PVWatts Calculator. <https://pvwatts.nrel.gov/pvwatts.php>

AECOM sorted City-owned buildings based on their roof age, energy intensity, and electricity generation potential. City staff selected the Govans Multipurpose Center and the War Memorial Building for the rooftop solar analysis.

Methodology

Table 6 and Table 7 summarize the PV system assumptions and financial inputs for both rooftop solar installation with roof replacement and rooftop solar installation without roof replacement.

1. Solar PV System and Roof Replacement

- **PV System Capacity:** For the two selected buildings, AECOM estimated the optimal solar panel size using the [PVWatts Calculator tool](#).¹⁷ The annual electricity generation capacity (in kWh) for each building was calculated assuming that 70% of each building's roof area is available for PV.
- **Electricity Generation:** AECOM calculated the average annual electricity consumption per building based on the data provided by the City, assuming annual electricity consumption for each building would be constant for the analysis period of 25 years, to account for the full life cycle of the installed PV system. The City-provided 2023 electricity unit cost was inflated annually using the forecasted percentage increase in electricity price from the Energy Information Administration (EIA).
- **Baseline Roof Replacement Cost:** Each building's roof area and its baseline roof replacement cost were provided in the building portfolio dataset. Table 8 summarizes the baseline roof load-bearing capacity by assuming that the average roof can hold 20 pounds per square foot and multiplying that by each building's roof area.¹⁸
- **Marginal Roof Replacement Cost:** The marginal cost for load capacity enhancement is based on a University of Nebraska study showed that the cost of increasing rooftop structural loading for a commercial building is \$40 per square foot for an increase of 28 pounds per square foot of load capacity, which amounts to about \$1.40 per pound of increased capacity per square foot.¹⁹ AECOM used this dollar metric to estimate the marginal cost required for retrofitting existing roofs for each building to accommodate the additional weight from solar panels. The marginal roof replacement cost represents the incremental cost associated with retrofitting roofs to be solar-ready in addition to the baseline roof replacement.

¹⁷ PVWatts Calculator. <https://pwwatts.nrel.gov/pwwatts.php>

¹⁸ "How much weight can a roof hold", America's Choice Roofing, February 2022, <https://www.americaschoiceroofing.com/blog/great-falls/how-much-weight-can-a-roof-hold/>

¹⁹ "Green Roofs Increase Structural Loading Costs", University of Nebraska-Lincoln, 2018, https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1023&context=arch_land_facultyschol

2. Calculation of Financial Metrics

- **Capital Cost:** The capital cost of PV installation was calculated by multiplying a unit cost of \$3.02/Watt by the system capacity.²⁰ The capital cost for rooftop solar with roof replacement considered the cost of increasing the loading capacity to accommodate the additional weight of the PV systems, using the metric of \$1.40 per pound of increased capacity per square foot from the University of Nebraska study as described above. The marginal capital cost is estimated to be \$27,000 for an additional 18,500 pounds for the War Memorial building, and \$13,000 for an additional 9,300 pounds for the Govans Community Center building.
- **M&R Cost:** Using NREL's annual operations and maintenance (O&M) unit cost estimate (\$/kW) from its 2022 report, AECOM derived the year-over-year M&R cost for each proposed system.²¹ The levelized M&R cost for a 25-year analysis period was around \$18/kW. The M&R cost only covers the maintenance of the PV system, and therefore is the same for both roof replacement scenarios.
- **Total Tax Credit:** The analysis assumed that the 30% Solar Investment Tax Credit (ITC) in the form of direct pay would be available as revenue, reducing the upfront installation cost of PV solar on each building.²² The credit amount was calculated by multiplying 30% to the required initial investment for each building. Note that the ITC will require tax-exempt claimants to comply to the domestic content requirement starting in 2026. The requirement states that after 12/31/2026, at least 55% of the manufactured products must use domestic content.²³
- **Total Cost Savings:** Total cost savings were calculated as the sum of the total electricity cost the City would have incurred without solar power generation.
- **Total Revenue:** AECOM calculated total revenue per building by adding the tax credit, net metering income (where applicable), and cost savings from avoided electricity cost.

²⁰ "Solar Panel Cost in Maryland", Energy Sage, March 2023, <https://www.energysage.com/local-data/solar-panel-cost/md/?rc=seia>

²¹ "U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, with Minimum Sustainable Price Analysis: Q1 2022", National Renewable Energy Laboratory, 2022, <https://www.nrel.gov/docs/fy22osti/83586.pdf>

²² Domestic Content Bonus Credit Guidance Under Sections 45, 45Y, 48, and 48E, US Department of the Treasury, <https://www.irs.gov/pub/irs-drop/n-23-38.pdf>

²³ "Domestic Content Bonus Credit Guidance Under Sections 45, 45Y, 48, and 48E", IRS. <https://www.irs.gov/pub/irs-drop/n-23-38.pdf>

Table 6. Fiscal Analysis Inputs without Roof Replacements

All numbers are rounded up to the nearest thousand.

		Govans Multipurpose Center	War Memorial Building
Solar PV System	Installation Year	2023	2023
	PV System Capacity	108 kW	215 kW
	Electricity Generation, in kWh (First Year)	150,000	299,000
	Electricity Generation, in kWh (Total)	3,456,000	6,882,000
	Solar Energy Consumed Onsite	100%	100%
Financial Metrics	Total Capital Cost	\$326,000	\$648,000
	Total Tax Credit (Solar Investment Tax Credit of 30%)	\$98,000	\$194,000
	Total M&R Cost	\$45,000	\$89,000
	Annual Cost Savings (from Avoided Electricity Costs)	\$402,000	\$800,000

Table 7. Fiscal Analysis Inputs with Roof Replacements

All numbers are rounded up to the nearest thousand.

		Govans Multipurpose Center	War Memorial Building
Rooftop Replacement	Roof Area (square feet)	9,000	19,000
	Baseline Roof Weight Capacity (pounds)	186,000	370,000
	Baseline Roof Replacement Cost	\$269,000	\$870,000
	Marginal Cost for Load Capacity Enhancement	\$13,000	\$27,000
Solar PV System	Installation Year	2023	2023
	PV System Capacity	108 kW	215 kW
	Electricity Generation, in kWh (First Year)	150,000	299,000
	Electricity Generation, in kWh (Total)	3,456,000	6,882,000
	Solar Energy Consumed Onsite	100%	100%
	PV System Weight (pounds)	14,000	29,000
	% of PV System Weight over Total Weight Capacity	8%	8%
	PV Solar Installation Cost	\$326,000	\$648,000
Financial Metrics	Total Capital Cost (PV Solar and Roof Replacement)	\$595,000	\$1,518,000
	Total Tax Credit (Solar Investment Tax Credit of 30%)	\$98,000	\$194,000
	Total M&R Cost	\$45,000	\$89,000
	Total Cost Savings (from Avoided Electricity Costs)	\$402,000	\$800,000

3. Calculation of Financial Returns Metrics

- **Annual Cost Savings:** Annual cost savings were calculated as the sum of the total electricity cost the City would have incurred without solar power generation divided by 25 years.
- **ROI:** The 25-year ROI was calculated by dividing the net profit (the difference between total revenue and operating cost) by the capital cost.
- **Net Present Value (NPV):** AECOM estimated the NPV by subtracting the total revenue from the total cost, all expressed in present terms. A positive NPV indicates that the total revenue of the investment exceeds its lifecycle costs.
- **Payback Period:** AECOM conducted a payback period analysis to evaluate the economic viability of each PV solar installation, given that the lifecycle of solar panels is typically 25 years. To assess the payback period, AECOM calculated the annual net cash flow and observed the year in which the cumulative net present value (NPV) became positive.

Limitations and Future Considerations

- **Uncertainty on the Need to Invest in Solar-Ready Roofs:** The proposed PV solar system will weigh less than 10% of the total load capacity of each roof of the two buildings. Therefore, it is unclear whether the City will need to increase the load capacity of the roofs beyond the base case roof replacement.
- **War Memorial Building's Roof Replacement Plan:** As of December 2023, the War Memorial building is undergoing a design phase for a roof replacement. Given that the new roof will have a 5-year warranty which would be voided if the City installed rooftop solar, the City may postpone the rooftop solar installation until 2028, upon the roof warranty's expiration. Thus, the fiscal analysis may have to be adjusted to account for this contingency.
- **Cost Savings from Coordinating Roof Replacement and Rooftop Solar Installation:** A 2021 report from the DOE found that homeowners saved an average of \$4,000 by replacing their roof and installing rooftop solar panels at the same time.²⁴ Due to insufficient available data, AECOM excluded the calculation of potential cost savings that the City could realize by simultaneously replacing municipal roofs and installing solar panels. While there is limited research on the cost savings for commercial buildings, implementing roof replacement and rooftop solar installations simultaneously is likely to be most efficient since the lifetime of a commercial roof and solar panels are similar.
- **Solar Power Purchase Agreements (PPAs):** The analysis assumed that the City would own the rooftop solar infrastructure, which would entail the City bearing all associated costs. PPAs are a popular financing model for local government solar projects, and the City could consider adopting them as it plans to expand its solar portfolio. In this "third-party" ownership model, a developer procures,

²⁴"Replacing your roof" It's a great time to add solar", Becca Jones-Albertus, July 28, 2021, <https://www.energy.gov/eere/solar/articles/replacing-your-roof-its-great-time-add-solar#:~:text=Combined%20with%20a%20roof%20replacement,homeowners%20an%20average%20of%20%244%2C000.>

installs, and operates the solar photovoltaic system on a municipal site, while the government entity enters into a long-term (typically 15-25 years) contract to purchase 100% of the electricity generated by the system from the developer.²⁵ The primary benefit of this financing model is that because the developer handles the cost of procurement and installation, the municipality will have low to zero upfront costs. In addition, because of the long-term nature of the contract, the cost of electricity is either fixed at a constant rate or escalates at a predetermined rate during the contract term, providing the City with improved cost stability and visibility.²⁶

Summary Results

Table 8 summarizes the fiscal analysis results for the two buildings. Given that the average useful life cycle of rooftop solar is usually between 25 and 30 years, both city-owned buildings have positive returns from a rooftop solar installation with payback years below 25 years.

Table 9 summarizes the fiscal analysis results for the two buildings with the roof replacement cost incorporated in the capital cost. Note that the capital cost of rooftop solar with roof replacement assumes retrofitting the newly replaced roofs to add load capacity. Due to the higher initial investment required in this scenario, the ROI and NPV metrics decreased significantly, as the additional investment in roof replacement does not generate additional cost savings.

Table 8. Fiscal Analysis Results without Roof Replacement Cost

All numbers are rounded up to the nearest thousand.

Financial Returns	Govans Multipurpose Center	War Memorial Building
Annual Cost Savings	\$16,000	\$32,000
Return on Investment (ROI)	40%	40%
Net Present Value (NPV)	\$129,000	\$ 257,000
Payback Period	19 years	20 years

Table 9. Fiscal Analysis Results with Roof Replacement Cost

All numbers are rounded up to the nearest thousand.

Financial Returns	Govans Multipurpose Center	War Memorial Building
Annual Cost Savings	\$16,000	\$32,000
Return on Investment (ROI)	-22%	-38%
Net Present Value (NPV)	-\$140,000	-\$613,000

²⁵ "Power Purchase Agreement Checklist for State and Local Governments", National Renewable Energy Laboratory (NREL), <https://www.nrel.gov/docs/fy10osti/46668.pdf>

²⁶ "Solar Power Purchase Agreements", <https://www.seia.org/research-resources/solar-power-purchase-agreements>

Payback Period	Beyond 25 years	Beyond 25 years
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Co-Benefits

Municipal solar projects can yield economic opportunities for Baltimore. As the City scales up its municipal solar projects, direct and indirect jobs tied to the solar industry will be created, strengthening the local economy. Moreover, installing PV solar on City-owned buildings serves as an opportunity to raise awareness of the benefits of solar energy, encouraging communities to learn about renewable energy, sustainability, and energy efficiency.

In general, ensuring that the municipality's facilities are solar ready can pave the way towards reducing the City's reliance on a fuel-dependent energy grid. Although not considered in this analysis, rooftop solar installation can also be combined with battery storage, which can generate the added benefit of strengthened resilience during extreme weather events.

In addition to the general benefits associated with municipal solar, city stakeholders stated additional candidates for City-owned solar projects, such as school buildings and parking canopies, could provide significant community benefits. These were not considered in this particular analysis but have the potential to generate not only energy costs savings but also additional community benefits. For example, installing rooftop solar on school buildings can generate benefits such as improved air quality for students, educational opportunities, and enhanced resilience against power disruptions if paired with battery storage.²⁷ Solar canopies over parking lots are also strong candidates as they can provide shade over pavement thereby reducing the heat island effect, and unlike rooftop solar arrays which are restricted by roof characteristics, the panels on solar canopies can be oriented to maximize electricity production.²⁸

Potential Federal Funding Opportunities

Table 10 highlights the wide range of funding opportunities for municipal solar projects. The Investment Tax Credit (ITC), under the Inflation Reduction Act (IRA), allows the City to receive direct payment for all types of renewable energy projects including solar. In addition to the funding opportunities listed in the table below, there are a number of other solar-related funding opportunities that focus on community or residential solar projects, as the City considers expanding its solar projects.

²⁷ In Wise County in southeast Virginia, the savings generated from solar energy paid for solar apprenticeships wherein high school students were paid to help with the installation. The energy credits generated from the school's solar panels can also be distributed across the community – for example, in Heart-Butte, Montana, three-quarters of the energy credits were arranged to help lower the electric bills of households in the community. "Facing Budget Shortfalls, These Schools Are Turning to the Sun", New York Times, 15 September 2022, <https://www.nytimes.com/2022/09/15/climate/solar-energy-school-funding.html>

²⁸ "Solar Canopies: Bring solar panels to your parking lot", Energy Sage, October 2023, <https://www.energysage.com/business-solutions/solar-canopy-installations-bring-shade-clean-energy-parking-lot/>; "Why Putting Solar Canopies on Parking Lots is a Smart Green Move", Yale Environment360, November 2021, <https://e360.yale.edu/features/putting-solar-panels-atop-parking-lots-a-green-energy-solution>

Table 10. Funding Table

Department	Program	Description	Link
Department of the Treasury	Clean Energy Investment Tax Credit (ITC)	Authorized under the Inflation Reduction Act (IRA), the ITC is a dollar-for-dollar credit for expenses invested in renewable energy properties. Tax-exempt entities like the municipality and school districts are eligible for the full direct payment up to the cost of the project.	IRA Provisions related to Renewable Energy
Department of Energy (Office of State and Community Energy Programs)	Energy Efficiency and Conservation Block Grant (EECBG) Program	Authorized under the IIJA, this program is designed to support states, local governments, or tribes to implement strategies to reduce energy use, reduce fossil fuel emissions, and improve energy efficiency, this grant program can be applied to a broad range of eligible uses including: 1.) the development/installation of onsite renewable energy technology in any government building, and 2.) the development/implementation of energy efficiency programs for buildings and facilities within the jurisdiction of the eligible entity.	Energy Efficiency and Conservation Block Grant
Maryland Energy Administration	Public Facility Solar Grant Program	The program supports the planning and installation of solar arrays on existing infrastructure of public facilities for Maryland's County or Municipal governments.	Public Facility Solar Grant
Department of Energy	Renew America's Schools Program	\$500 million program to promote implementation of clean energy improvements at <u>public schools</u> nationwide – eligible projects include installation of new HVAC and ventilation systems, or renewable energy technologies.	Renew America's Schools

Municipal Action 3: Create Net-Zero Plan for City Government Facilities

Action Description

This action in the CAP reads as follows:

“Evaluate how to transition City municipal buildings to net-zero emissions buildings and establish a maximum offset goal.”

AECOM conducted a fiscal analysis of **upgrading space heating and cooling and domestic hot water (DHW) systems in three municipal buildings**. The analysis assumes replacing natural-gas-fired systems with rooftop unit heat pumps or rooftop heat pump water heaters using industry benchmarks and research from the Department of Energy. AECOM conducted a fiscal analysis of the Baltimore City Police South Eastern District building’s gas-fired boilers, the Health Department Headquarters’ gas-fired HVAC system, and the Northern Community Action Center’s gas-fired HVAC system, based on input from the City.

Data and Methodology

Dataset

Similar to the analysis of municipal rooftop solar, AECOM used the DGS-provided building portfolio database and the facility energy use dataset for the net-zero emissions action. The annual energy usage data for 2021 and 2022 was available, reporting on each building’s use of electricity, natural gas, and steam. Buildings with gas-fired boilers or gas-fired heaters were identified and prioritized based on the system’s remaining life years and replacement cost, to focus on near-term implementation. Note that the replacement cost of each City-owned gas-fired system was provided, but not the M&R cost.

Asset Selection for Fiscal Analysis

AECOM sorted City-owned buildings based on their existing systems, cost of replacement, and remaining life years of their gas-fired systems. City staff selected three buildings of varying sizes and electric transition scopes. The Northern Community Action Center was selected to represent a smaller-scale replacement project, and the Health Department Headquarters was selected to represent a larger-scale replacement project, with 10 large rooftop AC units. The City Police Southeastern District was selected because it began designing its new HVAC system, and the fiscal analysis could complement the ongoing efforts.

Methodology

1. System Information

For each of the three selected buildings, AECOM used a unit costing approach to model the transition to electric scenario (rather than finding the exact electric replacement system). The efficiency factor between gas boilers and heat pump

water heaters was estimated at 3.75, and that between gas-heaters and electric heat pumps at 4.25, based on national coefficient of performance metric reported by the Energy Information Administration (EIA).²⁹ The efficiency factors were multiplied to the electricity consumption (in kWh) to accurately capture the reduced future electricity consumption due to the improved efficiencies of transitioning to electric alternatives.

The lifecycle information on existing equipment was provided from the system portfolio database provided by DGS. The 20-year lifecycle of the electric alternatives was estimated based on industry benchmarks. Note that for the Baltimore City Police South Eastern District building, the current equipment and the electric alternative have different lifecycles.

2. Calculation of Financial Metrics

Table 11 summarizes the lifecycle costs and cost savings associated with each building's transition to electric systems.

- **Capital Cost:** The replacement cost of gas-fired systems was provided from the system portfolio database. The capital cost of replacing the current system with electric alternatives assumed the full initial investment which includes both equipment cost and the installation cost. The costing information came from EIA's 2023 report on building sector equipment costs.³⁰ For costs that were reported for 2022, AECOM accounted for inflation and expressed them in 2023 dollars. AECOM converted the existing system's capacity (expressed in MBH or tons) to the required capacity of electric alternatives (expressed in BTU/h or kW) and multiplied the relevant unit cost to determine the total capital investment.
- **M&R Cost:** Similar to the capital cost methodology, AECOM used a unit cost approach to calculate the operations and maintenance cost. Using industry benchmarks, AECOM assumed a unit cost of \$3.00 per kBTU/hour/year for gas-fired boilers and \$380/year for a 90kBTU/hour rooftop AC with gas-heat.³¹ For electric systems, AECOM assumed a unit cost of \$1.47 per kBTU/hour/year for heat pumps and \$1,057.80/year for a heat pump water heater sized at 50kW.³²
- **Fuel and Electricity Cost:** Each building's natural gas usage was multiplied by the City-provided fuel cost of \$1.80/therms in 2023 dollars. Using the EIA natural gas price forecast, AECOM forecasted the increase in annual fuel cost for the analysis timeframe. For electricity, the City-provided unit electricity cost of \$0.11/kWh was used for 2023, and the EIA forecast of electricity price was used to calculate future spending on electricity.
- **Total Lifecycle Cost:** The lifecycle cost was calculated by summing up the upfront acquisition cost, and total M&R cost, and fuel or electricity cost for each system.

²⁹ "Updated Buildings Sector Appliance and Equipment Costs and Efficiencies", EIA, March 2023, <https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf>

³⁰ "Updated Buildings Sector Appliance and Equipment Costs and Efficiencies", EIA, March 2023, <https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf>

³¹ Updated Buildings Sector Appliance and Equipment Costs and Efficiencies", EIA, March 2023, <https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf>

³² Updated Buildings Sector Appliance and Equipment Costs and Efficiencies", EIA, March 2023, <https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf>

- **Total Cost Savings:** AECOM summed up the total cost savings of electric alternatives by finding the difference between the M&R cost and electricity cost of electric systems and the M&R cost and fuel cost of gas-fired systems. Because the current gas-fired boiler at the Baltimore City Police building has a life cycle that is ten years longer than the heat pump water heater, the life cycle costs should be interpreted with consideration for the difference in timeframe. The cost savings of \$432,000 from fuel cost reduction represents the first 20 years of the gas-fired boiler's fuel cost.

Table 11. Fiscal Analysis Inputs

All numbers are rounded up to the nearest thousand.

		Baltimore City Police Southeastern District		Health Department Headquarters		Northern Community Action Center -Govans	
Replacement Scenario		Gas-Fired System	Electric Alternative	Gas-Fired System	Electric Alternative	Gas-Fired System	Electric Alternative
System Information	Equipment Type	Gas-fired boiler	Heat pump water heater	Rooftop unitary AC with gas heat	Rooftop Heat pump	Rooftop unitary AC with gas heat	Rooftop Heat pump
	Life Cycle (years)	30	20	20	20	20	20
Financial Metrics	Total Capital Cost	\$147,000	\$352,000	\$590,000	\$328,000	\$133,000	\$67,000
	Total M&R Cost	\$53,000	\$107,000	\$112,000	\$39,000	\$23,000	\$8,000
	Fuel / Electricity Cost	\$641,000	\$193,000	\$401,000	\$176,000	\$49,000	\$22,000
	Total Life Cycle Cost	\$840,000	\$653,000	\$1,102,000	\$543,000	\$205,000	\$96,000
	Total Cost Savings		\$170,000		\$297,000		\$42,000

3. Calculation of Financial Returns Metrics

AECOM assessed the following financial performance metrics for each building's gas-fired systems. The results are shown in Table 12.

- **Annual Cost Savings:** The cost savings from transitioning to electric alternatives were calculated by finding the cost difference between the M&R and fuel costs of gas-fired systems and electric systems. AECOM then divided the value by lifecycle years to find the annual cost savings associated with each building-level replacement with electric alternatives.
- **Return on Investment (ROI):** The ROI for each electric system was calculated by dividing the cost savings from M&R and fuel costs by its lifecycle cost.
- **Marginal ROI:** The 20-year marginal ROI for each electric system was calculated by dividing the cost savings from M&R and fuel costs by the difference in lifecycle costs. For example, the City of Baltimore Police South Eastern District building's electric heat pump water heater has a life cycle of 20 years, while the gas-fired boiler has a life cycle of 30 years. The net cost reduction only accounted for the first 20 years of the marginal savings, rather than the full 30 years, to avoid overestimating the cost savings resulting from transitioning to electric heat pumps.
- **Life Cycle Net Present Value (NPV):** AECOM estimated the NPV by subtracting the total lifecycle revenue from the total lifecycle costs. The NPV for each electric scenario is negative, since the overall savings do not exceed the total cost incurred during the 20-year life cycle.
- **Equivalent Annual Annuity:** The equivalent annual annuity (EAA) expresses the total value of each investment into an equal annual cash flow over the project life cycle. Due to the two different life cycles of the police building scenarios, AECOM calculated the EAA to fairly compare the investments.

Limitations and Future Considerations

- **Unit cost approach:** Due to the complicated nature of sizing and costing building energy retrofits, AECOM used a unit cost approach to estimate the costs associated with replacing the existing systems with electric alternatives.
- **Exclusion of small equipment:** The Health Department Headquarters has 10 units of Carrier packaged rooftop units with gas heat and 12.5 tons of cooling capacity, and 3 units of small gas-fired unit heaters. The small gas-fired unit heaters were not included in the analysis due to limited information and relatively small energy impact compared to the packaged rooftop units.
- **Constant degradation and constant gas/electricity usage:** Given the two years of available data on energy usage, AECOM found the 2-year average energy consumption per building and held it constant for the full life cycle.
- **Energy retrofit walkthrough:** The model only considers the installation and acquisition costs of the zero-carbon HVAC systems in the capital cost estimates.

An energy walkthrough, a systematic inspection of a building to identify opportunities to improve energy efficiency, is a common step in identifying the optimal HVAC systems. However, due to the targeted scope of HVAC upgrades and the limited available information on the cost of a full building walkthrough, AECOM did not include it in the fiscal analysis.

- **Emissions from the power grid:** While electrification of HVAC systems can reduce building emissions through reducing fossil-fuel usage, if the electricity grid largely consists of fossil fuels, electrification of HVAC systems could potentially lead to increased GHG emissions. Thus, the makeup of the electricity grid is closely tied to the municipal action's potential to reduce emissions and improve air quality. BGE is Baltimore's sole electricity transmission and distribution utility, and PJM Interconnection is a regional electricity grid operator that is the primary supplier of electricity to BGE.³³ Between January through August 2023, 44% of PJM's grid was fueled by natural gas, and 15% by coal.³⁴ However, PJM is in the process of transitioning to increase its reliance on renewable energy sources, prioritizing more than 1,200 projects mostly investing in renewables.³⁵ As the power grid becomes more decarbonized, electrifying the city's assets will yield more environmental benefits in addition to the cost savings.

Summary Results

Table 12 summarizes the fiscal analysis results for three buildings. All three buildings have a positive ROI but a negative NPV; this indicates the projects require a high upfront capital cost and the cost savings do not fully offset the high capital cost in the full system life cycle. Despite the negative NPV, **the lower NPV for zero-carbon alternatives compared to natural gas-based systems indicates that the City will incur positive cost savings by switching to electric alternatives.**

The health department headquarters has the highest ROI due to the large cost savings from M&R and fuel cost, as well as its lower capital cost of heat pumps compared to the current rooftop AC system. AECOM calculated the equivalent annual annuity (EAA) for each project to compare the projects with different life spans. EAA is a financial metric that represents the constant annual cash flow in present terms, and a project with a higher EAA would be a better financial investment. For instance, replacing the existing gas-fired boiler in the police building with another one is equivalent to paying \$51,000 every year for the next 30 years and replacing it with a heat pump water heater is equivalent to paying \$14,000 every year for the next 20 years. Therefore, even after accounting for the different life spans of

³³ "City of Baltimore 2017 Greenhouse Gas Emissions Inventory Report", Johns Hopkins University Department of Environmental Health and Engineering, November 2020, https://www.baltimoresustainability.org/wp-content/uploads/2021/09/2017_Baltimore_Inventory_v5-1.pdf

³⁴ "PJM System Mix – System Mix by Fuel – 01/2023 to 8/2022", PJM Interconnection, <https://gats.pjm-ews.com/GATS2/PublicReports/PJMSystemMix/Filter>

³⁵ "2022 in Review: Planning for the Future Grid", PJM Inside Lines, January 2023, <https://insidelines.pjm.com/2022-in-review-planning-for-the-future-grid/#:~:text=During%20the%20transition%20period%20%E2%80%93%20expected,new%20rules%20by%20early%202026>

the two systems, transitioning to heat pump water heaters is a better investment for the City.

The marginal ROI for the Police building is high due to the low lifecycle cost differential between the current system and electric alternative, demonstrating that with a relatively small additional investment, the City can achieve significant cost savings.

Table 12. Fiscal Analysis Results

All numbers are rounded up to the nearest thousand.

	Baltimore City Police South Eastern District		Health Department Headquarters		Northern Community Action Center -Govans	
Replacement Scenario	Gas-Fired System	Electric Alternative	Gas-Fired System	Electric Alternative	Gas-Fired System	Electric Alternative
Equipment Type	Gas-fired boiler	Heat pump water heater	Rooftop unitary AC with gas heat	Rooftop Heat pump	Rooftop unitary AC with gas heat	Rooftop Heat pump
Annual Cost Savings	-	\$9,000	-	\$15,000	-	\$2,000
Return on Investment (ROI)	-	26%	-	55%	-	44%
Marginal Return on Investment (ROI)	-	489%	-	53%	-	39%
Life Cycle NPV	-\$840,000	-\$182,000	-\$1,102,000	-\$31,000	-\$188,000	-\$25,000
Equivalent Annual Annuity (EAA)	-\$51,000	-\$14,000	-\$84,000	-\$2,000	-\$14,000	-\$2,000

Co-Benefits

Replacing gas-fired systems with electric alternatives in municipal buildings can reduce greenhouse gas emissions, even though it may increase electricity consumption.³⁶ This is because the electricity grid is becoming increasingly decarbonized, with a growing share of renewable energy sources. Additionally, energy efficiency retrofits can be implemented in municipal buildings to reduce overall energy consumption. For example, building retrofits, including a new all-electric HVAC system and an upgraded chilled water plant, performed in the IRS New Carrollton Financial Services Center as part of the federal government's efforts at building decarbonization yielded reduced energy use by 60%, eliminated 20,000 metric tons of annual GHG emissions, and reduced annual energy costs by \$3

³⁶ Note that as described in the analysis limitations, because the replacement of gas-fired systems with electric alternatives may increase electricity consumption, greenhouse gas emissions may increase in the short-term depending on the emissions intensity of the grid.

million.³⁷ In addition to the direct economic benefits, the City may be incentivized to invest in net-zero buildings due to new environmental regulations targeting institutional boilers and heaters.³⁸ Proactively investing in zero carbon equipment allows the City more time to purchase the optimal equipment rather than having to make short-term modifications to existing equipment, which tends to be more expensive.

The three buildings that were analyzed consume around 25,000 tons of natural gas during the equipment life cycle, which emits about 145 million pounds of carbon dioxide (CO₂).³⁹ Reducing natural gas usage not only is beneficial for cost reduction but also improved air quality and health outcomes. The specific benefits will depend on what type of retrofit is performed on the building, but generally net-zero buildings can improve both indoor and outdoor air quality, decrease energy use, and reduce reliance on fossil fuels.⁴⁰

Potential Federal Funding Opportunities

Retrofits for net-zero buildings can be funded using federal funding opportunities as well as tax credits. Table 13 summarizes different funding programs the City can consider to finance building retrofit projects.

³⁷ "FACT SHEET: White House Takes Action on Climate by Accelerating Energy Efficiency Projects Across Federal Government", The White House, 3 August 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/03/fact-sheet-white-house-takes-action-on-climate-by-accelerating-energy-efficiency-projects-across-federal-government/>

³⁸ "Industrial, Commercial, and Institutional Boilers and Process Heaters: National Emission Standards for Hazardous Air Pollutants (NESHAP) for Major Sources", US Environmental Protection Agency (EPA), <https://www.epa.gov/stationary-sources-air-pollution/industrial-commercial-and-institutional-boilers-and-process-0>

³⁹ "Natural gas explained, EIA, <https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php#:~:text=Natural%20gas%20is%20a%20relatively%20clean%20burning%20fossil%20fuel&text=About%20117%20pounds%20of%20CO,MMBtu%20of%20distillate%20fuel%20oil>.

⁴⁰ "The Health, Economic and Community Benefits of Zero-Carbon Buildings", World Resources Institute, September 2022, <https://www.wri.org/insights/health-economic-and-community-benefits-zero-carbon-buildings>

Table 13. Funding Table

Department	Program	Description	Link
US Department of Energy (Office of State and Community Energy Programs)	Energy Efficiency and Conservation Block Grant (EECBG) Program	Authorized under the IIJA, this program is designed to support states, local governments, or tribes to implement strategies to reduce energy use, reduce fossil fuel emissions, and improve energy efficiency, this grant program can be applied to a broad range of eligible uses including: 1.) development and implementation of energy efficiency and conservation strategy, and 2.) conducting building energy audits.	Energy Efficiency and Conservation Block Grant (EECBG)
US Department of the Treasury	Clean Energy Investment Tax Credit (ITC)	Authorized under the Inflation Reduction Act (IRA), the ITC is a dollar-for-dollar credit for expenses invested in renewable energy properties. Tax-exempt entities like the municipality and school districts are eligible for the full direct payment up to the cost of the project.	IRA Provisions related to Renewable Energy
US Department of the Treasury	179D Deduction (Energy-Efficient Commercial Buildings Tax Deduction)	Authorized under the Inflation Reduction Act (IRA), the Section 179D deduction is focused on new construction or improvements to buildings that reduce energy use by making investments in HVAC and or interior lighting systems, or building's envelope. For tax-exempt properties, this deduction can be passed to the designers of the properties, including engineers, architects, contractors, energy providers, and environmental consultants. If a 50% reduction in energy usage can be achieved, a tax deduction of up to \$1.80 per square foot is available.	179D Commercial Buildings Energy Efficiency Tax Deduction
Baltimore Gas & Electric (BG&E)	Energy Solutions for Business Program	BGE's program offers financial incentives to all commercial, industrial, government, institutional, and nonprofit customers in BGE's service territory. Both the Prescriptive and Custom programs offer financial incentives covering up to 50% of the total cost for retrofit projects as well as up to 75% of the incremental cost for new construction and equipment replacement at the end of its lifespan.	BGE Energy Solutions for Business Program Fact Sheet