PALMER TOWNSHIP

2022 Inventory of Communitywide Greenhouse Gas Emissions

DECEMBER 4, 2023

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

ICLEI Local Governments for Sustainability

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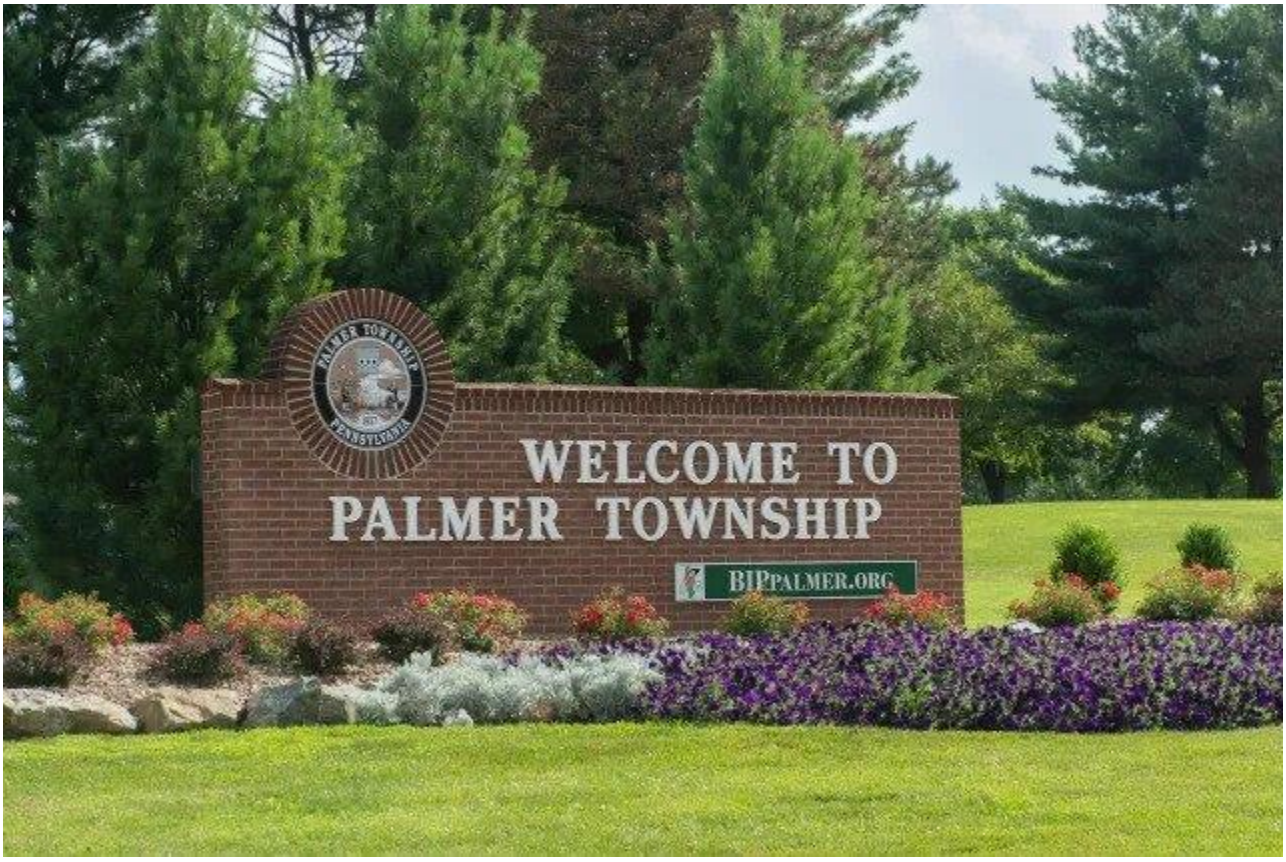

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Executive Summary

The Palmer Township Board of Supervisors, municipal government as well as Palmer's residents recognize 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.

Palmer Township has a rich history of projects designed to be conscious of environmental impacts led by the Palmer Township Environmental Steering Committee. In the past, these projects have included composting workshops, rain barrel education, hazardous waste and yard waste collection events as well as a recycling program that is over four decades old. Palmer Township has also been certified as a "Tree City" by the Arbor Day Foundation. Moving into the future, Palmer Township has developed the Master Greenway Plan to inhibit flooding of Bushkill Creek and Lehigh River.

This report provides estimates of Greenhous Gas Emissions resulting from activities in Palmer Township as a whole in 2022.

Key Findings

Figure 1 shows communitywide emissions by sector. The largest contributor is Industrial Energy with 45.2% of emissions. The next largest contributors are Transportation (21.3%) and Residential Energy (17.3%). Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Commercial Energy, Solid Waste and Water Treatment were responsible for the remaining 16.1% of emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within Palmer Township; 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.

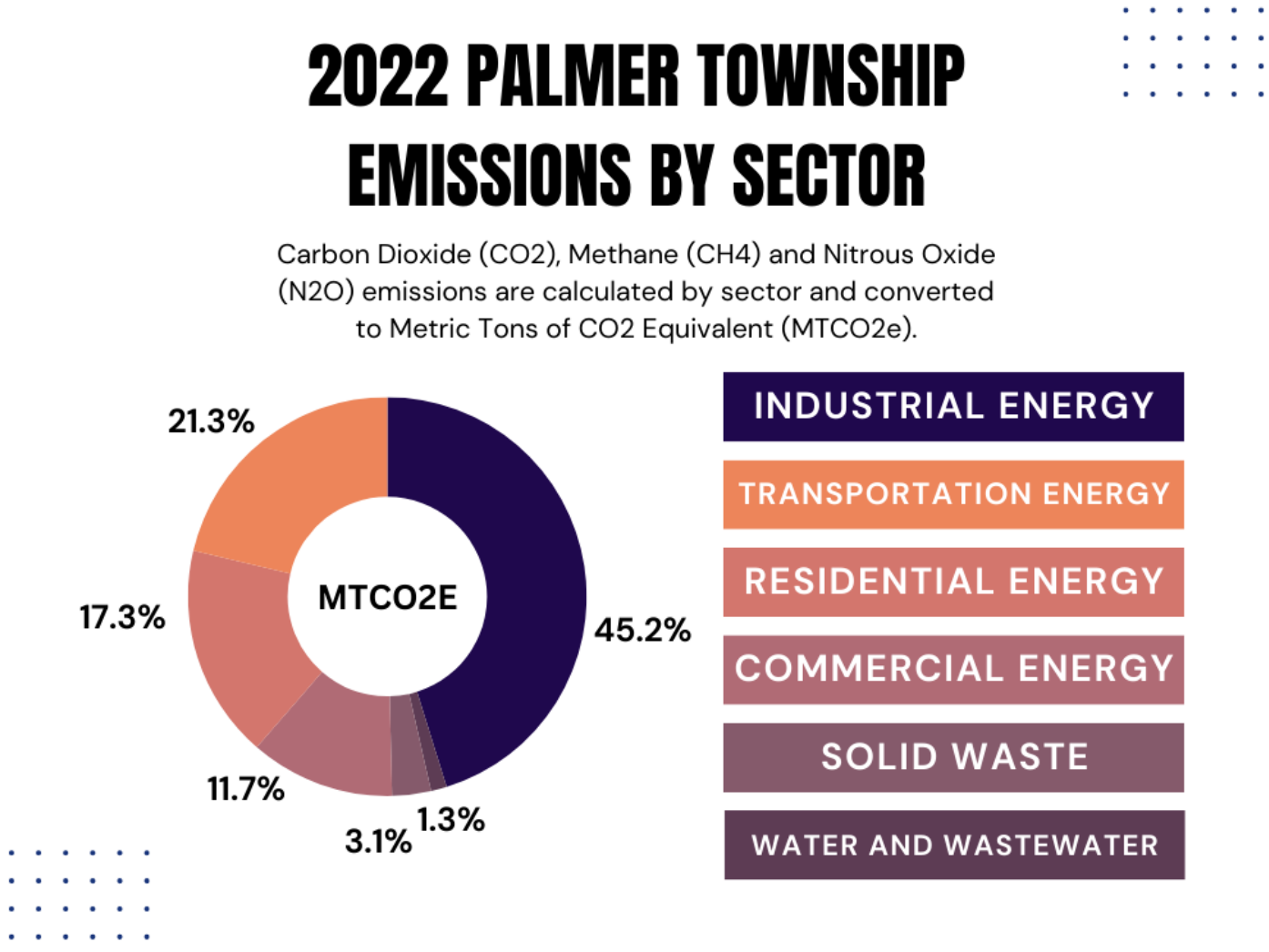


Figure 1-GHG Emissions by Sector

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 Palmer Township 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].

[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 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.

According to the 2018 Fourth National Climate Assessment, conducted by the U.S. Global Research Program in 2018, the northeast region of the country faces mounting threats from increased precipitation, flooding and storm surge. To compound matters, warming ocean temperatures exponentially increase the intensity of coastal storms.[3]
Average rainfall in the Lehigh Valley region has increased 4.6 inches over the past two decades.[4] Increases in rainfall are expected to continue with more frequent severe rainfall events expected. Flooding is currently the highest risk and costliest occurrence of regional climate change. Heat waves are also projected to increase with an average of 37 days above 90°F and 12 days above 95°F annually by 2050.[4] Heat waves jeopardize the health and wellbeing of residents as well as the stability of the existing energy infrastructure.

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 spend 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.

[3] U.S. Global Change Research Program. (2018). National Climate Assessment – Ch 18: Northeast. Retrieved from https://nca2018.globalchange.gov/chapter/19/

[4] Lehigh Valley Planning Commission. (2023). Lehigh Valley Greenhouse Gas Assessment. Retrieved from https://www.flipsnack.com/9A575F88B7A/lehigh-valley-greenhouse-gas-assessment.h

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

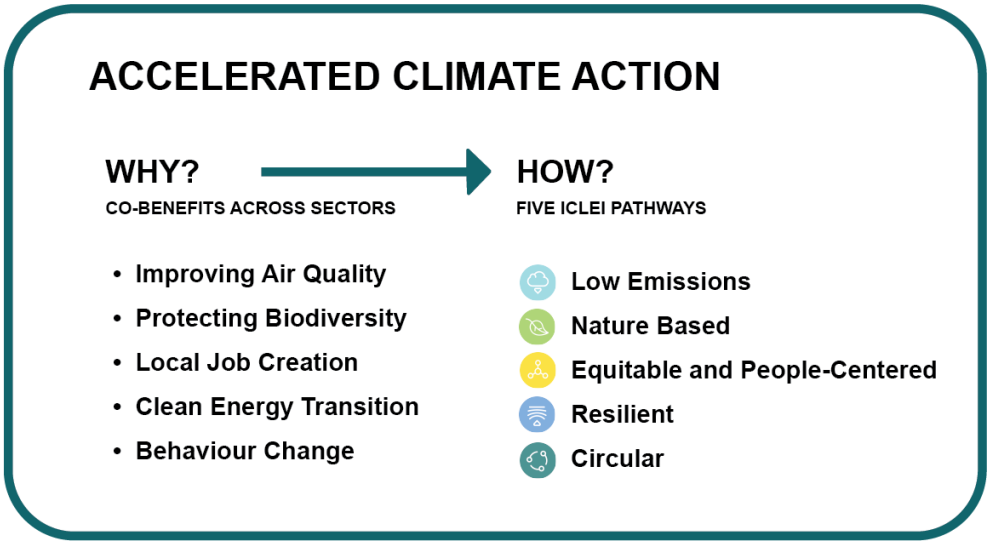
Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the impacts of climate change.

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 Palmer township to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation and other benefits of sustainable development.

To complete this inventory, Palmer Township 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, Palmer Township 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[5];
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 Palmer Township.

Figure 2-ICLEI Community Milestones

[5] 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 Palmer Township 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 3: 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, 2021)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	29.8
Nitrous Oxide (N2O)	273

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions[6] 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
- Wastewater processing

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 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.

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

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Palmer Township'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	169,183,699	kWh	41,648
	Natural Gas	619,329.21	MMBtu	33,104
	Fuel Oil, Kerosene	591,830.91	Gallons	6,128.4
	Propane	49414.58	Gallons	281.71
Residential energy total: 81,162.11 $MTCO_2e$				
Commercial energy	Electricity	89,957,715	kWh	27,692
	Natural gas	458,237.52	MMBtu	24,493
	Fuel Oil	37,759.09	MMBtu	2,833.3
Commercial energy total: 55,018.3 $MTCO_2e$				
Industrial energy	Electricity	122,831,438	kWh	37,812
	Natural gas	3,272,762.12	MMBtu	173,876
Industrial energy total: 211,688 $MTCO_2e$				
On-road transportation	Gasoline (passenger vehicles)	182,487,955	VMT	73,684
	Diesel (passenger vehicles)	391,023	VMT	563.32
	Diesel (freight trucks)	12,954,472	VMT	18,662.68
Construction	Vehicles	2655.82	$MTCO_2$	2,662.9
	Vehicles	0.088	$MTCH_4$	See above (calculated together)
Agricultural	Vehicles/Equipment	694.69	$MTCO_2$	697.18
	Vehicles/Equipment	0.0308	$MTCH_4$	See above (calculated together)
Recreational Equipment	Personal Watercraft, Snowmobiles, ATV's	131.542	$MTCO_2$	143.5
	Personal Watercraft, Snowmobiles, ATV's	0.148	$MTCH_4$	See above (calculated together)
Industrial (Not included in VMT)	Vehicles/Equipment	1778.2	$MTCO_2$	1780.7
	Vehicles/Equipment	0.031	$MTCH_4$	See above (calculated together)
Lawncare-Residential	Vehicles/Equipment	1227.92	$MTCO_2$	1303.4
	Vehicles/Equipment	0.934	$MTCH_4$	See above (calculated together)
Railroad	Vehicles/Equipment	319.75	$MTCO_2$	324.01

Transportation and Maintenance	Vehicles/Equipment	0.025	$MTCH_4$	See above (calculated together)
	Vehicles/Equipment	0.0082	N_2O	See above (calculated together)
Transportation total: 99,821.69 $MTCO_2e$				
Solid Waste	Waste Generated	7600.76	Tons	13,784
	Compost Emissions	2988.16	Tons	1,117
Solid waste total: 14,901 $MTCO_2e$				
Water and Wastewater Treatment	Wastewater Treatment Energy Usage	2,799,442	kWh	861.78
	Wastewater Digester Emissions	110,000	scf/day	5,173.8
Water and wastewater total: 6,035.58 $MTCO_2e$				
Process and Fugitive Emissions	Natural Gas	0.029	$MTCO_2$	225.82
	Natural Gas	2.93	$MTCH_4$	See above (calculated together)
Fugitive emissions total: 225.82 $MTCO_2e$				
Total community-wide emissions (not including wastewater estimation)				**471,354.58**

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

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:

- Industrial
- Transportation
- Commercial

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 Palmer Township Board of Supervisors, will be helpful to complete a future inventory consistent with this one.

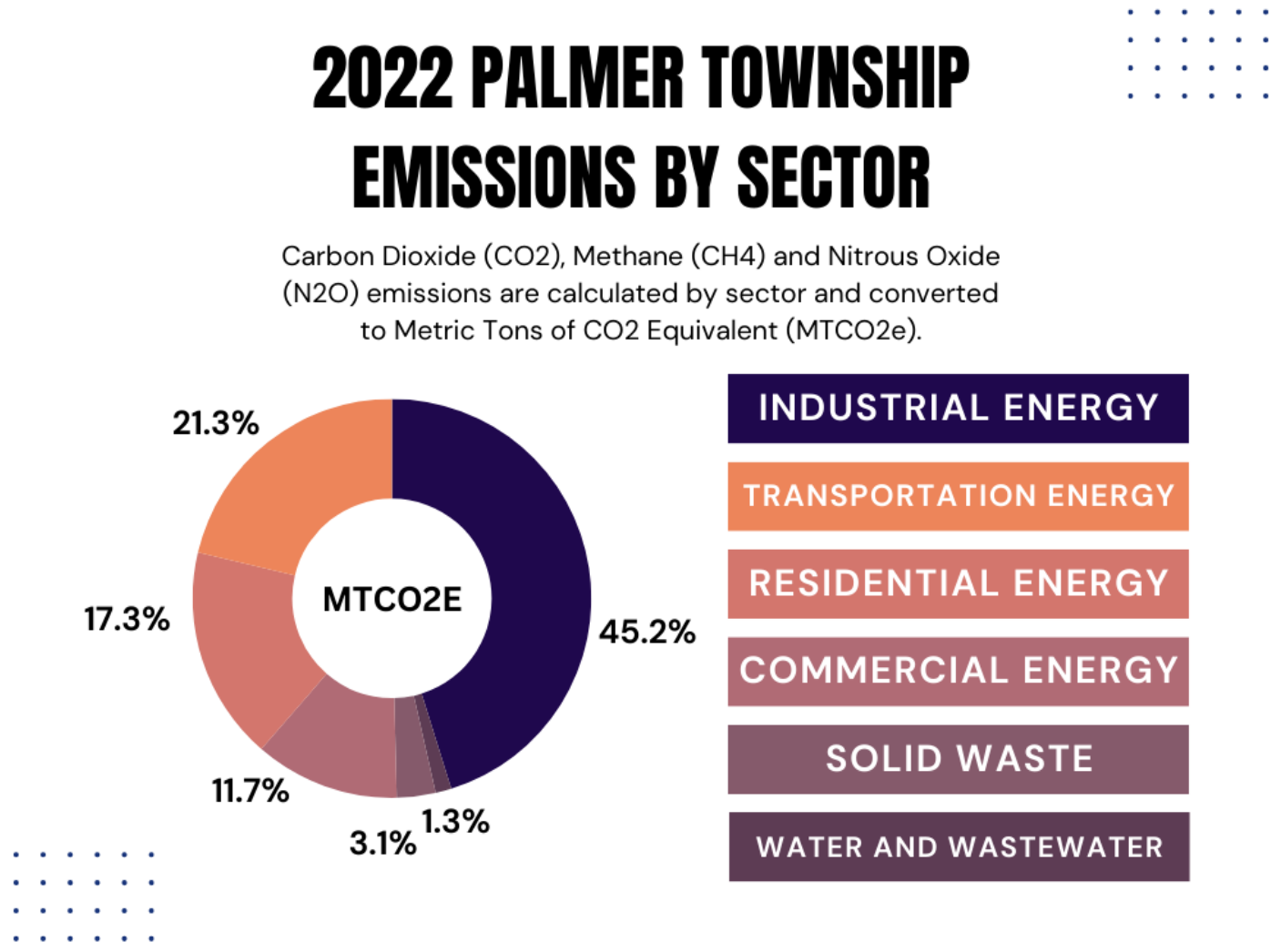


Figure 4- Communitywide Emissions by Sector

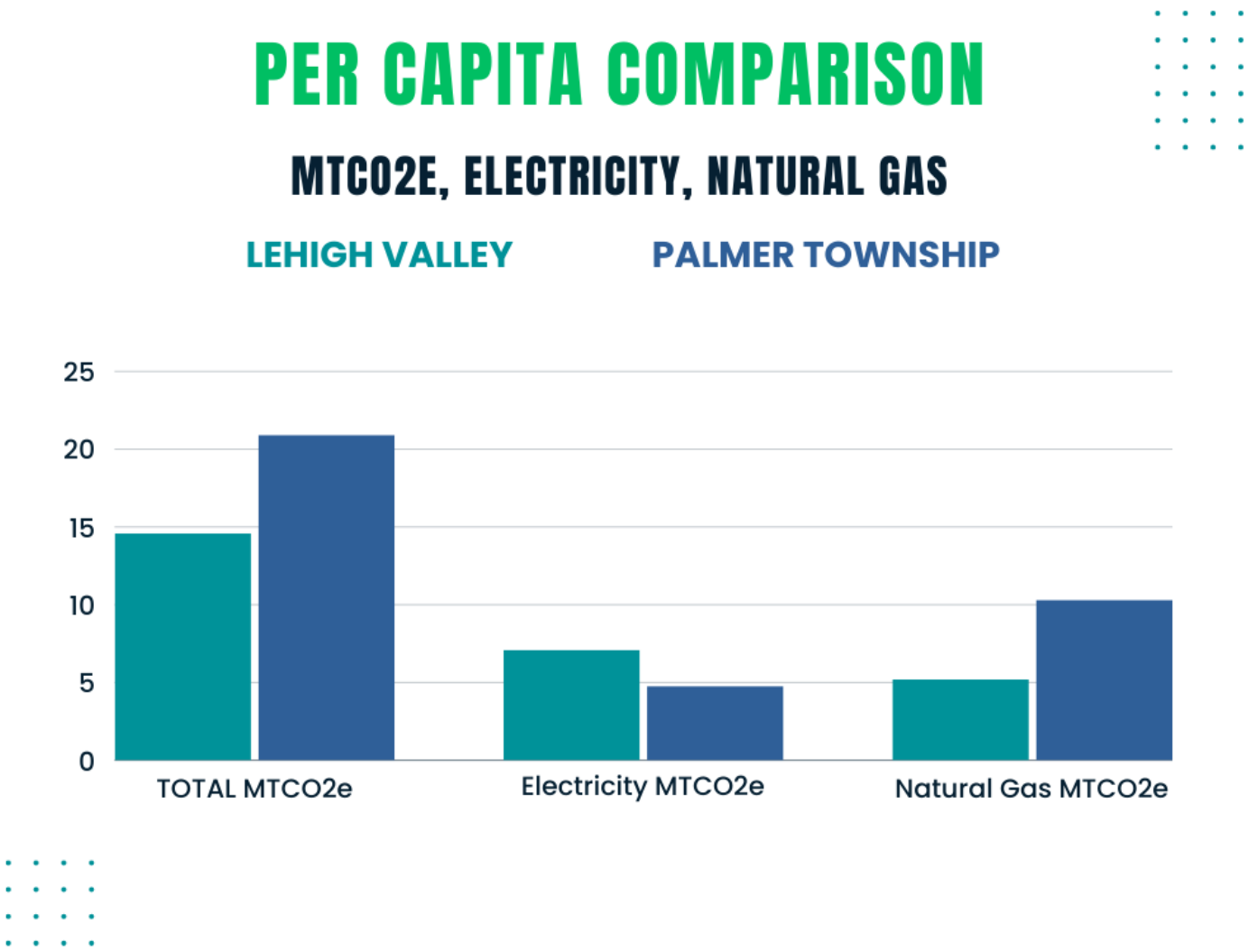


Figure 5- Per Capita Energy Emissions Comparison

PER CAPITA TRANSPORTATION COMPARISON

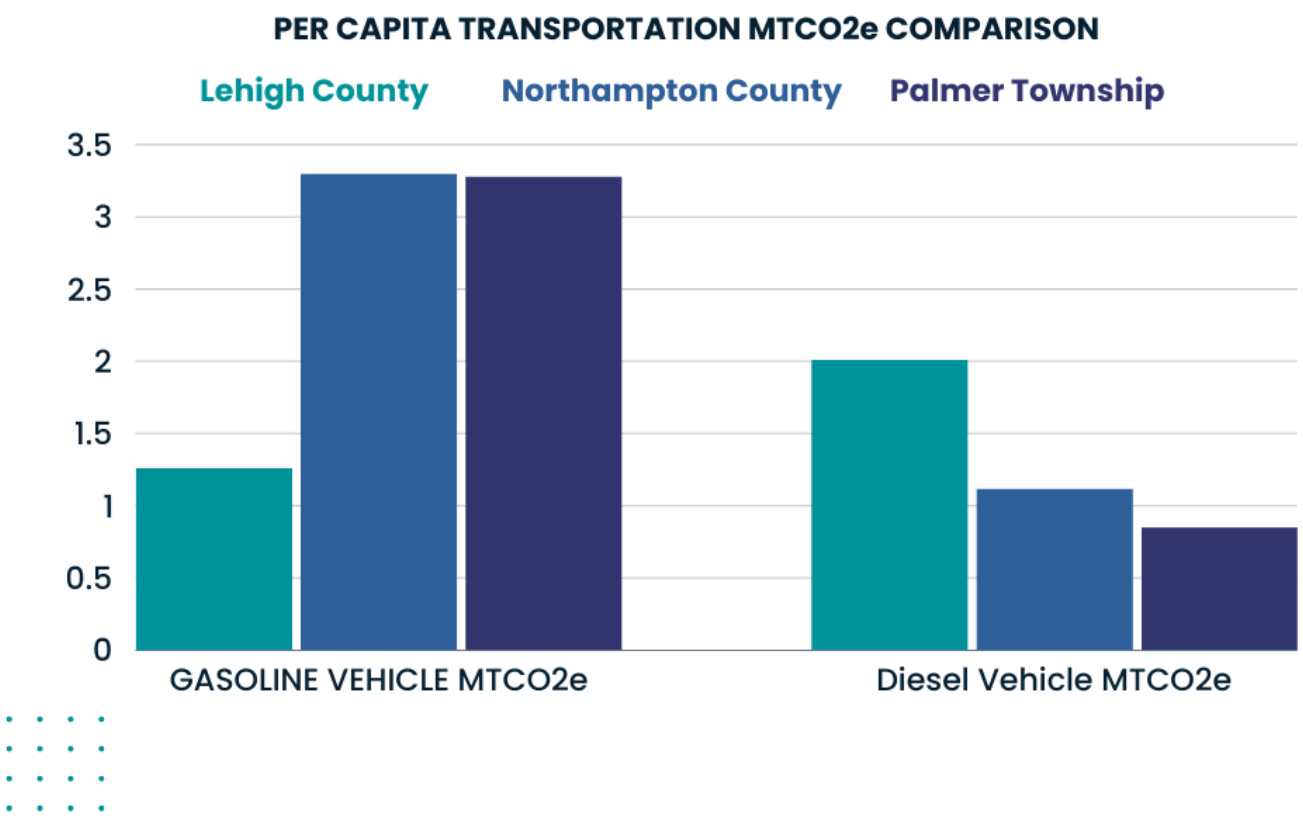


Figure 6- Per Capita Transportation Emissions Comparison

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 build upon the existing Master Greenway Plan as well as the Lehigh Valley Transportation Decarbonization Workshop with a more 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, Palmer Township 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 Transportation, Industrial, Residential and Commercial sectors as well as communitywide transportation patterns will be particularly important to focus on. Through these efforts and others, Palmer Township can achieve environmental, economic, and social benefits beyond reducing emissions.

Appendix: Methodology Details

Energy

The following tables shows 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	Met-Ed. Utility	N/A
Residential, commercial, and industrial electricity consumption	PPL Energy	N/A
Residential, commercial, and industrial natural gas consumption	UGI Utilities	N/A

Table 4: Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2021	672.8	49	7

Transportation

Table 5: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Vehicle miles travelled	Pennsylvania DOT	N/A

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	25.3	0.0084	0.0069
Gasoline	Light truck	18.2	0.0117	0.0087
Gasoline	Heavy truck	5.383557	0.0719	0.0611
Gasoline	Motorcycle	44	0.0084	0.0069
Diesel	Passenger car	25.3	0.0005	0.001
Diesel	Light truck	18.2	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	Easton Area Joint Sewer Authority	Electricity used not provided.
Digester Gas Combustion/Flaring		
Energy used in wastewater facilities	ICLEI	Electricity used at EAJSA was not provided. Data was extrapolated from Easton's own GHG Inventory and scaled to Palmer Township's population.

Solid Waste

Table 8: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
	Waste Management	N/A

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.