Bowling Green Metropolitan Statistical Area (BG MSA) Priority Climate Action Plan

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Executive Summary

The Bowling Green Metropolitan Statistical Area (BG MSA) consists of the City of Bowling Green, Kentucky, the rest of Warren County, and the three surrounding counties of Allen, Butler, and Edmonson. A mixture of urban, rural, and rapidly growing suburban communities can be found in the BG MSA. Without intervention, the effects of climate change will continue to be felt in the region through the coming decades, furthering social vulnerability and climate impacts that can reduce the quality of life and economic prosperity for the BG MSA's residents.

Kentucky and five of the census tracts in the BG MSA are ranked in the 90th percentile or higher in overall climate vulnerability according to the latest Climate Vulnerability Index.[1] This index finds that census tracts across Warren, Allen, Butler, and Edmonson counties are at risk for higher numbers of air pollution-related deaths as well as economic and productivity losses brought on by climate change. Further, five census tracts in the four BG MSA counties are designated as disadvantaged regarding climate change, health, and income disparities.[2]

The BG MSA's Priority Climate Action Plan (PCAP) is a proactive step to address the negative impacts and challenges brought by climate change. This document serves as the first iteration of the BG MSA's first climate action plan and builds upon independent climate planning initiatives within the BG MSA. This iteration of the plan will be improved upon in the Comprehensive Climate Action Plan (CCAP) phase of the CPRG program. PCAP acts as a roadmap to reduce greenhouse gas (GHG) emissions and other air pollutants in the BG MSA and seeks to improve quality of life for those living and working in its four counties.

The City of Bowling Green's Environmental Compliance Division, with support from the city's Neighborhood and Community Services, prepared this PCAP in response to the Climate Pollution Reduction Grant Program (CPRG) initiated by the EPA. The CPRG is a significant constituent of the broader Inflation Reduction Act (IRA) legislation sanctioned in 2022. The creation of this PCAP was successful largely due to a $1 million planning grant awarded to the BG MSA through the CPRG program.

The contents of this PCAP are as follows and describe the current state of emissions and impacts in the BG MSA as well as the corresponding priority measures proposed to reduce air pollution: (1) greenhouse gas inventory, (2) priority pollution reduction measures and associated emissions reduction potential, (3) co-pollutant benefits analysis, (4) low income and disadvantaged communities analysis, and (5) authority to implement.

The BG MSA has selected five overarching strategies as priority areas for emissions reduction: (1) transportation improvements, (2) building energy efficiency enhancement, (3) renewable energy enhancement, (4) waste diversion and landfill management, (5) land use enhancement. Within these five strategies, the BG MSA has

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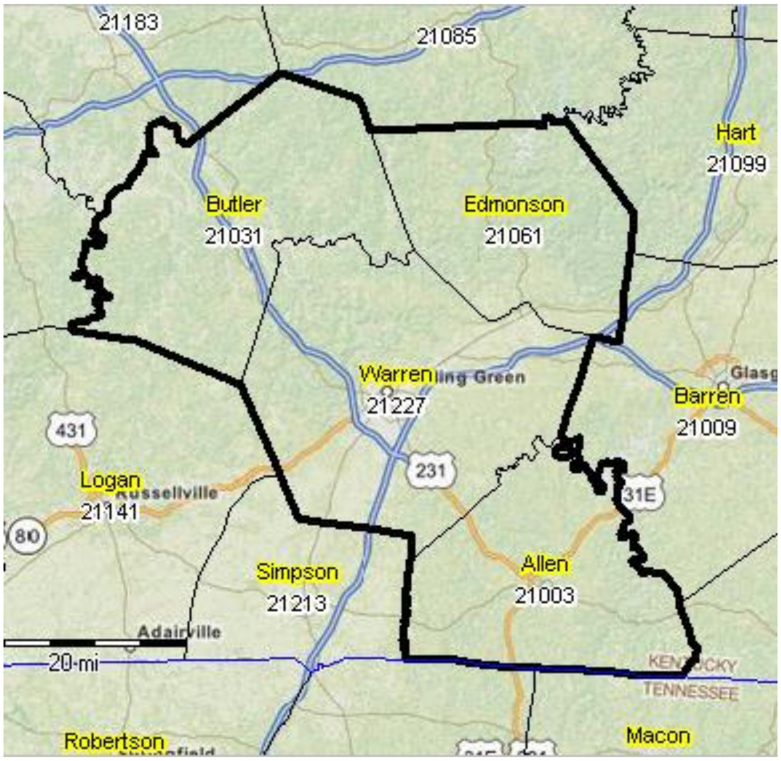
[1] Environmental Defense Fund, Overall Climate Vulnerability in The U.S. | The U.S. Climate Vulnerability Index, 2024.

[2] The EPA defines disadvantaged communities as (1) census tracts that are at or above the threshold for one or more environmental, climate, or other burdens and associated socioeconomic burdens, (2) census tracts that are on land within the boundaries of Federally Recognized Tribes, or (3) census tracts that are surrounded by disadvantaged communities and are at or above the 50% percentile for low income. Each category of burden is defined by relevant indicators; for example, communities facing health burdens are at or above the 90th percentile for asthma or diabetes or heart disease or low life expectancy. Census tract boundaries for statistical areas are determined by the U.S. Census Bureau once every ten years. For a detailed definition of disadvantaged communities by the EPA, see: Council on Environmental Quality, Climate & Economic Justice Screening Tool. November 2022

identified twelve high-priority actions, hereafter referred to as “measures,” that have the scope to mitigate GHG emissions by an estimated 4% by the year 2030 and 10% by the year 2050 from a 2019 base year.

Figure 1: Bowling Green core-based statistical area (CBSA) boundary defined by the Office of Management and Budget (OMB)[3]



[3] United States Census Bureau, [Metropolitan and Micropolitan Statistical Areas.](https://www.census.gov) 2022.

1 Plan Context

1.1 Climate Pollution Reduction Grant Overview

The EPA initiated the CPRG program to assist state, tribal, local, and territory groups in mitigating GHGs and related pollutants. This is achievable through the implementation of new technologies, enhancing operational efficiencies, and adaptations to new energy sources. This program, legislated under Section 60114 of the Inflation Reduction Act (IRA), is available across all 50 states, territories, tribal governments, and 67 major metropolitan statistical areas.

The CPRG program operates in two stages:

> Phase 1: This stage provides flexibility to states, local governments, tribes, and territories to formulate climate action plans addressing GHG emissions reduction in six key sectors.
>
> Phase 2: In this stage, a grant fund amounting to $4.6 billion is available to execute the GHG mitigation measures identified in Phase 1.

This document represents the BG MSA's PCAP developed as part of Phase 1 of the CPRG program. This plan was informed by input from local governments, businesses and nonprofits, and the BG MSA residents. The PCAP identifies a strategic set of high-priority, near-term actions ready for implementation to curtail GHG pollution in the BG MSA. The implementation of this PCAP began on March 1, 2024. In the future, the PCAP will be broadened into a Comprehensive Climate Action Plan (CCAP) through the continued use of the original planning grant.

1.2 Scope of the Priority Climate Action Plan

The PCAP has been meticulously formulated to cater to the BG MSA's distinct four-county region of Allen, Butler, Edmonson, and Warren Counties. The entirety of the PCAP—including the GHG inventory, the measures designed to reduce GHGs, and all the agencies, departments, and public stakeholders involved—focuses specifically on the BG MSA.

The BG MSA's GHG inventory is comprehensive and addresses emissions from several distinct sectors including:

- Transportation
- Electricity Production & Consumption
- Industry
- Agriculture, Natural & Working Lands
- Commercial & Residential Buildings
- Waste, Wastewater, & Materials Management

Following guidance established by the EPA, the PCAP's GHG emission reduction measures have been strategically selected to focus on near-term, high-priority actions that are ready for immediate implementation. However, it is important to note that this list of measures is not exhaustive and does not encompass all potential emission sources. There will be an opportunity for the BG MSA to further enhance the scope and coverage of the GHG emission reduction measures through the creation of the CCAP.

1.3 Rationale for Selection of Sectors

For each sector included in the local inventory, Table 1 briefly describes why the sector was included in the inventory and the relative significance of the sector in terms of the magnitude of emissions from existing inventories, the associated geographic distribution of the sources, and recent trends in readily available activity data for the source category.

Table 1: Rationale for sector selection[4]

Sectors included in inventory	Rationale for sectors Included in GHG inventory
Transportation	Transportation activities were the largest source (29%) of total U.S. greenhouse gas emissions in 2021. From 1990 to 2021, transportation CO2 emissions from fossil fuel combustion increased by 19%. Transportation activities occur in all communities.
Electricity Production & Consumption	The electric power sector accounted for 25% of total U.S. greenhouse gas emissions in 2021. Power generation and/or consumption occurs among all communities.
Industry	The industrial sector accounted for 24% of U.S. greenhouse gas emissions in 2021. Since 1990, industrial sector emissions have declined by 11%. In 2021, total energy use in the industrial sector increased by 2% due to an increase in total industrial production and manufacturing output. EPA's GHGRP data provide additional insights into underlying trends in the industrial sector.
Agriculture, Natural & Working Lands	This sector includes fluxes of carbon from activities such as converting forests to agricultural use and practices that remove CO2 from the atmosphere and store it in long-term carbon sinks like forests. In 2021, the net CO2 removed from the atmosphere by natural and working lands was 12% of total U.S. greenhouse gas emissions. Between 1990 and 2021, total carbon sequestration in this sector decreased by 14%, primarily due to a decrease in the rate of net carbon accumulation in forests, as well as an increase in CO2 emissions from urbanization. Agriculture accounted for about 10% of U.S. greenhouse gas emissions in 2021, and agricultural soil management was the largest source of N2O emissions. Enteric fermentation was the largest source of CH4 emissions.
Commercial & Residential Buildings	In 2021, the commercial and residential sectors accounted for 7% and 6 % of total U.S. greenhouse gas emissions, respectively. Emissions from the commercial and residential sectors have increased since 1990. Total residential and commercial greenhouse gas emissions, including direct and indirect emissions, in 2021 have increased by 2% since 1990. In 2021, an increase of 0.5% in heating degree days increased energy demand for heating in the residential and commercial sectors, however, a 1.8% decrease in cooling degree days compared to 2020 reduced demand for air conditioning in the residential and commercial sectors.
Waste, Wastewater & Materials Management	This sector includes landfills, composting, and anaerobic digestion. Landfills were the third largest source of anthropogenic methane emissions in 2021, and landfills accounted for 1.9 % of total U.S. greenhouse gas emissions. Wastewater treatment, both domestic and industrial, was the third largest anthropogenic source of N2O emissions in 2021, accounting for 5.2% of national N2O emissions and 0.3% of total U.S. greenhouse gas emissions. Emissions from wastewater treatment increased by 6.1 MMT CO2e (41.6%) since 1990 because of growing U.S. population and protein consumption.

[4] United States Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. April 2023.

1.4 History of Climate Planning within the Bowling Green MSA

The PCAP represents a significant milestone as the inaugural comprehensive climate planning document encompassing the entirety of the BG MSA. It provides a high-level analysis of the region's greenhouse gas emissions and its impacts on communities and provides an initial emissions inventory and GHG emission reduction strategy to build on in the future.

The PCAP builds upon a series of independent climate planning initiatives already undertaken within the BG MSA, such as the following:

- The Office of Sustainability at Western Kentucky University (WKU) has conducted multiple emissions inventories, focused on quantifying the institution's specific carbon footprint. Furthermore, to enhance regional climate resilience, the Barren River Area Development District has developed detailed hazard mitigation plans for all four of the BG MSA counties, identifying areas vulnerable to climate-induced natural disasters, including severe flooding and drought.
- As part of active measures to prepare for future natural disasters, such as the EF3 tornado that struck in December 2021, the City of Bowling Green is in the process of constructing community tornado shelters in several low-income neighborhood parks.
- Environmental regulatory oversight within the BG MSA is jointly managed by the City of Bowling Green's Environmental Compliance Division, the Warren County Division of Stormwater Management, and the Warren County Division for Environmental Planning & Assistance. Notably, Allen, Butler, and Edmonson counties currently do not have their own dedicated environmental divisions.
- Pertinent research has also been conducted by the WKU Department of Earth, Environmental, and Atmospheric Sciences, focusing on the region's unique karst topography. Their studies explore the process of limestone dissolution by rainwater as a potential mechanism for atmospheric carbon dioxide removal.

Past and ongoing sustainability initiatives indicate a strong ambition within the BG MSA for climate action. Successful implementation of this PCAP is intended to further enhance climate action to build resilience for the people of the BG MSA.

2 Plan Development

The BG MSA actively pursued the inclusion of varied stakeholders across various industry sectors and organizations throughout the PCAP development process. The BG MSA worked to gather viewpoints through multiple modes of communication, such as face-to-face discussions, town hall meetings, and surveys targeting public participation. The following sections of this document describe the BG MSA's strategy for engaging key stakeholders and community members across all four of the BG MSA counties. Input gathered from this engagement are incorporated throughout the climate action planning process of the PCAP with a focus on the selection of priority measures that address stakeholder and community interests.

2.1 Intergovernmental and Interagency Coordination

The City of Bowling Green led collaborative efforts among the county and city governments that make up the BG MSA, along with locally established utility providers, with the intention of unifying planning strategies within the scope of this PCAP. These discussions sought to accrue early insights and viewpoints from multiple institutional representatives, thereby ensuring that the PCAP encapsulates critical priorities and GHG reduction interests of public-sector agencies within the BG MSA's purview. Consequently, these entities – including, but not limited to, the governments of Warren, Allen, Butler and Edmonson counties and the cities of Scottsville, Brownsville, and Morgantown - may be deemed eligible to be sub-awarded implementation funding provided by the EPA as a part of the CPRG program.

Consistency between governmental departments, as well as interagency coordination, was realized through direct collaboration with quasi-governmental agencies such as the Barren River Area Development District (BRADD); local non-profit organizations such as Kentuckians for the Commonwealth and the local chapter of the Sierra Club; industry such as Crown Cork & Seal; local utility companies such as Atmos Energy, Warren Rural Electrical Co-Op Corporation (Warren RECC), and Bowling Green Municipal Utilities (BGMU); and Mammoth Cave National Park, as well as individual community members residing in the BG MSA.

2.2 Public Engagement

Public and stakeholder involvement plays a crucial role in the PCAP, as it enables the plan to address the interests and concerns of diverse stakeholder groups. The BG MSA reached out to stakeholders through multiple methods including in-person town-halls and a pair of public surveys to garner feedback on residents' priorities and concerns around air pollution. Live feedback was provided during the town halls and the City of Bowling Green received a total of 136 responses to the public survey.

In-person and virtual stakeholder engagement

The BG MSA facilitated public involvement through multiple formats to connect with a broad, diverse group of residents and stakeholders within its constituencies. This involvement included:

2
Online surveys

4
Town halls

Public Survey

To start the stakeholder engagement process, an initial test survey was released to the public in the summer of 2023 through the City of Bowling Green's website to collect from the public. During this initial outreach, a total of 19 ideas/suggestions were submitted via email to the City.

An official stakeholder engagement plan was developed as a part of the PCAP process with the intent of releasing a more robust, wider-reaching survey to capture community thoughts on climate change but also gain an understanding of the needs of entire demographic living in the BG MSA communities. The public survey provided a description of the CPRG program and sought residents' perspectives on air pollution. The survey collected demographic information as well as opinions of climate and economic conditions that are of most concern to the BG MSA residents. Digital formats were publicized via social media platforms and on the City of Bowling Green's website.

The demographic range of responses included individuals between the ages of 18 to 84 and of six different races. Of total respondents, 36% are residents of low-income and disadvantaged communities (LIDAC) within the BG MSA.[5] The survey asked respondents to rank eight potential benefits of emissions reduction efforts to determine the priorities of the BG MSA's residents. Table 2 provides a summary of the frequency with which each benefit was selected from the drop-down menu of the eight benefits listed, which was used to inform the selection of GHG reduction measures.

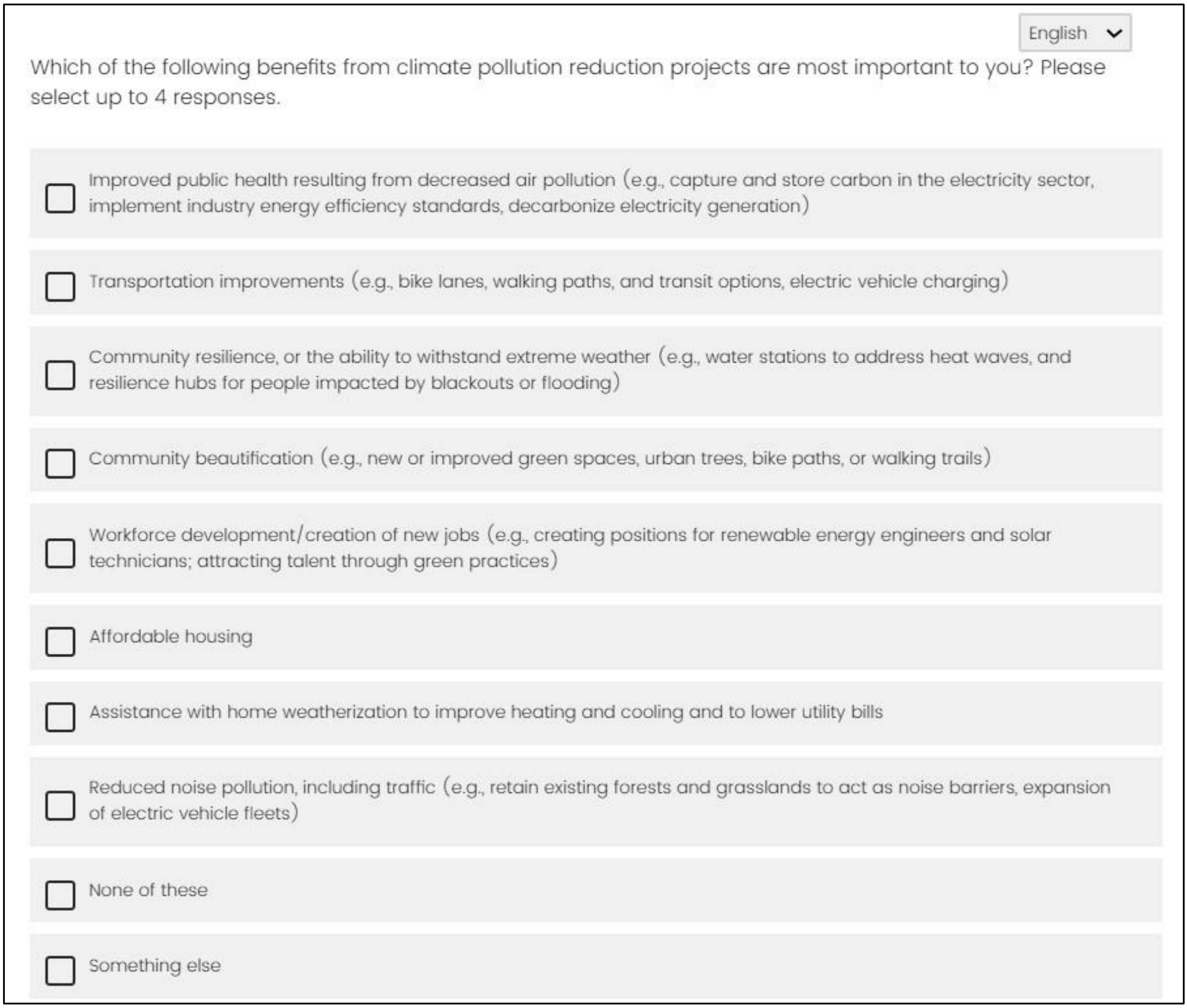
Table 2: Frequency of each benefit selected by respondents in the public survey

Benefits from climate pollution reduction projects most important to you, your family, and your community	Frequency chosen[6]
Affordable housing	45.5%
Transportation improvements (e.g., bike lanes, walking paths, and transit options, electric vehicle charging)	57.4%
Community resilience, or the ability to withstand extreme weather (e.g., water stations to address heat waves, and resilience hubs for people impacted by blackouts or flooding)	49.3%
Community beautification (e.g., new or improved green spaces, urban trees, bike paths, or walking trails)	50%
Improved public health resulting from decreased air pollution (e.g., capture and store carbon in the electricity sector, implement industry energy efficiency standards, decarbonize electricity generation)	30.8%
Assistance with home weatherization to improve heating and cooling and to lower utility bills	58.1%
Workforce development/creation of new jobs (e.g., creating positions for renewable energy engineers and solar technicians; attracting talent through green practices)	40.4%
Reduced noise pollution, including traffic (e.g., retain existing forests and grasslands to act as noise barriers, expansion of electric vehicle fleets)	23.5%
None of these *(written responses)*	1.4%
Something else *(written responses)*	4.4%

[5] Excluding incomplete responses, percentage of responses from LIDACs was determined using LIDACs as defined by the EJScreen-combined shapefile provided for CPRG. See: United States Environmental Protection Agency, Inflation Reduction Act Disadvantaged Communities Map. November 2023.

[6] Respondents could choose more than one concern in the survey.

Figure 2: Sample public survey question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Which of the following benefits from climate pollution reduction projects are most important to you? Please select up to 4 responses.

- ☐ Improved public health resulting from decreased air pollution (e.g., capture and store carbon in the electricity sector, implement industry energy efficiency standards, decarbonize electricity generation)
- ☐ Transportation improvements (e.g., bike lanes, walking paths, and transit options, electric vehicle charging)
- ☐ Community resilience, or the ability to withstand extreme weather (e.g., water stations to address heat waves, and resilience hubs for people impacted by blackouts or flooding)
- ☐ Community beautification (e.g., new or improved green spaces, urban trees, bike paths, or walking trails)
- ☐ Workforce development/creation of new jobs (e.g., creating positions for renewable energy engineers and solar technicians; attracting talent through green practices)
- ☐ Affordable housing
- ☐ Assistance with home weatherization to improve heating and cooling and to lower utility bills
- ☐ Reduced noise pollution, including traffic (e.g., retain existing forests and grasslands to act as noise barriers, expansion of electric vehicle fleets)
- ☐ None of these
- ☐ Something else

The survey asked respondents to rank eight potential challenges related to emissions reduction efforts to identify the concerns most important to the BG MSA's residents. Table 3 provides a summary of the frequency with which each challenge was selected from the drop-down menu of the eight challenges listed, which was used to inform the selection of GHG reduction measures.

Table 3: Frequency of each concern selected by respondents in the public survey

Concerns or challenges related to climate pollution reduction projects are most important to you, your family, and your community	Frequency chosen[7]
Short-term disruptions due to road closures, construction, etc.	60.3%
Land use changes, e.g., areas repurposed for solar generation	59.6%
Increased living costs	50.0%
Increased utility costs	29.4%
Unequal impacts and effects in my community	23.5%
Workforce concerns, e.g., loss of established jobs or new skills	27.9%
Less reliable energy	22.1%
Burdensome regulations	10.3%
None of these *(written responses)*	8.8%
Something else *(written responses)*	0.7%

Town Halls

Four community meetings in the form of town halls were held during the PCAP process, one in each of the counties. Meeting times and locations were publicized via the online survey, social media, printed in local newsletters, and posted on community billboards. Attendees at the town hall were told about the CPRG program and funding the BG MSA received to develop the PCAP. Attendees had the opportunity to ask questions about the program and share their own thoughts, concerns, and ideas of how the program could be best implemented to improve resilience in the greater community.

Town hall attendees made it known at all four meetings that inefficient bus transit, a lack of green spaces, and insufficient electric charging infrastructure exist as key roadblocks to reducing the BG MSA's total emissions. Requests for building efficiency incentives, the planting of native plant life for carbon sequestration, and the adoption of wider solar use were utilized to guide several of the measures included in this PCAP.

In all, more than 40 interested MSA residents attended one of the town hall events, creating the foundation for the first group of stakeholders whose input will continue to inform CPRG implementation grant construction and the creation of the CCAP.

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[7] Respondents could choose more than one concern in survey.

3 Bowling Green MSA's Greenhouse Gas Inventory

The BG MSA compiled an inaugural greenhouse gas (GHG) inventory that summarizes the chief emitters of greenhouse gases (GHGs) across the Metropolitan Statistical Area utilizing 2019 as an emissions base year. This year was selected due to the comprehensive, precise, readily available nature of the data acquired during this year, as well as its reflection of standard operations.

The GHG base year inventory provides a foundation upon which to construct meaningful and impactful environmental policy. The BG MSA will continuously improve upon its operational emissions inventory management in future years as additional data becomes available and as calculation methodologies are refined.

3.1 Data, Scope, and Methods

The BG MSA's GHG inventory was prepared using EPA's Local Greenhouse Gas Inventory Tool: Community Module,[8] and associated guidance from the GHG Protocol for Community-Scale Greenhouse Gas Inventories.[9]

The BG MSA leveraged inter-agency relationships and knowledge of municipal databases to provide quantifications of operations and activities that occurred in 2019 where feasible. For select sectors, data was sourced from national databases as a calculation input.

Table 4: Data sources and methodologies by sector for the BG MSA's GHG base year inventory

Emissions sectors	Data sources and high-level methodology[10]
Mobile	The BG MSA provided data on the municipal fleet and Scottsville Bus Transit System. Residential vehicle use occurring in the BG MSA was extrapolated using The Kentucky Transportation Cabinet reports on daily vehicle miles traveled for the four counties and the State of Kentucky 2021 Collision Facts report to determine vehicle type distribution.
Stationary	Fuel use data for homes in the BG MSA was extrapolated from the Edmonson County Residential Characteristics Report provided by the BG MSA. It was assumed that fuel consumption in residential homes across the four counties was consistent and proportional, and a weighted average of number of homes with each heat type was applied across the BG MSA. Average residential consumption for each fuel type in the East South-Central and South region was gathered from the U.S. Energy Information Administration Residential Energy Consumption Survey and multiplied by the number of homes in the BG MSA using those fuel types to determine total stationary fuel consumption. Residential coal consumption was extrapolated from specification sheets of residential coal stoves/ovens. Data on commercial and institutional facilities in the BG MSA was supplied by the BG MSA, and all facilities were mapped to a CBECS-compatible category. Commercial/institutional fuel consumption was extrapolated from the mean major fuel intensity of the mapped CBECS category, the square footage of the facility, and the weighted average fuel use in the region per CBECS.

[8] United States Environmental Protection Agency, Local Greenhouse Gas Inventory Tool. January 2024.
[9] GHG Protocol, Community-Scale Greenhouse Gas Inventories. January 2024.
[10] BG MSA, PCAP Appendix A, Section B – GHG Inventory. February 2024.

	Data on industrial facilities in the BG MSA was sourced from the Barren River Area Development District (BRADD) GIS database. Each facility was assigned an industry mapping to align with the industries outlined in the Manufacturing Industry Energy Consumption Survey for the South Region as provided by the U.S. EIA. Average national industrial floor space and average national fuel consumption by facility type as provided by the U.S. EIA was applied to the total industrial facilities in the BG MSA. The amount of butane and propane used was based upon U.S. EIA averages for hydrocarbon gas liquids. Steam production associated with natural gas burning was estimated using standard unit conversion.
Solid waste	Data on solid waste generation and disposal (classified as either municipal waste, industrial waste, or special waste) in the BG MSA was sourced from the Team Kentucky Energy and Environment Cabinet Solid Waste Branch Public documents - Waste Quantity Report 2015 - 2020. Total solid waste that was produced or sourced from the four counties within the BG MSA was summed by county. Utilized the California Air Resources Board Landfill Emissions Tool, as based on the IPCC First Order of Decay model to determine associated CH4 outputs per annual short tons of waste landfilled. Based on knowledge of the BG MSA it was assumed that no facilities in the BG MSA had a landfill gas collection system in 2019. An assumption was applied across all waste disposal facilities that waste was deposited in facilities at the same annual rate as in 2019 for the period of 2010-2019, to determine emissions associated with waste decomposition. A small number of landfills located outside the BG MSA geographic boundary (e.g., Glasgow landfill) are used to dispose of waste generated from inside the BG MSA boundary. For 2019, these facilities were included in solid waste calculations to provide a more conservative estimate of the impact of waste management within the BG MSA. For more context on these outside of geographic boundary facilities serving the BG MSA see the waste production section below.
Wastewater	Per conversation with the BG MSA and as observed by site visits the BG MSA is primarily served by anaerobic wastewater facilities that do not conduct nitrification/denitrification, and a significant portion of the MSA population is on septic systems. Data for total population served by wastewater treatment facilities per the Kentucky Infrastructure Authority WRIS Portal. The population of the BG MSA served by septic was estimated by subtracting the population served by municipal wastewater facilities from the total BG MSA population. Per annual purchase/treatment records provided by the BG MSA water treatment occurs at the following facilities in the BG MSA: o Scottsville Water Department o Butler County Water System o Morgantown Water System o Edmonson County Water System o Bowling Green Municipal Utility (BGMU)
Electricity	Utility providers in the BG MSA were determined as based on the Electric Service Areas Map as published by the Kentucky Public Service Commission and dated May 26, 2023. As based on this map the BG MSA is served by the following utilities: o Bowling Green Municipal Utility (BGMU)

	○ Warren Rural Electric Cooperative Corporation (RECC) ○ Tri-County Electric Membership Corporation (EMC) ○ Pennyrile RECC ○ Farmers RECC ○ Kentucky Utilities Company Total annual electricity consumption in Warren, Butler, Edmonson, and Allen counties was estimated using electricity sales data from the above utility providers. Data for the portions of the BG MSA served by BGMU, Pennyrile RECC, and Farmers RECC was provided by the BG MSA. Data for Warren RECC and Tri-County EMC was sourced from the U.S. Energy Information Administration Annual Electric Power Industry Report Form. Portion of the total utility provider sales relevant to the BG MSA counties for Warren RECC and Tri-County EMC was estimated based upon area (Warren, Butler, and Edmonson sales were considered to account for ~50% of the total Warren RECC service area and Allen sales were assumed to account for 30% of the total Tri-County EMC service area). Data for Kentucky Utilities Company was excluded from these calculations due to the small service area (around Mammoth Cave National Park) and the difficulty / level of uncertainty around extrapolating the BG MSA usage from service provision to the entire state.
Water	Per the California Department of Water Resources imported water refers to the amount of water transferred across hydrologic region boundaries from one agency to another. The assumption was applied that 100% of water purchased in the BG MSA is locally sourced, from waters of the Commonwealth of Kentucky. As the Local Inventory Tool only calculates emissions associated with imported water, no emissions were associated with this sector in 2019. Per annual purchase/treatment records provided by the BG MSA, facilities within the BG MSA where water purchasing / distribution is occurring: ○ Warren County Water District ○ Allen County Water District ○ Brownsville Municipal Water System
Agriculture and land management	Data on annual nutrient application sourced from the U.S. EPA EnviroAtlas tool. Total BG MSA land cover related to cultivated crops was sourced via the EnviroAtlas tool and was considered agricultural land. A geographic boundary aligned with the BG MSA area was set in the EnviroAtlas tool to source data on annual nitrogen, phosphorous, and manure application in kg/hectare/year. The BG MSA area application per hectare was applied to the total hectares of cultivated crop land cover in the four MSA counties. An assumption was applied that nitrogen application was associated with synthetic fertilizer application, and phosphorous application was associated with organic fertilizer application.
Urban Forestry	Data on tree cover area in the BG MSA was provided by Western Kentucky University. Data on total urban area with tree cover was segmented by residential, commercial, and industrial.
Waste Production	A small number of landfills located outside of the BG MSA geographic boundary (e.g., Glasgow landfill) are used to dispose of waste generated inside the BG MSA. For 2019, these facilities were included in solid waste calculations to provide a more conservative estimate of the impact of waste management within the BG MSA - and as such no emissions were associated with this optional Scope 3 waste production category of emissions.

	As the BG MSA gathers increasingly granular data for emissions calculations, waste that is sourced from within the BG MSA boundaries, but disposed of outside of the same boundaries, may be reported as optional Scope 3 waste production (pending greater insight into the characteristics of the solid waste).
Additional emissions	N/A – No additional emissions were included in the 2019 emissions inventory

Table 5: Metric tons of gases by sector in the BG MSA's GHG inventory

Sector	Carbon dioxide (CO_2)	Methane (CH_4),	Nitrous oxide (N_2O)	Total (MT CO_2e)*
Mobile	798,627.25	0.55	5.39	798,633.19
Stationary	936,929.54	2,400.94	1,023.60	940,354.08
Solid waste	-	202,991.77	-	202,991.77
Wastewater	-	57,176.39	2,048.60	59,224.99
Electricity	1,286,451.66	3,299.79	4,666.58	1,294,418.03
Water	-	-	-	-
Agriculture and land management	-	-	276,611.26	-
Urban Forestry	- 42,289.72	-	-	-
Waste Production	-	-	-	-
Total BG MSA gross emissions	**3,022,008.46**	**265,869.45**	**284,355.41**	**3,572,233.32**
Total BG MSA net emissions	**2,979,718.74**	**265,869.45**	**284,355.41**	**3,529,943.60**

* Fluorinated gases were not calculated in the EPA Local Greenhouse Gas Inventory Tool, as based on the data inputs that were available and tool limitations.

Greenhouse Gas Emissions by Sector and Gas

In 2019, the total GHG emissions of the BG MSA measured at 3,572,233.32 MT CO_2e. This figure was reduced by 42,289.72 MT CO_2e due to the presence of carbon sinks due to practices of land-use, changes in land-use, and forestry sectors (LULUCF). These emissions, associated with urban forestry and retained tree cover, reduced net emissions to 3,529,943.60 MT CO_2e - as visualized in Figure 3.

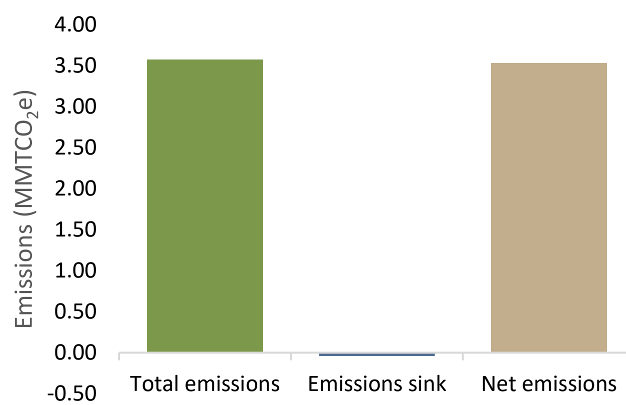


Figure 3: BG MSA's 2019 GHG total, net emissions

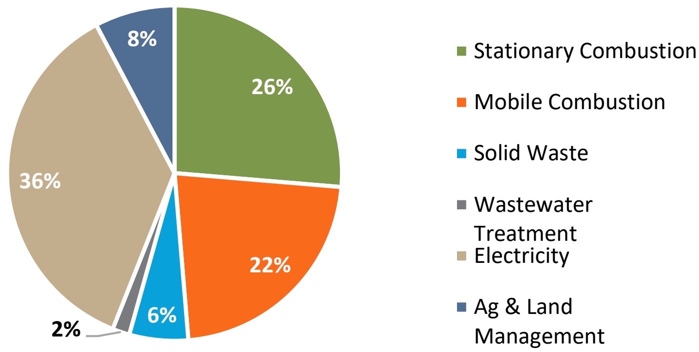


Figure 4: BG MSA's 2019 GHG emissions by sector

Figure 4 illustrates the emissions contribution to each sector in 2019. Electricity (36%) was indicated to be the highest emitting sector for the BG MSA in 2019, followed by stationary combustion (26%), mobile combustion (22%), agriculture and land management (8%), solid waste (6%), and wastewater treatment (2%).

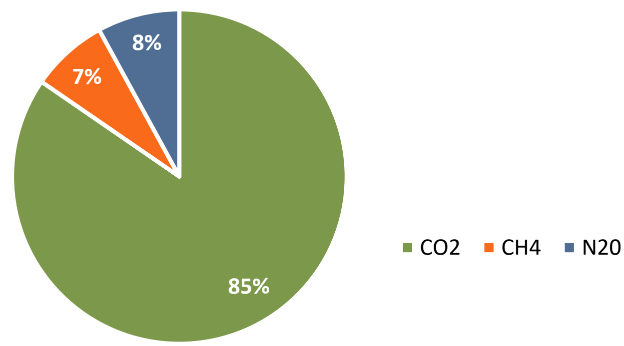


Figure 5: BG MSA's 2019 GHG emissions by gas type

CO_2 resulting from the electric, stationary combustion, and mobile combustion sectors was most of the BG MSA's emissions profile in 2019. The primary sectors contributing to CH_4 emissions were solid waste and wastewater treatment. The agriculture and land management sector was the heaviest contributor to total N_2O emissions. Fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) were not calculated in the EPA Local Greenhouse Gas Inventory Tool, as based on the data inputs that were available and tool limitations. In future inventories the BG MSA intends to assess any additional priority GHGs that may be present in the inventory. Figure 5 presents an overview of GHG emissions by gas type.

Sectors as provided by the EPA Local Greenhouse Gas Inventory Tool were mapped to the sectors outlined by the U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021 (see section 2.3 – Rationale for selection of sectors) in Table 6 below. [11] The BG MSA approached selecting priority sectors for reduction measure implementation based on existing knowledge of the U.S. national emissions profile, the weighting of the BG MSA's 2019 emissions profile, and understanding of the sectors that have the largest impact in the BG MSA. The BG MSA has a large concentration of industry and agriculture, and residential populations are generally concentrated around urban centers (e.g., Bowling Green).

Table 6: Mapping of GHG inventory sectors to priority sectors for reduction measures

Inventory emissions sectors	Associated priority sector for reduction measure implementation
Mobile	Transportation
Stationary	Industry, Commercial & Residential Buildings
Solid waste	Water, Wastewater, & Materials Management

[11] United States Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2021. April 2023.

Wastewater	Water, Wastewater, & Materials Management
Electricity	Electricity Production & Consumption
Water	Water, Wastewater, & Materials Management
Agriculture and Land Management	Agriculture & Natural Working Lands
Urban Forestry	No sector associated[12]
Waste Production	Water, Wastewater, & Materials Management

4 Priority Climate Pollution Reduction Measures

The BG MSA developed the following set of 12 emissions reduction measures, categorized into five overarching, high-level strategies, to address climate pollution in the BG MSA. These measures were selected in accordance with CPRG program guidance to choose measures that are high impact, benefit LIDACs, and are ready to implement.[13] Note that high-level strategies are included for organizational and strategic direction but are not themselves quantified. Strategies were developed in coordination with key stakeholders and community input and reflect emissions reductions measures that the BG MSA has direct authority to implement.

Table 7 provides projected GHG emissions reductions accumulated over two timeframes: 2025-2030, and 2025-2050. Projected changes in GHG emissions for measures 1.1 to 1.4, 3.1, 4.1, and 5.1 were modeled using the Rocky Mountain Institute's Energy Policy Simulator (EPS).[14] Projected changes in GHG emissions for measures 2.1 to 2.4 and 3.2 were modeled by the Tennessee Department of Environment and Conservation (TDEC) using a combination of EPA's Global Change Analysis Model Long-term Interactive Multi-Pollutant Scenario Evaluator (GLIMPSE) program and manual calculations. See Appendix A, Section C for the methodology used to quantify GHG emissions reduction potential of implementing the priority measures.

Table 7: Priority GHG reduction measures and associated reductions projected (cumulative within each time period)

		Cumulative GHG emission reductions (MTCO2e)	
Strategy	Priority Measure	2025-2030	2025-2050
1. Transportation improvements	1.1 Electrify public transit fleet	(368)	(2,728)
	1.2 Expand public transit and improve routes	(8)	(113)
	1.3 Expand shared use paths	(2)	(24)
	1.4 Improve traffic flow and efficiency	(117,216)	(2,403,393)
2. Building energy efficiency enhancement	2.1 Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings	(200,000)	(1,700,000)
	2.2 Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights	(20,000)	(600,000)
	2.3 Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings	(200,000)	(1,800,000)

[12] No sector was associated with urban forestry as it is considered an emissions sink for the BG MSA
[13] United States Environmental Protection Agency, EPA CPRG Planning Grants Program Guidance for States-Municipalities-Air Agencies. March 2023.
[14] Energy Innovation Policy & Technology LLC, Energy Policy Simulator. 2024.

	2.4 Weatherization programs for residential buildings	(100,000)	(700,000)
3. Renewable energy enhancement	3.1 Developing and distributing solar energy generation	(66,060)	(252,003)
	3.2 Upgrading electricity distribution	(10,000)	(100,000)
4. Waste diversion and landfill management improvements	4.1 Programs to divert organic waste from landfills	(49,727)	(1,097,176)
5. Land use enhancement	5.1 Expand green spaces	(1,561)	(11,995)
TOTAL ABATEMENT POTENTIAL		(764,942)	(8,667,432)

Strategy 1: Transportation improvements

The transportation sector in the BG MSA emits an estimated 22% of overall emissions. Measures under strategy 1 include electrifying the transportation fleet, expanding bus transit, and improving routes, expanding shared use paths, and improving traffic flow and efficiency.

Measure 1.1: Electrify public transit fleet

This measure will gradually replace the current gasoline-powered public transportation fleet in the BG MSA with electric vehicles to reduce the GHG emissions from the transportation sector between 2026 to 2050. The BG MSA's current public transportation fleet consists of 52 vehicles, comprised of 25 buses/cutaways, and 27 vans/minivans.[15]

Measure 1.2: Expand public transit and improve routes

This measure entails improvements to the BG MSA's public transit by expanding its reach to populations currently isolated from public transportation access and improving efficiency of routes. This measure intends to increase the areas serviced by public transit. As public transit ridership improves, the amount of passenger cars on the road contributing to air pollution is reduced, resulting in potential air quality benefits over time.

Measure 1.3: Expand shared use paths

This measure develops multi-use paths to connect residents with their important locations and services in their neighborhoods, such as schools, bus stops, grocery stores, and recreational activities. Shared use paths encourage active transport and community connectivity by accommodating micro-mobility, such as walking and cycling, as a form of commute.

Measure 1.4: Improve traffic flow and efficiency

This measure focuses on minimizing time vehicles spend idling in traffic by improving overall efficiency of the road network. This can be achieved through a variety of means, such as smart traffic management technologies, intersection upgrades, or traffic signal optimization.

Strategy 2: Building energy efficiency enhancement

The industry, commercial, and residential buildings sectors in the BG MSA emit an estimated 26% of overall emissions in the BG MSA. This collection of measures anticipates the implementation of various incentive programs to promote energy efficiency enhancements to buildings across the industrial, commercial, and residential sectors.

[15] National Transit Database, 2022 Revenue Vehicle Inventory. *Federal Transit Administration*. February 2024.

Measure 2.1: Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings

This measure addresses the commercial building sector from the perspective of energy efficiency improvements that can be made to existing buildings. Examples include but are not limited to the replacement of existing products (e.g., space heating, ventilation, air-cooling systems, cooking appliances, etc.) with certified energy-efficient products.

Measure 2.2: Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights

This measure aims to reduce emissions by improving lighting efficiency and thereby saving energy and associated emissions that would otherwise be generated. The ultimate emission sources are the existing and future fleet of electricity generating units serving the defined geographic areas. However, this measure focuses on the end-use of lighting specifically, so emission reductions are translated from energy saved (e.g., kWh) to emissions reduced in the production of the electricity.

Measure 2.3: Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings

This measure addresses the residential building sector from the perspective of energy efficiency improvements that can be made to existing buildings. Examples include but are not limited to the replacement of existing products (e.g., space heating, ventilation, air-cooling systems, cooking appliances, etc.) with certified energy-efficient products.

Measure 2.4: Weatherization programs for residential buildings

This measure focuses on energy management actions taken at the residential level to improve energy efficiency in dwellings. Specifically, various building envelope weatherization and insulation strategies are anticipated. Such measures can reduce homeowner fossil fuel combustion for heating as well as reduce the demand for electricity associated with space heating and cooling. These weatherization programs may result from home energy audit programs and DIY energy workshops (e.g., window and door seals and improved insulation, and more efficient water heating systems).

Strategy 3: Renewable energy enhancement

The electricity production and consumption sector in the BG MSA emits an estimated 36% of overall emissions. This proposed strategy promotes renewable energy production and enhances energy efficiency within the BG MSA, via small and community solar projects and improvements in electricity distribution infrastructure, laying the groundwork for an anticipated shift towards vehicle electrification and reduced fossil fuel dependency.

Measure 3.1: Developing and distributing solar energy generation

This measure centers on implementing small-scale and community shared solar energy across the BG MSA's residential and commercial areas. It involves fitting solar PV panels in various locales, from rooftops to vacant land. The solar power created enhances the existing electrical grid's stability and resilience, fostering a broader, communal shift towards harnessing renewable energy sources within the BG MSA.

Measure 3.2: Upgrading electricity distribution

This measure aims to reduce transmission loss and thereby reduce overall power consumption through increased efficiency. Other related measures will be considered that aim to upgrade the electricity distribution system and position the state for increased load growth in response to vehicle electrification and the transition away from fossil fuel use have potential to provide further improvements to the grid.

Strategy 4: Waste diversion and landfill management improvements

Measure 4.1: Programs to divert organic waste from landfills

The waste, wastewater, and materials management sector in the BG MSA emits an estimated 8% of overall emissions. This measure aims to reduce the amount of organic waste in landfills that contributes to methane emissions by developing composting programs that help reduce food waste. As of March 2024, the BG MSA does not have a formal composting program. This measure encourages emissions reductions by reducing emissions associated with food waste in municipal solid waste landfills.

Strategy 5: Land use enhancement

Measure 5.1: Expand green spaces

The agriculture and land management sector in the BG MSA emits an estimated 8% of overall emissions. This measure focuses on expanding green spaces that enhance urban greenery with native vegetation, such as low-lying shrubs that do not interfere with overhead power lines.

5 Co-Pollutant Benefits Analysis

Categories of air pollutants such as Criteria Air Pollutants (CAPs), Hazardous Air Pollutants (HAPs), and Volatile Organic Compounds (VOCs) pose potential threats to public health.[16] The pivotal measures pinpointed in this plan aim to curb CAPs, HAPs, and VOCs, thereby promoting better public health outcomes for the residents within the BG MSA region. Lowering harmful air contaminants can result in decreased levels of respiratory and cardiovascular diseases, thus, cutting down hospital admissions and overall medical expenses, while simultaneously fostering healthier and more resilient communities.[7]

This section presents the co-pollutants inventory for the year 2017 in the BG MSA region, with data divided by sectors as defined by the National Emissions Inventory (NEI). The data is further segmented by county. In addition, this section offers an estimate of the potential impact on select CAPs, HAPs, and VOCs due to the execution of each priority measure.

5.1 Bowling Green MSA's Co-Pollutant Inventory

The BG MSA utilized emissions statistics from the 2017 edition of EPA's NEI,[17] focusing on CAPs, HAPs, and (VOCs) within the MSA to establish a 2017 base year co-pollutant inventory.[18]

Figure 6 presents the top 10 highest emitting sectors of air pollution in the BG MSA, focusing on five key CAPs (particulate matter, carbon monoxide, lead, sulfur dioxide, nitrogen dioxide),[16] total HAPs, and total VOCs.[19] These 10 sectors cumulatively accounted for 84% of air pollution emitted in the BG MSA in 2017, based on selected CAPs and total HAPs. Co-pollutant emissions data, categorized according to the sectors classified by the NEI, can be reviewed in Appendix A, Section D. Note that the sectors identified in the NEI co-pollutant inventory do not directly correspond with the sectors and subsectors of the GHG inventory.

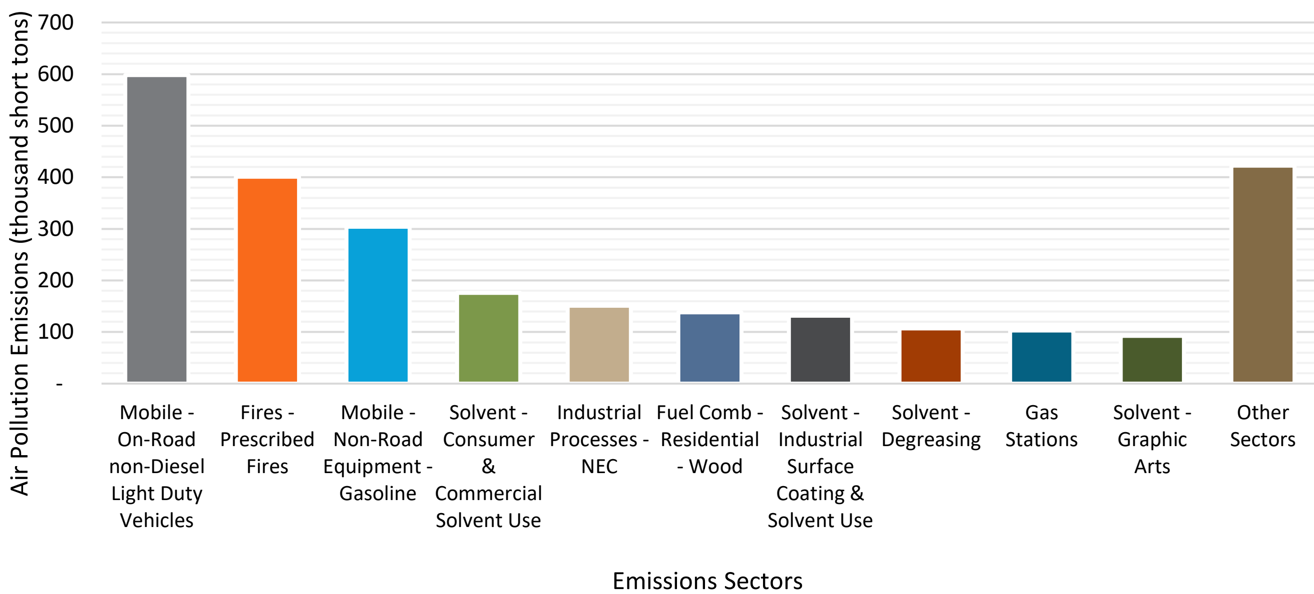
[16] The EPA defines six CAPs relevant to air pollution. Ozone is excluded from the co-pollutant inventory as ozone is not directly emitted but formed as a secondary reaction from other pollutants. See: United States Environmental Protection Agency, Criteria Air Pollutants. February 2024.

[17] United States Environmental Protection Agency, 2017 National Emissions Inventory (NEI) Data. December 2023.

[18] 2017 was chosen as the co-pollutant base year inventory, as this is the most recent inventory from the NEI that is unaffected by the COVID-19 pandemic and its subsequent impact on emissions changes.

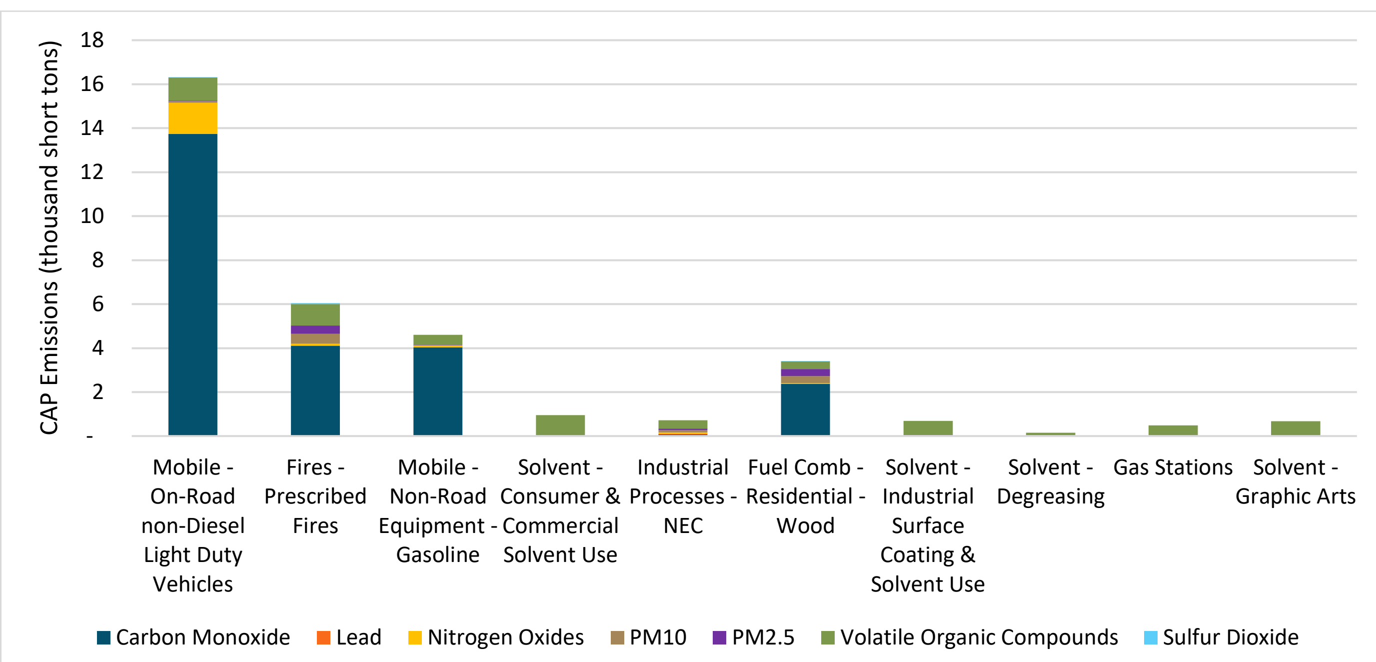
[19] Biogenic emissions from vegetation and soil were excluded from this analysis due to being naturally occurring emissions. The 2017 NEI estimates 3,479,256 tons of chosen co-pollutants (particulate matter, carbon monoxide, lead, sulfur dioxide, nitrogen dioxide, total HAP, and total VOC) emitted from the "Biogenics - Vegetation and Soil" sector. The NEI defines the "Biogenics – Vegetation and Soil" sector as occurring from natural sources. See: United States Environmental Protection Agency, 2017 National Emissions Inventory: January 2021 Updated Release, Technical Support Document. February 2021.

Figure 6: Top 10 air pollution emissions sectors in the Bowling Green MSA



Light duty non-diesel vehicles are the largest source of air polluting emissions in the BG MSA, due to the use of personal vehicles as the most common mode of commuting in all four counties.[20] Subsequently, the next leading source of emissions is prescribed fires, chiefly comprised of carbon monoxide emissions. Although prescribed fires play a vital role in land management, they can release significant volumes of air pollutants when not carefully managed. Figure 7 showcases the volume of CAP emissions of the highest emitting sectors.

Figure 7: Composition of CAP emissions in top ten highest emitting sectors in the Bowling Green MSA



[20] United States Census Bureau, Commuting Characteristics. 2022.

Carbon monoxide and volatile organic compounds are the most prevalent CAPs in the BG MSA, primarily driven by emissions activity corresponding to mobile on-road non-diesel light duty vehicles and prescribed fires. Targeted air pollution reduction efforts that address these air pollutants could yield improvements in air quality.

5.2 Co-pollutant Emission Changes from Priority Measures

Each priority pollution reduction measure chosen in the BG MSA has the potential to reduce CAP and HAP emissions and associated burdens associated with air pollution. Table 8 indicates how each measure is expected to impact six key air pollutants in the BG MSA in the short term, by 2030, and in the longer term, by 2050.

Projected changes in co-pollutant emissions for measures 1.1 to 1.4, 3.1, 4.1, and 5.1 were modeled using the Rocky Mountain Institute's Energy Policy Simulator (EPS). Projected changes in co-pollutant emissions for measures 2.1 to 2.4 and 3.2 were modeled by TDEC using a combination of EPA's Global Change Analysis Model Long-term Interactive Multi-Pollutant Scenario Evaluator (GLIMPSE) program and manual calculations. A dash, "—" is indicated where co-pollutants were not evaluated for the PCAP. See Appendix A, Section C for the methodology used to quantify air pollutant reduction potential of implementing the priority measures.

Table 8: Estimated impact of priority pollution reduction measures on co-pollutant emissions[21]

	Air pollution reduction potential 2025 to 2030 (short tons)						Air pollution reduction potential 2025 to 2050 (short tons)					
Priority measure	CO	NOx	$PM_{2.5}$	PM_{10}	SO2	VOC	CO	NOx	$PM_{2.5}$	PM_{10}	SO2	VOC
1.1 Electrify public transit fleet	(4)	(2)	(0.1)	(0.1)	(0)	(0.3)	(44)	(10)	(0.4)	(0.5)	(0)	(3)
1.2 Expand public transit and improve routes	(0.1)	(0)	(0)	(0)	(0)	(0)	(2)	(0.2)	(0)	(0)	(0)	(0.2)
1.3 Expand shared use paths	(0)	(0)	(0)	(0)	(0)	(0)	(0.8)	(0)	(0)	(0)	(0)	(0)
1.4 Improve traffic flow and efficiency	198	149	6	10	1	28	4,029	3,353	132	218	(221)	676
2.1 Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings	—	—	—	—	—	—	—	(818)	—	—	(1,205)	—
2.2 Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights	—	—	—	—	—	—	—	(291)	—	—	(429)	—
2.3 Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings	—	—	—	—	—	—	—	(868)	—	—	(1,280)	—
2.4 Weatherization programs for residential buildings	—	—	—	—	—	—		(317)	—	—	(467)	
3.1 Developing and distributing solar energy generation	(25)	(50)	(4)	(6)	(70)	(0.2)	(63)	(166)	(14)	(23)	(190)	(7)
3.2 Upgrading electricity distribution	—	—	—	—	—	—	—	(34)	—	—	(51)	—
4.1 Programs to divert organic waste from landfills	(0.2)	(0.4)	(0.1)	(0.1)	(0.1)	(0.4)	(530)	(511)	(49)	(57)	(535)	61
5.1 Expand green spaces	0	0	0	0	0	0	3	1	0	0	0	2

"—" indicates that co-pollutant benefit has not been evaluated for the PCAP.

[21] Total co-pollutant emissions impacts for the full suite of measures have not been calculated for the PCAP. Co-pollutant impacts for individual measures that have been evaluated at this stage are shown in the table. Total co-pollutant emissions projections will be evaluated for the CCAP.

6 Low-Income and Disadvantaged Communities (LIDAC) Benefits Analysis

6.1 LIDAC Benefits Analysis Methodology

As part of the CPRG program, the BG MSA conducted a LIDACs Benefit Analysis to align with Executive Order 14008 that set forth the Justice40 Initiative, which sets out to provide 40% of the total benefits of all relevant federal investments to disadvantaged communities. The priority measures identified in this PCAP have the potential to benefit LIDAC populations across the BG MSA.

To identify low-income and disadvantaged areas, the BG MSA leveraged the Climate and Economic Justice Screening Tool (CEJST) and the EPA's Environmental Justice Screening and Mapping Tool (EJScreen). The EPA recommends using the following definitions for LIDACs:[22][23]

- Any census tract that is included as disadvantaged in CEJST; and/or,
- Any census block group that is at or above the 90th percentile for any of EJScreen's Supplemental Indexes when compared to the nation or state; and/or,
- Any geographic area within Tribal lands and indigenous areas as included in Screen.

Further, the definition of "disadvantaged" in CEJST is that the income level of the census tract is at or above the 65th percentile for low income coupled with several "categories of burden" such as climate change, energy consumption, health conditions, housing conditions, legacy pollution, transportation accessibility, water and wastewater management, and workforce development statuses. These factors can be elaborated as follows:

- **Climate Change Factors:** Communities are considered disadvantaged if they are within census tracts that either match or exceed the 90th percentile for predicted variables such as agricultural loss rate, building loss rate, population loss rate, anticipated flood risk, or projected wildfire risk.
- **Energy Consumption Factors:** Communities are considered disadvantaged if they fall within the census tracts registering at or above the 90th percentile for energy costs or Particulate Matter 2.5 ($PM_{2.5}$) in the air.
- **Health-Related Factors:** Communities are considered disadvantaged if they rank at or above the 90th percentile for conditions such as asthma, diabetes, heart disease, or low life expectancy in their respective census tracts.
- **Housing Conditions:** Communities are considered disadvantaged if they, within their respective census tracts, have historically experienced underinvestment or rank at or above the 90th percentile for housing costs, lack of green spaces, lack of indoor plumbing, or the presence of lead paint.
- **Legacy Pollution Factors:** Communities are considered disadvantaged category if they inhabit census tracts with at least one abandoned land mine or formerly used defense site or rank at or above the 90th percentile concerning proximity to hazardous waste facilities, superfund sites (National Priorities List (NPL)), or Risk Management Plan (RMP) facilities.
- **Transportation Conditions:** Communities are considered disadvantaged if they meet or surpass the 90th percentile for exposure to diesel particulate matter, transportation barriers, and heavy traffic proximity and volume.

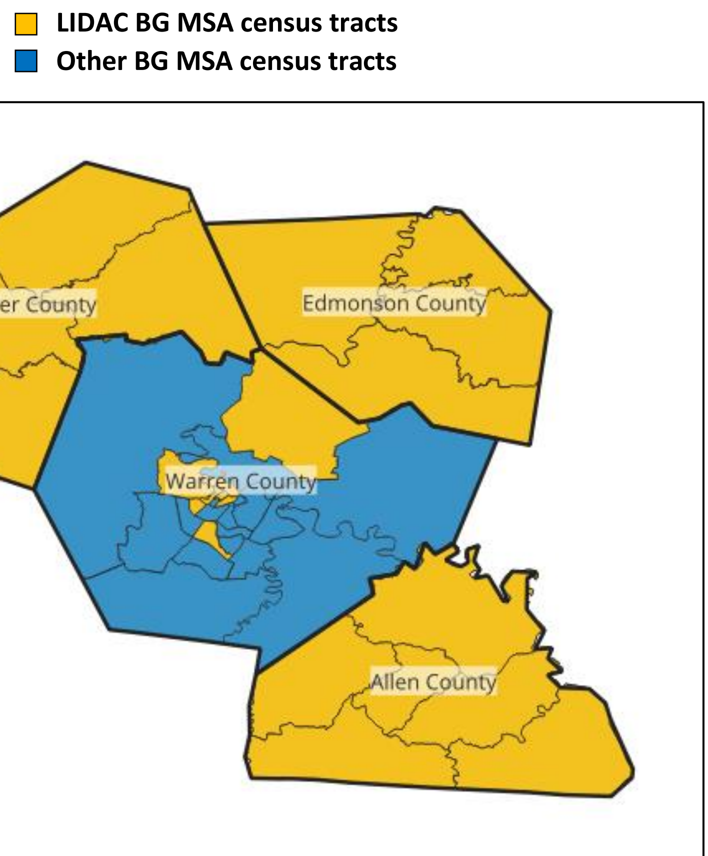
[22] Council on Environmental Quality, Climate & Economic Justice Screening Tool. November 2022.
[23] United States Environmental Protection Agency, EJScreen (epa.gov). January 2024.

- **Water and Wastewater-Related Aspects:** Communities are considered disadvantaged if they are in census tracts that rank at or above the 90th percentile for underground storage tanks and releases or wastewater discharge.
- **Workforce Development Factors:** Communities are considered disadvantaged if they lie within census tracts that are at or above the 90th percentile for linguistic isolation, low median income, poverty, or unemployment. This is especially the case if more than 10% of the population, aged 25 years and older, have an educational level that is less than a high school diploma.

6.2 Low-Income and Disadvantaged Communities in the Bowling Green MSA

Located within the geographical boundaries of the BG MSA, LIDACs are distributed across all four constituent counties. The BG MSA encompasses 39 census tracts, 22 of which are defined by CEJST as LIDAC regions. See Appendix A, Section E for the list of census tracts in the BG MSA.

Figure 8: BG MSA LIDACs by county[24]



[24] This map identifies LIDAC Census Tracts according to the Council on Environmental Quality's CEJST tool. The CEJST tool provides the most in-depth analysis of the different categories of burden faced most by LIDACs in the BG MSA. The area identified in Figure 8 may differ slightly from that which is identified in *Figure 14*, which is a combination of EJScreen and CEJST shapefiles, and shows additional LIDAC census divisions but lacks data on categories of burden needed for further analysis. The demographics analyzed for both figures are consistent, and all LIDACs were still engaged throughout the analysis process.

LIDACs in Allen County

All of Allen County's six census tracts are designated as LIDAC. The categories of burden experienced in this county include climate change, housing, health, and transportation. 15.3% of Allen County's population is below the poverty line,[25] and all census tracts within the county are at least the 89th percentile with respect to vulnerabilities to population loss, including fatalities and injuries resulting from natural hazards. Two census tracts, including the district encompassing Scottsville, are above the 90th percentile for heart disease and/or low life expectancy. Two census tracts are above the 90th percentile for lacking indoor plumbing, and four lack affordable, safe, reliable, and efficient transportation opportunities for citizens.[26]

LIDACs in Butler County

Four of Butler County's five census tracts are designated as LIDAC. 17.1% of the county's population is below the poverty line.[27] All four census tracts are vulnerable to the legacy pollution and climate change categories of burden due to the persistence of abandoned coal mines through the county and expected population loss because of natural hazards, respectively. Despite I-165 and U.S. 231 running through the county, three of the four LIDAC census tracts experience transportation barriers. Other issues include a persistent lack of plumbing in one census tract and rates of heart disease and low life expectancy above the 90th percentile.[26]

LIDACs in Edmonson County

All of Edmonson County's four census tracts are designated as LIDAC. In the county, it is important to note that one whole census tract is the jurisdiction of Mammoth Cave National Park. This zone meets the legacy pollution burden threshold due to poverty levels in the 99th percentile and the presence of abandoned mine land. Two other census tracts also are impacted by legacy pollution due to the presence of abandoned mine lands. Edmonson County has an overall poverty rate of 15.8%.[28] In two tracts, energy cost with respect to household income lies above the 90th percentile and transportation barriers also exist above the 90th percentile. Rates of heart disease are above the 85th percentile in the county, with two tracts surpassing the 90th percentile threshold to be designated the health category of burden. In the northeast corner of the county, unemployment is above the 95th percentile and 27% of the population aged 25 and older do not hold a high school diploma.[26]

LIDACs in Warren County

Warren County is the most populous county in the BG MSA and encompasses the city of Bowling Green. Eight census tracts in the county are designated LIDAC, seven of which are within the city limits. Six of the seven clustered around the city center face generally higher rates of poverty, above the 90th percentile. Over 15% of people aged 25 or older in these census tracts do not hold a high school diploma. While the poverty rate in Warren County is 18.7%,[29] many LIDAC areas of Bowling Green have poverty rates above the 90th percentile. Rates of asthma, diabetes, heart disease, and low life expectancy are all above the 90th percentile in some parts of the city. Housing costs near the center of the city are above the 90th percentile, and other LIDAC designated regions of the county face transportation barriers as well.

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[25] Barren River Area Development District, Allen County Overview. 2022

[26] Council on Environmental, Climate & Economic Justice Screening Tool. November 2022.

[27] Barren River Area Development District, Butler County Overview – BRADD Planning. 2022.

[28] Barren River Area Development District, Edmonson County Overview – BRADD Planning. 2022.

[29] Barren River Area Development District, Warren County Overview – BRADD Planning. 2022.

Racial and Immigrant Demographics in the BG MSA

The city of Bowling Green is more racially diverse compared to Kentucky as a whole. The 2022 US Census reports that 34.2% of the city's residents are people of color (POC), as opposed to the state's 16.8%. Bowling Green also has a higher foreign-born population — 13.9%, which is over three times the rate for the whole of Kentucky.[30] Kentucky was ranked fourth in the nation for refugee settlement during the 2022 fiscal year and Bowling Green remains a hub for refugee resettlement thanks in part to local institutions like the International Center of Kentucky. Between 2018 and 2022, 69.4% of the 2,283 immigrant arrivals were refugees.[31] In the 2022 fiscal year alone, the International Center resettled 826 people which included 255 refugees, 352 Afghan natives, four Ukrainians, and nine special immigrants visa holders. Additionally, the city has welcomed many immigrants from the Democratic Republic of Congo, Cuba, Burma, Nigeria, and Rwanda.[32]

More broadly, 11,274 immigrants lived in Warren County in 2016 – the top countries and regions of origin being Bosnia, Mexico, Myanmar, Sub-Saharan Africa (including Ghana, Zaire, and Kenya), Iraq, and El Salvador. This is part of an 86.6% growth in the immigrant population since 2011.[33] Of the 64,423 people that worked in Warren County during this time, 7.4% (or 4,754) are estimated to be foreign-born. Immigrants make up 10.3% of Warren County's employed labor force. Immigrants represent significant portions of these industries' workforces: 23.7% in manufacturing, 20.8% in transportation and warehousing, 8.5% in construction, 7.8% in education, and 7.2% in professional services.[33]

Education-wise, compared to U.S.-born residents of Warren County, immigrants are less likely to have a bachelor's degree or higher with 19.8% of immigrants holding a college degree compared to 30.6% of U.S.-born residents.[33] While race, ethnicity, or immigrant status does not directly contribute to LIDAC designation, many of the LIDAC sectors in Bowling Green are also among the most diverse. The four LIDAC census tracts west of Kentucky Street in Bowling Green are all at least 45% POC. The primary POC demographics within these districts are Black or African American and Hispanic or Latino, though there is a large Asian population as well below Morgantown Road.

The remaining LIDAC districts in the broader BG MSA are largely White, excepting the Mammoth Cave National Park district which is only 21% White. This area also has the smallest population compared to other census tracts in the MSA, at 268.[34]

6.3 Climate vulnerabilities among LIDACs

Health Disparities in the BG MSA

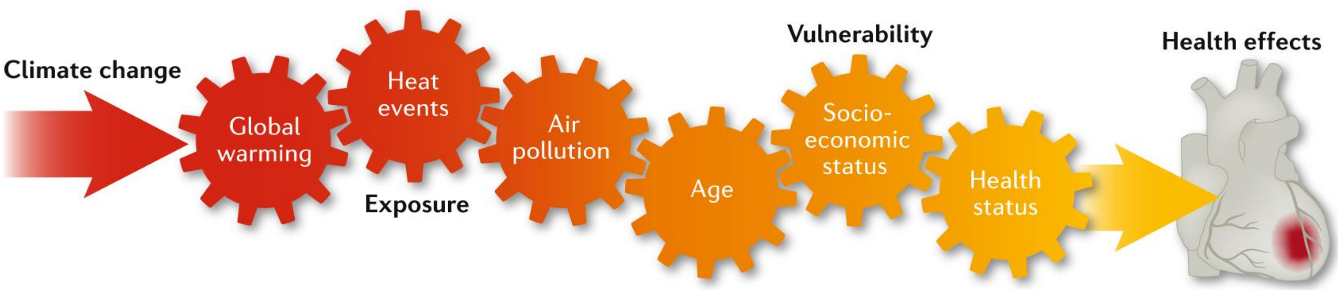
The entire BG MSA, but specifically urban areas of Bowling Green in Warren County, present some of the most compelling examples of communities facing health disparities. This community illustrates the intricate complexities of racial, socio-economic, and health-related challenges that are being further exacerbated by

[30] United States Census Bureau, U.S. Census Bureau QuickFacts: United States. July 2023.
[31] Kentucky Office for Refugees, Bowling Green Arrivals | Kentucky Office For Refugees (kentuckyrefugees.org). *Catholic Charities of Louisville, Inc.* 2024.
[32] Watson, A., The International Center of Kentucky resettled over 800 people during the 2022 federal fiscal year (wkyufm.org). *WKU Public Radio.* December 2022.
[33] New American Economy, G4G_Warren-County_V5.pdf (newamericaneconomy.org). June 2018.
[34] Council on Environmental Quality, Climate & Economic Justice Screening Tool. November 22, 2022.

climate change. It is among the most racially diverse regions within the BG MSA, with persons of color constituting 57% of the local population. One example, as described in the EPA's Climate Change and Social Vulnerability Report, studies have discovered higher rates of exposures to $PM_{2.5}$ and ozone in communities that have more racial minorities and higher rates of childhood asthma.[35]

Drawing on findings from the EPA's Climate Change and Social Vulnerability Report, increased exposure rates to $PM_{2.5}$ and ozone in communities with a higher proportion of racial minorities and rampant instances of childhood asthma. These findings bear relevance to the urban area of the BG MSA, as this region, too, exhibits alarmingly high rates of significant health conditions. The percentiles for diagnoses of diabetes, asthma, and coronary heart disease stand at 97th, 93rd, and 97th, respectively. Also, these high rates of heart conditions in these census tracts pose great concern as increased temperatures make these individuals the most vulnerable to acute cardiovascular disease events.[36]

Figure 9: Factors contributing to the cardiovascular risks of climate change[36]



Furthermore, the disadvantaged financial status of residents in these tracts is evidenced by the fact that they also exist in the 90th percentile for income levels at or below 100% of the federal poverty line and dwell at the 93rd percentile for income levels at or below 200% of the federal poverty line.

This intricate tapestry of racial, socio-economic, and health-related challenges presents a compelling case for intensive support and intervention aimed at restoring equity and improving life conditions therein.

Legacy Pollution in the BG MSA

Legacy pollution is a prominent concern in the BG MSA. Legacy pollution is a type of long-lasting contamination that is traditionally linked to past industrial activities that typically lingers for extended periods due to difficulties in managing or eliminating the cause of pollution. Common forms of legacy pollution can span from heavy metals and radioactive waste to persistent organic pollutants.

In the BG MSA, the most significant source of legacy pollution is traced back to abandoned coal mines located in several sectors within Edmonson, Butler, and Warren Counties. A disproportionately large segment of the population falls within the 65th percentile of low-income rates, and as such, creates a county-wide vulnerability to this type of pollution. There is a pervasive difficulty in addressing and eradicating the root cause of this

[35] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.
[36] Peters, A., Schneider, A., Cardiovascular risks of climate change | Nature Reviews Cardiology. *Nature Reviews Cardiology*. November 9, 2020.

contamination, especially without the allocation of adequate state and federal level funding toward abandoned mine land reclamation and restoration projects.

Abandoned coal mines pose the greatest risk to the BG MSA population when they have the potential to contaminate vital water sources. The toxic interplay of erosion and chemical reactions can lead to the introduction of harmful substances to water bodies when this drainage mixes with groundwater, surface water, and soil. The resulting toxic liquid can threaten the health of both humans and animals, as well as impose a direct impact on vegetation, including agricultural crops. Effective action to address this legacy pollution is vital to safeguard the health of the community and protect the environment.

Transportation Disparities in the BG MSA

The BG MSA sits in a unique location with regard to transportation. Proximity to regional hubs, Nashville, TN and Louisville, KY, and Mammoth Cave National Park, coupled with the fact that Bowling Green has been identified by the United States Census as one of the fastest growing cities in Kentucky,[37] brings sizeable residential and tourist traffic to the BG MSA. All four counties in the BG MSA identified tourism/cultural development and transportation as key pillars for development in the near term.

Among the four counties, 11 census tracts are at or above the 90th percentile for possessing barriers to affordable, equitable, reliable, and safe transportation options for citizens,[38] many of which do not have a major interstate or intercounty road channeling through them. Of these 11 census tracts, 10 are identified as LIDACs. Apart from Warren County and the city of Bowling Green, 25% or more of residents in every other county in the BG MSA work outside of their county of residence. As a result, transportation barriers have a significant impact on the local and regional economy, not to mention the income status of LIDACs in these regions. Even within Bowling Green, transportation disparities disproportionately impact refugee immigrant populations who are reliant on simple, affordable, and reliable public transportation to reach work and receive necessary services.[39]

Aside from the economic effects, transportation barriers also impact access to healthcare. Studies by the National Institute of Health show that individuals who reside in nonurban communities, such as in Allen, Butler, and Edmonson Counties, face greater transportation barriers to healthcare access versus those in urban communities.[40] This is often attributable to lack of access to a vehicle and/or longer travel times to see a physician or a specialist.[40] Even in urban areas, a lack of public transit and transit education create transportation barriers, especially for populations who are obese, chronically ill, or have a disability. In Bowling Green, 15% of citizens are disabled, 11% of citizens are 65 years old or older, and 23.3% are below the city poverty line. These populations are more vulnerable to transportation barriers to health and economic stability.[41]

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[37] United States Census Bureau, What is the Fastest-Growing City or Town in Your State?, *May 2020*

[38] Council on Environmental Quality, Climate & Economic Justice Screening Tool. *November 22, 2022.*

[39] Floyd, L., Refugees settling in Bowling Green (wbko.com) *WBKO. March 21, 2022.*

[40] Wolfe, M. K., McDonald, N. C., Holmes, G. M., Transportation Barriers to Health Care in the United States: Findings From the National Health Interview Survey, 1997–2017 - PMC (nih.gov). *American Journal of Public Health*. June 2020.

[41] Barren River Area Development District, Warren County Overview – BRADD Planning. 2022.

6.4 Climate risks and impacts facing LIDACs

Climate vulnerabilities present compounding risks and resulting impacts for LIDAC populations throughout the BG MSA. Various categories of burden, defined by CEJST, align with four primary risks to LIDAC groups, and are illustrated in *Table 9*.

Table 9: Overview of how CEJST categories of burden defining low-income and disadvantaged communities may compound the risks of climate changes identified by EPA

		Compounded risk			
Category of burden		Premature deaths and asthma diagnoses related to $PM_{2.5}$ exposure	Premature deaths related to extreme temperatures	Labor hour losses related to extreme temperatures	Property damage related to inland flooding
a. Health and healthcare access	Underlying medical condition, e.g., lung and heart diseases	✓	✓	✓	
b. Exposure to harmful chemicals or pollution	Exposure to lead paint	✓	✓		
	Exposure to legacy pollution, e.g., hazardous waste sites, mines, defense sites or industries that historically generate pollutants	✓	✓		
c. Poor public Infrastructure	Lack of access to green space		✓		✓
	Lack of access to reliable transportation		✓	✓	
	Low grid reliability		✓		
	High cost of energy		✓		
	Historic disinvestment				✓

Premature deaths and asthma diagnoses related to $PM_{2.5}$ exposure.

As part of the Southeast U.S. region, the BG MSA is potentially at the forefront of an impending health crisis tied to changes in our climate. Among all the U.S. regions, the Southeast is anticipated to be the most significantly impacted when it comes to increases in premature mortality among individuals aged 65 and above, resulting from climate-influenced alterations in $PM_{2.5}$. As illustrated in Table 10, under a scenario of 2°C global warming compared to the 1986-2005 baseline, an additional 1,900 premature deaths are expected in the Southeast. This alarming figure constitutes 64% of the total U.S. premature deaths attributable to $PM_{2.5}$ exposure under such circumstances.

In a more severe scenario of 4°C global warming relative to the same baseline, there is a projection of an additional 3,900 premature deaths. They represent 58% of total premature deaths in the U.S. on account of $PM_{2.5}$ exposure.[42]

[42] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.

It is noteworthy to reiterate that based on the current pace of global warming, an increase of 2°C is highly probable by mid-century and an increase of 4°C by the end of the century.[43] Therefore, farsighted policy planning and preventative interventions are essential to mitigate the potentially fatal health impacts of climate-change-induced $PM_{2.5}$ exposure.

Table 10: Projected regional changes in annual premature deaths among people ages 65 and older due to greater exposure to $PM_{2.5}$ under warming relative to 1986-2005. Data: US EPA[44]

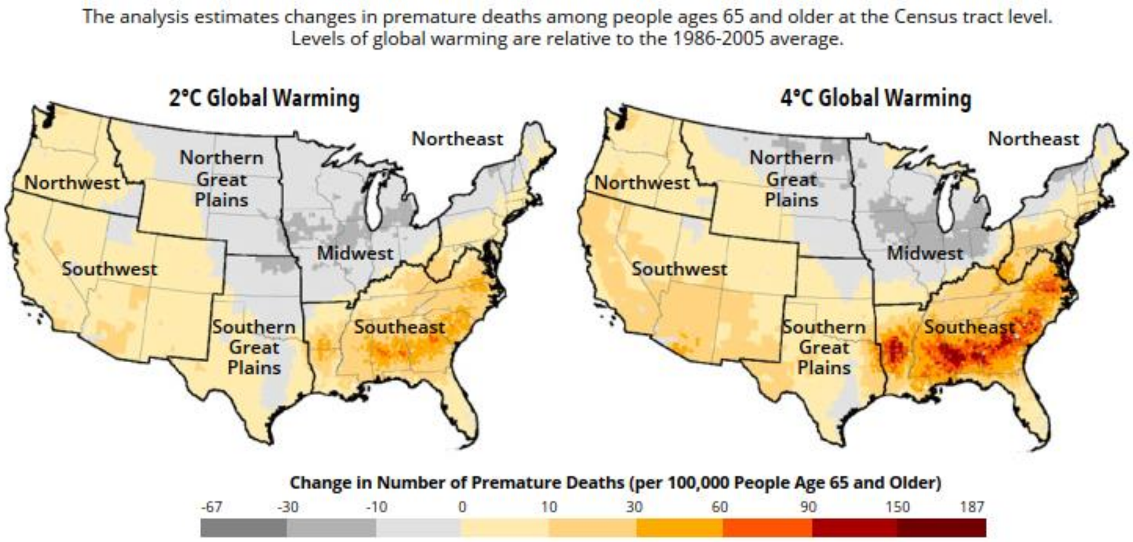
	Global warming (relative to 1986-2005)	
Region	2°C	4°C
Midwest	-850	-900
Northeast	400	1200
Northwest Great Plains	-43	-29
Northwest	79	180
Southeast	1900	3900
Southern Great Plains	-3	290
Southwest	610	1200
National Total	2093	5841

As depicted in Figure 10, current projections indicate that changes in annual premature mortality resulting from the climate-change-induced influence on $PM_{2.5}$ in the Southeast region are primarily concentrated in northern Louisiana, southern Arkansas, across the Gulf South, Georgia, and South Carolina. This suggests that the rate of such premature deaths within the BG MSA may be anticipated to be lower than the overall regional average.

However, considering the local health and environmental implications within the BG MSA, a future evaluation of premature deaths specific to this region may be informative to accurately capturing the adverse effects of climate change on local health.

[43] Schwalm, C. R., Glendon, S., Duffy, P. B., RCP8.5 tracks cumulative CO_2 emissions. *Proceedings of the National Academy of Sciences*. August 3, 2020.
[44] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.

Figure 10: Projected changes in annual premature deaths due to climate change-driven effects on $PM_{2.5}$[45]



Premature deaths related to extreme temperatures

As aforementioned, all the counties in the BG MSA have census tracts that are deemed disadvantaged to health-rated factors. Therefore, there is significant risk of premature deaths to extreme temperatures in the BG MSA. Although the Climate Change and Social Vulnerability in the United States report did not include the BG MSA, specifically, it can be used as a frame of reference. The report included projections indicating that the Midwest, Northeast, and Southeast regions will experience the most significant temperature increases in comparison to overall global warming trends.[45]

The report assessed the effects of extreme cold and heat on premature mortality across 49 major U.S. cities, including Nashville, which has no appreciable topographic, climate, or geographic difference from the BG MSA to impact weather.[46][47] Therefore, Nashville will serve as the closest proxy for the BG MSA in predicting how the BG MSA will be impacted. As illustrated in Figure 11 below, the Southeast region, particularly cities like New Orleans, Greensboro, and Orlando, is predicted to witness the steepest rise in premature mortality following a 2°C increase in global temperatures.[45] This represents a premature mortality rate of four to six individuals for every 100,000 residents annually, attributed to extreme thermal conditions.[45] Nashville, and de facto the BG MSA, is expected to see a premature mortality rate of two to four individuals for every 100,000 residents annually in this scenario.[45]

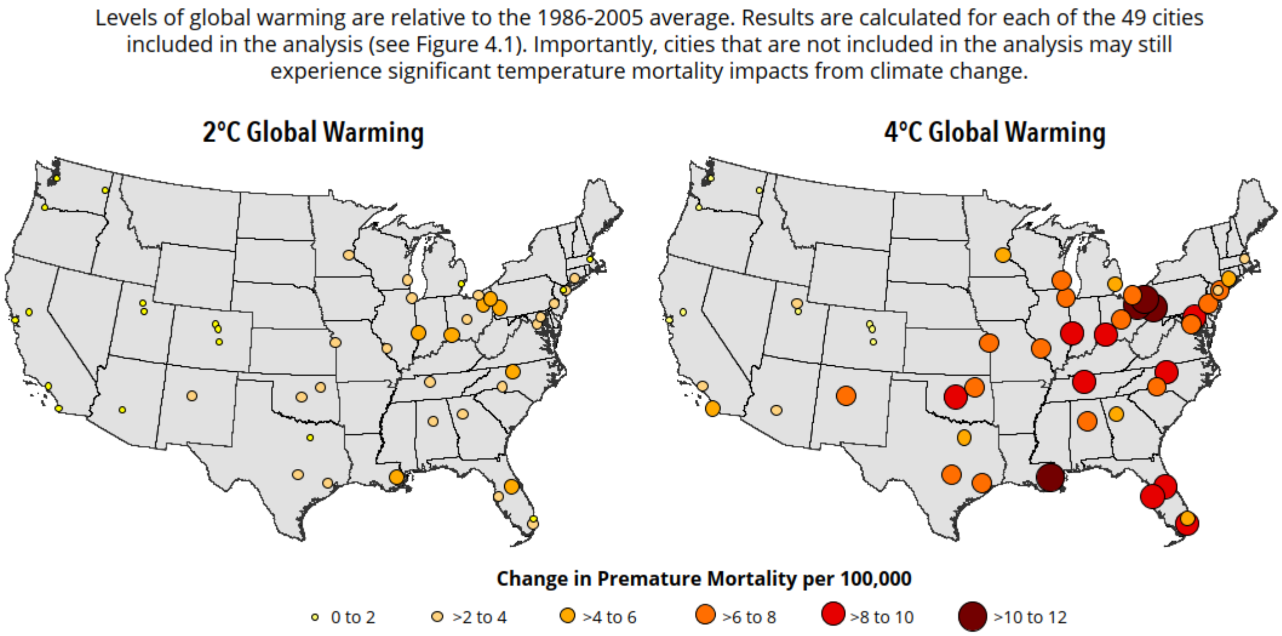
Under the more severe scenario of 4°C global warming, the mortality rates associated with extreme temperatures are expected to rise even more.[45] New Orleans is projected to experience the highest premature mortality rate within the Southeast, with a projected ten to twelve premature deaths per 100,000 residents due to extreme weather events.[45] This is followed by Nashville, Greensboro, Tampa, Orlando, Miami, and de facto BG MSA, where the premature mortality rate resulting from intense climatic fluctuations is projected to affect eight to ten people per 100,000.[45]

[45] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.

[46] US Climate Data, Climate Bowling Green - Kentucky and Weather averages Bowling Green (usclimatedata.com). 2019.

[47] US Climate Data, Climate Nashville - Tennessee and Weather averages Nashville (usclimatedata.com). 2019.

Figure 11: Projected Increase in Annual Premature Mortality Rates due to Extreme Heat and Cold[48]



Labor hour losses related to extreme temperatures

Extreme temperatures can create unsafe working conditions and losses in productivity for workers throughout the BG MSA. This especially holds true for outdoor laborers like agriculture and construction workers as well as those who work indoors without air conditioning, such as some manufacturing, industrial, or warehouse employees.

The Southeast is projected to be disproportionately and negatively impacted by lost labor hours, second only to the Southern Great Plains region. According to the EPA, with a 2°C increase in temperature, the Southeast will lose 20 labor hours per weather-exposed worker due to high temperatures per year which represents 21% of the national total of labor hours lost per year. In a 4°C warming scenario, this number increases to 44 hours (representing 19%).

As Figure 12 represents, the BG MSA lies in the zone of 20-30 labor hours lost per year in a 2°C scenario, and 40-60 labor hours lost per year in a 4°C case. Broadly, in the Southeast, low-income individuals are 16% more likely to live in areas with highest projected losses of labor hours due to climate related increases in high-temperature days. Similarly, minorities are 9% more likely to live in areas with potential for high impact.[48]

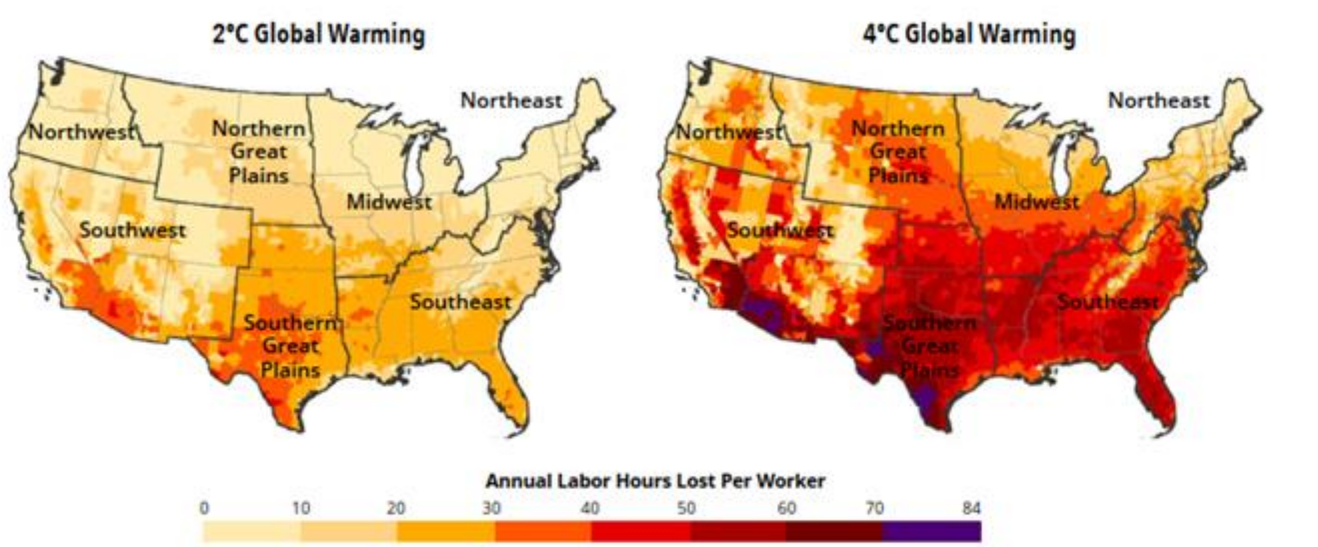
With roughly 18% of the BG MSA population below the poverty line, labor hour loss due to climate-related increases in temperature presents a risk to LIDAC groups' financial security. As the manufacturing industry is the largest industry in the BG MSA, an increase in temperatures similarly threatens the economy of the quad-county region if workers are unable to report to work or must limit the number of hours worked due to extreme temperature guidelines and laws or other climate-related impediments.[49] Low-income workers additionally may face hardships such as a lack of access to health care or employer-sponsored health insurance, additionally

[48] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.
[49] Barren River Area Development District, Warren County Overview – BRADD Planning. 2022.

increasing vulnerability to heat exposure.[50] Similarly, in every LIDAC-designated census tracts in the BG MSA, over 10% of people aged 25 years or older do not have a high school diploma. These populations are more likely to work in agriculture, construction, or manufacturing industries which are generally more susceptible to extreme-heat-related labor hour losses.

Foreign-born immigrants in Warren County make up 10.3% of the county's employed labor force and make up 23.7% of workers in the manufacturing industry. Further, immigrants represent 20.8% of employees in the transportation and warehousing industry as well as 8.5% of employees in the construction industry and tend to concentrate in more manual occupations.[51] In Warren County, 9.4% of working-aged immigrants work as laborers/movers, 8% work as inspectors, testers, and sorters, 4.3% work as assemblers and fabricators, 3.7% are agriculture workers, and 3.5% are production workers.[51] These industries and occupations are particularly susceptible to labor hour losses due to extreme temperature conditions and can threaten the livelihoods of many immigrant households in the BG MSA.

Figure 12: Projected Labor Hours Lost Each Year due to Climate Change[50]



Property damage related to inland flooding and extreme weather events

The Barren River and Green River watersheds are major components of the BG MSA's topography. The Green River watershed encompasses parts of Butler County and Edmonson County, while similarly, the Barren River watershed covers significant portions of Allen County and Warren County, including the city of Bowling Green. Various LIDAC census tracts exist along the Barren and Green Rivers.

In Bowling Green itself, two census tracts that border the Barren River are identified as LIDAC – both are in at least the 90th percentile for poverty, and over 30% of the 25-year-old and up population do not hold a high

[50] United States Environmental Protection Agency, Climate Change and Social Vulnerability in the United States. September 2021.
[51] New American Economy, G4G_Warren-County_V5.pdf (newamericaneconomy.org). June 3, 2018.

school diploma.[52] In Allen County, all census tracts in the county are designated LIDAC, and such communities that border the Barren River and the Barren River Lake are especially vulnerable to inland flooding in the case of extreme weather events. Similarly in Butler County, three census tracts that border the Green River are identified as LIDAC, in addition to the entirety of Edmonson County. These LIDAC communities are also vulnerable to inland flooding and have experienced flood advisories as recently as February 2024.[53]

As the Green River and Barren River are part of an intricate system of waterways that connect Kentucky, extreme rain events in other parts of the state could bring flood surges to the BG MSA. In July 2023, heavy rainfall in western Kentucky caused major flooding, including in the town of Mayfield in Graves County where nearly one foot of precipitation fell in 24 hours.[54] Damage related to this major flooding event included property loss/damage, crop loss, power outages, threat to life, and infrastructure damage. Though according to CEJST, the BG MSA is not designated as a projected flood risk zone, and while the major burden of damage was not in the BG MSA, increased likelihood of such extreme weather events in the vicinity poses an increased threat to the Bowling Green community, especially vulnerable LIDAC groups. In cases of flooding, for households in the BG MSA whose income is below the federal poverty line, the ability to recover is relatively more expensive and difficult.

More pertinent to the BG MSA, however – especially in Allen and Butler Counties – is the expected population loss rate due to natural disasters, which in many LIDAC census tracts lies above the 90th percentile. In December 2021, severe tornado activity ripped through western Kentucky, causing over $305 million in damages through the state.[55] In Bowling Green, a pair tornadoes – one reaching EF3 strength - damaged homes, businesses, and churches and left 17 Warren County residents dead. With this tornado activity, throughout the southeastern United States, upwards of 200,000 customers experienced power outages, including widespread outages in the BG MSA.[56] Similar to increased likelihood of inland flooding events, as climate change worsens, intense storms are predicted to afflict the BG MSA with greater frequency and severity. This poses an increased risk to LIDAC populations that lack the economic resiliency to rebound from the financial toll associated with climate-related disasters.

[52] Council on Environmental Quality, Climate & Economic Justice Screening Tool. November 2022.
[53] Wells, D, Flood Advisory issued for some along Green River (wbko.com). *WBKO.* February 2024.
[54] WDRB Media, Nearly a foot of rain floods parts of western Kentucky, Mayfield hard hit by storms | News from WDRB | wdrb.com. July 2023.
[55] Federal Emergency Management Agency, One Year Later, Tornado Recovery Continues to Make Progress. December 2022.
[56] Bloch, M., Collins, K., Gamio, L., Lutz, E., Patel, J. K., Reinhard, S., Singhvi, A., Cai, W., Maps: Where the Tornadoes Struck, Destroying Buildings and Homes - The New York Times (nytimes.com). *New York Times*. December 2021.

6.5 Engagement with LIDACs

The following overview provides a summary of (i) the methods used to engage LIDACs throughout the development of the PCAP; (ii) LIDAC priorities and concerns; and (iii) the process for incorporating LIDAC priorities and concerns into GHG emission reduction measure prioritization process.

Engagement methods

The BG MSA's primary engagement methods included four community meetings at all counties in the BG MSA, held on February 5 and February 6, 2024, and a pair of public surveys. During the public community meetings, the BG MSA provided representatives an overview of the Priority Climate Action Plan, introduced the CPRG program, and distributed the public survey. Public meetings solicited input from residents regarding their priorities and concerns relative to pollution reduction.

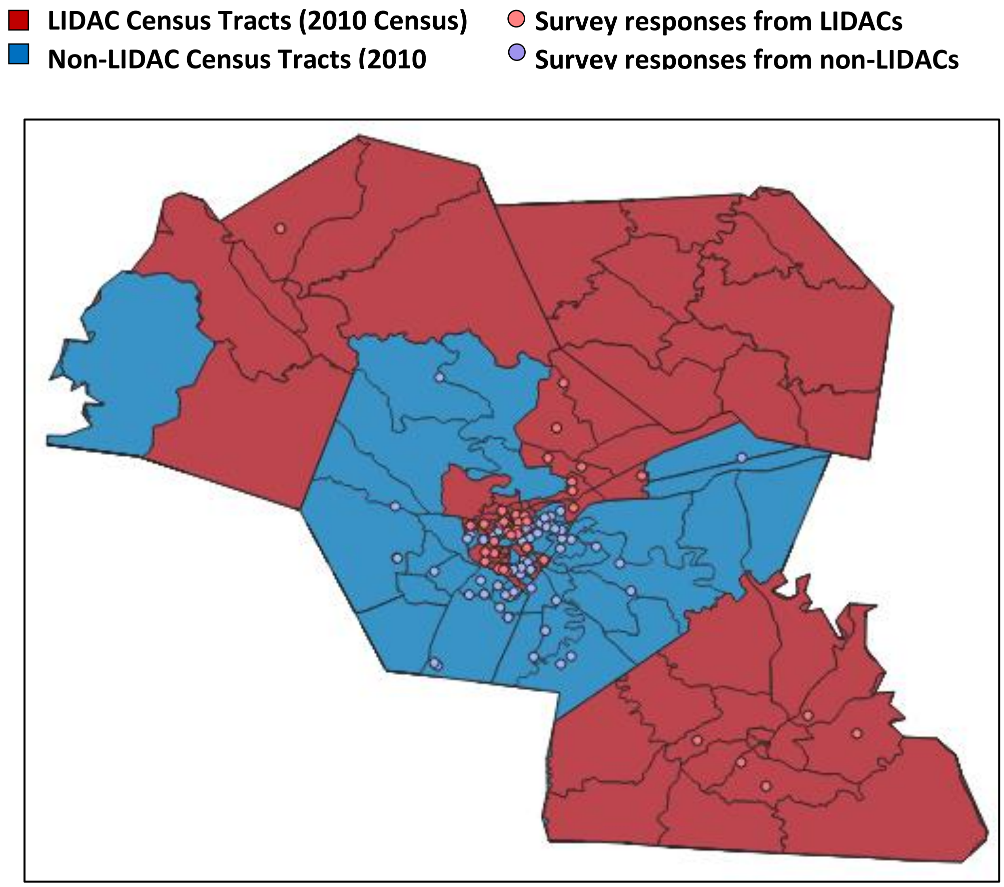
The public survey was disseminated through various platforms designed to maximize respondent outreach, including community and school newsletters and through the engagement of community leaders. This survey consisted of multiple-choice questions which invited participants to identify their top quartet of priorities and issues related to climate reduction initiatives. The survey design was flexible and respondent-friendly, so if survey takers could not identify with the given choices, they had the opportunity to contribute their unique personal responses towards both their priorities and concerns.

Recognizing the linguistic diversity within the BG MSA, and to ensure adherence to the EPA's Meaningful Involvement Policy, care was taken to make the survey accessible in both English and Spanish.[57] This was a strategic consideration, cognizant of a significant Hispanic demographic within the region, which represents upwards of 9,500 individuals across the BG MSA.

This outreach strategy yielded a robust response with a total of 136 participants engaging in the survey process. The feedback received played an instrumental role in the effort to create informed, inclusive, and effective climate reduction strategies.

[57] United States Environmental Protection Agency, Achieving Health and Environmental Protection Through EPA's Meaningful Involvement Policy. October 2023.

Figure 13: Public survey responses with respondent location[58]



56% of the census tracts in the BG MSA are considered LIDAC, under the definition given by the CPRG program. 130 of the 136 responses to the public survey contained complete home location data which was used to identify the share of LIDAC responses. 47 of the 130 survey responses (36%) with location data were from LIDACs within the BG MSA.

[58] United States Environmental Protection Agency, Inflation Reduction Act Disadvantaged Communities Map. November 2023.

LIDAC Priorities and Concerns

Community members across the BG MSA ranked their priorities and concerns related to emissions reduction measures as a part of the public survey. Table 11 shows the results of the LIDAC respondents in order from highest to lowest priorities and concerns.

Table 11: Priorities and concerns of emissions reductions measures corresponding to LIDAC respondents of the public survey (ranked from highest to lowest)

Ranking	Priority	Concern
1	Affordable housing	Increased utility costs
2	Assistance with home weatherization to improve heating and cooling and to lower utility bills	Increased living costs
3	Transportation improvements (e.g., bike lanes, walking paths, and transit options, electric vehicle charging)	Unequal impacts and effects in my community
4	Community resilience, or the ability to withstand extreme weather (e.g., water stations to address heat waves, and resilience hubs for people impacted by blackouts or flooding)	Less reliable energy
5	Community beautification (e.g., new or improved green spaces, urban trees, bike paths, or walking trails)	Workforce concerns, e.g., loss of established jobs or new skills
6	Improved public health resulting from decreased air pollution (e.g., capture and store carbon in the electricity sector, implement industry energy efficiency standards, decarbonize electricity generation)	Burdensome regulations
7	Workforce development/creation of new jobs (e.g., creating positions for renewable energy engineers and solar technicians; attracting talent through green practices)	Land use changes, e.g., areas repurposed for solar generation
8	Reduced noise pollution, including traffic (e.g., retain existing forests and grasslands to act as noise barriers, expansion of electric vehicle fleets)	Short-term disruptions due to road closures, construction, etc.

Incorporating LIDAC priorities into the process for measure prioritization

Through the BG MSA's meaningful engagement with LIDACs across the state, the priorities identified above were incorporated into the GHG emissions reduction measure selection process, allowing for a Priority Climate Action Plan that reflects the priorities of the BG MSA's low-income and disadvantaged communities.
Specifically, to develop a preliminary list of GHG emissions reduction measures, the BG MSA developed a consolidated list of measures from EPA and other sources, and then filtered the list based on CPRG criteria, including emissions reduction potential, implementation, readiness, and LIDAC priority.

Affordable housing emerged as a priority, leading to the development of initiatives like home weatherization and rebates for energy-efficient equipment in buildings. These measures enhance energy efficiency and have the potential to render housing more affordable by reducing long-term energy costs.

The demand for improved transportation was addressed by expanding public transit, improving routes, and developing shared use paths. These strategies aim to reduce dependence on personal vehicles and provide more affordable, environmentally friendly alternatives.

Community beautification has been addressed through the expansion of green spaces and the planting of native trees and shrubs, making strides towards a more appealing urban environment.

The aspiration for improved community resilience and public health was addressed through the creation of measures like the development and distribution of solar energy generation. This strategy not only diminishes reliance on carbon-intensive energy sources but also yields improved air quality.

Recognizing concerns regarding increased living and utility costs, workforce disruptions, energy reliability, regulatory burdens, changes in land use, and short-term disruptions due to construction, the devised measures aim to mitigate these impacts. For instance, programs to divert organic waste from landfills and the improvement of stormwater infrastructure would present minimal hurdles to the community.

Given the priority for workforce development, measures that promote renewable energy and energy efficiency have been at the forefront. These sectors carry the potential for extensive job creation and the attraction of skilled talent.

Overall, these measures exhibit a careful assimilation of both the community's priorities and concerns, endeavoring to strike a balance between environmental, economic, and social benefits.

6.6 Benefits and concerns

The proposed measures for the BG MSA are intended to reduce GHGs, improve sustainability, infrastructure, and community health. The electrification of public transit fleets, expansion of public transit, improvement of traffic flow, and development of shared use paths enhance transport efficiency and air quality. Weatherization programs and incentives for energy-efficient appliances aim to boost building efficiency, generate savings, and benefit the local economy.

Developing and distributing solar energy generation allows for cleaner, cost-efficient energy production. Additionally, diverting organic waste from landfills helps reduce landfill use and methane emissions. Developing green spaces also has positive environmental and health impacts.

Despite these benefits, challenges such as capital and maintenance costs, space limitations, need for community acceptance, and funding streams need to be systematically addressed to ensure successful implementation of these measures. The goal is to optimize the potential benefits while effectively managing the associated concerns.

Potential benefits and disbenefits

Potential benefits and disbenefits associated with priority measure implementation are summarized in this section. To determine potential benefits of GHG reduction measures for LIDACs, each measure was reviewed against the benefits and concerns ranked in the survey.

Table 12 below summarizes the potential benefits associated with each priority GHG reduction measure. Measures that have the potential to provide a *direct* benefit are indicated with a black circle (●), measures that have the potential to provide an *indirect* benefit are indicated with a white circle (○), measures that have the potential to create a disbenefit are indicated with an "X," and measures that are not applicable to a specific benefit are indicated with a dash (–). For a description of the criteria used to define each benefit and disbenefit, see Appendix A, Section F.

Table 12: Qualitative assessment of potential LIDAC benefits resulting from GHG reduction measure implementation

	Potential benefit							
Priority measure	Affordable housing, including utility bills	Transportation improvements	Community beautification	Community resilience	Improved public health	Assistance with home weatherization pollution	Workforce development	Reduced noise pollution
1. Transportation improvements								
1.1 Electrify public transit fleet	–	●	–	○	●	–	○	●
1.2 Expand public transit and improve routes	–	●	–	○	●	–	○	X
1.3 Expand shared use paths	–	●	●	○	○	–	●	X
1.4 Improve traffic flow and efficiency	–	–	–	–	○	–	●	●
2. Building energy efficiency enhancement								
2.1 Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings	–	–	–	–	○	–	–	–
2.2 Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights	–	–	●	–	○	–	–	–
2.3 Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings	●	–	–	–	○	–	–	–
2.4 Weatherization programs for residential buildings	●	–	–	–	○	–	●	–
3. Renewable energy enhancement								
3.1 Developing and distributing solar energy generation	●	–	–	●	○	–	●	–
3.2 Upgrading electricity distribution	●	–	–	●	○	–	●	–
4. Waste diversion and landfill management improvements								
4.1 Programs to divert organic waste from landfills	–	–	–	–	○	–	●	–
5. Land use enhancement								
5.1 Expand green spaces	–	–	●	○	●	–	●	–

Potential benefits and disbenefits of strategy 1: Transportation improvements

The first strategy measure for GHG reduction includes several transportation improvements, such as electrifying the public transit fleet, expanding public transit and improving routes, expanding shared use paths, and improving traffic flow and efficiency.

Each of these measures carries potential benefits for the BG MSA, as outlined in Table 13.

Table 13: LIDAC emissions reductions priorities corresponding to strategy 1: transportation improvements (ranked from highest to lowest)

LIDAC Ranking	Benefit
3	Transportation improvements
4	Community resilience
5	Community beautification
6	Improved public health
7	Workforce development

8	Reduced noise pollution

Figure 14: BG MSA 2010 census tracts at or over the 90th percentile for DOT travel barriers

Tracts at or over the 90th percentile for DOT travel barriers
Other BG MSA census tracts

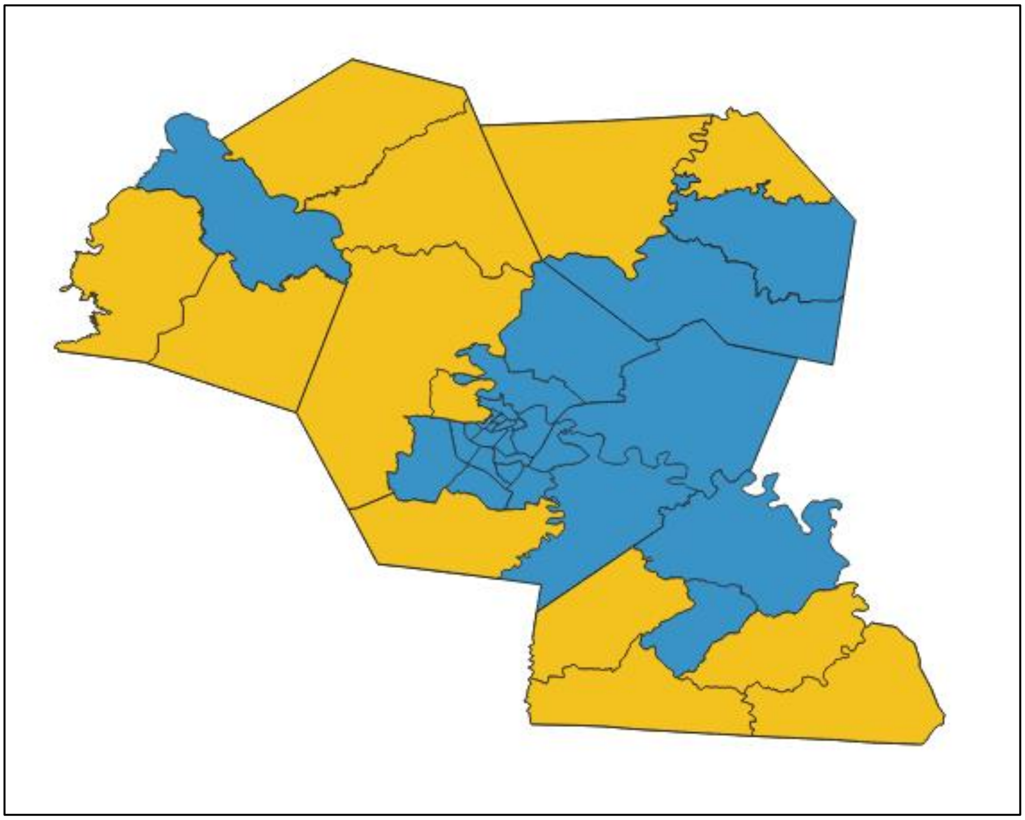


Table 14: Census tracts at or over the 90th percentile for DOT travel barriers by county

County	Count of census tracts at or over the 90th percentile for DOT travel barriers
Allen County	4
Butler County	4
Edmonson County	2
Warren County	3

The transportation improvements strategy for GHG reduction provides various potential benefits, each aligning with key priorities identified by LIDAC communities:

- **Transportation Improvements, Ranked 3rd (LIDAC Ranking)**: Electrification of the public transit fleet, expansion of public transit and improved routes directly enhance community mobility and accessibility.
- **Community Resilience, Ranked 4th**: All measures indirectly aid community resilience. They reduce reliance on non-renewable energy sources and promote the use of efficient, eco-friendly transportation alternatives.
- **Community Beautification, Ranked 5th**: The measure involving expanding shared use paths enhances community aesthetics by adding recreational infrastructures like bike paths and walking trails.
- **Improved Public health, Ranked 6th**: All measures indirectly contribute to improved public health by reducing carbon emissions, thereby improving air quality.
- **Workforce Development, Ranked 7th**: These measures, especially expanding public transit and improving routes, as well as electrifying the public transit fleet, are likely to result in job creation, contributing to workforce development.
- **Reduced Noise Pollution, Ranked 8th**: Electrification of the public transit fleet as well as the improvement of traffic flow and efficiency can contribute to reduced noise pollution, especially in inner-city and residential areas.

Overall, the measures under the transportation improvements strategy collectively contribute to addressing the identified LIDAC priorities while advancing the broader sustainability framework for the BG MSA.

Although there many benefits to these measures, there is a potential disbenefit:

- **Noise Pollution:** Expanded public transit, like more frequent buses, can increase noise pollution due to engine sounds, brakes, honking, and passenger noises. However, this can be offset by bus electrification or less cars on the road due to improvements in micro-mobility.

Despite adding to noise, these measures provide significant benefits like improved accessibility and sustainable transport.

Potential benefits and disbenefits of strategy 2: Building energy efficiency enhancement

The second strategy for promoting the use of certified energy-efficient equipment and lighting in commercial, industrial, and residential buildings and weatherizing homes has the potential to reduce excess energy use and associated electricity generation emissions. Additionally, co-benefits that could be realized from these measures include community beautification through upgraded streetlights and workforce development opportunities.

Table 15: LIDAC emissions reductions priorities corresponding to strategy 2: building energy efficiency enhancement (ranked from highest to lowest)

LIDAC Ranking	Benefit
1	Affordable housing
4	Community resilience
5	Community beautification
6	Improved public health
7	Workforce development

Figure 15: BG MSA 2010 census tracts at or over the 90th percentile for energy burden

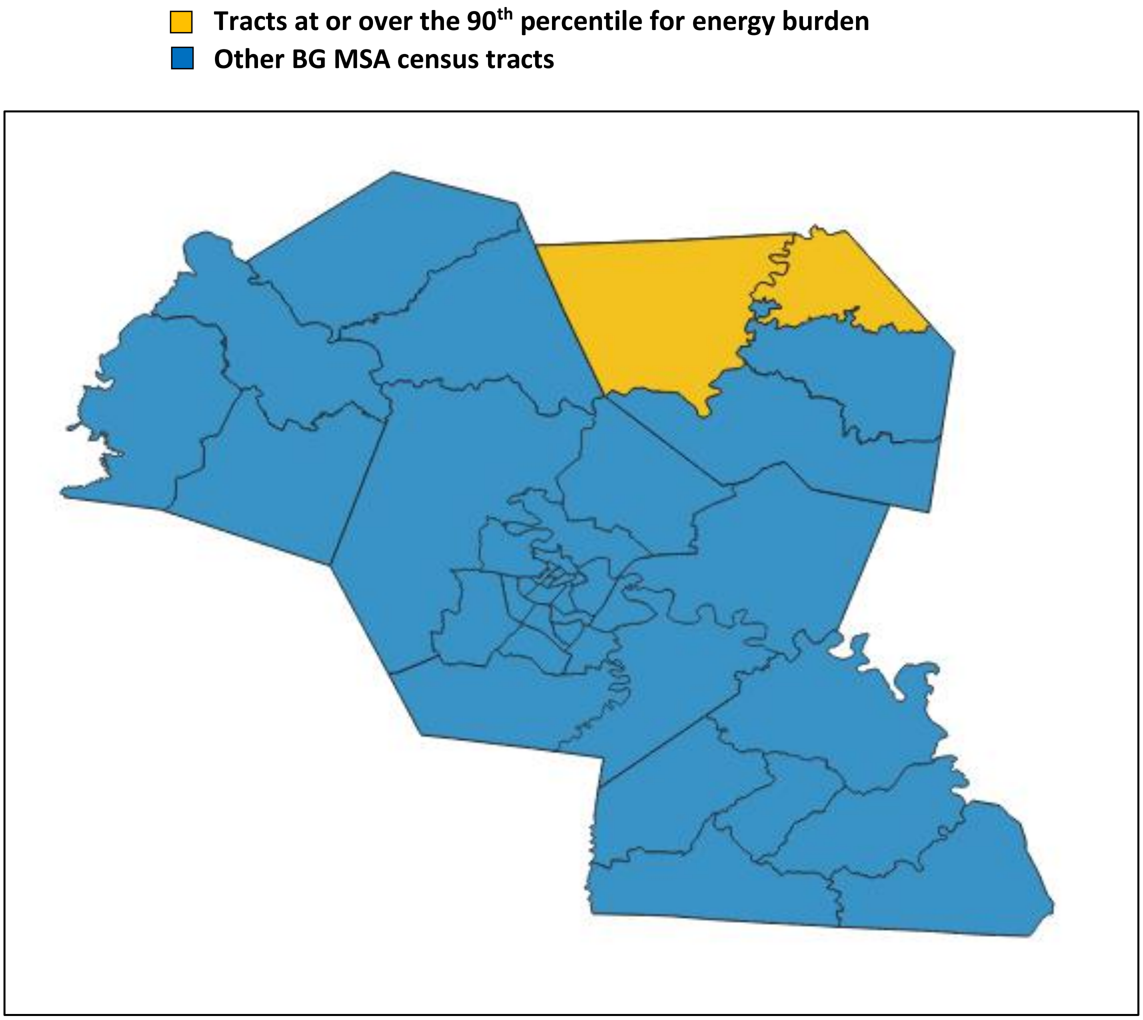


Table 16: Census tracts at or over the 90th percentile for energy burden by county

County	Count of census tracts at or over the 90th percentile for energy burden
Edmonson County	2

Communities in Edmonson County facing energy burden experience disproportionately high energy bills relative to their income.[59] High energy costs could be due to infrastructure limitations or unavailability of energy efficiency programs.

[59] The EPA defines energy burdened communities as census tracts that are at or above the 90th percentile for energy cost, determined by average household annual energy cost in dollars divided by the average household income. See: Council on Environmental Quality, Climate & Economic Justice Screening Tool. November 2022.

The building energy efficiency enhancement strategy under the GHG reduction measures aligns with several key priorities identified by LIDAC communities:

- **Affordable Housing, Ranking 1st:** The measures designed to reduce energy demand in residential buildings support housing affordability by lowering utility costs.
- **Community Beautification, Ranking 5th:** Utilizing energy-efficient lighting in public spaces such as sidewalks and streets enhances community beautification and augments safety levels.
- **Improved Public Health, Ranking 6th:** All measures in this category indirectly enhance air quality by reducing the energy consumed for heating, cooling, and operating buildings. These improved conditions can lead to significant public health benefits.
- **Workforce Development, Ranking 7th:** Proactive measures to replace inefficient appliances and lighting provide short-term work opportunities. Simultaneously, weatherization programs require a sustained, skilled workforce, ultimately contributing to long-term job creation**.**

Overall, these measures tap into the heart of the listed LIDAC priorities, paving the way for a comprehensive sustainability framework within the BG MSA. Also, note, there were no identified disbenefits for this strategy.

Potential benefits and disbenefits of strategy 3: Renewable energy enhancement

The third GHG reduction strategy focuses on enhancing renewable energy via two initiatives: developing solar energy generation and upgrading electricity distribution. By modernizing the electrical infrastructure for improved efficiency and reduced power losses, this strategy aids in reducing emissions. Simultaneously, these measures contribute towards cost savings, increased housing affordability, and enhanced quality of life for the BG MSA community.

Table 17: LIDAC emissions reductions priorities corresponding to strategy 3: renewable energy enhancement (ranked from highest to lowest)

LIDAC Ranking	Benefit
1	Affordable housing
4	Community resilience
6	Improved public health
7	Workforce development

These initiatives relate directly to key priorities acknowledged by LIDAC communities:

- **Housing Affordability, Ranking 1st:** Advanced distribution systems help reduce electricity losses, producing potential utility cost savings, which directly bolsters housing affordability.
- **Improved Public Health, Ranking 6th:** Efficient electricity distribution reduces energy loss during transmission, which lessens the overall demand for energy generation. This decrease could lead to a reduction in emissions from fossil fuel-powered plants, improving air quality and public health.
- **Community Resilience, Ranking 4th:** Infrastructure upgrades can enhance load management and fault isolation, relieving pressure on the power grid during extreme weather events. This supports community resilience and aligns with the shift to renewable energy sources, reducing reliance on traditional fossil fuel-powered energy.

- **Workforce Development, Ranking 7th:** Upgrading electricity distribution requires skilled labor, creating an increased demand for trained professionals. This implies increased job creation and workforce development in the sector.

Overall, these renewable energy enhancement measures aim to address specific LIDAC priorities while advancing comprehensive sustainability objectives within the BG MSA community. Also, note, there were no identified disbenefits for this strategy.

Potential benefits and disbenefits of strategy 4: Waste diversion and landfill management improvements

The fourth strategy for GHG reduction revolves around waste diversion, specifically, implementing programs to divert organic waste from landfills.

Table 18: LIDAC emissions reductions priorities corresponding to strategy 4: waste diversion and landfill management improvements (ranked from highest to lowest)

LIDAC Ranking	Benefit
6	Improved public health
7	Workforce development

This strategy corresponds with two primary LIDAC community priorities:

- **Improved Public Health, Ranked 6th:** Implementing these programs leads to a significant reduction of harmful greenhouse gases like methane by diverting organic waste from landfills, thereby enhancing local air quality and public health**.**
- **Workforce Development, Ranked 7th**: These waste diversion measures help stimulate job growth in fields such as waste collection, recycling, and composting, alongside potential opportunities for community education programs about waste management.

In sum, this waste diversion strategy underscores a commitment towards creating healthier environments and greater employment opportunities in the BG MSA community, aligning with the broader goals for sustainability and resilience. Also, note, there were no identified disbenefits for this strategy.

Potential benefits and disbenefits of strategy 5: Land use enhancement

The fifth strategy in the GHG reduction measures emphasizes land use enhancement, particularly by expanding green spaces within the community.

Table 19: LIDAC emissions reductions priorities corresponding to strategy 5: land use enhancement (ranked from highest to lowest)

LIDAC Ranking	Benefit
4	Community resilience
5	Community beautification
6	Improved public health
7	Workforce development

This strategy intersects with several key LIDAC community priorities:

- **Community Resilience, Ranked 4th:** Green spaces provide natural landscapes that can absorb rainfall, reducing flood risks, and serve as natural 'carbon sinks,' which helps combat the impacts of climate change.

- **Community Beautification, Ranked 5th:** The creation of green spaces enhances the aesthetic appeal of the community and contributes to beautification efforts.
- **Improved Public Health, Ranked 6th:** The expansion of green spaces supports outdoor activities that encourage physical wellbeing, improve mental health, and contribute to improved public health overall.
- **Workforce Development, Ranked 7th:** The creation and ongoing maintenance of green spaces can lead to job creation opportunities, thus contributing to workforce development.

Overall, the land use enhancement strategy, particularly the expansion of green spaces, aligns well with the identified community priorities, contributing to a greener, healthier, and more resilient BG MSA while also aiding in workforce development. Also, note, there were no identified disbenefits for this strategy.

7 Authority to Implement

Under the guidelines of Section 137 of the Clean Air Act (42 U.S.C. § 7437), the law specifies that the implementation grants for CPRG shall be allocated to entities that meet the stipulated eligibility criteria. These eligible entities mainly include bodies such as municipalities, state agencies, and entities responsible for controlling and managing air pollution.[60]

These eligible entities, as declared in the CPRG Implementation Notice of Funding Opportunity (assistance listing number 66.046), are endowed with the authoritative rights to apply for, manage, and distribute the CPRG funds.[61] These funds serve the core purpose of implementing the measures distinctively outlined in the Priority Climate Action Plan.

However, it is critical to note that the sub-award of these funds by the aforementioned entities ought to be in strict accordance with the EPA's Subaward Policy. This ensures that the funds are utilized in a transparent, accountable, and responsible manner, thereby guaranteeing the successful implementation of the Priority Climate Action Plan and achieving the broader goals of environmental conservation and sustainability.

The City of Bowling Green has the statutory authority to implement the investment programs as detailed in this PCAP. This statutory authority to implement has been determined by the Bowling Green Code of Ordinances KRS 82.082, Provision 2-1.03, which reads "that all bond issues, bond contracts, and contracts of any nature, and all laws which may be passed in the future shall be made by the City as a Home Rule Class city."[62] This ordinance provides the City of Bowling Green with the statutory authority to distribute CPRG funding to governmental, non-profit and for-profit entities in order to carry out the measures described in this PCAP.

[60] United States House of Representatives, 42 USC 7437: Greenhouse gas air pollution plans and implementation grants. 2024.

[61] United States Environmental Protection Agency, Climate Pollution Reduction Grants Program: Implementation Grants General Competition. September 2023.

[62]Kentucky Legislature, Kentucky Statute KRS 82.082. *n.d.*

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The City of Bowling Green's Environmental Compliance Division and the Department of Neighborhood and Community Services would like to express their sincere appreciation to the following persons and organizations for their assistance during the PCAP process:

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- David Burch, Mayor of Scottsville
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- Bowling Green Municipal Utilities
- Warren Rural Electrical Co-Op Corporation
- Atmos Energy Corporation
- EPA Region 4 Staff
- City of Bowling Green Board of Commissioners

Appendix A

Section A – Glossary of Terms

Benefits Analysis: GHG reduction measures often convey air quality and pollution benefits beyond just the GHG reductions. This section provides quantified estimates of co-pollutant reductions (e.g., $PM_{2.5}$, NOx, SO_2, VOCs, air toxics, etc.) that would accrue from the implementation of the GHG reduction measures. [63]

Climate Pollution Reduction Grant (CPRG): Program under the Inflation Reduction Act (IRA) providing $5 billion in grants to states, local governments, tribes, and territories to develop and implement plans for reducing greenhouse gas emissions and other harmful air pollution. [64]

Community Shared Solar: A Community shared solar program operates on the concept where a single, large solar photovoltaic (PV) system supplies electricity or financial benefits to several members within a community. This program is particularly beneficial for members who might not have direct access to solar power. This includes individuals living in rented properties, properties with roofs that don't get enough sunlight, or those who can't afford to have a solar system installed on their property for various reasons.[65]

Comprehensive Climate Action Plan (CCAP): A narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.[66]

Degree Days: Degree days are relative measurements of outdoor air temperature. Heating degree days are deviations of the mean daily temperature below 65 degrees Fahrenheit, while cooling degree days are deviations of the mean daily temperature above 65 degrees Fahrenheit. Heating degree days have a considerably greater effect on energy demand and related emissions than do cooling degree days. Excludes Alaska and Hawaii. Normals are based on data from 1991 through 2020. The variation in these normals during this time-period was ±16% and ±27% for heating and cooling degree days, respectively (99% confidence interval).[67]

Greenhouse Gases (GHGs): Gases, such as carbon dioxide, methane, nitrous oxide, and certain synthetic chemicals, that trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere. This heat trapping causes changes in the radiative balance of the Earth—the balance between energy received from the sun and emitted from Earth—that alter climate and weather patterns at global and regional scales.[68]

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[63] United States Environmental Protection Agency, EPA's Climate Pollution Reduction Grants: Noncompetitive planning grants for state, territory, local, and tribal governments. September 2023.
[64] United States Environmental Protection Agency, Climate Pollution Reduction Grants. February 2024.
[65] United States Environmental Protection Agency, Community Shared Solar | US EPA. February 2024.
[66] United States Environmental Protection Agency, DRAFT Priority Climate Action Plan Guidance: An Outline for States and MSAs. December 2023.
[67] United States Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. April 2023.
[68] United States Environmental Protection Agency, Greenhouse Gases. July 2023

Greenhouse Gas (GHG) Inventory: A list of emission sources and sinks, and the associated emissions quantified using standard methods.[69] The PCAP must include a “simplified" inventory (see Section 2.1). The CCAP must include a comprehensive inventory of emissions and sinks for the following sectors: industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management.

Greenhouse Gas (GHG) Reduction Measures: These are programs, policies, projects, and measures (collectively referred to as “GHG reduction measures,” or “measures”)[70] that will reduce GHG emissions in the BG MSA. While there are many ways to reduce GHG emissions overall, the CPRG program provides guidance that the PCAP focus on near-term, high-priority, implementation-ready measures; additional measures may be considered for inclusion in the CCAP. The BG MSA’s PCAP has 12 measures, divided into 5 overarching strategies derived from stakeholder engagement, GHG reduction potential, and authority to implement.

Intersection With Other Funding Availability: Various funding mechanisms exist beyond the CPRG to fund GHG reduction measures (e.g., the Bipartisan Infrastructure Law [BIL], the Infrastructure, Investments, and Jobs Act [IIJA]). This section of the PCAP describes whether specific mechanisms exist for each measure and how they might interact with CPRG implementation funding.

Low Income / Disadvantaged Communities (LIDACs): Communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. Although the Inflation Reduction Act does not formally define LIDACs, the EPA strongly recommended grantees to use the Climate and Economic Justice Screening Tool and the Environmental Justice Screening and Mapping Tool to identify LIDACs in their communities. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.[71]

LIDAC Benefits Analysis: GHG reduction measures additionally often convey co-benefits beyond air quality and pollution reduction. These may include economic co-benefits (e.g. jobs, wages, taxes), resilience co-benefits (e.g. reduced risk of flooding, decreased heat island effect), health benefits (e.g., decreased risk of asthma, lower rates of heat-related morbidity), and more[72]. This section analyzes these co-benefits as well as their distribution among the BG MSA’s population to ensure they are being felt by the BG MSA’s low-income and disadvantaged communities (LIDACs). This aligns the BG MSA’s PCAP with the requirements and guidance set forth in the Justice40 initiative.

MSA: Metropolitan statistical areas as defined by the U.S. Census 2020 MSA population.[73] A list of eligible MSAs can be found in Appendix 15.2 of in EPA’s CPRG: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies.

Notice of Funding Opportunity (NOFO): A formal announcement of available funding and invitation for entities to submit applications, along with program information and criteria.

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[69] United States Environmental Protection Agency, GHG Inventory Development Process and Guidance. November 2023.
[70] United States Environmental Protection Agency, CPRG General Competition NOFO. September 2023.
[71] United States Environmental Protection Agency, DRAFT Priority Climate Action Plan Guidance: An Outline for States and MSAs. December 2023.
[72] United States Environmental Protection Agency, LIDAC Technical Guidance - Final_2.pdf (epa.gov). April 2023.
[73] United States Census Bureau, Metropolitan and Micropolitan Statistical Areas Totals: 2020-2022 (census.gov). June 2023.

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

Review of Authority to Implement: This review documents status of the statutory or regulatory authority to implement each GHG reduction measure in the BG MSA.

State: all 50 U.S. states and the District of Columbia and Puerto Rico. All other Tribes or U.S. territories (the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands) should follow CRPG guidance for Tribes and Territories.

Sustainability: Sustainability is the principle of ensuring all our survival and well-being needs, directly or indirectly linked to our natural environment, are met in a way that fosters a healthy coexistence of humans and nature. It prioritizes the balance of meeting present needs without compromising the capacity of future generations to meet theirs.[74]

Volatile Organic Compound (VOC): VOCs are a subgroup of hazardous air pollutants (HAPs). They are organic chemicals that have a high vapor pressure at ordinary room temperature, meaning they easily become gases or vapors. VOCs are found in many products, including paints, cleaning supplies, pesticides, building materials, and furnishings, and are emitted from burning fuel. High levels of VOCs contribute to respiratory illnesses and other health issues.

[74] United States Environmental Protection Agency, Learn About Sustainability. October 2023.

Section B – Greenhouse Gas Inventory

Table 20: BG MSA's greenhouse gas emissions (MTCO2e) by sector

Sector/Source	GHG emissions (MTCO2e)
Stationary Combustion – Commercial/Institutional	43,025
CO_2 from Fossil Fuel Combustion	42,894
CH_4 from Fossil Fuel Combustion	94
N_2O from Fossil Fuel Combustion	37
Stationary Combustion – Residential	27,150
CO_2 from Fossil Fuel Combustion	27,066
CH_4 from Fossil Fuel Combustion	94
N_2O from Fossil Fuel Combustion	37
Stationary Combustion – Industrial	870,178
CO_2 from Fossil Fuel Combustion	866,969
CH_4 from Fossil Fuel Combustion	2,239
N_2O from Fossil Fuel Combustion	970
Mobile Combustion – Commercial/Institutional	815
Gross CO_2 from Gasoline Combustion	695
Gross CO_2 from Diesel Combustion	114
Gross CO_2 from CNG Combustion	0
Mobile Combustion – Residential	797,818
Gross CO_2 from Gasoline Combustion	707,408
Gross CO_2 from Diesel Combustion	90,004
Gross CO_2 from CNG Combustion	406
Solid Waste	202,992
Landfills with No LFG Collection	202,992
Landfills with Comprehensive LFG Collection	0
Landfills with Partial LFG Collection	0
Wastewater	59,225
CO_2 Emissions from Wastewater Treatment	0
CH_4 Emissions from Wastewater Treatment	57,176
N_2O Emissions from Wastewater Treatment	2,049
Electricity – Commercial/Institutional	759,153
CO_2 from Electricity Use	754,481
CH_4 from Electricity Use	1,935
N_2O from Electricity Use	2,737
Electricity – Residential	349,265
CO_2 from Electricity Use	345,116
CH_4 from Electricity Use	890
N_2O from Electricity Use	1,259
Electricity – Industrial	186,000
CO_2 from Electricity Use	184,855
CH_4 from Electricity Use	474
N_2O from Electricity Use	671
Agriculture and Land Management – Commercial/Institutional	276,611
Fertilizer Application Emissions from Synthetic N_2O	271,928
Fertilizer Application Emissions from Organic N_2O	4,427
Fertilizer Application Emissions from Manure N_2O	256
Urban Forestry	(42,290)
Carbon Sequestered in Commercial/Institutional Zones	(16,517)
Carbon Sequestered in Residential Zones	(16,762)
Carbon Sequestered in Industrial Zones	(9,011)
Total Emissions (Sources)	3,572,233
Land-Use, Land-Use Change, and Forestry (LULUCF) Sector Net Total (Sinks)	(42,290)
Net Emissions (Sources and Sinks)	3,529,943

Section C – Modeling Assumptions

Emissions reductions from GHG and co-pollutants were estimated for the 12 priority measures identified in the PCAP. Projected changes in GHG emissions and co-pollutant emissions for measures 1.1 to 1.4, 3.1, 4.1, and 5.1 were modeled using the Rocky Mountain Institute's EPS tool.[75] Projected changes in GHG emissions and co-pollutant emissions for measures 2.1 to 2.4 and 3.2 were modeled by the Tennessee Department of Energy and Conservation (TDEC) using EPA's GLIMPSE program and manual calculations. Resulting impacts in 2025 to 2050 are quantified through December 31, 2049.

The measures modeled in EPS comprised of a "business-as-usual" (BAU) and a "policy" scenario developed by the BG MSA to project assumptions and key inputs related to the measure through 2050. The BAU scenario assumes no implementation of the GHG reduction measure but may consider impacts of existing initiatives in the BG MSA.[76] The BAU scenario projects GHG emission impact on the current course, leveraging publicly available population and development projections through 2050. The policy scenario aims to estimate an aggressive rate of measure implementation.

EPS estimates emissions impacts from a provided list of emissions reduction policies pre-populated in the tool. The EPS policy that corresponds best to each priority measure was selected to model emissions reductions potential. If the EPS policy did not meet the full intent of the measure, the model was modified and adjusted to calculate the proper outputs. The corresponding EPS policy to each measure is indicated below, where applicable. The corresponding policies in the EPS are provided in the desktop model using the BAU and policy scenarios and their key inputs. The difference in impact between the two scenarios was then used to quantify the impact of the measure.

The section below provides an overview of the scenarios, assumptions, and metrics that served as key inputs to modeling the priority measures utilizing one of the following tools: EPS, GLIMPSE, or manual calculation.

Strategy 1: Transportation improvements

Measure 1.1: Electrify public transit fleet

Overview

The EPS policy 'Electric Vehicle Sales Standard' was used to quantify the impact of the 'electrify public transit fleet' measure. This measure aims to replace the current public/private BG MSA transportation fleet (consisting of buses, cutaways, vans, and minivans) with electric vehicles to reduce GHG emissions in the transportation sector. In this EPS policy, a percentage of new vehicles sold to be EVs compared to typical diesel buses and gasoline cars/SUVs. To meet the Electrical Vehicle Sales Standard, the BG MSA public transport buses and cutaways were equated to Passenger Buses and the BG MSA public transport vans and minivans were equated to Passenger Cars and SUVs. The use of this standard will help quantify the impact in GHG emission reductions if our measure is implemented.

This policy models the adoption of electric vehicles for commuter transportation by multiple entities. The entities included in this model are GoBG Transit (City of Bowling Green), Bowling Green Transit, Topper Transit

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[75] Energy Innovation Policy & Technology LLC, Energy Policy Simulator. 2024.

[76] County Strategic Plans were considered in the development of the BAU scenario for each policy. BAU scenarios may see impact where existing initiatives in the BRADD strategic county plans correspond to a priority measure. See: Barren River Area Development District (BRADD), County Resources. 2022.

(Western Kentucky University), Warren County/Warren County Community Services, Inc., and Scottsville Transit. Asset data was collected from the National Transit Database from the Federal Transit Administration.[77]

Public transit electrification goals in BG MSA

There is currently no policy or initiative in the BG MSA for the electrification of their public transportation fleet. There have been strides towards electrification of school buses, such as the 13 electric school buses that have been supplied to the Bowling Green Independent School District[78], however, there have been no such strides for commuter buses to date. This electrification was made possible by the EPA's Clean School Bus Rebate Program, which provided a $5,135,000 grant.

The business-as-usual scenario aims to project the total public transit fleet requirement, leveraging population growth data. Additionally, there is no evidence of acquisition or use of electric buses, cutaways, vans, or minivans in the BG MSA for commuter purposes and are there currently no policies or incentives for the electrification of public transportation vehicles, specific to the BG MSA. The policy scenario attempts to replace the entire BG MSA public transportation fleet with electric vehicles by the year 2050. Details of how the business-as-usual (BAU) and policy scenarios were estimated are below:

BAU scenario

According to the National Transit Database, there were 25 buses/cutaways and 27 vans/minivans in the BG MSA in 2022. Leveraging 2022 population estimates from the United States Census Bureau [79] and population projections from the Kentucky State Data Center[80], the future requirement for public transportation vehicles in the BG MSA was estimated. Assuming the population to public transportation ratio will remain the same between 2022 and 2050, and the ratio of buses/cutaways to vans/minivans will also remain the same, the 2050 public transportation requirement of 36 buses/cutaways and 40 vans/minivans was projected.

Year	Total Buses/Cutaways	Total Vans/Minivans
2022	25	27
2025	26	28
2030	28	30
2040	32	35
2050	36	40

Policy scenario

There are currently no electric public transportation vehicles used in the BG MSA and a starting year of 2026 for electric vehicle acquisition was assumed. The policy scenario assumes a yearly acquisition of about 1.5 electric buses/cutaways and about 1.7 vans/minivans, rounded to the nearest full number of vehicles in each target year, to achieve full electrification of the projected BG MSA commuter fleet by 2050.

Year	Electric Buses/Cutaways	Electric Vans / Minivans

[77] National Transit Database, 2022 Revenue Vehicle Inventory. *Federal Transit Administration.* February 2024.
[78] Barclay, J, Blue Bird Delivers 13 Electric School Buses to Bowling Green Independent Schools in Kentucky. *Blue Bird.* September 2023.
[79] United States Census Bureau, U.S. Census Bureau QuickFacts: Butler County, Kentucky; Allen County, Kentucky; Edmonson County, Kentucky; Warren County, Kentucky. February 2024.
[80] Kentucky State Data Center, Population and Household Projections in Kentucky, Kentucky Counties, and Area Development Districts. *University of Louisville.* August 2022.

2022	0	0
2025	0	0
2030	6	6
2040	21	24
2050	36	40

Measure 1.2: Expand public transit and improve routes

Overview

The EPS policy 'Mode Shifting' is used to quantify the impact of the 'expand public transit and improve routes' measure. To focus on the impact of mode shifting from passenger vehicles to public buses, the specific key input selected under this policy is passenger cars and SUVs.

To select a realistic target for this policy, changes in public transit ridership under two scenarios were estimated: (1) BAU scenario and (2) policy scenario.

Details of how the BAU and policy scenarios were estimated are below:

Public transit expansion goals in BG MSA

Currently, Warren County has an objective to increase the area serviced by Go BG public transit by 30% by 2027.[81] Thus, the public transit ridership is assumed to increase by 5% in Warren County by 2030, 10% by 2040, and 15% by 2050, under the assumption that implementation will begin to take affect by 2026.[82]

Population growth in BG MSA

The Kentucky State Data Center is responsible for the demographic and population projections for each county in Kentucky.[83] Projections for the residential population of Allen County, Butler County, Edmonson County, and Warren County are available through 2050.

BAU scenario

The variables used to project the business-as-usual scenario for expanding public transit and improving routes in the BG MSA are (1) increase in public transit ridership and (2) VMT reduced from passenger cars.

Impact of VMT in the BG MSA

In 2023, the total number of passengers on GoBG Transit's bus routes was 54,100[84]. Assuming this number is the number of unique rides taken on public transit in the year, it is estimated that 19 to 29 Daily Vehicle Miles Traveled (DVMT) in a passenger car is reduced for each public transit ride. DVMT in passenger cars per capita is determined utilizing the following data sources: DVMT per county published by the Kentucky Transportation Cabinet,[85] county population published by the U.S. Census,[86] commuting characteristics by county published by the U.S. Census.[87]

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[81] Barren River and Development District, Warren County Strategic Objectives. 2022.

[82] As Go BG makes up only 67% of Warren County's public fleet, an increase in area serviced is not assumed to equate an equivalent increase in ridership in the whole county. See: National Transit Database, 2022 Revenue Vehicle Inventory. *Federal Transit Administration*. February 2024.

[83] Kentucky State Data Center, Population and Household Projections in Kentucky, Kentucky Counties, and Area Development Districts. *University of Louisville.* August 2022.

[84] Novoselia, M., Bowling Green's growth outpaces public transportation. *WKU Journalism.* March 2023.

[85] Sanford, G., Planning Highway Information (HIS Database) | KYTC. *Team Kentucky Transportation Cabinet.* 2022.

[86] United States Census Bureau, QuickFacts Kentucky. December 2022.

[87] United States Census Bureau, Commuting Characteristics. December 2022.

Scenario	Item	Current state	2025	2030	2040	2050
BAU	Increase in public transit ridership (%) - Warren County	0%	0%	5%	10%	15%
	VMT in passenger cars reduced	1,552,518	1,552,518	1,630,143	1,707,769	1,785,395

Policy scenario

Under the policy scenario, public transit ridership is assumed to increase in all counties to 15% by 2050. This follows GoBG Transit's goal of increasing areas serviced by 30% by 2027 in the BAU scenario. This policy assumes the number of vehicles would remain constant, [88] and that the current routes will improve to connect residents to the urban center.

Scenario	Item	Current state	2025	2030	2040	2050
POLICY	Increase in public transit ridership (%) – Allen, Butler, Edmonson, and Warren County	0%	0%	5%	10%	15%
	VMT in passenger cars reduced	1,552,518	1,552,518	1,659,381	1,779,531	1,881,041

Measure 1.3: Expand shared use paths

Overview

The EPS policy 'Mode Shifting' is used to quantify the impact of the 'expand shared use paths' measure. To focus on the impact of mode shifting from passenger vehicles to walking, the specific key input selected under this policy is passenger cars and SUVs. This measure intends to reduce emissions associated with passenger vehicles by increase safe and well-connected pedestrian infrastructure that encourages micromobility.

To select a realistic target for this policy, changes in VMT from people walking instead of driving for their commute under two scenarios were estimated: (1) BAU scenario and (2) policy scenario.

Details of how the BAU and policy scenarios were estimated are below:

Sidewalk expansion goals in BG MSA

Currently, Warren County has objectives identify connectivity measures to and from downtown areas and aims to seek funding for sidewalk repairs in 2024.[89] Additionally, the Bowling Green Public Works Department has established a sidewalk plan with an associated set of "prioritized projects" that will create a basic skeletal framework of sidewalks to provide safe routes to schools and parks within all the City's neighborhoods.[90]

Commuting by walking in the BG MSA

As of 2022, the US Census estimates that 1.8% of people in the BG MSA walk to work[91]. This applies to the total number of workers in the MSA (35% of total population).[95] This measure uses this data to assume that 1.8% of people in the BG MSA commute by walking.

[88] See measure 1.1 for details on public fleet vehicles per county.

[89] Barren River and Development District, Warren County Strategic Objectives. 2022.

[90] City County Planning Commission, Focus 2030 Comprehensive Plan for Warren County. January 2023.

[91] United States Census Bureau, Commuting Characteristics. 2022.

Population growth in the BG MSA

The Kentucky State Data Center is responsible for the demographic and population projections for each county in Kentucky.[92] Projections for the residential population of Allen County, Butler County, Edmonson County, and Warren County are available through 2050.

BAU scenario

The variables used to project the business-as-usual scenario for expanding shared use paths in the BG MSA are (1) percentage increase in commuting by walking and (2) VMT reduced from passenger cars.

Impact of VMT in the BG MSA

In 2023, the total amount of the BG MSA population using walking as a form of commute was estimated to be 1.8% according to US Census estimates of means of transportation to work. As Warren County currently has objectives in place for measures related to sidewalk expansion measures, as mentioned in "sidewalk expansion goals" above, a 7% increase in walking as a form of commute is attributed to the BAU scenario by 2030 and remains consistent through 2050. Thus, 8.8% Warren County's population is estimated to commute by walking every year between 2030-2050.[93]

VMT impact is calculated by reducing the annual per capita passenger vehicle miles for the expected percentage of the population commuting by walking that year. VMT in passenger cars per capita is determined utilizing the following data sources: DVMT per county published by the Kentucky Transportation Cabinet,[94] county population published by the U.S. Census,[95] commuting characteristics by county published by the U.S. Census.[91]

Scenario	Item	Current state	2025	2030	2040	2050
BAU	Increase in commuting by walking (%) - Warren County	0%	0%	7%	0%	0%
	VMT in passenger cars reduced	29,816,897	30,712,614	191,417,466	177,760,332	198,916,912
	VMT in motorcycles reduced	1,170,303	1,205,459	7,513,069	6,977,031	7,807,420

Policy scenario

Under the policy scenario, commuting by walking is estimated to increase by 10% in the BG MSA for a total of 11.8% in the year 2050. The difference between the BAU and policy scenario for this measure accounts for a 3% (7% to 10%) increase in commuting by walking in 2050 in all counties.[96] The corresponding decrease in passenger vehicle miles from pedestrians replacing cars is shown in the table below. It is implied that the shared use paths

[92] Kentucky State Data Center, Population and Household Projections in Kentucky, Kentucky Counties, and Area Development Districts. *University of Louisville.* August 2022.

[93] A 7% increase in walking to commute to work over the period of 2025-2030 under the BAU scenario for this measure references the impact of a similar measure in Minneapolis's walking and biking improvement plan. This plan saw a walking as a form of commute increase 7% between 2012-2016. Differences in Minneapolis's geographic, regulatory, and political landscape from that of the BG MSA that can affect the impacts of this measure were not evaluated. See: Longenecker, P., Walking and Biking in Numbers. *Minneapolis City of Lakes.* 2018.

[94] Sanford, G., Planning Highway Information (HIS Database) | KYTC. *Team Kentucky Transportation Cabinet.* 2022.

[95] United States Census Bureau, QuickFacts Kentucky. December 2022.

[96] Warren County comprises nearly 70% of the population of the BG MSA, which is expected to make up the largest portion of commuters walking. Therefore, the relative increase in commuting by walking in the other counties is proportionate to the population: Allen, Butler, and Edmonson counties comprise about 30% of the BG MSA population, thus this measure estimates a 3% increase in commuting by walking, proportionate to population.

will be built primarily in densely populated areas, like the City of Bowling Green, to connect residents to the urban center. Population growth is accounted for in the emissions projections.

Scenario	Item	Current state	2025	2030	2040	2050
POLICY	Increase in commuting by walking (%) – Allen, Butler, Edmonson, and Warren County	0%	0%	10%	0%	0%
	VMT in passenger cars reduced	29,816,897	30,712,614	213,087,368	238,360,445	266,729,495
	VMT in motorcycles reduced	1,170,303	1,205,459	8,363,605	9,355,565	10,469,040

Measure 1.4: Improve traffic flow and efficiency

Overview

This program to improve traffic flow and efficiency is a measure intended to reduce the GHG emissions from the transportation sector in the BG MSA. The hypothesis is that by reducing or eliminating causes for congestion in the BG MSA, there will be an increase the fuel efficiency of commuters, thereby reducing emissions due to idling, starting, stopping, and driving at an inefficient miles-per-gallon speed in heavy traffic areas, to reduce the energy from excess fuel consumption in the BG MSA.

The assets included in this model are divided into two main categories – gasoline combustion vehicles and diesel combustion vehicles. The measure input is energy in thousand British Thermal Units or kBTU which is reduced by increasing efficiency by improving traffic flow patterns. The EPS policy "Fuel Economy Standard" was adjusted to estimate the reduction of energy consumption (kBTU) due to fuel consumption, by improving traffic flow and efficiency, thereby reducing GHG emissions through implementation. The policy scenario attempts to aggressively reduce energy through combustion found by the excess gasoline and diesel consumed during heavy traffic conditions. The policy scenario tests the effect of eliminating congestion and inefficiency by 100% by the year 2026 and plots the energy reduction by the policy as the BG MSA population increases through 2050. Of note in this measure is that the entire BG MSA population and its growth over time was used to estimate the effect of the measure versus utilizing the to the true population of registered drivers in the BG MSA as found in the BRADD County Plans.

BAU scenario

To create the model, 2019 auto commuter statistics for the State of Kentucky were collected from the Federal Highway Administration of the U.S. Department of Transportation[97]. For consistency, 2019 base data was used across this measure because it was the most complete available, e.g., 2020 data was deemed not representative of regular traffic due to the pandemic and values for 2021 and 2022 were not as comprehensive. These figures were leveraged to understand the percentage of registered automobiles, trucks, motorcycles, and buses in the State of Kentucky. These percentages were multiplied by population statistics in the BG MSA from the U.S. Census Bureau [98] to estimate the makeup of commuter vehicles in the BG MSA.

[97] Federal Highway Administration, Highway Statistics 2019 - Policy | Federal Highway Administration (dot.gov). *United States Department of Transportation*. February 2022.
[98] United States Census Bureau, U.S. Census Bureau QuickFacts: Butler County, Kentucky; Allen County, Kentucky; Edmonson County, Kentucky; Warren County, Kentucky. February 2024.

The 2021 Urban Mobility Report and Appendices from Texas A&M University[99] was leveraged to determine the amount of excess gasoline consumption due to congestion by light-duty vehicles in Bowling Green. Using the auto commuter source data from the Federal Highway Administration, the total number of truck registrations (light and heavy duty) were identified in the State of Kentucky for 2019 and the ratio of heavy to light trucks registered was estimated. Applying this (heavy to light duty truck) ratio to the total amount of excess gas consumed in all urban areas provided the total estimated excess amount of diesel consumed by heavy trucks and gasoline for light trucks.

Using the average miles per gallon of the various vehicle types found from the Alternative Fuels Data Center, Average Fuel Economy by Major Vehicle Category,[100] and the average amount of vehicles miles traveled per vehicle,[101] the total amount of annual fuel consumed in Bowling Green was estimated. The additional fuel consumption due to traffic congestion estimate was added to the annual average fuel consumption to form an estimate for total fuel consumed per vehicle type while in heavy traffic or congestion in Bowling Green.

Using the ratio of heavy-duty trucks to light duty trucks, the total amount of diesel and gas consumed per vehicle type was estimated in the BG MSA. The total gasoline and diesel values were multiplied by the 2030, 2040, and 2050 population projections from the Kentucky State Data Center to project the gasoline and diesel consumption for those years. The total projected gallons of diesel and gasoline were converted to kBTUs to understand the total energy expended in the business-as-usual scenario:

Year	Energy (kBTU) from Gasoline Consumption	Energy (kBTU) from Diesel Consumption
2030	30,433,132,473	15,259,899,367
2040	34,042,632,695	17,069,788,973
2050	38,094,299,701	19,101,391,564

Policy scenario

A starting year of 2026 was assumed for improving traffic flow and efficiency to reduce fuel consumption and therefore reduce GHG emissions. The policy scenario assumes that 100% of excess fuel will be eliminated by 2026, and the kBTU changes between 2026 and 2050 are due to population change between those years. The results of the policy scenario results reflect the application to the entire BG MSA population versus registered drivers. This, when compared to the GHG inventory for mobile combustion, illustrates that a more conservative approach was taken when estimating the mobile combustion emission. As the GHG inventory is further refined during the next phase, it is expected to see an increase in baseline emissions for the transportation sector.

Year	Energy (kBTU) from Gasoline Consumption	Energy (kBTU) from Diesel Consumption
2030	29,249,336,642	15,189,425,261
2040	32,718,433,594	16,990,956,336
2050	36,612,497,812	19,013,176,468

[99] Transportation Institute, 2021 Urban Mobility Report and Appendices. *Texas A&M*. June 2021.
[100] Alternative Fuels Data Center, Average Fuel Economy by Major Vehicle Category. February 2020.
[101] Alternative Fuels Data Center, Average Annual Vehicle Miles Traveled by Major Vehicle Category. January 2024.

Year	Reduction in kBTU from elimination of excess Gasoline and Diesel Consumption
2030	1,254,269,937
2040	1,403,031,738
2050	1,570,016,985

Strategy 2: Building energy efficiency enhancement

Measures 2.1 to 2.4 were modeled by TDEC utilizing a combination of the GLIMPSE tool and manual calculation:

- Measure 2.1: Incentive programs for implementation of end-use energy efficiency measures in existing commercial buildings
- Measure 2.2: Incentive programs for the purchase of certified energy-efficient lighting in commercial and industrial buildings, as well as streetlights
- Measure 2.3: Incentive programs for the purchase of certified energy-efficient building products to replace inefficient products in residential buildings
- Measure 2.4: Weatherization programs for residential buildings

The GLIMPSE model was used to estimate the annual electricity savings that would result from each incentive if implemented in Tennessee. Knowing that Tennessee represents 66% of the Tennessee Valley Authority's (TVA) service territory, the total TVA-wide savings could be estimated from these measures. Finally, based on knowledge that the BG MSA represents 2% of TVA's service area, the relative portion of savings that could be achieved in the BG MSA was derived. Estimates of the electricity saved annually (e.g., MWh) was subsequently converted to avoided emissions using emission factors from EPA's Emissions and Generation Resource Integrated Database (eGRID) Power Profiler for SRTV (SERC Tennessee Valley).

For example, GLIMPSE projected that Tennessee could avoid nearly 13,000 GWh of electricity consumption for the period 2025 to 2030 with the proposed commercial building end-use energy efficiency measures. Knowing that those 13,000 GWh represent 66% of the total TVA generation, 13,000 was divided by 0.66 to estimate the total TVA generation for the corresponding period, about 19,690 GWh. Because the BG MSA consumed 2% of the TVA generation (it is assumed that this proportion will remain constant into the future), the corresponding savings attributable to the BG MSA would be 2% of 19,690 GWh or about 394 GWh for the period 2025 to 2030. Electricity saved annually was subsequently converted to avoided emissions using emission factors from EPA's eGRID Power Profiler for SRTV. For the example above, the calculation 394 GWh x 4.22E-04 MMT CO2e/GWh provides about 0.2 MMT CO2e avoided.

Strategy 3: Renewable energy enhancement

Measure 3.1: Developing and distributing solar energy generation

Overview

The EPS policy "Distributed Solar Carve-Out" was utilized to quantify the elevation in electricity production stemming from developing and distributing solar energy generation because of this initiative. This model obliges an expressly defined percentage of the total retail electricity demand to be supplied by distributed solar systems. In the process of modeling this measure, the pivotal variable subject to analysis will be the difference in electricity manufactured by developing and distributing solar energy generation between a BAU and policy scenario.

This measure focuses on electricity generation solely by solar PVs in two categories: (1) generation from small-scale solar PVs, and (2) generation from community solar PV systems.

Solar PV generation in the BG MSA today

In 2024 in the BG MSA, Solar PV generating capacity is 650 kilowatts (kW) from 28 houses that have small-scale solar PVs. There is currently only one county in the BG MSA that has ordinances for community solar projects, Warren County.[102] Although Warren does have an ordinance for community solar, there have not been projects to date.[103] Therefore, the current Solar PV generating capacity from community solar projects is zero. For broader context on the State of Kentucky's community solar project, there is only five projects with the most recent two being completed in 2019. [103]

BAU

In this analysis, it is posited that the growth of small-scale PV capacity in the BAU scenario within the BG MSA will align with the projected expansion rate for PVs in end-use sectors across the United States,[104] as posited by the Annual Energy Outlook (AEO) 2023 Reference case.[105] According to this scenario, the annual average growth rates for PV capacity in end-use sectors stands at 7.4% from 2025 to 2030, 6.1% from 2030 to 2035, 5.2% from 2035 to 2040, 4.5% from 2040 to 2045, and 4.1% from 2045 to 2050. Applying these growth rates to the small-scale PV capacity within the BG MSA can produce a projection of electricity generation under the BAU scenario from 2022 to 2050, as displayed below.

As for the growth in community solar PV capacity in the BAU scenario within the BG MSA is anticipated that there would not be any community solar projects. Due to the limited scope of community solar within Kentucky, the lack of ordinances in three of the four counties to implement these projects, and current lack thereof, this was an assumption that was drawn for the current modeling for the PCAP.

Policy	Item	2022	2025	2030	2035	2040	2045	2050
BAU	End-use sector solar PV generating capacity each year (kW)	48,590,000	67,560,000	68,000,000	120,790,000	151,867,000	185,800,000	224,2600,000
	Small-scale PV generating capacity	650	752.55	1,008.76	1,343.59	1,798.03	2,498.34	3,327.61

[102] Mattingly, H., KY Solar Ordinances (arcgis.com). *Kentucky Office of Energy Policy. 2024.*

[103] Chan, G., Heeter, J., Xu, K., Sharing the Sun Community Solar Project Data. *United States Department of Energy*. December 12, 2023

[104] The EIA defines end-use sectors as including combined-heat-and-power plants and electricity-only plants in the commercial and industrial sectors that have a non-regulatory status. It also includes small on-site generating systems in the residential, commercial, and industrial sectors used primarily for own-use generation, but which may also sell some power to the grid.

[105] The reference case represents EIAs best guess under nominal conditions, which presumes no new policy or laws over the modeled time horizon. See: United States Energy Information Administration, Narrative 2023 - U.S. Energy Information Administration (EIA). March 2023.

	in Georgia each year (kW)							
	Community solar PV (kW)	0	0	0	0	0	0	0
	Total solar PV potential (kW)	48,590,650	67,560,753	68,001,009	120,791,344	151,868,798	185,802,498	2,242,603,328

Policy scenario

Within the policy scenario, there is a prediction of more accelerated growth rates for both small-scale PV capacity and community solar capacity in the BG MSA, when compared to the growth rates without policy intervention. This assumption is mainly due to the introduction of a measure that encourages small-scale PV generation and community solar PV generation.

The AEO 2023 Low Zero-Carbon Technology Cost case's projections for generating capacity of PVs in end-use sectors from 2025 to 2050 serves as a reference for this policy scenario, as presented in below. This case was chosen mainly because the incentives for community solar projects would likely be in the form of an investment tax credit or production tax credit, thereby reducing the costs of solar PVs.

Subsequently, it is posited that the amount of small-scale solar PVs' generating capacity within the BG MSA in the policy scenario will grow at the same rate as that of the PVs in the U.S end-use sectors, as predicted by the AEO 2023 Low Zero-Carbon Technology Cost case.[106] According to this case, the average annual rate of growth for generating capacity of PVs in end-use sectors is forecasted to be 7.6% from 2025 to 2030, 5.9% from 2030 to 2035, 6.0% from 2035 to 2040, 6.8% from 2040 to 2045, and 5.9% from 2045 to 2050.

These growth averages are applied to the small-scale PV generating capacity within the BG MSA to project its electricity generation capacity in the policy scenario from 2022 to 2050.

There is a further assumption that the generating capacity of community solar PV within the BG MSA in the policy scenario will grow at the same pace as the project growth of PVs in the U. S's electric power sector according to the AEO 2023 Low Zero-Carbon Technology Cost case. As per this case, the average annual growth rate stands at 21.8% from 2025 to 2030, 8.6% from 2030 to 2035, 4.2% from 2035 to 2040, 4.7% from 2040 to 2045, and 4.2% from 2045 to 2050. These rates are applied to the community solar PV capacity in the BG MSA to project its generating capacity inside the policy scenario from 2022 to 2050, which is illustrated in below.

Policy	Item	2022	2025	2030	2035	2040	2045	2050
POLICY	End-use sector solar PV generating capacity each year (kW)	48,630,000	67,480,000	93,270,000	120,920,000	156,930,000	210,170,000	272,290,000

[106] The AEO 2023 Low Zero-Carbon Technology Cost case assumes technology costs of power generation technologies that produce zero emissions are lower than the Reference case. Specifically, it is assumed that overnight capital costs and fixed operating and maintenance costs decline more rapidly than in the Reference case.

	Small-scale PV generating capacity in Georgia each year (kW)	650	752.55	1,008.76	1,343.59	1,798.03	2,498.34	3,327.61
	Electric power sector PV solar generating capacity each year (kW)	74,980,000	182,280,000	380,850,000	544,950,000	658,660,000	813,140,000	982,650,000
	Community solar PV generating capacity each year (kW)	0	2,000	4,401.69	6,649.18	8,167.83	10,276.38	12,623.47
	Total solar PV generating capacity each year (kW)	123,610,650	249,762,753	474,125,410	665,877,993	815,599,966	1,023,322,775	1,254,955,951

Measure 3.2: Upgrading distribution

The scaling approach described in strategy two to convert results from Tennessee to the BG MSA remained the same, utilizing 2% as the proportion of TVA's service area that represents the BG MSA. MWh savings for this measure were calculated using EPA's State Inventory Tool (SIT). SIT estimated transmission and distribution losses based on an assumed 5.1% loss (for our baseline year of 2019). This loss percentage was altered using a range of improvements from 0.5% to 4.0% to estimate how much electricity could be conserved.

The Energy Information Administration (EIA) estimates that from 2018 through 2022, annual electricity transmission and distribution (T&D) losses averaged about 5% of the electricity transmitted and distributed. Transmission losses are a function of the distance between the generator and the consumer (the farther it must travel the more is lost), the voltage and resistance of the transmission lines (the "quality" of the lines), and the amount of energy flowing through the line (higher loads generally mean more heat and more loss).

This priority measure aims to reduce transmission loss and thereby reduce overall power consumption through increased efficiency. Other related measures that aim to upgrade the electricity distribution system and position the state for increased load growth in response vehicle electrification and the transition away from fossil fuel use have potential to provide further improvements to the grid. Such additional measures may be considered later.

Strategy 4: Improve waste diversion and landfill management

Measure 4.1: Programs to divert organic waste from landfills

Overview

The EPS policy 'methane capture' is used to quantify the impact of the 'organic waste diversion from landfills' measure. To focus on the impact of organic waste diversion in methane capture the specific key input selected under this policy is 'water and waste.'

To select a realistic target for this policy, EY estimated the future food waste makeup in landfills under two scenarios: (1) BAU scenario and (2) policy scenario.

In 2050, total food waste makeup in landfills in Bowling Green is estimated to be 55,025 metric tons if no interventions are taken (BAU scenario), and 0 metric tons under this proposed measure (policy scenario). The comparison of BAU to the policy scenario indicates that the measure will increase organic waste diversion notably through investment in compost facilities in the BG MSA. The measure is assumed to be effective January 1, 2025.

Details of how the BAU and policy scenarios were estimated are below:

Waste diversion targets in Bowling Green

Currently there are no active organics disposal bans or mandated recycling of organics in the City of Bowling Green to address organic waste diversion from landfills.

Population growth

The Kentucky State Data Center is responsible for the demographic and population projections for each county in Kentucky.[107] Projections for the residential population of Allen County, Butler County, Edmonson County, and Warren County are available through 2050.

BAU scenario

The variable used to project the business-as-usual scenario for organic waste diversion in landfills in the BG MSA is tons of food waste per capita. This variable was found by calculating the total food waste in the State of Kentucky in 2022 published by ReFED, 1.08 million tons,[108] as a proportion of population in the State of Kentucky in 2022 published by the U.S. Census, 4,511,563 people.[109] The resulting calculation estimates 0.239 tons of food waste per capita in the State of Kentucky in 2022. This variable was used to estimate the amount of food waste in Bowling Green as follows:

Scenario	Item	Current state	2025	2030	2040	2050
BAU	Food surplus per capita (tons)	0.239	0.239	0.239	0.239	0.239
	Population growth in the BG MSA[107]	185,682	191,260	202,421	226,429	253,378
	Food waste makeup in the landfills (tons)	44,449	45,785	48,457	54,204	60,655
	Methane captured (kg CO2e)	0	0	0	0	0

In the BAU scenario, the food waste makeup in the landfills grows based on the year over year (YoY) projection of population growth across the BG MSA. To conduct the modeling in the BAU and policy scenarios, diversion of food waste from landfills corresponds to methane diverted. As no amount of food waste is expected to be diverted from landfills under the BAU scenario, methane is not assumed to be captured under this scenario.

Policy scenario

[107] Kentucky State Data Center, Population and Household Projections in Kentucky, Kentucky Counties, and Area Development Districts. *University of Louisville.* August 2022.
[108] ReFED Insights Engine, Food Waste Monitor. *ReFED.* November 2023.
[109] United States Census Bureau, QuickFacts Kentucky. *US Census.* December 2022.

As the BG MSA does not currently have programs to divert organic waste from landfills, a 50% organic waste reduction goal by 2030 is proposed in alignment with the national food loss and waste reduction goal of 50% reduction by 2030.[110] Similarly, a 100% food waste reduction goal by 2050 is proposed under this scenario. Leveraging the current state data sourced from ReFED, the percentage of food waste makeup in landfills decreases to half of its present-day levels by 2030 and reaches full diversion by 2050. A linear decrease is applied based on this proposed target for the years 2030, 2040, and 2050. This scenario assumes a 1,050 kg CO2e of methane emissions per metric ton of food waste.[111,112]

Strategy 5: Land use enhancement

Measure 5.1: Expand green spaces

Overview

This program is to increase open space within the BG MSA is a measure intended to help sequester CO2 over time and offset CO2 emissions emitted due to development and construction. The EPS policy 'Afforestation and Reforestation' is focused on increasing the sequestration of carbon dioxide by planting forests. The policy takes a hard percentage of potential green space achieved. While the BG MSA is not planning on planting forests, they are planning to conserve land and/or plan for more open space in the form of parks, green roof applications, and trails as an example, to reduce further development. The use of this policy will quantify the impact in GHG emission reductions if our measure is implemented.

EnviroAtlas[113] was used to pull 2019 land use statistics for each county including the total county area, developed land, undeveloped land, and increase in developed land over the previous three years. These statistics were leveraged to sum the total areas, total developed areas, and total undeveloped areas in the combined counties. Details of how the BAU and policy scenarios were estimated are below.

BAU scenario

According to the data from EnviroAtlas, developed land in the BG MSA has increased by 7.81 km² between 2016-2019. By dividing that increase by three (number of years), the BG MSA is projected to increase its developed land by approximately 2.6 km² per year, or 643 acres. This growth rate was used to estimate the growth of developed land in the BG MSA in 2025, 2030, 2040, and 2050 for the BAU scenario:

Year	Total Developed Land in BG MSA (acres)	Less Green Space from previous year (acres)
2023	28,358	
2025	29,644	1,287
2030	32,861	3,216
2040	39,294	6,433

[110] United States Environmental Protection Agency, U.S. 2030 Food Loss and Waste Reduction goal. *EPA.* September 2015.
[111] 0.0375 metric tons of fugitive methane emissions released per metric tons of food waste is assumed from EPA's 2023 Food Waste Management report that states "for every 1,000 tons (907 metric tons) of food waste landfilled, an estimated 34 metric tons of fugitive methane emissions are released." See: United States Environmental Protection Agency Office of Research and Development, Quantifying Methane Emissions from Landfilled Food Waste. October 2023.
[112] Metric tons fugitive methane emissions are converted into kg CO2e using EPA's Greenhouse Gas Equivalencies Calculator, which estimates that 1 metric ton of methane emissions is equivalent to 28 metric tons of kg CO2e. See: United States Environmental Protection Agency. Greenhouse Gas Equivalencies Calculator. February 2024.
[113] EnviroAtlas, EnviroAtlas Summarize My Area. *United States Environmental Protection Agency*. 2019.

2050	45,727	6,433

Policy scenario

The World Health Organization has recommended an ideal value of 50m² of green space per individual.[114] Assuming a starting year of 2026, the green space recommendation was multiplied by the population projections for the BG MSA in 2030, 2040, and 2050 from the Kentucky State Data Center to project the estimate space requirements for the policy scenario: [115]

Year	Total Green Space Requirements in the BG MSA (acres)
2030	2,501
2040	2,798
2050	3,131

[114] Russo, A and Giuseppe, C., Modern Compact Cities: How Much Greenery Do We Need?. *Department of Landscape Design and Sustainable Ecosystems, Peoples' Friendship University of Russia, RUDN University*. October 2018.
[115] Kentucky State Data Center, Population and Household Projections, Kentucky, Kentucky Counties, and Area Development Districts. *University of Louisville*. August 2022.

Section D – Co-Pollutant Inventory

Table 21: BG MSA co-pollutant inventory by NEI sector

Sector	CO (tons)	Lead (lbs)	NOx (tons)	PM2.5 (tons)	PM10 (tons)	SO2 (tons)	VOC (tons)	HAPs (lbs)
Agriculture - Crops & Livestock Dust	-	-	-	847	4,247		-	-
Agriculture - Fertilizer Application	-	-	-	-	-	-		
Agriculture - Livestock Waste	-	-	-	-	-	-	150	28,136
Biogenics - Vegetation and Soil	2,178	-	1,009	-	-	-	15,611	3,460,458
Bulk Gasoline Terminals	-	-	-	-	-	-	127	12,306
Commercial Cooking	29	-	-	70	76	-	10	10,368
Dust - Construction Dust	-	-	-	83	829	-	-	-
Dust - Paved Road Dust	-	-	-	123	488	-	-	-
Dust - Unpaved Road Dust	-	-	-	119	1,195	-	-	-
Fires - Agricultural Field Burning	106	-	3	12	17	2	13	4,924
Fires - Prescribed Fires	4,115	-	84	376	445	40	979	394,972
Fires - Wildfires	111	-	2	10	11	1	26	13,043
Fuel Comb - Comm/Institutional - Biomass	35	2	2	2	5	-	1	1,978
Fuel Comb - Comm/Institutional - Coal	-	-	-	-	-	-	-	-
Fuel Comb - Comm/Institutional - Natural Gas	18	2	18	3	4	-	1	754
Fuel Comb - Comm/Institutional - Oil	-	-	1	-	-	-	-	80
Fuel Comb - Comm/Institutional - Other	-	-	-	-	-	-	-	1
Fuel Comb - Electric Generation - Coal	-	-	-	-	-	-	-	-
Fuel Comb - Electric Generation - Natural Gas	-	-	-	-	-	-	-	9
Fuel Comb - Electric Generation - Oil	1		3	-	-	-	-	116
Fuel Comb - Electric Generation - Other	-	-	-	-	-	-	-	-
Fuel Comb - Industrial Boilers, ICEs - Biomass	-	-	-	-	-	-	-	-
Fuel Comb - Industrial Boilers, ICEs - Coal	-	-	-	-	-	-	-	-
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	55	-	59	9	12	-	3	881
Fuel Comb - Industrial Boilers, ICEs - Oil	-	-	-	-	-	-	-	-
Fuel Comb - Industrial Boilers, ICEs - Other	-	-	-	-	-	-	-	
Fuel Comb - Residential - Natural Gas	28	-	68	-	-	-	4	112
Fuel Comb - Residential - Oil	-	-	-	-	-	-	-	1
Fuel Comb - Residential - Other	6	-	21	-	-	-	-	22
Fuel Comb - Residential - Wood	2,376	-	35	315	315	7	358	134,758
Gas Stations	-	-	-	-	-	-	484	102,471
Industrial Processes - Cement Manuf	-	-	-	-	-	-	-	-
Industrial Processes - Chemical Manuf	-	-	-	3	4	-	24	-
Industrial Processes - Ferrous Metals	-	-	-	-	-	-	-	-
Industrial Processes - Mining	-	-	-	14	102	-	-	-
Industrial Processes - NEC	73	14	84	69	103	-	381	150,213
Industrial Processes - Non-ferrous Metals	128	171	69	55	63	-	7	55,343
Industrial Processes - Oil & Gas Production	771	-	503	11	11	1	2,010	38,442
Industrial Processes - Petroleum Refineries	-	-	-	-	-	-	-	-
Industrial Processes - Pulp & Paper	-	-	-	1	1	-	-	-
Industrial Processes - Storage and Transfer	-	1	-	22	50	-	46	4,193
Miscellaneous Non-Industrial NEC	46	-	1	7	10	-	33	15,446
Mobile - Aircraft	185	337	11	3	4	1	9	5,981
Mobile - Commercial Marine Vessels	-	-	-	-	-	-	-	-
Mobile - Locomotives	28	-	145	4	4	-	7	5,917
Mobile - Non-Road Equipment - Diesel	137	-	301	23	25	-	27	25,399
Mobile - Non-Road Equipment - Gasoline	4,038	-	75	15	16	-	465	299,443
Mobile - Non-Road Equipment - Other	145	-	24	1	1	-	4	1,640
Mobile - On-Road Diesel Heavy Duty Vehicles	424	-	1,320	55	77	3	87	35,857
Mobile - On-Road Diesel Light Duty Vehicles	250	-	84	2	5	-	26	9,170
Mobile - On-Road non-Diesel Heavy Duty Vehicles	433	-	41	1	2	-	21	11,487
Mobile - On-Road non-Diesel Light Duty Vehicles	13,746	-	1,410	28	75	11	1,051	581,737
Solvent - Consumer & Commercial Solvent Use	-	-	-	-	-	-	945	174,947
Solvent - Degreasing	-	-	-	-	-	-	144	106,837
Solvent - Dry Cleaning	-	-	-	-	-	-	-	4,734
Solvent - Graphic Arts	-	-	-	-	-	-	682	91,867
Solvent - Industrial Surface Coating & Solvent Use	6	-	8	26	26	-	622	130,923
Solvent - Non-Industrial Surface Coating	-	-	-	-	-	-	206	54,706
Waste Disposal	1,495		53	249	274	16	111	61,497
Grand Total	30,963	527	5,434	2,558	8,497	82	24,675	6,031,169

Section E – Census Tracks in the BG MSA

Summary of LIDACs in the BG MSA by Census Tract and County

Census tract 2010 ID	County Name	Identified as disadvantaged	Total threshold criteria exceeded	Total categories exceeded	Identified as disadvantaged without considering neighbors	Total population
21003920100	Allen County	TRUE	1	1	TRUE	3178
21003920200	Allen County	TRUE	3	3	TRUE	2833
21003920300	Allen County	TRUE	3	2	TRUE	4990
21003920400	Allen County	TRUE	1	1	TRUE	4890
21003920500	Allen County	TRUE	2	2	TRUE	1430
21003920600	Allen County	TRUE	3	3	TRUE	3623
21031930100	Butler County	TRUE	3	3	TRUE	3120
21031930200	Butler County	TRUE	3	3	TRUE	1763
21031930300	Butler County	TRUE	3	3	TRUE	4826
21031930400	Butler County	TRUE	6	5	TRUE	1904
21031930500	Butler County	FALSE	0	0	FALSE	1151
21061920200	Edmonson County	TRUE	4	4	TRUE	4306
21061920300	Edmonson County	TRUE	3	3	TRUE	1300
21061920400	Edmonson County	TRUE	2	2	TRUE	6264
21061980100	Edmonson County	TRUE	1	1	TRUE	268
21227010100	Warren County	TRUE	3	2	TRUE	2670
21227010200	Warren County	TRUE	5	2	TRUE	3632
21227010300	Warren County	TRUE	2	2	TRUE	4260
21227010400	Warren County	FALSE	0	0	FALSE	5903
21227010500	Warren County	TRUE	1	1	TRUE	2492
21227010600	Warren County	FALSE	0	0	FALSE	4153
21227010701	Warren County	FALSE	0	0	FALSE	5549
21227010702	Warren County	FALSE	0	0	FALSE	6247
21227010801	Warren County	FALSE	0	0	FALSE	2970
21227010802	Warren County	FALSE	0	0	FALSE	7942
21227010803	Warren County	TRUE	1	1	TRUE	6700
21227010900	Warren County	FALSE	0	0	FALSE	4494
21227011001	Warren County	TRUE	1	1	TRUE	3976
21227011002	Warren County	FALSE	0	0	FALSE	7246
21227011100	Warren County	FALSE	0	0	FALSE	6423
21227011200	Warren County	TRUE	3	3	TRUE	5517
21227011300	Warren County	FALSE	0	0	FALSE	4898
21227011401	Warren County	FALSE	0	0	FALSE	7196
21227011402	Warren County	FALSE	0	0	FALSE	3026
21227011500	Warren County	FALSE	0	0	FALSE	7221
21227011600	Warren County	FALSE	0	0	FALSE	5471
21227011700	Warren County	TRUE	1	1	TRUE	8556
21227011800	Warren County	FALSE	0	0	FALSE	5869
21227011900	Warren County	FALSE	0	0	FALSE	6241

Section F – Implementation Planning

Implementation Timeline

Task	Description	Start Date	End Date
1	Notice of Intent to Apply for Funds	Feb 1, 2024	Feb 1, 2024
2	Application Submission	March 1, 2024	April 1, 2024
3	Funding Received	TBD	TBD
4	Estimated Project Start Date	TBD	TBD
5	Year 1 – Coordination and standing up the Project	TBD	TBD
6	Year 2 – Expense 25% of the budget through appropriate programs	TBD	TBD
7	Year 3 – Expense 25% of the budget through appropriate programs	TBD	TBD
8	Year 4 – Expense 25% of the budget through appropriate programs	TBD	TBD
9	Year 5 – Expense 25% of the budget through appropriate programs	TBD	TBD

Section G – Public Survey Analysis Guidelines

Determining if the measure addressed benefits or concern

Each measure was individually reviewed and vetted against criteria for benefits and concerns to determine if the emission reduction measure addressed a benefits or concern from the survey. The criteria (or guardrails) helped determine if a measure addressed a benefit or concern by providing guidance on how the benefit or concern could be addressed.

Table 22: Criteria developed to determine if measures address survey benefits.

Survey options	Improved air quality and public health resulting from decreased air pollution	Transportation improvements, such as bike, walk, and transit options and electric vehicle infrastructure	Community resilience, or the ability to withstand extreme weather events	Community beautification, such as new or improved green spaces, bike paths, or walking trails	Workforce development and the creation of new jobs	Housing and housing affordability, including reduced utility costs	Reduced noise pollution, including traffic and construction noise	Assistance with home weatherization to improve heating and cooling and to lower utility bills
Criteria to determine how a GHG reduction measure may address benefits								
Yes (Y)	Likely to decrease NOx, methane, and other emissions that contribute to air pollution	Likely to have direct impacts to create, fund or incentivize new or update existing transportation modes	Likely to directly increase community resilience to withstand extreme weather (e.g., vulnerability assessments, interventions to help respond to events and recovery)	Likely to directly increase beautification (e.g., infrastructure for bikes and walking)	Likely to directly require additional workforce to complete the measure (e.g., new infrastructure)	Likely to directly increase housing affordability or utility costs (e.g., solar rebates)	Likely to directly reduce noise pollution (e.g., traffic and construction - switch from diesel engines to electric engines)	Likely to directly improve effectiveness of heating and cooling or to reduce the cost of utility bills
No (N)	Likely to directly increase NOx, methane, and other emissions that contribute to air pollution	Likely to counter or decrease measures to create, fund or incentivize new or update existing transpiration modes	Likely to counter community resilience measures	Likely to counter beautification efforts	Likely to decrease workforce in a specific sector due to the measure	Likely to directly decrease housing affordability or utility costs	Likely to increase noise pollution (e.g., traffic and construction noise)	Likely to decrease the effectiveness of heating and cooling or to increase the cost of utility bills
NA	No direct impact on air pollution	No direct transportation benefits	No direct community resilience benefits	No direct beautification benefits	No direct workforce implications	No direct implications for housing affordability or utility costs	No direct noise pollution implications	No direct implications for heating or cooling effectiveness or utility costs