Allentown

Inventory of Communitywide Greenhouse Gas Emissions - 2023

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Produced by the Penn State
Local Climate Action Program
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Table of Contents

Tables and Figures

List of Tables

List of Figures

Executive Summary

Allentown 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.

Allentown's current initiatives towards sustainability include efforts to convert the city's fleet to electric vehicles and the distribution of the Youth Climate Action Fund which provides mini-grants to youth for climate change research. Additionally, Allentown has partnered with the city of Bethlehem, Pennsylvania to expand its healthy homes project which works toward lead and radon abatement. Lastly, Allentown has recently secured funding for the creation of its own Local Climate Action Plan in the future, and a replicable greenhouse gas inventory can be a critical tool in identifying high-emitting sectors in the community and determining future climate initiatives.

This report provides estimates of greenhouse gas emissions resulting from activities in Allentown as a whole in 2023.

Key Findings

Figure 1 shows communitywide emissions by sector. The largest contributor is Commercial and Industrial Energy with 36.6% of emissions. The next largest contributors are Transportation (29.9%) and Residential Energy (27.4%). Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Solid waste and Water/Wastewater were responsible for the remaining (less than 6.1%) of emissions.

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

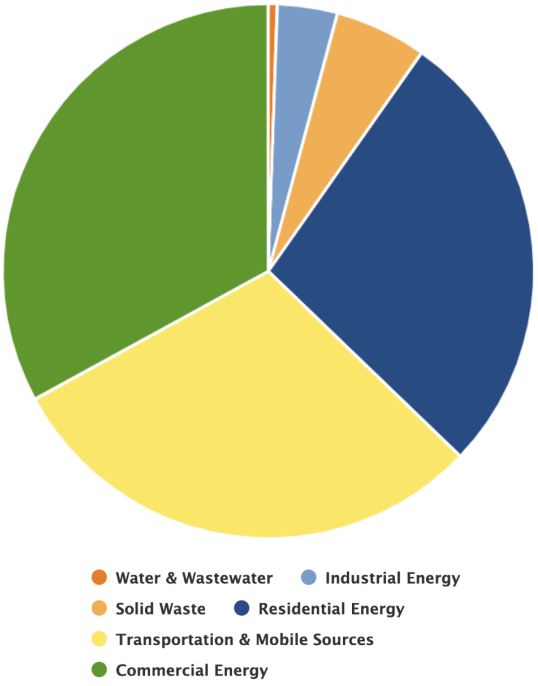


Figure 1: 2023 Emissions by Sector for Allentown

Introduction to Climate Change

Naturally occurring gases in the atmosphere trap solar radiation and influence the Earth's climate. This phenomenon is known as the **greenhouse effect**. While the greenhouse effect is a naturally occurring phenomenon that makes life on this planet possible, 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]. Communities like Allentown are already experiencing the consequences of global climate change.

Human activities are estimated to already 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

According to the 2021 Pennsylvania Climate Impacts Assessment, the annual temperature in Pennsylvania is expected to increase to 5.9 degrees Fahrenheit by 2050. Additionally, the frequency of extreme heat days (90 degrees Fahrenheit or above) is expected to reach 37 or more days per year which is an increase from the current 5 days during the baseline period. While the state gets warmer, there will also be an increase in annual rainfall, increased flood risks, and a disproportionate burden on low-income households to handle the increased environmental burdens.

Recognizing that our communities are where we first experience the impacts of climate change, addressing the causes and consequences at the local level makes sense. Communities around 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 have more money to add to the local economy. Reducing fossil fuel use improves air quality and

increasing opportunities for walking and bicycling improves residents' health.

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.

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

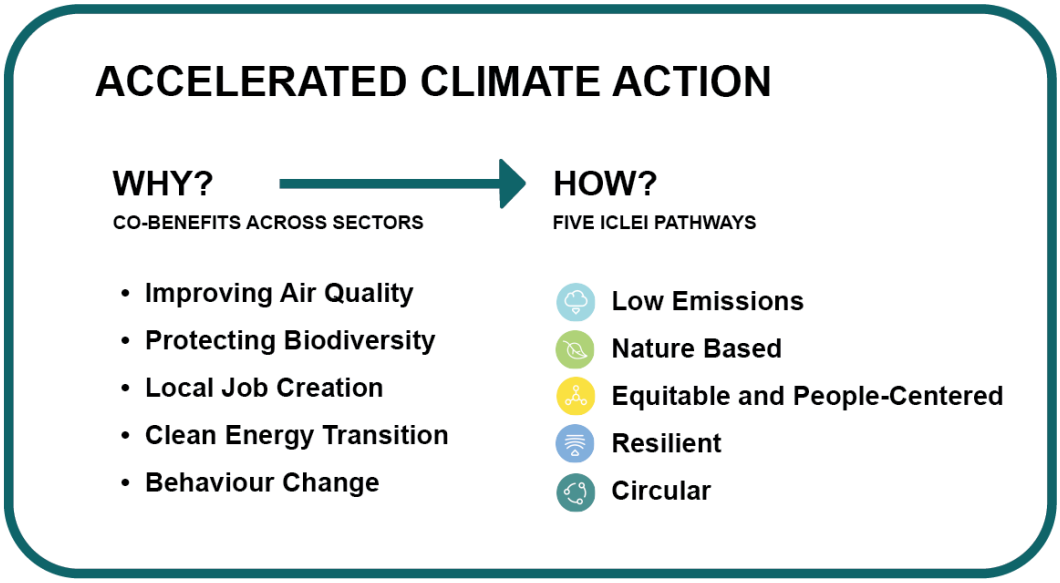
Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the impacts of climate change.

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 Allentown 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 Penn State Local Climate Action Program utilized tools and guidelines from 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, Allentown 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 GreenClimateCities Framework

For this inventory, Allentown's process is informed by ICLEI's GreenClimateCities Framework for integrated climate action. The Allentown follows the stepwise approach shown below in Figure 3, which involves collecting and analyzing climate data, action, implementation, leadership, and collaboration—always with an equity lens.

The Framework is organized into Analyze, Act, and Accelerate phases for communities pursuing integrated climate action. The Framework incorporates greenhouse gas emissions reductions, climate adaptation actions, and equitable, inclusive decision-making. Allentown's inventory has Science-Based Targets[3] and falls under Step C- Analyze and set a baseline.

Over 600 U.S. communities have followed this basic Framework, previously known as ICLEI's Five Milestones for Emissions Management, and today, it is represented through the streamlined Analyze-Act-Accelerate model shown below.

[3] 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 discusses a **communitywide inventory** for Allentown, covering emissions-generating activities for activity throughout the jurisdiction.

A **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.

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), 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. Note that the previous inventory report utilized the IPCC's Fifth Assessment 100 Year Global Warming Potentials which varied slightly - methane at 28 and nitrous oxide at 265.

Table 1: Global Warming Potential Values (IPCC, 2021)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	25
Nitrous Oxide (N2O)	298

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions[4] 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 within the community boundary, and 2) GHG emissions produced as a consequence of community "activities".

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

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. Allentown's community greenhouse gas emissions inventory utilizes 2023 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.

Inventory Results

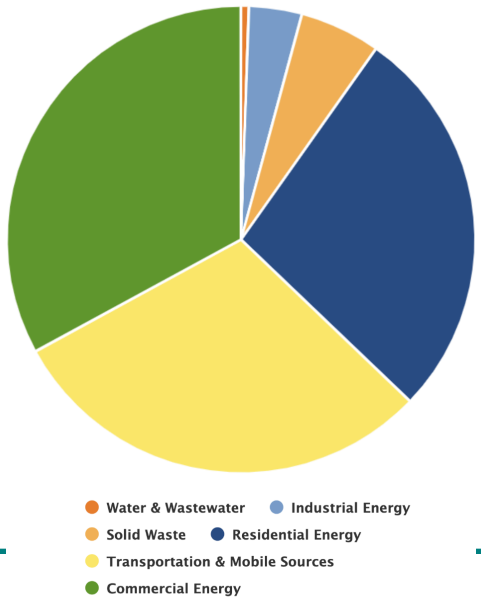
The total communitywide emissions for the 2023 inventory are shown in Table 2 and Figure 5.

Table 2: Communitywide Emissions Inventory

Sector	Fuel or source	2023 Usage	Usage unit	2023 Emissions ($MTCO_2e$)
Residential energy	Electricity (PPL)	523,016,102	kWh	155,476
	Natural Gas	1,404,000	MMBtu	74,669
	Distillate Fuel Oil	716,112	MMBtu	53,317
	HGL	38258	MMBtu	2,374
	Kerosene	9146	MMBtu	692
	Wood fuel	7289	MMBtu	71
Residential energy total				**286,599**
Commercial energy	Electricity	579,451,229	kWh	172,252
	Natural gas	2,925,231	MMBtu	155,573
	Distillate Fuel Oil	165,133	MMBtu	12,295
	HGL	71,528	MMBtu	4,439
	Kerosene	1766	MMBtu	134
Commercial energy total				**344,693**
Industrial energy	Electricity	128,783,180	kWh	38,283
Industrial energy total				**38,283**

On-road transportation	Gasoline (passenger vehicles)	465690537.24	VMT	181583
	Diesel (passenger vehicles)	Not available		
	Diesel (freight trucks)	55639731.76	VMT	72761
Transit	Unknown	2.365977	Metric Tons	2.365977
Aviation	Jet A (Jet Kerosene)	Not available		
	Aviation Gasoline	Not available		
Off-Road	Diesel	452081.734	MMBtu	33454
	Gasoline	220193.070	MMBtu	15807
	LPG	94505.71	MMBtu	5820
	CNG	9861.557	MMBtu	613
Waterborne	Diesel	711.219	MMBtu	52.584
	Gasoline	3160.758	MMBtu	222.01
Rail	Diesel	31761.672	MMBtu	2370
Transportation total				**312,691**
Solid Waste	Waste Generated	134,249	Tons	55,105
Solid waste total				**55,105**
Water and wastewater	Water Treatment Energy Usage	10,229,490	kWh	3,614
	Nitrogen Discharge	2,363	kg N / day	1,850
	Process Nitrogen Emissions from Wastewater Treatment	124,880	People	240
Water and wastewater total				**5,704**
Total community-wide emissions				**1,043,074**

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



Conclusion

Congratulations! This inventory marks the completion of Milestone One of the Five ICLEI Climate Mitigation Milestones. Allentown is taking important and necessary steps to reduce climate changing emissions and build a more resilient community. Keep the momentum moving! Whether this inventory marks the very first attempts at climate action in your community or is a continuation of ongoing efforts, we have more work to do.

Next Steps:

1. **Use the findings of this inventory to focus and prioritize actions to reduce emissions**. Based on the inventory results, the following areas have the greatest potential for emissions reduction:
    i. Commercial & Industrial Energy
    ii. Transportation & Mobile Sources
    iii. Residential Energy

2. **Utilize the data in this inventory for informing the shape of a future climate action plan.**
    a. Forecast emissions, consider setting a target, and work toward the development of a robust climate action plan that identifies specific quantifiable strategies to reduce emissions and meet any targets it sets.

3. **Repeat another GHG inventory in two to five years 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 provided to Allentown, will be helpful to complete a future inventory consistent with this one.

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 global 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.

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 Commercial & Industrial Energy, Transportation, and Residential Energy will be particularly important to focus on. Through these efforts and others, Allentown 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	Utility provided kWh per zipcode, each zipcode that covered a part of Allentown was downscaled according to its population in Allentown / total pop in zipcode. **Note:** Electricity used for wastewater treatment was included in Commercial Electricity.
Residential, commercial, and industrial natural gas consumption	NREL's SLOPE Tool	Used SLOPE's projected values for "Business as Usual" in Allentown. **Data gap**: Could not find data estimating/projecting industrial natural gas usage.
Residential & Commercial Non-utility Fuel Consumption: Distillate Fuel Oil, HGL, Kerosene, Wood Fuel	EIA	Used EIA's Residential/Commercial Non-Utility Fuel Estimates for PA, downscaled to Allentown's population.

Table 4: Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2023 (proxy from 2022)	652.5	45	6

Transportation

Table 5: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Vehicle miles traveled	Google EIE	VMT represents 100% of all in-boundary transportation and 50% trans-boundary. **Data gap:** MPG nor emissions factors per mile not reviewed.
Transit ridership	Not reviewed	

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	Not available	Not available	Not available
Gasoline	Light truck	Not available	Not available	Not available
Gasoline	Heavy truck	Not available	Not available	Not available
Gasoline	Motorcycle	Not available	Not available	Not available
Diesel	Passenger car	Not available	Not available	Not available
Diesel	Light truck	Not available	Not available	Not available
Diesel	Heavy truck	Not available	Not available	Not available

Wastewater

Table 7: Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide Operations		

Nitrogen Discharge	LCA's Interim Final Report (2016), Table 1	**Data gap/assumption:** Used the Revised Grandfathered Total N loads per day from 2016 report, unable to find more recent data
Digester Gas Combustion/Flaring		

Potable Water

Table 8: Potable Water Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Potable Water Treatment Electricity & Natural Gas	LCA's Allentown Energy Report - Dec 2023	Used the LCA's daily energy usage (kWh) and natural gas usage (c.c.f.) for month of December, multiplied by 12 to estimate yearly usage

Solid Waste

Table 9: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Residential & Commercial Waste	PA Dept of Environmental Protection's 2022 Waste Characterization Study for Southeastern PA, U.S. Census	Used PA Dept of Environmental Protection's 2022 Waste Characterization Study for Southeastern PA for annual tonnage per person, multiplied by commercial and residential establishment data for Allentown city (U.S. Census)

Inventory Calculations

The 2023 inventory was calculated following the US Community Protocol and ICLEI's ClearPath software. As discussed in Inventory Methodology, the IPCC Sixth 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.