BOROUGH OF MECHANICSBURG

2022 Inventory of Communitywide Greenhouse Gas Emissions

Produced by the Mechanicsburg Office of Sustainability with
Assistance from ICLEI – Local Governments for Sustainability USA

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Executive Summary

The Borough of Mechanicsburg recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community.

Mechanicsburg is taking climate action. The 'Trees for All' project prioritizes revitalizing the urban tree canopy as a carbon drawdown and public health strategy. The Commission has set a goal to plant 500 trees by 2028 and this has been bolstered by securing a grant through the USDA Forest Service Urban and Community Forestry Grant program. Participation in the Environmental Protection Agency's 'Food: Too Good to Waste' program helps inform residents of the impacts of food waste across 6 weeks. Further, expanding walking trails and parks allow residents to travel on foot and enjoy natural spaces. These projects are a launching pad for further emission reductions, and support the Borough's mission to make Mechanicsburg, 'A Good Place to Live.'

This report provides estimates of greenhouse gas emissions resulting from activities in the Borough of Mechanicsburg as a whole in 2022.

Key Findings

Figure 1 shows communitywide emissions by sector. The largest contributor is Residential Energy with 37.33% of emissions. The next largest contributors are Commercial Energy 26.50% and Transportation 22.93%. Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Industrial Energy, Solid Waste, Water & Wastewater, and Process & Fugitive Emissions were responsible for the remaining (less than 13.24%) of emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within the Borough of Mechanicsburg; information that is key to guiding local reduction efforts. These data will also provide a baseline against which the city will be able to compare future performance and demonstrate progress in reducing emissions.

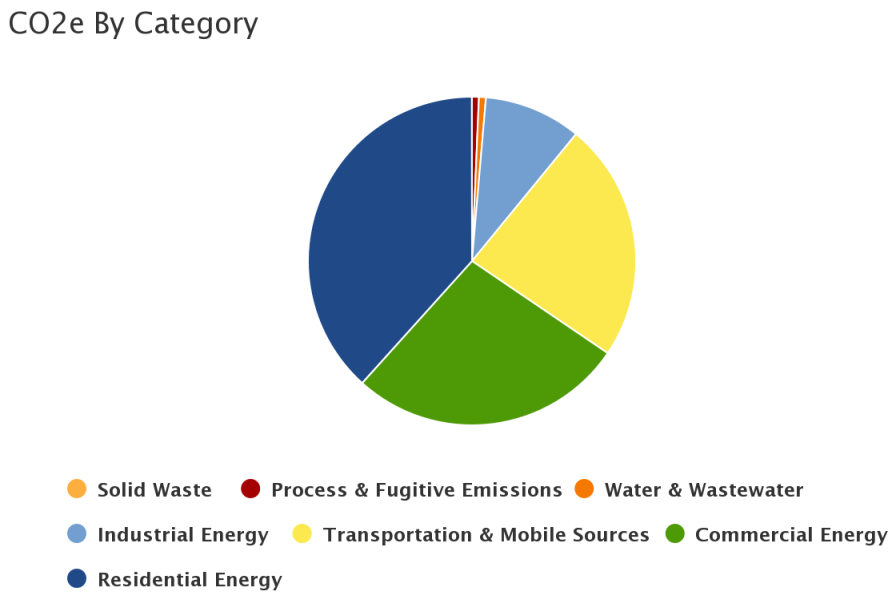

Figure 1: Community Emissions by Sector

Introduction to Climate Change

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise, threatening the safety, quality of life, and economic prosperity of global communities. Although the natural greenhouse effect is needed to keep the earth warm, a human enhanced greenhouse effect with the rapid accumulation of GHG in the atmosphere leads to too much heat and radiation being trapped. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report confirms that human activities have unequivocally caused an increase in carbon emissions[1]. Many regions are already experiencing the consequences of global climate change, and the Borough of Mechanicsburg is no exception.

Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (high confidence) Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (high confidence), but these emissions alone are unlikely to cause global warming of 1.5°C (medium confidence). Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (high confidence). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (high confidence)[2].

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[1]IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

[2]IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the

According to the 2021 Pennsylvania Climate Impacts Assessment, increasing average temperatures and heavy precipitation and inland flooding will be the two highest-risk hazards by 2050 that could affect the entire state, including the Borough of Mechanicsburg. Increasing temperatures will have dire consequences on human health and environmental justice and equity. The increase in heavy precipitation and flooding will have impacts on human health, agriculture, and built infrastructure. We will also see other hazards such as heat waves, landslides, sea level rise, and severe tropical and extra-tropical cyclones across the state. All of these hazards will lead to economic impacts that will then have to be managed by the Borough of Mechanicsburg or the state of Pennsylvania[3].

Many communities in the United States have started to take responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, when residents save on energy costs, they are more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

[3] ICF. (2021, July 28). *Pennsylvania Climate Impacts Assessment 2021*. PA DEP. https://greenport.pa.gov/elibrary//GetDocument?docId=3667348&DocName=PENNSYLVANIA%20CLIMATE%20IMPACTS%20ASSESSMENT%202021.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c/span%3e%204/30/2023

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

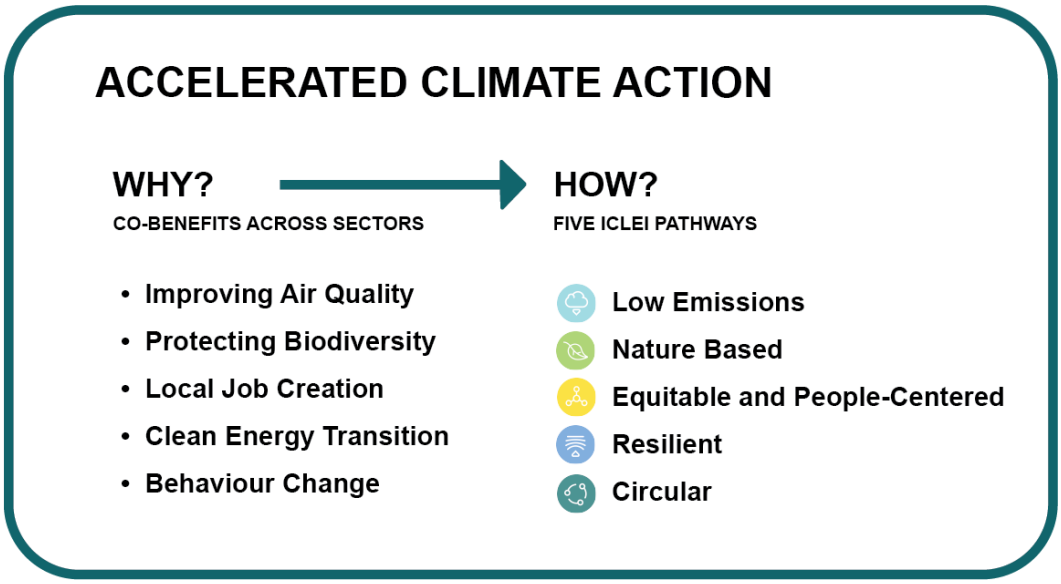
Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the impacts of climate change.

Cities, towns and counties are well placed to define coherent and inclusive plans that address integrated climate action — climate change adaptation, resilience and mitigation. Existing targets and plans need to be reviewed to bring in the necessary level of ambition and outline how to achieve net-zero emissions by 2050 at the latest. Creating a roadmap for climate neutrality requires the Borough of Mechanicsburg to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation and other benefits of sustainable development.

To complete this inventory, the Borough of Mechanicsburg utilized tools and guidelines from ICLEI - Local Governments for Sustainability (ICLEI), which provides authoritative direction for greenhouse gas emissions accounting and defines climate neutrality as follows:

> The targeted reduction of greenhouse gas (GHG) emissions and GHG avoidance in government operations and across the community in all sectors to an absolute net-zero emission level at the latest by 2050. In parallel to this, it is critical to adapt to climate change and enhance climate resilience across all sectors, in all systems and processes.

To achieve ambitious emissions reduction, and move toward climate neutrality, the Borough of Mechanicsburg will need to set a clear goal and act rapidly following a holistic and integrated approach. Climate action is an opportunity for our community to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequality, and improving the health of people and nature.



ICLEI Climate Mitigation Milestones

In response to the climate emergency, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries, as well as influencing regional emissions through partnerships and advocacy. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones, also shown in Figure 2:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions Science Based Target[4];
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One and provides a foundation for future work to reduce greenhouse gas emissions in the Borough of Mechanicsburg.

FIGURE 1: ICLEI CLIMATE MITIGATION MILESTONES

[4] Science-Based Targets are calculated climate goals, in line with the latest climate science, that represent your community's fair share of the ambition necessary to meet the Paris Agreement commitment of keeping warming below 1.5°C. To achieve this goal, the Intergovernmental Panel on Climate Change (IPCC) states that we must reduce global emissions by 50% by 2030 and achieve climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Borough of Mechanicsburg community as a whole. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

FIGURE 2: RELATIONSHIP OF COMMUNITY AND GOVERNMENT OPERATIONS INVENTORIES

As local governments continue to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (Community Protocol) and the Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions (LGO Protocol), both of which are described below.

Three greenhouse gases are included in this inventory: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Many of the charts in this report represent emissions in "carbon dioxide equivalent" (CO2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 6th Assessment Report:

Table 1: Global Warming Potential Values (IPCC, 2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	28
Nitrous Oxide (N2O)	265

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions[5] was released by ICLEI in 2019, and represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

The community inventory in this report includes emissions from the five Basic Emissions Generating Activities required by the Community Protocol. These activities are:

- Use of electricity by the community
- Use of fuel in residential and commercial stationary combustion equipment
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater treatment and distribution
- Generation of solid waste by the community

The community inventory also includes the following activities:

- Wastewater processing
- Fugitive emissions from natural gas leakage

Quantifying Greenhouse Gas Emissions

Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by "sources" located

[5] ICLEI. 2012. US Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from http://www.icleiusa.org/tools/ghg-protocol/community-protocol

within the community boundary, and 2) GHG emissions produced as a consequence of community "activities".

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere	The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions.

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. The division of emissions into sources and activities replaces the scopes framework that is used in government operations inventories, but that does not have a clear definition for application to community inventories.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. The Borough of Mechanicsburg's community greenhouse gas emissions inventory utilizes 2022 as its baseline year, because it is the most recent year for which the necessary data are available.

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.

- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO2/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath tool.

Community Emissions Inventory Results

The total communitywide emissions for the 2022 inventory are shown in Table 2 and Figure 5.

TABLE 2: COMMUNITYWIDE EMISSIONS INVENTORY

Sector	Fuel or source	2022 Usage	Usage unit	2022 Emissions ($MTCO_2e$)
Residential energy	Electricity (PPL)	46155837.56	kWh	14,154
	Natural Gas (UGI Utilities)	146667.64	MMBtu	7,800
	Residential Distillate Fuel & Kerosene	459112.823	Gallons	4,717
	Residential Propane	140273.307	Gallons	792
Residential energy total: 27,463 $MTCO_2e$				
Commercial energy	Electricity (PPL)	40289133.91	kWh	12,355
	Natural gas (UGI Utilities)	98987.94	MMBtu	5,265
	Commercial Distillate Fuel Oil	61733.02868	Gallons	634
	Commercial Motor Gasoline	57725.65982	Gallons	510
	Commercial Propane	42575.85069	Gallons	240
	Commercial Kerosene	566.8960835	Gallons	5.794
Commercial energy total: 19,496 $MTCO_2e$				
Industrial energy	Electricity (PPL)	18773119.1	kWh	5,757
	Natural gas (UGI Utilities)	20712.04	MMBtu	1,099
	Industrial Non-Utility Fuels	0	N/A	0
Industrial energy total: 6,856 $MTCO_2e$				
On-road transportation	Gasoline & Diesel (passenger vehicles)	29299522	Annual VMT	11,814
	Diesel (freight trucks)	3510693	Annual VMT	5,057
Transportation total: 16,871 $MTCO_2e$				

Solid Waste	Waste Generated	1692.99	Tons	1,900
Solid waste total: 1,900 $MTCO_2e$				
Water and wastewater	WasteWater Treatment Energy Usage	1502424.8	kWh	461
	Water Treatment Energy Usage	NE		NE
	Wastewater Treatment	10506	people	26.9
	Digester Combustion and Flaring	10269.91	scf/day	1.748
	Nitrogen Discharge	13870	Kg N/ day	29.74
Water and wastewater total: 511.94 $MTCO_2e$				
Process & Fugitive Emissions	Fugitive Emissions from Natural Gas Distribution	266368	MMBtu	492
Process & Fugitive total: 492 $MTCO_2e$				
Total community-wide emissions				**73,133 $MTCO_2e$**

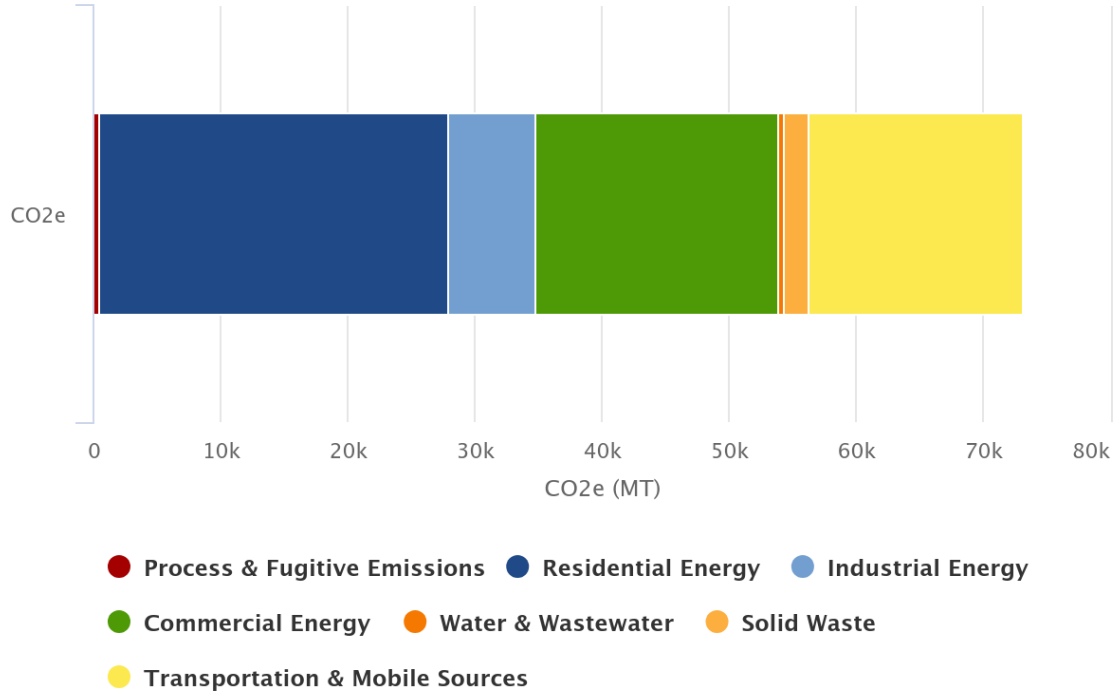


Figure 4: Community-wide Emissions by Sector

Figure 4 shows the distribution of communitywide emissions by sector. Residential Energy is the largest contributor, followed by Commercial Energy & Transportation.

Next Steps:

The inventory should be used to focus and prioritize actions to reduce emissions. Based on the inventory results, the following areas have the greatest potential for emissions reduction:

- Residential Energy
- Commercial Energy
- Transportation & Mobile Sources

Completion of another GHG inventory in two to five years is recommended in order to assess progress resulting from any actions implemented. The detailed methodology section of this report, as well as notes and attached data files in the ClearPath tool and a master data Excel file provided to the Borough of Mechanicsburg, will be helpful to complete a future inventory consistent with this one.

Conclusion

This inventory marks the completion of Milestone One of the Five ICLEI Climate Mitigation Milestones. The next steps are to forecast emissions, set an emissions-reduction target, and create a robust climate action plan that identifies specific quantified strategies that can cumulatively meet that target.

The Intergovernmental Panel on Climate Change (IPCC) states that to meet the Paris Agreement commitment of keeping warming below 1.5°C we must reduce global emissions by 50% by 2030 and reach climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. More than ever, it is imperative that countries, regions, and local governments set targets that are ambitious enough to slash carbon emissions between now and mid-century.

Science-Based Targets are calculated climate goals, in line with the latest climate science, that represent a community's fair share of the global ambition necessary to meet the Paris Agreement commitment. To achieve a science-based target, community education, involvement, and partnerships will be instrumental.

In addition, the Borough of Mechanicsburg will continue to track key energy use and emissions indicators on an on-going basis. It is recommended that communities update their inventories on a regular basis, especially as plans are implemented to ensure measurement and verification of impacts. Regular inventories also allow for "rolling averages" to provide insight into sustained changes and can help reduce the change of an anomalous year being incorrectly interpreted. This inventory shows that Residential Energy and Commercial Energy as well as communitywide transportation patterns will be particularly important to focus on. Through these efforts and others, the Borough of Mechanicsburg can achieve environmental, economic, and social benefits beyond reducing emissions.

Appendix: Methodology Details

Energy

The following tables show each activity, related data sources, and notes on data gaps.

TABLE 3: ENERGY DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Residential, commercial, and industrial electricity consumption	PPL	Data reported assumed to be for the entire 17055 and 17050 zip code area which necessitates downscaling. Wastewater treatment plant data assumed to be included in the commercial sector which then needs adjustment for double counting.
Residential, commercial, and industrial natural gas consumption	UGI Utilities	N/A
Residential Distillate Fuel and Kerosene Consumption	EIA Data – 2021, USCB	EIA data for state total usage by fuel type downscaled to Mechanicsburg using the proportions of households in Mechanicsburg using each fuel to households in the entire state. Assumes equal fuel usage across all households. Disconnect in the data: EIA separated DFO and Kerosene, USBC did not. Combined number assumes DFO emissions factor for Kerosene.
Residential Propane Consumption	EIA Data – 2021, USCB	IA data for state total usage by fuel type downscaled to Mechanicsburg using the proportions of households in Mechanicsburg using each fuel to households in the entire state. Assumes equal fuel usage across all households.

TABLE 4: EMISSIONS FACTORS FOR ELECTRICITY CONSUMPTION

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2022	729	0.0004	0.0004

Transportation

TABLE 5: TRANSPORTATION DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Vehicle miles travelled	Data acquired from Luke Arnold, Borough of Mechanicsburg Environmental Programs Coordinator	Estimated VMT within PennDOT's Roadway Management System (RMS). Accounted for other local VMT not in the PennDOT RMS database (e.g. non-state-owned roads).

For vehicle transportation, it is necessary to apply average miles per gallon and emissions factors for CH4 and N2O to each vehicle type. The factors used are shown in Table 6.

TABLE 6: MPG AND EMISSIONS FACTORS BY VEHICLE TYPE

Fuel	Vehicle type	MPG	CH_4 g/mile	N_2O g/mile
Gasoline	Passenger car	25.2	0.0078	0.0061
Gasoline	Light truck	17.9	0.0110	0.0073
Gasoline	Heavy truck	5.383557	0.0719	0.0611

Gasoline	Motorcycle	44	0.0078	0.0061
Diesel	Passenger car	25.2	0.0005	0.001
Diesel	Light truck	17.9	0.001	0.0015
Diesel	Heavy truck	6.561615	0.0051	0.0048

Wastewater

TABLE 7: WASTEWATER DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide Operations		
Nitrogen Discharge	Mechanicsburg Borough Wastewater Treatment Plant and Luke Arnold	Assumed gas composition of 65% CH4 is consistent for flaring and combustion
Digester Gas Combustion/Flaring		
Energy used in wastewater facilities		Assumed to be double counted with commercial sector reported by PPL

Potable Water

TABLE 8: POTABLE WATER DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
-	-	This data has been requested but not reported yet.

Solid Waste

TABLE 9: SOLID WASTE DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Solid Waste	Penn Waste	Used EPA default- 100% mixed MSW.

Fugitive Emissions

TABLE 10: FUGITIVE EMISSIONS DATA SOURCES

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Fugitive Emissions from Natural Gas Distribution	UGI Utilities	Assumes a 3% leakage rate, Natural gas energy density = 1028 btu/scf, natural gas density = 0.8 kg/m^3, 93.4% CH4, 1% CO2 content

Inventory Calculations

The 2022 inventory was calculated following the US Community Protocol and ICLEI's ClearPath software. As discussed in Inventory Methodology, the IPCC 6th Assessment was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO2 equivalent units. ClearPath's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factor to calculate the final CO2e emissions.