MID-SOUTH
CLIMATE ACTION PLAN

PRIORITY REDUCTION MEASURES
FEBRUARY 2024

Office of Sustainability and Resilience
MEMPHIS AND SHELBY COUNTY

Foreword by Mayor Paul Young

In partnership with Shelby County Mayor Lee Harris and mayors and officials across our metropolitan area, I am pleased to present the Mid-South Climate Action Plan, an eight-county effort to begin comprehensively addressing our region's contributions to climate change. In 2011, I joined the Memphis and Shelby County Office of Sustainability and Resilience as its first administrator, and our charge was to begin implementing the Sustainable Shelby Plan, the Mid-South region's first sustainability plan. Since then, we have seen the implementation of the Sustainable Shelby plan grow into formal commitments and efforts of City and County government to tackle climate change by reducing greenhouse gas emissions, investing in alternative energy sources, and enhancing the resilience of our communities.

Over time, Sustainable Shelby paved the way for the Memphis Area Climate Action Plan, which set specific actions and achievable targets to reduce harmful emissions from transportation, energy, and waste. The Memphis Area Climate Action Plan aligned with our city's comprehensive plan, Memphis 3.0, and its vision for future growth and development, focusing on building up, not out. Finally, the Memphis Area Climate Action Plan aligned with the City's goals of encouraging walkability, transit access, and denser, mixed-use development to help reduce our community's climate change impacts and improve the quality of life for our residents. But we can't tackle climate change alone in Memphis and Shelby County.

We must work together to address climate change as a region. Successful implementation of this plan will require the efforts of our entire region, whether urban, suburban, or rural; or whether you live in Arkansas, Mississippi, or Tennessee.

I challenge each community to look at how climate change impacts you and join us in this important effort for the future of our region.

Foreword by Mayor Lee Harris

From Sustainable Shelby nearly 15 years ago to the Memphis Area Climate Action Plan in 2019, Shelby County Government has been a leader across the metropolitan area investing in solutions to address climate change. Our priority has been to lead by example. We have installed new solar facilities, including the largest solar facility ran by a local government in our region. We have passed bipartisan local legislation that requires a green fleet transition across county government and invested in electric vehicles and EV chargers. All the while, we have continued to lower our own emissions by investing in energy efficiency measures in county facilities and increase recycling. We're also addressing the real effects of climate change head on by investing in flood resilience in our most vulnerable communities and weatherization of low-income residents' homes across Shelby County. We understand that Shelby County is not facing the climate crisis alone and that's why we stand ready to help other counties across the region to join in the fight.

The Mid-South Climate Action Plan builds on efforts to advance sustainable practices across the eight-county metropolitan area. Many of the recommendations in the Mid-South Climate Action Plan are very similar to the action in our county's plan from 2019. We know the most effective strategies for fighting climate change are to reduce reliance on fossil fuels, increase our use of clean, renewable energy, change our land use to bring destinations closer together, improve transit and active transportation options, and reduce waste that ends up in landfills. It's important that all of us join to advance these commonsense practices for the future of our region and our communities.

Climate change is an immediate issue that poses tangible threats to our entire eight-county metropolitan region. Communities across the Mid-South are at greater risk of increased flooding, more frequent heat events that disproportionately impact low-income residents, more frequent drought events that hurt farmers, ports, and river commerce, and increasingly severe storms. It is important that our metropolitan region acts now and acts together. I am excited to work with City of Memphis Mayor Paul Young and mayors and officials across our metropolitan area to implement this plan.

ACKNOWLEDGMENTS

The Mid-South Priority Climate Action Plan would not have been possible withouth the significant contributions in time, energy, and thought of many. Thank you to all the Mid-South community members who gave their time to provide input in the development of this plan.

COMMITTED GOVERNMENTS

- City of Bartlett, TN
- City of Crawfordsville, AR
- City of Germantown, TN
- City of Grand Junction, TN
- City of Hernando, MS
- City of Marion, AR
- City of Memphis, TN
- City of Millington, TN
- City of Olive Branch, MS
- City of Senatobia, MS
- City of Somerville, TN
- City of Southaven, MS
- City of West Memphis, AR
- City of Williston, TN
- Fayette County, TN
- Shelby County, TN
- Tipton County, TN
- Town of Arlington, TN
- Town of Collierville, TN
- Town of Horseshoe Lake, AR
- Tunica County, MS

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- Arkwings Foundation
- Assissi Foundation
- Bevo Boys Fitness Academy
- Binghampton Development Corporation
- Center for Transforming Communities
- City of Memphis Fire Department
- City of Memphis Division of Housing & Community Development
- City of Memphis Solid Waste Division
- City of Memphis Public Works Division
- Clean Memphis
- Climate Reality Project Memphis Chapter
- Cowanhouse

- CRG Foundation
- Downtown Memphis Commission
- Fletchers Memorial Community Baptist Church
- Glankler Brown, PLLC
- God's Advocate for Justice
- Green & Healthy Homes Initiative
- High Expectations Aerial Arts
- Innovate Memphis
- Knowledge Tree Foundation
- Legal Aid of Arkansas
- Memphis Metropolitan Planning Organization
- Memphis Zoo
- Memphis-Shelby County Airport Authority
- Midsouth Development District
- MLGW
- Moore Tech
- Protect our Aquifer
- ShelbyCares on Third
- Shelby County Department of Housing
- Shelby County Health Department
- Shelby County Roads, Bridges & Engineering Department
- Shelby Farms Park Conservancy
- Shelby Literacy Center
- Sierra Club
- Teamsters Local 667
- TennGreen Land Conservancy
- Tennessee Farm Bureau
- Tennessee Interfaith Power and Light
- The Works, Inc.
- Vibrant Memphis, Inc.
- West Memphis Metropolitan Planning Organization
- Westside Unitarian Universalist Church
- Wolf River Conservancy
- Young, Gifted, & Green

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ACRONYMS & ABBREVIATIONS

AADT: Annual Average Daily Traffic
AVERT: AVoided Emissions and geneRation Tool
BEB: Battery electric bus
Bike/ped: bicycle and pedestrian
BIL: Bipartisan Infrastructure Law
BIPOC: Black, Indigenous, and other People of Color
BRT: Bus Rapid Transit
BTS: Bureau of Transportation Statistics
BUILD: Better Utilizing Investments to Leverage Development
CARB: California Air Resources Board
CCAP: Comprehensive Climate Action Plan
CEJST: Climate and Environmental Justice Screening Tool
CEPA: Central Electric Power Association
CH_4: Methane
CIRIS: City Inventory Reporting and Information System
CO: Carbon Monoxide
CO_2: Carbon Dioxide
CO_2e: Carbon Dioxide equivalent
CPRG: Climate Pollution Reduction Grants
DOE: United States Department of Energy
DPD: Memphis-Shelby County Division of Planning and Development
EIA: United States Energy Information Administration
EJScreen: Environmental Justice Screening and Mapping Tool
EPA: United States Environmental Protection Agency
FAA: Federal Aviation Administration
FEMA: Federal Emergency Management Agency
FLIGHT: Facility-Level Information on GreenHouse gases Tool
GHG: Greenhouse gas
GPC: Global Protocol for Community-Scale GHG Emissions Inventories
GRRP: Green and Resilient Retrofit Program
HFUD: Hardeman-Fayette Utility District
HPS: high-pressure sodium
HUD: United States Department of Housing and Urban Development
HVAC: heating, ventilation, and air conditioning
IRA: Inflation Reduction Act of 2022
kBtu: thousands of British thermal units
kWh: kilowatt-hour
LED: light-emitting diode
LGGIT: Local Greenhouse Gas Inventory Tool
LIDAC: Low-income and disadvantaged communities
LOL: leased outdoor lighting
MATA: Memphis Area Transit Authority
MHA: Memphis Housing Authority
MLGW: Memphis Light, Gas and Water
MOVES: MOtor Vehicle Emission Simulator
MPO: Metropolitan Planning Organization
MSA: Metropolitan Statistical Area
$mtCO_2e$: metric tons of carbon dioxide equivalent
MW: megawatt
N_2O: Nitrous Oxide
NOAA: National Oceanic and Atmospheric Administration
NOx: nitrogen oxide
O&M: operations and maintenance
OPSNET: The US Federal Aviation Administration's Operations Network
OSR: Memphis-Shelby County Division of Planning and Development's Office of Sustainability and Resilience
PCAP: Priority Climate Action Plan
PHA: public housing authority
PM2.5: Particulate Matter 2.5
ROG: Reactive Organic Gas
SAIFI: System Average Interruption Frequency Index
TDEC: Tennessee Department of Environment and Conservation
TDOT: Tennessee Department of Transportation
TVA: Tennessee Valley Authority
VMT: Vehicle Miles Traveled
VOC: Volatile Organic Compounds
WAP: Weatherization Assistance Program

INTRODUCTION

Increases in global temperatures caused by the unprecedented influx of greenhouse gas emissions released by human activities are impacting (and will continue to impact) every corner of our globalized world. The Mid-South is not exempt from the changing climate and its varied impacts on our communities. Within the Mid-South, residents are experiencing more frequent and intense climate hazards like extreme heat, flooding, and damaging winds. Beyond the debilitating safety, public health, and financial consequences of these events, the region's low-income and disadvantaged communities are the least equipped to adapt and protect themselves from these changes.

Understanding the need to mitigate the Mid-South's contribution to climate change and adapt for the challenges it brings, the Memphis and Shelby County Division of Planning and Development's Office of Sustainability and Resilience (OSR) is partnering with 19 committed jurisdictions to produce the *Mid-South Climate Action Plan: Priority Reduction Measures* to support investment in policies, practices, and technologies that can reduce pollutant emissions, create high-quality jobs, spur economic growth, and enhance the quality of life in the Mid-South region.

As seen in Figure 1, the Mid-South region is located in a unique geographic position requiring increased

Figure 1. Location of the Memphis, TN-MS-AR Metropolitan Statistical Area

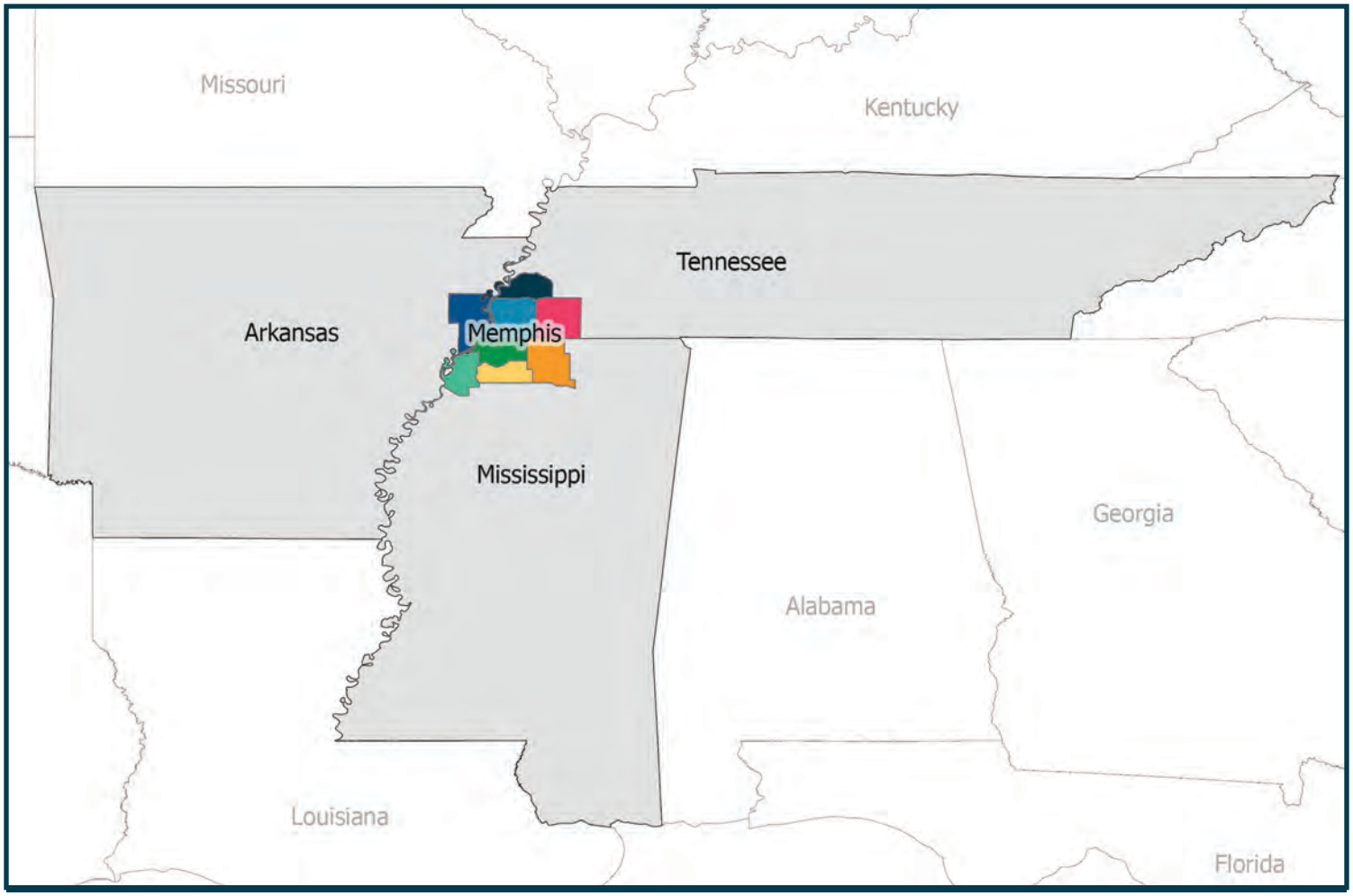


Figure 2. Phase 1 Planning Grant Deliverables

coordination among committed jurisdictions. The Memphis, TN-MS-AR Metropolitan Statistical Area (MSA) is situated along the Mississippi River at the intersection of Arkansas, Mississippi, and Tennessee. This plan provides a baseline estimate of current greenhouse gas (GHG) emissions released within the Memphis MSA, describes the specific climate threats facing our communities, and outlines five implementation ready greenhouse gas reduction measures to significantly reduce Memphis MSA emissions.

CLIMATE POLLUTION REDUCTION GRANTS PROGRAM

The *Mid-South Climate Action Plan* is part of an unprecedented, nationwide effort for states, heavily populated metropolitan areas, and tribal governments to simultaneously create plans to reduce their GHG emissions. The United States Environmental Protection Agency's (EPA) Climate Pollution Reduction Grants (CPRG) program is funding the planning process.[1] The CPRG program was established in the Inflation Reduction Act of 2022[2], and the program provides grants to government entities to develop and implement plans for reducing GHG emission and other harmful air pollutants. The CPRG offers an opportunity both to calculate greenhouse gas emissions and to develop transformative projects that will have long-term effects on the overall resilience and sustainability of the Mid-South and its residents.

The program contains two phases. During Phase 1, the EPA distributed non-competitive planning grants to states, the most populous metropolitan areas, and tribal governments. These planning grants provide funding through 2027 for the recipients to develop a priority climate action plan (PCAP), a comprehensive climate action plan (CCAP), and a status report on implementation progress at the end of the grant. Additional information regarding the timeline for the Phase 1 deliverables is available in Figure 2.

Phase 2 is a competitive grant program to implement actions identified in the PCAPs. The EPA released a Notice of Funding Opportunity on September 20, 2023, for the Phase 2 competitive implementation grants. Applications are due on April 1, 2024. Only GHG reduction measures included in a PCAP are eligible for funding.

PLAN OVERVIEW

For the purposes of the CPRG program, this plan is the priority climate action plan for the Memphis, TN-MS-AR MSA. All participating jurisdictions are qualified to apply for the $4.6 billion in implementation grants to execute the recommend projects in the PCAP. The priority actions and GHG reduction measures within this plan are eligible to receive funding under the EPA's CPRG Implementation Grant General Competition in Phase 2 and other funding streams as applicable.

This plan is organized into five sections:

1. **Introduction:** Contains the plan overview as well as a description of the planning process and engagement conducted to develop the plan.
2. **Greenhouse Gas Emissions Inventory**: Contains the simplified 2019 greenhouse gas emissions inventory for the MSA. The inventory included in this plan focuses on emissions from the following sources: electricity generation and use, industry, residential and commercial buildings, and transportation. The comprehensive climate action plan will include additional sectors in order to provide a complete picture of emissions within the Mid-South.
3. **Impacts of Climate Change on the Mid-South**: Provides an overview of the current and expected climate impacts affecting our region with particular attention paid as to how climate hazards will affect our low-income and disadvantaged communities.
4. **Reduction Measures**: Presents a detailed account for the five priority reduction measures recommended by this plan. For each reduction measure, the plan:

   a. outlines targets for 2030 and 2050,

   b. estimates cumulative reductions in GHG emissions from full implementation,

   c. estimates reductions in criteria and hazardous air pollutants in the year 2030 (as applicable),

   d. provides project cost estimates,

   e. estimates the percent of low-income and disadvantage census block groups impacted by the measure,

   f. discusses co-benefits, and challenges that might occur as a result of project implementation,

   g. lists the potential implementation partners and reviews their authority to implement the project,

   h. and outlines potential funding opportunities.

5. **Conclusion and Next Steps**: Discusses how to use this plan for federal grant applications and provides information on the comprehensive climate action planning process.

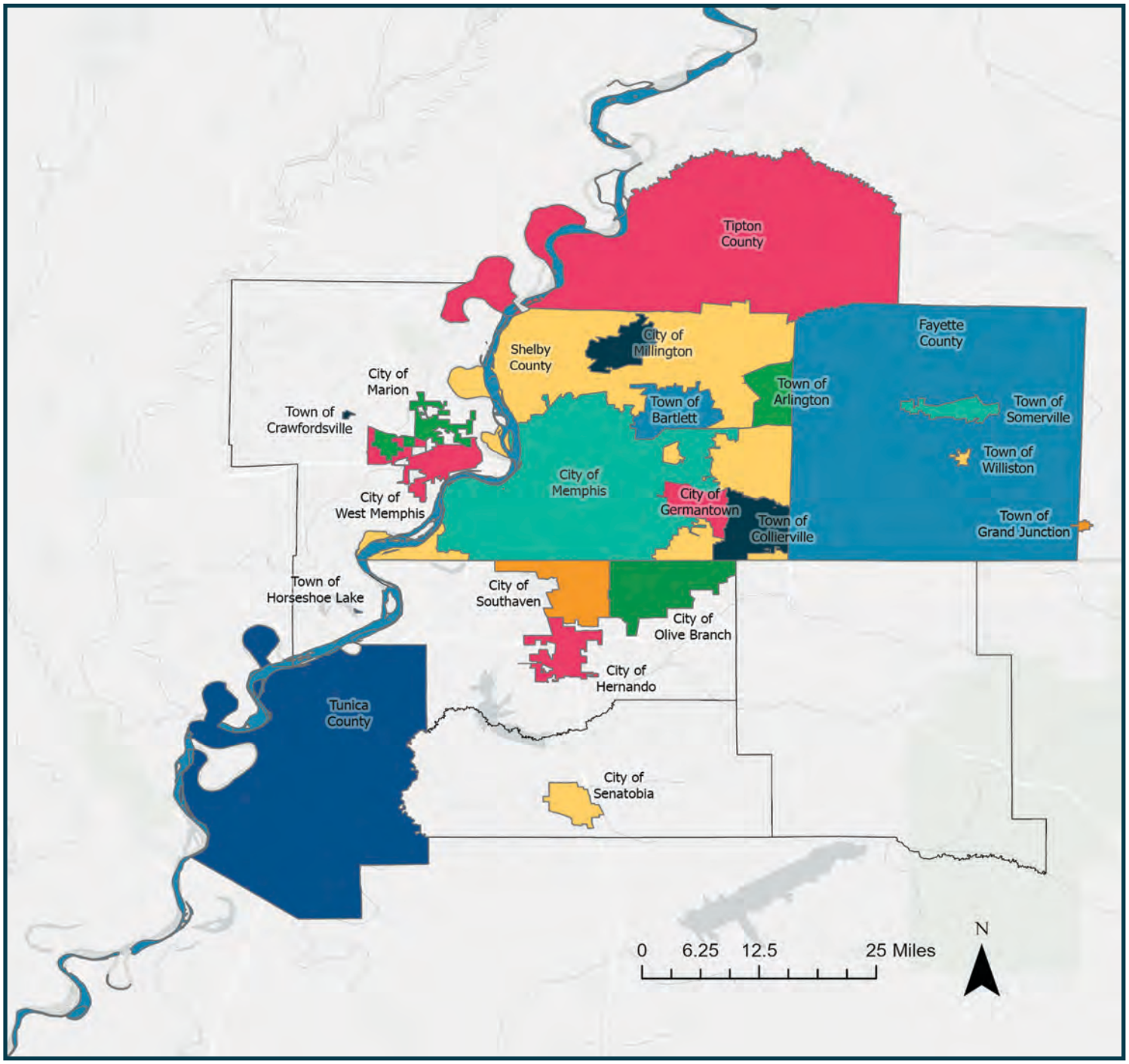
Scope

This plan covers all counties within the Memphis MSA. These counties include Shelby, Fayette, and Tipton in Tennessee; DeSoto, Marshall, Tate, and Tunica in Mississippi; and Crittenden in Arkansas. Within the MSA, 21 local governments committed to the planning process.

Committed Jurisdictions:

- City of Bartlett, TN
- City of Crawfordsville, AR
- City of Germantown, TN
- City of Grand Junction, TN
- City of Hernando, MS
- City of Marion, AR
- City of Memphis, TN
- City of Millington, TN
- City of Olive Branch, MS
- City of Senatobia, MS
- City of Somerville, TN
- City of Southaven, MS
- City of West Memphis, AR
- City of Williston, TN
- Fayette County, TN
- Shelby County, TN
- Tipton County, TN
- Town of Arlington, TN
- Town of Collierville, TN
- Town of Horseshoe Lake, AR
- Tunica County, MS

Figure 3. Committed Local Governments/Jurisdictions



Building on fifteen years of sustainability and resilience planning in the region, the *Mid-South Regional Resilience Master Plan*[3] and the *Memphis Area Climate Action Plan*[4] informed the contents of this plan. The Office of Sustainability and Resilience developed these complimentary plans in 2019 and they address both types of climate action: adaptation and mitigation. The *Mid-South Regional Resilience Master Plan* used climatic and meteorological data to analyze the greatest natural risks to the Mid-South region. It also provides broad recommendations on how we as a community can prepare and adapt to these risks to be more resilient in the future. The *Memphis Area Climate Action Plan* established a community-wide greenhouse gas emissions inventory for Shelby County and provides specific recommendations on actions to reduce and mitigate greenhouse gas emissions attributed to the county.

It is important to note many sustainability and resilience actions can be both mitigation and adaptation actions. For example, trees take in carbon dioxide (a mitigation action) while also providing better stormwater retention due to their long roots, which reduces flooding (an adaptation action). While the two plans have different focuses, there is overlap in some of the recommendations; it is important to have a holistic view of the sources of climate pollution as well as our response to its effects.

What is a Greenhouse Gas (GHG) reduction measure?

Similar to the *Memphis Area Climate Action Plan,* this plan focuses on actions that can mitigate greenhouse gas emissions. Within this plan, these actions are called GHG reduction measures. GHG reduction measures are any projects, programs, or policies resulting in greenhouse gas emissions reductions. Reduction measures can be existing projects we would like to expand, projects in the planning stage, or ideas for the future.

The reduction measures included in this plan are high-priority, implementation-ready projects, programs, or policies local governments or their agencies have the authority to carry out. The committed local governments and stakeholders identified projects and initiatives that are priorities within the next three to five years. The priority GHG reduction measures in this plan include:

- LED streetlight retrofits
- Local government energy efficiency upgrades and renewable energy installations
- Low-income housing energy efficiency retrofits
- Investments in public transit
- Investments in multimodal transportation

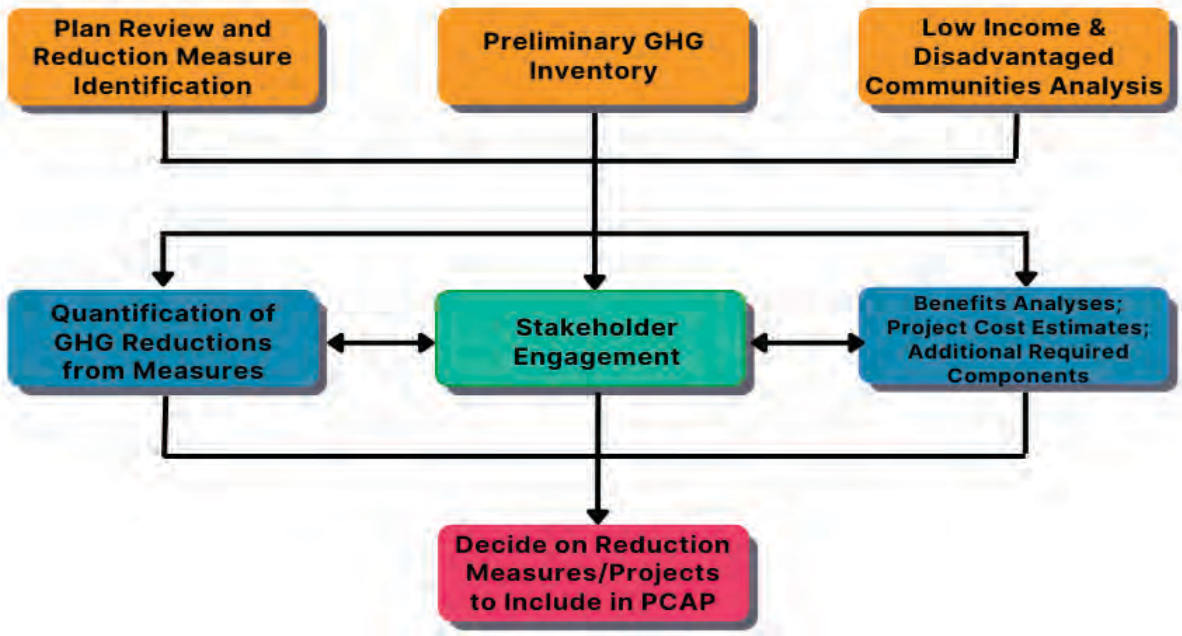
PROCESS AND STAKEHOLDER ENGAGEMENT

As the lead organization, OSR led the planning effort from September 2023 through February 2024. As seen in Figure 4, OSR followed a multi-faceted and fluid process in order to meet the CPRG program deadlines.

In the first phase of plan development, the project team reviewed existing plans to identify potential reduction measures, compiled the simplified 2019 GHG emissions inventory, and conducted the initial low-income and disadvantaged communities analysis. The project team reviewed 79 state, regional, and local plans identifying existing goals and projects to be considered for the GHG reduction measures. OSR asked local governments to submit specific, high priority projects to be considered for inclusion in the priority reduction measures. The engagement subcontractor used the resulting list to inform stakeholder surveys.

OSR followed the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories* to develop the 2019 GHG inventory for the eight-county MSA. For more information on the methodologies used to compile the inventory, please refer to Appendix 1.

Figure 4. Priority Climate Action Plan Process



For the third task in the first phase, staff used the Climate and Economic Justice Screening Tool (CEJST) and the EPA's Environmental Justice Screening Tool (EJScreen) to identify low-income and disadvantaged communities within the Memphis MSA. OSR incorporated additional information and datasets from local resources to characterize the nature of environmental risks and vulnerabilities burdening the communities. Staff also shared this analysis with the engagement subcontractor to help develop the stakeholder engagement strategy.

In the second phase of plan development, the project team used the information gathered in the first phase to inform the stakeholder engagement process as well as the quantification of the GHG reduction measures, benefits analyses, and project cost estimates. The three tasks in this phase informed and built off each other. For example, staff began working on reduction measures that were prevalent in the initial plan review and received high approval from stakeholders in the first engagement survey.

Throughout the process, OSR endeavored to develop a plan inclusive of feedback provided by all committed local governments, the public, and other interested stakeholders who participated in engagement activities during the planning timeframe. The project team gathered this input and feedback using four processes: ad hoc communication with committed local governments, stakeholder engagement led by the University of Memphis, information received from the Tennessee Department of Environment and Conservation's (TDEC) PCAP public engagement process, and input from the Technical Advisory Committee.

1. The project team maintained ad hoc communication with the committed jurisdictions and government agencies throughout the planning process to gather data needed for the various analyses and receive feedback on the proposed reduction measures. As an early step in the plan development, OSR surveyed the local governments about key stakeholders in their communities and existing programs and priorities that could result in GHG reductions. In addition, the engagement subcontractor - University of Memphis Department of City and Regional Planning – invited all committed local governments to participate in the stakeholder engagement process.

2. Due to the short timeframe for plan development, OSR gave the University of Memphis a subaward to conduct stakeholder engagement to identify and understand climate concerns, priorities, and actions for this plan. Stakeholders participated in a series of three online workshops and three online surveys. Overall, this approach was a rapid assessment technique to allow for swift feedback to inform the priority reduction measures included in this plan. Appendix 3 contains the detailed report, comments, and analysis. The report also includes an evaluation of the engagement and recommendations on how to improve engagement activities in the comprehensive planning process to address gaps in reaching low-income and disadvantaged communities as well as more rural communities. The comprehensive planning process will begin in the spring or summer 2024.

3. As a part of their public engagement process for the CPRG planning grant, TDEC distributed an online public survey statewide. OSR distributed the link to the survey on social media channels and newsletters and sent the link to stakeholders and committed jurisdictions to distribute through their own networks. The survey was available for approximately two months and asked participants to prioritize emission sectors, what individual actions they take to reduce greenhouse gas emissions, and motivations, challenges, and benefits related to those actions. Additionally, the survey asked respondents to provide information on any ongoing projects and future projects they wanted to see enacted that reduce emissions in the area. TDEC shared with OSR the survey responses of the respondents who identified their home location within the Memphis MSA's boundaries. Appendix 4 includes a summary of the responses.

4. OSR established a Technical Advisory Committee to provide knowledge and input on the assumptions and analyses of this plan. The committee has a diverse membership with representatives from organizations involved in energy, utilities, transportation, housing, waste management, and environmental justice. The members met on January 18, 2024, and February 14, 2024, to review the data, calculations, assumptions, and methodologies used in the development of the greenhouse gas inventory, climate impacts analysis, and greenhouse gas reduction measures. The Technical Advisory Committee will continue to meet on a bi-monthly basis through the completion of the comprehensive climate action plan.

Building relationships with stakeholders and communities takes time and transparency. Given the time constraints in developing the PCAP from September 2023 through February 2024, the project team continues to plan for more robust and diverse public engagement to occur during the comprehensive climate action planning process.

For the quantification of GHG reductions from each measure, OSR began by outlining 2030 and 2050 goals for potential reduction measures based on the information collected in the first phase. Staff then ran scenarios to estimate the annual reductions greenhouse gases through 2050 if partners reach full implementation of the measure. Then staff compiled this information into two metrics: the cumulative GHG emissions reductions from 2025 to 2030 and the cumulative GHG emissions reductions from 2025 to 2050.

Concurrently with the quantification of the reduction measures and the stakeholder engagement outlined below, staff worked with the Technical Advisory Committee to provide the additional required components for the PCAP. These components include the benefits and disbenefits analysis, the project cost estimates, the estimated percentage of impacted LIDAC census block groups, potential implementation partners with authority to implement the measure, potential funding

sources, and the estimated reduction in criteria and hazardous air pollutants. Criteria and hazardous air pollutants are gases regulated by the Clean Air Act. For additional information on the methodologies regarding the quantification of each reduction measure, the benefits analyses, and the cost evaluations, see Appendix 2.

At the end of the engagement activities, data analysis, and benefits analysis, OSR presented the five proposed reduction measures to the committed jurisdictions for their consent to include the measures in the PCAP.

ENDNOTES

1 U.S. EPA (2024, February 16). *Climate Pollution Reduction Grants*. Retrieved from https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants

2 The White House. (2023, September 21). *Inflation Reduction Act Guidebook*. Retrieved from https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

3 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Retrieved from https://resilientshelby.com/wp-content/uploads/2020/01/Final_MRRP_Low_Res_Spreads.pdf.

4 Memphis and Shelby County Division of Planning and Development. (2019). *Memphis Area Climate Action Plan*. https://shelbycountytn.gov/DocumentCenter/View/37431/Memphis-Area-Climate-Action-Plan-2019-FINAL_4_JANUARY-2020

GREENHOUSE GAS (GHG) EMIS

In order to take action on climate change, we must first understand how the Mid-South is contributing to greenhouse gas (GHG) emissions. For the purpose of this PCAP, the Office of Sustainability and Resilience developed the estimated 2019 greenhouse gas inventory for the eight counties of the Memphis MSA using the methodology it has developed over the years for the Shelby County GHG inventory. Since it is not currently possible to provide precise measurements of GHG emissions for all sources, staff used various models to estimate the emissions. This inventory's methodology aligns with the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories*,[1] and focuses on emissions resulting from the consumption of fuel in various sectors.

There are many sources of GHGs produced by both humans and released by nature. The human sources include the vehicles we use, the electricity and natural gas we consume in our homes, businesses, and factories, the waste we dispose of, and the food we grow. Natural processes both release and capture GHG emissions. Wildfires and decaying materials release GHGs into the air, while trees, other leafy plants, and the ocean capture the carbon (referred to as carbon sinks). The GHG emissions inventory included below contains emissions estimates for some, but not all of these sources. Because this is not a comprehensive inventory of all the GHG emissions the Memphis MSA is contributing annually, we call this a simplified inventory. The simplified inventory includes the following sectors: electricity generation and use,

GREENHOUSE EFFECT

WHAT IS THE GREENHOUSE EFFECT?

Carbon dioxide and other specific gases released into the atmosphere form a semi-permeable barrier around the earth, like the glass of a greenhouse, which allows sunlight to reach the earth and prevents some heat from escaping. This barrier is essential for life to thrive on earth, but it is a careful balance that evolved prior to the industrial revolution. As we burn more fuels than ever before, the layer becomes denser (like very thick glass), and more and more heat is trapped close to the earth. Due to this effect, these gases are referred to as greenhouse gases (GHGs).

The primary GHGs include:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Fluorinated gases
- Water vapor

CO_2 is the most prevalent GHG, and as such, references to "carbon" usually imply all greenhouse gases. However, some GHGs are hundreds of times more potent than CO_2. So, inventories often convert the other gases into a metric known as carbon dioxide equivalent (CO_2e) based on their potency (or global warming potential) in relation to CO2's potency. This allows us to quickly assess the impact of all gases in a standardized form.

SIONS INVENTORY

residential and commercial buildings (fuel consumption), industry (fuel consumption), transportation, and forestry. The Office of Sustainability and Resilience focused on these specific sectors because they are consistently the largest sources of GHG emissions and carbon sinks in the annual Shelby County inventory.

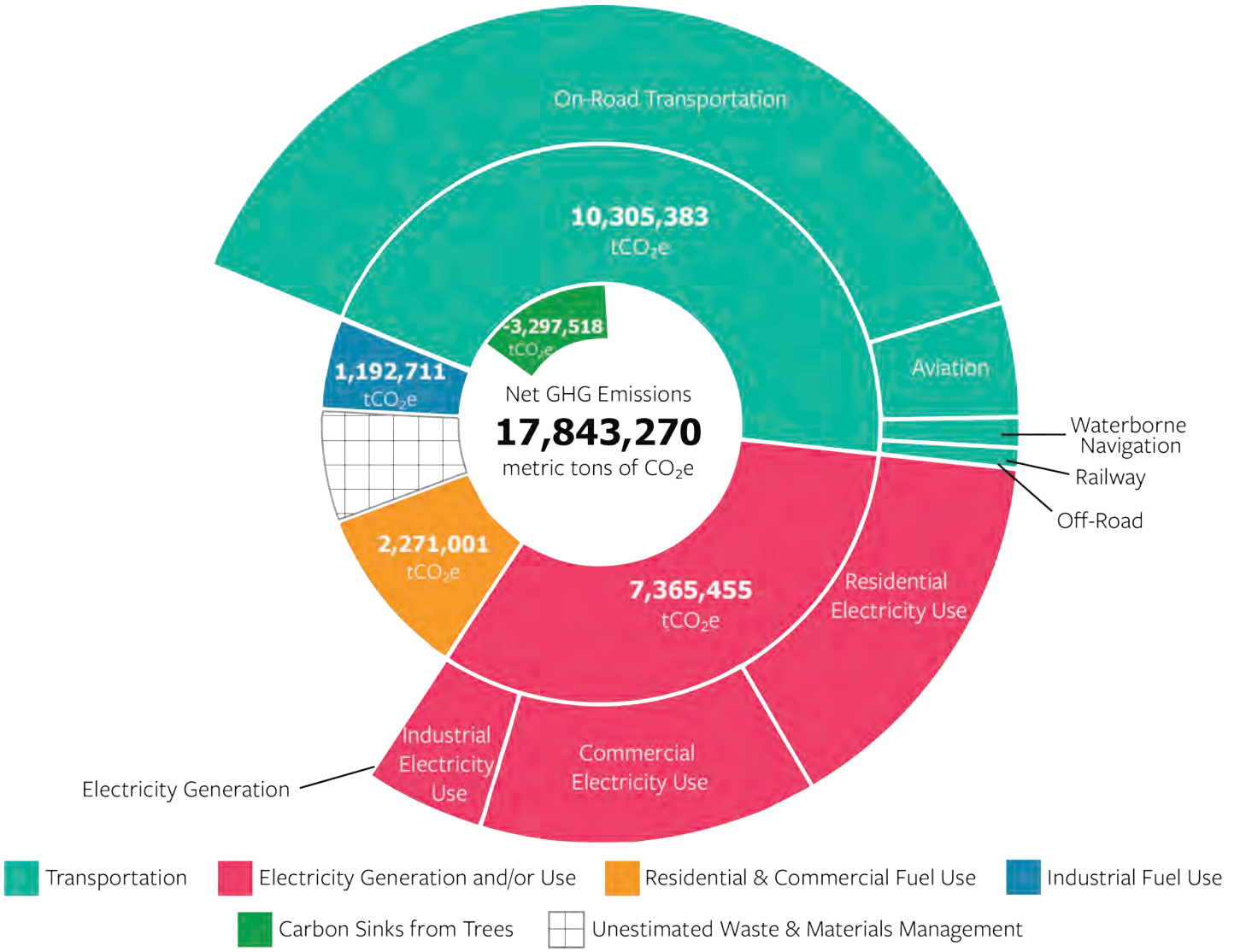
The Office of Sustainability and Resilience will build on the simplified 2019 inventory to develop a comprehensive inventory for the comprehensive climate action plan, which will include emissions from agriculture/working lands and waste and materials management. The final inventory will act as a baseline inventory for the Mid-South region. Once the baseline is completed, the project team will develop projections of future emissions, which can then be used to inform emissions reduction targets and strategies.

The table below and the figure on the next page show the Memphis MSA's simplified, community wide GHG emissions inventory in metric tons of carbon dioxide equivalent (mtCO2e) for 2019. The table displays the total mtCO2e for each sector and subsector. Figure 5 displays the total mtCO2e captured by forests and trees (innermost ring) and emitted for each sector (second ring). The third

Table 1. Simplified 2019 MSA-Wide GHG Emissions Estimates (metric tons of CO_2e)

	CO_2	CH_4	N_2O	Total $mtCO_2e$
Electricity Generation and/or Use	**7,319,086**	**18,044**	**28,253**	**7,365,455**
Electricity Use by Residential Buildings	3,338,622	7,864	11,031	3,357,576
Electricity Use by Commercial Buildings	2,931,435	7,594	12,956	2,951,993
Electricity Use by Industrial Buildings	1,042,529	2,581	4,260	1,049,375
Fuel Use to Power Electricity Generation	6,500	4	7	6,511
Residential & Commercial Buildings	**2,268,436**	**1,246**	**1,319**	**2,271,001**
Fuel/Gas Combustion by Residential Buildings	1,386,617	732	693	1,388,042
Fuel/Gas Combustion by Commercial Buildings	790,852	417	395	791,664
Gas Combustion for Lawn & Garden Use	90,967	97	232	91,296
Industry	**1,184,732**	**2,496**	**5,483**	**1,192,711**
Fuel/Gas Combustion by Industrial Buildings	695,095	489	702	696,286
Petroleum Refining	489,637	2,007	4,781	496,425
Transportation	**9,523,181**	**25,776**	**101,111**	**10,305,383**
On-Road Transportation	8,090,604	23,776	88,949	8,858,644
Railways	177,377	389	1,197	178,963
Waterborne Navigation	260,331	1,388	2,917	264,635
Aviation	990,582	147	8,048	998,777
Off-Road Transportation	4,287	76	-	4,364
Agriculture, Natural & Working Lands	**-3,297,518**	**-**	**-**	**-3,297,518**
Carbon Sequestration from Trees	-3,297,518	-	-	-3,297,518
Fugitive Emissions from Oil & Natural Gas Systems	**5,229**	**1,032**	**3**	**6,264**
Total Net GHG Emissions	**17,003,146**	**48,593**	**136,170**	**17,843,296**

Figure 5. Simplified 2019 MSA-Wide GHG Emissions Estimates (metric tons of CO_2e)



ring shows the subsectors as a proportion of each sector. To give a more complete picture, staff included a rough percentage of the amount of emissions expected from the waste and materials management sector based on the percentage of the waste sector in the Shelby County inventory (ranges between 6 – 8 percent).

The inventory was developed using a variety of data including but not limited to:

- Facility-specific GHG data published by the EPA in the Facility Level Information on Greenhouse Gases tool (FLIGHT),[2]
- Models run in EPA's MOtor Vehicle Emission Simulator (MOVES),[3]
- US Energy Information Administration (EIA)'s Form EIA-861 and Form EIA-176,[4]
- US Federal Aviation Administration's Operations Network (OPSNET),[5]
- Data from the Bureau of Transportation Statistics,[6] and
- National Land Cover Database Tree Canopy Cover Dataset.[7]

Appendix 1 contains the detailed methodology and quality assurance procedures for the preparation of this inventory.

ENDNOTES

1 GHG Protocol. (2024). *GHG Protocol for Cities*. Retrieved from https://ghgprotocol.org/ghg-protocol-cities

2 EPA. (2023). *2022 Greenhouse Gas Emissions from Large Facilities*. Retrieved from https://ghgdata.epa.gov/ghgp/main.do

3 EPA. (2024). *MOVES and Mobile Source Emissions Research*. Retrieved from https://www.epa.gov/moves

4 U.S. Energy Information Administration - EIA – Independent Statistics and Analysis. (2023). *Annual Electric Power Industry Report, Form EIA-861 Detailed Data Files*. Retrieved from https://www.eia.gov/electricity/data/eia861/

5 U.S. Federal Aviation Administration. (2024). *The Operations Network* (*OPSNET*). Retrieved from https://aspm.faa.gov/opsnet/sys/main.asp

6 Bureau of Transportation Statistics. (2021). *National Transportation Statistics*. Retrieved from https://www.bts.gov/topics/national-transportation-statistics

7 Multi-Resolution Land Characteristics (MRLC) Consortium. (2024). *Multi-Resolution Land Characteristics (MRLC) Consortium*. Retrieved from https://www.mrlc.gov/

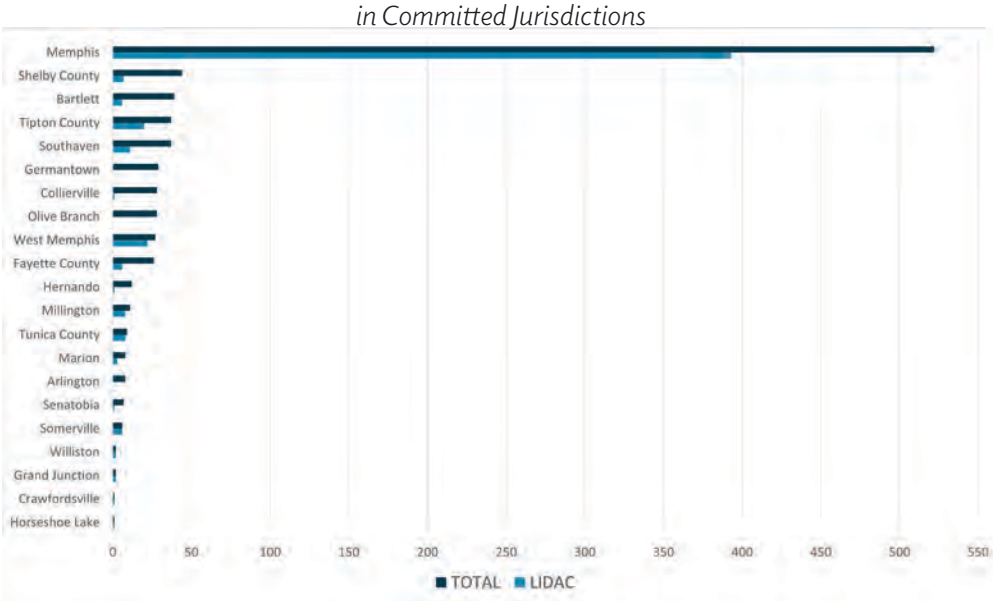
IMPACTS OF CLIMATE CHANGE C

The Mid-South Climate Action Plan focuses on reducing GHG emissions attributed to activities in the Memphis MSA. However, it is difficult to see the myriad of ways climate pollution is impacting our communities today and in the future. As our GHG emissions rise into the atmosphere and insulate the earth, the global temperature increases slightly. This temperature increase is destabilizing our climate systems, resulting in abnormal weather patterns.

As the climate crisis escalates, hazards like extreme heat, flash flooding, and damaging winds will continue to affect the Mid-South with increased severity and frequency. Without proper infrastructure, emergency preparedness, and a thorough understanding of existing threats, low-income and disadvantaged communities (LIDACs) will continue to face the brunt of climate change and its consequences. Within the Mid-South PCAP's committed jurisdictions, 498 of the Memphis MSA's 884 census block groups (56 percent) are identified as LIDACs following the Climate and Economic Justice Screening Tool[1] (CEJST) and Environmental Justice Screening and Mapping Tool[2] (EJScreen) methodologies. Forty-two percent of the Memphis MSA's population is located within LIDAC tracts, and the majority are concentrated within the City of Memphis.

Published in 2019, the *Mid-South Regional Resilience Master Plan* describes the primary climate threats facing the Mid-South as the climate crisis escalates. These threats include extreme heat and drought, flash and riverine flooding, damaging wind, winter storms, and tornadoes. While this plan's geographic scope does not extend as far as the Mid-South PCAP's, the following analysis builds off the research provided by the plan but focuses on how these hazards impact LIDACs in particular and updates the data points used to encompass the entirety of the Memphis MSA.

Figure 6. Total Census Block Groups and LIDAC Census Block Groups in Committed Jurisdictions



ON THE MID-SOUTH

Figure 7. LIDAC Census Block Groups in Committed Jurisdictions

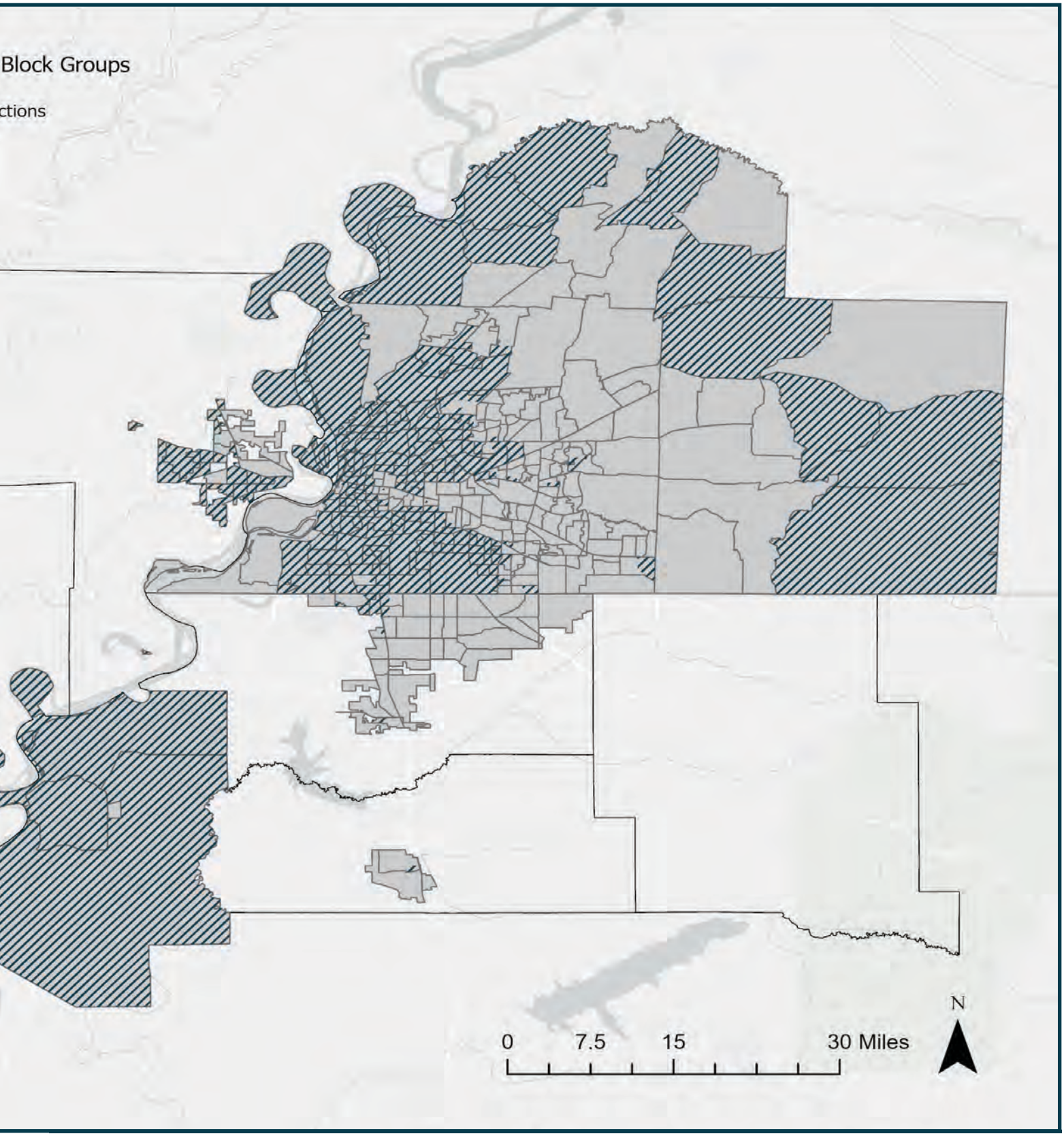
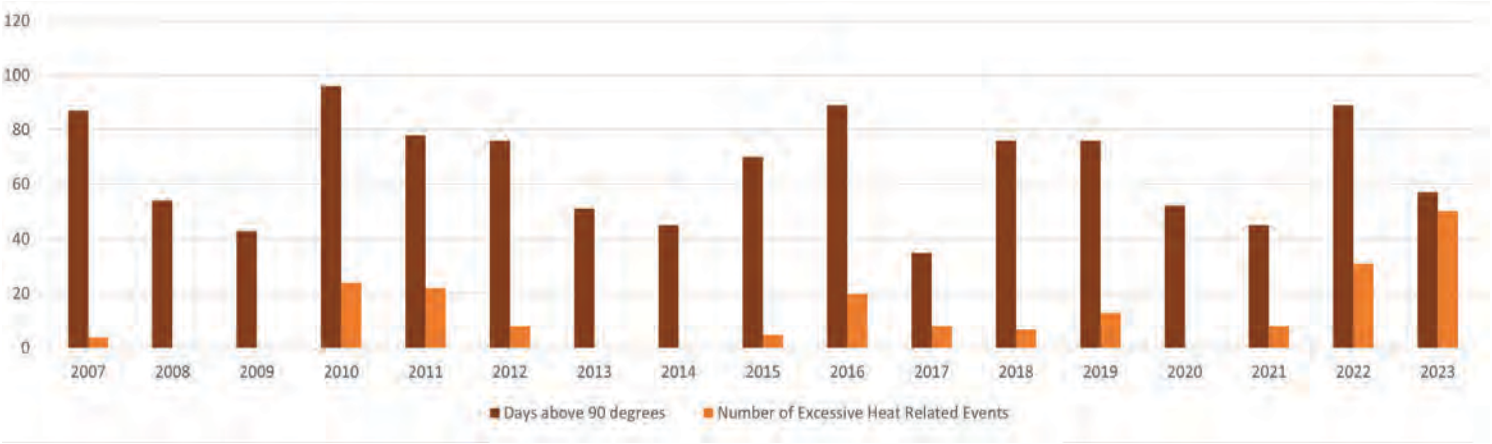


Figure 8. Extreme Heat in the Memphis MSA from 2007 to 2023



Sources: National Weather Service. "NOWData." Memphis Area - Climate Memphis - Calendar Day Summaries - Max Temp. https://www.weather.gov/wrh/climate?wfo=meg; and NCEI. "Storm Events Database." National Centers for Environmental Information. https://www.ncdc.noaa.gov/stormevents/

EXTREME HEAT

Extreme heat is defined as temperatures and/or humidity levels exceeding the average within a particular time and place. Extreme heat is the highest climate related cause of death in the United States[3], and as temperatures continue to rise, vulnerable groups are put further at risk.

The first requirement of an extreme heat event is a higher-than-average temperature, of which the Mid-South is expected to see significant increases in the coming decades. In 2010, the City of Memphis could expect around 57 days a year to reach 90°F. Today, on average, the area can expect 68. By 2075, models are projecting upwards of 97 days reaching 90°F and 82 to 114 days of extreme heat.[4]

Many people's understanding of heat stops at the daily temperature. While temperature is an important factor that must be considered when measuring heat, it is not the only factor contributing to how human bodies may experience heat. For example, the heat index combines both temperature and relative humidity to provide a more accurate measure of how the human body perceives heat and ultimately how it impacts public health. When experiencing high heat, the human body perspires to regulate its internal temperatures. When sweat evaporates, the body cools itself down. However, in humid conditions, the rate of evaporation decreases and limits the cooling process; human bodies feel warmer in humid environments and cooler in arid environments. When heat indexes exceed 90°F, prolonged exposure and/or physical activity increases chances of heat stroke, heat cramps, or heat exhaustion.[5] Even more comprehensive than heat index, wet-bulb globe temperature incorporates temperature, humidity, wind speed, sun angle, and cloud cover into its measurements. When wet-bulb globe temperatures exceed 90 degrees, working or exercising in direct sunlight will exhaust the body after fifteen minutes of activity.

The graph above demonstrates the difference in tracking days above 90 degrees versus excessive heat related events. The National Oceanic and Atmospheric Administration (NOAA) Storm Events Database reports an excessive heat event "whenever heat index values meet or exceed locally/regionally established excessive heat warning thresholds."[6] The number of days exceeding 90 degrees does not necessarily correlate with the number of excessive heat events. For example, 2023 logged fewer days above 90°F than years prior, but the number of extreme heat related events spiked. In summary, while daily temperature is a common heat measurement, it does not fully reflect how

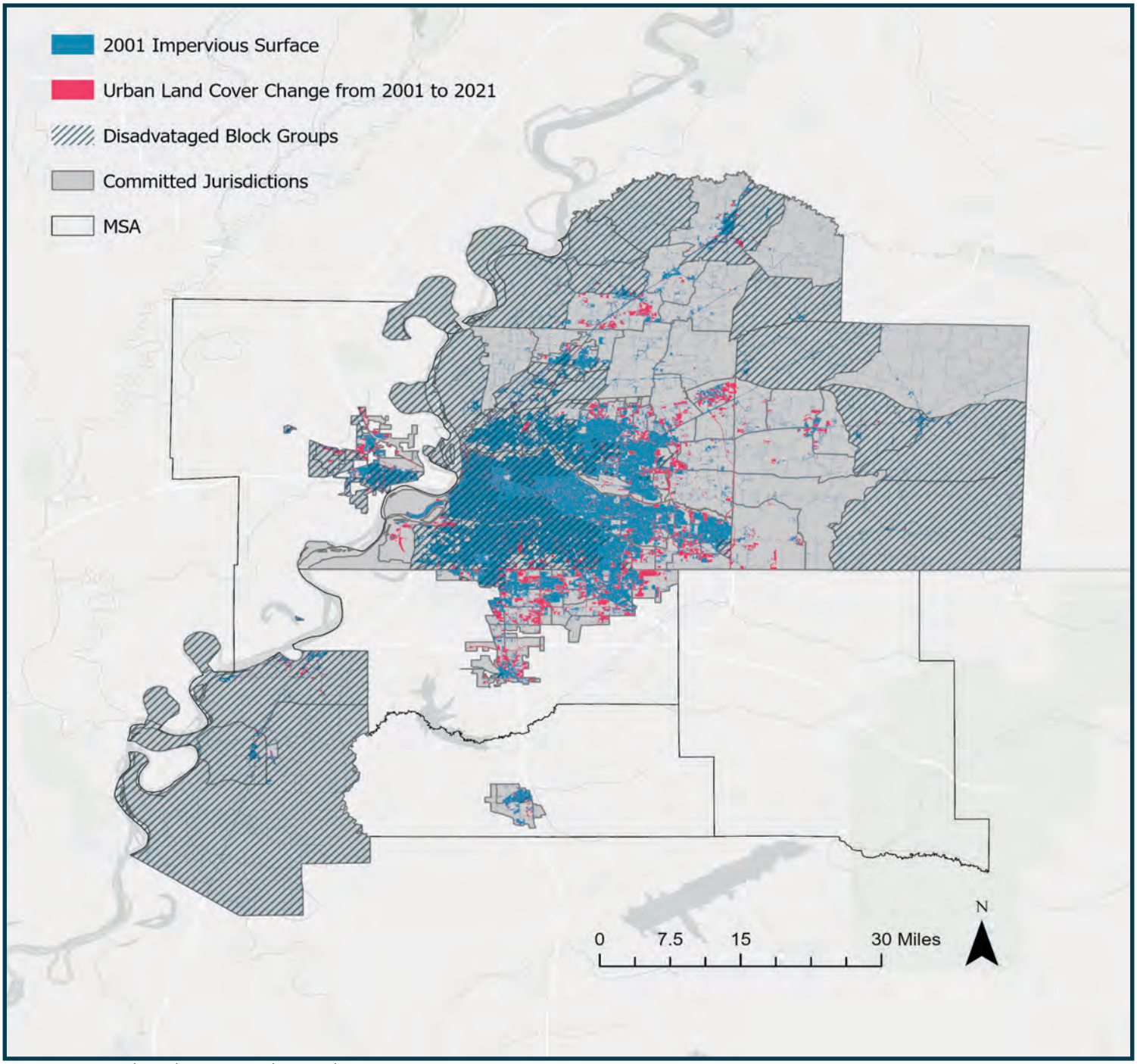
the day's weather may affect Mid-South communities.

Urban Heat Island Effect

The urban heat island effect describes the phenomenon in which temperatures are higher in urban areas than rural areas. Due to the urban heat island effect, the City of Memphis's temperatures reach around 16°F higher than surrounding areas, and Memphis residents experience 21 more days per year above 90°F than those in more rural areas.[7]

The nature of urban development (e.g., increased levels of impervious surfaces, limited green and blue spaces, etc.) causes this discrepancy. As seen in Figure 9, within committed jurisdictions, impervious surfaces increased by 16.1 percent between 2001 and 2021. This increase is likely attributed to the Memphis MSA's sprawling development patterns.[8]

Figure 9. Change in Impervious Surface in Committed Jurisdictions from 2001 to 2021



Source: National Land Cover Database. Urban Imperviousness. 2021, 2001.

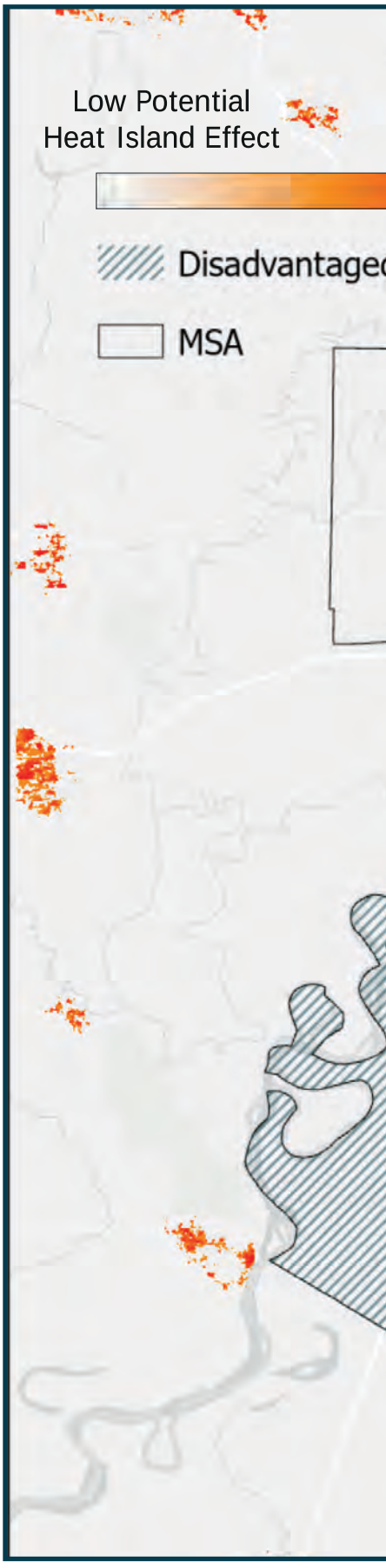
Due to decades of systemic disinvestment through practices like redlining and the construction of the interstate highway system, the urban heat island effect particularly affects LIDAC census block groups. Urban heat island effect is prevalent within low-income and disadvantaged communities because of the large amounts of impervious surfaces and limited access to greenspace in the built environment. Fifty three percent of all impervious surface in the Memphis MSA is located within LIDAC census block groups.[9]

Risk to Public Health

Extreme heat has a higher likelihood to impact public health than any other climate-related hazard. Individuals who are more exposed to high temperatures (e.g., those without reliable space cooling systems, the unhoused, or those who work in an outdoor setting), sensitive to extreme heat's impacts (e.g., the elderly, infants, people with chronic illness)[10], and/or are less able to respond and prepare for its impacts are particularly at risk of heat related illness or death.[11] Since 2010, there were 18 fatalities in the Memphis MSA directly attributed to extreme heat[12], but oftentimes heat-related casualties are attributed to other causes, primarily respiratory disease.[13] Extreme heat also increases the chance of strokes and other health complications.

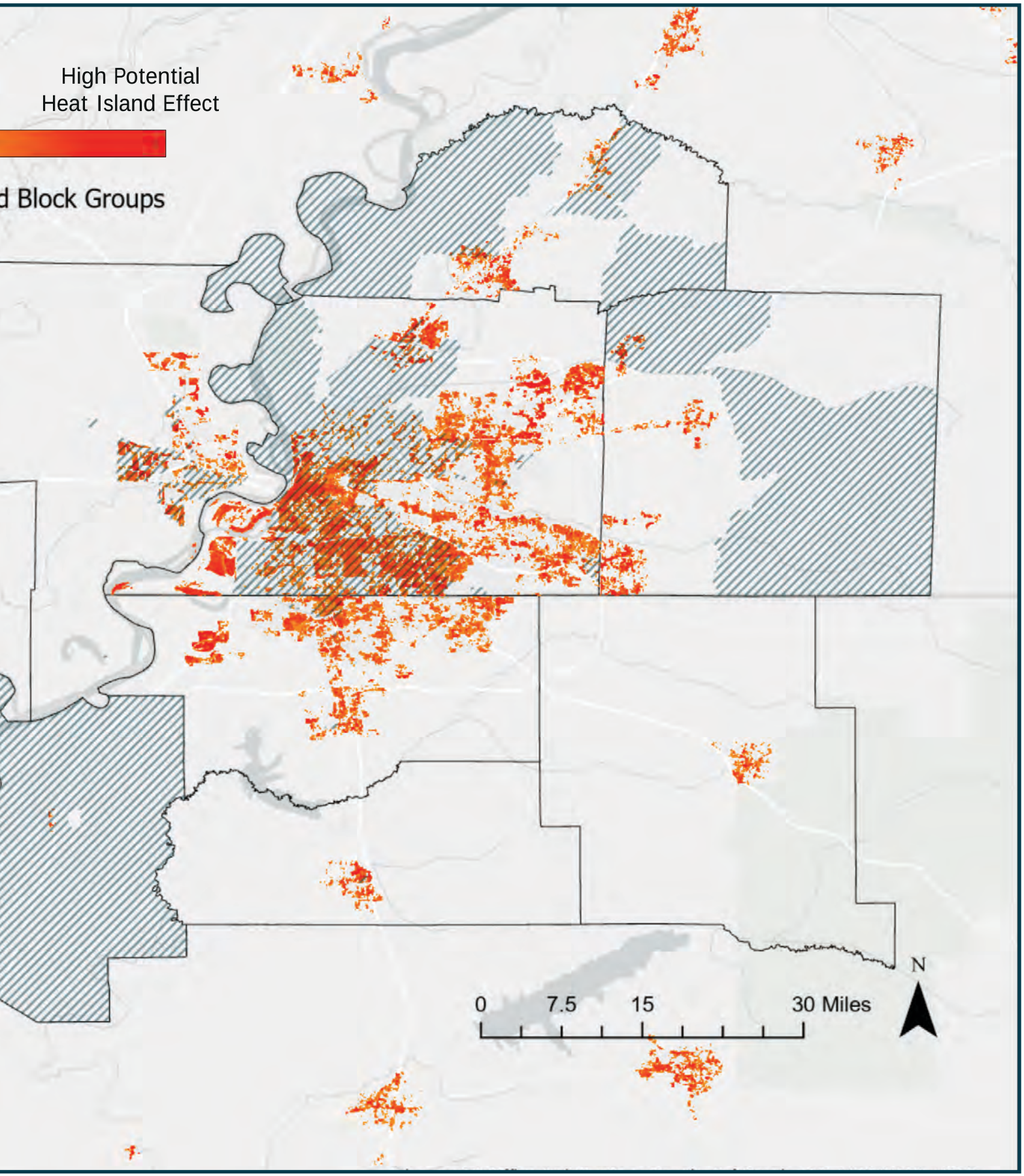
Hot, humid environments encourage the development of ozone, the primary component of smog, leading to increased air pollution.[14] This creates increasingly dangerous conditions for those with respiratory and cardiovascular diseases. Within committed jurisdictions, 96 census tracts (30 percent of the total population) are within the 90th percentile of residents diagnosed with asthma (95 of these tracts are LIDAC tracts).[15]

In the event of a power outage, blackout conditions may result in dangerously high temperatures inside buildings reliant on heating, ventilation, and air conditioning (HVAC) systems. Additionally, when temperatures exceed 95°F at 100 percent humidity or wet-bulb temperatures exceed 96 degrees, the human body is no longer able to maintain viable internal temperatures without air-conditioning. To mitigate these risks, the need to ensure vulnerable groups have access to reliable HVAC is paramount.



Source: The Trust for Public Land. "Heat Se

Figure 10. Heat Severity in 2021



verity 2021."

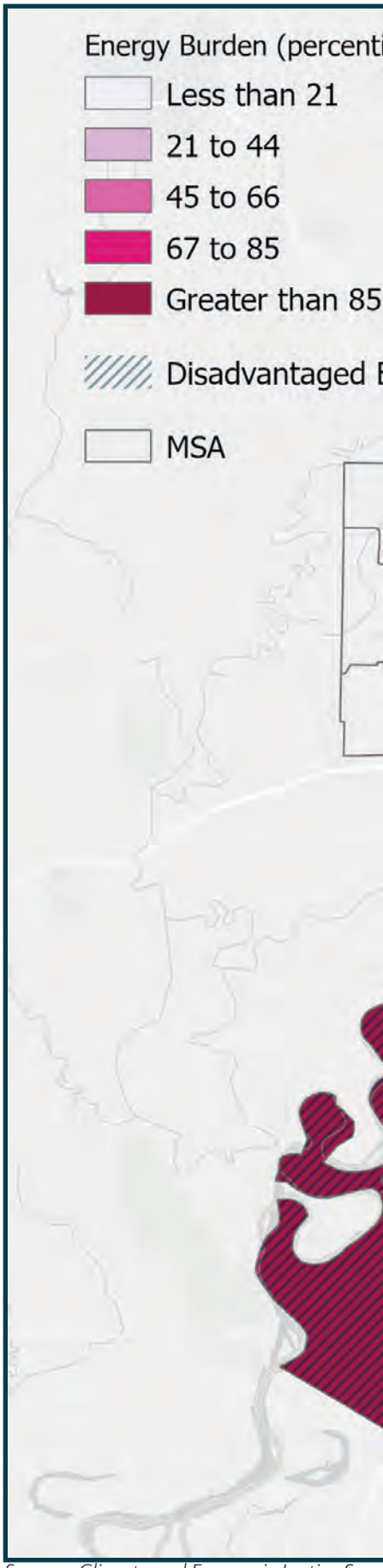
Financial Burden

Extreme heat has a variety of financial impacts. It can affect personnel finances, businesses, and agriculture. For example, health issues can have considerable ramifications for personal finances. Within the Memphis MSA, 9.5 percent of residents are uninsured, and 27 percent of households earning less than $50,000 a year (the Memphis MSA median household income being $64,008) are uninsured.[16]

In addition, extreme heat increases energy costs associated with cooling homes. The City of Memphis faces the most significant energy burden in the country. Where the average US household spends around 3.5 percent of their income on energy costs, the average Memphis household spends 6.2 percent. Low-income households, however, spend upwards of 25 percent of their income on energy bills alone.[17] Seventy census tracts (all LIDAC) are within the 90th percentile of CEJST's energy burden threshold (Figure 11).

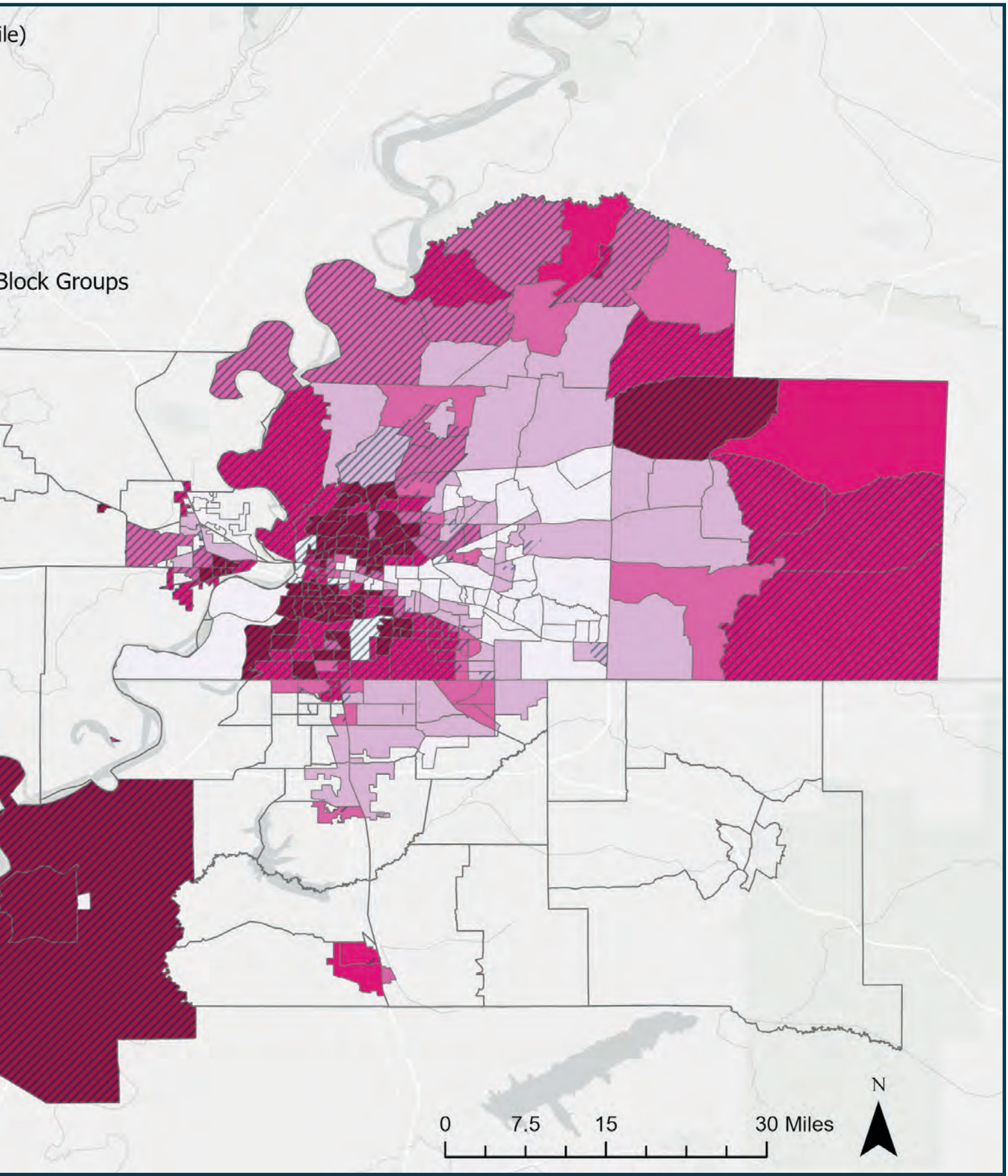
Extreme heat creates unsafe working conditions for people working outdoors and/or in manual labor occupations. Beyond employee productivity sharply declining when temperatures exceed 84°F, physical exertion poses serious threats to workers' health and safety.[18] Within the Memphis MSA, 27 percent of the labor force works in outdoor and/or manual labor occupations.[19]

Crop production and livestock are notable industries expected to undergo negative impacts from climate change. Within the Memphis MSA, three counties – Crittenden, Tunica, and Tipton – have primarily agricultural land uses. When temperatures exceed 84°F, corn and soybean yields, two of the predominant crops produced in the Mid-South[20], plummet. Additionally, as pastures are negatively affected by high temperatures, farmers depend more on hay in the winter to feed their livestock; this is a growing financial burden placed on farmers.[21]



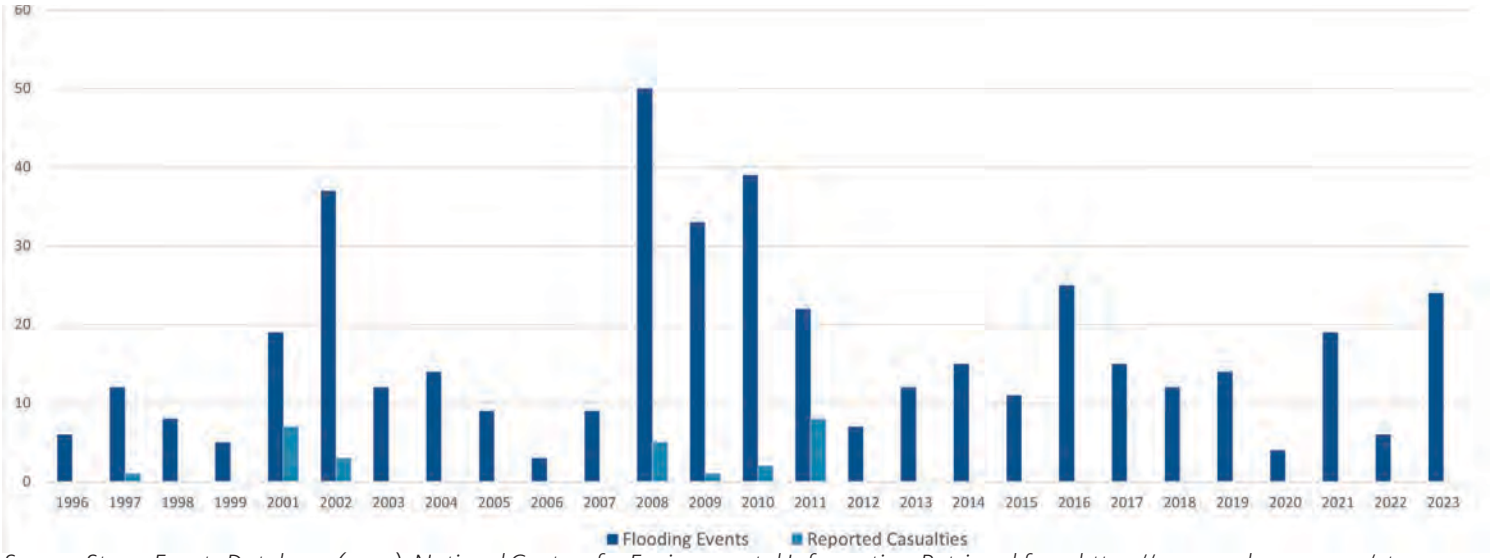
Source: Climate and Economic Justice Scre

Figure 11. Energy Burden Severity by Census Tract



ening Tool. (2022). Retrieved from https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5

Figure 12. Reported Flooding Events in the Memphis MSA from 1996 to 2023



Source: Storm Events Database. (2023). National Centers for Environmental Information. Retrieved from https://www.ncdc.noaa.gov/stormevents/

FLASH AND RIVERINE FLOODING

Due to its location along the Mississippi River and several tributaries, the Mid-South is susceptible to both flash and riverine flooding events. As defined by the 2016 Shelby County Hazard Mitigation Plan, riverine flooding is "excess water flowing from rivers and other bodies of water... onto riverbanks and adjacent floodplains,"[22] whereas flash flooding refers to "excess precipitation that does not directly drain into the stormwater drainage system."[23]

Typically, the region receives 53.67 inches of precipitation annually.[24] From 1996 to 2023, there were 442 reported flooding events, 27 flood related deaths and injuries, and over $3 billion in property damage costs, including the record-breaking 2011 Mississippi River floods.[25] As global precipitation patterns shift due to increases in air and ground temperature, the Mid-South is expected to experience an increase in frequency and duration of flash and riverine flooding events. By the late 21st century, there is projected to be a 5.29 percent increase in precipitation levels.[26]

Stormwater Drainage

Flooding is exacerbated in areas with high levels of impervious surfaces and insufficient stormwater drainage. In recent history, man-made gray infrastructure like gutters, storm drains, and pipes has successfully managed excess stormwater. However, as climate change brings increased precipitation levels, these traditional stormwater management strategies are becoming increasingly overwhelmed. Additionally, urban spaces with fewer tree coverage and vegetative cover will experience more frequent and severe surface flooding events.[27]

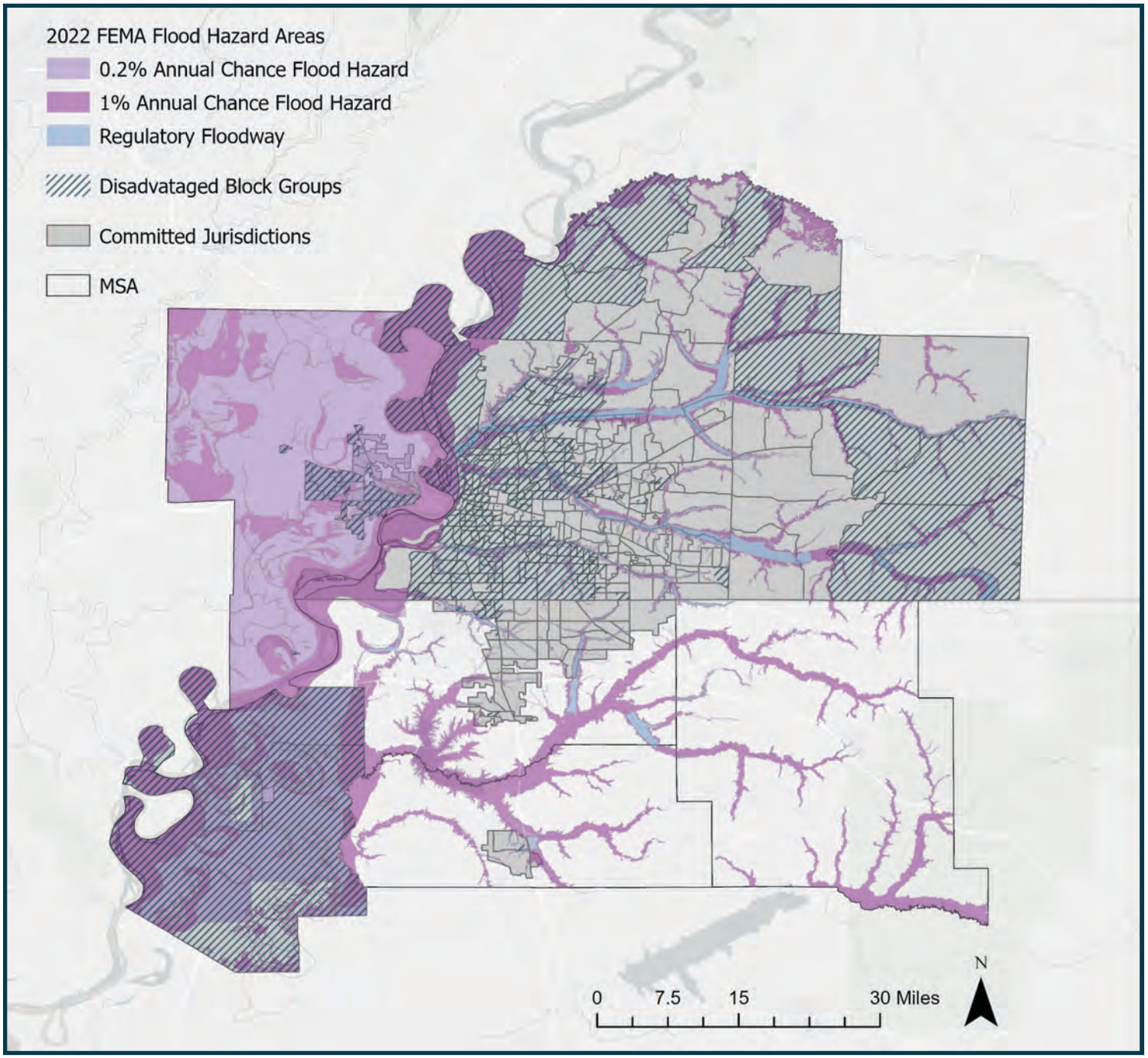
Impacts

Within the Memphis MSA, 58 percent of all census block groups and 52 percent of LIDAC census block groups are located within 100 feet of a 2022 Federal Emergency Management Agency (FEMA) flood hazard area.[28] FEMA produces flood hazard area maps (also referred to as flood or floodplain maps) to inform national flood insurance rates. The intent of the maps is to deter development in areas of flood risk.[29] As flooding events continue to increase in frequency and magnitude, these groups are increasingly facing health, safety, and financial risks.

Financially, property owners within flood zones are more susceptible to costs associated with foundational instability caused by erosion and general property damage caused by standing water. Impassable roadways affect commuters' access to employment as well as working parents' access to schools, which they rely on for childcare.[30]

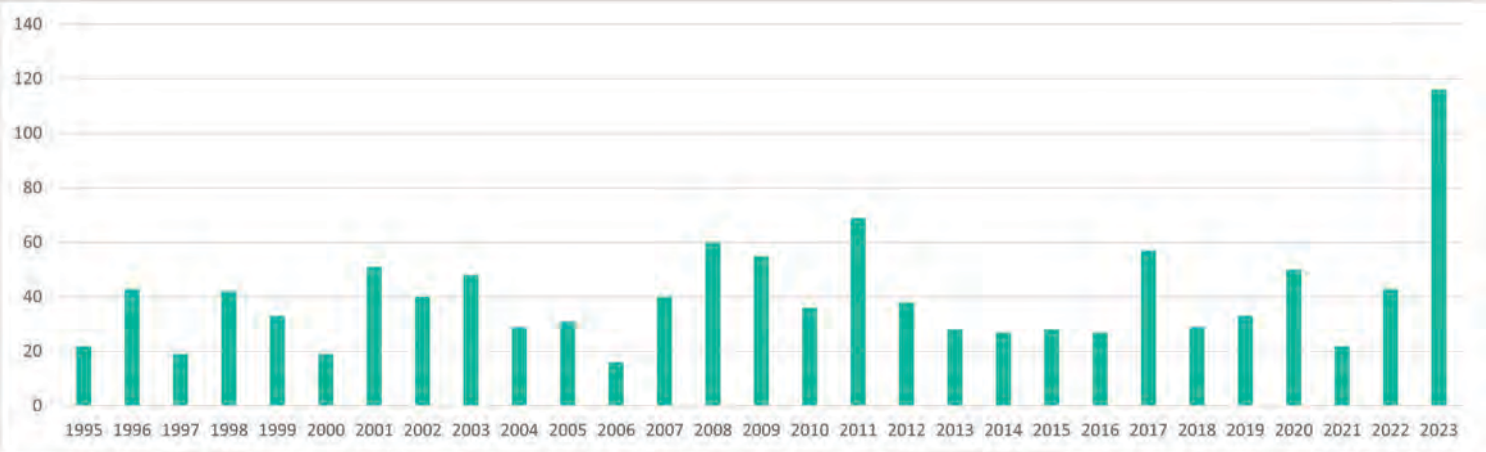
As flooding events become more common, insurance companies are increasing premiums. The increase in premiums makes it unaffordable for homeowners to maintain coverage, and more homeowners are choosing to go without insurance. Without coverage, homeowners then have to bear all costs associated with property damage.[31]

Figure 13. Flood Hazard Areas in the Memphis MSA



Source: Federal Emergency Management Agency. National Flood Hazard Layer

Figure 14. Damaging Wind Events in the Memphis MSA from 1995 to 2023



Source: Storm Events Database. (2023). National Centers for Environmental Information. Retrieved from https://www.ncdc.noaa.gov/stormevents/

Flooding has direct and indirect impacts on health and safety. During floods, individuals are at risk of getting swept away or hit by debris in fast moving water. Indirectly, flood waters can damage utility infrastructure leaving residents without power. As mentioned in previous sections, power outages often make residents more vulnerable by impacting those who rely on medical devices and exacerbating the impacts of heat and cold. Flooding also impedes emergency vehicles' roadway access, which makes it difficult to reach individuals caught in a flood or stranded in homes inundated with flood waters.[32]

DAMAGING WINDS

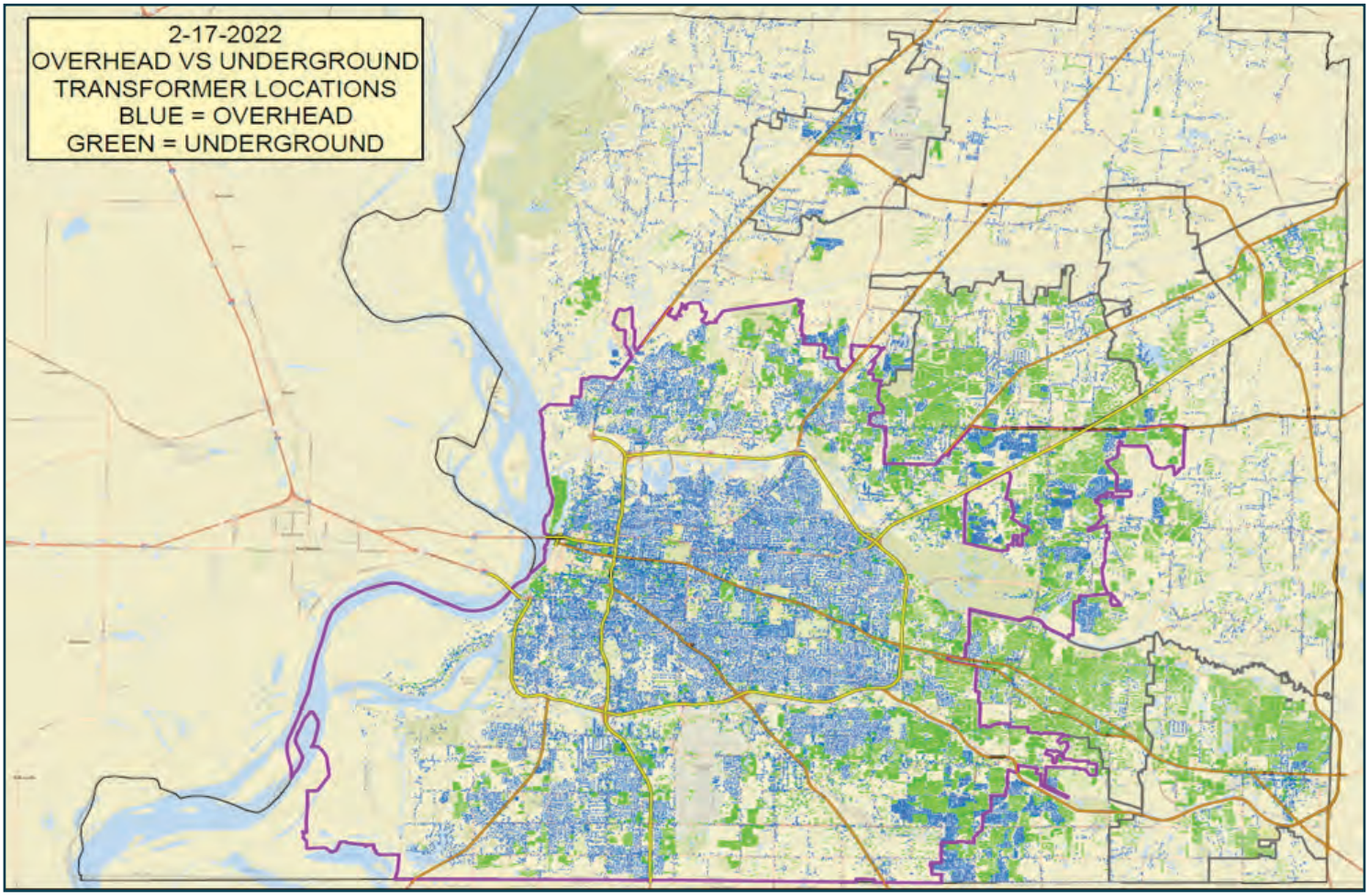
The National Weather Service defines wind as severe if it exceeds 58 miles per hour. Severe winds are caused by a high-pressure air system meeting a low-pressure air system and wind speeds increase when differences in atmospheric pressure also increase. The full impact of severe winds to the Memphis MSA is still unknown and research is ongoing. However, globally, the shifts in air temperature are impacting wind patterns.[33]

Power Outages

In the Mid-South, severe winds, primarily those associated with thunderstorms, pose significant threats to infrastructure and property, most notably utility infrastructure. Utility companies report that wind gusts exceeding 20-30 miles per hour result in an increase in the number of down power lines.[34] As many residents in the MSA are reliant on above ground power lines, winds frequently cause extended power outages for residents and business owners. Any loss of power exacerbates the public health risks associated with extreme heat and cold events.

Using the System Average Interruption Duration Index, a metric that measures the total time an average customer experiences an outage, the average American experiences five hours of total disruption a year.[35] Between the years 2019 and 2022, 52 percent of block groups within the City of Memphis experienced longer disruption times than the American average, with 82 percent of these block groups designated as LIDACs.[36] LIDAC groups experience an average of 6.2 outage hours annually and 2.3 unique interruptions a year.

Figure 15. Overhead vs. Underground Transformers in the Memphis Light, Gas, and Water Service Area



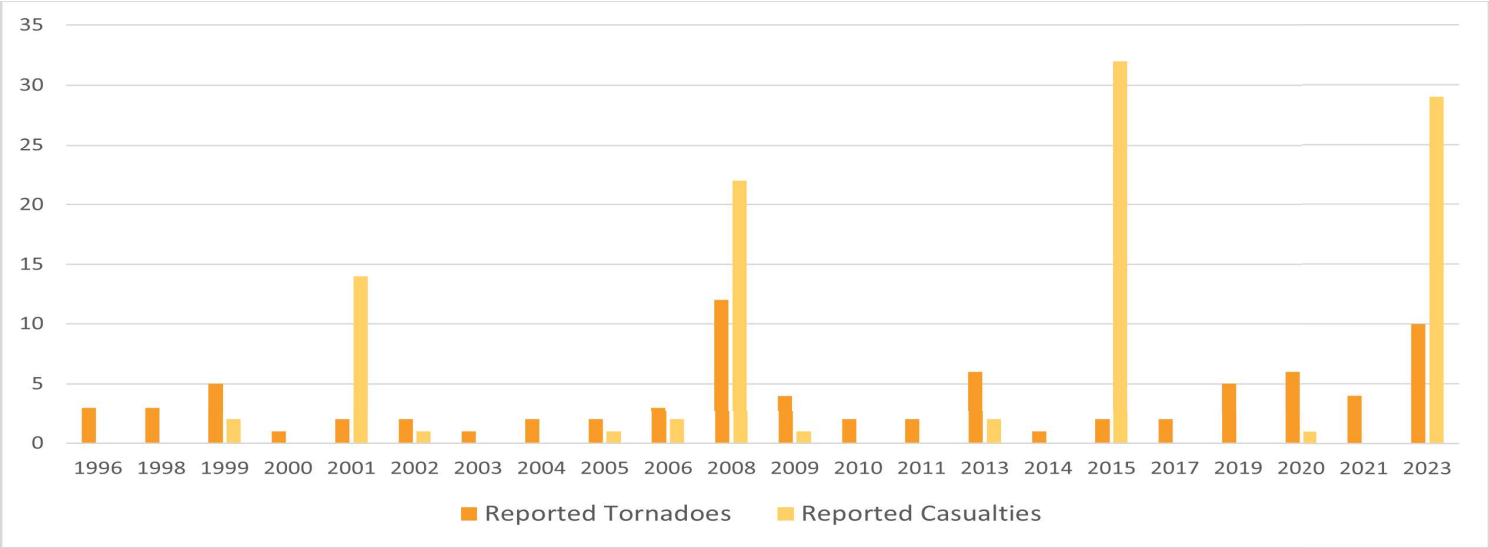
Source: Memphis Light, Gas, and Water

TORNADOES

Recent studies have shown an increase in tornado frequency in the Mid-South and a less predictable tornado season throughout the year. While it is unclear if these changes are due to natural variability or the climate crisis, the Mid-South region is particularly vulnerable to their impacts. Currently, the Memphis MSA is located in the area of the U.S. that experiences the most casualties from tornadoes, and this is likely to continue in the future due to social vulnerabilities.[37]

As the severity and paths of tornadoes are varied and unpredictable, so are their impacts. As illustrated in Figure 16, the number of tornadoes within a given year does not always correlate with the number of casualties (injuries and deaths). In 2015, for example, there were relatively few reported tornadoes. However, in December of that year, one EF-4 tornado[38] (classified by the National Weather Service as a violent storm with wind speeds between 166 and 200 miles per hour) ran through Holly Springs, MS resulting in thirty injuries and two deaths. In late March of 2023, an outbreak of tornadoes hit Tipton County, TN resulting in twenty-eight injuries and two deaths.

Figure 16. Reported Tornadoes in the Memphis MSA from 1996 to 2023

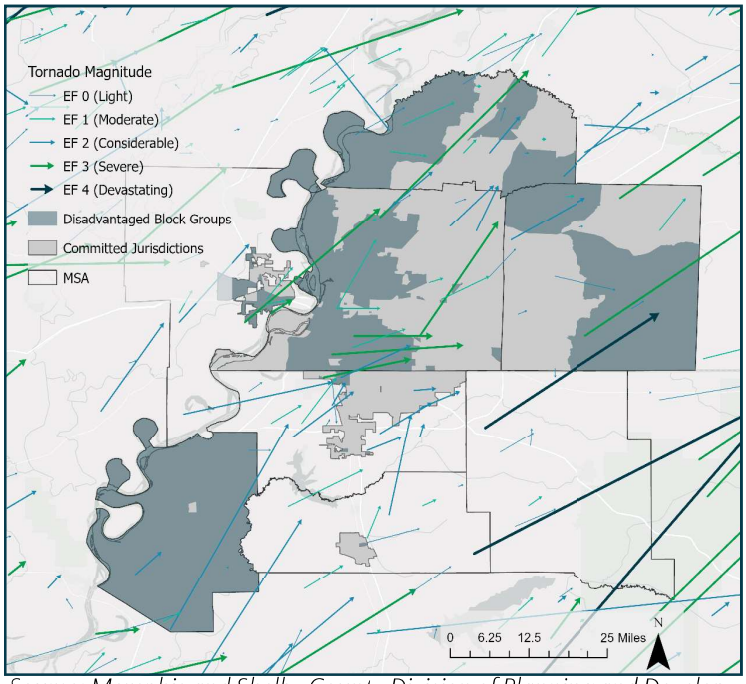


Source: Storm Events Database. (2023). National Centers for Environmental Information. Retrieved from https://www.ncdc.noaa.gov/stormevents/

Housing Vulnerability

Mobile homes are highly vulnerable to tornadoes. The safest place for people to shelter from a tornado is in a basement.[39] However, most people in the Mid-South rely on interior rooms as most homes were built without basements. In addition, mobile homes are highly vulnerable to tornadoes. Without underground or interior rooms, mobile home residents are particularly at risk. LIDAC census block groups in Tunica, Fayette, and Tipton Counties have the highest percentages of mobile homes within the MSA. Eight percent of housing units are mobile homes. Within Tunica County (where all but one census tract is LIDAC), the figure reaches 26 percent. Mobile homes make up 12 percent of Tipton and Fayette County housing units.[40]

Figure 17. Map of Historic Tornado Paths.



Source: Memphis and Shelby County Division of Planning and Development. (2019). Mid-South Regional Resilience Master Plan.

WINTER WEATHER

Cold weather is typical during winter season in the Mid-South, and as a result hazardous winter weather such as snow, ice, and wind chill will occur. While the Mid-South experiences fewer winter events than other regions in the US, individuals and municipalities are often ill-equipped to deal with the impacts, primarily snow and ice accumulation.[41] As shifts in climate patterns bring an increase in precipitation levels, the region will likely experience an increase in ice and snowfalls as well. Over time, however, precipitation will manifest as rain rather than winter weather as global temperatures rise.

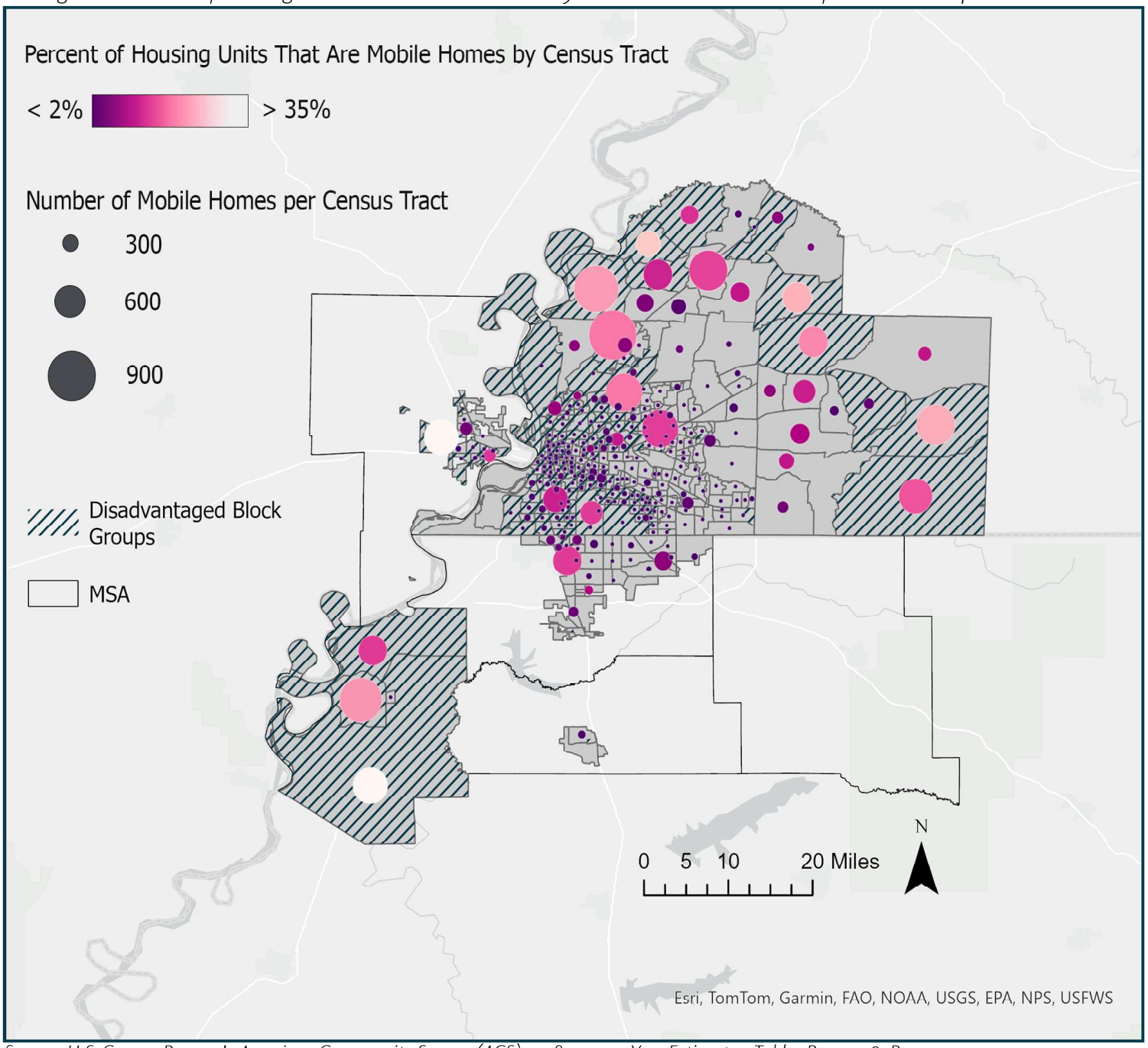
Impacts

Similar to the extreme heat events experienced in the summertime, winter weather can overwhelm and/or damage utility infrastructure leaving residents without

electricity or clean water. Increases in demand for power to manage temperatures that can dip thirty degrees below average strain the electric grid. To prevent grid failure, MLGW, for example, has implemented rolling blackouts and called for customers to limit power consumption where possible. In addition to overwhelming the system, snow and ice accumulation can result in downed power lines, leaving residents without electricity.[42]

Residents are also impacted by boil water advisories when pipes burst from freezing weather. Low pressure in the water distribution system allows bacteria or other quality problems to enter the water supply. In these events, residents must boil water to drink, brush their teeth, wash dishes, or prepare food. In the winter of 2024, 600,000 people within Shelby County were without clean drinking water due to unusually cold temperatures.[43]

Figure 18. Percent of Housing Units That are Mobile Homes by Census Tract and Number of Mobile Homes per Census Tract



Source: U.S. Census Bureau's American Community Survey (ACS) 2018-2022 5-Year Estimates. Tables B25024 & B25032

Winter weather can also have significant impacts on operations of schools, public buildings, and businesses. The region has limited snowplows, and when heavy snowfall or ice accumulation impact roadways, residents are discouraged from driving due to the dangerous conditions. Until snow and ice melts and roadways become passable, these events obstruct daily life in the Mid-South.[44]

Freezing temperatures bring increased chance of frostbite, hypothermia, and dehydration to the Mid-South.[45] Unhoused individuals are particularly at risk of these conditions when they are unable to secure shelter. Community Alliance for the Homeless' 2023 Point in Time report counted 1,292 total unhoused individuals and 165 without shelter in Memphis and Shelby County.[46]

CONCLUSION

Climate change's impacts on the Mid-South affect everyone, but the most at risk are those with the least resources to protect themselves from climate hazards. Consequences of the changing climate (e.g., utility blackouts, downed power lines, and rising insurance costs) pose public health, safety, and economic risks to the Mid-South's most vulnerable groups.

While not all reduction measures in this plan will alleviate the climate events currently experienced in our communities, there are opportunities to reduce the emissions causing these hazards while also mitigating their impacts. Where co-benefits exist, they are included in the reduction measure analysis. To adapt for and mitigate the increasingly severe weather events following the climate crisis (even beyond the projections described above), we must work as a community to reduce our GHG emissions.

ENDNOTES

1 Climate and Economic Justice Screening Tool. (2022). Retrieved from https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5

2 Environmental Protection Agency. (2024). *EPA's Environmental Justice Screening and Mapping Tool* (Version2.2) . Retrieved from https://www.epa.gov/ejscreen

3 U.S. Global Change Research Program (2009),. *Fourth National Climate Assessment*. 203, , as cited in the *Mid-South Regional Resilience Master Plan*. Pg. 59.

4 Climate Impact Lab. *How Much Hotter Is Your Hometown Than When You Were Born?* New York Times. 2018. https://www.nytimes.com/interactive/2018/08/30/climate/how-much-hotter-is-your-hometownhtml?rref=collection%2Fsectioncollection%2Fclimate&action=click&contentCollection=climate&region=stream&module=stream_unit&version=latest&contentPlacement=3&pgtype=sectionfront

5 NOAA's National Weather Service. (n.d.). *What is the heat index?* Retrieved from https://www.weather.gov/ama/heatindex

6 National Weather Service. (2021). *National Weather Service Instruction*. NOAA. Pg. A-13. Retrieved from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf

7 National Centers for Environmental Information (NCEI). (2019). *Storm Events Database*. National Centers for Environmental Information, as cited in the Mid-South Regional Resilience Master Plan. Pg. 64.

8 National Land Coverage Database. Urban Imperviousness. 2021, 2001. *Landsat imagery was converted to polygon layers. The geographic area of 2001 impervious surface was divided by 2021 impervious surface.*

9 Intersect tool was used to calculate % of impervious surface covered by LIDAC block groups.

10 Centers for Disease Control and Prevention. (2017). *Heat and People with Chronic Medical Conditions*. Retrieved from https://www.cdc.gov/disasters/extremeheat/medical.html

11 Environmental Protection Agency, Center for Disease Control and Prevention (2016). *Climate Change and Extreme Heat: What You Can Do to Prepare.*

12 National Centers for Environmental Information. (2023). *Storm Events Database*. Retrieved from https://www.ncdc.noaa.gov/stormevents/

13 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan.* Pg. 61.

14 Shen L*, Mickley LJ, Gilleland E. (2016). *Impact of increasing heatwaves on U.S. ozone episodes in the 2050s: Results from a multi-model analysis using extreme value theory.* Pg. 43. Retrieved from doi:10.1002/2016GL068432.

15 Climate and Economic Justice Screening Tool. (2022).

16 Memphis MSA. (2021). *U.S. Census Bureau American Community Survey (ACS) 2021 5-Year Estimates. Table B27015.* Retrieved from https://data.census.gov

17 American Council for an Energy-Efficient Economy. (2016). *Lifting the High Energy Burden in America's Largest Cities*. Retrieved from https://www.aceee.org/sites/default/files/publications/researchreports/u1602.pdf

18 Zhang, and Peng. (2015, September 04). *Temperature and Economic Growth: New Evidence from Total Factor Productivity.* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2654406

19 United States Census Bureau. (2021). *American Community Survey 5-year Estimates,* Table C24050. Those working in *Natural resources, construction, and maintenance occupations & production, transportation, and material moving occupations*. Retrieved from https://data.census.gov

20 U.S. Department of Agriculture. (2023). *CroplandCROS*. Retrieved from https://croplandcros.scinet.usda.gov/

21 Memphis and Shelby County Division of Planning and Development (2019). *Mid-South Regional Resilience Master Plan.* Pg. 61.

22 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan.* Pg. 39

23 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan.* Pg. 51

24 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience*

Master Plan. Pg. 41

25 National Centers for Environmental Information. (2023). *Storm Events Database*. Retrieved from https://www.ncdc.noaa.gov/stormevents/

26 Memphis and Shelby County Division of Planning and Development (2019). *Mid-South Regional Resilience Master Plan*. Pg. 51.

27 Memphis and Shelby County Division of Planning and Development (2019). *Mid-South Regional Resilience Master Plan*.

28 Percentages determined from overlaying the FEMA Flood Hazard Area map and LIDAC census block groups in ArcGIS Pro.

29 Federal Emergency Management Agency. (2024, February 16). *National Flood Hazard Layer*. U.S. Department of Homeland Security. Retrieved from https://www.fema.gov/flood-maps/national-flood-hazard-layer

30 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*.

31 Council on Foreign Relations. (2023). *Climate change and U.S. Property Insurance: A Stormy Mix*. Retrieved from https://www.cfr.org/article/climate-change-and-us-property-insurance-stormy-mix

32 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg. 43.

33 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg. 33.

34 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg. 33.

35 EIA. (2020). *U.S. Energy Information Administration. U.S. power customers experienced an average of nearly five hours of interruptions in 2019*. Retrieved from https://www.eia.gov/todayinenergy.detail.php?id=45796

36 LIDAC census block groups were layered over MLGW 2019 – 2022 System Average Interruption Duration Index map. Data provided by Donald Roberts on 12/8/2023.

37 Gensini, Vittorio A., and Harold E. Brooks. (2018). *Spatial trends in United States tornado frequency.* NPJ climate and atmospheric science 1, no.1 (2018): 38.

38 The Enhanced Fujita Scale (EF) rates tornadoes based on estimated wind speeds and related damage.

39 Centers for Disease Control and Prevention. (2022). *Stay Safe During a Tornado*. Retrieved from https://www.cdc.gov/disasters/tornadoes/during.html

40 United States Census Bureau. (2022). *American Community Survey 5-year Estimates,* Table(s) B25024, B25032*: ACS Demographic and Housing Estimates*. Retrieved from ://www.arcgis.com/home/item.html?id=90cb97fca2f44c1384581fbb039df6bd

41 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg. 83.

42 Action 5 News. (2024, January 19). *Conversation Alerts, Rolling Blackouts, Boiling Wate: A New Normal?* Retrieved from https://www.actionnews5.com/2024/01/19/conservation-alerts-rolling-blackouts-boiling-water-new-normal/

43 AP News. (2024, January 22). *Memphis Residents Endure Day 4 of Water Problems as Freezing Weather Bursts Pipes Across the South*. Retrieved from https://apnews.com/article/winter-weather-freezing-temperatures-cold-memphis-water-948b57293a383883a99f5a0d6239cef7

44 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg 84.

45 Action 5 News. (2024, January 17). *Frostbite, Hypothermia, Dehydration All Dangers of Freezing Temps Across Mid-South*. Retrieved from https://www.actionnews5.com/2024/01/18/frostbite-hypothermia-dehydration-all-dangers-freezing-temps-across-mid-south/

46 Community Alliance for the Homeless, Inc. (2023) Point-in-Time Report for Memphis/Shelby County. https://www.cafth.org/point-in-time-count/

REDUCTION MEASURES

As seen in the Greenhouse Gas (GHG) Inventory section, multiple sectors contribute to the climate crisis. The largest contributor is transportation, specifically on-road cars, trucks, and buses. Electricity use is second, with most electricity consumed by residential buildings. The third largest sector is natural gas and other fuels consumed by residential buildings and uses. These three sectors impact most aspects of our lives, and we must make transformative changes in order to prevent even more extreme natural hazards in the future.

The reduction measures included in this plan are high-priority, implementation-ready projects, programs, or policies that local governments or their agencies have the authority to carry out. They also focus on the sectors with the most to gain from interventions. The committed local governments and stakeholders identified projects and initiatives that are priorities within the next three to five years. Due to the entwined nature of how buildings consume both electricity and fuel sources, the reduction measure in the residential and commercial buildings sector addresses all energy consumption by the buildings.

The priority GHG reduction measures by sector include:

- Electricity Use and Generation
  - E.1: Retrofit Outdoor Streetlights to LED Fixtures
  - E.2: Local Government Energy Audits and Renewable Electricity Installations
- Residential and Commercial Buildings
  - R.1: Low-Income Residential Energy Efficiency Retrofits
- Transportation
  - T.1: Enhance Public Transit
  - T.2: Connected Greenways Network

Table 2. Priority Reduction Measures Impact Summary

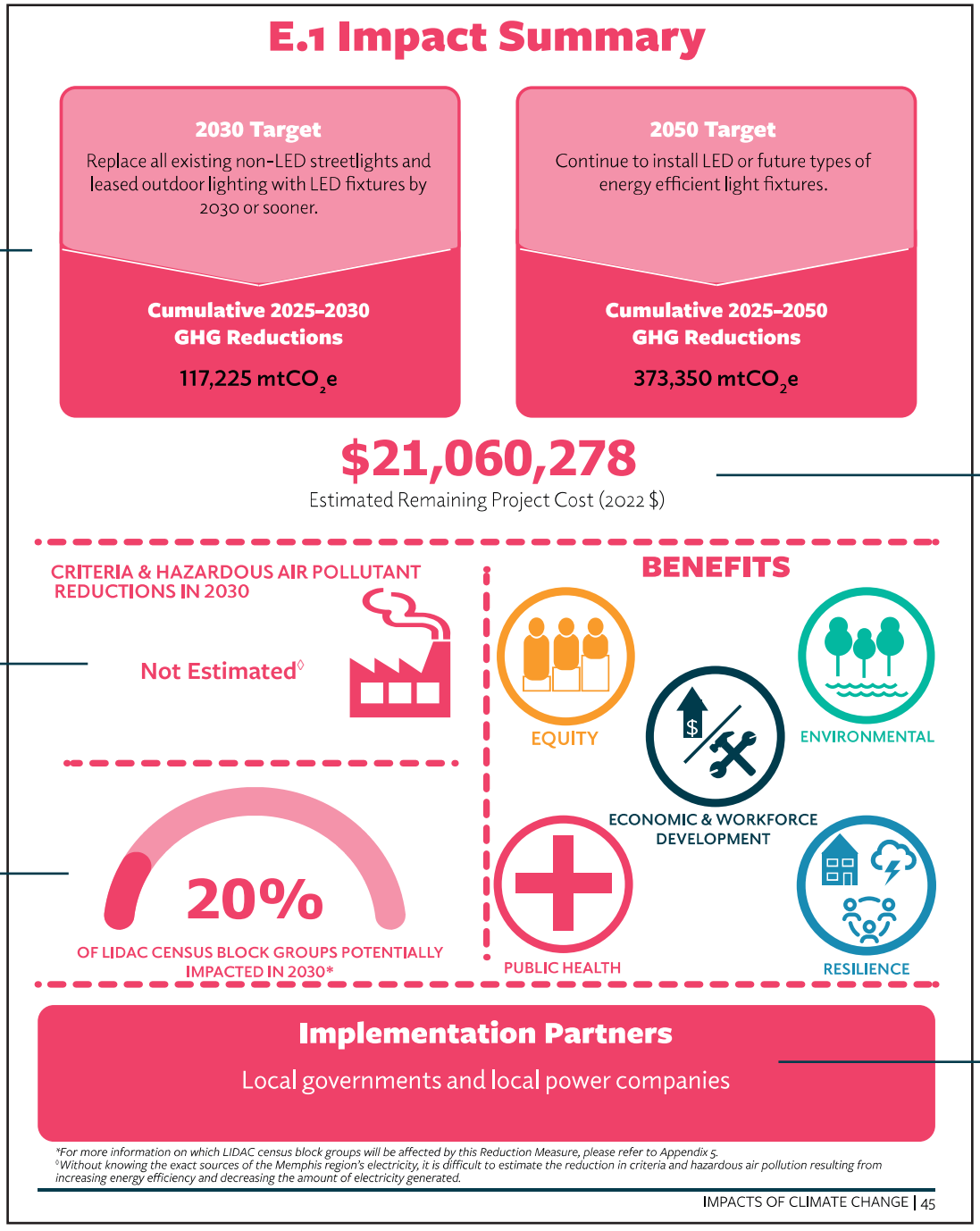
	Cumulative GHG Reductions ($mtCO_2e$)				
Reduction Measure	**2025-2030**	**2025-2050**	**Estimated Project Cost (2022 $)**	**LIDAC Impacted (%)**	**Co-Benefits**
E1: Retrofit Outdoor Streetlights to LED Fixtures	117,225	373,350	21,060,278	20	
E2: Local Government Energy Audits and Renewable Electricity Installations	11,893	207,685	53,021,353	Not Estimated	
R1: Low-Income Residential Energy Efficiency Retrofit	68,980	485,771	621,895,238	Not Estimated	
T1: Enhance Public Transit	31,988	388,756	1,120,500,000	23	
T2: Connected Greenways Network	102.23	865.91	398,496,095	60	

REDUCTION MEASURE COMPONENTS

This section provides information on targets for 2025 and 2030 and the respective estimated cumulative ghg reductions.

This section provides the estimated project cost in 2022 $.

If applicable to the reduction measure, this section provides estimated reductions in criteria and hazardous air pollutants in the year 2030.



This section provides an estimation of the percent of low-income and disadvantaged communities (LIDAC) census block groups in the MSA who would be impacted by the reduction measure.

This section lists the potential key implementation partners if the measure were implemented.

This section discusses the co-benefits that may occur upon implementation of the reduction measure. Topic areas include equity, environmental, public health, economic and workforce development, and resilience.

This section outlines the acquired funds and potential funding opportunities to implement the reduction measure.

This sec
challeng
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funding for projects and programs cutting carbon emissions, improving energy efficiency, and reducing energy use. Retrofitting streetlights and outdoor lights are eligible projects. This program is useful because it allows the expenditure of funds on all types of outdoor lights. Within the Memphis MSA, Shelby County, Memphis, Germantown, Collierville, Bartlett, DeSoto County, Olive Branch, and Southaven received formula allocated funds through this program. One potential issue for this funding source is that the allocations are unlikely to cover the full cost of retrofitting all the lights in the recipient jurisdictions.

CO-BENEFITS

EQUITY: The implementation of LED streetlights may bring down customer fees in the mid- and long-term, which would particularly benefit low-income customers. This would occur due to the lower projected maintenance costs from LED fixtures as well as reduced energy consumption overall. However, the cost savings are not guaranteed because savings ultimately depend on how utilities account for streetlighting maintenance funds. Customers are more likely to see the savings if there is a lighting fee on their utility bill than if local taxes incorporate streetlight maintenance.

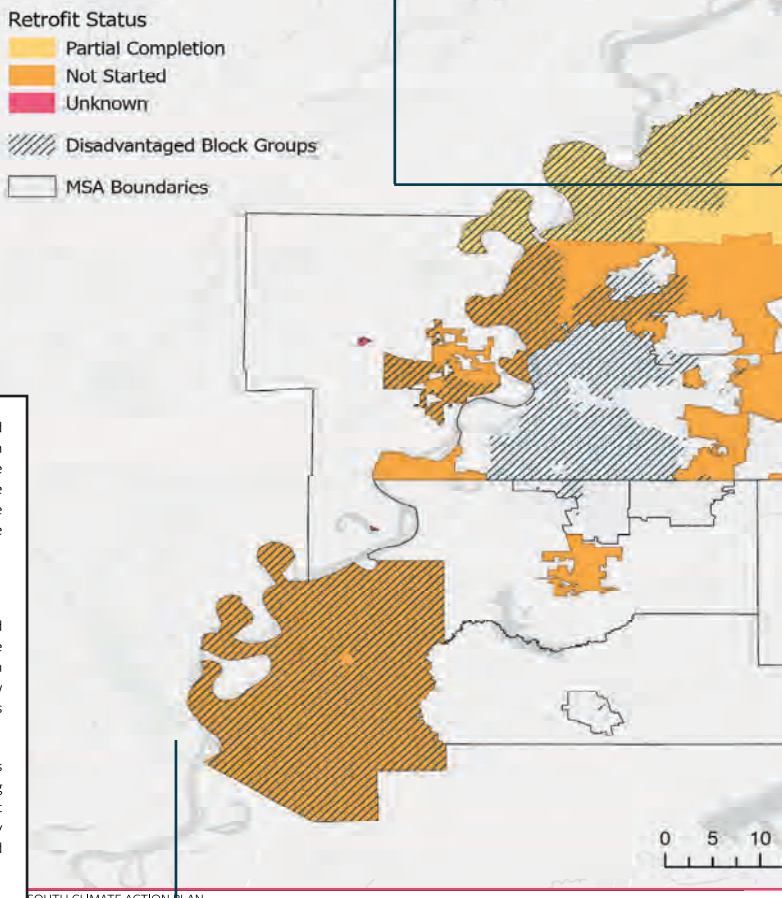
ENVIRONMENTAL: LED fixtures may have environmental benefits if the retrofit program requires retrofits to comply with dark sky recommendations. Dark sky recommendations include installing properly shielded LED streetlights with warmer color temperatures, which can help reduce light pollution, benefiting human and animal circadian rhythms and animal migrations. In addition, energy savings from LEDs may result in less demand for electricity generation. A lower generation demand could result in improved air quality in the communities near fuel-burning power plants.

PUBLIC HEALTH: Due to a lower requirement of electricity, LED lights emit fewer greenhouse gases, yielding improvements in air quality and health. Additionally, the long-lasting nature of LEDs provides reliable light, leading to a reduced number of collisions and an increase in the safety of cyclists, pedestrians, and drivers at night.

ECONOMIC AND WORKFORCE DEVELOPMENT: Retrofits may create new jobs and provide workforce development opportunities including forklift certification and third-party logistics (3PL) skills. Additionally, if the retrofit programs include requirements to recycle old light fixtures, there will be a higher need for workers to break down the lights into separate more valuable components, which will promote a circular economy.

RESILIENCE: LED lights are more durable and longer lasting. This helps increase infrastructure resilience and lowers maintenance requests for bulb outages.

Figure 20. Outstanding LED Streetlight Retrofit Projects



ction discusses the disbenefits and
ges associated with the reduction
e. Topic areas include financial,
onal, education and behavior change,
nd other challenges.

DISBENEFITS AND CHALLENGES

FINANCIAL: Although local governments or utilities will recoup the upfront expense over time through electricity savings, landing the upfront investment from jurisdictions and gaining political support for the project may be challenging due to other community needs. An updated life cycle cost-benefit analysis including economic considerations such as operations and maintenance costs and the time value of money should provide a more comprehensive picture of the payback period and return on investment. Additional benefits such as improved safety with better lighting and fewer outages are also considerations to add to the cost-benefit analysis of this project.

OPERATIONAL: To meet the 2030 implementation goal, local governments and utilities need to determine a realistic timeline of the full life cycle cost/benefit analysis and the financing, bidding, contracting and installation process. Additional employee training and education will be needed for the installation and maintenance of the new LED lights.

EDUCATION AND BEHAVIOR CHANGE: Implementers should develop an effective communication strategy to set expectations and teach leaders and community members about the transition period before LED lights reach normal operations. Public education should also focus on the short and long-term benefits and the shift in light color.

POLICY CHANGE: Depending on the financial framework for implementation, local governments or power companies may need to consider changes to existing policies.

REVIEW OF AUTHORITY TO IMPLEMENT

Depending on the ownership structure of the streetlights and LOLs, local governments may have the authority to implement E.1: Retrofit Outdoor Streetlights to LED Fixtures. If the local government owns the fixtures or they have a municipally owned electric utility, they have the authority to maintain and replace them, likely through their Public Works departments. If the local power company owns the streetlights, the local government may enter into a contract with the utility to work toward replacing the streetlights.

This section provides the review of authority to implement in regards to potential implementation partners for the reduction measure.

Since 2019, many municipalities in the Memphis MSA have begun or completed streetlight retrofit programs. Memphis, Olive Branch, Covington, Munford, Somerville, and Senatobia have completed the first phase of retrofits in their communities, while Bartlett, Collierville, Millington, and Southaven are in the midst of retrofit projects. The map to the left shows committed local governments where retrofits are still needed. These include jurisdictions that have conducted partial retrofits and need additional funding as well as those that have not begun the retrofit process.

POTENTIAL FUNDING OPPORTUNITIES

There are a few federal funding opportunities for retrofitting street lighting to LEDs, but most focus on specific roadway projects rather than comprehensive lighting projects allowing local governments or utilities to retrofit all outdoor lights.

The Bipartisan Infrastructure Law (BIL) established the **Carbon Reduction Program**, which provides funds for projects designed to reduce carbon dioxide emissions from on-road highway sources. Funding is available through Fiscal Year 2026 through state Departments of Transportation and Metropolitan Planning Organizations. Funds may be used to replace street lighting and traffic control devices, as well as other transportation projects, on any road that has a federal classification such as interstate, collector, and local roads.

The **Safe Streets and Roads for All Grant Program** is another potential funding source established through the BIL. At time of publication, the grant program had $3 billion still available for future funding rounds. This is a competitive grant program consisting of both a planning grant program to develop a comprehensive safety action plan and an implementation grant program to fund construction/implementation of projects and strategies in an existing action plan. Such projects could include correcting common risks such as installing improved lighting, which could incorporate a transition to LED streetlights. Many local jurisdictions in the Memphis MSA are eligible to apply for the implementation grant program using the Memphis Metropolitan Planning Organization's Safety Action Plan as a reference.

The BIL also established the **Energy Efficiency and Conservation Block Grant Program**, which provides

This map provides the geographic location that would be impacted by the reduction measure.

Reduction Measure E.1: Retrofit Outdoor Streetlights to LED Fixtures

OVERVIEW

This reduction measure aims to replace all non-LED streetlights and leased outdoor lights (LOLs) located within the boundaries of the committed governments with LED bulbs. LOLs are lights in public spaces such as parks and are not located adjacent to roads. Implementation of this action will involve each local government and/or local power company to develop life cycle cost-benefit analyses of making the switch to LED bulbs in their jurisdictions or service areas. They will also need to identify the best way to calculate for the upfront replacement costs and determine an efficient and feasible schedule for bidding, contracting, and installation. Implementation should also include development of public education and communications materials to explain the community-wide benefits of transitioning to more efficient streetlights.

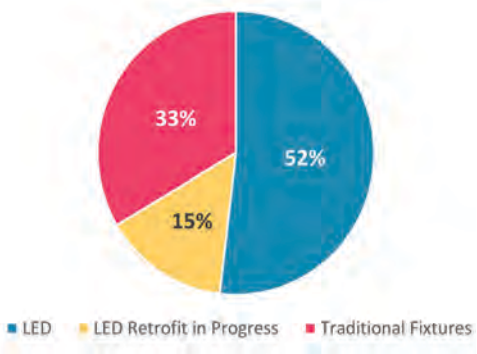
Local power companies and local governments will be the primary implementation partners for this action. Several committed jurisdictions have already completed or are actively completing LED retrofit projects. It is highly recommended that governments and local power companies share their experiences, best practices, and lessons learned with each other to enable all committed jurisdictions to complete this goal as efficiently as possible.

WHY IS THIS A PRIORITY ACTION?

As a region, the Memphis MSA is in the midst of a major lighting infrastructure transition. Retrofitting streetlights and LOLs is a more environmentally and economically sustainable action than the preceding technology of high-pressure sodium (HPS) and other non-LED bulbs. Many of our local power companies and governments have acted independently to make this switch due to the economic savings for both entities, which has resulted in a patchwork of those communities with LED streetlights and those without. As of January 2024, there are an estimated 58,902 unconverted light fixtures.[1] We encourage the key implementing agencies of this action to continue building off the existing momentum to maximize greenhouse gas emissions reductions and savings for all communities.

Transitioning to LED bulbs will use less energy, reduce maintenance and electricity costs, and solve issues with HPS bulbs, such as high failure rates and marginal light quality. Over time, the local power companies and their customers can expect to see not only energy savings, but also an economic return on investment due to the durability and reduced maintenance associated with LED fixtures.

Figure 19. Composition of Streetlights and Leased Outdoor Lights



BACKGROUND

Improving energy efficiency in streetlights presents a significant opportunity to reduce energy consumption, decrease operations and maintenance costs, and save money for residents. Currently, there are 181,202 streetlights and LOLs within the boundaries of our committed local governments. Around 52 percent of these lights are LEDs, 15 percent are in the process of being retrofitted, and most of the remaining non-LED lights are HPS bulbs.[2]

E.1 Impact Summary

2030 Target

Replace all existing non-LED streetlights and leased outdoor lighting with LED fixtures by 2030 or sooner.

Cumulative 2025-2030 GHG Reductions

117,225 $mtCO_2e$

2050 Target

Continue to install LED or future types of energy efficient light fixtures.

Cumulative 2025-2050 GHG Reductions

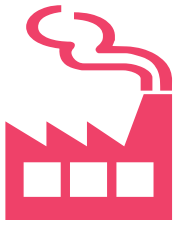
373,350 $mtCO_2e$

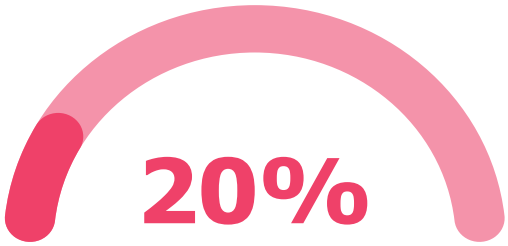
$21,060,278

Estimated Remaining Project Cost (2022 $)

CRITERIA & HAZARDOUS AIR POLLUTANT REDUCTIONS IN 2030

Not Estimated◊



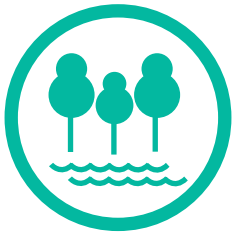


20%

OF LIDAC CENSUS BLOCK GROUPS POTENTIALLY IMPACTED IN 2030*

BENEFITS

EQUITY



ENVIRONMENTAL

ECONOMIC & WORKFORCE DEVELOPMENT

PUBLIC HEALTH

RESILIENCE

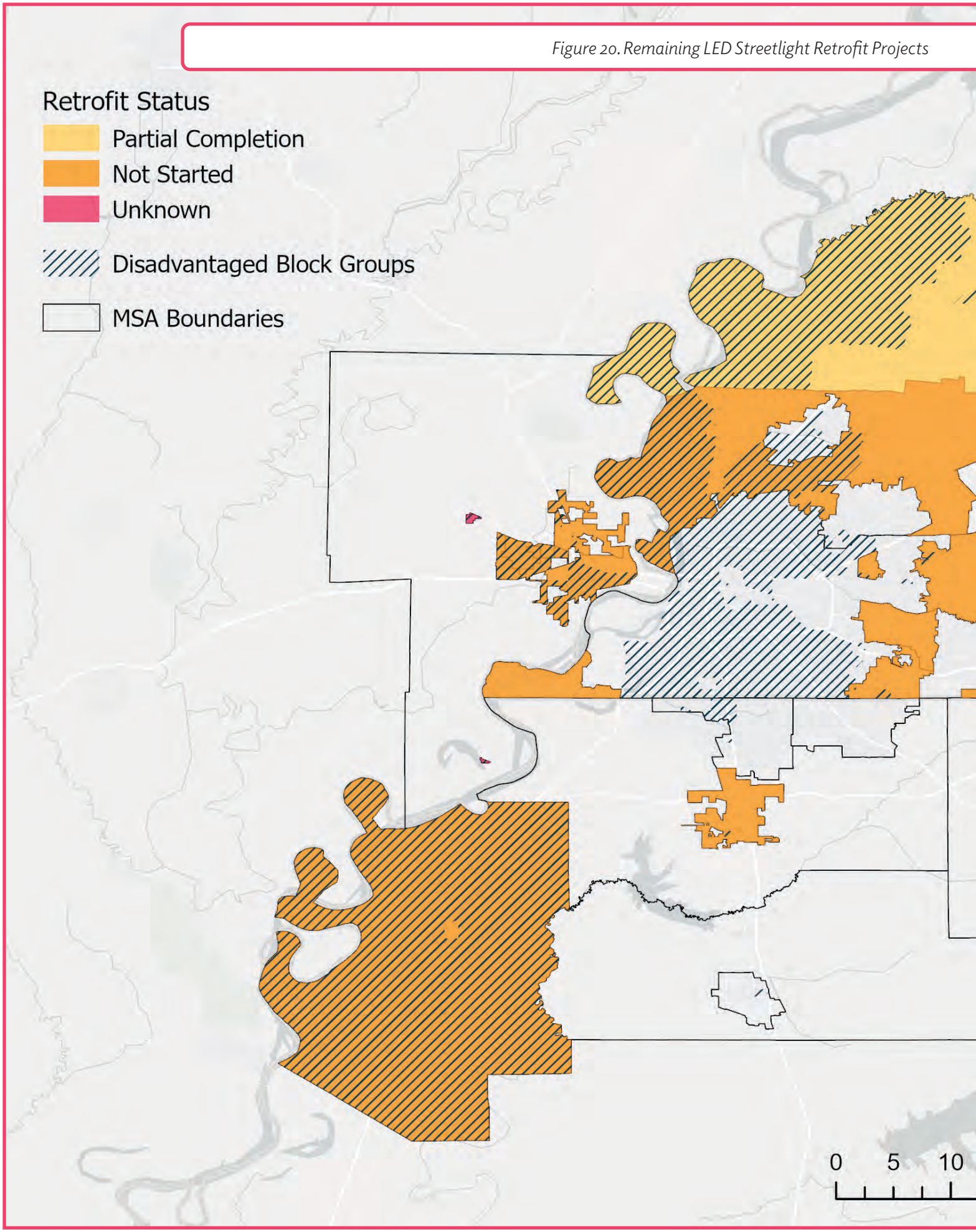
Implementation Partners

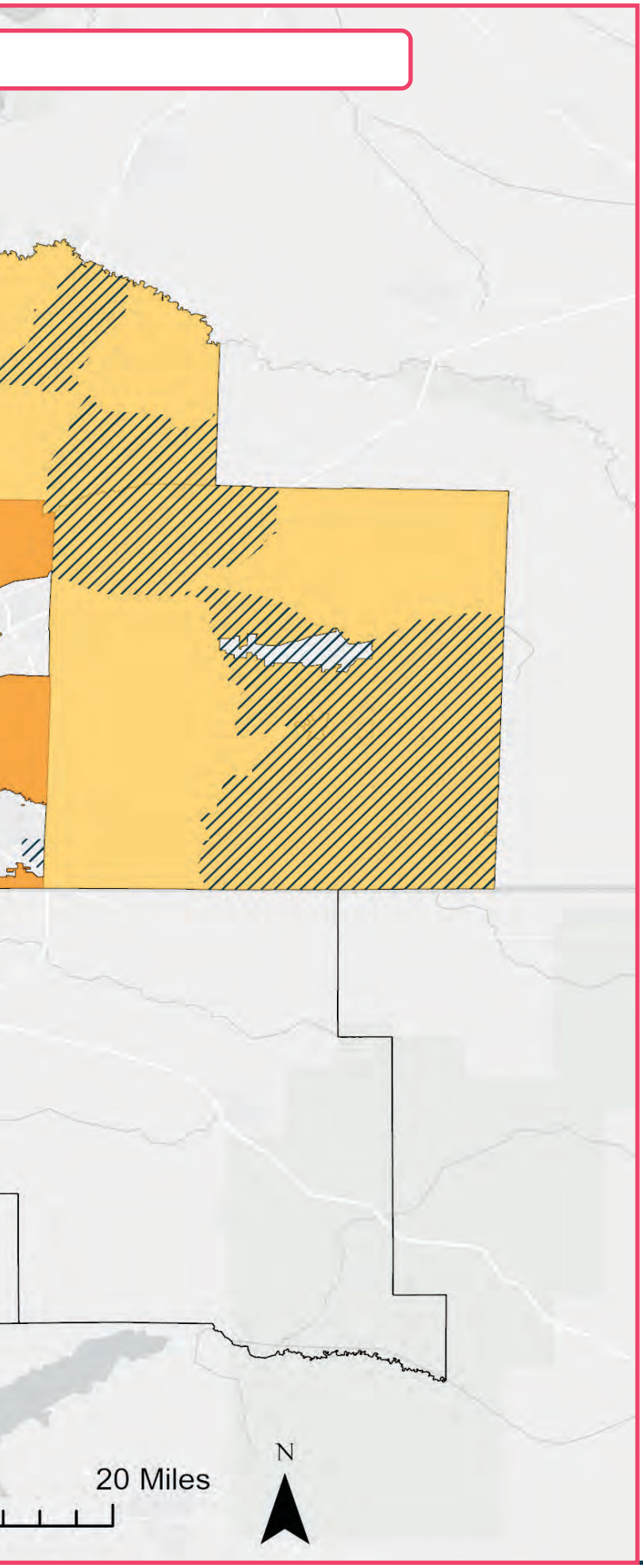
Local governments and local power companies

**For more information on which LIDAC census block groups will be affected by this Reduction Measure, please refer to Appendix 5.*

◊Without knowing the exact sources of the Memphis region's electricity, it is difficult to estimate the reduction in criteria and hazardous air pollution resulting from increasing energy efficiency and decreasing the amount of electricity generated.

Figure 20. Remaining LED Streetlight Retrofit Projects





Since 2019, many municipalities in the Memphis MSA have begun or completed streetlight retrofit programs. Memphis, Olive Branch, Covington, Munford, Somerville, and Senatobia have completed the first phase of retrofits in their communities, while Bartlett, Collierville, Millington, and Southaven are in the midst of retrofit projects. The map to the left shows committed local governments where retrofits are still needed. These include jurisdictions that have conducted partial retrofits and need additional funding as well as those that have not begun the retrofit process.

POTENTIAL FUNDING OPPORTUNITIES

There are a few federal funding opportunities for retrofitting street lighting to LEDs, but most focus on specific roadway projects rather than comprehensive lighting projects allowing local governments or utilities to retrofit all outdoor lights.

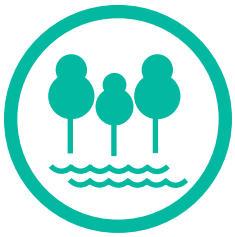
The Bipartisan Infrastructure Law (BIL) established the **Carbon Reduction Program**, which provides funds for projects designed to reduce carbon dioxide emissions from on-road highway sources. Funding is available through Fiscal Year 2026 through state Departments of Transportation and Metropolitan Planning Organizations. Funds may be used to replace street lighting and traffic control devices, as well as other transportation projects, on any road that has a federal classification such as interstate, collector, and local roads.

The **Safe Streets and Roads for All Grant Program** is another potential funding source established through the BIL. At time of publication, the grant program had $3 billion still available for future funding rounds. This is a competitive grant program consisting of both a planning grant program to develop a comprehensive safety action plan and an implementation grant program to fund construction/implementation of projects and strategies in an existing action plan. Such projects could include correcting common risks such as installing improved lighting, which could incorporate a transition to LED streetlights. Many local jurisdictions in the Memphis MSA are eligible to apply for the implementation grant program using the Memphis Metropolitan Planning Organization's Safety Action Plan as a reference.

The BIL also established the **Energy Efficiency and Conservation Block Grant Program**, which provides funding for projects and programs cutting carbon emissions, improving energy efficiency, and reducing energy use. Retrofitting streetlights and outdoor lights are eligible projects. This program is useful because it allows the expenditure of funds on all types of outdoor lights. Within the Memphis MSA, Shelby County, Memphis, Germantown, Collierville, Bartlett, DeSoto County, Olive Branch, and Southaven received formula allocated funds through this program. One potential issue for this funding source is that the allocations are unlikely to cover the full cost of retrofitting all the lights in the recipient jurisdictions.

CO-BENEFITS

EQUITY: The implementation of LED streetlights may bring down customer fees in the mid- and long-term, which would particularly benefit low-income customers. This would occur due to the lower projected maintenance costs from LED fixtures as well as reduced energy consumption overall. However, the cost savings are not guaranteed because savings ultimately depend on how utilities account for streetlighting maintenance funds. Customers are more likely to see the savings if there is a lighting fee on their utility bill than if local taxes incorporate streetlight maintenance.



ENVIRONMENTAL: LED fixtures may have environmental benefits if the retrofit program requires retrofits to comply with dark sky recommendations. Dark sky recommendations include installing properly shielded LED streetlights with warmer color temperatures, which can help reduce light pollution, benefiting human and animal circadian rhythms and animal migrations. In addition, energy savings from LEDs may result in less demand for electricity generation. A lower generation demand could result in improved air quality in the communities near fuel-burning power plants.

PUBLIC HEALTH: Due to a lower requirement of electricity, LED lights emit fewer greenhouse gases, yielding improvements in air quality and health. Additionally, the long-lasting nature of LEDs provides reliable light, leading to a reduced number of collisions and an increase in the safety of cyclists, pedestrians, and drivers at night.

ECONOMIC AND WORKFORCE DEVELOPMENT: Retrofits may create new jobs and provide workforce development opportunities including forklift certification and third-party logistics (3PL) skills. Additionally, if the retrofit programs include requirements to recycle old light fixtures, there will be a higher need for workers to break down the lights into separate more valuable components, which will promote a circular economy.

RESILIENCE: LED lights are more durable and longer lasting. This helps increase infrastructure resilience and lowers maintenance requests for bulb outages.

DISBENEFITS AND CHALLENGES

FINANCIAL: Although local governments or utilities will recoup the upfront expense over time through electricity savings, landing the upfront investment from jurisdictions and gaining political support for the project may be challenging due to other community needs. An updated life cycle cost-benefit analysis including economic considerations such as operations and maintenance costs and the time value of money should provide a more comprehensive picture of the payback period and return on investment. Additional benefits such as improved safety with better lighting and fewer outages are also considerations to add to the cost-benefit analysis of this project.

OPERATIONAL: To meet the 2030 implementation goal, local governments and utilities need to determine a realistic timeline of the full life cycle cost/benefit analysis and the financing, bidding, contracting and installation process. Additional employee training and education will be needed for the installation and maintenance of the new LED lights.

EDUCATION AND BEHAVIOR CHANGE: Implementers should develop an effective communication strategy to set expectations and teach leaders and community members about the transition period before LED lights reach normal operations. Public education should also focus on the short- and long-term benefits and the shift in light color.

POLICY CHANGE: Depending on the financial framework for implementation, local governments or power companies may need to consider changes to existing policies.

REVIEW OF AUTHORITY TO IMPLEMENT

Depending on the ownership structure of the streetlights and LOLs, local governments may have the authority to implement E.1: Retrofit Outdoor Streetlights to LED Fixtures. If the local government owns the fixtures or they have a municipally owned electric utility, they have the authority to maintain and replace them, likely through their Public Works departments. If the local power company owns the streetlights, the local government may enter into a contract with the utility to work toward replacing the streetlights.

MILESTONES

1. Prepare an up-to-date, full life cycle cost-benefit analysis for retrofitting streetlights and leased outdoor lighting including operations and maintenance cost, energy use costs, and other economic considerations for jurisdictions that have not begun retrofits.
2. Research best practices and approaches for comprehensive streetlight retrofit programs in other cities, and share lessons learned from retrofit programs in Shelby County, Olive Branch, Somerville, Senatobia, and others.
3. Continue to explore financing options for the retrofit programs, including bond issuances and loans that can be repaid with operations and maintenance savings.
4. Ensure new LED streetlights are designed with an appropriate color temperature of 3,000 degrees Kelvin or lower and are properly shielded.
5. Develop a debris and waste management plan identifying appropriate facilities to recycle usable parts from the non-LED fixtures prior to being sent to a landfill.
6. Develop a public education and communications campaign to explain project implementation, timeline, and up front costs as well as the short- and long-term community-wide benefits.
7. Complete the retrofit projects in all committed jurisdictions.

ENDNOTES

1 Numbers gathered from personal communication with local power companies, committed jurisdictions, and retrofit providers. Full sources are listed in Appendix 2.

2 Numbers gathered from personal communication with local power companies, committed jurisdictions, and retrofit providers. Full sources are listed in Appendix 2.

Reduction Measure E.2: Local Government Energy Audits and Renewable Electricity Installations

OVERVIEW

Improving energy efficiency in new and existing buildings and government facilities and transitioning to renewable energy sources are essential steps toward achieving a more sustainable, prosperous, and equitable region. The strategies for this reduction measure include a mix of approaches to achieve this: MSA-wide energy efficiency audits of government buildings and facilities, energy efficiency upgrades on 200 local government buildings by 2035, and the installation of 15 megawatts (MW) of renewable energy capacity to partially offset local government energy consumption by 2040.

To implement these strategies, governments need additional funding for the initial energy audits, subsequent energy efficiency upgrades, and renewable energy facility installations. Energy efficiency upgrades include installing new energy efficient chillers, HVACs, heat pumps, windows, boilers, and LED lights. Renewable energy installations include but are not limited to solar panels, wind turbines, and renewable fuels, specifically biogas, collected from landfills and wastewater treatment centers.

WHY IS THIS A PRIORITY ACTION?

While the Mid-South Climate Action Plan focuses on reducing emissions and improving quality of life community-wide, it is important for local governments to lead by example and provide services in a way that contributes to the long-term financial, social, and environmental health of the Mid-South region. Through energy audits, energy efficiency upgrades, and investments in renewable energy facilities, local governments may set a standard for additional projects to reduce emissions from buildings energy consumption.

Additionally, committed jurisdictions have expressed interest and/or are already preparing energy efficiency projects for public buildings. Ninety-five percent of stakeholders who participated in the engagement surveys agree there is a need to complete energy-efficiency improvements, 94 percent agreed there was a need to identify and improve low-performing public buildings, and 89 percent supported installing solar panels on public buildings.

BACKGROUND

Within the Memphis MSA, commercial and institutional buildings emit an estimated 3.7 million metric tons of carbon dioxide equivalent (CO_2e) a year attributed to electricity and natural gas consumption. MSA committed jurisdictions have the most opportunity to reduce GHG emissions through building energy use, and local governments and their agencies have already taken steps to improve energy efficiency and reduce the carbon footprint of public operations. For example, the Memphis-Shelby County Airport Authority is planning to improve energy efficiency at the Memphis International Airport through new glass/glazing, upgraded mechanical, electrical, and plumbing systems, and vestibule upgrades. The City of Germantown and the City of Olive Branch have already completed energy audits on public buildings and identified energy efficiency improvements (e.g., high efficiency HVAC equipment, water boilers, window retrofits, and LED light replacements). The Town of Arlington made great strides by completing LED lighting upgrades and installing energy efficient HVAC systems in all municipal buildings.

E.2 Impact Summary

2030 Target

Complete energy audits of MSA public buildings and begin energy efficiency upgrades.

Cumulative 2025-2030 GHG Reductions

11,893 $mtCO_2e$

2050 Target

Complete energy efficiency upgrades on 200 local government buildings by 2035. Install 15 MW of renewable energy capacity to offset local government energy consumption by 2040.

Cumulative 2025-2050 GHG Reductions

207,685 $mtCO_2e$

$53,021,353

Estimated Remaining Project Cost (2022 $)

CRITERIA & HAZARDOUS AIR POLLUTANT REDUCTIONS IN 2030

2.09 tons of CO

3.27 tons of NOx

0.805 tons of PM2.5

0.205 tons of VOCs

Not Estimated*

OF LIDAC CENSUS BLOCK GROUPS POTENTIALLY IMPACTED IN 2030

BENEFITS

ENVIRONMENTAL

ECONOMIC & WORKFORCE DEVELOPMENT

RESILIENCE

Implementation Partners

Local governments and local power companies

**Criteria and hazardous air pollutant emissions would come from combustion of fuels to generate electricity as well as provide heating to buildings. While energy efficiency upgrades and installation of renewable electricity will result in reductions in criteria and hazardous air pollutants, those reductions will be seen in the communities with fuel-burning power plants. Without knowledge of the exact source of all electricity consumed by the Memphis MSA, we cannot provide location-based estimates.*

Based on initial cost and energy savings assumptions, rehabbing 200 public buildings (average size of 20,000 square feet) could result in 11,722,843 annual savings of kilowatt-hours (kWh) across the region. To achieve this, an estimated average cost of $57,500 per building ($11,500,000 total) is needed.

In addition to energy efficiency upgrades, there are various planned renewable energy projects awaiting funds to implement. Greening the electric grid has the highest potential for achieving deep greenhouse gas emissions reductions, and the costs for renewable energy sources such as wind, solar, and biogas have decreased dramatically over the last few decades along with substantial improvements to the technology involved in these power sources.

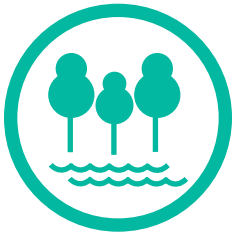
POTENTIAL FUNDING OPPORTUNITIES

One potential route to fund the higher upfront costs of energy efficiency upgrades in local government buildings is to contract with energy service companies using a performance-based contract business model.[1] The model allows government entities and institutions to conduct the improvements and pay for them through the energy savings in the future.

The Inflation Reduction Act (IRA) expanded existing tax credits for clean energy technologies to allow tax-exempt entities to take advantage of the incentives. This allowance, called **direct pay or elective pay**, opens the doors for governments to receive payment equal to the full value of tax credits for building qualifying clean energy projects. These incentives are available for solar, wind, and battery storage projects, as well as installing electric vehicle charging infrastructure, and purchasing clean vehicles if the projects meet the requirements for the tax credit programs. In addition, it is possible to combine these reimbursements with other federally funded projects.

The Bipartisan Infrastructure Law (BIL) established the **Energy Efficiency and Conservation Block Grant Program**, which provides funding for projects and programs cutting carbon emissions, improving energy efficiency, and reducing energy use. Energy audits, energy efficiency retrofits for governments buildings, and the design and installation of renewable energy generators are eligible projects. Within the Memphis MSA, Shelby County, Memphis, Germantown, Collierville, Bartlett, DeSoto County, Olive Branch, and Southaven received formula allocated funds through this program. One potential issue for this funding source is the allocations were relatively small compared to the amounts needed and are likely to only benefit a single building or facility.

The Federal Aviation Administration received $15 billion through the BIL to create the **Airport Infrastructure Grant.** The Memphis-Shelby County Airport Authority received more than $33.5 million dollars over two grant cycles in 2022 and 2023 to fund several projects at the airport, including improvements of the terminal buildings. The improvements of the terminal buildings include energy efficiency upgrades. Funding can also be used for runways, taxiways, safety and sustainability projects, airport-transit connections, and roadway projects. The funding is available for the federal government fiscal year 2024 as well.



CO-BENEFITS

ENVIRONMENTAL: Reductions in energy use may result in less demand for electricity generation. A lower generation demand could result in improved air quality in the communities near fuel-burning power plants.

ECONOMIC AND WORKFORCE DEVELOPMENT: The implementation of sustainable and energy efficient building projects can result in new businesses and job opportunities by increasing demand for contractors and technicians with experience in the energy efficiency and renewable energy fields.

RESILIENCE: This action could lead to financial savings for local governments which they could invest into infrastructure and maintenance improvements in the electricity distribution network to improve system resilience. In addition, local governments can take a community resilience, microgrid approach and install solar arrays and batteries at community centers, libraries, and other neighborhood and community focused buildings. These buildings can then use the solar to provide power during power outages. This better enables these buildings to be shelters and heating and cooling centers for community members during extreme heat and winter weather events.[2] This would also provide benefits to the unhoused population or those without adequate heating and cooling in their homes.

DISBENEFITS AND CHALLENGES

FINANCIAL: Upfront infrastructure costs are high, but payback is possible over the life of the installations. Many of these projects will be eligible for the new rebates and direct pay options established in the Inflation Reduction Act.

OPERATIONAL: Additional employee training and education will be needed for the maintenance of the new energy efficiency upgrades and renewable energy systems. Local governments should consider including operations and maintenance agreements in procurement requests in order for local government staff to learn from the installers during the first few transition years using the new technologies and systems.

POLICY CHANGE: Procurement and construction policies may need to change to prioritize more energy efficient upgrade options.

REVIEW OF AUTHORITY TO IMPLEMENT

The authority to implement the E.2 Reduction Measure depends on the ownership and location of the building in question and the regulations in place regarding what renewable energy generators can or cannot be installed. In general, local governments have full authority to pursue energy efficiency upgrades and install renewable energy generators on public property owned by local governments. However, they may encounter certain restrictions based on historic preservation or energy generation regulations depending on the site in question and local power company agreements with electricity distributors, such as the Tennessee Valley Authority.

MILESTONES

1. Local governments should work with utility providers to compile building consumption data into a regularly updated database for each local jurisdiction. The databases should be comprehensive of all government facilities in order to track energy use trends and better understand opportunities for reductions in energy consumption. There are several energy managers and tracking software packages available if the jurisdiction does not have a tracking system in place.

2. Train and/or hire staff dedicated to energy management and achieving energy use reduction targets.

3. Conduct energy audits on local government buildings, prioritizing the largest energy consumers first, with the ultimate goal of developing a portfolio-wide strategy for implementing energy efficiency improvements and promoting energy conservation.

4. Incorporate a solar feasibility assessment as part of the energy audit in order to evaluate the economic and technical feasibility of installing solar generation at government buildings and facilities.

5. Consider implementing policies requiring Capital Improvement Plan projects for building renovations to compare the cost of reuse/renovation versus new construction.

6. Consider adopting green building standards for all new government facilities and major redevelopments.

7. Begin energy efficiency upgrades on buildings based on the findings of the energy audits.

8. Identify additional public property appropriate for renewable energy installations and conduct site and project savings assessments.

9. Construct renewable electricity installations.

ENDNOTES

1 National Association of Energy Service Companies. *The ESCO Story*. Retrieved from https://www.naesco.org/esco/

2 Memphis and Shelby County Division of Planning and Development. (2019). *Mid-South Regional Resilience Master Plan*. Pg. 261.

Reduction Measure R.1: Low-Income Residential Energy Efficiency Retrofits

OVERVIEW

Increasing energy efficiency in the Memphis MSA's residential sector will help decrease overall energy consumption. Programs such as one encouraging energy efficiency in residential spaces will reduce residential energy consumption and, accordingly, decrease overall energy consumption. Regardless of the extent of grid decarbonization in our area, decreasing energy consumption will decrease emissions, as there will be a decreased demand for energy generation (and a decrease in the amount of resources necessary to generate electricity). Embracing energy efficiency will also decrease energy burdens, a widely faced problem experienced predominantly by low-income households in the region.

Using the estimated number of homes retrofitted in 2019, the goal is to increase the number of low-income households served by weatherization and energy efficiency retrofit programs by 500 percent over five years. The overall target reduction in energy usage through these programs is 30 percent. Retrofits to households include improving weatherization and insulation, installing smart thermostats to reduce energy consumption, and installing more energy efficient appliances and home products such as windows and roofs. Implementing this action will involve creating new programs to reach more residents and expanding existing weatherization and energy efficiency programs offered.

Additionally, this reduction measure focuses on workforce development to address capacity issues due to a lack of workers in the Mid-South region certified to work on weatherization projects. There is a large demand for the kinds of jobs that make residential energy efficiency retrofit programs successful. Groups implementing energy efficiency and weatherization programs in the Memphis MSA have noted there are not enough auditors or contractors in the area who are qualified to complete the approved work orders. There is some movement on this front, as William R. Moore College of Technology has a weatherization training program starting in February 2024. If a workforce development pipeline were developed further to help fill this need, the region's energy efficiency programs can provide more services to more households each year.

WHY IS THIS A PRIORITY ACTION?

Residential retrofits for energy efficiency are a priority because residential energy usage is one of the largest sources of greenhouse gas emissions within the Mid-South. Reducing GHG emissions from energy usage and generation can (and should) be approached both from the supply side in grid decarbonization and from the demand side with programs like energy efficiency retrofits. The National Renewable Energy Laboratory estimates that the three states represented in the Memphis MSA (Arkansas, Mississippi, and Tennessee) could save an average of 26 percent of energy used in single-family homes by installing energy efficiency measures.[1] Full implementation of this reduction measure could reduce the Memphis MSA's cumulative emissions related to energy consumption by 485,441 metric tons of carbon dioxide equivalent (CO_2e) by 2050. Additionally, stakeholder engagement for the *Mid-South Climate Action Plan: Priority Reduction Measures* identified residential energy efficiency as one of the top priorities for survey respondents. Completing energy-efficiency improvements and offering green jobs in disadvantaged communities was one of the top five measures selected by survey respondents, with 95 percent of respondents agreeing that the

R.1 Impact Summary

2030 Target

Increase number of low-income households served by energy efficiency and weatherization programs in the Mid-South from 2019 estimates by 500%.

Cumulative 2025-2030 GHG Reductions

68,980 $mtCO_2e$

2050 Target

Maintain annual number of low-income households served by energy efficiency and weatherization programs and continue workforce development trainings.

Cumulative 2025-2050 GHG Reductions

485,441 $mtCO_2e$

$621,895,238

Estimated Remaining Project Cost* (2022 $)

CRITERIA & HAZARDOUS AIR POLLUTANT REDUCTIONS IN 2030

Not Estimated◊

100%

OF LIDAC CENSUS BLOCK GROUPS POTENTIALLY IMPACTED IN 2030 ±

BENEFITS

EQUITY

ENVIRONMENTAL

ECONOMIC & WORKFORCE DEVELOPMENT

PUBLIC HEALTH

RESILIENCE

Implementation Partners

Local governments, housing agencies, community organizations, utility providers, workforce development organizations, educational institutions, and private contractors and energy auditors

**Estimated project cost is based on existing investments per household from existing programs. It does not include potential rebates from federal tax credits.*
◊Without knowing the exact sources of the Memphis region's electricity, it is difficult to estimate the reduction in criteria and hazardous air pollution resulting from increasing energy efficiency and decreasing the amount of electricity generated.
± For more information on which LIDAC census block groups will be affected by this Reduction Measure, please refer to Appendix 5.

measure should be a priority.

In the Memphis MSA specifically, there is a confluence of several factors making energy efficiency – and particularly residential energy efficiency – a high priority. People in the MSA struggle with a particularly high level of energy burden, especially people in low-income and disadvantaged communities. Many historical factors – such as patterns of disinvestment and racial prejudice, and inefficient land use development patterns – played a large and ongoing role in the Memphis MSA's current need to address populations housed in inadequate housing, which is intertwined with experiencing high levels of energy burden. Though a wide variety of programs are already in place throughout the region, the scope of the issue in the Mid-South suggests the level of pre-existing support may be inadequate. Because there are so many households who qualify for assistance and such limited sources of funding, demand for these programs outpaces the number of projects agencies can complete each year, and only a small portion of the households who need assistance can receive it each year.

The lack of qualified workers to complete required components of energy efficiency and weatherization projects also limits the number of households existing programs can serve each year. Though homeowners can install several energy efficiency upgrades – such as replacing incandescent light bulbs with LED versions or installing an aerator on a faucet to save water – many more require specialists for proper installation. In order to meet the targets of this reduction measure a coordinated effort must occur to ramp up workforce development programs tied to certification programs for necessary auditors and specific types of retrofits to increase the pool of auditors and contractors available to do the work.

BACKGROUND

A building's energy efficiency is determined by several factors, such as the materials used in construction, the appliances used to power the building, and the condition of the building itself. In a residential setting, many of the most common and effective energy efficiency measures involve weatherization. The process of weatherization generally refers to a variety of measures (such as adding insulation or sealing cracks around doors or windows) undertaken to protect a building against weather hazards, such as heat, cold, and precipitation. Many weatherization measures also provide energy efficiency benefits. For example, improving the insulation of a building can help heating and cooling systems work more efficiently. An uninsulated building may have leaks to the outside, which cause heating and cooling systems to work harder to maintain a comfortable temperature inside. Adding new or improved insulation seals leaks and allows heating and cooling systems to work solely on the air within the building, using less energy. Similarly, replacing old appliances like water heaters can improve energy efficiency, as newer technology has enabled many appliances to perform better with less energy.

The Memphis MSA has a strong demand for weatherization assistance created by several compounding factors. The first is the issue of the aging housing stock across the Mid-South. According to the 2022 American Community Survey, 47 percent of the housing units in the entire Memphis MSA were constructed prior to 1980. When looking at just the previously identified low-income and disadvantaged communities in our region, 69 percent of housing units were constructed before 1980.[2] Differences in construction methods used decades ago versus today and general aging of structures account for some of the need these older housing units have. However, deferred maintenance due to prohibitive costs may also be contributing to the need for weatherization assistance. This may be more present in housing units where vulnerable populations (e.g., low-income households, renters, etc.) live.

Another factor driving demand for weatherization and energy efficiency retrofits is energy burden, or the percentage of income used toward utility bills, which can be exacerbated by poor housing quality. Though there is no standardized definition of what classifies as a high energy burden, researchers' suggestions for the threshold of high energy burdens range between 6 percent and 11 percent of

income spent toward utility bills.[3,4] Memphis (and the Mid-South generally) has struggled with high energy burdens for a long time. A 2016 report by the American Council for an Energy-Efficient Economy identified Memphis as having the highest energy burden for low-income households in the nation, finding that some households were paying up to 25 percent of their income on energy bills.[5]

Demographic trends accompanying high energy burden can include income levels, age, homeownership, and race. As of 2020, for instance, Black or African-American households had a 45 percent higher median energy burden than non-Hispanic White households.[6] Renters are also more likely to experience high energy burden, as are the elderly and people with low incomes.[7] The Memphis MSA has higher proportions than the rest of the nation in three of the four demographic trends discussed above: low-income households, people who rent their homes, and people who identify as Black or African-American.[8] One method to reduce energy burden is weatherization, which reduces energy consumption and in turn reduces the price of utility bills and the share of income used to pay them. The map [below/above/to the side] demonstrates the severity of energy burden within the committed jurisdictions in the MSA. Seventy census tracts (all LIDAC) are within the 85th percentile of Climate and Economic Justice Screening Tool's (CEJST) energy burden threshold. This means residents in these census tracts have a higher energy burden than roughly 85 percent of the U.S. population. These residents likely have the highest need for weatherization assistance and the lowest ability to pay for upgrades.

Living in an energy-inefficient home, particularly one not properly weatherized, can lead to increased likelihood of health problems.[9] Inadequate weatherization can result in increased exposure to extreme weather, making a house uncomfortable or, in severe cases, unhealthy to live in. An unhealthy home poses an increased risk of chronic illnesses or an increase in severity of symptoms for preexisting illnesses, such as arthritis, asthma, and respiratory illnesses. Mental health challenges can also be present in households that are not properly weatherized or are overly energy burdened, driven by factors such as financial instability, feelings of lack of agency or ownership, and insecurity in housing.

As mentioned above, this reduction measure requires a larger workforce than what currently exists in the Memphis MSA for these types of projects. If the workforce development component is carefully structured, it can provide additional benefits to low-income and disadvantaged communities, many of which have high unemployment and low educational attainment rates. In the Memphis MSA LIDACs, the average unemployment rate, 12 percent, is more than double the national average, which was 5 percent as of the 2022 American Community Survey.[10] The average proportion of people in the Mid-South's LIDACs who have had some post-secondary education is 45 percent, which is significantly lower than the national average of 64 percent.[11] Many energy efficiency jobs offer a living wage without the need for an academic degree.[12] While current landscape of energy efficiency-related jobs suggests advanced degrees are not necessarily required, trades and vocational training and certificate programs are advantageous to grow the field. Since the training needed to gain employment in energy efficiency can be completed quickly (the new weatherization training program at Moore Tech lasts two weeks, while other vocational training programs can last multiple months, if not years), the financial benefits of these new jobs can be realized relatively quickly. Despite this, LIDACs do not comprise a proportionate share of the energy efficiency workforce on a national scale.[13] This gap suggests a disconnect between those who could most benefit from these jobs and access to the training opportunities required to enter the field.

POTENTIAL FUNDING OPPORTUNITIES

Existing Funding Availability

A number of existing programs can assist in the implementation of this measure. Both the federal government and utility providers offer these programs. Additionally, there are other funding sources available for weatherization assistance.

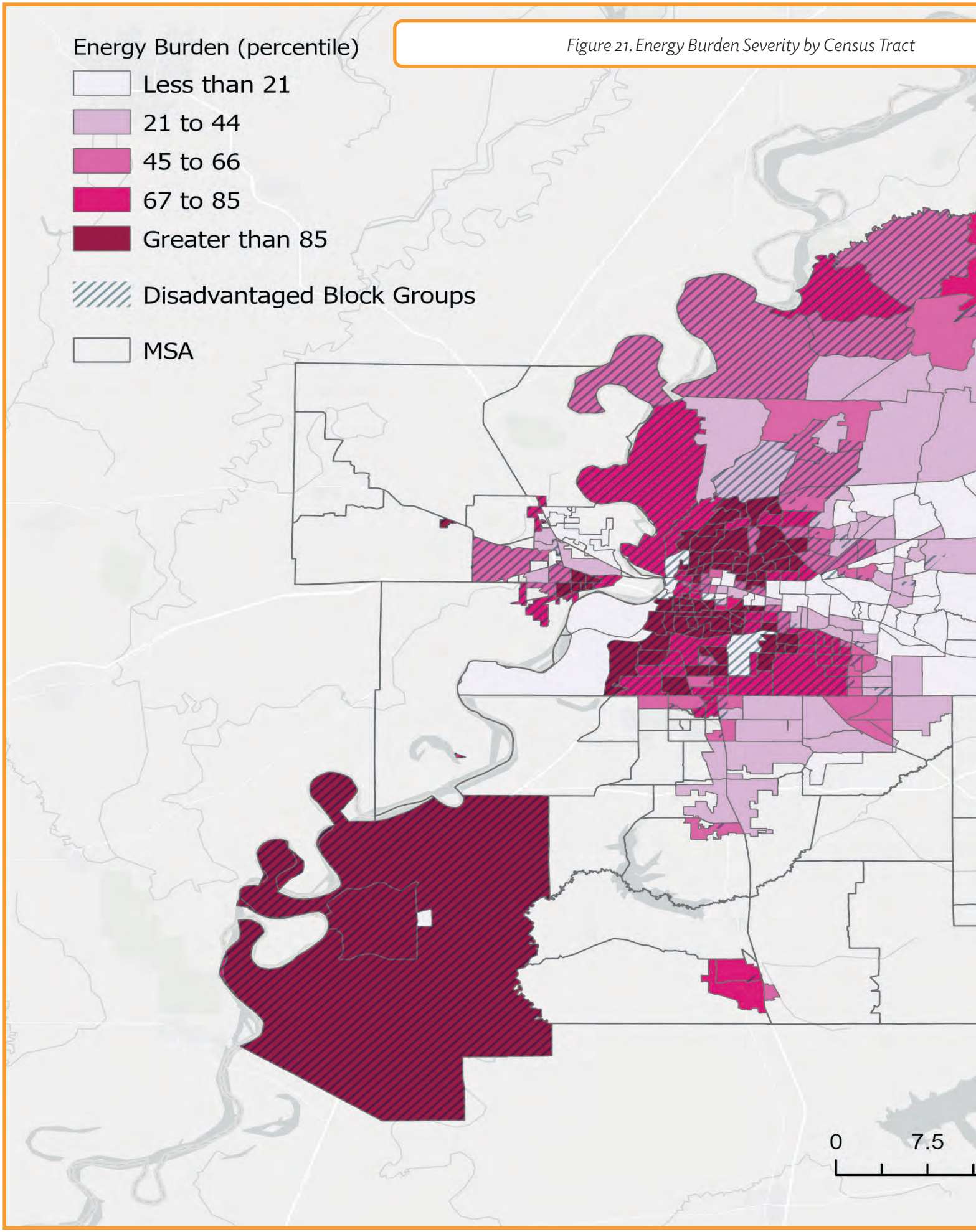
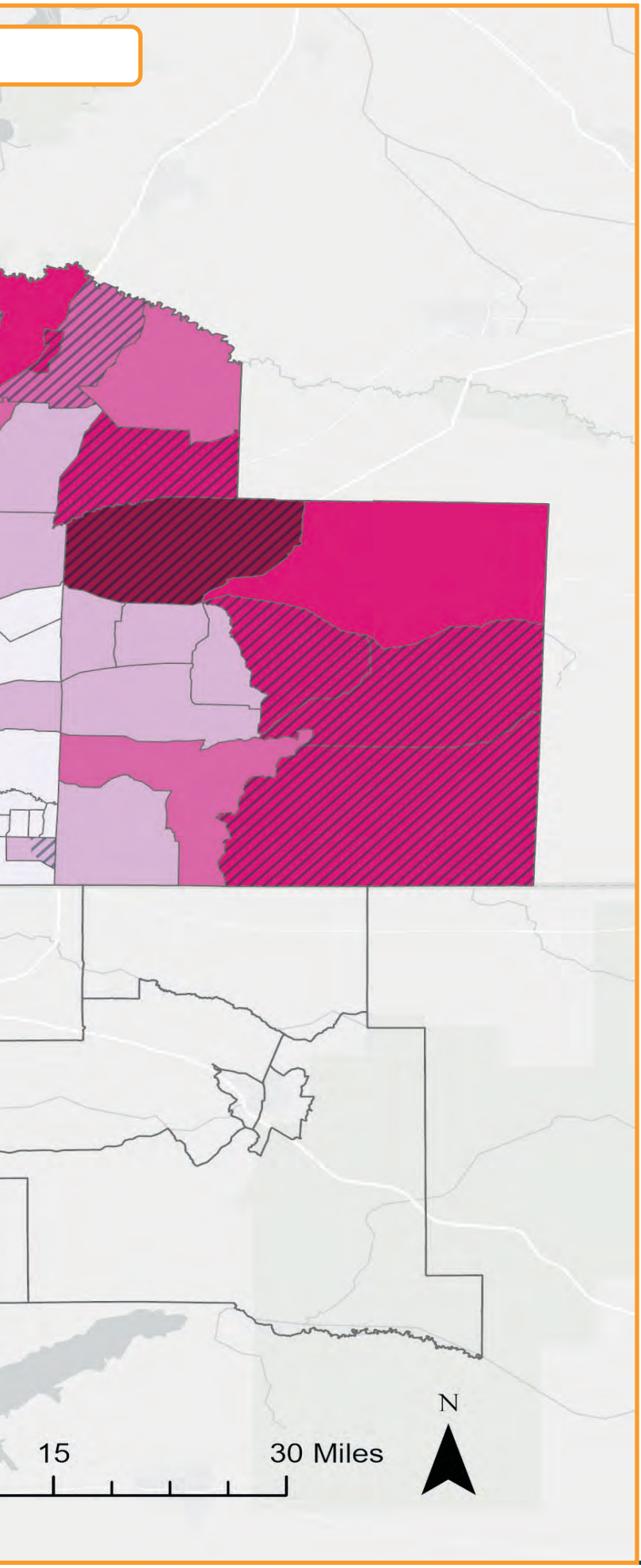


Figure 21. Energy Burden Severity by Census Tract



Title VI of the Energy Conservation and Production Act authorized the **Weatherization Assistance Program (WAP)**. The WAP allows states and/or territories to allocate funding towards installing a variety of energy efficiency measures in residential buildings and is a formula grant administered by the United States Department of Energy (DOE). Each state and/or territory has their own qualification criteria for who can apply for funding through WAP, and each state/territory has the authority to delegate groups known as Community Action Agencies to oversee local weatherization programs. In the Mid-South region, there are five Community Action Agencies overseeing programs. WAP prioritizes applicants by the presence of vulnerable household members (including people 60 years of age or older, people with disabilities, and children under the age of six), household income levels, levels of energy burden, and whether the household is considered a high residential energy user.

The DOE also operates the **Energy Efficiency Revolving Loan Fund Capitalization Grant Program**, which will enable the creation of revolving loan funds overseen by state energy offices. The DOE is currently reviewing applications to announce awards in spring 2024. It is worth noting the DOE designated both Tennessee and Arkansas as "priority states", which means they will receive supplemental funding.[14] The revolving loans created through the program will be used for energy efficiency audits and upgrades for both commercial and residential structures.

The Green and Resilient Retrofit Program (GRRP) is a new program offered through the United States Department of Housing and Urban Development (HUD), financed through the Inflation Reduction Act of 2022. The GRRP focuses on increasing energy efficiency in HUD-assisted multifamily properties and has a two-pronged approach: one element offers grants and loans to increase energy efficiency, and another creates a benchmarking program to aid any interested property manager who wants to begin tracking energy utilization and efficiency. Grants and loans distributed through the GRRP offer funding for multifamily properties to install energy efficiency measures (like electric HVAC heat pumps or energy efficient windows) or to obtain green certification (like LEED).

There are three main energy efficiency programs managed by utility providers targeted toward low-income communities, and they function similarly to each other. The Tennessee Valley Authority (TVA) offers the **HomeUplift program**, which provides a variety of energy efficiency upgrades to low-income households who are subscribers of participating

local power companies. Entergy, which services areas in our Arkansas and Mississippi jurisdictions, has funding for income-eligible customers to receive minor weatherization repairs to their homes through the **Low-Income Solutions Program**. Memphis Light, Gas and Water (MLGW) offers a weatherization program specific to their customers. **Share the Pennies** is a bill rounding program that funds grants to low-income homeowners seeking to weatherize their homes or install energy efficiency measures at home.

Additionally, there are rebate-based programs offering money back for the installation of energy efficiency measures homes. Starting this year, individuals can file for the **Energy Efficient Home Improvement Credit tax credit** if they made certain energy efficient upgrades to their homes within the tax year. Rebate amounts vary based on the type of measure installed. Utility providers also offer rebate programs for several energy efficiency measures, such as TVA's **EnergyRight program** or Entergy's **Home Energy Solutions program**, with some measures offered free of charge to customers.

There is also a federal grant program available for workforce development accompanying residential energy efficiency retrofits. The Department of Energy's **State-Based Home Energy Efficiency Contractor Training Grants**, announced in July 2023, provides funding for state energy offices to create training programs for the contractors who would complete energy efficiency work. As the application deadline for this program was on January 31, 2024, it is unclear at the time of writing how the state programs will operate and how much funding will be available for each state.

Funding Gap Analysis

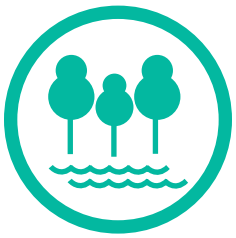
While there are many existing programs addressing weatherization and energy efficiency, there is a large gap between need and funding availability. The Department of Energy's Weatherization Assistance Program (WAP), for example, provides targeted assistance for low-income, elderly, and disabled adults and families, and it has a wide variety of qualifying projects. However, there is only enough yearly funding for a small fraction of the people who require assistance, especially in rural counties, where managing agencies tend to have large service areas and small budgets (e.g., Delta Human Resource Agency, which manages the WAP for Fayette, Tipton, and Lauderdale Counties in Tennessee, budgeted for twelve units for the fiscal year 2024-2025). Demand for spaces in these programs is so high that many agencies have paused accepting applications while they work through the list of previously approved projects, which can have hundreds of households on them.

Demand is similarly high with utility-funded programs, such as the TVA's HomeUplift program. This program operates in a similar fashion to the WAP, providing financial assistance for households to weatherize their single-family homes. TVA delegates implementation of this program to its providers, who must opt into the program to provide funding for their subscribers. Though not all TVA utility providers in the Mid-South region participate in HomeUplift, the ones that do have such high demand for services they accept applications infrequently.

Other gaps in existing programs come from the structure of the programs themselves. Multifamily housing is often unaddressed in energy efficiency programs, likely due to the issue of split incentives; in other words, it is easier to incentivize or provide financial assistance to single-family households, as there is one owner, while the allocation of incentives or assistance between a landlord and a set of renters poses a logistical concern for many programs. There are a few programs starting to be available for multifamily housing, such as parts of the Department of Housing and Urban Development's Green and Resilient Retrofit Program; however, the program began in 2023, and it is difficult to access its effectiveness at this time.

CO-BENEFITS

EQUITY: Low-income housing retrofits will help reduce the energy burden many low-income and disadvantaged communities in the Mid-South experience. Reducing energy usage in residential settings will decrease utility bills and free up dollars to pay for other needs of low-income households. This project will also increase access to energy efficiency measures, especially in households that may not have considered them before. Adding capacity to energy efficiency programs can ensure more households are able to access these programs. Making improvements through weatherization or energy efficiency upgrades can also make housing units better to live in, reducing stresses related to health, safety, and personal finances.



ENVIRONMENT: Reductions in energy use may result in less demand for electricity generation. A lower generation demand could result in improved air quality in the communities near fuel-burning power plants. Additionally, more energy efficient homes require less work from air conditioners to cool the home. Air conditioners work by forcing hot air from the building into the outdoors which can impact the immediate temperature surrounding the home. The mitigating impact is more noticeable in highly urban areas experiencing the urban heat island effect, with many air conditioners forcing air out onto streets.

PUBLIC HEALTH: Many weatherization and energy efficiency retrofit programs fix leaks, improve insulation, or perform roof or foundation repairs, all of which decrease the likelihood of harm from extreme weather, such as extreme heat or cold. Properly climate-controlled housing can improve the health of its occupants, reducing exposure to harmful allergens and mold and decreasing likelihood of respiratory illnesses like asthma. A similar benefit can be derived from improved performance of natural gas-powered appliances since well-maintained gas appliances will reduce the amount of indoor pollution and improve indoor air quality.

ECONOMIC & WORKFORCE DEVELOPMENT: There is a great opportunity for job training to accompany weatherization or energy efficiency upgrades, as many of these measures require specialized workers to ensure proper installation. Implementation partners have noted there is a strong demand for workers with knowledge in energy efficiency, and job training programs could help fill the need. Skills learned through these programs would typically lead to jobs with higher wages. Additionally, assisting households with weatherization and energy efficiency upgrades could help alleviate pressures in their personal budgets and allow them the freedom to use that money for other priorities.

RESILIENCE: This reduction measure will decrease the likelihood of harm from extreme weather, such as extreme heat or cold, as it will improve insulation for homes and provide increased access to efficient space heating and/or cooling systems. Increasing the amount of people who can remain safely in their homes during extreme weather will also reduce the demand on heating and cooling centers. Reducing energy use will also reduce strain on the electric grid, as reduced energy consumption will reduce generation needs during peak hours. Additionally, energy efficiency could lead to improved community resilience, as it will improve financial resilience through new, well-paying jobs and decreased energy burden.

DISBENEFITS AND CHALLENGES

FINANCIAL: Implementation partners need additional funding to increase the number of households served. Without funding from programs such as the DOE's Weatherization Assistance Program, the initial cost of purchase of many energy efficiency measures can be prohibitive for low-income households, especially if additional repairs or maintenance are needed prior to the energy efficiency interventions. Financing for ongoing operation and maintenance costs for energy efficiency measures (such as windows) needs to be identified, as the maintenance costs for some households may be as prohibitive as the purchase and installation costs.

OPERATIONAL: Due to the high number of existing programs, agencies need to coordinate and consider creating a shared referral or application system to streamline the process and ensure they are not placing the burden of navigating bureaucracy on applicants. Tracking of the program's effectiveness will pose a challenge, as it may require residents' consent to access their utility data prior to, during, and after their participation in the program, and it will require cooperation among utility providers to provide the data. Additional concerns about tracking program effectiveness are related to people moving, as the new residents may not be interested in participating in the program moving forward, which would reduce the amount of data available for analysis. Finally, the ongoing skilled labor shortage will likely continue through the beginning of any new energy efficiency programs, at least until the first graduates of the workforce development program are ready to take on projects.

EDUCATION AND BEHAVIOR CHANGE: Retrofit programs require a lot of customer education and behavior change throughout the life of the project. Program implementers should provide information to those who could benefit from a retrofit program making clear the long-term benefits of energy efficiency measures, specifically the impact on household finances. Additionally, programs for rental units will need to provide additional information on how programs benefit not only the renter's utility bill, but also home maintenance conducted by the landlord. Continuing education after installation should remind participants to incorporate new practices in their day-to-day routines. This information will also be beneficial to new occupants in homes that have previously been a beneficiary of these programs, as it will help ensure the previous progress continues.

POLICY CHANGE: Home improvements often have a side-effect of raising property values and eventually property taxes. It is important to explore policies that ensure the financial benefits from energy efficiency do not unintentionally penalize low-income households for installing energy efficiency measures. Some existing policies, such as the City of Memphis's Ordinance 5292, *An Ordinance to Provide for Minimum Energy Efficiency in Rental Property*, have led to increased energy efficiency in residential rental buildings, and encouraging neighboring jurisdictions to adopt similar legislation would help expand these results further in the region.[15] These policies may need additional support in the form of advocacy at the state level to ensure enforceability.

REVIEW OF AUTHORITY TO IMPLEMENT

One of the primary groups with authority to implement this reduction measure is public housing authorities (PHAs), of which there are many throughout the Mid-South. The PHAs managing affordable housing units, such as the Memphis Housing Authority (MHA), have the authority to implement energy efficiency measures for those properties, especially since the improvements generally affect the livability of the unit, and are incorporated in federal housing quality standards.[16] Through the utilization of HUD funds, MHA's Capital Improvements department completes "numerous improvement projects to maintain and improve MHA properties," including tasks such as "capital maintenance, rehabilitation,

and development/redevelopment of projects."[17] Some PHAs can also develop supplementary services for people who would qualify for their assistance, which can include things like employment training programs.[18]

Local governments also have the authority to implement policies and create programs related to low-income residential energy efficiency retrofits through several avenues. For jurisdictions with municipally owned utilities, local governments have the authority to set policies or create programs enabling low-income households to benefit from energy efficiency programs. A more broadly applicable way for jurisdictions to implement policies and programs toward low-income residential energy efficiency retrofits is to use the authority available in municipal departments already doing work in this field. Examples can include housing departments, planning and development departments, and community development departments, though other departments could have authority depending on the jurisdiction's municipal structure. These departments are able to directly oversee these programs and manage funding sources like grants.

MILESTONES

1. Identify and organize implementation partners for the residential energy efficiency retrofits (such as local governments, housing agencies, community development corporations, and utility providers) and for the associated workforce development (such as educational institutions, workforce development organizations, and experienced auditors and contractors).
2. Identify and pursue funding sources ensuring the programs have longevity and preventing replication of gaps in existing programs.
3. Leverage existing efforts and other public and private energy efficiency investments to improve coordination and maximize the benefit of existing programs.
4. Establish and ramp up workforce development programs for skilled, quality jobs supporting a residential energy efficiency and/or weatherization retrofit program, such as for auditors and installers.
5. Create outreach programs for potential applicants to the energy efficiency program and to the workforce development program encouraging participation.
6. Determine measurable outcomes of success for both programs, such as units of energy saved per household and job placement rates.
7. Establish funding for ongoing maintenance of energy efficiency measures once installed, which would increase their longevity.
8. Engage homeowners in education regarding proper maintenance and operation of energy efficiency measures in their homes.

ENDNOTES

1 National Reneweable Energy Laboratory. *State Fact Sheets - ResStock.* Retrieved from https://resstock.nrel.gov/factsheets/.

2 United States Census Bureau. (2022). *American Community Survey 5-Year Estimates, Table B25034: Year Structure Built*. Retrieved from https://data.census.gov.

3 APPRISE (Applied Public Policy Research Institute for Study and Evaluation). (2007). *Ratepayer-Funded Low-Income Energy Programs: Performance and Possibilities*. Retrieved from http://www.appriseinc.org/reports/NLIEC%20Multi-Sponsor%20Study.pdf.

4 Fisher Sheehan and Colton. (2013). *Home Energy Affordability Gap*. Retrieved from www.homeenergyaffordabilitygap.com.

5 American Council for an Energy-Efficient Economy (ACEEE). (2020). *National and Regional Energy Burdens.* Retrieved from https://www.aceee.org/sites/default/files/pdfs/ACEEE-01%20Energy%20Burden%20-%20National.pdf

6 ACEEE. (2020). *National and Regional Energy Burdens*. Retrieved from https://www.aceee.org/sites/default/files/pdfs/ACEEE-01%20Energy%20Burden%20-%20National.pdf

7 ACEEE (2016). *Lifting the High Energy Burden in America's Largest Cities*. Retrieved from https://www.aceee.org/sites/default/files/publications/researchreports/u1602.pdf

8 United States Census Bureau. (2022). A*merican Community Survey 5-Year Estimates, Tables DP04, DP05, and S1701.* Retrieved from https://data.census.gov.

9 ACEEE. (2016). *Lifting the High Energy Burden in America's Largest Cities*. Retrieved from https://www.aceee.org/sites/default/files/publications/researchreports/u1602.pdf.

10 United States Census Bureau. (2022). *American Community Survey 5-Year Estimates, Table B23025: Employment Status for the Population 16 Years and Over.* Retrieved from https://data.census.gov.

11 United States Census Bureau. (2022). A*merican Community Survey 5-Year Estimates, Table B15003: Educational Attainment for the Population 25 Years and Over.* Retrieved from https://data.census.gov.

12 Mark Muro, Adie Tomer, Ranjitha Shivaram, and Joseph Kane. (2019). *Advancing Inclusion through Clean Energy Jobs.* Retrieved from https://www.brookings.edu/articles/advancing-inclusion-through-clean-energy-jobs/.

13 Mark Muro, Adie Tomer, Ranjitha Shivaram, and Joseph Kane. (2019). *Advancing Inclusion through Clean Energy Jobs.* Retrieved from https://www.brookings.edu/articles/advancing-inclusion-through-clean-energy-jobs/.

14 U.S. Department of Energy. (2022). *Bipartisan Infrastructure Law – Energy Efficiency Revolving Loan Fund Capitalization Grant Program*. Retrieved from https://www.energy.gov/sites/default/files/2022-10/SEP-FAQs-RLF-BIL-v2.pdf

15 Memphis Codes of Ordinances. (2009). *Ordinance No. 5292*. Retrieved from https://library.municode.com/tn/memphis/ordinances/code_of_ordinances?nodeId=352924

16 U.S Department of Housing and Urban Development. (2022). Inspection form. Retrieved from https://www.hud.gov/sites/dfiles/OCHCO/documents/52580A.PDF

17 Memphis Housing Authority. Capital Improvements. Retrieved from https://www.memphisha.org/departments/capitalimprovements.php

18 U.S Department of Housing and Urban Development. HUD's Public Housing Program. Retrieved from https://www.hud.gov/topics/rentalassistance/phprog

Reduction Measure T.1: Enhance Public Transit

OVERVIEW

To enhance public transit within the Memphis MSA, several actions are recommended: fully implement the *Memphis 3.0 Transit Vision* by 2030; increase ridership and improve frequency to meet long-range (2040/2050) ridership objectives; and convert the Memphis Area Transit Authority's (MATA's) entire fleet to electric by 2034 as outlined in the *Zero Emissions Fleet Transition Plan*.

The essential components of the *Transit Vision* include investing in and expanding frequent transit service, and the *Zero Emissions Fleet Transition Plan* focuses on how MATA plans to procure battery electric buses. Implementing the *Transit Vision* network will allow riders to reach an estimated 39 percent more jobs within an hour and expand frequent bus service to 79,000 more people.[1] The *Transit Vision* also recommends improvements to weekend service and enhanced connections to other transportation modes. The *Zero Emissions Fleet Transition Plan* calls for a rapid transition of MATA entire fleet within the next decade.[2] By completing the goals of both plans in tandem, the Mid-South will see reductions in GHG emissions from both personal vehicles and buses.

The mechanisms needed to implement this action include additional dedicated funding for MATA (*Transit Vision* recommendations will require $36.7 million annually in 2022 dollars, in addition to maintaining MATA's current operating budget), procurement of battery electric buses (BEBs), installation of bus charging infrastructure, and public outreach and education on the proposed network changes and their benefits.

WHY IS THIS A PRIORITY ACTION?

On-road transportation is the largest source of GHG emissions in the Mid-South with an estimated 8.9 million metric tons of carbon dioxide equivalent (CO_2e) emitted in 2019. While energy efficiency improvements in vehicles and newer technologies such as fully electric vehicles will allow the region to see improvements in emissions over time, focusing solely on consumer adoption does not provide the same community benefits and may encourage current development patterns increasing impervious surfaces and thereby exacerbate extreme heat events.

A robust, climate-ready public transit system benefits the entire Memphis MSA. Within the Memphis MSA, 90.3 percent of workers commute by personal vehicle.[3] Improved bus routes and frequency ensure transit riders are able to get to jobs, community anchors, and recreational activities without using personal vehicles, which will reduce emissions and traffic on transit corridors.

MATA's plans are in place and its staff is actively working to realize the goals in both the *Transit Vision* and *Zero Emissions Fleet Transition Plan* in the next decade. MATA has received capital funding to implement the Memphis Innovation Corridor, Crosstown Connector, and electric bus transition plan.[4] However, in order to ensure MATA services maintain current ridership fees and accessibility for transit riders, additional federal, state, and local financial

T.1 Impact Summary

2030 Target

Increase ridership and improve frequency to meet Memphis 3.0 Transit Vision ridership goals and convert 70% of MATA's bus fleet to electric.

Cumulative 2025-2030 GHG Reductions

31,988 **$mtCO_2e$**

2050 Target

Convert 100% of MATA's bus fleet to electric.

Cumulative 2025-2050 GHG Reductions

388,756 **$mtCO_2e$**

$792,500,000

Estimated Cumulative Operational Budget (2022 $)

$328,000,000

Estimated Remaining Capital Costs◊ (2022 $)

CRITERIA & HAZARDOUS AIR POLLUTANT REDUCTIONS IN 2030

22.64 tons of CO

24.11 tons of NOx

0.69 tons of PM2.5

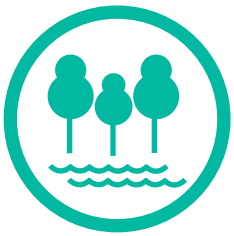
1.47 tons of VOCs

23%

OF LIDAC CENSUS BLOCK GROUPS POTENTIALLY IMPACTED IN 2030*

BENEFITS

EQUITY



ENVIRONMENTAL

PUBLIC HEALTH

ECONOMIC & WORKFORCE DEVELOPMENT

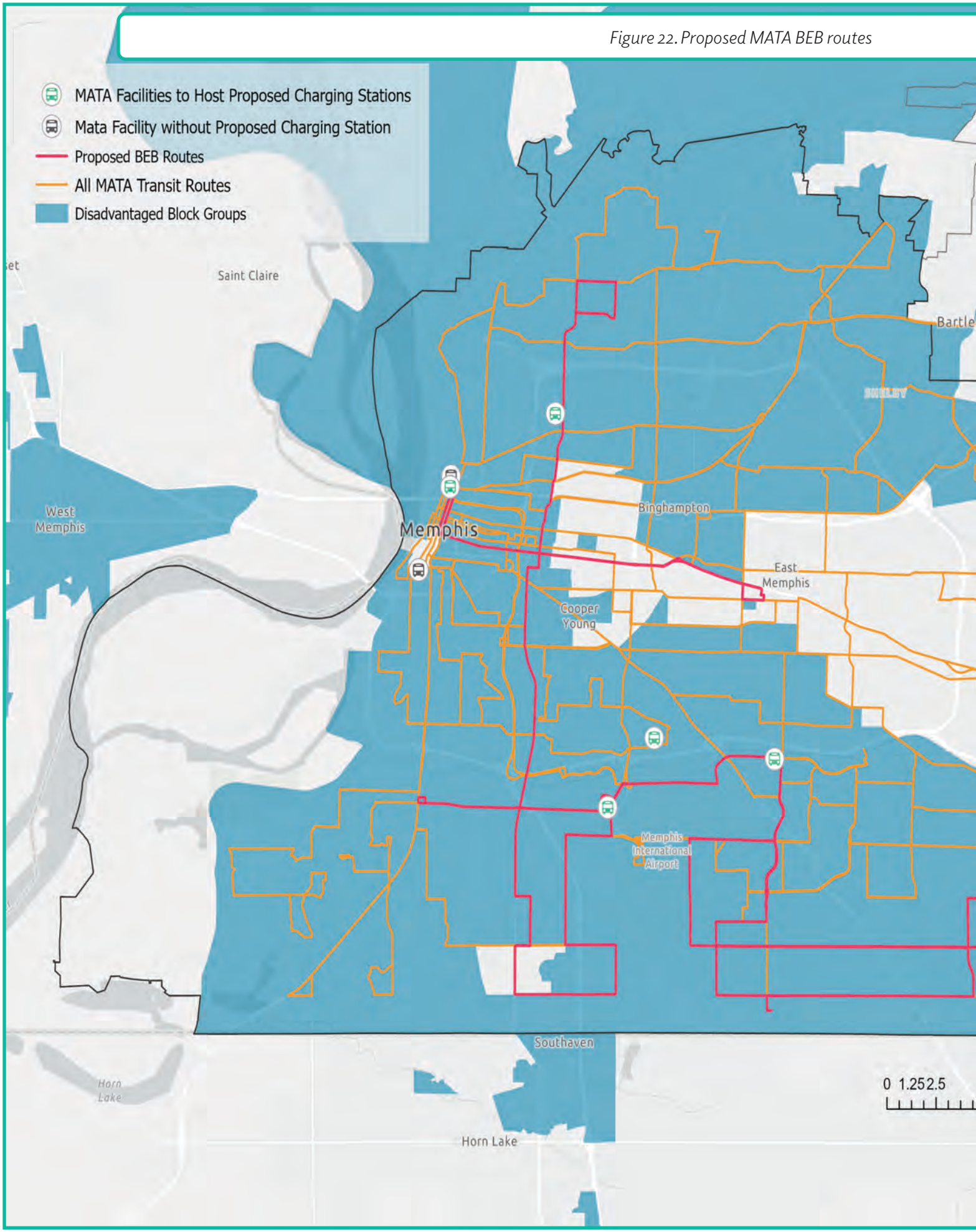
Implementation Partners

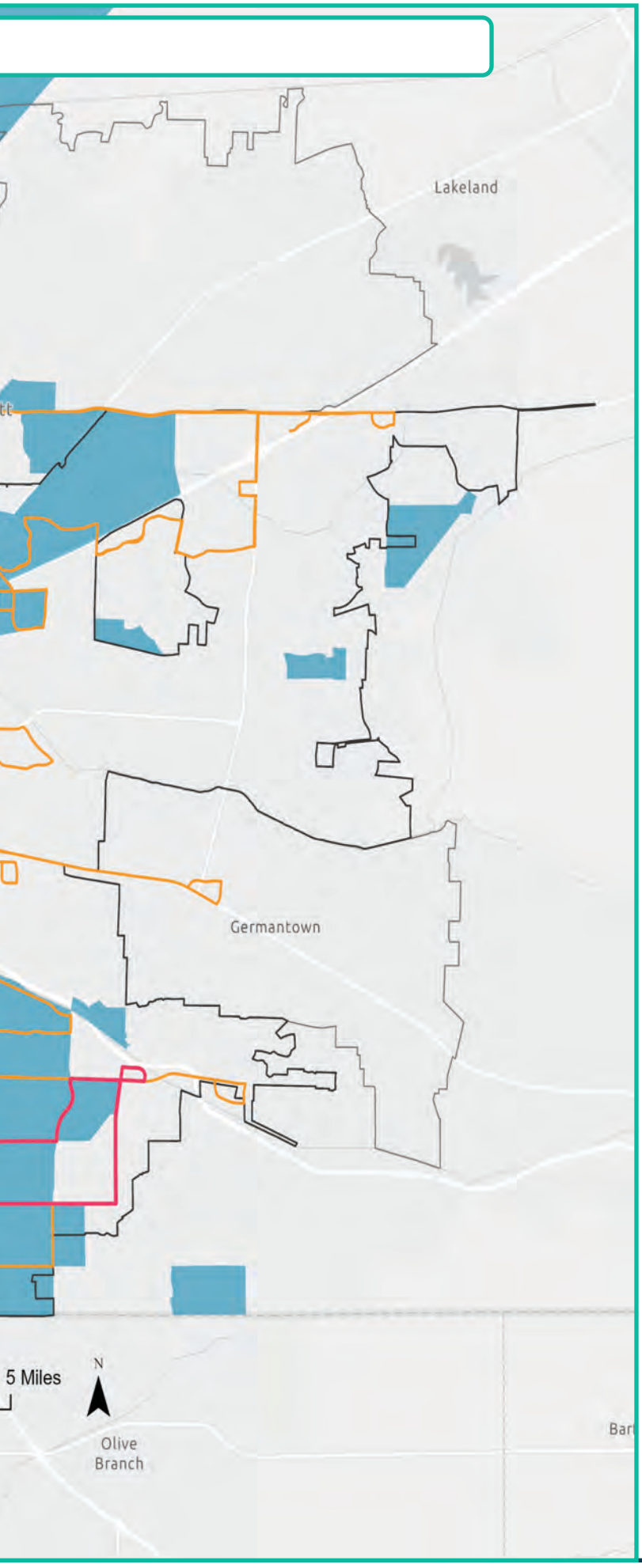
MATA, MLGW, and local governments

◊ *Estimated project cost is for remaining projects that have not been started and does not include charging stations needed along bus corridors. Only includes cost to purchase buses and construct new O&M Facility.*

* *For more information on which LIDAC census block groups will be affected by this Reduction Measure, please refer to Appendix 5.*

Figure 22. Proposed MATA BEB routes





support is needed to increase bus frequency, build the new operations and maintenance (O&M) facility with capacity to charge 114 electric buses, purchase the remaining 71 electric buses,[5] and construct in-route charging depots.

While there are ample funding sources for the capital costs needed to purchase equipment and build new infrastructure, the main funding issue MATA faces is the additional $36.7 million operational budget (in 2022 dollars) needed per year to improve bus frequency.[6] During the stakeholder engagement process for this plan, stakeholders consistently ranked providing a dedicated source of funding to MATA as the highest-priority reduction measure in the transportation sector. In 2022, the City of Memphis and Shelby County governments committed dedicated annual funding to MATA, but it is not the full amount needed.

As MATA service hours have decreased due to funding limitations, its ridership has followed suit. Current federal and state funding opportunities generally do not allow use of funds for operational costs. This puts the burden on local governments and MATA to find dedicated funding sources, or other ways to fund bus frequency improvements. Unfortunately, alternatives include raising ridership fees or cutting routes, both of which may result in fewer riders on the system and less ability to cover operating costs.

BACKGROUND

MATA is the public transportation provider for the Memphis area. Servicing approximately 300 square miles and half of the MSA's 1.3 million residents, MATA is one of the largest public transit operators in the state of Tennessee. The fleet is comprised of 114 active buses with a peak demand of 71 vehicles during the week. This leaves 22 spare buses or a 20 percent spare ratio. Within the 300 square mile service area, there are three transit centers.

The *Transit Vision*, completed as part of the *Memphis 3.0* comprehensive planning effort in 2019 and updated in 2023, proposes route changes and bus frequency goals. MATA has implemented the majority of the route changes and is now focusing on improving the frequency of buses, which requires additional sustained funding to implement.

Completed in May 2022, the *Zero Emissions Fleet Transition Plan* is meant to guide the transition of all fixed-route services to a zero-emission bus fleet with updated

charging infrastructure and equipment. The *Zero Emissions Fleet Transition Plan* also identifies federal, state, and local funding sources to pursue in order to implement the plan. MATA is leveraging the transition to zero-emissions vehicles as an opportunity to reduce carbon emissions and improve air-quality while providing a necessary upgrade to MATA's fixed route services and infrastructure. In 2023, MATA placed its first three BEBs into services, and MATA has secured funding to purchase an additional 40 electric buses to enter service by 2027.

In order to pursue fleet electrification, MATA is in the design phase of building a more centrally located O&M facility. Built between 1979 – 1980, MATA's current O&M Facility has surpassed the typical lifespan of transit operations and facilities. The facility's age and placement on a landfill site has been a source of financial strain on MATA operations, maintenance, and budget. Since 1991, the authority has allocated over $21 million to maintain day-to-day operations, prevent safety risks, and repair structural issues due to settlement. In certain parts of the facility, settlements of up to five feet continue to pose safety risks and damage facilities and equipment.

The map on the preceding page shows the locations of the initial routes where the electric buses will be assigned in the first five years of operation in relation to the low-income and disadvantaged communities census block groups in Memphis. The routes include the Innovation Corridor Bus Rapid Transit (BRT) line, the Crosstown Connector, and MATA route 30 in southeast Memphis. MATA selected these specific routes based on analysis providing connections for Memphians to employment opportunities. The Memphis Airport, for example, encompasses 25 percent of the Memphis region's employment opportunities; providing connections to this employer is one of MATA's key focuses for improved bus transit.

POTENTIAL FUNDING OPPORTUNITIES

MATA has already identified and secured a variety of federal, state, and local funds to acquire zero emission buses, charging equipment, and other required infrastructure to achieve a fully electric fleet and transit vision goals. *While financing options for capital improvements are identified, and in many cases secured, MATA lacks the operational funds necessary to maintain services.*

Acquired Funds

As part of the Federal Transit Administration's **Low and No-Emissions Grant Program**, MATA received $23.2 million award for the purchase of 16 BEBs, 16 depot chargers, and four opportunity chargers.

In 2019 MATA received a $12.0 million **Better Utilizing Investments to Leverage Development (BUILD) Grant** in support of the Innovation Corridor Bus Rapid Transit Project. MATA is using the BUILD Grant funds combined with $5.6 million in matching funds provided by the City of Memphis ($4.6 million) and Shelby County ($1.0 million) to acquire 10 BEBs to provide service on the Innovation Corridor. The 10 BEBs will replace the three existing peak period diesel buses and provide seven additional buses for service expansion within the corridor.

Most recently, the U.S. Department of Transportation awarded MATA $25 million in **Rebuilding American Infrastructure with Sustainability and Equity (RAISE)** funding to implement the Crosstown Corridor and Safety Enhancement Program.

In May 2021, MATA received a $2.1 million Transit and Shuttle Bus Grant under the **Volkswagen Settlement Environmental Mitigation Trust** from the Tennessee Department of Environment & Conservation (TDEC). City capital improvement plan funding totaling $1.0 million provided the local match. MATA used this funding to purchase 3 BEBs, which replaced three existing diesel buses.

A $11.2 million **Congestion Mitigation and Air Quality Improvement** program grant from the Tennessee Department of Transportation (TDOT) (grant number TN-2021-033) will be matched by $2.8 million in City capital improvement plan funds to acquire 10 BEBs. These buses will be assigned to Route 30 – Brooks and will replace the four existing peak

period diesel buses and provide six additional buses for service expansion.

Opportunities

The following provides an overview of funding opportunities MATA is eligible to apply for or is already preparing.

In February of 2024, MATA applied for the $1.5 million **Advanced Transportation Technology and Innovation** grant from the Federal Highway Association. To improve transit efficiency, the awardees aim to design planning and operations software focused on fixed route planning, on-demand integration, micro transit, multi-modal transit systems, and equitable design to address various barriers and challenges while striving for seamless integration.

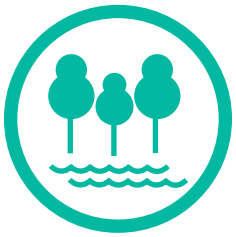
MATA is awaiting award status updates from TDOT's $1.65 million **Strengthening Mobility and Revolutionizing Transportation** grant. Funds will support planning and technology development for integration of on-demand zones with fixed routes, as well as a micro transit pilot project.

MATA intends to apply for the Federal Transit Administration's $390 million **Buses and Bus Facilities program** in 2024. The funding will help transit agencies replace aging buses, reduce air pollution, provide good-paying jobs, and improve the reliability of transit systems.

The United States Department of Transportation's **Neighborhood Access and Equity Program** will provide up to $3.155 billion in grant awards to connect communities by supporting neighborhood equity, safety, and affordable transportation access as well as mitigating negative environmental impacts. This program provides funding for community planning, capital construction, and regional partnerships.

CO-BENEFITS

EQUITY: Transit service is essential to many memphis residents who don't have resources for car ownership or have mobility issues. Increased frequency and on-time performance can reduce travel time for transit riders. Reliability helps people manitain jobs without having to face negative consequences for delays that are out of their control and increases the range of accessible jobs.



ENVIRONMENT: Reducing personal vehicle trips and electrification of MATA's bus fleet will improve air quality. Full implementation of this reduction measure will decrease the amount of oil and other fluid discharge to both natural water systems and city stormwater systems.

PUBLIC HEALTH: The emissions reduced from fewer personal automobile trips and a transition to BEBs will result in cleaner air, potentially improving asthma rates. From 2020 to 2022, there were 4,906 crashes within the Crosstown Corridor route, in which 20 resulted in pedestrian or cyclist fatalities. MATA is designing new transit stops and facilities to improve pedestrian safety by improving intersections, filling sidewalk gaps, installing enhancements in compliance with the Americans with Disabilities Act, re-striping bike lanes, and enhancing street lighting. Better bus service can cause riders to become more involved in extracurricular or community activities, access

higher quality food stores, and increase their ability to access healthcare services and other social services.

ECONOMIC & WORKFORCE DEVELOPMENT: The *Transit Vision* estimates the enhanced network will improve connections to employment centers and jobs (39 percent more jobs reachable within an hour) and where people live (79,000 more people near frequent bus service). In addition, the initial routes selected for transitioning to zero emissions buses were chosen to

DISBENEFITS AND CHALLENGES

FINANCIAL: Raising the necessary funding to implement the Transit Vision and MATA's long-term goals presents challenges. MATA is significantly underfunded and needs large, dedicated annual funding to meet long terms goals. There are high upfront capital costs to purchase and construct the necessary infrastructure to transition to electric buses; however, there may be lower lifecycle costs for fuel and maintenance throughout the life of the new vehicles.

OPERATIONAL: The electric load needed for a full transition to electric buses will be high and there are near-term power generation limitations due to large economic growth across the Tennessee Valley Authority's distribution jurisdiction. MATA will need to work closely with MLGW while planning the bus charging hub. MATA should consider installing battery storage as part of their 100 electric bus goal. To manage increased operations, MATA expects challenges regarding recruiting sufficient qualified staff.

MATA must develop contingency plans to handle climate related events such as flooding or power outages affecting facilities where bus charging occurs. In extreme cold weather conditions, charging the buses may take longer than usual, and power interruptions at charging stations can affect how quickly these buses recharge.

EDUCATION AND BEHAVIOR CHANGE: Effectively communicating route schedules changes to bus riders and the general public will be critical in increasing ridership. Such communications should have a focus on showing the system is reliable and addressing social stigmas around public transit.

OTHER CHALLENGES: Battery disposal and recycling processes may pose difficulties, so there is a need to plan for the end of life of all new technologies acquired. There is also a need to address how LIDAC communities can gain access to MATA's services when they reside or work outside of MATA's service area.

REVIEW OF AUTHORITY TO IMPLEMENT

As a government agency, MATA has the authority to implement the T.1 Priority Climate Action. A City of Memphis ordinance established MATA in 1975 to act as the public transportation provider for the City of Memphis and parts of Shelby County. The Memphis Mayor, with approval from the Memphis City Council, appoints the policy board governing MATA. In addition, local governments have the authority to dedicate funding to MATA.

MILESTONES

1. Continue to provide and increase dedicated annual funding to MATA and increase immediate annual funding by $31.7 million to implement the *Memphis 3.0 Transit Vision*.
2. Pursue funding to construct the planned high-frequency Bus Rapid Transit services on targeted corridors.
3. Pursue grants and subsidies to help cover the higher upfront capital cost of electric buses and charging infrastructure.
4. Improve the frequency of MATA's service to provide effective service and increase ridership.
5. Continue to evaluate developing dedicated bus lanes on routes.
6. Fully implement the *Zero Emissions Fleet Transition Plan* by procuring electric buses and building the infrastructure needed to charge the vehicles.
7. Explore options for enroute charging to enable expansion of electric buses to longer routes in the transit system.
8. Develop a public communications outreach campaign to provide information on proposed service improvements and new buses, and foster support for increase, dedicated funding.

ENDNOTES

1 Transit Vision Memphis. (2024). *The Future of Transit in the City of Memphis*. Retrieved from https://transitvision.memphistn.gov/

2 Memphis Area Transit Authority. (2022) *Zero Emissions Fleet Transition Plan*.

3 United States Census Bureau. (2022). *American Community Survey 5-Year Estimates, Table DP03: Selected Economic Characteristics*. Retrieved from https://data.census.gov

4 For more information regarding these specific projects, please go to https://memphisinnovationcorridor.com/, http://bit.ly/dailymemphian-mata, and https://www.matatransit.com/about/current-future-projects/.

5 Memphis Area Transit Authority. (2022) *Zero Emissions Fleet Transition Plan*.

6 The $ figure is based on 2019 estimate of $30 million needed annually. Staff adjusted the figure to reflect inflation.

Reduction Measure T.2: Connected Greenways Network

OVERVIEW

This reduction measure aims to implement trails, greenways, and greenspaces identified in various municipal plans as well as the *Mid-South Regional Greenprint and Sustainability Plan* (also referred to as *GREENPRINT 2015/2040*)[1]. The plan recommends a connected network of trails, greenways, and greenspace across four counties in the Mid-South: Shelby County and western Fayette County, TN; eastern Crittenden County, AR; and northern DeSoto County, MS.

Implementation of this measure entails the completion of remaining trails, infrastructure, and bicycle and pedestrian (bike/ped) facilities identified by committed jurisdictions. The proposed network includes more than 500 miles of greenways and more than 200 miles of on-street connectors, such as bike lanes. As of 2023, approximately 383 miles of greenways (77 percent) and 137 miles of on-street connectors (70 percent) are awaiting implementation. Additionally, the City of Senatobia is awaiting funds to implement greenways. Local governments and participating organizations in the region will be the key implementors for this measure.

WHY IS THIS A PRIORITY ACTION?

Transportation is the highest emitting sector in the Mid-South with on-road transportation being the largest source of emissions. Within the Memphis MSA, 90.3 percent of workers commute by personal vehicle.[2] The region's sprawling development patterns make walking and cycling commutes a challenge. By strategically connecting office, retail, and residential nodes throughout urban centers, the committed jurisdictions can maximize the efficacy of multi-modal greenways and trails as emission reduction measures. The installation of safe, connected multi-modal networks will reduce emissions from short personal vehicle trips.

Additionally, vested stakeholders highly support this reduction measure. Eighty-nine percent of survey respondents agree our built environment should be designed so people do not have to drive as much, and 83 percent agreed a network of safe cycling and walking paths was a high priority climate action. By providing safe, accessible opportunities for residents to walk or cycle rather than drive, this reduction measure facilitates a cultural transition to low-carbon transportation alternatives.

While progress has been made since the original conception of the greenway network, approximately 75 percent of the identified network still needs to be completed. Jurisdictions need additional funding to reduce the harmful impacts current transportation trends have on the natural environment through a regional shift towards more sustainable transportation practices.

BACKGROUND

GREENPRINT 2015/2040 is the final product of a planning process funded by a $2,619,999 Sustainable Communities Regional Planning Grant from the United States Department of Housing and Urban Development (HUD) awarded to Shelby County Government in 2011. The plan envisions a regional network of connected greenspaces to promote long-term housing and land use, resource conservation, environmental protection, accessibility, community health and wellness, transportation alternatives, economic development, neighborhood engagement, and social equity in the Mid-South. If the regional network were fully realized today, it would link to 95 percent

T.2 Impact Summary

2030 Target

Construct 32 miles of greenway trails and on-street corridors.

Cumulative 2025-2030 GHG Reductions

102.23 **$mtCO_2e$**

2050 Target

Construct 520 miles of greenway trails and on-street corridors.

Cumulative 2025-2050 GHG Reductions

865.91 **$mtCO_2e$**

$398,496,095

Estimated Remaining Project Cost (2022 $)

CRITERIA & HAZARDOUS AIR POLLUTANT REDUCTIONS IN 2030

0.125 tons of CO

0.004 tons of NOx

0.000 tons of PM2.5

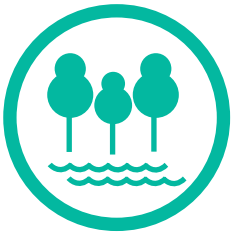
0.008 tons of VOCs

60%

OF LIDAC CENSUS BLOCK GROUPS POTENTIALLY IMPACTED IN 2030*

BENEFITS

EQUITY



ENVIRONMENTAL

ECONOMIC & WORKFORCE DEVELOPMENT

PUBLIC HEALTH

RESILIENCE

Implementation Partners

Local governments (public works and parks and recreation departments), state departments of transportation, and non-profit organizations

** For more information on which LIDAC census block groups will be affected by this Reduction Measure, please refer to Appendix 5.*

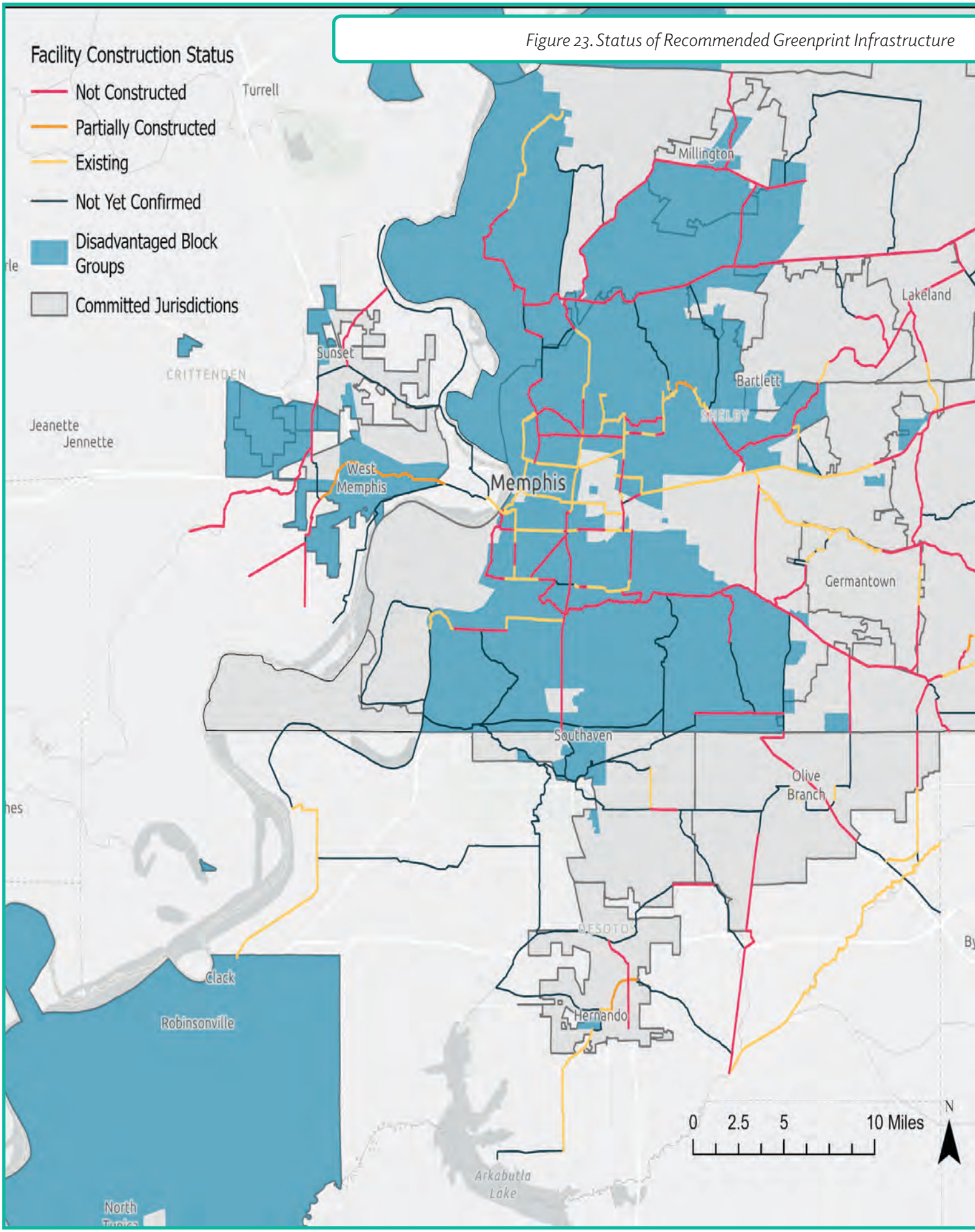
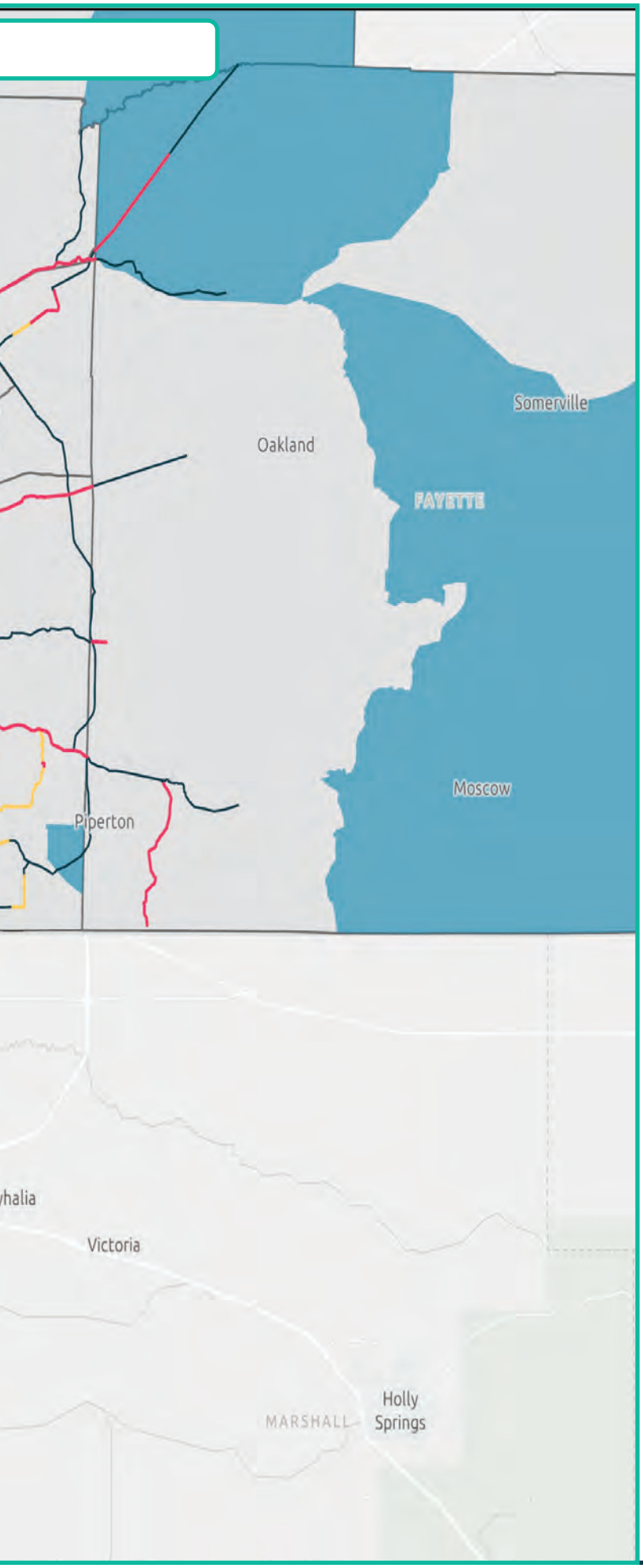


Figure 23. Status of Recommended Greenprint Infrastructure



of the large park acreage in the region, connect 78 percent of the region's population living within one mile of a corridor, connect 79 percent of the region's jobs within one mile of a corridor, and improve access to alternative transportation for all, including low-income and disadvantaged households and those with limited access to jobs.

During the analysis of local plans, the project team observed numerous municipalities highlighting a need for better multimodal transportation infrastructure in their area. This included continuing to develop the proposed greenway trails as well as identifying additional bike and pedestrian routes outside of the network. Six out of the eight counties in the Memphis MSA had plans featuring proposed bike and pedestrian routes.

The map to the left displays status updates for greenways within the *GREENPRINT 2015/2040* boundaries layered over LIDAC census block groups. By incorporating the *GREENPRINT 2015/2040* with projects identified by committed jurisdictions outside of the plan's original scope, this reduction measure will affect 59.5 percent of LIDAC block groups.

POTENTIAL FUNDING OPPORTUNITIES

Acquired Funds

In 2023, the Tennessee Department of Transportation (TDOT) received a $13.2 million **Rebuilding American Infrastructure with Sustainability and Equity** grant. This grant will fund the Eliminating Barriers on North Watkins project, or project ELBOW, which includes the design and reconstruction of the Wolf River bridge. The project also entails about 3.3 miles of complete streets, multimodal infrastructure including a separated bike lane, and sidewalk improvements on the North Watkins Street corridor at Delano Avenue to North Parkway.

The Federal Highway Administration's **Surface Transportation Block Grants Program** serves as the funding source for many current projects within the greenways network. The Chelsea Ave. Greenline project has a total budget of $5,379,000 with $4,303,200 in federal funds and $1,075,800 in local funds. This project will design and construct a shared-use path in the abandoned Union Pacific Railroad running adjacent to Chelsea Ave. from Evergreen St. to Washington Park. The Shelby Farms Greenline Bridge has a budget of $5,325,000 with $4,260,000 being federal and $1,065,000 being local. These funds will allow expansion of the Shelby Farms Greenline to the west through the construction of a bridge over an active railroad. The expansion will link midtown Memphis to important regional bike/ped corridors. Lastly, the South Memphis Greenline project has a budget of $3,685,000 with $2,948,000 being

federal funds and $737,000 being local. This project will include the design and construction of a shared use path running northeast from Marjorie St. to Trigg Ave. in South Memphis.

Another federal program providing funds for multiple projects in the greenways network is the **Congestion Mitigation and Air Quality Improvement** program. In 2019, the City of Memphis received $1,769,400 in federal grant funds to construct the Chelsea-Hollywood corridor which includes adding protected bicycle-pedestrian facilities on and adjacent to Chelsea Ave. and on-street bike facilities to Hollywood St. as a continuation of the Chelsea Ave. Greenline. In 2019, the City of Memphis was also awarded funds in the amount of $4,865,939 for the Watkins-Presley On-Street project which includes the incorporation of bicycle-pedestrian facilities on North Watkins St., Cleveland St., Bellevue Blvd., and Elvis Presley Blvd.

Opportunities

There are a number of federal grant programs available that provide funding opportunities for bike/ped infrastructure and transportation projects. Below is an overview of those opportunities which this reduction measure would be eligible for.

The **Environmental and Climate Justice Program** – created by the Inflation Reduction Act (IRA) under the Clean Air Act – provides funding for climate and environmental projects benefiting underserved communities. The program will disburse $2.8 billion in financial assistance and $200 million in technical assistance by September 2026.

The U.S. Department of Transportation received $3.155 billion through the IRA to establish the **Neighborhood Access and Equity Grant Program**. The program will support planning and construction efforts under three types of grants: Community Planning, Capital Construction, and Regional Partnerships Challenge. This program supports equity, safety, and access to affordable transportation in neighborhoods, in addition to mitigating harmful environmental impacts.

The **Safe Streets and Roads for All Grant Program** was established through the Bipartisan Infrastructure Law with $5 billion total in funding to be appropriated from 2022 to 2026. This program funds initiatives to prevent roadway deaths and severe injuries. As of December 2023, over $3 billion in funding was still available.

CO-BENEFITS

EQUITY: This measure could decrease pedestrian and traffic fatalities disproportionately affecting Black, Indigenous, and People of Color, or BIPOC, communities by increasing bike/ped infrastructure and reducing speeds on roadways. Additionally, LIDACs in general have less access to personal vehicles and use walking and public transit as a mode of transportation more than other demographic groups. Therefore, implementation of this measure would increase roadway safety and quality for a lot of community members. It is crucial to ensure equitable geospatial dispersion of this infrastructure, avoiding concentration in more affluent areas. By focusing on this, LIDACs would benefit from increased access to green space and bike/ped infrastructure which they often lack.

ENVIRONMENTAL: This reduction measure could encourage a shift from short personal vehicle trips to biking and walking, in turn reducing car emissions and improving air quality. If this investment is implemented in conjunction with public transit investment, car ridership can decrease further.

PUBLIC HEALTH: Improved signage and safer roadways for commuters using all transportation modes can reduce traffic casualties and injuries. Safer bike and pedestrian roadways can increase access to high quality food sources, healthcare, social services, and community building activities. The increase in safer bike/ped transportation could also result in health benefits from personal fitness. Increased vegetation can improve air quality and mitigate the effects of urban heat.

ECONOMIC AND WORKFORCE DEVELOPMENT: The construction and maintenance of bike and pedestrian infrastructure will provide both short and long-term job opportunities. This will also advance green technology workforce development and training. An increase of greenways and other green infrastructure can also spur economic (re)development in nearby communities.

RESILIENCE: Many proposed greenways are along waterways and located in or near floodplains. Acquiring land for greenways ensures a buffer between streams and buildings. Greenway projects in these areas should consider incorporating stream restoration or flood natural flood detention measure to reduce the impact of flooding on surrounding neighborhoods.

DISBENEFITS AND CHALLENGES

FINANCIAL: There is a need for dedicated funding opportunities for protected bike and pedestrian pathways beyond grants. In order to maintain bike/ped infrastructure, committed jurisdictions need long-term plans to fund repaving and general routine maintenance. Additionally, creating programs that engage both the public and private sector would be good funding sources.

OPERATIONAL: A feeling of security is integral to the success of isolated trails, so local governments should implement safety measures along trails to alleviate the fear of crime and increase access to emergency help. Additionally, trails need regular maintenance to remain visually appealing to citizens; corporate sponsors could aid with associated costs.

EDUCATION AND BEHAVIOR CHANGE: Public education and outreach on bike and pedestrian safety is necessary to ensure safe outcomes of this measure. Such outreach programs should not just be geared towards bikers and pedestrians but also vehicle users. Furthermore, education should focus on how to use existing routes for commuting in addition to exercise and recreation. Implementation partners need to consider supplemental programs to address barriers to bike access. Topics of these programs would include social stigmas, storage access at home and work, resource availability for places like bike repair shops and other related businesses, affordability of equipment, etc.

POLICY CHANGE: In order to reduce the duplication of efforts, local government comprehensive and capital improvement plans should incorporate projects listed in regional plans such as the *GREENPRINT 2015/2040*. There will also need to be a dedicated tracking system to measure utilization. When prioritizing projects for implementation, policy makers should consider projects that fill in gaps in order to improve functionality of trails for commuting.

OTHER CHALLENGES: This reduction measure alone will not likely reduce GHG emissions significantly, but if enacted in tandem with public transit measures, it can have an effective and positive impact on safety and community building in LIDACs.

REVIEW OF AUTHORITY TO IMPLEMENT

It is likely the conditions of accepted grants will impact the specific implementation partners and their authority to implement the T.2 Reduction Measure. State and local governments have the authority to construct and maintain transportation infrastructure on rights-of-way they own. Governments also have the authority to acquire land for transportation purposes.

MILESTONES

1. Continue exploring other funding opportunities, keeping in mind the ongoing financial demand of maintenance and upkeep of the trails.
2. Organize and partner with stakeholders (bike businesses, non-profit organizations, advocacy groups, etc.) across various disciplines to certify unity and equity in the development of the network.
3. Conduct public education campaigns and community outreach surrounding bike and pedestrian safety.
4. Ensure trail connectivity across jurisdictional boundaries through trans-jurisdictional communication and collaboration.
5. Develop a dedicated tracking program or mechanism to keep up with the status of trails and be well informed throughout the development of the network.
6. Fully construct a greenway network spanning the Memphis MSA.

ENDNOTES

1 Memphis and Shelby County Divsion of Planning and Development. (2015). *Mid-South Regional Greenprint and Sustainability Plan*.

2 United States Census Bureau. (2022). *American Community Survey 5-Year Estimates, Table DP03: Selected Economic Characteristics*. Retrieved from https://data.census.gov

NEXT STEPS

The Mid-South Climate Action Plan: Priority Reduction Measures is the first major deliverable under the Climate Pollution Reduction Grants (CPRG) planning grant awarded to Shelby County Government. The CPRG implementation grant program allows eligible entities to apply for funding to implement any of the priority reduction measures included in this plan. Applications are due on April 1, 2024, and additional information is available at https://www.epa.gov/inflation-reduction-act/about-cprg-implementation-grants.

The Memphis and Shelby County Division of Planning and Development's Office of Sustainability and Resilience (OSR) will continue working with its partners and the 19 additional committed jurisdictions on planning, engagement, and action to reduce emissions. In 2025, OSR will publish a comprehensive climate action plan (CCAP) establishing targets and strategies to reduce greenhouse gas emissions across all sectors. The CCAP will include near- and long-term emissions projections, a suite of emission reduction measures, a robust analysis of measure benefits, plans to leverage federal funding, and a workforce planning analysis. In 2027, OSR will publish a status report detailing the progress of implementation for measures included in this plan and the CCAP, any relevant updates to the analyses in both plans, and next steps and future budget and staffing needs to continue implementation for the greenhouse gas reduction measures.

For questions about the Mid-South Climate Action Plan or to stay updated on this work, please visit our website at https://osr.shelbycountytn.gov/cprg.

APPENDIX 1: GREENHOUSE GAS EMISSIONS INVENTORY METHODOLOGY AND DATA SOURCES

The simplified 2019 greenhouse gas (GHG) emissions inventory for the Memphis, TN-MS-AR Metropolitan Statistical Area (MSA) was developed using the *Global Protocol for Community-Scale GHG Emissions Inventories* (GPC) methodological framework and is consistent with the Intergovernmental Panel on Climate Change greenhouse gas inventory guidance. Due to time constraints, the project team focused on estimating emissions from the following sectors for the *Mid-South Climate Action Plan Priority Reduction Measures*: electricity generation and/or use, residential and commercial buildings, industry, transportation, and carbon sinks from trees. In addition, the simplified inventory only includes estimates for carbon dioxide, nitrous oxide, and methane. The project team will expand the simplified inventory to include all sectors and greenhouse gases in the Mid-South Comprehensive Climate Action Plan.

Staff compiled the inventory using the C40 Cities' City Inventory Reporting and Information System (CIRIS). CIRIS separates emissions into the following categories: stationary emissions, transportation, waste, industrial processes, and agricultural, forestry, and other land use. These categories differ slightly from the sectors the U.S. Environmental Protection Agency (EPA) has defined for the Climate Pollution Reduction Grants program: electricity

GPC Reference No.	GHG Emissions Source (By Sector and Sub-sector)		EPA-Defined Sector	Included in Simplified 2019 GHG Inventory
I	**STATIONARY ENERGY**			
I.1	**Residential Buildings**			
I.1.1	Emissions from fuel combustion within the MSA boundary	→	Residential & Commercial Buildings	✓
I.1.2	Emissions from grid-supplied energy consumed within the MSA boundary	→	Electricity Generation and/or Use	✓
I.2	**Commercial & Institutional Buildings & Facilities**			
I.2.1	Emissions from fuel combustion within the MSA boundary	→	Residential & Commercial Buildings	✓
I.2.2	Emissions from grid-supplied energy consumed within the MSA boundary	→	Electricity Generation and/or Use	✓
I.3	**Manufacturing Industries & Construction**			
I.3.1	Emissions from fuel combustion within the MSA boundary	→	Industry	✓
I.3.2	Emissions from grid-supplied energy consumed within the MSA boundary	→	Electricity Generation and/or Use	✓
I.4	**Energy Industries**			
I.4.1	Emissions from fuel combustion within the MSA boundary			

GPC Reference No.	GHG Emissions Source (By Sector and Sub-sector)		EPA-Defined Sector	Included in Simplified 2019 GHG Inventory
	Electricity generation (1.A.1.a.i)	➔	Electricity Generation and/or Use	✓
	Petroleum refining (1.A.1.b)	➔	Industry	✓
I.5	**Agriculture, Forestry & Fishing Activities**			
I.5.1	Emissions from fuel combustion within the MSA boundary	➔	Residential & Commercial Buildings	✓
I.8	**Fugitive Emissions from Oil & Natural Gas Systems**			
I.8.1	Emissions from fugitive emissions within the MSA boundary	➔	Fugitive Emissions from Oil & Natural Gas Systems	✓
II	**TRANSPORTATION**			
II.1	**On-Road Transportation**			
II.1.1	Emissions from fuel combustion for on-road transportation occurring in the MSA	➔	Transportation	✓
II.2	**Railways**			
II.2.1	Emissions from fuel combustion for railway transportation occurring in the MSA	➔	Transportation	✓
II.3	**Waterborne Navigation**			
II.3.3	Emissions from transboundary journeys occurring outside the MSA, and T&D losses from grid-supplied energy consumption	➔	Transportation	✓
II.4	**Aviation**			
II.4.1	Emissions from fuel combustion for aviation occurring in the MSA	➔	Transportation	✓
II.4.3	Emissions from transboundary journeys occurring outside the MSA, and T&D losses from grid-supplied energy consumption	➔	Transportation	✓
II.5	**Off-Road Transportation**			
II.5.1	Emissions from fuel combustion for off-road transportation occurring in the MSA	➔	Transportation	✓
III	**Waste**			
III.1	**Solid Waste Disposal**			
III.1.1	Emissions from solid waste generated in the MSA and disposed in landfills or open dumps within the MSA	➔	Waste & Materials Management	
III.1.2	Emissions from solid waste generated in the MSA but disposed in landfills or open dumps outside the MSA	➔	Waste & Materials Management	
III.2	**Biological Treatment of Waste**			
III.2.1	Emissions from solid waste generated in the MSA that is treated biologically within the MSA	➔	Waste & Materials Management	
III.2.2	Emissions from solid waste generated in the MSA but treated biologically outside the MSA	➔	Waste & Materials Management	
III.3	**Incinernation & Open Burning**			
III.3.1	Emissions from waste generated and treated within the MSA	➔	Waste & Materials Management	
III.3.2	Emissions from waste generated within but treated outside of the MSA	➔	Waste & Materials Management	
III.4	**Wastewater Treatment & Discharge**			

GPC Reference No.	GHG Emissions Source (By Sector and Sub-sector)		EPA-Defined Sector	Included in Simplified 2019 GHG Inventory
III.4.1	Emissions from wastewater generated and treated within the MSA	➔	Waste & Materials Management	
III.4.2	Emissions from wastewater generated within but treated outside of the MSA	➔	Waste & Materials Management	
IV	**INDUSTRIAL PROCESSES & PRODUCT USE (IPPU)**			
IV.1.1	Emissions from industrial processes occurring in the MSA boundary	➔	Industry	
V	**AGRICULTURE, FORESTRY & OTHER LAND USE**			
V.1	Emissions from livestock	➔	Agriculture, Natural & Working Lands	
V.2	Emissions from land	➔	Agriculture, Natural & Working Lands	✓
V.3	Emissions from aggregate sources and non-CO_2 emission sources on land	➔	Agriculture, Natural & Working Lands	

generation and/or use, residential and commercial buildings, industry, transportation, waste and materials management, and agriculture, natural and working lands. Both groupings include a comprehensive accounting of all major sources of GHG emissions. The table below maps the CIRIS categories and sub-categories to the appropriate EPA-defined sector.

The methodology included in this appendix is organized using the CIRIS categories.

For information on the quality assurance procedures followed for the GHG emissions inventory, please refer to the Quality Assurance Project Plan for this project located at https://osr.shelbycountytn.gov/CPRGdocuments.

STATIONARY ENERGY

Emissions from Fuel Combustion (Natural Gas, Propane, Other Oils and Gases)

The first step in estimating GHG emissions from natural gas consumption involved identifying the providers' service areas. While electricity providers usually have a service map publicly available, this information is not typically available for natural gas providers. Staff used information available on providers' websites and the descriptions, when available, of the territory served by the provider to approximate their service territories. Most of the fourteen natural gas providers in the region operate only within the MSA. For these providers, staff used consumption data reported in the United States Energy Information Administration (EIA)'s Form EIA-176. The data used typically came from the columns labeled "Total Volume," except for the industrial volumes, which used the "Industrial Sales Volume" columns to demonstrate the volume consumed in the MSA and not volumes being purchased in the MSA and used elsewhere.

Staff had to estimate the amount of natural gas combusted for a few natural gas providers because available information suggested their service area extended beyond the boundaries of our MSA. For two of these providers, Atmos Energy and Summit Utilities, staff used per capita consumption data for the states in the MSA where they operate (Mississippi and Arkansas, respectively) to scale down the EIA's state-level report of Natural Gas Consumption by End Use for 2019 and estimate the amount of natural gas consumption attributable to the counties in our MSA serviced by these providers. Because this

calculation used population numbers at both the state and county levels, staff assumed all residents of a geographic area received natural gas service, which likely not the case.

The project team estimated consumption data for Hardeman-Fayette Utility District (HFUD) by halving the consumption numbers reported in Form EIA-176. Based on the description of HFUD's service area on their website, approximately half of their service area is within the MSA.

The EPA's Facility-Level Information on Greenhouse gases Tool (FLIGHT) provided emissions data on two of the landfills in the MSA as well as the non-natural gas consumption by major industrial emitters. Data came from Subpart C: General Stationary Fuel Consumption. While there are two other landfills servicing the Memphis MSA, neither of these landfills (the Crittenden County Landfill and the North Shelby Landfill) submitted information regarding stationary emissions for 2019. Staff did not include natural gas emissions from FLIGHT in order to prevent double counting emissions. Staff assumed emissions estimates for the natural gas providers included combustion by industry.

Information for fuel consumption for the energy industry also came directly from FLIGHT, using Subpart C: General Stationary Fuel Consumption. In some cases, there were multiple reported sources of combustion for a given fuel type (e.g., the Tennessee Valley Authority (TVA)'s Allen plant has multiple turbines each using natural gas and distillate fuel oil). Staff added the emissions for each fuel type to get a full total for the facility, with each fuel type listed separately for each facility.

The stationary emissions section of the inventory includes estimates for gasoline combustion by vehicles used in construction, commerce and industry, lawn and garden, and agriculture. These are vehicles whose primary use is not transportation. The project team used a per capita estimation method to calculate the fuel consumption for these uses because the smallest scale data available – the Federal Highway Administration's Highway Statistics – was at the state level. Staff calculated per capita fuel consumption per state and then multiplied by each county's population to calculate the amount of fuel consumption proportionally attributable to our MSA.

Emissions from Consumption of Grid-Supplied Energy (Electricity)

Per the *Global Protocol for Community-Scale GHG Emissions Inventories*, the project team estimated emissions from grid-supplied energy using electricity consumption instead of electricity generation. This is because the Memphis MSA consumes more electricity than it generates. In addition, the Memphis MSA is served by two different grid systems: the TVA and the Mississippi Valley subregions of SERC. If staff made emissions estimates based on generation, they would underestimate the emissions for the Mississippi Valley areas, as the power plants in the Memphis MSA service the TVA grid. Basing the emissions estimates off consumption focuses on electricity usage occurring within the region and better represents the full picture of energy use in the MSA.

Some electricity providers have a service area entirely within the boundaries of the MSA. In addition, staff included Northcentral Electric Cooperative in this group since only a small portion of their service area outside of the MSA's boundaries. Staff reported the consumption data for these providers directly from the EIA's Form EIA-861, using the relevant sector's sales column of the Sales to Ultimate Customers report.

Three electricity providers with service areas extending past the boundaries of our MSA sent consumption data to the project team at staff's request. The project team estimated emissions for the remainder of the electricity providers using an adjusted per capita approach. Staff used estimates from FindEnergy.com to determine the proportion of customers residing in each county to calculate estimated electric consumption.

The project team did not include information regarding about two electricity providers due to a lack of information available about the service territories and percentage of their customers residing with the MSA. In addition, there is conflicting information regarding whether or not Central Electric Power Association (CEPA) services Tate County. The EIA listed Tate County as one of the counties where CEPA operated in 2019, but there is no other information available suggesting this is the case. Staff omitted CEPA under the assumption this was a clerical error. These omissions may in the underestimation the total GHG emissions for the MSA.

Staff assumed other subsectors, such as commercial and industrial, included data regarding electricity consumption for agricultural, forestry, and fishing activities based on correspondence with some of the electricity providers servicing more rural areas of the MSA.

Emissions from Energy Generation Supplied to the Grid

Staff used emissions estimates from flight for this sector. The two TVA power plants' data comes from Subpart D: Electricity Generation, while the information from the Texas Gas Transmission stations in Lake Cormorant, MS and Covington, TN comes from Subpart W: Petroleum and Natural Gas Systems.

Emissions from Fugitive Emissions from Oil and Natural Gas Systems

While there are many natural gas pipelines running through the Memphis MSA, we limited the scope of inquiry to natural gas providers in our territory and to transmission pipelines that reported operations and emissions in our territory.

The Texas Gas Transmission company has two stations in the MSA: one in Covington, TN and another in Lake Cormorant, MS. Both stations report their emissions to the EPA, so staff used their reported data from the FLIGHT tool, using Subpart W: Petroleum and Natural Gas Systems. Staff used data reported as "Equipment Leaks Surveys and Population Counts." Staff used the same methodology to report emissions from two of the natural gas providers in the MSA: Memphis Light, Gas and Water (MLGW) and City of Covington.

For the remaining natural gas providers, the project team used the EIA's Form EIA-176 following the same methodology used to calculate natural gas consumption. Due to an absence of data, the amount of emissions resulting from leaks in Summit Utilities' transmission system was not estimated.

Data Sources

Childress, Hallee. (2023, December 18). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.

Find Energy. *Compare Electricity Providers and Rates*. Retrieved from https://findenergy.com/electricity/.

Helton, Pam. (2023, November 21). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.

Henson, April. (2023, November 21). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.

Ondra, Todd. (2023, November 29). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.

U.S. Census Bureau. (2019). *American Community Survey, 5-Year Estimates, Table DP05: ACS Demographic and Housing Estimates*. Retrieved from https://data.census.gov.

U.S. Census Bureau. (2019). *American Community Survey, 5-Year Estimates, Table S1101: Households and Families*. Retrieved from https://data.census.gov.

U.S. Department of Transportation, Federal Highway Administration. (2019). *Highway Statistics 2019, Table MF-24: Private and Commercial Nonhighway Uses of*

Gasoline. Retrieved from https://www.fhwa.dot.gov/policyinformation/statistics/2019/mf24.cfm.

U.S. Energy Information Agency. (2019). *Annual Report of Natural and Supplemental Gas Supply and Disposition, Form EIA-176*. Retrieved from https://www.eia.gov/naturalgas/ngqs/#?year1=2019&year2=2019&company=Name.

U.S. Energy Information Agency. (2019). *Annual Electric Power Industry Report, Form EIA-861*. Retrieved from https://www.eia.gov/electricity/data/eia861/.

U.S. Energy Information Agency. (2019). *Natural Gas Consumption by End Use*. Retrieved from https://www.eia.gov/dnav/ng/ng_cons_sum_a_EPG0_vrs_mmcf_a.htm.

U.S. Environmental Protection Agency. (2019). *Facility Level Information on GreenHouse gases Tool* (*FLIGHT*). Retrieved from https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

TRANSPORTATION

On-Road

Staff calculated the emissions estimates from the on-road sector using EPA's MOtor Vehicle Emission Simulator (MOVES) tool. Local activity data on vehicle miles traveled (VMT) were obtained from the Tennessee Department of Transportation and the West Memphis Metropolitan Planning Organization (MPO). Local meteorology data was obtained from the National Oceanic and Atmospheric Administration (NOAA). For counties without local meteorology data available on NOAA, staff used a nearby county's data. The Memphis MPO provided local data on vehicle age distribution. All non-local data was derived from the MOVES default database. The MOVES tool calculated county-scale estimates of on-road vehicle emissions, and staff input the emissions directly into CIRIS.

Rail

The project team used the Bureau of Transportation Statistics (BTS) County Transportation Profiles, Table 1-1: System Mileage within the United States, and Table 4-5: Fuel Consumption by Mode of Transportation in Physical Units to approximate amount of fuel consumed within the Memphis MSA's limits. These estimates only consider Class I Railroads, not Class II or III. Staff entered the estimated fuel consumption in to CIRIS to generate the GHG emissions.

Aviation

The number of aircraft operations (arrivals and departures) came primarily from the Federal Aviation Administration's Operations Network (OPSNET). Staff retrieved flight information from OPSNET for the Memphis International Airport and the Millington-Memphis Airport. The project team divided operations at these airports by the total national operations reported in OPSNET. The national fuel consumption reported in BTS' Table 4-5 was then multiplied by the operations ratio to calculate the proportion of aviation kerosene and jet fuel used by these two airports to reflect emissions from arrivals/departures occurring within the MSA's boundary. Staff also requested the amount of fuel sold at other airports in the MSA including Tunica Municipal Airport, Fayette County Airport, West Memphis Municipal Airport, Olive Branch Airport, Charles W. Baker Airport, and General DeWitt Spain Airport. All fuel consumption data was entered into CIRIS to generate the GHG emissions.

Waterborne

The approximate amount of fuel consumed within the Memphis MSA's limits was calculated using BTS's Table 4-5. Staff used a per capita method to estimate the amount of fuel based on the percentage of the United States' population residing in the Memphis MSA. The calculated fuel consumption was entered into CIRIS to generate the GHG emissions.

Off-Road

Staff calculated emissions from the off-road sector using MOVES. Local meteorology data was obtained from NOAA and for those counties that did not have local meteorology data available, a nearby county's data was used. All non-

local data was obtained from the MOVES default database. Emissions were calculated for the following equipment types: airport support, pleasure craft, railroad, and recreational. Staff input the county-scale estimates of off-road vehicle emissions directly into CIRIS.

Data Sources

On-Road and Off-Road emission estimates: United States Environment Protection Agency, Office of Transportation and Air Quality. Motor Vehicle Emission Simulator: MOVES4 (2023). Retrieved from https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

Tennessee VMT data: Tennessee Department of Transportation, Road Inventory Office (2019). *2019 HPMS DVMT Rural and Urban by County*. Retrieved from https://www.tn.gov/tdot/long-range-planning-home/longrange-road-inventory/longrange-road-inventory-highway-performance-monitoring-system.html

Arkansas VMT data: Moore, Ralph. (2023, December 19). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

Meteorology data: National Centers for Environmental Information, National Oceanic and Atmospheric Administration. Local Climatological Data (2019). Retrieved from https://www.ncdc.noaa.gov/cdo-web/datatools/lcd

County rail mileage: United States Department of Transportation, Bureau of Transportation Statistics. County Transportation Profiles (2019). Retrieved from https://www.bts.gov/ctp

U.S. rail mileage: United States Department of Transportation, Bureau of Transportation Statistics. *Table 1-1: System Mileage within the United States* (2019). Retrieved from https://www.bts.gov/content/system-mileage-within-united-states

Fuel Consumption: United States Department of Transportation, Bureau of Transportation Statistics. *Table 4-5: Fuel Consumption by Mode of Transportation in Physical Units* (2019). Retrieved from https://www.bts.gov/content/fuel-consumption-mode-transportation

Flight operations data for Memphis International and Millington-Memphis: Federal Aviation Administration, The Operations Network (2019). Retrieved from https://aspm.faa.gov/opsnet/sys/main.asp

Tunica Municipal Airport fuel consumption: Warner, Marie. (2023, November 16). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

Fayette County Airport fuel consumption: Tapp, Karley. (2023, November 16). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

West Memphis Municipal Airport fuel consumption: Suiter, Candra. (2023, November 29). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

Olive Branch Airport fuel consumption: Ondra, Todd. (2023, November 29). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

Charles W. Baker Airport fuel consumption: McBride, Jason. (2022, January 21). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

General DeWitt Spain Airport fuel consumption: McBride, Jason. (2022, January 21). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

U.S. Population: U.S. Census Bureau (2019). American Community Survey. Retrieved from https://data.census.gov/table?g=010XX00US

Local age distribution data: Warren, Nick (2023, November 20). Personal communication to Logan Landry, Memphis-Shelby County Office of Sustainability and Resilience.

CARBON SINKS

Staff used the EPA's Local Greenhouse Gas Inventory Tool (LGGIT) to estimate carbon sequestration from trees within the Memphis MSA's boundary . National Land Cover Database Tree Canopy Cover data was retrieved from the United States Department of Agriculture Forest Service. Total Urban Area and Percent of Urban Area with Tree Cover was calculated on a per county basis in ArcGIS Pro and input into the LGGIT tool. Sequestration in metric tons of carbon dioxide equivalent (CO2e) was calculated in LGGIT.

Data Sources

Tree Canopy data: United States Department of Agriculture (2023). 2019 National Land Cover Database Tree Canopy Cover. Retrieved from https://data.fs.usda.gov/geodata/rastergateway/treecanopycover/index.php

APPENDIX 2: REDUCTION MEASURE METHODOLOGY AND DATA SOURCES

REDUCTION MEASURE E.1: RETROFIT OUTDOOR STREETLIGHTS TO LED FIXTURES

Quantification Methods

Greenhouse Gas (GHG) Reduction Potential

In the business-as-usual scenario, the total electricity consumption of streetlights and leased outdoor lighting (LOL) in the Memphis, TN-MS-AR Metropolitan Statistical Area (MSA) is 180,240,384 kilowatt-hours (kWh) annually, based on current average electricity consumption per streetlight/LOL in Shelby County.

Staff calculated the cost of electricity and electricity emissions factor used in both the business-as-usual scenario and the action scenario using the 2023 Annual Energy Outlook published by the U.S. Energy Information Administration (EIA).

This action is designed to retrofit 100 percent of high-pressure sodium (HPS) streetlights and LOLs in the Memphis MSA with LED bulbs by 2030. The analysis incorporates all LED retrofits in progress and completed since 2019 as well as proposes timelines starting in 2025 for jurisdictions that have not started streetlight retrofits. Local jurisdictions, local power companies, and retrofit providers supplied information on the current composition of streetlights and status of retrofit projects.

In order to analyze the GHG emissions reduction potential of retrofitting existing streetlights with LED, the quantification assessed the change in kWh usage through 2050 as streetlights and LOLs were replaced through 2030. Staff used an HPS to LED conversion analysis completed in Phoenix, Arizona to account for the longer lifespan of LEDs and lower energy usage.

Cost Evaluation

The major costs of this policy are the costs of buying new LED fixtures and installing these fixtures. There is also an associated maintenance cost, but since LEDs have a longer lifespan, they have a lower maintenance cost than their HPS counterparts. Staff calculated the average LED installation cost by dividing the cost of the Memphis LED retrofit project by the number of lights retrofitted.

The major cost savings of this policy are the energy savings associated with more efficient LED bulbs and the avoided cost of maintenance. This analysis found there is a cost savings of $186 associated with every metric ton of carbon dioxide equivalent (CO_2e) abated under this policy.

Criteria and Hazardous Air Pollutants Reduction Potential

The Clean Air Act regulates criteria and hazardous air pollutants. These pollutants have significant impacts on public health and include the following gases: ozone, particulate matter 2.5 ($PM_{2.5}$), carbon monoxide (CO), nitrogen oxide (NO_x), and volatile organic compounds (VOC). When applicable throughout the reduction measures, staff researched and estimated potential reductions in the year 2030. Retrofitting streetlights and LOLs will not provide reductions to emissions of criteria and hazardous air pollutants within the Memphis MSA. It is possible the reduction in energy consumption may contribute to a reduced demand for electricity generation, which could result in a reduction of air pollutants from power plants. However, this will depend on the electric grid mix and the amount of carbon-free electricity sources in use at that time.

LIDAC Analysis

Twenty-eight percent of block groups identified as low-income and disadvantaged communities (LIDAC) will be

affected by the implementation of remaining streetlight retrofit projects. To determine this, staff intersected committed jurisdictions with outstanding retrofit projects intersected with LIDAC census block groups. The share of LIDAC census block groups within these project areas was calculated at 101 out of 498 census block groups.

Key Assumptions

The business-as-usual scenario includes two key assumptions regarding electricity consumptions. First, it assumes electricity consumption will remain at 2022 levels through 2050. Second, it assumes streetlights in committed jurisdictions outside of Shelby County consume the same amount of electricity as those installed in Shelby County.

This analysis assumes all lighting in the business-as-usual scenario is HPS luminaries and that these lights will be replaced on a one-to-one ratio with LED bulbs. Additionally, it assumes the average HPS bulb in the Phoenix analysis and LOLs are approximately equivalent to standard streetlights in energy consumption and retrofitting requirements. The analysis does not distinguish between streetlights and LOLs even though LOLs are often larger and require more electricity (on average). This is primarily due to many jurisdictions/utilities not distinguishing between the two categories. In the absence of a full streetlight inventory from all committed jurisdictions, the analysis calculated a system average HPS rating of 250 watts to be replaced by a 125-watt LED equivalent.

This analysis includes projected emissions factors calculated using data from the EIA, and as a result, the GHG savings drop over time to account for the following assumption: as a higher proportion of electricity generated by renewable energy enters the electrical grid, the carbon intensity of the grid will decline. If the grid does not diversify as quickly as the EIA projections indicate, the GHG reductions achieved by this action will be significantly greater in the later years.

Data Sources

Streetlight & LOL counts/composition & retrofit statuses:

- Bakken, Bob. (2022). *Southaven streetlights being switched to LED lighting*. Retrieved December 14, 2023, from DeSoto County News: https://desotocountynews.com/desoto-county-news/southaven-street-lights-being-switched-to-led-lighting/
- Cree Lighting. (2016). *Town of Somerville*. Retrieved December 15, 2023, from https://creelighting-canada.com/case-study/town-of-somerville/
- Franklin, William. (2023, December 27). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.
- Gates, Brad. (2023, December 4). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.
- Henson, April. (2024, January 3). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.
- Memphis Light, Gas and Water (MLGW). (2017). *Facts & figures for year ending December 31, 2016*. Retrieved December 12, 2023, from http://www.mlgw.com/images/content/files/pdf/Facts%20%26%20Figures%202017.pdf
- MLGW. (2023). *Memphis LED Upgrade Program*. Accessed December 12, 2023, from https://awpmentgis.teamworx.com/portal/apps/sites/#/memphis-led-upgrade-program

- Russell, Michael. (2023, December 19). Personal communication to Robin Richardson, Memphis-Shelby County Office of Sustainability and Resilience.
- Standridge, Rhonda. (2024, January 25). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

Total electricity consumption by lighting in Shelby County:

- MLGW. (2020). *2019 Annual Report*. Retrieved December 12, 2023, from About / Annual Report: https://www.mlgw.com/about/annualreport
- MLGW. (2021). *2020 Annual Report*. Retrieved December 12, 2023, from About / Annual Report: https://www.mlgw.com/about/annualreport
- MLGW. (2022). *2021 Annual Report*. Retrieved December 12, 2023, from About / Annual Report: https://www.mlgw.com/about/annualreport
- MLGW. (2023). *2022 Annual Report*. Retrieved December 12, 2023, from About / Annual Report: https://www.mlgw.com/about/annualreport

Projections of the Cost of Electricity and Electricity Consumption: U.S. Energy Information Administration. (2023). *Annual Energy Outlook 2023, Reference Case Table 8. Electricity Supply, Disposition, Prices, and Emissions*. Retrieved December 12, 2023, from https://www.eia.gov/outlooks/aeo/tables_ref.php

Maintenance and Replacement Costs for HPS and LED Lighting: Silsby, Shane L. (2013). *HPS to LED conversion: A City of Phoenix experience*. Retrieved December 28, 2023, from https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/silsby_msslc-phoenix2013.pdf

Carbon Dioxide Emissions Projections: U.S. Energy Information Administration. (2023). *Annual Energy Outlook 2023, Reference Case Table 18. Energy-Related Carbon Dioxide Emissions by Sector and Source*. Retrieved December 12, 2023, from https://www.eia.gov/outlooks/aeo/tables_ref.php

High Pressure Sodium to LED Conversion Calculator: https://www.accessfixtures.com/hps-to-led-calculator/ Accessed on December 28, 2023.

REDUCTION MEASURE E.2: LOCAL GOVERNMENT ENERGY AUDITS AND RENEWABLE ELECTRICITY INSTALLATIONS

Quantification Methods

GHG Reduction Potential

Staff gathered some average energy efficiency upgrade numbers from PATH Company, LLC, a local contractor working on energy efficiency upgrades for many of the committed jurisdictions. These figures included average size of a municipal building in square feet, average energy savings per building in thousands of British thermal units (kBtu), and average upgrade cost. Staff converted the average energy savings from kBtu to megawatt-hours and then calculated the amount of GHG emissions reductions using EIA projected emissions rates from electricity consumption through 2050.

The Office of Sustainability and Resilience conducted an analysis of all the existing comprehensive and capital improvement plans for each jurisdiction. Staff also sent out a survey requesting potential projects to be included in the climate action plan. Staff used information from these two sources as well as knowledge of specific solar projects to compile a list of potential solar projects over the next 15 years. Staff then either calculated the available square feet on the identified parcel or estimated electricity generation needed to power the identified building to estimate annual electricity generation in kWh and then converted that to estimated megawatts (MW) of capacity needed. Staff then calculated the GHG emissions reductions using the MW capacity and a standard emissions factor.

Cost Evaluation

Staff used a previous cost estimate for conducting an

energy audit and solar feasibility assessment of the 165 Shelby County government buildings as a basis for determining the approximate cost to conduct energy audits for all committed jurisdictions. It does not account for jurisdictions that have already conducted energy audits on a portion of or all of their buildings.

Staff used the average cost per municipal building ($57,500) and multiplied it by the number of buildings the target aims to retrofit by 2030.

Staff calculated the average cost of installing solar by using a mid-range estimate of $3.75/watt and multiplied that by the estimated watt-capacity needed for each identified solar project.

Criteria and Hazardous Air Pollutants Reduction Potential

The Clean Air Act regulates criteria and hazardous air pollutants. These pollutants have significant impacts on public health and include the following gases: ozone, particulate matter 2.5 (PM2.5), carbon monoxide (CO), nitrogen oxide (NOx), and volatile organic compounds (VOC). When applicable throughout the reduction measures, staff researched and estimated potential reductions in the year 2030. Staff used the EPA's AVoided Emissions and geneRation Tool (AVERT) Web Edition to estimate the potential reductions in criteria and hazardous air pollutants in 2030. Staff ran the tool using the Tennessee independent electricity region, due to this region supplying an estimated 70 percent of electricity to the Memphis MSA. Staff input the estimated reductions in total annual generation from energy efficiency upgrades to municipal buildings in 2030. Staff also included total expected capacity of distributed solar photovoltaic in 2030, based on the reduction measure targets.

LIDAC Analysis

This reduction measure does not have any direct impact on LIDAC census block groups; however, there is the potential to have several indirect impacts based on how local governments choose to spend utility bill savings. While energy efficiency upgrades and installation of renewable electricity will result in reductions in criteria and hazardous air pollutants, those reductions will be seen in the communities with fuel-burning power plants. Without knowledge of the exact source of all electricity consumed by the Memphis MSA, we cannot provide location-based estimates.

Key Assumptions

The cost evaluation for energy audits is dependent on assuming the amount of municipal buildings is directly proportional to the population of the jurisdiction.

This reduction measure assumes the average municipal building is 20,000 square feet and the average savings per building will be 200,000 kBtu. Staff received these estimates from a local contractor experienced in conducting energy efficiency upgrades in municipal buildings throughout the Mid-South region. They also provided a cost estimate range per building, which Office of Sustainability and Resilience staff took the midpoint of $57,500 to include as the average cost per building.

The analysis of GHG reductions from energy efficiency upgrades includes projected emissions factors calculated using data from the EIA, and as a result, the GHG savings drop over time to account for an assumption that the electrical grid will be less carbon intensive as more renewable energy generates electricity. If the grid does not diversify as quickly as the EIA projections indicate, the GHG reductions achieved by this action will grow in the later years.

This reduction measure assumes all renewable energy installations will be solar arrays. Staff chose this assumption due to the large amount of data on solar installations and lack of knowledge on costs of installing wind or biogas collection systems.

While the energy efficiency upgrades analysis includes emissions factors improving over the years, the emissions reductions from the installation of solar arrays is based

off a static emissions factor. Staff calculated the static emissions factor using the AVERT Web Edition based on the Tennessee data from the Emissions and Generation Resource Integrated Database. Input data for the tool included average annual MW generation capacity of solar provided by Memphis Light, Gas and Water (MLGW). The assumption for this measure is that installation of solar will change the composition of electricity generated, and staff did not have information available on what that impact would be.

Data Sources

Average Cost and Savings from energy efficiency upgrades: Franklin, William. (2024, February 1). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

Projections of the Cost of Electricity and Electricity Consumption: U.S. Energy Information Administration. (2023). *Annual Energy Outlook 2023, Reference Case Table 8. Electricity Supply, Disposition, Prices, and Emissions*. Retrieved December 12, 2023, from https://www.eia.gov/outlooks/aeo/tables_ref.php

Average Solar Generation Capacity & Cost: Williamson, Becky. (2023, June 2). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

Solar Installation Emissions Factors: AVERT Web Edition: https://www.epa.gov/avert/avert-web-edition (accessed February 1, 2024)

REDUCTION MEASURE R.1: LOW-INCOME RESIDENTIAL ENERGY EFFICIENCY RETROFITS

Quantification Methods

GHG Reduction Potential

The project team calculated the reduction potential for GHG emissions using a 30 percent reduction in energy consumption for both electricity and natural gas in residential settings. The calculation began with 2019, the year of our baseline inventory, and calculated the amount of emissions avoided by the reduction in energy consumption for households served by energy efficiency and weatherization programs. For each subsequent year, this 30 percent reduction is calculated for the cumulative number of low-income households served by energy efficiency and weatherization programs, adding new households each year as part of the implementation path.

The amount of emissions avoided incorporated the emissions both from electricity and natural gas. Future emissions factors for these sources of energy came from the EIA. The net greenhouse gas emissions reduction is in metric tons of carbon dioxide equivalent.

Cost Evaluation

Our evaluation of costs for this reduction measure was based on historic investments in energy efficiency and weatherization projects in the Memphis MSA, as well as average household utility bills. The first part of the calculation was an average based on data staff found regarding typical project costs for completed projects in 2019. Due to data limitations, this average was based on project costs in Tennessee (see Key Assumptions below).

The costs of the reduction measure also incorporated the energy costs for low-income households, as reducing the amount of energy burden is one of the indirect goals. Staff calculated this amount by computing the difference between projected energy costs without energy efficiency upgrades and projected energy costs following upgrades. Yearly energy expenditures used projections provided by the EIA for the future costs in electricity and natural gas. Consumption data per household for each year represented in the measure was calculated using average energy consumption data from the EIA for households in the South and comparing the data with the Memphis MSA's total energy consumption and the proportion of households in the MSA who would qualify as low-income.

Additionally, staff incorporated $1 million per year until 2050 in funding for workforce development into the estimates. This number could include student tuition costs to facilities like Moore Tech College of Technology, student outreach programs, and funding for instructors and/or mentorship programs.

Criteria and Hazardous Air Pollutants Reduction Potential

The Clean Air Act regulates criteria and hazardous air pollutants. These pollutants have significant impacts on public health and include the following gases: ozone, particulate matter 2.5 (PM2.5), carbon monoxide (CO), nitrogen oxide (NOx), and volatile organic compounds (VOC). When applicable throughout the reduction measures, staff researched and estimated potential reductions in the year 2030.

Staff did not estimate the potential for criteria and hazardous air pollutants reduction for this measure. The greatest potential for reducing these pollutants for this measure comes from reducing (or eliminating) natural gas usage in residential settings. Making the switch from natural gas to electricity, especially switching the energy source for an entire house versus for an appliance, can be quite expensive. Not many energy efficiency and weatherization projects will allow switching of fuel types, and when they do, they typically only allow it on a case-by-case basis. Additionally, feedback from the stakeholders regarding the reduction or elimination of natural gas informed the project team that incorporating full electrification into the recommendations would encounter significant community resistance.

LIDAC Analysis

Staff assumed all LIDAC groups within our committed jurisdictions will benefit from this reduction measure, as the programs proposed are geared specifically toward low-income households. Additionally, staff expects some low-income households who do not live in LIDAC census block groups will benefit from the programs described in this reduction measure.

Key Assumptions

The project team made several assumptions in order to enable the calculation of the quantification methods described above. The first assumption is regarding historical documentation of energy efficiency and weatherization projects completed in the Memphis MSA in 2019. In their research, staff did not find information about projects completed in Arkansas and Mississippi jurisdictions in the Memphis MSA. While they were able to find proposed budgets for the versions of the Weatherization Assistance Program administered by the Arkansas Department of Environmental Quality and the Mississippi Department of Environmental Quality, staff could not find documentation of how many projects were completed in the Arkansas and Mississippi counties, nor how much those projects costed. The calculations assume the data we did have available regarding the Tennessee jurisdictions would be applicable to the rest of the MSA. Staff also assumed that since they were unable to find information regarding the completion of energy efficiency and weatherization projects in Arkansas and Mississippi for 2019, projects in these counties in the MSA were not completed.

Staff also assumed a ten-year standard life cycle for residential energy efficiency measures. Energy efficiency measures can have a wide range of life cycles, depending on the scale of the work completed. Additionally, the efficacy of some measures, such as energy efficient appliances, can decline over time as appliances age and need additional maintenance. The ten-year assumption served as an average lifespan for any energy efficiency measure.

Finally, the yearly amount of increase in homes served in order to achieve the implementation goal of a 500 percent increase from 2019 estimates assumes a constant increase since 2019. This was not the case; the beginning of the 2019 novel coronavirus pandemic in 2020 led to delays in project completion and likely impacted the number of homes served.

Data Sources

Moore Tech College of Technology. *Retrofit Installer Technician* (*Weatherization*). Retrieved from https://www.mooretech.edu/retrofit-installer-technician-weatherization.

Shelby County Department of Housing. (2020). *Program Year 2019 Consolidated Annual Performance and Evaluation Report*. Retrieved from https://shelbycountytn.gov/DocumentCenter/View/38448/1-CAPER_PY-19--

Tennessee Housing Development Agency. (2019). *Investments & Impacts*. Retrieved from https://thda.org/pdf/2019-Investments-and-Impacts_Final.pdf.

U.S. Census Bureau. (2019). *American Community Survey, 5-Year Estimates: S1101 Households and Families*. Retrieved from https://data.census.gov/table/ACSST5Y2019.S1101?g=310XX00US32820&y=2019.

U.S. Census Bureau. (2019). *American Community Survey, 5-Year Estimates: S1903 Median Income in the Past 12 Months* (*in 2019 Inflation-Adjusted Dollars*). Retrieved from https://data.census.gov/table/ACSST1Y2019.S1903?g=310XX00US32820&y=2019.

U.S. Census Bureau. (2019). *American Community Survey, 5-Year Estimates: S2503 Financial Characteristics*. Retrieved from https://data.census.gov/table/ACSST5Y2019.S2503?g=310XX00US32820&y=2019.

U.S. Energy Information Administration. (2019). *Annual Energy Outlook 2019, Reference Case Projection Table 2: Energy Consumption by Sector and Source*. Retrieved from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=2-AEO2019&cases=ref2019&sourcekey=0.

U.S. Energy Information Administration. (2019). *Annual Energy Outlook 2019, Reference Case Projection Table 3: Energy Prices by Sector and Source*. Retrieved from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2019&cases=ref2019&sourcekey=0.

U.S. Energy Information Administration. (2019). *Annual Energy Outlook 2019, Reference Case Projection Table 13: Natural Gas Supply, Disposition, and Prices*. Retrieved from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=13-AEO2019&cases=ref2019&sourcekey=0.

U.S. Energy Information Administration. (2023). T*able CE1.4 – Summary annual household site consumption and expenditures in the South – totals and intensities, 2020*. Retrieved from https://www.eia.gov/consumption/residential/data/2020/c&e/pdf/ce1.4.pdf.

Williamson, Becky. (2022, June 27). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience.

REDUCTION MEASURE T.1: ENHANCE PUBLIC TRANSIT

Quantification Methods

GHG Reduction Potential

This reduction measure calculated the amount of reduction in GHG emissions resulting from the conversion of diesel buses to battery electric buses as well as reducing personal vehicle trips due to increased frequency of buses along routes. Because diesel buses produce more GHGs per mile than passenger cars, a sufficient number of passenger vehicle trips must be eliminated to compensate for the increased bus GHG emission rate. To calculate the business-as-usual scenario, staff used bus vehicle miles travelled and annual vehicle passenger miles obtained from the National Transit Database specific to the Memphis Area Transit Authority (MATA) for the years 2019 through 2022. The bus vehicle miles traveled (VMT) was assumed to grow at the level of bus VMT growth in the *Shelby County Air Quality Conformity Demonstration*. Staff calculated bus vehicle emissions rates using the bus emissions factor generated by the US Environmental Protection Agency (EPA)'s MOtor Vehicle Emission Simulator (MOVES) and the bus passenger miles travelled and energy consumption

forecasts from the EIA. The project team estimated passenger vehicle emissions rates using the average personal vehicle fuel consumption forecasts from the EIA. Transit Vision envisions an increase of 165,000 bus revenue hours through the implementation of this program.

It is assumed bus VMT would increase by the same percentage as the increase in revenue hours of 44 percent. In this analysis, staff assumed the increased bus service to start in 2024, with a 5 percent increase in bus VMT, with the full 44 percent VMT increase achieved by 2030 and thereafter. Additionally, the calculations assume 79 electric buses added to the vehicle fleet by 2030, replacing existing diesel buses. By 2034, the entire bus fleet is assumed to be electric, as detailed in the *Zero Emissions Fleet Transition Plan*. The project team assumed the VMT from these electric buses would replace an equivalent amount of VMT from diesel buses.

The increase in bus passenger miles was assumed to be double the percentage increase in bus revenue miles. This increase in bus passenger miles is due to the implementation of the Memphis 3.0 Transit Vision was then converted to a reduction in passenger vehicle VMT by dividing the increase in bus passenger miles by an estimate of the average vehicle occupancy for Shelby County of 1.79 persons per vehicle.

The GHG emissions savings from this scenario included the GHG emission reductions achieved by the reduced passenger vehicle VMT, added to the GHG emissions from the increased bus VMT. Staff calculated the portion of the bus VMT provided by electric buses by multiplying that portion of the VMT by the EIA projected emissions rates from electricity consumption through 2050.

Cost Evaluation

The Office of Sustainability and Resilience received project cost estimates from MATA for the capital projects. Estimated project cost is for remaining unstarted projects and does not include charging stations needed along bus corridors. It only includes the cost to purchase buses and to construct a new operations and maintenance facility. The estimate for operations costs comes from initial reports and presentations made about the Memphis 3.0 Transit Vision and is multiplied by the number of years from now until 2050. Staff then adjusted for inflation the 2019 cost projections into 2022 dollars, as applicable.

Criteria and Hazardous Air Pollutants Reduction Potential

The Clean Air Act regulates the criteria and hazardous air pollutants. These pollutants have significant impacts on public health and include the following gases: ozone, particulate matter 2.5 (PM2.5), carbon monoxide (CO), nitrogen oxide (NOx), and volatile organic compounds (VOC). When applicable throughout the reduction measures, staff researched and estimated potential reductions in the year 2030.

To calculate the criteria and hazardous air pollutant reductions in 2030, staff multiplied the projected VMT for electric buses by an average emissions factor for model year 2018 diesel buses based on the EMFAC2017 software by the California Air Resources Board (CARB). Staff then multiplied the expected reductions in VMT from passenger vehicles by the 2017 average auto emission factors for fleet of light-duty passenger vehicles generated from the EMFAC2017 software. Both sets of emissions factors assume an average temperature of 75°F and 50 percent relative humidity. Staff added together both sets of numbers to calculate the cumulative number of estimated emissions reductions in the year 2030 from implementation of this reduction measure.

LIDAC Analysis

Although MATA services are limited to primarily to the City of Memphis, within the first five years of project rollout, 23 percent of LIDAC census block groups within committed jurisdictions will be located within ¼ mile of an electric bus route. By 2050, impacted LIDAC census block groups increase to 77 percent.

To calculate LIDAC impacts by 2035, a ¼ mile buffer was place around the three battery electric bus (BEB) routes currently planned for rollout. Any LIDAC groups that intersected with these buffers are considered impacted. The same process was used to calculate LIDAC impacts by 2050, but a buffer was placed around all existing bus routes planned to run using BEBs.

Key Assumptions

The increase in bus VMT and bus ridership was based on the expected increase in bus revenue hours. Actual changes in ridership could vary significantly.

Staff based the projected cost estimates on current estimates from MATA and do not account for inflation. It is likely the actual cost will fluctuate with some costs going down as heavy-duty electric vehicle technology improves and some costs rising due to inflation and rising rates for construction and materials. Additionally, the cost analysis, does not fully include net costs estimates and potential savings on fuel costs as the fleet switches from diesel to electric.

Data Sources

MATA bus revenue miles, passenger miles, unlinked trips, and bus revenue hours of service:

- Federal Transit Administration. (2020). *Memphis area transit authority 2019 annual agency profile*. National Transit Database. Retrieved December 29, 2023, from https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2019/40003.pdf
- Federal Transit Administration. (2021). *Memphis area transit authority 2020 annual agency profile*. National Transit Database. Retrieved December 29, 2023, from https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2020/40003.pdf
- Federal Transit Administration. (2022). *Memphis area transit authority 2021 annual agency profile*. National Transit Database. Retrieved December 29, 2023, from https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2021/40003.pdf
- Federal Transit Administration. (2023). *Memphis area transit authority 2022 annual agency profile*. National Transit Database. Retrieved December 29, 2023, from https://www.transit.dot.gov/sites/fta.dot.gov/files/transit_agency_profile_doc/2022/40003.pdf

Bus VMT projected growth rate: Memphis Metropolitan Planning Organization. (2022). *Air Quality Conformity Demonstration for the Fiscal Year 2023-2026 Transportation Program (TIP) and Amendments to the Livability 2050 Regional Transportation Plan (RTP): Shelby County, Tennessee*. Retrieved December 19, 2023, from https://memphismpo.org/plans/transportation-improvement-program-tip/fy-2023-26-transportation-improvement-program-tip

Emission factors: United States Environment Protection Agency, Office of Transportation and Air Quality. MOtor Vehicle Emission Simulator: MOVES4 (2023). Retrieved from https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

Bus passenger miles travelled and energy use forecasts: U.S. Energy Information Administration. (2020). *Annual Energy Outlook 2020, Reference Case Table 7. Transportation Sector Key Indicators and Delivered Energy Consumption*. Retrieved December 20, 2023, from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=7-AEO2020&region=0-0&cases=ref2020&start=2018&end=2050&f=A&linechart=ref2020-d112119a.48-7-AEO2020~ref2020-d112119a.11-7-AEO2020~ref2020-d112119a.64-7-AEO2020&ctype=linechart&chartindexed=0&sourcekey=0

Average Personal Vehicle Fuel Consumption: U.S. Energy Information Administration. (2020). *Annual Energy Outlook 2020, Reference Case Table 40. Light-Duty Vehicle Miles per Gallon by Technology Type*. Retrieved December 20, 2023, from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=50-AEO2020&sourcekey=0

Schedule and cost for Electric Bus Acquisition: Memphis Area Transit Authority. (2022). *Zero Emissions Fleet Transition Plan*.

Projections of the Cost of Electricity and Electricity Consumption: U.S. Energy Information Administration. (2023). *Annual Energy Outlook 2023, Reference Case Table 8. Electricity Supply, Disposition, Prices, and Emissions*. Retrieved December 12, 2023, from https://www.eia.gov/outlooks/aeo/tables_ref.php

Cost estimates for capital projects: Smith, Jordan. (2024). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. January 12, 2024.

Emissions factors for criteria and hazardous air pollutants: California Air Resources Board. (2019). *Methods to Find the Cost-Effectiveness of Funding Air Quality Projects: Emission Factor Tables September 2019*. Retrieved January 9, 2024, from https://ww2.arb.ca.gov/sites/default/files/2020-06/Congestion_Mitigation_Air%20_Quality_Improvement_Program_emission_factor_tables_sept2019.pdf

REDUCTION MEASURE T.2: CONNECTED GREENWAYS NETWORK

Quantification Methods

GHG Reduction and Criteria and Hazardous Air Pollutants Reduction Potential

Emission reduction estimates for this reduction measure are based on CARB's *Quantifying Reductions in Vehicles Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks,* April 2019. This method uses factors like the length of a given project, the average bike trip length, and annual average daily traffic (AADT) on a parallel road to estimate VMT reductions. The state Departments of Transportation of Arkansas, Mississippi, and Tennessee publicly list AADT data and the project team retrieved it. Staff obtained average bike trip length from the Federal Highway Administration's National Household Travel Survey. This method also includes a credit for activity center proximity, but no research has been done at this time for calculations to include said credit. Staff verified and/or updated the construction status of greenways and on-street segments using Google Earth imagery and Google Earth Street View.

Staff used the EPA's MOVES tool to derive the passenger vehicle emission rates for GHGs and Criteria and Hazardous Air Pollutants using Shelby County data, assuming Shelby County as a representative for the region. Staff applied the rates to all greenway and on-street segments. Emission rate growth factors were calculated using data on energy use by mode in British thermal units (Btu), a measurement of a fuel's heat content, and passenger miles traveled from the EIA.

In order to determine estimated reductions per year, staff developed a proposed construction schedule. The construction schedule starts at a central point of Shelby County and moves out in 5-mile increments. The segments that intersected with each buffer were then assigned a 5-year period as follows: 5-mile buffer: 2025-2030; 10-mile buffer: 2031-2035; 15-mile buffer: 2036-2040; 20-mile buffer: 2041-2045; 25+ miles: 2046-2050. Staff then assigned all segments an individual year within their 5-year periods, with consideration given to segments highlighted in the Greenprint Network Development Proposal.

Cost Evaluation

Staff used a cost estimate for the construction of multi-use trails and on-street bike lanes developed in the *Mid-South Regional Greenprint Plan* to estimate the remaining project cost for this reduction measure. The remaining project cost only accounts for construction costs of $979,548.88 per mile of multi-use trail and $167,670.53 per mile of on-street bike lane (adjusted from 2014 $ to 2022 $). The total project cost does not include routine maintenance or additional infrastructure costs.

LIDAC Analysis

By incorporating the Greenprint with projects identified by committed jurisdictions outside of the plan's original scope, this reduction measure will affect 59.5 percent of

LIDAC census block groups. Any disadvantaged census block group located within ¼ mile of a planned greenway is considered impacted.

Key Assumptions

This analysis assumes there will be a mode shift from auto commuting trips to bike and pedestrian commuting trips. Multi-use trails are often used recreationally so there is no guarantee this measure will reduce personal vehicle trips.

In the quantification of emissions reductions, Shelby County is assumed as the representative county for the region. Emission factors were calculated using Shelby County data and assigned to all segments in the network's region.

The emission reduction calculations for 2025-2050 assume the construction timeline will be built out as planned. The real emission reduction amounts are subject change as it is not guaranteed the timeline will be followed as scheduled.

Using CARB's equation to quantify VMT reduction from new bike infrastructure projects required multiple assumptions. The equation uses a default value of 200 days of use per year to account for behavioral change impacted by weather. Additionally, the average bike trip length is a national average which may not accurately reflect the Mid-South region's average bike trip length.

Data Sources

Average bicycle trip length: U.S. Department of Transportation, Federal Highway Administration. (2022). 2022 National Household Travel Survey, 2022 Survey Data. Retrieved from https://nhts.ornl.gov/

VMT Reduction equation: California Air Resources Board (2019). *Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks;* Section B: Existing Quantification Method. Retrieved from https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/bicycle_facilities_technical_041519.pdf

Tennessee AADT: Tennessee Department of Transportation, Tennessee Traffic Information Management and Evaluation System. Traffic Count Database System (2022). Retrieved from https://tdot.public.ms2soft.com/tcds/tsearch.asp?loc=Tdot&mod=TCDS

Mississippi AADT: Mississippi Department of Transportation, MDOT Traffic County Application (2022). Retrieved from https://mdot.ms.gov/portal/traffic_volume/

Arkansas AADT: Arkansas Department of Transportation, Traffic Information Systems. Interactive ADT Web APP (2022). Retrieved from https://gis.ardot.gov/portal/apps/webappviewer/index.html?id=7c81a313f4174b99b2a01713c328bb7a

Emission factors: United States Environment Protection Agency, Office of Transportation and Air Quality. MOtor Vehicle Emission Simulator: MOVES4 (2023). Retrieved from https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

Information on segment construction status:

- Google LLC, Google Earth V 10.45.0.3 (2023). Retrieved from https://earth.google.com/web/@35.12848249,-89.94175295,130.70848129a,171910.68568887d,35y,0h,0t,0r/data=OgMKATA
- Wolf River Conservancy, Interactive Map (2024). Retrieved from https://www.wolfriver.org/map
- Big River Park Conservancy, Big River Trail. Retrieved from https://www.bigrivertrail.com/

Estimate of the cost of multi-use trails and bike lanes: Shelby County Government. (2014). *Mid-South Regional Greenprint and Sustainability Plan*. Pg. 108. Retrieved from https://memphismpo.org/resources/projects/greenprint-plan

Emission Factor growth rate: US Energy Information Administration (2020). Annual Energy Outlook 2020, *Table 7. Transportation Sector Key Indicators and Delivered Energy Consumption*. Retrieved from https://www.eia.gov/

outlooks/aeo/data/browser/#/?id=7-AEO2020&region=0-0&cases=ref2020&start=2018&end=2050&f=A&linechart=ref2020-d112119a.48-7-AEO2020~ref2020-d112119a.11-7-AEO2020~ref2020-d112119a.64-7-AEO2020&map=&ctype=linechart&chartindexed=0&sourcekey=0

APPENDIX 3: UNIVERSITY OF MEMPHIS STAKEHOLDER ENGAGEMENT REPORT

The University of Memphis stakeholder engagement report starts on the following page.

Stakeholder Views on Climate Pollution Reduction Measures for the Mid-South Priority Climate Action Plan

Prepared by:
Stephen Kofi Diko (PhD)
Truus Apoanaba Abuosi

Date:
February 2024

Office of Sustainability and Resilience
MEMPHIS AND SHELBY COUNTY

THE UNIVERSITY OF MEMPHIS

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Background

The Memphis and Shelby County Division of Planning and Development's Office of Sustainability and Resilience (OSR) collaborated with the University of Memphis Department of City and Regional Planning to complete stakeholder engagement activities for the Mid-South Priority Climate Action Plan (PCAP). The PCAP is one of the deliverables of the climate action planning processes under the EPA's Climate Pollution Reduction Grant (CPRG). The engagement process collected the views of stakeholders from different organizations in the Mid-South Region to understand the climate risks and vulnerability of their jurisdictions and identify priority actions that can contribute to building resilience by reducing climate pollution (or greenhouse gas (GHG) emissions).

The stakeholder engagement process relied on the existing leadership and partnerships of the OSR to reach out to stakeholders of the Mid-South Region. This included stakeholders who agreed to be part of the OSR's CRPG as well as other organizations interested in building resilience in the Mid-South Region.

The Mid-South PCAP engagement process involved three online workshops and a Delphi-informed technique that comprised three separate online surveys with stakeholders of the various jurisdictions in the Mid-South Region. This engagement approach was a rapid assessment technique that allowed for rapid feedback on climate priority actions from stakeholders of the various Mid-South Region. Additionally, this approach was appropriate due to the limited time to engage stakeholders in the Mid-South Region. Stakeholders were mostly institutions and/or organizations. The stakeholder engagement process was led by Stephen Kofi Diko (PhD), an Assistant Professor at The University of Memphis Department of City and Regional Planning.

This report constitutes the findings from the three separate online surveys with stakeholders.

The Engagement Process

Online Workshops

Stakeholders from the Mid-South Region were invited to three online workshops. These workshops were held via the Zoom video conference platform. Workshop One included a presentation by Leigh Huffman, Manager at the OSR, and Dr. Stephen Diko, Assistant Professor at the University of Memphis. Workshop One introduced stakeholders to the CPRG and the Mid-South PCAP engagement process, and what was expected of stakeholders. Specifically, the workshop covered the background of CPRG, CPRG deliverables, project scope, what the OSR aims to do for the Mid-South climate action planning process, the engagement plan, engagement principles, and approach. Workshop One occurred on December 4, 2023, with 61 participants.

Workshop Two was held on January 22, 2024, to share with stakeholders the findings of Surveys One and Two and to get feedback to inform Survey Three. The workshop covered the status of Mid-South CPRG, GHG emissions inventory for the Mid-South Region, progress on stakeholder engagement with a focus on findings from Surveys One and Two, and information about Survey Three. There were 59 participants in this workshop.

Workshop Three took place on February 19, 2024, where the ranking and final set of climate priority actions from the three surveys for the Mid-South PCAP were presented to stakeholders. There were 29 participants in this workshop.

Overview of Surveys

Stakeholders—mostly institutions/organizations— participated in a Delphi-informed approach that comprised a series of three online surveys. The Delphi Technique is:

> "a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this 'structured communication' there is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses."[1]

In this approach, stakeholders from the various jurisdictions in the Mid-South Region were considered to know the climate risks and hazards as well as the priority actions needed to address these risks and hazards for their jurisdictions or areas of operation. It offered the opportunity to build consensus on the various climate priority actions for the Mid-South Region, which some refer to as "situated knowledge."[2] This Delphi approach utilized ratings and rankings to understand stakeholders' climate priorities and actions. The survey was emailed to stakeholders of the jurisdictions involved in the CPRG and resilience planning in the Mid-South Region as well as non-profits in the Mid-South Region listed in an existing database developed by LIVEGIVEmidsouth and available online.[3]

Survey One

Survey One aimed to understand stakeholders' views on the climate risks and hazards, priorities, and actions for their jurisdictions. It was the first step in the stakeholder engagement process to gather stakeholders' views about priority climate risks, hazards, and priorities for the Mid-South PCAP. It comprised four parts:

- Part 1: Questions about climate pollution(s), climate risks, and/or hazards.
- Part 2: Questions about climate priorities and suggestions or recommendations for climate priorities for their jurisdictions.
- Part 3: Questions about climate actions and suggestions or recommendations for climate actions for their jurisdictions.

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[1] Okoli, C. and S.D. Pawlowski. 2004. 'The Delphi method as a research tool: an example, design considerations and applications.' Information & Management, Volume 42 : 1, 15–29. As of 10 June 2021: https://doi.org/10.1016/j.im.2003.11.002

[2] Cunliffe, A.L. and G. Scaratti. 2017. 'Embedding Impact in Engaged Research: Developing Socially Useful Knowledge through Dialogical Sensemaking.' Brit J Manage, 28: 29–44. As of 10 June 2021: https://doi.org/10.1111/1467-8551.12204

[3] LIVEGIVEmidsouth (2021). Analyze Community Data. https://roundtable.livegivemidsouth.org/organizations

- Part 4: Stakeholder background and/or representation.

The questionnaire for Survey One was converted to an online survey using Qualtrics. Stakeholders completed Survey One between December 4, 2023, and December 22, 2023. There was a total of 45 participants in Survey One.

Survey Two

Survey Two furthered the engagement process to build consensus on the priority climate actions for the Mid-South PCAP. Survey Two aimed to identify areas of broad agreement and disagreement based on feedback from Survey One. Stakeholders indicated whether they agreed or disagreed with priority statements grouped under six (6) thematic areas for the Mid-South PCAP. These priorities were mostly informed by climate actions that 56% or more stakeholders indicated as priority actions for their jurisdictions.

- Mid-South Priority GHG Emission Sources
- Mid-South Priority Climate Hazards, Impacts, and Vulnerabilities
- Mid-South Priority Climate Actions on Energy
- Mid-South Priority Climate Actions on Transportation
- Mid-South Priority Climate Actions on Waste
- Mid-South Priority Climate Actions on Government and Business Operations

The questionnaire for Survey Two was also converted to an online survey using Qualtrics and was available for completion by stakeholders between January 4, 2024, and January 17, 2024. There was a total of 57 participants in Survey Two.

Survey Three

Survey Three was the last round of surveys to build consensus on the final set of climate priority actions for the Mid-South PCAP. It aimed to identify areas of broad agreement and disagreement based on a set of seven feasibility criteria. It was made available to stakeholders between January 26, 2024, and February 9, 2024. Similarly, the questionnaire for Survey Three was converted to an online survey using Qualtrics. There was a total of 37 participants in Survey Three. The questionnaires for the three surveys can be found in the Appendix of this report.

The responses from the three surveys were summarized using frequency tables comprising the count and percentages of responses. In addition, bar and pie charts were used to present some of the results.

For Surveys One and Three, additional analysis was conducted. To determine which of the statements about climate priorities and actions from Survey One to use in Survey Two, five categories were identified to select the top actions to address climate pollution reduction and build resilience. These categories represent the percentage of stakeholders' views on statements about climate priorities and actions from Survey One. This analysis resulted in the identification of 26 top priority climate actions for Survey Two.

- Very high priority (70% and above)
- High priority (60% - 69%)
- Medium priority (56 – 59%)

- Some priority (50 – 55%)
- Low priority (40 – 49%),
- Very low priority (39% and below).

For stakeholders to rank the climate priorities in Survey Three, they were asked to share their views on 26 actions based on seven criteria expressed in the form of five-point Likert scale questions:

- Implementation Framework

    1. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?
    2. Would implementing this action have a positive impact on low-income and disadvantaged communities?

- Alignment with Guiding Principles for Implementing Climate Actions

    3. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)
    4. Equity and Environmental (Climate) Justice
    5. Centralizing Reducing GHG emissions
    6. Cost-Effectiveness
    7. Building Climate Pollution and Economy Synergies

The analysis did not include "Do not know" responses. Sentiment scores were estimated for each criterion under each action by calculating the mean scores of the stakeholders' responses. Two measures were then derived from the sentiment scores to help with the ranking of stakeholders' views on the 26 climate actions for Mid-South PCAP. The first measure aggregated the seven sentiment scores for the seven criteria for each action, and the second measure calculated the mean score for the seven sentiment scores for the seven criteria. Both measures yielded the same ranking results.

Analysis of Survey Results

Background of Participants

The survey gathered information on the age, gender, race, and organizational affiliation of representatives of organizations—hereafter referred to as participants. Overall, there were 137 participants in the three surveys. There were a total of 45 participants in Survey One, 55 in Survey Two, and 37 in Survey Three. Most participants were associated with Non-Governmental Organizations (NGOs) or Community-Based Organizations (CBOs) in all three Surveys, followed by participants from Regional and Government Agencies. A smaller percentage of participants were from utility companies, private companies, or businesses. On gender, the majority of participants identified as female, and the majority of participants were White or Caucasian. Table 1 summarizes the participants' background.

Table 1: Background of Participants across the three Surveys

	Survey 1		Survey 2		Survey 3		Total	
Affiliations	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Non-governmental organization (NGO)/ Community-based organization	23	51%	31	56%	17	46%	71	52%
Utilities	1	2%	1	2%	1	3%	3	2%
Private Company/Business	1	2%	2	4%	2	5%	5	4%
Regional and Local Government Agency	19	42%	15	27%	14	38%	48	35%
Community Representative	0	0%	3	5%	2	5%	5	4%
I prefer not to answer	1	2%	0	0%	0	0%	1	1%
Other (specify)	0	0%	3	5%	1	3%	4	3%
Total	45	100%	55	100	37	100	137	100%
Gender	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Male	16	36%	28	51%	12	32%	56	41%
Female	24	53%	25	45%	22	59%	71	52%
Non-binary	1	2%	1	2%	2	5%	4	3%
Prefer not to say	4	9%	1	2%	1	3%	6	4%
Total	45	100%	55	100%	37	100%	137	100%
Age	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
18-24	1	2%	0	0%	0	0%	1	1%
25-34	9	20%	8	15%	8	22%	25	18%
35-44	11	24%	10	18%	9	24%	30	22%
45-54	10	22%	11	20%	5	14%	26	19%
55-64	7	16%	7	13%	10	27%	24	18%
65 and over	3	7%	19	35%	5	14%	27	20%
I prefer not to answer	4	9%	0	0%	0	0%	4	3%
Total	45	100%	55	100%	37	100%	137	100%
Race/Ethnicity	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
American Indian or Alaskan Native	0	0%	0	0%	2	5%	2	1%
Asian / Pacific Islander	2	4%	1	2%	2	5%	5	4%
Black or African American	8	18%	7	13%	4	11%	19	14%
Hispanic	0	0%	2	4%	2	5%	4	3%
White / Caucasian	31	69%	41	75%	24	65%	96	70%
Multiple ethnicity	0	0%	2	4%	2	5%	4	3%
I prefer not to answer	2	4%	2	4%	1	3%	5	4%
Other (please specify	2	4%	0	0%	0	0%	2	1%
Total	45	100%	55	100%	37	100%	137	100%

Where are Participants located?

The majority of participants were from Shelby County in all three Surveys. One reason for this could be the share of the population of the county in relation to the other counties in the Mid-South Region. Tables 2 and 3 provide the location of participants or their areas of operation.

Table 2: Location of Participants by County

	Survey 1		Survey 2		Survey 3		Total	
Counties	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
Crittenden	0	0%	0	0%	1	3%	1	1%
DeSoto	2	5%	0	0%	1	3%	3	2%
Hamilton	0	0%	1	2%	0	0%	1	1%
Jefferson	0	0%	1	2%	0	0%	1	1%
Knox	0	0%	1	2%	0	0%	1	1%
Montgomery	0	0%	2	4%	0	0%	2	2%
Shelby	35	83%	39	76%	32	91%	106	83%
Tate	1	2%	1	2%	1	3%	3	2%
Tunica	1	2%	1	2%	0	0%	2	2%
Multiple Counties	3	7%	5	10%	0	0%	8	6%
Total	42	100%	51	100%	35	100%	128	100%

Table 3: Specific Location of Participants

Survey 1	**Survey 2**	**Survey 2**
Bartlett	Memphis	Horseshoe Lake
Rogers- Legal aid of AR	Arlington, TN	Olive Branch, MS
Germantown	Germantown	Shelby County, TN
Memphis, TN	Millington	City of Germantown
All of Shelby County	Chattanooga	Shelby County, TN
West Memphis, AR	New Market	Memphis
Millington	Farragut, TN	Collierville
Tunica, MS	Clarksville-	City of Senatobia, MS
Senatobia	Senatobia, MS, Tate County, MS	
City of Olive Branch	Tunica, MS	
Hernando, MS	Shelby County and West TN	
Shelby and Desoto Counties	Southeast US Region	
6 counties in TN, MS, AR		
Shelby and Fayette counties		

Survey One Results

Climate Risks and Hazards

Participants answered three (3) questions relating to risks to climate hazards and impacts in their jurisdiction or organization's operational area. On climate hazards, 73% of participants expressed worry about both extreme heat and drought, along with damaging winds. Additionally, 71% indicated concern about extreme cold, ice, or winter weather, while 60% identified tornadoes and 58% associated their worries with flash flooding. On climate-related impacts, 93% of Survey One participants identified power interruptions or blackouts as a significant concern, 89% of participants indicated damage from falling trees as another major concern, while deteriorating infrastructure, wind damage, and flooding were also highlighted as notable impacts. Generally, the predominant climate impact reported by the majority of

participants was power interruption, wind damage and damage from falling trees, deteriorating infrastructure, and flooding. Participants had experienced these climate-related impacts in the past three years. Figure 1 illustrates these findings.

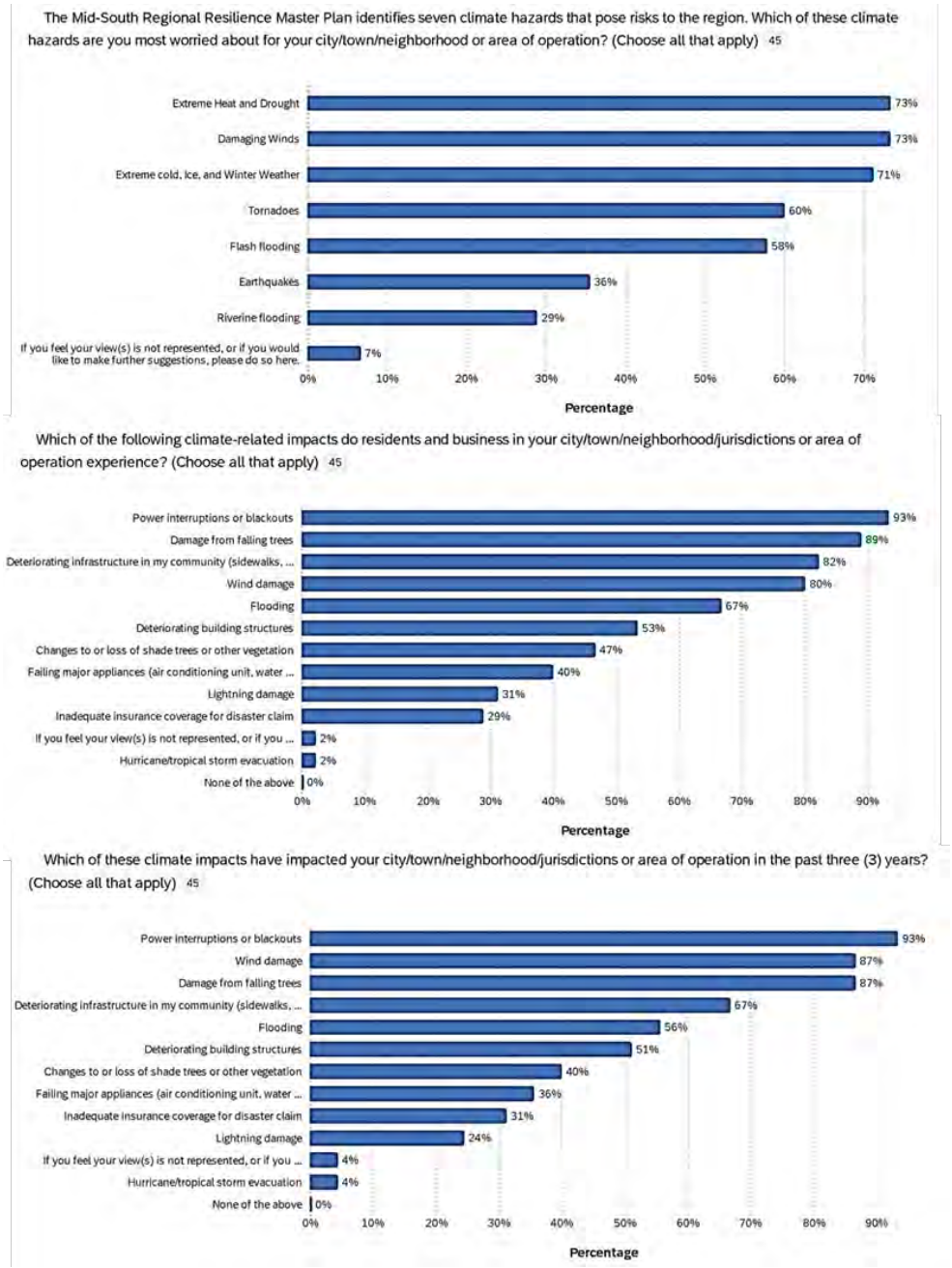


Figure 1: Participants' Views on Climate Hazards and Impacts

The number in the figure title represents the number of participants responding to the question.

Sources of GHG Emissions

Participants were asked to identify climate priorities for reducing climate pollution within their jurisdictions or their areas of operation. These actions covered actions to reduce GHG emissions from energy use in homes and buildings, energy, transportation, landfill waste, water

and sewage treatment plants, government operations, and companies and business operations. Generally, 93% of participants identified the transportation sector as the predominant source of regional GHG emissions. Additionally, 74% of participants identified the industrial sector as a major source of GHG emissions, with 65% of participants highlighting the emissions from the energy sector as well as commercial and residential buildings to be major sources of regional GHG emissions (Figure 2). Additionally, some participants suggested the inclusion of the agriculture sector as a major source of GHG emissions in the Mid-South Region.

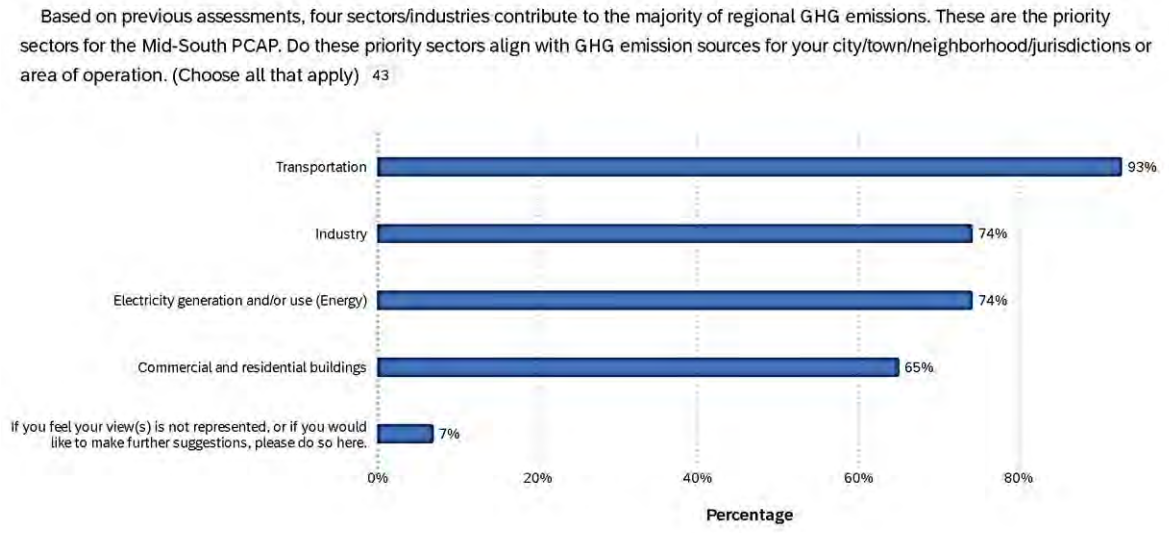


Figure 2: Participants' Views on Sources of GHG Emissions

Climate Priority Actions

In total, there were 86 distinct priority actions presented to participants to choose from, with the additional option of recommending or suggesting priority actions in cases where the options provided do not account for their views. In Survey One, the climate actions were grouped into five categories namely: Very high priority (70% and above), High priority (60% - 69%), Medium priority (56 – 59%), Some priority (50 – 55%), Low priority (40 – 49%), and Very low priority (39% and below). This categorization helped identify a potential set of climate priority actions that formed the basis for consensus building by stakeholders in Survey Two for the Mid-South PCAP.

Twenty-six actions out of the initial 86 were marked as the top climate priorities for the participants. These 26 climate priority actions received 56% or more agreement from the participants—i.e., medium to very high priority according to the categorization.

In the sections that follow on priority actions to reduce climate emissions, this report highlights the climate actions that constitute the top 26 of the 86 climate actions in Survey One.

Priority Actions to Reduce GHG Emissions from Energy

On energy, participants shared their views on priority actions that can reduce energy use in homes and buildings and priority actions that provide the cleanest energy. Six of the climate actions to reduce energy use made it to the top 26. For instance, 78% of participants indicated

that providing incentives for property owners to upgrade their buildings would be an effective strategy to decrease energy consumption in homes and buildings. Also, 71% of participants highlighted the completion of energy-efficiency improvements and the provision of green jobs in disadvantaged communities as a priority action to reduce energy use in residential and commercial buildings. Also, four actions to provide the cleanest energy and contribute to reducing GHG emissions made it to the top 26. For example, 64% of participants identified the installation of solar panels on public buildings, and 62% identified encouraging the installation of solar hot water systems as a priority action. Figure 3 summarizes participants' views of priority actions on energy.

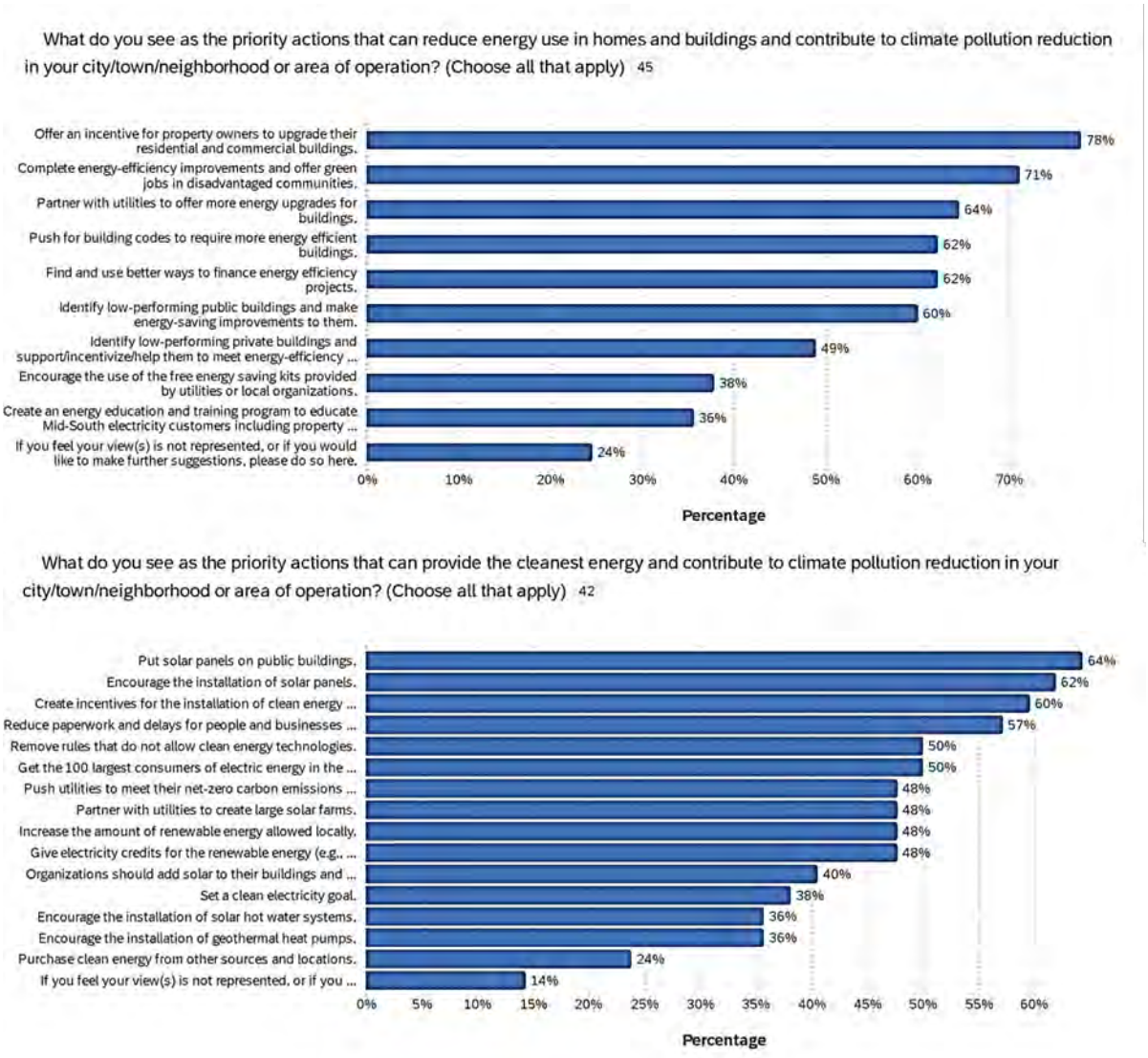


Figure 3: Participants' Views on Actions to Reduce GHG Emissions from Energy

Priority Actions to Reduce GHG Emissions from Transportation

The identified priority actions by participants reveal a comprehensive approach to addressing GHG emissions from transportation via systemic changes in infrastructure and policies to incentivize sustainable transportation choices. Three actions from climate actions to reduce emissions from transportation form part of the top 26 climate actions from participants. These included: the need to establish dedicated funding for public transit (73%), the need to design

the built environment in a way that reduces reliance on driving (64%), and the need to create a network of safe biking and walking paths that traverse the entire town (56%). Figure 4 summarizes participants' views of priority actions to reduce GHG emissions from transportation.

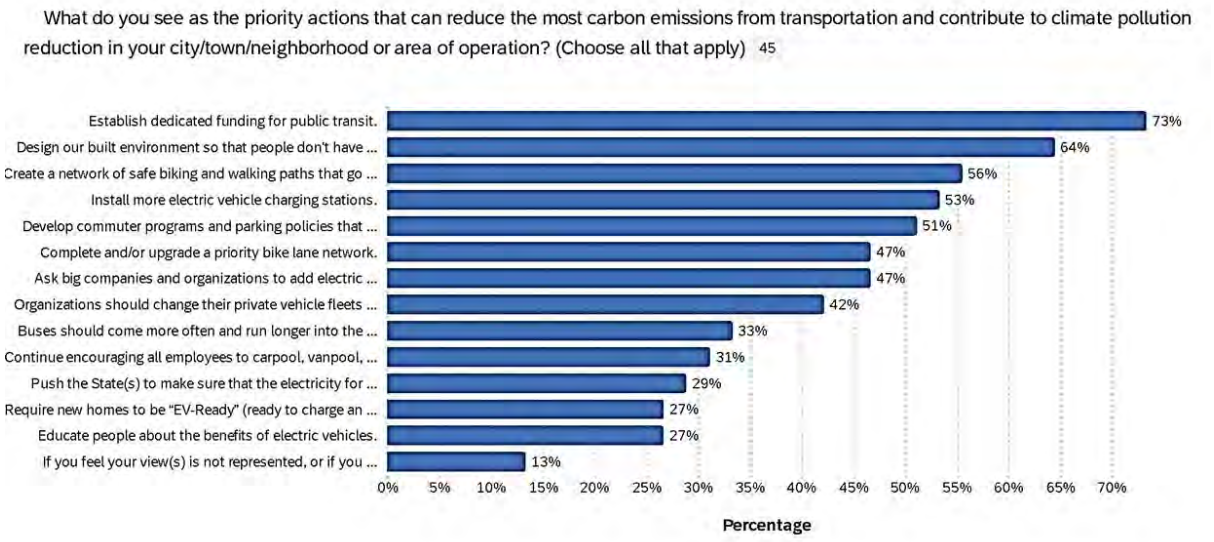


Figure 4: Participants' Views on Actions to Reduce GHG Emissions from Transportation

Priority Actions to Reduce GHG Emissions from Landfill Waste

Figure 5 outlines the priority actions identified by participants to reduce emissions from landfill waste. From the participants, 76% prioritized the requirement for recycling construction and demolition waste, 68% expressed a priority for initiatives aimed at reducing food waste from food-producing businesses, and 63% underscored a broader commitment to sustainable production practices by increasing efforts towards a circular economy and reducing manufacturing emissions. These three actions are part of the top 26 climate actions.

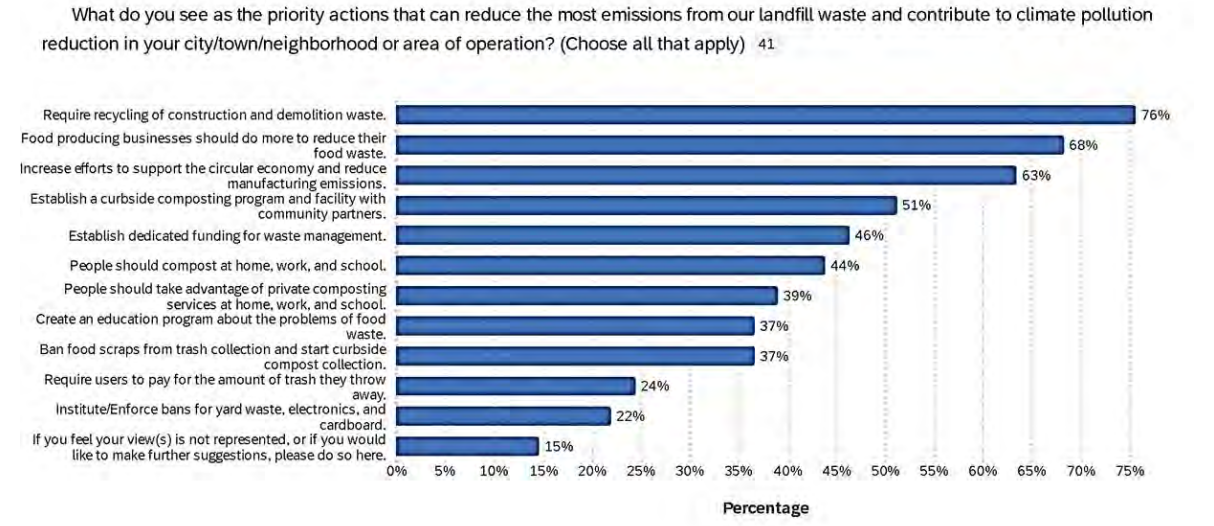


Figure 5: Participants' Views on Actions to Reduce GHG Emissions from Landfill Waste

Priority Actions to Reduce GHG Emissions from Water and Sewage Treatment Plants

To reduce emissions from water and sewage treatment plants, 70% of participants selected the creation of incentives to install water-saving fixtures. This is the only climate action included in the top 26 actions (Figure 6). The emphasis on incentivizing the installation of water-saving fixtures aligns with a broader commitment to sustainable water management practices as such fixtures contribute to reducing water consumption and inefficiencies while minimizing energy use in the energy-intensive processes in water treatment and sewage facilities.

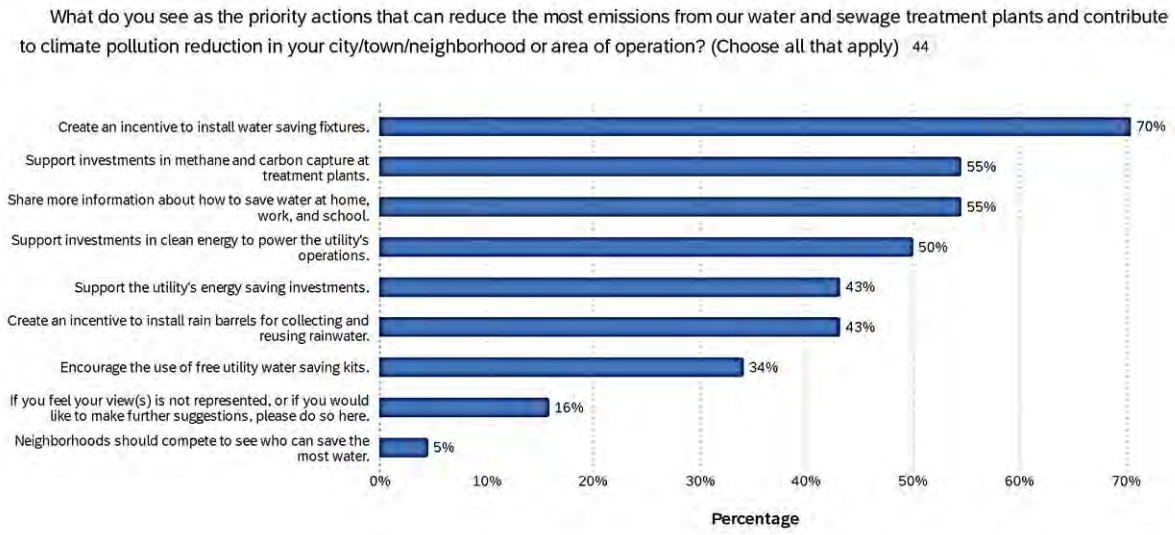


Figure 6: Participants' Views on Actions to Reduce GHG Emissions from Water and Sewage Treatment Plants

Priority Actions to Reduce GHG Emissions from Government and Business Operations

The top actions to reduce GHG emissions from government operations identified by participants were to: plant more trees (62%), adopt new development rules that are better for the environment (62%), and make all new government buildings environmentally friendly and net-zero carbon (60%). For business operations, 65% of participants highlighted the importance of creating incentives for companies and businesses to undertake energy-saving investments, 60% identified contributing to the creation of a low-carbon, climate-resilient, and circular economy as another significant priority, and 56% of participants supported the idea of re-orienting investments towards more sustainable technologies and businesses. Figure 7 summarizes these findings.

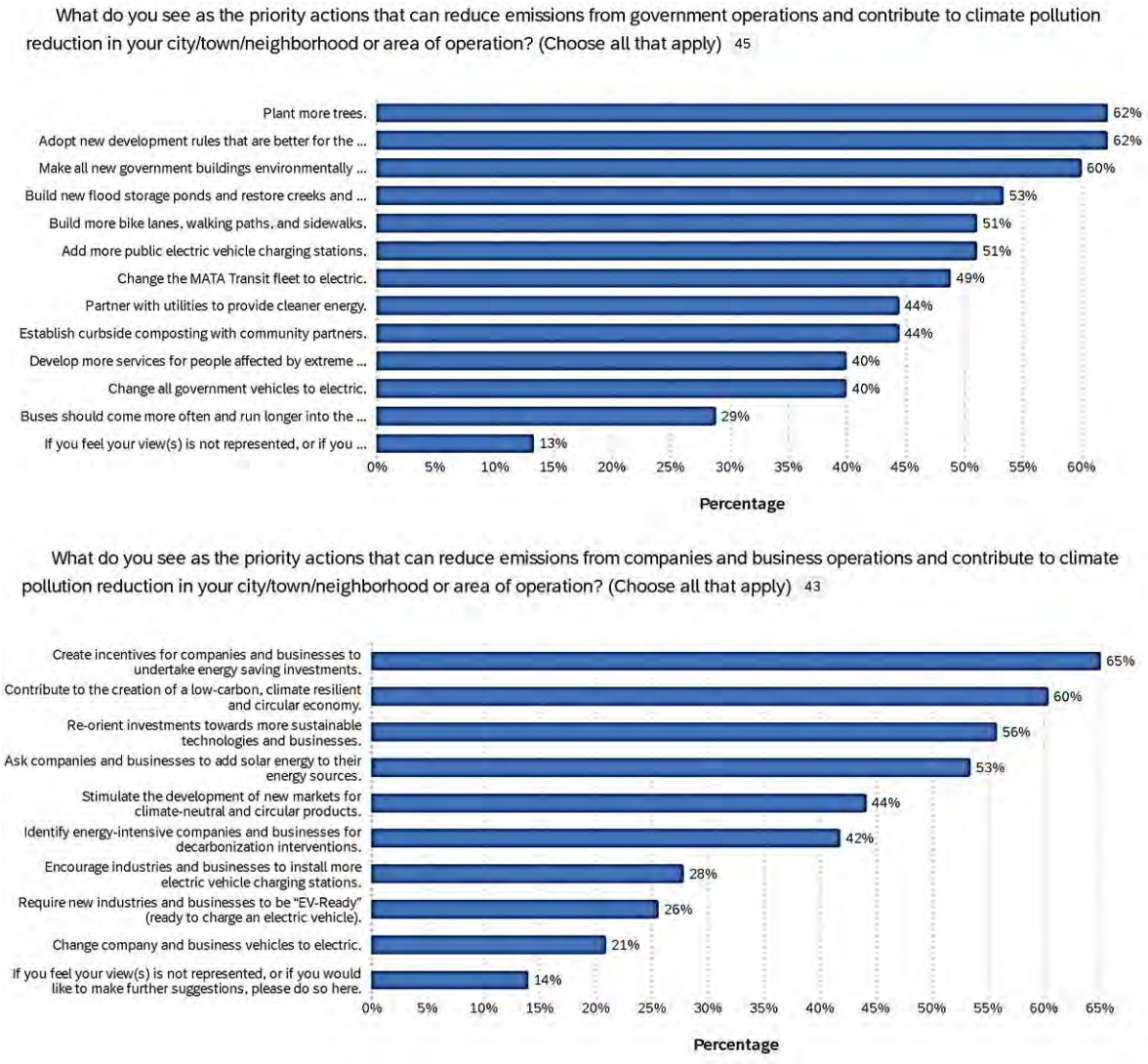


Figure 7: Participants' Views on Actions to Reduce GHG Emissions from Government and Business Operations

Priority Actions to Build Climate Resilience

In addition to asking questions on climate actions to reduce GHG emissions, participants responded to questions on actions to build climate resilience, the barriers to implementing these actions, and the principles that should underpin the actions for the Mid-South PCAP. Figure 8 summarizes participants' views on these.

To build climate resilience, three actions stood out: 62% of participants identified upgrading older neighborhoods to reduce flooding impacts, 60% highlighted building new flood storage ponds and restoring creeks and streams, and 56% identified designing buildings and infrastructure to lower impacts from climate hazards as priority climate actions for their jurisdiction or area of operation. However, the difficulty in making climate actions affordable and accessible to everyone, climate change not being the biggest concern in Mid-South residents' daily lives, and the overall cost implications of the changes needed to tackle climate change impacts are crucial barriers to implementing climate actions. Nonetheless, participants agree that four major principles should guide the climate pollution reduction priority actions

namely: Community Benefits, Equity and Climate Justice, Reducing Greenhouse Gas (GHG) emissions, and Cost-Effectiveness.

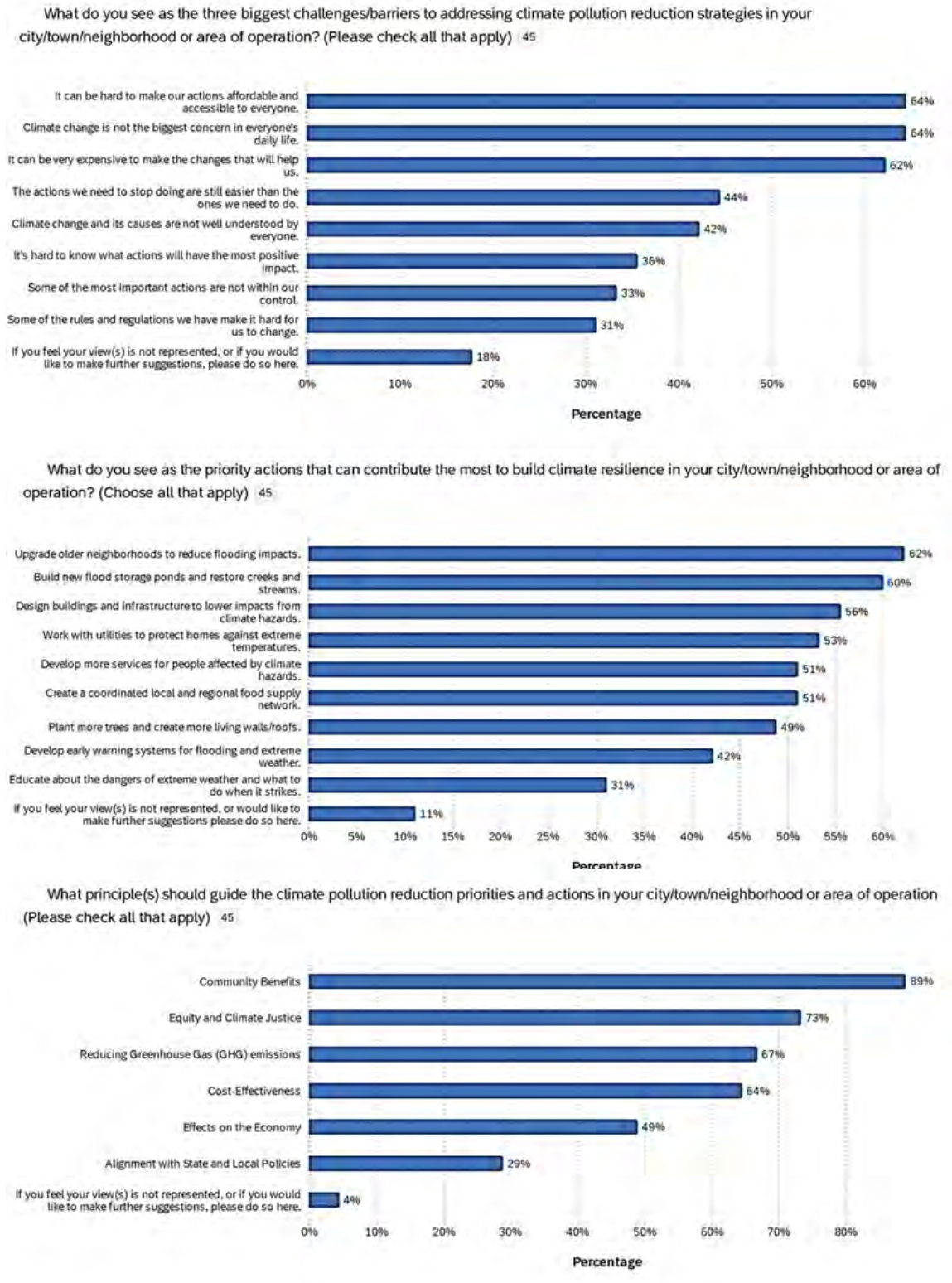


Figure 8: Participants Views on Actions, Principles, and Barriers to Building Climate Resilience

Summary of Priority Actions from Survey One

As indicated earlier, 26 out of the 86 climate actions constitute the top priority actions for consensus building in the Mid-South PCAP, and subsequently informed Survey Two and Three. Table 4 below outlines these climate actions.

Table 4: Top 26 Climate Actions by Participants from Survey One

No	Climate Actions	Count	Percentage	Category
1	Offer an incentive for property owners to upgrade their residential and commercial buildings.	35	78%	Very High Priority
2	Require recycling of construction and demolition waste.	31	76%	
3	Establish dedicated funding for public transit.	33	73%	
4	Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.	32	71%	
5	Create an incentive to install water-saving fixtures.	31	70%	
6	Food-producing businesses should do more to reduce their food waste.	28	68%	High Priority
7	Create incentives for companies and businesses to undertake energy-saving investments.	28	65%	
8	Partner with utilities to offer more energy upgrades for buildings.	29	64%	
9	Design our built environment so that people don't have to drive as much.	29	64%	
10	Put solar panels on public buildings.	27	64%	
11	Increase efforts to support the circular economy and reduce manufacturing emissions.	26	63%	
12	Push for building codes to require more energy-efficient buildings.	28	62%	
13	Find and use better ways to finance energy efficiency projects.	28	62%	
14	Plant more trees.	28	62%	
15	Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	28	62%	
16	Upgrade older neighborhoods to reduce flooding impacts.	28	62%	
17	Encourage the installation of solar panels.	26	62%	
18	Identify low-performing public buildings and make energy-saving improvements to them.	27	60%	
19	Make all new government buildings environmentally friendly and net-zero carbon.	27	60%	
20	Build new flood storage ponds and restore creeks and streams.	27	60%	
21	Contribute to the creation of a low-carbon, climate-resilient, and circular economy.	26	60%	
22	Create incentives for the installation of clean energy technology.	25	60%	
23	Reduce paperwork and delays for people and businesses that want to install renewable energy.	24	57%	Medium Priority
24	Create a network of safe biking and walking paths that go all around town.	25	56%	
25	Design buildings and infrastructure to lower impacts from climate hazards.	25	56%	
26	Re-orient investments towards more sustainable technologies and businesses.	24	56%	

The findings from Survey One provide some important implications for the Mid-South PCAP planning process. In the following numbered points, this report outlines some important implications based on the Survey One findings.

1. There is a shared concern among participants that extreme heat and drought, damaging winds, extreme cold, ice, and winter weather, tornadoes, and flooding are major climate hazards in their jurisdictions. These align with the Mid-South Regional Resilience Master Plan and suggest a need to ensure coherence between the existing plan— (other climate-related policies and plans)— and the Mid-South PCAP. The feedback from participants also underscores the fact that the Mid-South Region faces multiple climate risks and vulnerability that require an integrated effort to address the potential cascading impacts of the climate hazards.

2. The consensus on the transportation sector as a substantial source of GHG emissions underlines the sector's centrality to climate pollution reduction in the Mid-South Region. Subsequently, participants' views on climate actions reveal a shared desire to address GHG emissions from transportation comprehensively by focusing on systemic changes in neighborhood design, infrastructure, and policy initiatives that emphasize and incentivize sustainable transportation choices.

3. Participants also agreed with previous assessments identifying four sectors as major contributors to GHG emissions in the region transportation namely: industrial sector, energy sector, and commercial and residential buildings. This necessitates the continuous prioritization of these sectors in climate action processes in the Mid-South Region.

4. The emphasis on incentivizing property owners to upgrade buildings suggests a recognition of the role of residents' actions in climate pollution reduction. Furthermore, the acknowledgment of energy-efficiency improvements and green job creation in underserved communities aligns with a shared desire to build synergies between economic and environmental goals and a commitment to inclusive and sustainable practices.

5. The strong inclination towards addressing waste generated from construction activities emphasizes the importance of sustainable waste management practices in this sector. The desire to take action on food waste to reduce climate pollution also highlights a recognition of the significant environmental impact associated with food waste. Participants also shared a desire to address water waste via water conservation measures that contribute to reducing emissions from water and sewage treatment plants. Participants' emphasis on actions that incentivize the installation of water-saving fixtures aligns with a broader commitment to sustainable water management practices as such fixtures contribute to reducing water consumption and waste. This has implications for minimizing the energy need associated with water treatment and sewage facilities. Together, these actions reveal an awareness of the interconnectedness between water conservation and climate pollution reduction, while reflecting participants' interest in fostering a more circular and resource-efficient

economy that minimizes waste generation and mitigates GHG emissions in the Mid-South Region.

6. Additionally, participants' emphasis on actions that encourage the adoption of environmentally friendly development rules underscores a recognition of some barriers that limit the implementation of actions that can contribute to reducing climate pollution. Nonetheless, the shared recognition of the role of green infrastructure and sustainable urban planning in climate pollution reduction is reflected in the strong emphasis on planting more trees in the Mid-South Region—while taking cognizance of how to deal with their impacts on property damages during climate events.

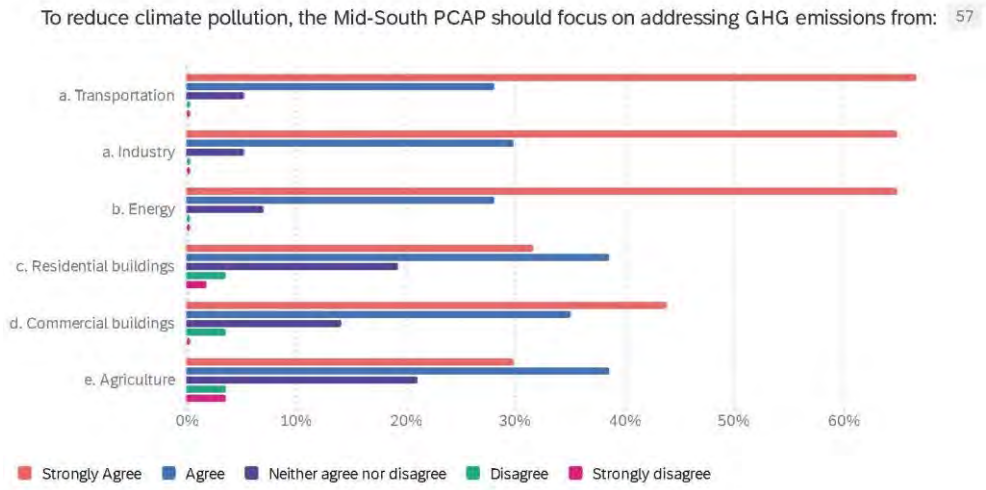
7. Furthermore, participants' emphasis on actions to make government buildings environmentally friendly and net-zero carbon shows a commitment to lead by example. Such leadership is also apparent in actions that call for companies and business operations to demonstrate strategic leadership in reducing emissions. The government and business sectors can thus develop partnerships to lead efforts in developing actions to incentivize energy-saving investments, promote a low-carbon circular economy, and re-orient investments towards climate pollution reduction in the Mid-South Region.

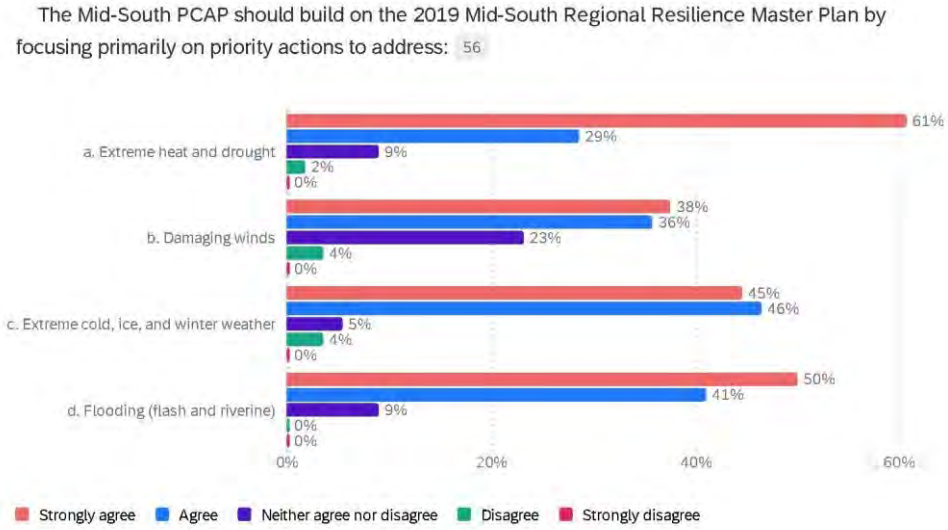
Survey Two Results

Priority Sectors for GHG Emission Reduction, Climate Hazards, and Climate Impacts

Participants in Survey Two agreed on six main priority sectors for GHG emissions in the Mid-South Region namely: (i) Transportation, (ii) Industry, (iii) Energy, (iv) Residential Buildings, (v) Commercial Buildings, and (vi) Agriculture. Survey Two participants also believed that the priority actions for the Mid-South PCAP should address extreme heat and drought, damaging winds, extreme winter weather, and flooding.

Additionally, participants identified that power outages resulting from climate events like storms and snow, and damage caused by trees falling due to severe winds and snow, as priority climate impacts. These priorities align with the Mid-South Regional Resilience Master Plan, which was adopted in 2019, indicating a need for alignment or coherence between existing regional and local climate priorities—especially when these views from participants are similar to those from Survey One, which were specific to participants' jurisdictions or areas of operation. Figure 9 summarizes participants' views.





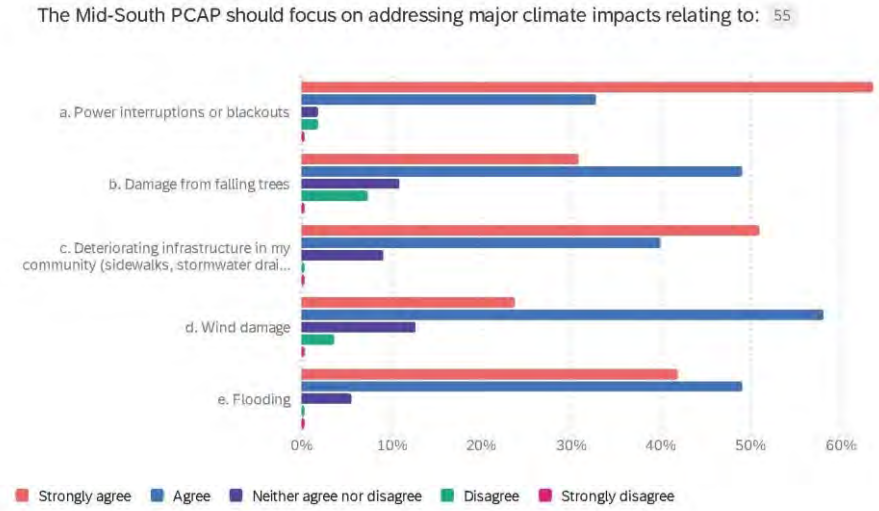


Figure 9: Participants' Views on GHG Emission Reduction Sectors, Climate Hazards, and Climate Impacts for the Mid-South PCAP

The number in the figure title represents the number of participants responding to the question

Neighborhoods and Residents' Vulnerability and Role in GHG emissions reduction

Climate change impacts are experienced at the local level, mostly by residents and in neighborhoods. This makes residents and neighborhoods crucial to efforts to address climate pollution reductions as well as their impacts. More importantly, by centralizing residents' and neighborhoods' vulnerability in these efforts, we can understand who is susceptible to climate pollution and its adverse impacts. Not surprisingly, participants agreed with this understanding with 69% of participants indicating that the Mid-South PCAP should also emphasize the role of residents in GHG emissions. Here, participants agreed that poverty, aging infrastructure, inadequate resources to invest in existing and new infrastructure, and inadequate climate insurance are crucial reasons why the Mid-South Region is vulnerable to climate pollution and its impacts. Figures 10 and 11 summarize participants' views.

Such broad consensus suggests a need for the Mid-South PCAP to not only emphasize efforts to reduce GHG emissions, but also endeavor to understand how these emissions have resulted in adverse effects on residents who are already experiencing adverse socio-economic challenges and disinvestments in their communities. For this reason, the Mid-South PCAP actions should emphasize ways to address climate pollution while also tackling the underlying equity issues in the Mid-South Region.

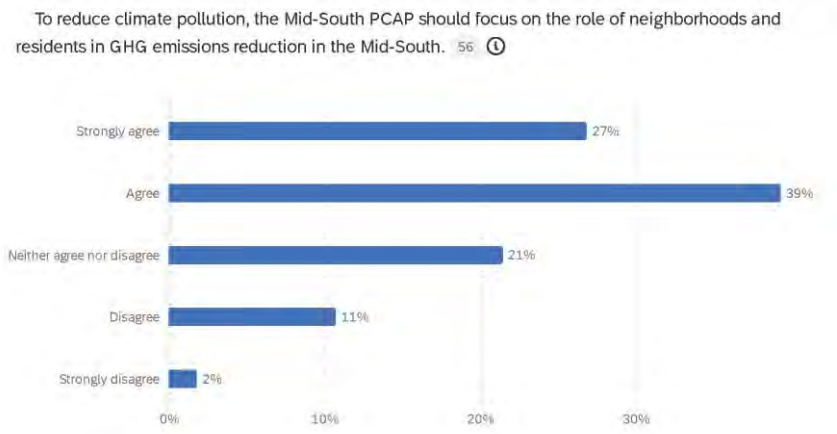


Figure 10: Participants view of the role of residents and neighborhoods in climate pollution reduction

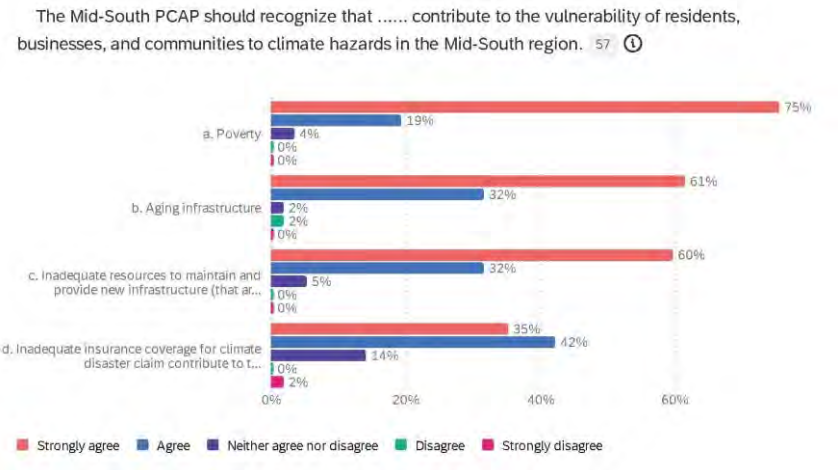


Figure 11: Participants view of the factors contributing to climate vulnerabilities

Recommended Actions for the Mid-South PCAP

All the 26 climate actions from Survey One were identified by participants as relevant for addressing climate pollution reduction and building resilience and were recommended for the Mid-South PCAP. The feedback from the participants was very high with a minimum of 81% of participants agreeing that these actions should be included in the Mid-South PCAP.

Of the top 10 climate actions with a high percentage of participants indicating their inclusion for the Mid-South PCAP, five related to energy actions that participants believe will contribute to reducing GHG emissions. These actions all emphasize the need for energy efficiency in buildings and the adoption of renewable energy sources to reduce climate pollution in the Mid-South Region. They were:

- Partner with utilities to offer more energy upgrades for buildings.
- Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.
- Push for building codes to require more energy-efficient buildings.
- Identify low-performing public buildings and make energy-saving improvements to them.
- Create incentives for the installation of clean energy technology.

The only action on transportation that made it to the top 10 action to be included in the Mid-South PCAP was "*Establish dedicated funding for public transit*." This in a way suggests a need for predictability in the funding sources for the public transit system in the region as it will allow for more efficient and reliable public transportation for residents. Also, only one action relating to business operations made it to the top 10, which was "*Contribute to the creation of a low-carbon, climate-resilient and circular economy*." The broadness of this action means that it is not only relevant for businesses but also applies to other sectors such as waste and energy. On waste, three out of the four actions presented to participants made it to the top 10, indicating that both energy and waste are major areas that stakeholders believe are fundamental to reducing climate pollution in the Mid-South Region. These actions on waste were:

- Food-producing businesses should do more to reduce their food waste.
- Increase efforts to support the circular economy and reduce manufacturing emissions.
- Create an incentive to install water-saving fixtures.

Nonetheless, the high agreement across all the actions shows that there was a shared belief among the participants that all 26 proposed actions could effectively reduce climate pollution in the Mid-South Region. Table 5 displays the percentage of participants who agreed on including the actions in the Mid-South PCAP.

Table 5: Actions for Mid-South Priority Climate Action Plan

No	Climate Actions	Sector	Agree	Neither Agree/Disagree	Disagree
1	Partner with utilities to offer more energy upgrades for buildings.	Energy	96%	3%	0%
2	Establish dedicated funding for public transit.	Transportation	95%	2%	3%
3	Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.	Energy	95%	2%	2%
4	Food producing businesses should do more to reduce their food waste.	Waste	95%	3%	2%
5	Push for building codes to require more energy efficient buildings.	Energy	94%	5%	0%
6	Identify low-performing public buildings and make energy-saving improvements to them.	Energy	94%	5%	0%
7	Increase efforts to support the circular economy and reduce manufacturing emissions.	Waste	94%	5%	0%
8	Create an incentive to install water saving fixtures.	Waste	93%	7%	0%
9	Contribute to the creation of a low-carbon, climate resilient and circular economy.	Business Operations	92%	7%	0%
10	Create incentives for the installation of clean energy technology.	Energy	92%	3%	2%
11	Plant more trees.	Government Operations	92%	7%	2%
12	Design buildings and infrastructure to lower impacts from climate hazards.	Government Operations	92%	5%	2%
13	Require recycling of construction and demolition waste.	Waste	90%	8%	2%
14	Reduce paperwork and delays for people and businesses that want to install renewable energy.	Energy	90%	7%	0%
15	Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	Government Operations	90%	8%	0%
16	Create incentives for companies and businesses to undertake energy saving investments.	Business Operations	90%	9%	2%
17	Find and use better ways to finance energy efficiency projects.	Energy	90%	8%	2%
18	Put solar panels on public buildings.	Energy	89%	8%	3%
19	Design our built environment so that people don't have to drive as much.	Transportation	89%	8%	2%
20	Build new flood storage ponds and restore creeks and streams.	Government Operations	88%	10%	0%
21	Offer an incentive for property owners to upgrade their residential and commercial buildings.	Energy	87%	10%	0%
22	Encourage the installation of solar panels.	Energy	87%	13%	0%
23	Upgrade older neighborhoods to reduce flooding impacts.	Government Operations	86%	8%	3%
24	Make all new government buildings environmentally friendly and net-zero carbon.	Government Operations	85%	10%	2%
25	Create a network of safe biking and walking paths that go all around town.	Transportation	83%	13%	2%
26	Re-orient investments towards more sustainable technologies and businesses.	Business Operations	81%	16%	0%

Survey Three Results

Ranking and Implementation Actors for Recommended Actions

The US Environmental Protection Agency (EPA) identifies PCAP actions as those that can be executed quickly and are prepared for implementation to reduce GHG emissions. The EPA characterizes these actions as "Near-term" and "Implementation ready".[4] Seven criteria were used to ascertain the near-term and implementation readiness of the 26 climate actions suggested for inclusion in the Mid-South PCAP.

Table 6 presents a summary of the actions analyzed. The highest-ranking actions relate to ecology, transportation, food, energy, built environment, and governance. These actions not only aim to reduce climate pollution but also indicate a need to address climate impacts by taking adaptation measures such as flood management. For instance, the actions "*Upgrade older neighborhoods to reduce flooding impacts*" and "*Build new flood storage ponds and restore creeks and streams*", which ranked fifth and ninth respectively, suggest that stakeholders are interested in responding to other climate issues besides pollution reduction.

Some top-ranking actions were broad, which highlights the need for a comprehensive and integrated approach to address climate pollution beyond just GHG emissions reduction. For example, "*Complete energy-efficiency improvements and offer green jobs in disadvantaged communities*" ranked third. Others include "*Contribute to the creation of a low-carbon, climate-resilient, and circular economy"* (4th), and "*Design our built environment so that people don't have to drive as much" (8th), and "Create incentives for the installation of clean energy technology*" (10th).

The views of participants regarding the organization responsible for implementing the recommended climate actions (Table 7) suggest two things. Firstly, local and regional governments should play a significant role in the implementation process through incentive programs, especially for the top 10 climate actions. Secondly, it is necessary to collaborate with various entities, including NGOs/CBOs, communities, businesses, and utility companies, to carry out the recommended actions in the Mid-South PCAP. Here, participants expressed the need for effective coordination since some of the actions are already being implemented in the Mid-South Region by different organizations.

However, the closeness of the scores indicates that any of the proposed climate actions can be included in the Mid-South PCAP. Therefore, the prioritized list of climate actions from participants should not be the sole basis for determining the climate actions to be included in the PCAP. Nonetheless, this list provides a strong foundation to complement all other analyses that support the Mid-South PCAP process. As a result, climate actions that are not highly ranked (i.e., not in the top 10) but align with the inventory analyses and other Mid-South PCAP processes should also be considered when finalizing the set of actions for the PCAP.

[4] EPA (2023). EPA's Climate Pollution Reduction Grants: Planning grants for state, territory, local, and tribal governments, Easternhttps://www.epa.gov/system/files/documents/2023-03/2023-03-09-Climate-Pollution-Reduction-Grant-Webinar-Tribal_0.pdf

Resources for the Implementation of Recommended Actions

Participants also shared their views on the resources required to implement each of the actions. As per the feedback obtained, which is shown in Table 8, participated suggested that there are already existing programs that can be expanded to reduce climate pollution in the region. For example, stakeholders identified that Property Assessed Clean Energy (PACE) Programs, Renewable Energy Certificate (RECs) programs, Tennessee Valley Authority (TVA) EnergyRight program, and Memphis Light, Gas and Water (MLGW) energy efficiency and weatherization assistance programs can assist in implementing the actions: "*Complete energy-efficiency improvements and offer green jobs in disadvantaged communities"*, "*Partner with utilities to offer more energy upgrades for buildings"*, "*Find and use better ways to finance energy efficiency projects"*, "*Re-orient investments towards more sustainable technologies and businesses"*, "*Put solar panels on public buildings"*, and "*Offer an incentive for property owners to upgrade their residential and commercial buildings"*.

Participants also identified some non-profit organizations as vital resources to implement certain climate actions. For instance, the Clean Memphis Project Green Fork initiative was recognized as a program that can support the implementation of the action, "*Food-producing businesses should do more to reduce their food waste"*. Similarly, The Works, Inc., ReGraze Memphis, and Binghampton Development Corporation were identified as organizations that can support the action to "*Increase efforts to support the circular economy and reduce manufacturing emissions"*. The BLDG Memphis Master Home Environmentalist (MHE) program was also identified as a program that can support the implementation of the action "*Complete energy-efficiency improvements and offer green jobs in disadvantaged communities"*.

Participants of Survey Three also identified financial resources as being crucial for the implementation of actions to reduce climate pollution in the Mid-South Region. Tax incentives and federal and state grants were suggested as important resources to fund these actions. Although stakeholders did not specify which particular state or federal grants could support these actions, their feedback suggests a need to identify and compile all available grants to support grant-writing efforts.

In addition to financial resources, some participants suggested amending existing municipal codes and implementing strategic code enforcement as ways to promote energy efficiency in buildings and reduce waste. The International Property Maintenance Code[5] was recommended as a way to reform building codes in a manner that contributes to energy efficiency and waste reduction in the Mid-South Region. Table 8 provides a summary of the resources suggested by participants that could aid in the implementation of these climate actions.

[5] International Code Council (2024). 2021 International Property Maintenance Code (IPMC). https://codes.iccsafe.org/content/IPMC2021P1/preface

Table 6: Participants' Ranking of Actions for the Mid-South Priority Climate Action Plan

Climate Actions	Total Score (35)	Average (5)	Rank
Plant more trees.	**29.61**	**4.23**	1
Establish dedicated funding for public transit.	**29.50**	**4.21**	2
Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.	**28.83**	**4.12**	3
Contribute to the creation of a low-carbon, climate-resilient, and circular economy.	**28.53**	**4.08**	4
Upgrade older neighborhoods to reduce flooding impacts.	**28.52**	**4.07**	5
Food-producing businesses should do more to reduce their food waste.	**28.43**	**4.06**	6
Create incentives for companies and businesses to undertake energy-saving investments.	**28.41**	**4.06**	7
Design our built environment so that people don't have to drive as much.	**28.36**	**4.05**	8
Build new flood storage ponds and restore creeks and streams.	**28.36**	**4.05**	9
Create incentives for the installation of clean energy technology.	**28.33**	**4.05**	10
Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	**28.04**	**4.01**	11
Partner with utilities to offer more energy upgrades for buildings.	**27.93**	**3.99**	12
Find and use better ways to finance energy efficiency projects.	**27.89**	**3.98**	13
Encourage the installation of solar panels.	**27.71**	**3.96**	14
Identify low-performing public buildings and make energy-saving improvements to them.	**27.68**	**3.95**	15
Require recycling of construction and demolition waste.	**27.65**	**3.95**	16
Re-orient investments towards more sustainable technologies and businesses.	**27.58**	**3.94**	17
Push for building codes to require more energy-efficient buildings.	**27.31**	**3.90**	18
Reduce paperwork and delays for people and businesses that want to install renewable energy.	**27.19**	**3.88**	19
Put solar panels on public buildings.	**27.18**	**3.88**	20
Create a network of safe biking and walking paths all around town.	**27.17**	**3.88**	21
Design buildings and infrastructure to lower impacts from climate hazards.	**27.06**	**3.87**	22
Make all new government buildings environmentally friendly and net-zero carbon.	**26.70**	**3.81**	23
Create an incentive to install water-saving fixtures.	**26.56**	**3.79**	24
Offer an incentive for property owners to upgrade their residential and commercial buildings (i.e. rebates, low-interest loan programs, etc.).	**25.74**	**3.68**	25
Increase efforts to support the circular economy and reduce manufacturing emissions.	**25.05**	**3.58**	26

Table 7: Agencies to Take Lead in the Implementation of Actions for the Mid-South Climate Action Plan according to Participants.

Climate Actions	Total Score (35)	Average (5)	Rank	LEAD IMPLEMENTATION ACTOR					
				NGOs/CBOs	Regional/ Local Government Agency	Private Companies/ Business	Utilities	Communities	Other (Specify):
Plant more trees.	**29.61**	**4.23**	1	81%	54%	46%	22%	73%	14%
Establish dedicated funding for public transit.	**29.50**	**4.21**	2	31%	79%	21%	13%	23%	15%
Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.[#]	**28.83**	**4.12**	3	23%	18%	25%	18%	8%	10%
Contribute to the creation of a low-carbon, climate-resilient, and circular economy.	**28.53**	**4.08**	4	76%	72%	72%	38%	62%	7%
Upgrade older neighborhoods to reduce flooding impacts.	**28.52**	**4.07**	5	53%	75%	28%	28%	58%	11%
Food-producing businesses should do more to reduce their food waste.	**28.43**	**4.06**	6	65%	43%	65%	13%	40%	10%
Create incentives for companies and businesses to undertake energy-saving investments.	**28.41**	**4.06**	7	38%	69%	56%	47%	19%	9%
Design our built environment so that people don't have to drive as much.	**28.36**	**4.05**	8	47%	76%	50%	13%	37%	8%
Build new flood storage ponds and restore creeks and streams.	**28.36**	**4.05**	9	65%	71%	29%	21%	53%	12%
Create incentives for the installation of clean energy technology.	**28.33**	**4.05**	10	46%	65%	43%	62%	24%	11%
Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	**28.04**	**4.01**	11	29%	74%	31%	9%	23%	9%
Partner with utilities to offer more energy upgrades for buildings.	**27.93**	**3.99**	12	38%	44%	33%	77%	21%	13%
Find and use better ways to finance energy efficiency projects.	**27.89**	**3.98**	13	55%	58%	55%	53%	21%	11%
Encourage the installation of solar panels.	**27.71**	**3.96**	14	70%	60%	48%	65%	48%	8%
Identify low-performing public buildings and make energy-saving improvements to them.	**27.68**	**3.95**	15	37%	71%	34%	46%	17%	7%
Require recycling of construction and demolition waste.	**27.65**	**3.95**	16	38%	73%	59%	11%	22%	8%
Re-orient investments towards more sustainable technologies and businesses.	**27.58**	**3.94**	17	40%	67%	57%	20%	37%	7%
Push for building codes to require more energy-efficient buildings.	**27.31**	**3.90**	18	31%	83%	24%	31%	17%	12%
Reduce paperwork and delays for people and businesses that want to install renewable energy.	**27.19**	**3.88**	19	39%	63%	34%	45%	18%	11%
Put solar panels on public buildings.	**27.18**	**3.88**	20	33%	73%	30%	43%	15%	8%
Create a network of safe biking and walking paths all around town.	**27.17**	**3.88**	21	55%	71%	18%	8%	45%	11%
Design buildings and infrastructure to lower impacts from climate hazards.	**27.06**	**3.87**	22	45%	67%	55%	24%	33%	9%
Make all new government buildings environmentally friendly and net-zero carbon.	**26.70**	**3.81**	23	29%	86%	29%	26%	11%	6%
Create an incentive to install water-saving fixtures.	**26.56**	**3.79**	24	39%	58%	32%	58%	16%	8%
Offer an incentive for property owners to upgrade their residential and commercial buildings (i.e. rebates, low-interest loan programs, etc.).	**25.74**	**3.68**	25	49%	65%	42%	63%	26%	16%
Increase efforts to support the circular economy and reduce manufacturing emissions.	**25.05**	**3.58**	26	50%	61%	74%	32%	32%	5%

[#] The structure of this question in the questionnaire was multiple choice instead of multiple answer questions. However, a similar interpretation can be made for the results like other actions.

Table 8: Resources for the Implementation of the Actions for the Mid-South Climate Action Plan according to Participants.

Climate Actions	Total Score (35)	Average (5)	Rank	Existing programs that could be expanded	Financial resources	Operational/ Staffing resources	Technology/ Software resources	Other
Plant more trees.	**29.61**	**4.23**	1	82%	45%	36%	9%	27%
Establish dedicated funding for public transit.	**29.50**	**4.21**	2	70%	57%	39%	22%	26%
Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.#	**28.83**	**4.12**	3	23%	18%	25%	18%	41%
Contribute to the creation of a low-carbon, climate-resilient, and circular economy.	**28.53**	**4.08**	4	56%	56%	31%	25%	31%
Upgrade older neighborhoods to reduce flooding impacts.	**28.52**	**4.07**	5	47%	63%	37%	21%	26%
Food-producing businesses should do more to reduce their food waste.	**28.43**	**4.06**	6	74%	33%	48%	15%	30%
Create incentives for companies and businesses to undertake energy-saving investments.	**28.41**	**4.06**	7	67%	50%	11%	28%	28%
Design our built environment so that people don't have to drive as much.	**28.36**	**4.05**	8	58%	42%	21%	25%	33%
Build new flood storage ponds and restore creeks and streams.	**28.36**	**4.05**	9	60%	65%	35%	15%	25%
Create incentives for the installation of clean energy technology.	**28.33**	**4.05**	10	45%	59%	18%	27%	27%
Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	**28.04**	**4.01**	11	64%	36%	36%	14%	23%
Partner with utilities to offer more energy upgrades for buildings.	**27.93**	**3.99**	12	50%	17%	29%	25%	33%
Find and use better ways to finance energy efficiency projects.	**27.89**	**3.98**	13	50%	58%	19%	27%	31%
Encourage the installation of solar panels.	**27.71**	**3.96**	14	58%	62%	23%	38%	27%
Identify low-performing public buildings and make energy-saving improvements to them.	**27.68**	**3.95**	15	46%	46%	38%	38%	33%
Require recycling of construction and demolition waste.	**27.65**	**3.95**	16	57%	33%	38%	19%	29%
Re-orient investments towards more sustainable technologies and businesses.	**27.58**	**3.94**	17	44%	50%	31%	6%	31%
Push for building codes to require more energy-efficient buildings.	**27.31**	**3.90**	18	40%	36%	32%	28%	32%
Reduce paperwork and delays for people and businesses that want to install renewable energy.	**27.19**	**3.88**	19	33%	46%	46%	33%	33%
Put solar panels on public buildings.	**27.18**	**3.88**	20	48%	64%	28%	36%	24%
Create a network of safe biking and walking paths all around town.	**27.17**	**3.88**	21	63%	54%	33%	17%	29%
Design buildings and infrastructure to lower impacts from climate hazards.	**27.06**	**3.87**	22	67%	44%	28%	33%	22%
Make all new government buildings environmentally friendly and net-zero carbon.	**26.70**	**3.81**	23	53%	47%	26%	32%	26%
Create an incentive to install water-saving fixtures.	**26.56**	**3.79**	24	68%	45%	27%	27%	27%
Offer an incentive for property owners to upgrade their residential and commercial buildings (i.e. rebates, low-interest loan programs, etc.).	**25.74**	**3.68**	25	53%	53%	33%	23%	43%
Increase efforts to support the circular economy and reduce manufacturing emissions.	**25.05**	**3.58**	26	59%	41%	41%	41%	32%

The structure of this question in the questionnaire was multiple choice instead of multiple answer questions. However, a similar interpretation can be made for the results like other actions.

Recommendations

The three surveys from the stakeholder engagement process for the Mid-South PCAP provide momentum for efforts to reduce climate pollution and build climate resilience. In the points that follow some recommendations are presented:

1. Climate change impacts continue to affect the various jurisdictions in the Mid-South Region. These impacts are making the region vulnerable, requiring urgent actions to mitigate and address their impacts.
2. It is important to compare the top priority sectors for addressing greenhouse GHG emissions, as identified by participants, with the inventory analysis in the PCAP process. This will help to identify mutual grounds and prioritize areas that need urgent attention. Participants' views are based on their everyday experiences with climate pollution in their jurisdictions and areas of operation. Incorporating participants' views in the inventory analysis can help validate the inventory analysis and provide insights into the contextual issues of climate pollution across various jurisdictions in the Mid-South Region. Additionally, this will allow the PCAP or subsequent climate action planning efforts to not only account for how much GHG emissions are being produced in the Mid-South Region but also how they are impacting residents in the region.
3. The Mid-South PCAP presents an opportunity to tackle climate-related issues, but it is important to ensure coherence and alignment with previous and ongoing initiatives like the Mid-South Regional Resilience Master Plan, and the efforts being carried out by non-profit organizations and other agencies such as TVA and MLGW.
4. The recommended actions by participants for the Mid-South PCAP are relevant for reducing climate pollution and building resilience in the Mid-South Region. The ranking of actions can help with the prioritization of actions for the PCAP. However, these rankings should be used in addition to other PCAP processes to inform the final set of actions that are included in the Mid-South PCAP, such as the inventory analysis.
5. It is important to note that most of the participants in the survey were from non-governmental and community-based organizations. This is a good because it shows that the interests and opinions of the various communities in the Mid-South Region are being considered in the PCAP process. However, it is important to remember that community and public engagement should not be replaced by this. Hence, the views of the residents of the Mid-South Region must be emphasized in the Mid-South climate action planning processes. This can be done during the comprehensive climate action planning stage of the CPRG.

Appendix

Names of Participating Organizations in the Surveys

Affiliate Organization of Survey One Participants

1. Alpha Omega Veterans Services, Inc.
2. Binghampton Development Corporation
3. Black Millennials 4 Flint
4. Center for Transforming Communities
5. City of Germantown
6. City of Hernando
7. City of Memphis
8. City of Memphis HCD
9. City of Memphis Solid Waste Division
10. City of Memphis, Public Works Division
11. City of Millington, TN
12. City of Olive Branch
13. City of Senatobia
14. Clean Memphis
15. DPD Department of Housing
16. Fletchers Memorial Community Baptist Church
17. High Expectations Aerial Arts
18. Innovate Memphis
19. Legal Aid of Arkansas
20. Memphis MPO
21. Memphis, Division of Fire Services
22. Memphis-Shelby County Airport Authority
23. Midsouth Development District
24. MLGW
25. ShelbyCares on Third
26. Shelby County Roads, Bridges and Engineering Department
27. Shelby Farms Park Conservancy
28. Sierra Club
29. TennGreen Land Conservancy
30. The Works Inc
31. Tunica County Government
32. Vibrant Memphis, Inc
33. West Memphis MPO
34. Wolf River Conservancy

Affiliate Organization of Survey Two Participants

1. Alpha Omega Veterans Services, Inc.
2. Arkwings Foundation, Memphis TN
3. Assisi Foundation
4. Bevo Boys Fitness Academy
5. Bevo Boys Fitness Academy
6. Binghampton Development Corporation
7. City of Memphis
8. City of Memphis HCD
9. City of Memphis Solid Waste Division
10. City of Millington
11. City of Olive Branch
12. City of Senatobia, MS
13. Climate Reality Project Memphis Chapter
14. Cowanhouse
15. CRG Foundation
16. Downtown Memphis Commission
17. Green & Healthy Homes Initiative
18. High Expectations Aerial Arts
19. Innovate Memphis
20. Knowledge Tree Foundation
21. Memphis International Airport
22. Memphis Light, Gas and Water
23. Moore Tech
24. Protect Our Aquifer
25. Shelby County
26. Shelby County Division of Planning and Development, Dept of Housing
27. Shelby County Health Department
28. Shelby Farms Park Conservancy
29. Sierra Club
30. Teamsters Local 667
31. Tennessee Farm Bureau
32. Tennessee Interfaith Power and Light
33. The City of Germantown
34. The Works, Inc.
35. Tunica County Government
36. Westside Unitarian Universalist Church

Affiliate Organization of Survey Three Participants

1. Alpha Omega Veterans Services, Inc.
2. Assisi Foundation
3. Bevo Boys Fitness Academy
4. Center for Transforming Communities
5. City of Germantown
6. City of Memphis
7. City of Memphis HCD
8. City of Olive Branch
9. City of Senatobia, MS. Tate County
10. Clean Memphis
11. Downtown Memphis Commission
12. Glankler Brown, PLLC
13. God's Advocate for Justice
14. Green & Healthy Homes Initiative
15. Innovate Memphis
16. Memphis Light, Gas and Water
17. Memphis Shelby County Division of Planning and Development
18. Memphis Urban Area Metropolitan Planning Organization (MPO)
19. Memphis Zoo
20. Shelby County
21. Shelby County Health Department
22. Shelby Literacy Center
23. Sierra Club
24. The Works, Inc.
25. Town of Horseshoe Lake
26. West Memphis Marion Area MPO
27. Wolf River Conservancy

Survey Questionnaires

Survey One

Questionnaire-Survey 1

Introduction

Thank you for agreeing to participate in the stakeholder engagement activities for the Mid-South Priority Climate Action Plan (PCAP) as part of the Climate Pollution Reduction Grants (CPRG) program. This is a consensus building exercise to identify priorities and actions for the Mid-South PCAP. As described in *Stakeholder Workshop 1*, held online on December 4, 2023, the stakeholder engagement activities will be a three-round survey that will gather the views of a wide range of stakeholders working to reduce climate pollution and address climate risks and hazards in the Mid-South region.

The aims of this first round of survey are (1) to understand stakeholders' views on the climate risks and hazards, priorities, and actions for their jurisdictions and 2) to gather stakeholders' suggestions for the next steps of stakeholder engagements to build consensus on climate priorities and actions for the Mid-South PCAP.

This survey consists of the following four sections:

- **Part 1**: Involves questions gathering your views about climate pollution(s), climate risks and/or hazards that your organization focuses on or that confronts the jurisdiction within which you mostly operate.
- **Part 2**: Asks stakeholders to identify climate priorities and suggestions or recommendations for climate priorities to include in the Mid-South PCAP.
- **Part 3**: Asks stakeholders to identify climate actions and suggestions or recommendations for climate actions to include in the Mid-Sout PCAP
- **Part 4**: Asks questions about stakeholder background and/or representation in the engagement process.

Once you access the survey, you will be guided to the relevant sections, which will enable you to respond. Our pilot testing suggests that it takes about 30 minutes in total to complete the survey.

We would be grateful if you could complete the survey by **Friday, December 22, 2023.**

Your answers to the survey will be used and reported anonymously so that you cannot be identified. Please feel free to share or forward the questionnaire to other stakeholders who may be interested in providing their views for the PCAP process.

If you have any further questions about this survey or how your data will be used, please do not hesitate to contact ***Stephen Kofi Diko*** at skdiko@memphis.edu, ***Truus Apoanaba Abuosi*** at t.a.abuosi@memphis.edu, and ***Leigh Huffman*** at Leigh.Huffman@memphistn.gov. Full details about the Mid-South Climate Action Planning process and the Climate Pollution Reduction Grant program can be found at the Memphis and Shelby County Office of Sustainability and Resilience website at: https://osr.shelbycountytn.gov/cprg.

Any answer you give will be treated in confidence in accordance with the University of Memphis Institutional Review Board standards. Please refer to the Privacy Notice in the email that outlines how we will use your data and the consent statement.

If you are happy to continue, please click below.

[ ] I agree to participate in this survey

1

Climate Risks and Hazards

1. The Mid-South Regional Resilience Master Plan identifies seven climate hazards that pose risks to the region. Which of these climate hazards are you most worried about for your city/town/neighborhood or area of operation? (Choose all that apply)

   - ☐ Damaging Winds
   - ☐ Riverine flooding
   - ☐ Flash flooding
   - ☐ Extreme Heat and Drought
   - ☐ Extreme cold, Ice, and Winter Weather
   - ☐ Tornadoes
   - ☐ Earthquakes

   If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

2. Which of the following climate-related impacts do residents and business in your city/town/neighborhood/jurisdictions or area of operation experience? (Choose all that apply)

   - ☐ Flooding
   - ☐ Hurricane/tropical storm evacuation
   - ☐ Wind damage
   - ☐ Lightning damage
   - ☐ Damage from falling trees
   - ☐ Power interruptions or blackouts
   - ☐ Deteriorating building structures
   - ☐ Failing major appliances (air conditioning unit, water heater, etc.)
   - ☐ Deteriorating infrastructure in my community (sidewalks, stormwater drains, etc.)
   - ☐ Changes to or loss of shade trees or other vegetation
   - ☐ Inadequate insurance coverage for disaster claim
   - ☐ None of the above

   If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

3. Which of these climate impacts have impacted your city/town/neighborhood/jurisdictions or area of operation in the past three (3) years? (Choose all that apply)

- ☐ Flooding
- ☐ Hurricane/tropical storm evacuation
- ☐ Wind damage
- ☐ Lightning damage
- ☐ Damage from falling trees
- ☐ Power interruptions or blackouts
- ☐ Deteriorating building structures
- ☐ Failing major appliances (air conditioning unit, water heater, etc.)
- ☐ Deteriorating infrastructure in my community (sidewalks, stormwater drains, etc.)
- ☐ Changes to or loss of shade trees or other vegetation
- ☐ Inadequate insurance coverage for disaster claim
- ☐ None of the above

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

4. In your opinion, what makes your city/town/neighborhood/jurisdictions or area most vulnerable to the noted climate hazards?

Climate Priorities and Actions

5. Based on previous assessments, four sectors/industries contribute to the majority of regional GHG emissions. These are the priority sectors for the Mid-South PCAP. Do these priority sectors align with GHG emission sources for your city/town/neighborhood/jurisdictions or area of operation. (Choose all that apply)

- ☐ Industry
- ☐ Electricity generation and/or use (Energy)
- ☐ Transportation
- ☐ Commercial and residential buildings

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

6. What do you believe should be the top priority sectors to contribute to climate pollution reduction for your city/town/neighborhood/jurisdictions or area of operation?

_____

_____

_____

_____

7. What do you see as the priority actions that can reduce energy use in homes and buildings and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Encourage the use of the free energy saving kits provided by utilities or local organizations.
- ☐ Push for building codes to require more energy efficient buildings.
- ☐ Partner with utilities to offer more energy upgrades for buildings.
- ☐ Create an energy education and training program to educate Mid-South electricity customers including property owners and residents about energy efficiency.
- ☐ Offer an incentive for property owners to upgrade their residential and commercial buildings.
- ☐ Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.
- ☐ Find and use better ways to finance energy efficiency projects.
- ☐ Identify low-performing public buildings and make energy-saving improvements to them.
- ☐ Identify low-performing private buildings and support/incentivize/help them to meet energy-efficiency targets.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

8. What do you see as the priority actions that can provide the cleanest energy and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Encourage the installation of solar panels.
- ☐ Encourage the installation of geothermal heat pumps.
- ☐ Encourage the installation of solar hot water systems.
- ☐ Partner with utilities to create large solar farms.
- ☐ Push utilities to meet their net-zero carbon emissions goals.
- ☐ Organizations should add solar to their buildings and parking areas.
- ☐ Purchase clean energy from other sources and locations.
- ☐ Remove rules that do not allow clean energy technologies.
- ☐ Create incentives for the installation of clean energy technology.
- ☐ Give electricity credits for the renewable energy (e.g., solar) residents generate.
- ☐ Increase the amount of renewable energy allowed locally.

- ☐ Get the 100 largest consumers of electric energy in the Mid-South to install solar panels.
- ☐ Put solar panels on public buildings.
- ☐ Reduce paperwork and delays for people and businesses that want to install renewable energy.
- ☐ Set a clean electricity goal.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

9. What do you see as the priority actions that can reduce the most carbon emissions from transportation and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Design our built environment so that people don't have to drive as much.
- ☐ Organizations should change their private vehicle fleets to electric or low-carbon fuel alternatives.
- ☐ Buses should come more often and run longer into the night.
- ☐ Complete and/or upgrade a priority bike lane network.
- ☐ Continue encouraging all employees to carpool, vanpool, take transit, bike, walk and work from home.
- ☐ Ask big companies and organizations to add electric vehicle charging onsite or to provide more electric vehicle charging for their clients and employees.
- ☐ Create a network of safe biking and walking paths that go all around town.
- ☐ Push the State(s) to make sure that the electricity for electric vehicles gets cleaner.
- ☐ Require new homes to be "EV-Ready" (ready to charge an electric vehicle).
- ☐ Install more electric vehicle charging stations.
- ☐ Educate people about the benefits of electric vehicles.
- ☐ Establish dedicated funding for public transit.
- ☐ Develop commuter programs and parking policies that reduce traffic pollution.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

10. What do you see as the priority actions that can reduce the most emissions from our landfill waste and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ People should compost at home, work, and school.
- ☐ People should take advantage of private composting services at home, work, and school.
- ☐ Food producing businesses should do more to reduce their food waste.

- ☐ Establish a curbside composting program and facility with community partners.
- ☐ Create an education program about the problems of food waste.
- ☐ Ban food scraps from trash collection and start curbside compost collection.
- ☐ Establish dedicated funding for waste management.
- ☐ Institute/Enforce bans for yard waste, electronics, and cardboard.
- ☐ Require users to pay for the amount of trash they throw away.
- ☐ Require recycling of construction and demolition waste.
- ☐ Increase efforts to support the circular economy and reduce manufacturing emissions.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

11. What do you see as the priority actions that can reduce the most emissions from our water and sewage treatment plants and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Encourage the use of free utility water saving kits.
- ☐ Neighborhoods should compete to see who can save the most water.
- ☐ Share more information about how to save water at home, work, and school.
- ☐ Create an incentive to install water saving fixtures.
- ☐ Create an incentive to install rain barrels for collecting and reusing rainwater.
- ☐ Support the utility's energy saving investments.
- ☐ Support investments in clean energy to power the utility's operations.
- ☐ Support investments in methane and carbon capture at treatment plants.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

12. What do you see as the priority actions that can reduce emissions from government operations and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Make all new government buildings environmentally friendly and net-zero carbon.
- ☐ Adopt new development rules that are better for the environment and contribute to climate pollution reduction.
- ☐ Develop more services for people affected by extreme weather.
- ☐ Partner with utilities to provide cleaner energy.
- ☐ Buses should come more often and run longer into the night.
- ☐ Build more bike lanes, walking paths, and sidewalks.
- ☐ Plant more trees.
- ☐ Change all government vehicles to electric.
- ☐ Change the MATA Transit fleet to electric.

- ☐ Add more public electric vehicle charging stations.
- ☐ Build new flood storage ponds and restore creeks and streams.
- ☐ Establish curbside composting with community partners.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

13. What do you see as the priority actions that can reduce emissions from companies and business operations and contribute to climate pollution reduction in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Stimulate the development of new markets for climate-neutral and circular products.
- ☐ Re-orient investments towards more sustainable technologies and businesses.
- ☐ Contribute to the creation of a low-carbon, climate resilient and circular economy.
- ☐ Identify energy-intensive companies and businesses for decarbonization interventions.
- ☐ Create incentives for companies and businesses to undertake energy saving investments.
- ☐ Change company and business vehicles to electric.
- ☐ Require new industries and businesses to be "EV-Ready" (ready to charge an electric vehicle).
- ☐ Encourage industries and businesses to install more electric vehicle charging stations.
- ☐ Ask companies and businesses to add solar energy to their energy sources.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

14. What do you see as the priority actions that can contribute the most to build climate resilience in your city/town/neighborhood or area of operation? (Choose all that apply)

- ☐ Upgrade older neighborhoods to reduce flooding impacts.
- ☐ Build new flood storage ponds and restore creeks and streams.
- ☐ Design buildings and infrastructure to lower impacts from climate hazards.
- ☐ Develop early warning systems for flooding and extreme weather.
- ☐ Educate about the dangers of extreme weather and what to do when it strikes.
- ☐ Develop more services for people affected by climate hazards.
- ☐ Work with utilities to protect homes against extreme temperatures.
- ☐ Plant more trees and create more living walls/roofs.
- ☐ Create a coordinated local and regional food supply network.

If you feel your view(s) is not represented, or would like to make further suggestions please do so here.

15. What are the climate actions currently being implemented in your city/town/neighborhood or by your organization?

Additional Information

16. What do you see as the three biggest challenges/barriers to addressing climate pollution reduction strategies in your city/town/neighborhood or area of operation? (Please check all that apply)

- ☐ Climate change is not the biggest concern in everyone's daily life.
- ☐ It can be hard to make our actions affordable and accessible to everyone.
- ☐ Some of the most important actions are not within our control.
- ☐ Climate change and its causes are not well understood by everyone.
- ☐ The actions we need to stop doing are still easier than the ones we need to do.
- ☐ Some of the rules and regulations we have make it hard for us to change.
- ☐ It can be very expensive to make the changes that will help us.
- ☐ It's hard to know what actions will have the most positive impact.

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

17. What principle(s) should guide the climate pollution reduction priorities and actions in your city/town/neighborhood or area of operation (Please check all that apply)

- ☐ Reducing Greenhouse Gas (GHG) emissions
- ☐ Cost-Effectiveness
- ☐ Community Benefits
- ☐ Effects on the Economy
- ☐ Alignment with State and Local Policies
- ☐ Equity and Climate Justice
- ☐ Other (please specify)

If you feel your view(s) is not represented, or if you would like to make further suggestions, please do so here.

18. Do you have anything else to add that you think is relevant to this survey, but wasn't part?

Demographics of Respondents

19. Name: _____

20. Name of Organization: _____

21. Email: _____

22. Location/City/Town/Neighborhood/Area of operation: _____

23. Please select the category that most corresponds to your organization. (Please choose only one)

- ○ Non-governmental organization (NGO)/ Community-based organization
- ○ Utilities
- ○ Private company/Business
- ○ Regional and Government Agency
- ○ Community Representative
- ○ I prefer not to answer
- ○ Other (specify)

24. What gender do you identify as? (Please choose only one)

- ○ Female
- ○ Male
- ○ Non-binary
- ○ I prefer not to answer

25. Select the range that best describes your age (Please choose only one)

- ○ Under 18
- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-54

- 55-64
- 65 and over
- I prefer not to answer

26. Which race or ethnicity best describes you? (Please choose only one)

- American Indian or Alaskan Native
- Asian / Pacific Islander
- Black or African American
- Hispanic
- White / Caucasian
- Multiple ethnicity
- I prefer not to answer
- Other (please specify)

THANK YOU FOR COMPLETING THIS SURVEY.

Survey Two (2) will be distributed in January 2024. In *Survey Two (2)*, your will be asked to agree (or disagree) with suggested climate priorities and actions from stakeholders who participated in *Survey One (1)*. The survey will consist of priorities and actions that will be distilled from stakeholder suggestions from *Survey One (1)* to inform a consensus list of priorities and actions for the Mid-South region.

Survey Two (2) will take about 20 minutes to complete. We would very much value your participation in *Survey Two (2)*, please tick below if you are happy to receive an invitation to the survey in January 2024. This is an opportunity for you and your colleagues to help shape the Mid-South Priority Climate Action Plan under the Climate Pollution Reduction Grant program.

1. I am happy to receive an invitation to the survey in December
2. I do not want to receive an invitation to the survey in December

If you have any questions, please do not hesitate to contact Stephen Kofi Diko at skdiko@memphis.edu, Truus Apoanaba Abuosi at t.a.abuosi@memphis.edu, and Leigh Huffman at Leigh.Huffman@memphistn.gov.

QUESTIONNAIRE-SURVEY 2

BUILDING CONSENSUS ON THE PRIORITY CLIMATE ACTIONS FOR THE MID-SOUTH PRIORITY CLIMATE ACTION PLAN

Introduction

Thank you for agreeing to participate in the stakeholder engagement activities for the Mid-South Priority Climate Action Plan (PCAP) as part of the Climate Pollution Reduction Grants (CPRG) program. This is a consensus building exercise to identify priorities and actions for the Mid-South PCAP. As described in *Stakeholder Workshop 1*, held online on December 4, 2023, the stakeholder engagement activities comprise a three-round survey that will gather the views of a wide range of stakeholders working to reduce climate pollution and address climate risks and hazards in the Mid-South region.

Findings from Survey 1

In *Survey 1*, 45 participants responded to the online questionnaire from a wide range of stakeholders who indicated their priority climate actions for their jurisdictions or area of operations. Participants were from non-governmental organizations/community-based organizations, regional and local government agencies, utility providers, and private businesses. The diversity of stakeholders provided a wide range of views that forms the basis for *Survey 2*. Overall, about 25 out of 86 actions had 56% or more stakeholders indicating those actions as their priority climate actions for their jurisdictions or area of operations.

Aim of Survey 2

Survey 2 furthers consensus building efforts on priority climate actions for the Mid-South PCAP so that a final set of climate priority actions can be identified. The aim of *Survey 2* is to identify areas of broad agreement and disagreement based on feedback from *Survey 1*. However, it is not necessary for you to have responded to Survey 1 to participate in this second survey.

In *Survey Two (2)*, you are kindly expected to indicate whether you agree or disagree with priority statements grouped under six (6) thematic areas. These priorities are mostly informed by climate actions that 56% or more stakeholders indicated as priority actions for their jurisdictions.

- Mid-South Priority GHG Emission Sources
- Mid-South Priority Climate Hazards, Impacts, and Vulnerabilities
- Mid-South Priority Climate Actions on Energy
- Mid-South Priority Climate Actions on Transportation
- Mid-South Priority Climate Actions on Waste
- Mid-South Priority Climate Actions on Government and Business Operations

Once you access the survey, you will be guided to the relevant sections, which will enable you to respond. Our pilot testing suggests that it takes about 15 minutes to complete the survey.

We would be grateful if you could complete the survey by **Wednesday, January 17, 2024.**

Your answers to the survey will be used and reported anonymously so that you cannot be identified. Please feel free to share or forward the Survey to other stakeholders who may be interested in providing their views.

If you have any questions about this survey or how your data will be used, please do not hesitate to contact ***Stephen Kofi Diko*** at skdiko@memphis.edu, ***Truus Apoanaba Abuosi*** at t.a.abuosi@memphis.edu, and ***Leigh Huffman*** at Leigh.Huffman@memphistn.gov. Full details about the Mid-South Climate Action Planning process and the Climate Pollution Reduction Grant program can be found at the Memphis and Shelby County Office of Sustainability and Resilience website at: https://osr.shelbycountytn.gov/cprg.

Any answer you give will be treated in confidence in accordance with the University of Memphis Institutional Review Board standards.

If you are happy to continue, please click below.

[ ] I agree to participate in this survey

Mid-South Priority GHG Emission Sources

Most stakeholders indicated the following as the Priority GHG Emission Sources for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with the statement(s) below for the Mid-South PCAP.*

1. To reduce climate pollution, the Mid-South PCAP should focus on addressing GHG emissions from:

GHG Emission Sources	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Transportation	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Industry	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Energy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Residential	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
e. Commercial	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
f. Agriculture	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

2. To reduce climate pollution, the Mid-South PCAP should focus on the role of neighborhoods and residents in GHG emissions reduction in the Mid-South.

Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the GHG Emission Sources that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

Mid-South Priority Climate Hazards, Impacts, and Vulnerabilities

Most stakeholders indicated the following as the climate hazards, impacts, and vulnerabilities for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with the statement(s) below for the Mid-South PCAP.*

3. The Mid-South PCAP should build on the 2019 Mid-South Regional Resilience Master Plan by focusing primarily on priority actions to address:

Climate Hazards	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Extreme heat and drought	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Damaging winds	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Extreme cold, ice, and winter weather	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Flooding (flash and riverine)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate hazards that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

4. The Mid-South PCAP should focus on addressing major climate impacts relating to:

Climate Impacts	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Power interruptions or blackouts	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Damage from falling trees	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Deteriorating infrastructure in my community (sidewalks, stormwater drains, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Wind damage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
e. Flooding	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate impacts that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

5. The Mid-South PCAP should recognize that ..... contribute to the vulnerability of residents, businesses, and communities to climate hazards in the Mid-South region.

Climate Vulnerabilities	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Poverty	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Aging infrastructure	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Inadequate resources to maintain and provide new infrastructure (that are resilient)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Inadequate insurance coverage for climate disaster claim contribute to the vulnerability of residents	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate vulnerabilities that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

Mid-South Priority Climate Actions on Energy

Most stakeholders indicated the following as the priorities to reduce Energy-related GHG emissions for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with these recommendations for the Mid-South PCAP.*

6. To reduce climate pollution (GHG emissions) from energy use, the Mid-South PCAP should focus on implementing actions that:

Climate Actions	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Offer an incentive for property owners to upgrade their residential and commercial buildings.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Partner with utilities to offer more energy upgrades for buildings.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Push for building codes to require more energy efficient buildings.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
e. Find and use better ways to finance energy efficiency projects.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

f.	Identify low-performing public buildings and make energy-saving improvements to them.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
g.	Put solar panels on public buildings.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
h.	Encourage the installation of solar panels.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
i.	Create incentives for the installation of clean energy technology.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
j.	Reduce paperwork and delays for people and businesses that want to install renewable energy.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate actions on Energy that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

Mid-South Priority Climate Actions on Transportation

Most stakeholders indicated the following as the priorities to reduce Transportation-related GHG emissions for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with these recommendations for the Mid-South PCAP.*

7. To reduce climate pollution (GHG emissions) from transportation, the Mid-South PCAP should focus on actions that:

	Climate Actions	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a.	Establish dedicated funding for public transit.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b.	Design our built environment so that people don't have to drive as much.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c.	Create a network of safe biking and walking paths that go all around town.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate actions on transportation that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

Mid-South Priority Climate Actions on Waste

Most stakeholders indicated the following as the priorities to reduce Waste-related GHG emissions for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with these recommendations for the Mid-South PCAP.*

8. To reduce climate pollution (GHG emissions) from waste the Mid-South PCAP should:

Climate Actions	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Require recycling of construction and demolition waste.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Encourage food producing businesses to do more to reduce their food waste.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Increase efforts to support the circular economy and reduce manufacturing emissions.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Create an incentive to install water saving fixtures.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate actions on waste that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

Mid-South Priority Climate Actions on Government and Business Operations

Most stakeholders indicated the following as the priorities to reduce GHG emissions from Government and Business Operations for their jurisdictions. *Please indicate the extent to which you AGREE or DISAGREE with these recommendations for the Mid-South PCAP.*

9. To reduce climate pollution (GHG emissions) from government operations, the Mid-South PCAP should encourage governments to:

Climate Actions	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Plant more trees.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Adopt new development rules that are better for the environment and contribute to climate pollution reduction.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Make all new government buildings environmentally friendly and net-zero carbon.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d. Upgrade older neighborhoods to reduce flooding impacts.	[ ]	[ ]	[ ]	[ ]	[ ]	
e. Build new flood storage ponds and restore creeks and streams.	[ ]	[ ]	[ ]	[ ]	[ ]	

f. Design buildings and infrastructure to lower impacts from climate hazards.	[ ]	[ ]	[ ]	[ ]	[ ]	

If you feel your suggestion is not represented, or would like to make further suggestions about the climate actions on government operations that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

10. To reduce climate pollution (GHG emissions) from business operations, the Mid-South PCAP should

Climate Actions	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Create incentives for companies and businesses to undertake energy saving investments.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Contribute to the creation of a low-carbon, climate resilient and circular economy.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
c. Re-orient investments towards more sustainable technologies and businesses.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the climate actions on business operations that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

11. To contribute to climate pollution reduction, the Mid-South PCAP should emphasize the principles of:

Principles	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't know
a. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
b. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

c.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
d.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
e.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If you feel your suggestion is not represented, or would like to make further suggestions about the principles that the Mid-South PCAP should prioritize or should not prioritize, please do so here:

12. Do you have anything else to add that you think is relevant to Survey 2, but wasn't part?

Demographics of Respondents

13. Name: _____

14. Name of Organization: _____

15. Email: _____

16. Location/City/Town/Neighborhood/Area of operation: _____

17. Please select the category that most corresponds to your organization. (Please choose only one)

- ○ Non-governmental organization (NGO)/ Community-based organization
- ○ Utilities
- ○ Private company/Business
- ○ Regional and Local Government Agency
- ○ Community Representative
- ○ I prefer not to answer
- ○ Other (specify)

18. What gender do you identify as? (Please choose only one)

- ○ Female
- ○ Male
- ○ Non-binary

- I prefer not to answer

19. Select the range that best describes your age (Please choose only one)

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and over
- I prefer not to answer

20. Which race or ethnicity best describes you? (Please choose only one)

- American Indian or Alaskan Native
- Asian / Pacific Islander
- Black or African American
- Hispanic
- White / Caucasian
- Multiple ethnicity
- I prefer not to answer
- Other (please specify)

THANK YOU FOR COMPLETING THIS SURVEY.

Survey Three (3) will be distributed in late January 2024. In *Survey Three (3)*, you will be asked to rank the final set of climate priorities from stakeholders who participated in *Survey Two (2)*. The survey will consist of priorities with high stakeholder agreement from *Survey Two (2)* to inform a final list of priority actions for the Mid-South PCAP.

Survey Three (3) will take about 15 minutes to complete. We very much value your participation in *Survey Three (3)*, please tick below if you are happy to receive an invitation to the survey. This is an opportunity for you and your colleagues to help shape the Mid-South PCAP under the Climate Pollution Reduction Grant program.

- O I am happy to receive an invitation to Survey 3
- O I do not want to receive an invitation to Survey 3

QUESTIONNAIRE-SURVEY 3

BUILDING CONSENSUS ON THE PRIORITY CLIMATE ACTIONS FOR THE MID-SOUTH PRIORITY CLIMATE ACTION PLAN

Introduction

Thank you for agreeing to participate in the stakeholder engagement activities for the Mid-South Priority Climate Action Plan (PCAP) as part of the Climate Pollution Reduction Grants (CPRG) program. This is a consensus-building exercise to identify priority actions for the Mid-South PCAP. As described in *Stakeholder Workshop 1 and 2*, held online on December 4, 2023, and January 22, 2024, respectively, the stakeholder engagement activities comprise a three-round survey that will gather the views of a wide range of stakeholders working to reduce climate pollution and address climate risks and hazards in the Mid-South region.

Findings from Surveys 1 and 2

In *Surveys 1 and 2*, participants were from non-governmental organizations/community-based organizations, regional and local government agencies, utility providers, and private businesses.

For *Survey 1*, 45 participants responded to the online questionnaire to indicate their priority climate actions for their jurisdictions or areas of operations. Overall, 26 out of 86 actions had 56% or more stakeholders indicating those actions as their priority climate actions for their jurisdictions or areas of operations. These actions became the basis of the *Survey 2* questionnaire where stakeholders were asked to indicate their agreement or disagreement on the actions to be included in the Mid-South PCAP. There were 57 participants for Survey 2, and for all the 26 actions presented, stakeholders agreed (81-96%) that these actions should be considered as climate pollution measures in the Mid-South PCAP.

Aim of Survey 3

Survey 3 is the last round surveys for the Mid-South PCAP and furthers the consensus-building efforts to identify the final set of climate priority actions for implementation. *Survey 3* aims to identify areas of broad agreement and disagreement based on a set of feasibility criteria for the 26 actions from *Survey 2*.

You can participate in *Survey 3*, even if you did not participate in *Surveys 1* and 2.

Once you access the survey, you will be guided to the relevant sections, which will enable you to respond. Our pilot testing suggests that it takes about 20 - 25 minutes to complete the survey.

We would be grateful if you could complete the survey by **Friday, February 9, 2024.** Your answers to the survey will be used and reported anonymously so that you cannot be identified. Please feel free to share or forward the Survey to other stakeholders who may be interested in providing their views.

If you have any questions about this survey or how your data will be used, please do not hesitate to contact ***Stephen Kofi Diko*** at skdiko@memphis.edu, ***Truus Apoanaba Abuosi*** at t.a.abuosi@memphis.edu, and ***Leigh Huffman*** at Leigh.Huffman@memphistn.gov. Full details about the Mid-South Climate Action Planning process and the Climate Pollution Reduction Grant program can be found at the Memphis and Shelby County Office of Sustainability and Resilience website at: https://osr.shelbycountytn.gov/cprg.

Any answer you give will be treated in confidence in accordance with the University of Memphis Institutional Review Board standards.

If you are happy to continue, please click below.

[ ] I agree to participate in this survey

Mid-South Priority Climate Actions on Energy

1. **Action 1.** Offer an incentive for property owners to upgrade their residential and commercial buildings (i.e. rebates, low-interest loan programs, etc.).

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

2. **Action 2**. Complete energy-efficiency improvements and offer green jobs in disadvantaged communities.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

3. **Action 3.** Partner with utilities to offer more energy upgrades for buildings.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

4. **Action 4.** Push for building codes to require more energy-efficient buildings.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

5. **Action 5.** Find and use better ways to finance energy efficiency projects.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

6. **Action 6.** Put solar panels on public buildings.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

7. **Action 7.** Identify low-performing public buildings and make energy-saving improvements to them.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

8. **Action 8.** Encourage the installation of solar panels.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

9. **Action 9.** Create incentives for the installation of clean energy technology.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

10. **Action 10.** Reduce paperwork and delays for people and businesses that want to install renewable energy.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

Mid-South Priority Climate Actions on Transportation

11. **Action 11.** Establish dedicated funding for public transit.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify)

12. **Action 12.** Design our built environment so that people don't have to drive as much.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

13. **Action 13.** Create a network of safe biking and walking paths all around town.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

Mid-South Priority Climate Actions on Waste

14. **Action 14.** Require recycling of construction and demolition waste.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

15. **Action 15.** Create an incentive to install water-saving fixtures.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this waste action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

16. **Action 16.** Food-producing businesses should do more to reduce their food waste.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

17. **Action 17.** Increase efforts to support the circular economy and reduce manufacturing emissions.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify): _____

Mid-South Priority Climate Actions on Government Operations

18. **Action 18.** Plant more trees.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

19. **Action 19.** Adopt new development rules that are better for the environment and contribute to climate pollution reduction.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

20. **Action 20.** Make all new government buildings environmentally friendly and net-zero carbon.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i.	Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

21. **Action 21.** Upgrade older neighborhoods to reduce flooding impacts.

a. Please share your opinion on the feasibility of building resilience through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to build resilience in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

22. **Action 22.** Build new flood storage ponds and restore creeks and streams.

a. Please share your opinion on the feasibility of building resilience through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to build resilience in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

23. **Action 23.** Design buildings and infrastructure to lower impacts from climate hazards.

a. Please share your opinion on the feasibility of building resilience through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to build resilience in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

Mid-South Priority Climate Actions on Business Operations

24. **Action 24.** Create incentives for companies and businesses to undertake energy-saving investments.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

25. **Action 25.** Contribute to the creation of a low-carbon, climate-resilient, and circular economy.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i. Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii. Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv. Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v. Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

26. **Action 26.** Re-orient investments towards more sustainable technologies and businesses.

a. Please share your opinion on the feasibility of reducing greenhouse gas emissions through this action, based on the identified criteria.

	Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Don't Know
i. Can this action be implemented within 1-3 years to significantly reduce GHG emissions in the Mid-South?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii. Would implementing this action have a positive impact on low-income and disadvantaged communities?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

b. Do you know of existing or additional resources that could be used to implement this program? If so, please elaborate in the response box below.

- ☐ Existing programs that could be expanded
- ☐ Financial resources
- ☐ Operational/Staffing resources
- ☐ Technology/Software resources
- ☐ Other

c. In your opinion, does this action align with the suggested guiding principles for the Mid-South PCAP?

		Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree	Don't Know
i.	Community Benefits and Co-Benefits (such as benefits to public health, air quality, resilience, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ii.	Equity and Environmental (Climate) Justice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iii.	Centralizing Reducing GHG emissions	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
iv.	Cost-Effectiveness	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
v.	Building Climate Pollution and Economy Synergies	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

d. Could you indicate which organization(s) you believe could take charge of carrying out this action?

- ☐ Non-governmental organization (NGO)/ Community-based organization
- ☐ Regional and Local Government Agency
- ☐ Private Companies/Business
- ☐ Utilities
- ☐ Communities
- ☐ Other (Specify):

_____

27. Do you have anything else you think is relevant to Survey 3, but wasn't part of?

_____

_____

_____

Demographics of Respondents

28. Name: _____

29. Name of Organization: _____

30. Email: _____

31. Location/City/Town/Neighborhood/Area of operation: _____

32. Please select the category that most correspond to your organization. (Please choose only one)

- ○ Non-governmental organization (NGO)/ Community-based organization
- ○ Utilities
- ○ Private Company/Business
- ○ Regional and Local Government Agency
- ○ Community Representative
- ○ I prefer not to answer
- ○ Other (specify)

What gender do you identify as? (Please choose only one)

- Female
- Male
- Non-binary
- I prefer not to answer

33. Select the range that best describes your age (Please choose only one)

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and over
- I prefer not to answer

34. Which race or ethnicity best describes you? (Please choose only one)

- American Indian or Alaskan Native
- Asian / Pacific Islander
- Black or African American
- Hispanic
- White / Caucasian
- Multiple ethnicity
- I prefer not to answer
- Other (please specify):_____

35. The Mid-South PCAP will have an acknowledgement section that would include a list of stakeholders. Kindly indicate whether you prefer to have your name listed or just the organization you affiliated with.

- I prefer to have my name listed.
- I prefer to have the organization I am affiliated with listed.
- I prefer not to answer.

THANK YOU FOR COMPLETING THIS SURVEY.

This is the end of the series of surveys for the Mid-South PCAP. We are extremely grateful that you were able to participate in these surveys to help shape the Mid-South PCAP under the Climate Pollution Reduction Grant program,

APPENDIX 4: TDEC PUBLIC ENGAGEMENT SURVEY

As a part of their public engagement process for the priority climate action plan (PCAP), The Tennessee Department of Environment and Conservation (TDEC) distributed an online public survey statewide. The Memphis and Shelby County Office of Sustainability and Resilience (OSR) distributed the link to the survey on social media channels and newsletters and sent the link to stakeholders and committed jurisdictions to distribute through their own networks. The survey was available for approximately two months and asked participants were to prioritize emission sectors, what individual actions they take to reduce greenhouse gas emissions, and motivations, challenges, and benefits related to those actions. Additionally, the survey asked respondents to provide information on any current occurring projects and future projects they wanted to see enacted to reduce emissions in the area. TDEC shared with OSR the survey responses of those respondents who pinned their home location within the Memphis metropolitan statistical area (MSA)'s boundaries.

We received 105 responses out of the 1,294 participants who provided their home location, with 38 (36 percent) of them residing in low-income and disadvantaged communities (LIDAC). Fifty-four respondents provided information on projects in their area.

Responses regarding future and current projects occurring in the MSA were included in the project analysis process and considered in the selection of priority reduction measures.

Respondents were asked to priority rank six greenhouse gas emission sectors (Transportation, Industrial Use, Natural and Working Lands, Residential & Commercial Buildings, Waste and Materials Management, and Electric Power). The most (25) respondents ranked the Industrial Use sector as their top priority closely followed by Transportation with 23 respondents placing it at the top. Following behind Transportation and Industrial comes Waste and Materials Management with 11 top rankings, Electric Power with 10, and Natural and Working Lands and Residential & Commercial Buildings both with 6.

When asked about what specific actions or strategies they take to reduce emissions, 78 percent of respondents said they reduce emissions by using energy-efficient appliances and light bulbs followed by 71 percent who said they recycle and reduce waste. 89 percent of respondents said concern for the environment and future generations was their motivation to take emission reduction actions and 68 percent cited a desire to reduce energy bills and save money. Seventy-five percent of respondents named the high cost of sustainable or energy-efficient alternatives as a challenge they face in implementing emission reduction actions.

Regarding benefits and challenges related to emission reduction projects, 77 percent of respondents thought that improved air quality and public health resulting from decreased air pollution was an important benefit to their community while 63 percent valued community resilience, or the ability to withstand extreme weather events. Seventy-two percent selected increased cost of living, including housing and utilities, as a concern around emission reduction projects while 59 percent expressed concern about increased disparity or inequity between communities.

APPENDIX 5: Low-Income and Disadvantaged Communities Census Block Groups

The table below lists the Memphis TN-MS-AT Metropolitan Statistical Area (MSA) low-income and disadvantaged community (LIDAC) census block groups as determined by the Climate and Economic Screening Tool (CEJST) and the Environmental Justice Screening and Mapping Tool (EJScreen). Each census block group is listed alongside its local jurisdiction and the reduction measure(s) it will be affected by.

		Reduction Measure					
					Target year		
Census Block Group GEOID	**Jurisdiction**	**E.1**	**E.2**	**R.1**	**T.1. 2030**	**T.1 2050**	**T.2**
471570211112	City of Bartlett			X		X	X
471570206214	City of Bartlett			X		X	
471570206213	City of Bartlett			X		X	
471570205314	City of Bartlett	X		X			X
471570211121	City of Bartlett			X		X	X
471570206523	City of Bartlett			X		X	
471570211122	City of Bartlett			X		X	X
471570206221	City of Bartlett			X		X	
471570211125	City of Bartlett			X		X	X
050350308071	City of Marion	X		X			
050350307021	City of Marion	X		X			
050350308042	City of Marion	X		X			
471570206212	City of Memphis			X		X	
471570099023	City of Memphis					X	
471570082005	City of Memphis			X	X	X	X
471570003001	City of Memphis			X		X	X
471570057002	City of Memphis			X		X	X
471570078214	City of Memphis			X		X	X
471570013003	City of Memphis			X		X	
471570206211	City of Memphis			X		X	
471570027002	City of Memphis			X		X	X
471570114013	City of Memphis			X	X	X	X
471570035001	City of Memphis			X	X	X	X
471570107203	City of Memphis			X		X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570055002	City of Memphis			X		X	X
471570205324	City of Memphis	X		X		X	
471570102203	City of Memphis			X	X	X	
471570116002	City of Memphis			X		X	X
471570098002	City of Memphis			X		X	X
471570223102	City of Memphis			X		X	
471570213342	City of Memphis			X		X	X
471570106303	City of Memphis			X		X	
471570105002	City of Memphis			X	X	X	X
471570222102	City of Memphis			X		X	X
471570062001	City of Memphis			X	X	X	X
471570007002	City of Memphis			X	X	X	X
471570205431	City of Memphis			X		X	X
471570079004	City of Memphis			X		X	X
471570118002	City of Memphis			X		X	
471570205111	City of Memphis			X		X	
471579801001	City of Memphis			X	X	X	X
471570050001	City of Memphis			X		X	
471570081101	City of Memphis			X		X	X
471570020001	City of Memphis			X		X	
471570063002	City of Memphis			X		X	X
471570221222	City of Memphis			X	X	X	
471570011001	City of Memphis			X		X	X
471570223224	City of Memphis			X		X	
471570219002	City of Memphis			X	X	X	
471570101201	City of Memphis			X	X	X	X
471570220241	City of Memphis			X	X	X	
471570110103	City of Memphis			X	X	X	
471570112002	City of Memphis			X	X	X	X
471570101221	City of Memphis			X		X	
471570226002	City of Memphis			X		X	X
471570087004	City of Memphis			X		X	
471570217312	City of Memphis			X		X	
471570028003	City of Memphis			X	X	X	X
471570015001	City of Memphis			X		X	X
471570056002	City of Memphis			X		X	X
471570036001	City of Memphis			X	X	X	X
471570099013	City of Memphis	X		X		X	X
471570100021	City of Memphis			X		X	X
471570102206	City of Memphis			X		X	X
471570067003	City of Memphis			X		X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570102104	City of Memphis			X	X	X	
471570108103	City of Memphis			X		X	X
471570205321	City of Memphis	X		X		X	
471570221321	City of Memphis			X	X	X	
471570030001	City of Memphis			X		X	X
471570079001	City of Memphis			X		X	
471570107103	City of Memphis			X		X	X
471570008001	City of Memphis			X		X	X
471570205413	City of Memphis			X		X	
471570223211	City of Memphis			X		X	
471570093003	City of Memphis			X		X	
471570117001	City of Memphis			X		X	X
471570217562	City of Memphis			X	X	X	
471570106203	City of Memphis			X	X	X	
471570006001	City of Memphis			X	X	X	X
471570221302	City of Memphis			X	X	X	
471570223221	City of Memphis			X		X	
471570080002	City of Memphis			X		X	
471570009001	City of Memphis			X		X	X
471570045001	City of Memphis			X		X	
471570088003	City of Memphis			X		X	
471570205423	City of Memphis			X		X	X
471570220231	City of Memphis			X	X	X	X
471570217601	City of Memphis			X	X	X	
471570032002	City of Memphis			X	X	X	
471570065001	City of Memphis			X		X	
471570053002	City of Memphis			X		X	X
471570221212	City of Memphis			X	X	X	
471570070001	City of Memphis			X		X	
471570075001	City of Memphis			X		X	X
471570223303	City of Memphis			X		X	
471570227003	City of Memphis			X		X	
471570113002	City of Memphis			X	X	X	X
471570102101	City of Memphis			X		X	
471570220252	City of Memphis			X	X	X	
471570217252	City of Memphis			X		X	X
471570037002	City of Memphis			X	X	X	X
471570087001	City of Memphis			X		X	
471570111001	City of Memphis			X		X	X
471570205212	City of Memphis	X		X		X	X
471570078212	City of Memphis			X	X	X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570082003	City of Memphis			X		X	
471570068002	City of Memphis			X		X	
471570102201	City of Memphis			X		X	
471570107201	City of Memphis			X		X	
471570115004	City of Memphis			X	X	X	X
471570206215	City of Memphis			X		X	
471570099021	City of Memphis	X		X		X	X
471570205322	City of Memphis			X		X	
471570079002	City of Memphis			X		X	
471570081201	City of Memphis			X		X	X
471570217573	City of Memphis			X		X	
471570206102	City of Memphis			X		X	
471570097002	City of Memphis			X		X	X
471570001003	City of Memphis			X		X	X
471570205421	City of Memphis			X		X	X
471570222205	City of Memphis			X	X	X	X
471570106301	City of Memphis			X		X	
471570117002	City of Memphis			X		X	X
471570060001	City of Memphis			X	X	X	X
471570106201	City of Memphis			X	X	X	
471570118003	City of Memphis			X	X	X	X
471570006002	City of Memphis			X		X	X
471570223222	City of Memphis			X		X	
471570101212	City of Memphis			X	X	X	X
471570221305	City of Memphis			X			X
471570211431	City of Memphis			X			
471570205232	City of Memphis			X			
471570225003	City of Memphis			X			
471570062002	City of Memphis			X		X	X
471570046001	City of Memphis			X	X	X	X
471570217212	City of Memphis			X		X	
471570217602	City of Memphis			X	X	X	
471570065002	City of Memphis			X		X	
471570053003	City of Memphis			X		X	X
471570221303	City of Memphis			X	X	X	
471570217464	City of Memphis			X	X	X	
471570025001	City of Memphis			X	X	X	X
471570102102	City of Memphis			X		X	
471570110101	City of Memphis			X	X	X	
471570220232	City of Memphis			X	X	X	
471570013001	City of Memphis			X		X	

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570089002	City of Memphis			X		X	
471570224103	City of Memphis			X		X	
471570217253	City of Memphis			X		X	X
471570111002	City of Memphis			X		X	X
471570015002	City of Memphis			X		X	X
471570225004	City of Memphis			X	X	X	X
471570220262	City of Memphis			X	X	X	
471570042001	City of Memphis			X	X	X	X
471570070002	City of Memphis			X		X	
471570087002	City of Memphis			X		X	
471570222202	City of Memphis			X		X	
471570225001	City of Memphis			X	X	X	X
471570004001	City of Memphis			X	X	X	X
471570100011	City of Memphis			X		X	
471570013004	City of Memphis			X		X	
471570028001	City of Memphis			X		X	X
471570078102	City of Memphis			X	X	X	X
471570035002	City of Memphis			X	X	X	X
471570055003	City of Memphis			X		X	X
471570091002	City of Memphis			X		X	
471570081204	City of Memphis			X		X	X
471570115001	City of Memphis			X	X	X	X
471570223103	City of Memphis			X		X	X
471570007003	City of Memphis			X		X	X
471570099011	City of Memphis	X		X		X	X
471570205411	City of Memphis			X		X	
471570217591	City of Memphis			X	X	X	
471570107101	City of Memphis			X		X	X
471570116003	City of Memphis			X		X	
471570078215	City of Memphis			X		X	X
471570079005	City of Memphis			X		X	
471570106103	City of Memphis			X		X	
471570059001	City of Memphis			X		X	X
471570205441	City of Memphis			X		X	X
471570217101	City of Memphis			X		X	X
471570205112	City of Memphis			X		X	X
471570206581	City of Memphis	X		X		X	
471570024001	City of Memphis			X		X	X
471570063003	City of Memphis			X		X	X
471570211222	City of Memphis			X		X	X
471570223212	City of Memphis			X		X	

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570221311	City of Memphis			X	X	X	
471570221223	City of Memphis			X	X	X	
471570050002	City of Memphis			X		X	X
471570219003	City of Memphis			X	X	X	
471570012001	City of Memphis			X		X	
471570227001	City of Memphis			X		X	
471570108202	City of Memphis			X		X	
471570112003	City of Memphis			X	X	X	
471570101222	City of Memphis			X	X	X	X
471570101204	City of Memphis			X		X	
471570221113	City of Memphis			X	X	X	X
471570069002	City of Memphis			X		X	
471570043001	City of Memphis			X		X	X
471570110201	City of Memphis			X	X	X	
471570206511	City of Memphis			X		X	
471570225002	City of Memphis			X	X	X	X
471570004002	City of Memphis			X		X	X
471570036002	City of Memphis			X	X	X	X
471570014001	City of Memphis			X		X	X
471570067004	City of Memphis			X		X	X
471570056003	City of Memphis			X		X	X
471570082001	City of Memphis			X		X	X
471570103001	City of Memphis	X		X		X	X
471570108104	City of Memphis			X		X	
471570078103	City of Memphis			X		X	
471570115002	City of Memphis			X	X	X	X
471570099012	City of Memphis	X		X		X	
471570211124	City of Memphis			X		X	X
471570001001	City of Memphis			X		X	X
471570030002	City of Memphis			X	X	X	X
471570205442	City of Memphis			X		X	X
471570116004	City of Memphis			X		X	X
471570223104	City of Memphis			X		X	X
471570221322	City of Memphis			X	X	X	
471570008002	City of Memphis			X		X	X
471570106104	City of Memphis			X		X	X
471570078221	City of Memphis			X	X	X	X
471570217571	City of Memphis			X	X	X	
471570222203	City of Memphis			X		X	X
471570059002	City of Memphis			X		X	X
471570080003	City of Memphis			X		X	

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570217102	City of Memphis			X		X	
471570009002	City of Memphis			X		X	X
471570205424	City of Memphis			X		X	
471570088004	City of Memphis			X		X	
471570217462	City of Memphis			X	X	X	
471570053001	City of Memphis			X		X	X
471570217592	City of Memphis			X	X	X	
471570221301	City of Memphis			X	X	X	
471570024002	City of Memphis			X		X	X
471570224101	City of Memphis			X		X	
471570217251	City of Memphis			X		X	X
471570012002	City of Memphis			X		X	
471570019001	City of Memphis			X		X	X
471570114011	City of Memphis			X		X	X
471570108203	City of Memphis			X		X	
471570100022	City of Memphis			X		X	X
471570101223	City of Memphis			X	X	X	X
471570038001	City of Memphis			X	X	X	X
471570043002	City of Memphis			X		X	X
471570069003	City of Memphis			X		X	
471570220253	City of Memphis			X	X	X	
471570206512	City of Memphis			X		X	
471570110202	City of Memphis			X	X	X	
471570101205	City of Memphis			X	X	X	X
471570082004	City of Memphis			X		X	
471570102204	City of Memphis			X	X	X	X
471570227004	City of Memphis			X			
471570211123	City of Memphis			X			X
471570205243	City of Memphis			X			
471570210211	City of Memphis	X		X			X
471570205213	City of Memphis			X			
471570068003	City of Memphis			X		X	X
471570078213	City of Memphis			X	X	X	X
471570205323	City of Memphis	X		X		X	
471570067001	City of Memphis			X		X	X
471570114021	City of Memphis			X		X	X
471570075002	City of Memphis			X		X	X
471570108101	City of Memphis			X		X	X
471570081202	City of Memphis			X		X	
471570106101	City of Memphis			X	X	X	
471570027001	City of Memphis			X	X	X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570116001	City of Memphis			X		X	
471570098001	City of Memphis			X		X	X
471570217581	City of Memphis			X	X	X	
471570206103	City of Memphis			X		X	X
471570106302	City of Memphis			X		X	
471570002001	City of Memphis			X		X	X
471570222103	City of Memphis			X		X	X
471570223101	City of Memphis			X		X	X
471570060002	City of Memphis			X	X	X	X
471570058001	City of Memphis			X		X	X
471570217551	City of Memphis			X		X	
471570205432	City of Memphis			X		X	X
471570106202	City of Memphis			X	X	X	
471570046002	City of Memphis			X	X	X	X
471570088001	City of Memphis			X		X	
471570101213	City of Memphis			X		X	
471570020002	City of Memphis			X		X	X
471570063001	City of Memphis			X		X	X
471570223301	City of Memphis			X		X	
471570081102	City of Memphis			X		X	X
471570074001	City of Memphis			X		X	
471570025002	City of Memphis			X	X	X	X
471570219001	City of Memphis			X	X	X	
471570011002	City of Memphis			X		X	X
471570205241	City of Memphis			X		X	
471570089003	City of Memphis			X		X	X
471570101202	City of Memphis			X	X	X	X
471570220242	City of Memphis			X	X	X	X
471570221221	City of Memphis			X	X	X	
471570217213	City of Memphis			X		X	
471570013002	City of Memphis			X		X	
471570224104	City of Memphis			X		X	
471570110102	City of Memphis			X	X	X	
471570221111	City of Memphis			X	X	X	X
471570070003	City of Memphis			X		X	X
471570217561	City of Memphis			X		X	
471570108102	City of Memphis			X		X	X
471570102205	City of Memphis			X		X	
471570028002	City of Memphis			X		X	X
471570100012	City of Memphis			X		X	
471570035003	City of Memphis			X	X	X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570056001	City of Memphis			X		X	X
471570067002	City of Memphis			X		X	X
471570078101	City of Memphis			X		X	X
471570081203	City of Memphis			X		X	X
471570114022	City of Memphis			X	X	X	X
471570217582	City of Memphis			X	X	X	
471570107102	City of Memphis			X		X	X
471570007004	City of Memphis			X		X	X
471570205412	City of Memphis			X		X	X
471570106102	City of Memphis			X	X	X	
471570221312	City of Memphis			X	X	X	
471570205433	City of Memphis			X		X	X
471570058002	City of Memphis			X		X	
471570080001	City of Memphis			X		X	
471570222201	City of Memphis			X	X	X	X
471570021001	City of Memphis			X	X	X	X
471570011003	City of Memphis			X		X	
471570008003	City of Memphis			X		X	X
471570223302	City of Memphis			X		X	
471570223213	City of Memphis			X		X	
471570081103	City of Memphis			X		X	X
471570219004	City of Memphis			X	X	X	
471570074002	City of Memphis			X		X	
471570227002	City of Memphis			X		X	
471570091001	City of Memphis			X		X	X
471570113001	City of Memphis			X		X	X
471570205242	City of Memphis			X		X	
471570224105	City of Memphis			X		X	
471570220251	City of Memphis			X	X	X	
471570221112	City of Memphis			X	X	X	X
471570069001	City of Memphis			X		X	X
471570101203	City of Memphis			X	X	X	X
471570057001	City of Memphis			X		X	
471570211111	City of Memphis			X		X	X
471570037001	City of Memphis			X	X	X	X
471570078211	City of Memphis			X	X	X	X
471570212001	City of Memphis			X		X	X
471570068001	City of Memphis			X		X	X
471570108201	City of Memphis			X		X	
471570107202	City of Memphis			X		X	X
471570082002	City of Memphis			X		X	

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570115003	City of Memphis			X	X	X	X
471570114012	City of Memphis			X		X	X
471570099022	City of Memphis			X		X	X
471570102202	City of Memphis			X		X	
471570059003	City of Memphis			X		X	X
471570055001	City of Memphis			X		X	X
471570206101	City of Memphis			X		X	X
471570222101	City of Memphis			X		X	
471570030003	City of Memphis			X	X	X	X
471570105001	City of Memphis			X	X	X	X
471570001002	City of Memphis			X		X	X
471570217572	City of Memphis			X	X	X	
471570217541	City of Memphis	X		X	X	X	X
471570007001	City of Memphis			X	X	X	X
471570205422	City of Memphis			X		X	X
471570222204	City of Memphis			X		X	X
471570118001	City of Memphis			X		X	
471570118004	City of Memphis			X		X	
471570106105	City of Memphis			X	X	X	X
471570079003	City of Memphis			X		X	X
471570009003	City of Memphis			X		X	X
471570205425	City of Memphis			X		X	
471570217211	City of Memphis			X		X	X
471570073002	City of Memphis			X	X	X	
471570097001	City of Memphis			X		X	X
471570080004	City of Memphis			X		X	
471570227005	City of Memphis			X		X	
471570089001	City of Memphis			X		X	X
471570221304	City of Memphis			X	X	X	X
471570223223	City of Memphis			X		X	
471570024003	City of Memphis			X		X	
471570108204	City of Memphis			X		X	
471570012003	City of Memphis			X		X	
471570102103	City of Memphis			X		X	
471570100023	City of Memphis			X		X	X
471570220233	City of Memphis			X	X	X	X
471570224102	City of Memphis			X		X	
471570019002	City of Memphis			X		X	X
471570087003	City of Memphis			X		X	
471570112001	City of Memphis			X	X	X	X
471570101211	City of Memphis			X	X	X	X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471570220261	City of Memphis			X	X	X	
471570217311	City of Memphis			X	X	X	
471570039001	City of Memphis			X	X	X	
471570205312	City of Memphis	X		X			
471570088002	City of Memphis			X			
471570205211	City of Memphis	X		X			X
471570211242	City of Memphis	X		X			X
471570205231	City of Memphis			X			
471570226001	City of Memphis	X		X	X	X	X
471570202212	City of Millington	X		X			X
471570203023	City of Millington			X			X
471570202101	City of Millington	X		X			X
471570203021	City of Millington			X			X
471570202211	City of Millington	X		X			X
471570202222	City of Millington	X		X			X
471570203022	City of Millington			X			X
281379504004	City of Senatobia			X			X
280330704222	City of Southaven			X			
280330704122	City of Southaven			X			
280330703102	City of Southaven			X			
280330703233	City of Southaven			X			
280330705222	City of Southaven			X			
280330704212	City of Southaven			X			
280330704221	City of Southaven			X			
280330704111	City of Southaven			X			X
280330705212	City of Southaven			X			
280330704123	City of Southaven			X			
280330704121	City of Southaven			X			
050350303021	City of West Memphis	X		X			
050350301012	City of West Memphis	X		X			X
050350312001	City of West Memphis	X		X			X
050350305032	City of West Memphis	X		X			X
050350301023	City of West Memphis	X		X			X
050350310001	City of West Memphis	X		X			
050350303011	City of West Memphis	X		X			
050350302013	City of West Memphis	X		X			X
050350303022	City of West Memphis	X		X			
050350312002	City of West Memphis	X		X			
050350302011	City of West Memphis	X		X			
050350306023	City of West Memphis	X		X			X
050350303012	City of West Memphis	X		X			X

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
050350302014	City of West Memphis	X		X			X
050350301021	City of West Memphis	X		X			
050350305031	City of West Memphis	X		X			X
050350302015	City of West Memphis	X		X			X
050350301011	City of West Memphis	X		X			X
050350301022	City of West Memphis	X		X			X
050350307031	City of West Memphis	X		X			X
050350306021	City of West Memphis	X		X			X
050350302012	City of West Memphis	X		X			X
470470603004	Fayette County	X		X			X
470470606001	Fayette County	X		X			
470470603001	Fayette County	X		X			
470470606004	Fayette County	X		X			
470470605022	Fayette County	X		X			
470470603002	Fayette County	X		X			X
470470605023	Fayette County	X		X			
470470605011	Fayette County	X		X			
470470606002	Fayette County	X		X			
470470605014	Fayette County	X		X			
470470605021	Fayette County	X		X			
470470605012	Fayette County	X		X			
470470603003	Fayette County	X		X			X
470470605024	Fayette County	X		X			
470470605013	Fayette County	X		X			
470470606003	Fayette County	X		X			
2803307112 41	Hernando city	X		X			X
471570203011	Millington city	X		X			X
471570201011	Shelby County	X		X			X
471570201014	Shelby County	X		X			
471570202221	Shelby County	X		X			
471570201012	Shelby County	X		X			X
471570216201	Shelby County	X		X			
471570217522	Shelby County	X		X			X
471570201013	Shelby County	X		X			X
471670401001	Tipton County	X		X			
471670401002	Tipton County	X		X			
471670401003	Tipton County	X		X			
471670402001	Tipton County	X		X			
471670402002	Tipton County	X		X			
471670403041	Tipton County	X		X			
471670403042	Tipton County	X		X			

Census Block Group GEOID	Jurisdiction	E.1	E.2	R.1	T.1. 2030	T.1 2050	T.2
471670403043	Tipton County	X		X			
471670404001	Tipton County	X		X			
471670404002	Tipton County	X		X			
471670406021	Tipton County	X		X			
471670406022	Tipton County	X		X			
471670406023	Tipton County	X		X			
471670407001	Tipton County	X		X			
471670407002	Tipton County	X		X			
471670407003	Tipton County	X		X			
471670407004	Tipton County	X		X			
471670407005	Tipton County	X		X			
471670410001	Tipton County	X		X			
471670410002	Tipton County	X		X			
050350310002	Town of Crawfordsville	X		X			
050350306022	Town of Horseshoe Lake	X		X			
281439502003	Tunica County	X		X			
281439501023	Tunica County	X		X			
281439501021	Tunica County	X		X			X
281439502001	Tunica County	X		X			
281439502004	Tunica County	X		X			
281439501022	Tunica County	X		X			
281439502002	Tunica County	X		X			
281439501011	Tunica County	X		X			