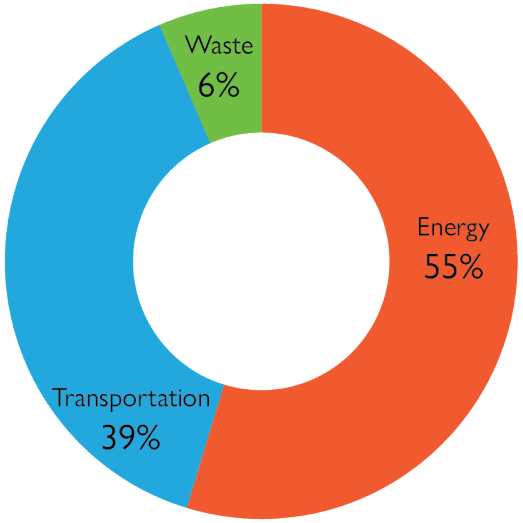
MEMPHIS AREA CLIMATE ACTION PLAN 2022 ANNUAL REPORT

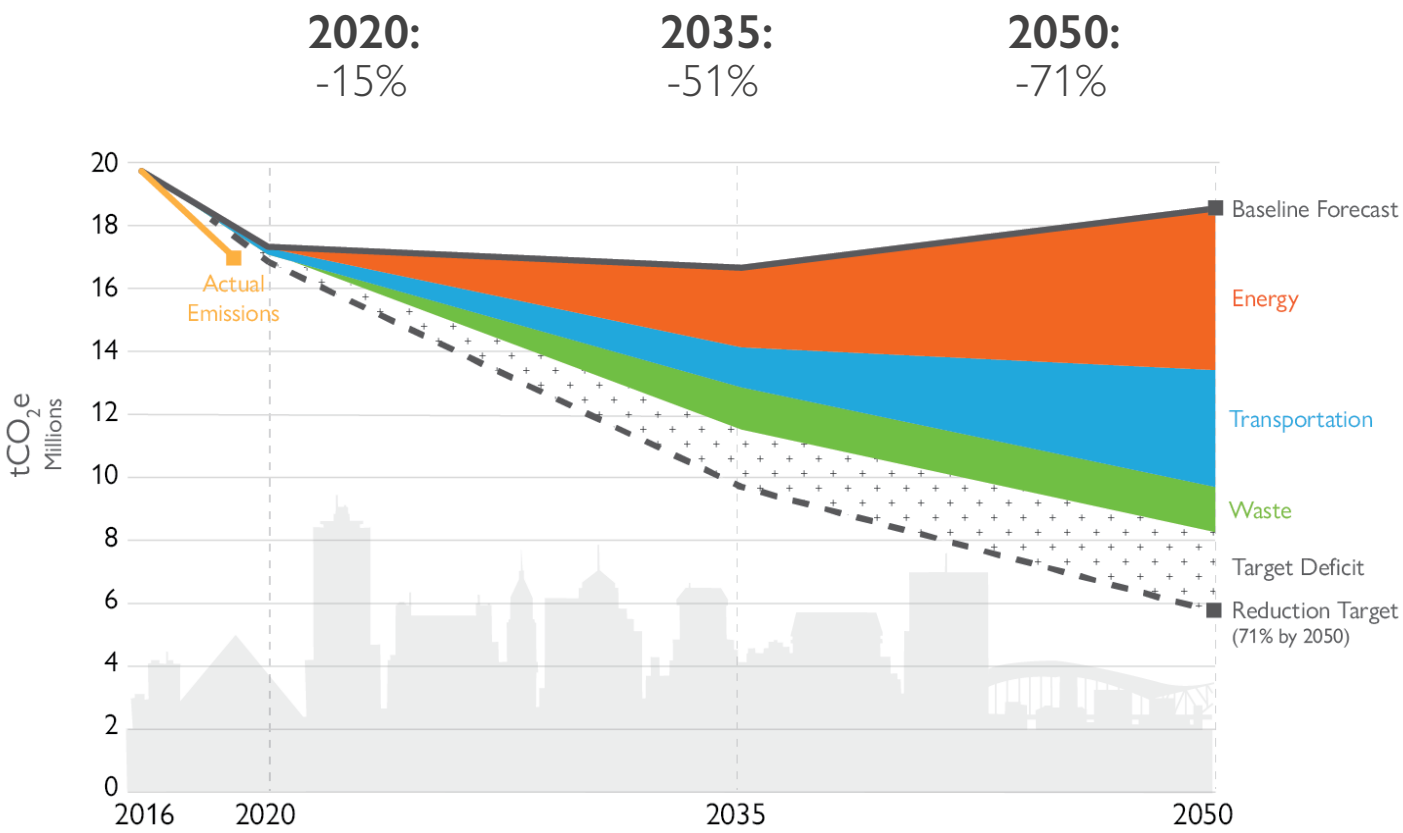
The Memphis Area Climate Action Plan is a framework for achieving significant reductions in our community's greenhouse gas (GHG) emissions and fostering a more equitable, healthy, and prosperous community. The plan provides information on existing emissions; sets short-, mid-, and long-term targets for reducing emissions; and outlines specific actions in three sectors - energy, transportation, and waste - to achieve these goals. The Annual Report tracks progress toward the goals and targets in the Plan and includes the most recent community-wide GHG Emissions Inventory. View the full plan at www.develop901.com/osr/memphisClimateActionPlan.

Current GHG Emissions (2019)



16,955,939
metric tons CO_2e

Greenhouse Gas Emissions Reduction Targets



Community-wide GHG Emissions Estimates[1]

(metric tons of CO_2e)

	Original 2016	Revised 2016	2019
Energy	**7,900,671**	**10,613,344**	**9,274,301**
Stationary Energy, Commercial and Institutional Buildings	3,692,414	3,692,414	2,920,712
Stationary Energy, Manufacturing and Construction	838,632	2,079,891	1,975,185
Stationary Energy, Residential Buildings	3,369,625	3,369,625	2,983,781
Stationary Energy, Energy Industries	--	465,933	502,982
Stationary Energy, Non-specified Sources	--	175,391	199,581
Stationary Energy, Fugitive Emissions from Oil and Natural Gas Systems	--	830,090	692,060
Transportation	**7,171,416**	**7,997,387**	**6,580,718**
Transportation, Aviation	352,392	1,027,716	1,088,011
Transportation, On-road	6,686,472	6,659,143	5,239,518
Transportation, Railway	88,591	89,523	66,735
Transportation, Waterborne Navigation	43,961	221,005	186,454
Waste	**2,119,828**	**1,158,912**	**1,100,920**
Waste, Biological Treatment of Waste	101,766	101,766	4,128
Waste, Solid Waste Disposal	1,933,456	753,875	793,005
Waste, Wastewater Treatment and Discharge	84,606	303,271	303,787
Grand Total	**17,191,915**	**19,769,643**	**16,955,939**

To reduce our community's carbon footprint, we first have to know where we stand in terms of greenhouse gas (GHG) emissions. The table above shows Shelby County's community-wide GHG inventories in metric tons of carbon dioxide equivalent (MT CO_2e) for the years 2016 and 2019.

The data available and methodologies used to estimate community-wide emissions inventories are constantly evolving as cities and researchers around the world find ways to improve the estimates. Best practices call for comparisons to occur between inventories that use the same methodology. Staff revised the 2016 baseline inventory to match the same methodology used for the 2019 emissions estimate and reflect the 2021 update to the *Global Protocol for Community-Scale Greenhouse Gas Inventories*.

1 See Appendix 1 for methodology and data sources for the GHG inventories.

SECTOR TARGET PROGRESS: ENERGY[1]

Baseline Emissions (2016):	Current Emissions (2019):	Emissions Reduction Targets:			Status:
10,613,344 metric tons CO_2e	9,274,301 metric tons CO_2e	2020: -21%	2035: -54%	2050: -81%	IN PROGRESS

1 Improve Energy Efficiency of Buildings & Key Infrastructure

Action	Objective	2016 Baseline	2021 Status	Implementation Status[2]
Green Building Standards	Codify and implement new green building regulations by 2022; full compliance by 2025.	Not codified	Not codified	Monitoring
Low-Income Housing Energy Efficiency	Increase # of low-income residences retrofitted by 500% by 2028; aim for a 30% reduction in energy usage per household.	433 homes in the base year	**101%** increase in low-income residences retrofitted annually	In Progress
Energy Efficiency Education & Outreach	Attain a 10% or greater reduction in average electricity use for residential and commercial sectors.	14,532.92 average kWh/ residential customer 144,951.1 average kWh/ commercial customer	**4%** reduction for residential **9%** reduction for commercial	In Progress
LED Streetlight Retrofit	Replace all existing non-LED streetlights and leased outdoor lighting (LOL) with LED bulbs by 2030 or sooner, beginning in 2025.	149,551 streetlights and LOLs in Memphis and Shelby County	**0%** converted to LED	In Progress
Residential Energy Efficiency Retrofits	By 2025, 15% of all residences will have energy-efficient space heating and cooling equipment and major appliances.	Baseline assumed 0% of owner-occupied homes	**3%** of owner-occupied homes	In Progress

2 Transform Our Energy Supply

Grid Decarbonization	Achieve 80% carbon-free energy in electricity supply by 2035; 100% carbon-free by 2050.	51% carbon free	**56%** carbon free	In Progress

3 Increase Green Infrastructure & Community Resilience

Urban Tree Canopy	Increase urban tree canopy coverage countywide to 60% by 2050.	37% coverage in 2012	**48%** coverage[3]	In Progress

1 See Appendix 2 for references.

2 **ON TRACK** = met or exceeded target/objective **IN PROGRESS** = target not met yet **MONITORING** = Not performing as expected or still defining an indicator

3 The most recent canopy analysis occured in 2012. Staff conducted an in-house preliminary analysis using 2021 LandSat images, but it has not been evaluated for accuracy.

SECTOR TARGET PROGRESS: TRANSPORTATION[1]

Baseline Emissions (2016):	Current Emissions (2019):	Emissions Reduction Targets:			Status:
7,997,387 metric tons CO_2e	6,580,718 metric tons CO_2e	2020: -13%	2035: -44%	2050: -62%	ON TRACK

1 Shift to Low-Carbon Transportation Modes & Reduce Reliance on Motor Vehicles

Action	Objective	2016 Baseline	2021 Status	Implementation Status[2]
Compact Land Use	Encourage denser, mixed-use development to reduce vehicle trips and support walking, biking, and transit.	56% of citywide building permit value was for development in Memphis 3.0 Anchor Areas.[3]	**44%** of citywide building permit value	Monitoring
Complete Streets to Encourage Walking & Bicycling	Convert 10% of vehicle trips to bike/ped modes by 2030; convert 40% of vehicle trips to bike/ped modes by 2050.	1.6% of commuting trips used bike/ped modes	**1.0%** of commuting trips	Monitoring
Public Transit	Implement the 3.0 Transit Vision by 2022.	Not implemented	MATA believes the Transit Vision will be fully implemented by 2030.	Monitoring
	Increase ridership and improve frequency to meet MATA's long-range objectives.	7.8 million annual unlinked trips; 7.0 million annual vehicle revenue miles	**5.1 million** annual unlinked trips; **5.7 million** annual vehicle revenue miles[4]	Monitoring
	Convert MATA's fleet to electric by 2050.	0 Electric buses	**0** Electric buses	In Progress
Transportation Demand Management	Reduce drive-alone commute trips by 10% by 2022; reduce drive-alone commute trips by 40% by 2050.	82.7% of commute trips are drive-alone	**77.1%** of commute trips are drive-alone	In Progress

2 Set the Stage for Vehicle Electrification

Electric Vehicles	Increase passenger vehicle travel using electric vehicles to 5% by 2025; 30% by 2035; 50% by 2050.	0.17% of passenger vehicles	**0.29%** of passenger vehicles	In Progress
	Increase freight travel using electric vehicles to 3% by 2025; 20% by 2035; 50% by 2050.	Baseline assumed 0%	Have not identified a tracking metric yet.	Monitoring

1 See Appendix 3 for references.

2 **ON TRACK** = met or exceeded target/objective **IN PROGRESS** = target not met yet **MONITORING** = Not performing as expected or still defining an indicator

3 Data is for calendar year 2018.

4 Data is for calendar year 2020.

SECTOR TARGET PROGRESS: WASTE[1]

Baseline Emissions (2016):	Current Emissions (2019):	Emissions Reduction Targets:			Status:
1,158,912 metric tons CO_2e	1,100,920 metric tons CO_2e	2020: -0.4%	2035: -63%	2050: -61%	ON TRACK

1 Reduce Waste & Move Toward a Zero-Waste Future

Action	Objective	2016 Baseline	2021 Status	Implementation Status[2]
Yard & Wood Waste Diversion	Cut yard/wood waste destined for landfills by half by 2035, relative to 2016.	4.4% of MSW destined to landfills by weight	A waste characterization study is required to track this.	Monitoring
Paper/Cardboard and Food Waste Reduction	Achieve a 20% reduction in paper/cardboard sent to landfills from commercial, institutional and industrial sectors by 2030.	34.6% of MSW destined to landfills by weight	A waste characterization study is required to track this.	Monitoring
	Achieve a 10% reduction in food waste sent to landfills from these sectors by 2030.	9.1% of MSW destined to landfills by weight	A waste characterization study is required to track this.	Monitoring
Inorganic Waste Diversion	Increase the landfill diversion rate of construction & demolition waste and plastic waste.	12.85% total waste diversion rate	**11.80%** total waste diversion rate	Monitoring

2 Promote a Cultural Shift in our Community's Approach to Waste

Tire Management & Collection Practices	Increase the use of recycled tire materials in building projects and reduce improper tire disposal through targeted programs.	157 tons collected	**1120 tons** collected	On Track

3 Improve Practices & Technology at Wastewater Treatment Facilities & Landfills

Methane Recovery & Landfill Gas Destruction	Extend the use of biogas controls to Class III and IV landfills by 2035.	Not implemented	Not implemented	Monitoring
	Improve the biogas capture rate at Class I landfills from 75% to 85% by 2020, and promote greater methane recovery over biogas flaring.	75%	**79.88%**[3]	Monitoring

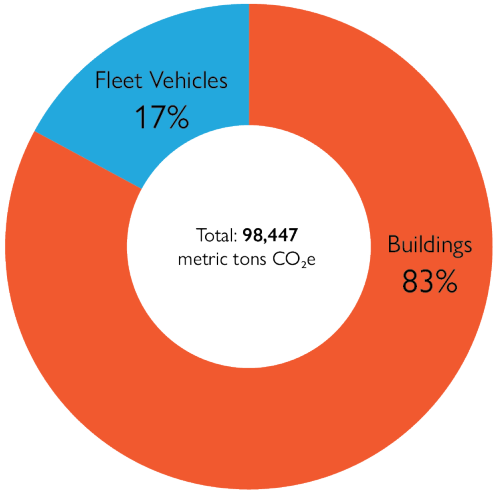
1 See Appendix 4 for references.

2 **ON TRACK** = met or exceeded target/objective **IN PROGRESS** = target not met yet **MONITORING** = Not performing as expected or still defining an indicator

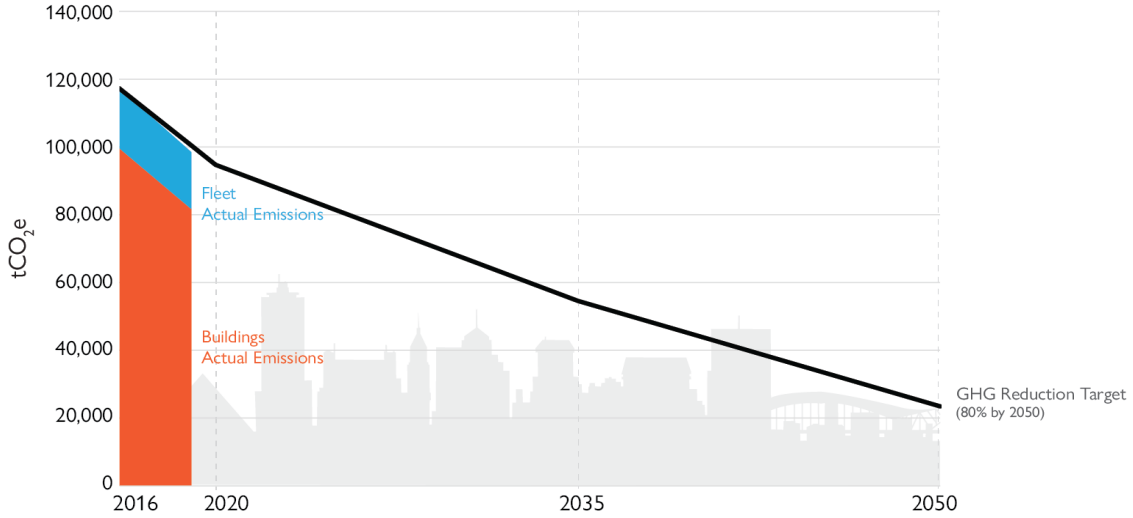
3 Data is for calendar year 2020.

CITY OF MEMPHIS GOVERNMENT INVENTORY[1]

Current GHG Emissions (2019)

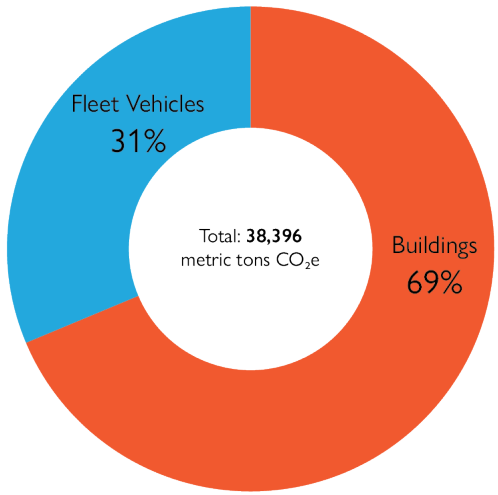


City of Memphis Government GHG Reductions & Progress Toward Target

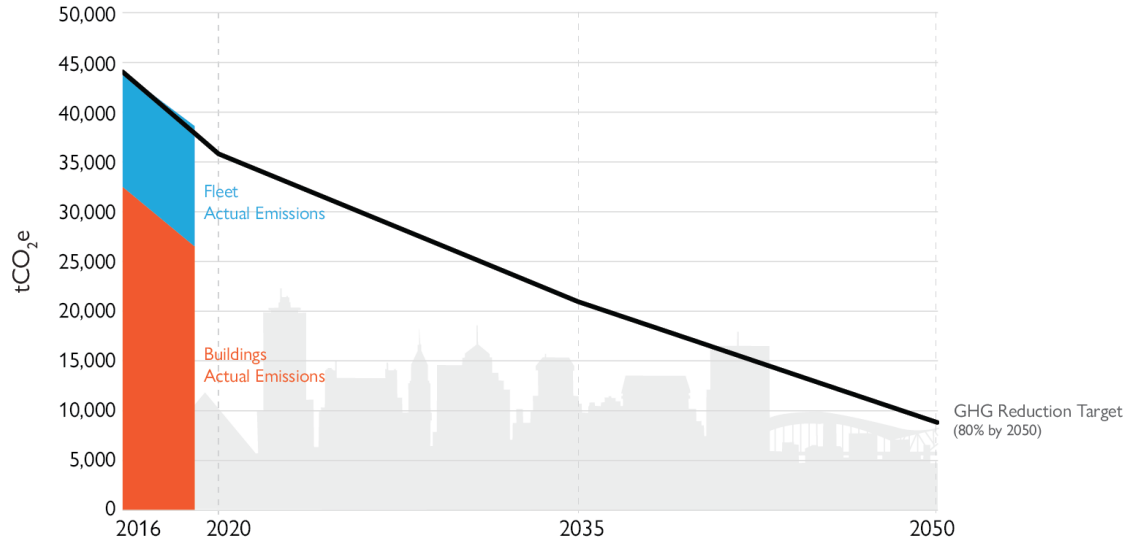


SHELBY COUNTY GOVERNMENT INVENTORY[1]

Current GHG Emissions (2019)



Shelby County Government GHG Reductions & Progress Toward Target



1 See Appendix 5 for references.

IMPLEMENTATION STEP PROGRESS: ENERGY[1]

E.1 Green Building Standards

Implementation Step	Status	Update
Require that all new municipal buildings and major renovations for the City and County meet LEED or Net Zero Energy standards.	**Proposed**	
Review approaches to implementing green building codes in other cities to assess best practices for adoption.	**Proposed**	
Gather input on the design and scale of mandatory green building standards in Memphis and Shelby County from the Memphis-Shelby County Building Code Board and other stakeholders in the building and development industry.	**Proposed**	
Adopt green building and energy codes that improve upon the requirements of model codes; consider standards such as the international Green Construction Code, ASHRAE Standard 189.1, and stretch codes implemented in other jurisdictions.	**Proposed**	
Explore the adoption of Net Zero building standards to achieve deeper energy savings and GHG reductions in the long-term.	**Proposed**	
Establish a regular and frequent review process for updating building and energy codes to ensure compliance with the latest green building standards.	**Proposed**	
Evaluate the feasibility of implementing benchmarking and transparency requirements for energy use in large commercial and multi-family buildings to encourage improved energy efficiency and to connect property owners to resources.	**Proposed**	
Consider requiring development projects that receive PILOTs (Payment in Lieu of Taxes) or other public incentives to meet minimum green building standards such as LEED certification or Net Zero Energy.	**Proposed**	
Consider expanding existing green building incentives in the PILOT (Payment in Lieu of Taxes) Program to encourage innovative, sustainable design in projects that receive public assistance.	**Proposed**	
Explore the adoption of other incentives to encourage green building above mandatory standards such as density bonuses, reduced minimum parking requirements, expedited review and permitting, reduced fees, and marketing assistance.	**In Progress**	In August 2022, the Memphis City Council adopted an ordinance establishing a Commercial Property Assessed Clean Energy and Resiliency (C-PACER) program. The City of Memphis has hired Opticos Design, Inc. to draft Urban Design Guidelines for new development projects within city limits, and has consulted with the DPD, Office of Sustainability and Resilience (OSR), to make sure the City is using this document as an opportunity to reinforce sustainability and resiliency goals.
Develop educational materials for the building/development community and the public on the benefits and implementation details of green building standards.	**Proposed**	

1 See Appendix 2 for references.

IMPLEMENTATION STEP PROGRESS: ENERGY

E.2 Low-Income Housing Energy Efficiency

Implementation Step	Status	Update
Aggressively pursue additional funding sources—both public and private—to expand existing weatherization programs for low-income residents.	**Ongoing**	Both City of Memphis and Shelby County have weatherization programs in place.
Leverage existing efforts such as the Healthy Homes Partnership (HHP), the Green & Healthy Homes Initiative (GHHI), and other public and private energy efficiency investments to improve coordination and maximize the benefit of existing programs.	**Proposed**	
Work with public and private partners to foster a skilled, quality workforce in the weatherization/energy efficiency field with a particular focus on creating jobs for residents in energy-burdened communities.	**Proposed**	
Strengthen complementary education programs for residents who receive weatherization assistance to encourage behaviors and practices that maximize energy efficiency and cost savings.	**Proposed**	
Develop more robust marketing, outreach, and engagement efforts in collaboration with residents in energy-burdened neighborhoods to provide information on existing programs and encourage participation.	**Proposed**	
Explore how new tools and programs—such as the Affordable Housing Trust Fund—can incorporate energy efficiency goals and standards.	**Proposed**	

E.3 Energy Efficiency Education & Outreach

Research best practices from effective residential and commercial campaigns encouraging energy efficiency and energy conservation.	**Proposed**	
Develop programs and materials with community members to determine what effective outreach looks like in terms of types of materials and delivery methods, content, and who is delivering information and messages to the community.	**Proposed**	
Engage high-profile leadership and well-known Memphians to promote energy efficiency/conservation campaigns.	**Proposed**	
Collaborate with community-based organizations, nonprofits, advocacy groups, faith communities, and large employers to raise awareness and encourage participation in energy efficiency campaigns or challenges.	**Proposed**	
Provide resources to the commercial sector on energy tracking tools in preparation for a commercial energy reduction challenge.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: ENERGY

E.4 LED Streetlight Retrofit

Implementation Step	Status	Update
Prepare an up-to-date, full life cycle cost/benefit analysis for retrofitting streetlights and leased outdoor lighting that includes operations and maintenance costs, energy use costs, and other economic considerations.	**Complete: City of Memphis** **Proposed: Shelby County**	The Allworld Project Management (AWPM) team worked closely with Ameresco, MLGW, and the City of Memphis to present a best/worst case scenario on a financial model. The expected energy savings from the streetlighting retrofit project include energy usage and operational/ maintenance cost over the anticipated lifetime of 20-25 years.
Research best practices and approaches for comprehensive streetlight retrofit programs in other cities.	**Complete: City of Memphis** **Proposed: Shelby County**	The project team recommended best practices and approaches based on their combined experience gained from completing more than 70 municipal streetlight projects worldwide. MLGW listed and researched streetlight luminaires/lighting controls from diffirent municipalities and vendors.
Explore financing options for the retrofit program, including bond issuances and loans that can be repaid with operations and maintenance savings.	**Complete: City of Memphis** **Proposed: Shelby County**	The AWPM and Ameresco team presented various financial options to MLGW and the City of Memphis. The current direction is for MLGW to issues bonds for this project. They expect for these bonds to be repaid through operational and maintenance savings.
Ensure the new LED streetlights are designed with an appropriate color temperature of 3,000 Kelvin or lower and are properly shielded.	**In Progress**	MLGW and the City of Memphis are currently reviewing color temperature for the streetlight retrofit.
Develop a public education and communications campaign to explain project implementation and up-front costs as well as the short- and long-term community-wide benefits.	**In Progress**	This is currently being developed in partnership with AWPM, Ameresco, MLGW, and the City of Memphis leadership team.

E.5 Residential Energy Efficiency Retrofits

Work with MLGW and other partners to develop a tariffed on-bill financing program for residential energy retrofits. Major steps include identification of initial capital to seed the program, utility and property data assessment to identify candidates, intake design, marketing materials development, and the potential implementation of a pilot project to test the concept.	**Proposed**	
Advocate for state legislation that allows the implementation of a local Residential Property Assessed Clean Energy (PACE) program. Work with local officials and other partners to develop policies and procedures for a local PACE program.	**Proposed**	
Work with MLGW, elected officials, and other partners to explore the feasibility of changing MLGW's charter to allow residential energy efficiency rebates.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: ENERGY

E.5 Residential Energy Efficiency Retrofits (continued)

Implementation Step	Status	Update
Enhance existing local education and marketing efforts that provide information on home energy audits, energy-efficient equipment and appliances, and renewable energy installation.	**Ongoing**	TVA and MLGW implemented the EnergyRight Marketplace in fourth quarter 2021, offering a web portal that enables customers to search on 30 categories of residential appliances and equipment based on Enervee efficiency score and other factors. Access at https://energyright.efficientchoice.com/
Develop a system to collect local data on sales and installations of energy-efficient appliances and other energy efficiency measures. This could involve public surveys, more comprehensive monitoring and assessment information from existing weatherization programs, or other data collection methods.	**In Progress**	OSR is looking into ways to measure the objective for this Priority Action.
For future efforts focusing on the commercial sector, develop local marketing campaigns to provide information on existing products such as Pathway Lending's Low-Interest Energy Efficiency and Renewable Energy Loans and TVA's EnergyRight energy efficiency incentives.	**Proposed**	

E.6 Grid Decarbonization

Advocate for TVA to increase the amount of renewable energy sources—particularly wind and solar—in its portfolio, whether through Renewable Energy Certificates, Power Purchase Agreements for renewable power, or development/ownership of new renewable energy generation assets.	**Ongoing**	DPD works with partners in other municipalities to advocate for increasing the amount of renewable energy sources in TVA's grid mix.
Commit to a Renewable Portfolio Standard for the City of Memphis and Shelby County local government operations and explore options for achieving these renewable goals, such as solar installations on government facilities, Renewable Energy Certificates, participating in community shared solar projects, and green tariff products.	**In Progress**	In June 2022, Shelby County entered into a contract to install two solar photovoltaic arrays that will power two County facilities.
Work with TVA and MLGW to push for new tools and programs that enable interested customers—public and private—to purchase or develop renewable energy.	**In Progress**	Increased solar installer marketing efforts and continued federal tax incentives have driven MLGW Applications for Interconnection from an annual average of 18 during 2004-2019 period to annual average of 99 during 2020-3Q2022.
Work with TVA and MLGW to explore changes to current contract terms that require all local power to be purchased through TVA and explore the feasibility of purchasing renewable energy from other third-party providers.	**Proposed**	
Encourage MLGW and local stakeholders to prioritize decarbonization and increasing renewable energy generation during internal resource planning processes.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: ENERGY

E.6 Grid Decarbonization (continued)

Implementation Step	Status	Update
Implement at least one local community shared solar project that includes subsidies for low-income household participation in the Memphis area by 2022.	**Proposed**	
Explore the implementation of a community shared solar program that includes policies and incentives to increase low-income household participation.	**Proposed**	

E.7 Urban Tree Canopy

Implement recommendations in the Memphis Regional Canopy Action Plan related to enhanced monitoring and data accessibility, improved regional and local management practices, and more robust public engagement/outreach and regional collaboration.	**Proposed**	
Implement recommendations in the Mid-South Regional Resilience Plan related to developing standard design guidelines for street tree plantings, coordinating work across agencies and municipalities, encouraging and incentivizing tree plantings on public and private land, and selecting native/non-invasive trees that can survive and thrive in an urban environment.	**Proposed**	
Review, improve, and align current urban forestry and landscaping standards in development codes to encourage protection and expansion of the urban tree canopy.	**Proposed**	
Develop a robust urban forestry program within the City of Memphis and/or Shelby County government and hire staff to implement.	**Proposed**	
Establish partnerships with nonprofits and philanthropy groups to pursue additional funding sources for tree planting and maintenance.	**Proposed**	
Work with MLGW to coordinate tree trimming needs for above-ground utility infrastructure with goals and standards for protecting the health of the urban tree canopy.	**Proposed**	
Coordinate tree canopy expansion work with potential efforts to develop solar generation facilities on vacant land.	**Proposed**	
Develop public education materials on tree standards; benefit of the urban tree canopy; impacts of invasive species on forest health; and proper selection, placement, planting, and care procedures.	**Proposed**	
Collaborate with community groups to enhance and expand stewardship programs for tree canopy maintenance and expansion.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: ENERGY

E.8 Climate Mitigation & Adaptation Alignment

Implementation Step	Status	Update
Implement projects and practices recommended in the Mid-South Regional Resilience Master Plan.	**In Progress**	In 2022, OSR began providing comments on land use and development cases in line with the recommended process in the Mid-South Regional Resilience Master Plan.
Prioritize cross-cutting mitigation/adaptation investments that reduce risks to low-income, vulnerable communities and improve equity outcomes.	**In Progress**	OSR manages the $60 million Natural Disaster Resilience Grant award, which funds several project throughout Memphis and Shelby County that address the impacts of the May 2011 floods in vulnerable communities.
Explore engineering designs and alternatives to traditional solutions that are more resilient to flooding and other severe weather events.	**Proposed**	
Pursue afforestation and reforestation strategies to achieve better erosion control, promote ecosystem services, and improve community access to green spaces.	**Proposed**	
Create additional institutional capacity to address changing climate adaptation needs as the effects of climate change are felt in the Memphis area.	**Proposed**	
Develop and implement community/neighborhood-scale demonstration projects to increase awareness and local resilience to flooding and other climate events.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: TRANSPORTATION[1]

T.1 Compact Land Use

Implementation Step	Status	Update
Implement the Memphis 3.0 vision and growth strategy focused on building density and mixed uses around community and city-wide anchor areas.	**In Progress**	The Department of Comprehensive Planning reviews land use development cases for consistency with the Memphis 3.0 comprehensive plan. Comprehensive Planning has also completed 11 Small Area Plans. Land Use and Development Services (LUDS) implemented a new review process to ensure both new residences and additions adhere to the UDC's contextual infill standards.
Update zoning and development codes to reflect the Memphis 3.0 vision and growth strategy particularly focusing on regulations that support walkable, infill, mixed-use development and the implementation of transit-oriented development.	**In Progress**	Memphis City Council rezoned 17 areas across the city to ensure compatibility with surrounding neighborhoods and the future land use map. The comprehensive rezoning was adopted on November 2, 2021.
Update the Unified Development Code (UDC) to require more robust bicycle parking/storage in commercial, multifamily, and mixed-use developments, and similarly shower and changing facilities in commercial developments.	**Proposed**	
Update UDC to replace minimum parking requirements with maximum parking requirements, or consider eliminating parking requirements.	**Proposed**	
Update UDC to develop incentives (e.g., reduced parking requirements) for developments that sponsor bike share stations and/or transit stop improvements.	**Proposed**	
Prioritize public infrastructure investments in anchor areas to accelerate private investment and achieve land use and connectivity goals.	**In Progress**	Accelerate Memphis - Invest in Neighborhoods launched in 2021 under the Strickland administration to serve as a catalyst for growth in the city. $75 million of the designated funds are for activating Memphis 3.0 recommended improvements. Accelerate Memphis has identified areas for large-scale investments in public spaces. During 2021, Comprehensive Planning coordinated the installation of crosswalk improvements in Raleigh and Whitehaven.
Develop incentives that encourage housing and employment growth around anchors and transit corridors.	**In Progress**	
Integrate high quality public spaces into anchor areas to encourage interaction and improve quality of life.	**In Progress**	
Preserve and encourage high quality affordable housing to support equitable, mixed-income communities.	**Proposed**	
Encourage small, local businesses to locate within anchor areas.	**Proposed**	

1 See Appendix 3 for references.

IMPLEMENTATION STEP PROGRESS: TRANSPORTATION

T.2 Complete Streets to Encourage Walking & Bicycling

Implementation Step	Status	Update
Implement Memphis 3.0's Comprehensive Streets Plan and the associated streetscape and road designs.	**Ongoing**	City of Memphis Department of Engineering utilizes the Memphis 3.0 Complete Streets plan.
Support implementation of the Greenprint network which includes greenway trails and on-street bicycle facilities.	**In Progress**	Progress continues on the Wolf River Greenway.
Establish a dedicated annual funding source of $20 million for pedestrian and bicycle safety improvements, and implement priority actions identified in the Memphis Pedestrian School Safety Action Plan and the Memphis MPO's Regional Bicycle Pedestrian Plan.	**Proposed**	
Prioritize pedestrian and bicycle safety infrastructure investments in the following areas: activity centers with higher numbers of pedestrians, cyclists, and transit riders; low-income communities; Memphis 3.0 anchors; and areas with high incidences of pedestrian/cyclist injuries and fatalities.	**Proposed**	
Enhance driver education and enforcement programs to increase awareness of cyclist/pedestrian rights and safety considerations.	**Proposed**	

T.3 Public Transit

Provide dedicated annual funding to MATA to increase the immediate annual funding by $30 million to implement the Memphis 3.0 Transit Vision.	**In Progress**	The Memphis City Council and Shelby County Commission passed resolutions in 2022 to provide a dedicated funding source totaling over $5 million in local operating funds for FY 2023. The funding mechanism is projected to provide over $30 million annually by 2030.
Improve the frequency of MATA's service to provide effective service and increased ridership.	**In Progress**	Improving frequency is a part of implementing the Memphis 3.0 Transit Vision.
Consider the development of dedicated bus lanes and high-frequency Bus Rapid Transit service on targeted corridors.	**Complete**	In December 2021, DPD, in collaboration with MATA, completed a transit oriented development (TOD) plan for the City's first bus rapid transit (BRT) – the Memphis Innovation Corridor.
Develop a public communications and outreach campaign to provide information on proposed service improvements and foster support for increased, dedicated annual funding.	**In Progress**	MATA is working on an information campaign.
Create a fleet electrification plan focusing on implementation and identification of funding.	**Complete**	In May 2022, MATA completed its Zero Emissions Fleet Transition Plan, which focuses on implementation through 2034 and identifies federal, state, and local funding opportunities.
Pursue grants and subsidies that can help cover the higher upfront capital cost of electric buses and charging infrastructure.	**Ongoing**	MATA has a dedicated team focused on applying for grants and other funding opportunities.

IMPLEMENTATION STEP PROGRESS: TRANSPORTATION

T.4 Transportation Demand Management (Commute Trips)

Implementation Step	Status	Update
Implement Transportation Demand Management programs at all major employers (500+ employees) in the Memphis area and encourage the inclusion of specific transportation demand management (TDM) strategies.	**Proposed**	
Consider updating development codes to reduce or eliminate minimum parking requirements.	**Proposed**	
Building off of the Downtown Memphis Parking Study and the work of the Downtown Mobility Authority, implement "smart parking" programs such as demand pricing, shared use off-street parking, and parking space availability smartphone applications.	**Proposed**	
Evaluate the allocation of a portion of parking revenue to transit and other multimodal improvements.	**Proposed**	

T.5 Electric Vehicles

To lead by example, Memphis and Shelby County Government should commit to transitioning their fleets to electric and begin building necessary charging infrastructure.	**In Progress**	Shelby County Government purchased its first electric vehicle (EV) in June 2022. In August 2022, Mayor Harris signed the Green Fleet Executive Order for committing to transition fleet vehicles to hybrid and electric. Public Works and DPD are managing a DOE-EV Grant which will procure 5 EVs and install charging infrastructure to support the vehicles.
Develop a comprehensive community-wide electric vehicle strategy that looks at current and future needs, identifies information gaps and barriers, and develops policies, programs, and projects that will lead to an effective charging network and advance electric vehicle adoption.	**Proposed**	
Make equitable access a guiding principle of any community-wide electric vehicle strategy and ensure that low-income and underserved communities can access infrastructure and participate in the EV market.	**Proposed**	
Consider updates to zoning and building codes to ensure that new development can accommodate electric vehicles.	**In Progress**	OSR has begun researching EV readiness language for parking lots.
Explore models and approaches to implementing a comprehensive network of public EV charging infrastructure, including curbside charging infrastructure, potential incentives or partnerships to provide dedicated EV charging stations, and potential funding sources that can help jumpstart a public charging network.	**In Progress**	The Tennessee Department of Environment and Conservation awarded MLGW a grant to install public-access DC Fast Chargers at two locations under the Fast Charge TN Network program, thereby tripling the number of public-access, non-proprietary fast charging sites in Shelby County. Tesla installed 12 proprietary Superchargers in the Wolfchase area.
Assess existing electric grid infrastructure and identify future needs to ensure the grid can provide increased service for EV charging infrastructure.	**In Progress**	DPD and MLGW are participating in discussions with fleet operators regarding EV adoption plans.

IMPLEMENTATION STEP PROGRESS: WASTE[1]

W.1 Yard & Wood Waste Diversion

Implementation Step	Status	Update
Implement a municipal curbside composting program for yard waste that includes fee changes to incentivize composting.	**Proposed**	
Expand municipal composting facility capacity or consider contracting with a private composting facility for this service.	**In Progress**	City of Memphis Solid Waste has contracted with Atlas Organics to manage the city-owned composting facility. The City is currently exploring expanding the facility.
Revise yard waste procedures to generate higher quality organic compost products.	**Proposed**	
Incentivize the markets for compostable materials, especially in industry and commercial settings, in order to support a circular economy and reduce waste.	**Proposed**	
Advocate for updated state-level landfill regulations that discourage and/or phase out disposal of organic waste in landfills.	**Proposed**	

W.2 Paper/Cardboard & Food Waste Reduction

Explore the development of programs and incentives to encourage increased paper/cardboard recycling and food waste composting for commercial, institutional, and industrial sectors, including specific use- or industry-themed competitions or challenges.	**Proposed**	
Collaborate and coordinate with private waste hauling companies to meet waste reduction goals.	**Proposed**	
Consider new regulations that require private waste hauling companies to offer recycling and food waste composting services.	**Proposed**	
Advocate for updated state-level landfill regulations that discourage and/or phase out disposal of food waste in landfills.	**Proposed**	
Explore future implementation of a municipal curbside composting program for food waste that would increase food waste composting from the residential sector.	**Proposed**	

W.3 Inorganic Waste Diversion

Reduce commercial and demolition waste by revising the building code so permitting would require the reduction, reuse, and recycling of materials.	**Proposed**	
Improve and develop public awareness and behavior change campaigns in the short term to minimize single-use plastics.	**Proposed**	

1 See Appendix 4 for references.

IMPLEMENTATION STEP PROGRESS: WASTE

W.3 Inorganic Waste Diversion (continued)

Implementation Step	Status	Update
Advocate at the state level for legislation that focuses on recycling and reuse of single-use plastics (e.g., bottle redemption programs) or reduction of single-use plastics (e.g., local ability to impose plastic bag fees or bans).	**Proposed**	
Advocate at the state level for incentives that support the development of renewable/recyclable product markets.	**Proposed**	

W.4 Tire Management & Collection Practices

Reuse tires to offset carbon emissions from the production of other materials; for example, using tires as roofing material rather than asphalt, which is emissions intensive to produce.	**Ongoing**	In 2022, TN Department of Environment and Conservation held the Tires to Trails grand opening at T.O. Fuller State Park. City of Memphis Solid Waste participated in the collection of the illegally dumped tires. The trail itself uses 24,000 tires, 120 tons of rubber for 2.9 miles of trail. https://youtu.be/WsL5EfL3hgg; Binghampton Development Corporation also collects illegally dumped tires to repurpose as dividers for bike lanes.
Reduce improper tire disposal through reworking current pickup practices and incentivizing recycling programs.	**In Progress**	Shelby County Roads, Bridges, and Engineering is procuring a medium-duty electric truck that will be used to expand its tire pickup program.
Consider implementation of more stringent and traceable tracking requirements for tire handling and disposal companies.	**Proposed**	

W.5 Education & Outreach

Ongoing campaigns with the City of Memphis and other local governments will be supported by the Office of Sustainability and Resilience and assessed for opportunities to reach additional residents in meaningful ways.	**Proposed**	
Conduct informal needs assessments with area stakeholders to determine marketing or social behavior change campaigns most needed in the region in 2020.	**Proposed**	
Integrate needs assessment findings into campaigns and build upon existing communication already in place from parties involved in waste management.	**Proposed**	
Create specific and targeted goals and outputs to assess impact.	**Proposed**	
Monitor changes in waste disposal and management over the course of the outreach and education campaigns, gauge effectiveness and impact of outreach campaigns, and reassess programs.	**Proposed**	

IMPLEMENTATION STEP PROGRESS: WASTE

W.6 Methane Recovery & Landfill Gas Destruction

Implementation Step	Status	Update
Starting in 2020, DPD staff aim to inquire with Class I landfill operator(s) how their biogas capture rate compares with the national average rate of 75%. Provided that incremental capture rates are feasible, DPD staff will coordinate the conversations to launch and implementation and monitoring plan to achieve a landfill biogas capture rate of 85% by 2020.	**Proposed**	
Starting in 2020, City of Memphis Public Works and DPD staff will initiate conversations surrounding installation of controls at Class III and IV landfills with targeted completion by 2035. The prospect of bringing to market recovered biomethane could be a significant incentive for landfills with a large biomethane generation potential.	**Proposed**	
Implement and support new legislation that lowers the threshold for mandatory installation of biogas controls, which can be used as a complementary implementation mechanism.	**Proposed**	
Wastewater treatment plant (WWTP) operators can plan to install methane recovery systems in all facilities within Shelby County by the end of 2035 with support from DPD and City government personnel. Starting in 2020, staff can evaluate whether methane recovery or biogas flaring is feasible at uncontrolled WWTPs. Provided that installation of controls is feasible, launch an implementation and monitoring plan to achieve this goal.	**Proposed**	

APPENDIX 1: COMMUNITY-WIDE GREENHOUSE GAS EMISSIONS INVENTORIES' METHODOLOGY AND DATA SOURCES

The Shelby County community-wide inventories are developed to inform the deliberations of the CAP process, measure progress toward the targets in the CAP, and meet the requirements of the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventory, or GPC.[1] The purpose of this section is to present the results of the GHG assessment and describe the methods and processes used to develop the revised base year and subsequent inventories. For the methodology used to conduct the original 2016 community-wide inventory, please refer to Appendix 1 in the Memphis Area Climate Action Plan.[2]

This section identifies key data sources, methods, and assumptions informing the assessment of GHG emission for the three sectors comprising the GPC BASIC inventory: stationary energy, transportation, and waste. Each sector was assessed using best-available energy and activity data in combination with best-in-class methodology. Sector GHG emissions were integrated into a single inventory using the City Inventory Reporting and Information System (CIRIS) tool. The inventory adopted the global warming potential values from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.[3] Unless stated otherwise below, the inventories use the Environmental Protection Agency's (EPA) 2018 and 2020 emissions factors for the 2016 inventory and 2019 inventory, respectively.[4]

Stationary Energy

Electricity and Natural Gas

Electricity and natural gas are provided to all customers in Shelby County by a single provider—Memphis Light, Gas and Water (MLGW). Data on 2016 sales of both electricity and natural gas were provided in MLGW's 2016 Annual Report.[5] Data on 2019 sales of both electricity and natural gas were provided in MLGW's 2019 Annual Report.[6] Electricity sales, in terms of kilowatt-hours (kWh), were broken down by the following customer types: residential, general service commercial, industrial, outdoor lighting and traffic signals, street lighting, and interdepartmental. Similarly, natural gas sales, in terms of thousand cubic feet (MCF), were broken down by the following customer types: residential, general service commercial, interdepartmental, and spot gas. Emissions from natural gas and other fuel types, such as propane and distillate fuel no. 2, used by industrial sources were gathered from the EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT).[7]

Emission factors for natural gas were fuel-based while utility-specific emission factors were used for electricity. The natural gas CO_2 emission factor represents the standard carbon content by unit of energy of natural gas. Emission factors for electricity are dependent upon the resource mix used to generate the electricity (i.e., the percentage of generation provided by fossil fuels, nuclear, renewables, etc.). Tennessee Valley Authority (TVA) meets the

1 Fong, W. K., Sotos, M., Doust, M., Schultz, S., Marques, A., & Deng-Beck, C. (2021). *Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities*. Retrieved December 2021, from Greenhouse Gas Protocol: https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

2 Memphis and Shelby County Division of Planning and Development. (2019). *Memphis Area Climate Action Plan.* Retrieved September 27, 2022, from Develop 901: https://www.develop901.com/osr/memphisClimateActionPlan

3 Intergovernmental Panel on Climate Change. (2007). *Fourth Assessment Report.* Retrieved September 27, 2022, from IPCC: https://www.ipcc.ch/assessment-report/ar4/

4 U.S. Environmental Protection Agency. (2022). *GHG Emission Factors Hub.* Retrieved January 13, 2022, from https://www.epa.gov/climateleadership/ghg-emission-factors-hub

5 Memphis Light, Gas, and Water. (2017). *2016 Annual Report.* Retrieved August 16, 2022, from About / Annual Report: https://www.mlgw.com/about/annualreport

6 —. (2020). *2019 Annual Report.* Retrieved August 16, 2022, from About / Annual Report: https://www.mlgw.com/about/annualreport

7 U.S. Environmental Protection Agency. (2021a). *Facility Level Information on Greenhouse Gases Tool.* Retrieved September 20, 2022, from https://ghgdata.epa.gov

electricity generation demands of all MLGW residential, commercial, and industrial customers in Shelby County.

While the same generation resource mix is used for all its customers, MLGW has 35 industrial customers for whom time-based rates are used and for which TVA has precise consumption information to match to the generation mix at those times. When calculating the overall MLGW carbon allocation values, those industrial customers are excluded because they get values assigned from their time-based consumption data. MLGW provided the 2016 and 2019 CO_2 emission rate for the non-industrial customers as well as the rates (without identifying information) of the 35 industrial customers.[8, 9] The rates for these industrial customers were averaged to estimate the CO_2 rate for industrial electricity consumption. The methane (CH_4) and nitrous oxide (N_2O) emission factors from electricity generation for all customers are from the EPA's 2016 and 2019 Emissions and Generation Resource Integrated Database (eGRID), representing the average systemwide resource mix used for electricity generation within the TVA region which includes all of Shelby County.[10, 11]

The natural gas and electricity consumption totals by sector were entered into CIRIS, along with the corresponding electricity emission factors by sector. From these inputs, the CIRIS tool calculated natural gas and electricity consumption emissions.

Non-specified Sources

Gasoline and diesel that is used by off-road vehicles or solely on the site of a business are considered stationary sources because they are not actively transporting people or goods from one location to another. The approximate amount of fuel consumed within Shelby County limits was calculated using the Bureau of Transportation Statistics Table 4-7: Domestic Demand for Gasoline by Mode.[12] Staff used the per capita method to estimate the amount of fuel based on the percentage of the United States' population that resides in Shelby County. The calculated fuel consumption was entered into CIRIS to generate the GHG emissions.

Energy Industries and Fugitive Emissions from Oil and Natural Gas Systems

Emissions from energy generation by power plants and refining operations are also reported in the stationary energy section of the inventory. Distribution systems of natural gas and oil refining have flaws where the gas or oil is released into the atmosphere. This type of release is called fugitive emissions. Data on the emissions from both the production and distribution of fuel was gathered from FLIGHT.[13]

Biogas

Landfill gas releases methane, which in Shelby County is captured and used for both heating and electricity. For that reason, energy recovered from landfills is reflected in the Shelby County inventory as a stationary energy source.

8 Williamson, Becky. (2018). Personal communication to Vivian Ekstrom, Memphis-Shelby County Office of Sustainability and Resilience. August 31, 2018.
9 —. (2020). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. December 17, 2021.
10 U.S. Environmental Protection Agency. (2018). *eGRID Summary Tables 2016*. Retrieved September 27, 2022, from EPA: https://www.epa.gov/egrid/download-data
11 —. (2021b). *eGRID Summary Tables 2019*. Retrieved December 14, 2021, from EPA: https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf
12 Bureau of Transportation Statistics. (2021). *National Transportation Statistics*. Retrieved January 11, 2022, from https://www.bts.gov/topics/national-transportation-statistics
13 —. (2021a). *Facility Level Information on Greenhouse Gases Tool*. Retrieved September 20, 2022, from https://ghgdata.epa.gov

Transportation

On-road

Emissions from the on-road sector were calculated using the geographic or territorial methodology. This methodology attempts to capture all on-road activity occurring within the geographic boundary, in this case, within Shelby County. Activity data on daily vehicle miles traveled (VMT) within Shelby County in 2016 and 2019 were obtained from the Tennessee Department of Transportation (TDOT).[14, 15] National data on the VMT and fuel consumption for each vehicle type were obtained from Federal Highway Administration (FHWA).[16] County-scale estimates of fuel consumption for each vehicle type were created using the proportion of Shelby County VMT compared to the national VMT. Estimated emissions were entered directly into CIRIS.

Rail

The approximate amount of fuel consumed within Shelby County limits was calculated using the Bureau of Transportation Statistics 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.[17, 18] These estimates only consider Class 1 Railroads, and not Class II and III. The estimated fuel consumption was entered into CIRIS to generate the GHG emissions.

Aviation

The number of aircraft operations (arrivals and departures) comes primarily from the Federal Aviation Administration's (FAA) Operations Network (OPSNET). The OPSNET system had operations information on the two largest airports in Shelby County—Memphis International Airport and Millington Regional Jetport.[19] Operations at these airports were divided by the total national operations reported in the OPSNET System. The national fuel consumption reported in the Bureau of Transportation Statistics Table 4-5 was then multiplied by operations ratio to calculate the proportion of aviation kerosene and jet fuel used by these two airports to reflect emissions from the landing/take-off cycles occurring within the County's geographical boundary.[20] Staff also requested the amount of fuel sold at Shelby County's other airports—Charles W. Baker and General DeWitt Spain.[21] All fuel consumption data were entered into CIRIS to generate the GHG emissions.

Waterborne Vessels

The approximate amount of fuel consumed within Shelby County limits was calculated using the Bureau of Transportation Statistics Table 4-5: Fuel Consumption by Mode of Transportation in Physical Units.[22] Staff used the per capita method to estimate the amount of fuel based on the percentage of the United States' population that resides in Shelby County. The calculated fuel consumption was entered into CIRIS to generate the GHG emissions.

14 Tennessee Department of Transportation. (2018). *HPMS 2016 DVMT.* Retrieved August 2018, from Highway Performance Monitoring System: https://www.tn.gov/content/dam/tn/tdot/long-range-planning/road-inventory/2016HPMSCntyDVMT.pdf

15 —. (2020). *2019 HPMS DVMT Rural and Urban by County.* Retrieved March 18, 2021, from Highway Performance Monitoring System: https://www.tn.gov/content/dam/tn/tdot/long-range-planning/road-inventory/2019_County_VMT.pdf

16 Federal Highway Administration. (2021). *Highway Statistics 2019 Table VM-1.* Retrieved January 13, 2022, from https://www.fhwa.dot.gov/policyinformation/statistics/2019/vm1.cfm

17 Bureau of Transportation Statistics. (2021). *National Transportation Statistics.* Retrieved January 11, 2022, from https://www.bts.gov/topics/national-transportation-statistics

18 Ibid.

19 U.S. Federal Aviation Administration. (n.d.). *The Operations Network (OPSNET).* Retrieved January 19, 2022, from https://aspm.faa.gov/opsnet/sys/main.asp

20 Bureau of Transportation Statistics. (2021). *National Transportation Statistics.* Retrieved January 11, 2022, from https://www.bts.gov/topics/national-transportation-statistics

21 McBride, Jason. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. January 21, 2022.

22 Bureau of Transportation Statistics. (2021). *National Transportation Statistics.* Retrieved January 11, 2022, from https://www.bts.gov/topics/national-transportation-statistics

Waste

Solid Waste

Data on solid waste were collected from different sources. For the waste disposed in landfills within Shelby County, emissions information was gathered from FLIGHT.[23] The landfills report emissions to the EPA using the first order decay methodology. In addition, Tennessee Department of Environment and Conservation provided the Solid Waste Origin Report (SWOR) for Shelby County.[24] The solid waste tonnage that went to landfills outside the county limits was gathered from the SWOR and then input into the methane commitment model embedded in the CIRIS tool. County specific solid waste composition data were not available, so the default composition assumptions in the tool were used.

Biological Treatment of Waste

The biological treatment of waste includes both commercial composting as well as digested sludge from wastewater treatment plants. The City of Memphis provided the amounts for both types of waste disposal,[25, 26] and the amounts were input in CIRIS using the wet waste defaults for composting and the dry waste defaults for anaerobic digestion.

Wastewater

The wastewater estimate was based on data provided by the City of Memphis.[27] Key information for the assessment includes an account of wastewater treatment options in Shelby County, the share of residents with wastewater access, and population in each jurisdiction.

Methane Emissions: for each treatment system/option, emissions were calculated in the CIRIS tool based on the county's population, a US default rate of biological oxygen demand (BOD) per capita, the proportion of residents with each type of wastewater collection, and distribution of total BOD by treatment system.

Nitrous Oxide Emissions: emissions occur in aerobic treatment plants and during the discharge of nitrogen in the effluent to aquatic environments. Emissions from aerobic treatment plants are directly proportional to the size of population serviced by the centralized treatment system (99%).

23 U.S. Environmental Protection Agency. (2021). *Facility Level Information on Greenhouse Gases Tool.* Retrieved September 20, 2022, from https://ghgdata.epa.gov
24 Perez, Christina. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. February 10, 2022.
25 Fryer, Amanda. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. January 28, 2022.
26 Hudgins, Donald. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. March 3, 2022.
27 Ibid.

APPENDIX 2: ENERGY SECTOR PRIORITY ACTION METHODOLOGY AND DATA SOURCES

PRIORITY ACTION E.1 GREEN BUILDING STANDARDS

The main objective of this priority action, to adopt mandatory green building standards and regulations, has not been codified as of the end of 2021. However, progress has been made in exploring and adopting incentive programs that promote energy efficient design, such as the newly adopted Commercial Property Assessed Clean Energy and Resiliency program,[1] and ongoing work to draft Urban Design Guidelines.[2]

PRIORITY ACTION E.2 LOW-INCOME HOUSING ENERGY EFFICIENCY

In order to track progress toward this objective, staff uses data from several low-income assistance energy efficiency and weatherization programs. These include:

- MLGW's Share the Pennies program
- The Weatherization Assistance Program (federal program administered locally by the City of Memphis Division of Housing and Community Development)
- The Tennessee Housing Development Agency Weatherization Assistance Program in Shelby County
- The Shelby County Department of Housing Rehabilitation Program

There are other low-income assistance programs for home renovations and efficiency improvements in place in Memphis, but the programs listed above are believed to be the largest and most widely used programs. Staff estimated that these programs served at least 433 households in 2018 (the baseline year for this priority action).[3] The goal is to increase this number to 2,163 households in ten years and stay steady at that level through the end of 2050.

For the 2021 target sector progress and implementation step updates, staff received information from MLGW,[4] City of Memphis Division of Housing and Community Development,[5] and Shelby County Department of Housing.[6] In 2021, the estimated number of households served by rehabilitation programs rose to 870 households, which is a 101 percent increase over the 2018 baseline.

PRIORITY ACTION E.3 ENERGY EFFICIENCY EDUCATION & OUTREACH

This action item strives to reduce the average amount of energy consumed by residential and commercial customers through education and outreach initiatives. The proxy target used to monitor progress toward the target is the average kWh per residential customer and the average kWh per commercial customer, annually reported by MLGW.[7, 8] Staff determined the percentage

1 Strebig, Neil. (2022, September 21). Memphis becomes first city in Tennessee with federal incentive for eco-friendly projects. *Daily Memphian.*
2 Finke, Drew. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. July 11, 2022.
3 Memphis and Shelby County Division of Planning and Development. (2019). *Memphis Area Climate Action Plan.* Retrieved September 27, 2022, from Develop 901: https://www.develop901.com/osr/memphisClimateActionPlan
4 Williamson, Becky. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. June 27, 2022.
5 Shumake, Patricia. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. June 22, 2022.
6 Sjostrom, Dana. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. May 23, 2022.
7 Memphis Light, Gas, and Water. (2017). *2016 Annual Report.* Retrieved August 16, 2022, from About / Annual Report: https://www.mlgw.com/about/annualreport
8 —. (2022). *2021 Annual Report.* Retrieved August 16, 2022, from About / Annual Report: https://www.mlgw.com/about/annualreport

reduction by taking the difference of the 2016 and 2021 reported averages divided by the 2016 averages, and then converting the results to precents.

PRIORITY ACTION E.4 LED STREETLIGHT RETROFIT

Reaching the target for this action item requires all streetlights and leased outdoor lighting in Shelby County to be converted to LED bulbs. At the time of publication, the City of Memphis is working on a streetlight retrofit project, and other jurisdictions such as Bartlett and Collierville have begun considering similar projects.[9] The baseline number of lights comes from *MLGW's Facts & Figures for Year Ending December 31, 2016*.[10]

PRIORITY ACTION E.5 RESIDENTIAL ENERGY EFFICIENCY RETROFITS

This action recommends using a subsidy program to incentivize homeowners to install energy efficient HVAC equipment and appliances. The baseline analysis and projected emissions reductions from implementation in the Climate Action Plan does not include retrofits to rental properties,[11] which is why the target tracking specifies a percentage of owner-occupied homes.

For the 2021 target sector progress, staff used the total number of Energy Star Homes built in the Memphis region,[12] and MLGW provided the number of participants in the MLGW EcoBuild Program and the number of Shelby County participants in the TVA EnergyRight Home Uplift Program.[13] Staff divided the sum of these numbers by the owner-occupied units from the 2020 American Community Survey 5-year estimates,[14] which was then converted to a percent.

Due to the difficulty in estimating the number of homes that have Energy Star appliances and the baseline assumption that 0 percent of owner-occupied homes contain Energy Star appliances, staff continues to research more comprehensive metrics to track progress toward this target.

For the implementation step updates, staff received information from MLGW.[15]

PRIORITY ACTION E.6 GRID DECARBONIZATION

MLGW provided the 2016 and 2021 electrical grid mix information including the percentage of carbon free electricity.[16, 17] Information on the

9 Henneghan, Erik. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. June 28, 2022.
10 Memphis Light, Gas, and Water. (2017). *Facts & Figures for Year Ending December 31, 2016.* Retrieved October 10, 2022, from http://www.mlgw.com/images/content/files/pdf/Facts%20%26%20Figures%202017.pdf
11 Memphis and Shelby County Division of Planning and Development. (2019). *Memphis Area Climate Action Plan.* Retrieved September 27, 2022, from Develop 901: https://www.develop901.com/osr/memphisClimateActionPlan
12 Energy Star. (n.d.). *Find Builders, Developers and Energy Rating Companies.* Retrieved August 16, 2022, from https://www.energystar.gov/partner_resources/partner_locator/state/tennessee?
13 Williamson, Becky. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. July 7, 2022.
14 U.S. Census Bureau. (2020). *American Community Survery 5-Year Estimates: CP04 Comparative Housing Characteristics.* Retrieved September 20, 2022, from https://data.census.gov/cedsci/table?q=CP04%3A%20COMPARATIVE%20HOUSING%20CHARACTERISTICS&g=0500000US47157&tid=ACSCP5Y2020.CP04
15 Williamson, Becky. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. July 7, 2022.
16 Williamson, Becky. (2018). Personal communication to Vivian Ekstrom, Memphis-Shelby County Office of Sustainability and Resilience. August 31, 2018.
17 Rosko, Natasha. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. May 5, 2022.

implementation step progress comes from MLGW[18] ongoing projects and initiatives that the Office of Sustainability and Resilience manages.

PRIORITY ACTION E.7 URBAN TREE CANOPY

Based on information from the *Memphis Regional Urban Tree Canopy Assessment*, approximately 36.8% of Shelby County land area was at least partly or fully covered in trees in 2012 (74,212 acres).[19] This target aims to increase that figure to 60% by 2050. Staff from the Office of Sustainability and Resilience calculated the preliminary 2021 canopy coverage estimate by conducting a supervised land cover classification using July 2021 Landsat images.[20] The preliminary analysis has not been evaluated for accuracy and may be updated in the future.

PRIORITY ACTION E.8 CLIMATE MITIGATION & ADAPTATION ALIGNMENT

This priority action does not have a quantitative target associated with it. The Office of Sustainability and Resilience continues to make progress on the implementation steps through managing the Natural Disaster Resilience Grant award and providing comments on land use and development cases. For more information on the *Mid-South Regional Resilience Master Plan,* please go to https://resilientshelby.com/.

18 Williamson, Becky. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. October 11, 2022.

19 The University of Memphis, Wolf River Conservancy. (2014). *Memphis Regional Urban Tree Canopy Assessment.* Retrieved from Issuu: https://issuu.com/univofmemphis/docs/1314-eng-627_cpgis_tree_canopy_repo

20 U.S. Geological Survey. (2021). Landsat-8 images captured on July 8, 2021: Tiles 020012 and 020013.

APPENDIX 3: TRANSPORTATION SECTOR PRIORITY ACTION METHODOLOGY AND DATA SOURCES

PRIORITY ACTION T.1 COMPACT LAND USE

Many of the recommended implementation steps for this priority action call for implementing parts of the *Memphis 3.0 Comprehensive Plan*. Due to the close connection to Memphis 3.0, staff developed a proxy metric to monitor progress toward denser, pedestrian-friendly development. Both the 2018 baseline percentage and the 2021 status update use citywide and anchor area permit values reported in the *Memphis 3.0 2021 Annual Report*.[1] The implementation step progress updates were also retrieved from the annual report. Additional information on Memphis 3.0 can be found at https://www.memphis3point0.com.

PRIORITY ACTION T.2 COMPLETE STREETS TO ENCOURAGE WALKING & BICYCLING

This priority action assumes that construction of more complete streets will lead to a reduction of personal vehicle trips, replacing them with pedestrian and bike trips. The objective calls for converting 10 percent of all vehicle trips to bicycling and pedestrian modes; however, it is difficult to measure total vehicle trips. The American Community Survey does provide estimates on the percent of commuting trips made via bicycle and pedestrian modes.[2, 3] Staff uses these estimates as the proxy metric for measuring progress toward this action.

PRIORITY ACTION T.3 PUBLIC TRANSIT

Memphis Area Transit Authority (MATA) provided information on implementation step progress as well as on Memphis 3.0 Transit Vision implementation and electric bus procurement.[4] Staff retrieved information on the amount of annual unlinked trips (ridership metric) and the amount of annual vehicle revenue miles (frequency metric) from the Federal Transit Administration's National Transit Database.[5]

PRIORITY ACTION T.4 TRANSPORTATION DEMAND MANAGEMENT (COMMUTE TRIPS)

This action aims to reduce the number of single-occupant vehicle trips to work through behavior change strategies. Staff uses the American Community Survey estimates on the percent of drive-alone commute trips to track progress towards this action's objectives.[6, 7]

1 Memphis and Shelby County Division of Planning and Development. (2021). *2021 Annual Report.* Retrieved September 20, 2022, from Memphis 3.0: https://www.memphis3point0.com/_files/ugd/100a0d_8c71b19c50304835a15f7a37dba98d0e.pdf

2 U.S. Census Bureau. (2016). *American Community Survey 5-Year Estimates: S0801 Commuting Characteristics by Sex.* Retrieved from https://data.census.gov/cedsci/table?q=S0801%3A%20COMMUTING%20CHARACTERISTICS%20BY%20SEX&g=0500000US47157&tid=ACSST5Y2016.S0801

3 U.S. Census Bureau. (2021). *American Community Survey 1-Year Estimates: S0801 Commuting Characteristics by Sex.* Retrieved September 20, 2022, from https://data.census.gov/cedsci/table?q=S0801%3A%20COMMUTING%20CHARACTERISTICS%20BY%20SEX&g=0100000US&tid=ACSST1Y2021.S0801

4 Lancaster, John. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. June 10, 2022.

5 Federal Transit Administration. (2020). *City of Memphis.* Retrieved September 20, 2022, from NTD Transit Agency Profiles: https://www.transit.dot.gov/ntd/transit-agency-profiles/city-memphis

6 U.S. Census Bureau. (2016). *American Community Survey 5-Year Estimates: S0801 Commuting Characteristics by Sex.* Retrieved from https://data.census.gov/cedsci/table?q=S0801%3A%20COMMUTING%20CHARACTERISTICS%20BY%20SEX&g=0500000US47157&tid=ACSST5Y2016.S0801

7 U.S. Census Bureau. (2021). *American Community Survey 1-Year Estimates: S0801 Commuting Characteristics by Sex.* Retrieved September 20, 2022, from https://data.census.gov/cedsci/table?q=S0801%3A%20COMMUTING%20CHARACTERISTICS%20BY%20SEX&g=0100000US&tid=ACSST1Y2021.S0801

PRIORITY ACTION T.5 ELECTRIC VEHICLES

Implementation of this action will lead to reductions in GHG emissions by replacing gasoline and diesel passenger and freight vehicles with electric vehicles. While EVs have no tailpipe emissions, there are GHG emissions associated with the process of generating the electricity needed to power these vehicles. However, electric vehicles are more efficient than conventional vehicles, leading to lower levels of GHG emissions even after the increase in emissions from the generation of additional electricity is accounted for.

Staff uses the number of electric vehicles registered in Shelby County[8] divided by the American Community Survey estimated number of vehicles in Shelby County[9] to calculate the baseline and 2021 percentage of passenger vehicle travel using EVs. The baseline metric for the conversion to electric vehicles uses 2018 data since 2016 data for Shelby County does not exist. Staff is still working on identifying a metric to determine the percent of freight travel using electric vehicles.

Information on the implementation step progress comes from ongoing projects and initiatives that the Office of Sustainability and Resilience manages.

8 Atlas Public Policy. (2022). *State EV Registration Data.* Retrieved August 16, 2022, from https://www.atlasevhub.com/materials/state-ev-registration-data/#dashboard

9 U.S. Census Bureau. (2021). *American Community Survey 1-Year Estimates: B25046 Aggregate Number of Vehicles Available by Tenure.* Retrieved September 20, 2022, from https://data.census.gov/cedsci/table?q=B25046&g=0100000US&tid=ACSDT1Y2021.B25046

APPENDIX 4: WASTE SECTOR PRIORITY ACTION METHODOLOGY & DATA SOURCES

PRIORITY ACTION W.1 YARD & WOOD WASTE DIVERSION

The proposed organic waste management action recommends diverting the amount of decomposable organic compounds (i.e., yard and wood waste) that yield biogas when landfilled. The objective calls for a reduction in the amount of wood and yard waste entering landfills. It is not possible to report on the 2021 status because a new waste characterization study and/or needs assessment has not been conducted since the 2016 baseline. The data for the 2016 baseline comes from the recent Shelby County solid waste needs assessment.[1]

Information on the implementation step progress comes from the City of Memphis Solid Waste Division.[2]

PRIORITY ACTION W.2 PAPER/CARDBOARD & FOOD WASTE REDUCTION

The proposed organic waste management action recommends diverting the amount of decomposable organic compounds (i.e., paper, cardboard, and food waste) that yield biogas when landfilled. The objective calls for a reduction in the amount of paper and food waste entering landfills. It is not possible to report on the 2021 status because a new waste characterization study and/or needs assessment has not been conducted since the 2016 baseline. The data for the 2016 baseline comes from the recent Shelby County solid waste needs assessment.[3]

PRIORITY ACTION W.3 INORGANIC WASTE DIVERSION

The GHG reduction benefits of plastic and C&D waste diversion reside primarily in lowering the demand for virgin materials that require fossil fuel-based energy to produce and transport over long distances. The data for the 2016 baseline comes from the recent Shelby County solid waste needs assessment.[4] Staff used the Solid Waste Origin Report (SWOR) for Shelby County provided by the Tennessee Department of Environment and Conservation to determine the 2021 diversion rate.[5]

PRIORITY ACTION W.4 TIRE MANAGEMENT AND COLLECTION PRACTICES

The GHG reduction benefits of waste tire management reside primarily in lowering the demand for virgin materials that require fossil fuel-based energy to produce and transport over long distances. The data for the 2016 baseline comes from the recent Shelby County solid waste needs assessment.[6] For both the objective and implementation step statuses, staff collected information on the amount and/or tonnage of tires collected from Shelby

1 Memphis Area Association of Governments. (2018). *Shelby County Solid Waste Needs Assessment.* Retrieved from Memphis Area Association of Governments: https://maagov.org/wp-content/uploads/2019/03/Shelby_NA_1_18-Revised-3.7.19.pdf

2 Davis, Philip. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. September 6, 2022.

3 Memphis Area Association of Governments. (2018). *Shelby County Solid Waste Needs Assessment.* Retrieved from Memphis Area Association of Governments: https://maagov.org/wp-content/uploads/2019/03/Shelby_NA_1_18-Revised-3.7.19.pdf

4 Ibid.

5 Perez, Christina. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. June 23, 2022.

6 Memphis Area Association of Governments. (2018). *Shelby County Solid Waste Needs Assessment.* Retrieved from Memphis Area Association of Governments: https://maagov.org/wp-content/uploads/2019/03/Shelby_NA_1_18-Revised-3.7.19.pdf

County Roads, Bridges, and Engineering Department;[7] City of Memphis Solid Waste Division;[8] and the Binghampton Development Corporation.[9] Staff converted the number of tires given to tons by using an average weight of 30 pounds per tire.

PRIORITY ACTION W.5 EDUCATION & OUTREACH

This action aims to improve diversion of waste from landfills through behavior change strategies and education campaigns focusing on proper waste disposal. At the time of this update, new education projects were not identified; however, the City of Memphis Solid Waste Division has continued outreach campaigns that were in effect prior to the Climate Action Plan.

PRIORITY ACTION W.6 METHANE RECOVERY & LANDFILL GAS DESTRUCTION

This action combines three strategies that reduce fugitive methane emissions from landfills and wastewater treatment plants. First, improve biogas capture rates at controlled Class I landfills. Second, evaluate feasibility and installing biogas controls at Class III and IV landfills if warranted. Third, install methane recovery systems in all wastewater treatment plants within Shelby County. In order to calculate the biogas capture rate at the Class I landfills, staff collected data from FLIGHT on annual quantity of recovered methane, annual methane generation, and estimated gas collection efficiency.[10] Staff derived the combined biogas capture rate proportional to the total amount of methane generated by each landfill.

$$\left(\frac{N.Shelby\ CH_4\ generation}{N.Shelby\ CH_4\ generation + S.Shelby\ CH_4\ generation}\right) * N.Shelby\ gas\ collection\ efficiency$$
$$+$$
$$\left(\frac{S.Shelby\ CH_4\ generation}{S.Shelby\ CH_4\ generation + N.Shelby\ CH_4\ generation}\right) * S.Shelby\ gas\ collection\ efficiency$$
$$= combined\ biogas\ capture\ rate$$

7 Martin, Cindy. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. August 30, 2022.
8 Fryer, Amanda. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. September 9, 2022.
9 Kizzee, Andy. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. August 23, 2022.
10 U.S. Environmental Protection Agency. (2021). *Facility Level Information on Greenhouse Gases Tool.* Retrieved September 20, 2022, from https://ghgdata.epa.gov

APPENDIX 5: LOCAL GOVERNMENT INVENTORIES' METHODOLOGY AND DATA SOURCES

While the 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 Memphis area. The purpose of this section is to present the results of the GHG assessment and describe the methods and processes used to develop the 2019 inventories. For the methodology used to conduct the original 2016 community-wide inventory, please refer to the Memphis Area Climate Action Plan.[1]

This section identifies key data sources, methods, and assumptions informing the assessment of GHG emission for the two sectors comprising the City of Memphis and Shelby County government operations inventories: energy use at government facilities and fuel use in government vehicle fleets. The inventories use the global warming potential values from the IPCC Fourth Assessment Report.[2] Unless stated otherwise below, the inventories use the EPA's 2020 emissions factors for the 2019 inventory.[3]

ELECTRICITY AND NATURAL GAS FOR GOVERNMENT BUILDINGS AND FACILITIES

Electricity and natural gas are provided by MLGW. Staff collected the electricity and natural gas data from both governments' master utility bills.

The natural gas data was converted to greenhouse gas emissions using the EPA's emissions factors.

Emission factors for electricity are dependent upon the resource mix used to generate the electricity (i.e., the percentage of generation provided by each type of fossil fuel, nuclear, and renewables). Tennessee Valley Authority (TVA) meets the electricity generation demands of all MLGW residential, commercial, and industrial customers in Shelby County. MLGW provided the 2019 CO_2 emission rate for the non-industrial customers.[4] The methane (CH_4) and nitrous oxide (N_2O) emission factors from electricity generation for all customers are from the EPA's 2019 Emissions and Generation Resource Integrated Database (eGRID), representing the average systemwide resource mix used for electricity generation within the TVA region.[5]

FUEL CONSUMPTION FOR GOVERNMENT FLEET VEHICLES

Staff collected information on the gallons of diesel and gasoline from both the City of Memphis and the Shelby County fleet managers.[6, 7] Staff converted the fuel data to GHG emissions using the EPA's emissions factors.

1 Memphis and Shelby County Division of Planning and Development. (2019). *Memphis Area Climate Action Plan.* Retrieved September 27, 2022, from Develop 901: https://www.develop901.com/osr/memphisClimateActionPlan

2 Intergovernmental Panel on Climate Change. (2007). *Fourth Assessment Report.* Retrieved September 27, 2022, from IPCC: https://www.ipcc.ch/assessment-report/ar4/

3 U.S. Environmental Protection Agency. (2022). *GHG Emission Factors Hub.* Retrieved January 13, 2022, from https://www.epa.gov/climateleadership/ghg-emission-factors-hub

4 Williamson, Becky. (2021). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. December 17, 2021.

5 U.S. Environmental Protection Agency. (2021). *eGRID Summary Tables 2019.* Retrieved December 14, 2021, from EPA: https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf

6 Philyaw, Derrick. (2022). Personal communication to Leigh Huffman, Memphis-Shelby County Office of Sustainability and Resilience. September 7, 2022.

7 Deatherage, Mike. (2022). Personal communication to Sara Barrera, Memphis-Shelby County Office of Sustainability and Resilience. April 5, 2022.