ClimateNav | CITY OF BLOOMINGTON

City of Bloomington, IN

2024 Community-Wide and Municipal Operations Greenhouse Gas Inventory

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Letter from the Assistant Director of Sustainability

I am proud to share the City of Bloomington's 2024 Community-Wide and Municipal Operations Greenhouse Gas Inventory Report.

This marks our second year completing the inventory in partnership with ClimateNav, a public-benefit startup that works with local governments to confront climate change and advance sustainability at the community level. As in prior years, these inventories adhere to internationally recognized standards, including the *Global Protocol for Community-Scale Emissions*, ensuring the highest level of rigor and consistency in measuring our carbon footprint.

A comprehensive greenhouse gas inventory is an essential tool for any city serious about addressing climate change. It enables us to pinpoint where emissions originate across our community, evaluate how local, state, and federal policies are shaping those trends, and direct resources where they can have the greatest impact. These data-driven insights strengthen our ability to secure competitive grant funding and to craft focused strategies that move the needle on local sustainability goals.

Bloomington has long been a vanguard for climate action and local sustainability work, and this report reflects that continued leadership. For the second consecutive year, we have paired a Municipal Operations Inventory with our Community-Wide Inventory, reinforcing our commitment to transparency and accountability for the City's own emissions. We have also continued to maintain and expand our Climate Action Dashboard at https://bloomington.climatenavhub.com, which has seen remarkable engagement — thousands of constituents have visited the platform to explore emissions data and learn about Bloomington's climate initiatives.

With a proven annual reporting process now in place for both the community-wide and municipal inventories, Bloomington remains among a distinguished group of cities nationwide leading the way on local climate accountability.

I invite every member of our community to explore this report and to participate in the work ahead. Together, we can build a more sustainable and resilient Bloomington for generations to come.

Shawn Miya
Assistant Director of Sustainability
City of Bloomington, Indiana

Introduction

An overview of the GHG inventory process and the relevant protocols and methodologies used in this report.

Background

Local governments are emerging as critical players in the global fight against climate change. Greenhouse gas inventories serve as their most powerful data-driven tool for understanding emission sources and charting a path toward net-zero emissions for the entire community.

Climate Change: A Global Challenge with Local Impacts

Climate change, driven primarily by human activities that release greenhouse gases (GHGs) into the atmosphere, represents one of the most pressing challenges facing the world today. As global temperatures rise, communities worldwide are experiencing more frequent and severe weather events, shifting precipitation patterns, rising sea levels, and disruptions to local ecosystems. These changes have far-reaching consequences for public health, economic stability, and social equity.

In Bloomington, as in many cities across the United States, the effects of climate change are already being felt. Increased flooding risks, more intense heat waves, and changes in local biodiversity are just a few examples of how global climate shifts are manifesting at the local level. Understanding and addressing these impacts is crucial for ensuring the long-term resilience and prosperity of the City.

The Rising Role of Local Governments in Climate Action

While climate change is a global issue, local governments are increasingly recognized as key players in both efforts to mitigate existing emissions and adapt to the changing climate. Cities and towns are often on the front lines of climate impacts and are uniquely positioned to implement targeted solutions that address their community's specific vulnerabilities and mitigation opportunities.

Local governments can influence a significant portion of a community's greenhouse gas emissions through policies and programs related to land use, transportation, building codes, and waste management. They also have the ability to lead by example, implementing sustainable practices in their own operations and inspiring action from residents and businesses.

Moreover, local governments are often more agile than larger governmental bodies, allowing them to experiment with innovative approaches and respond quickly to emerging challenges. By taking decisive action on climate change, cities like Bloomington can not only contribute to global efforts but also create more livable, sustainable, and economically vibrant communities for their residents.

Greenhouse Gas Inventories: A Foundation for Climate Action

A greenhouse gas (GHG) inventory is a comprehensive accounting of the GHG emissions produced by a specific entity—in this case, the City of Bloomington—over a given period. The inventory serves as a crucial tool for understanding a city's contribution to climate change and identifying opportunities for emission reductions.

By quantifying emissions from various sectors such as building energy, transportation, and waste management, a GHG inventory provides a baseline against which future progress can be measured. This data-driven approach enables city leaders to:

1. Set informed and achievable emission reduction targets
2. Develop targeted climate action plans and policies
3. Prioritize investments in low-carbon infrastructure and programs
4. Track progress over time and adjust strategies as needed
5. Engage stakeholders with clear, quantifiable information

For Bloomington, this inventory represents a commitment to transparency and actionable climate leadership. It provides a foundation for evidence-based decision-making and helps ensure that the city's climate efforts are focused on the areas of greatest impact.

Two Complementary Approaches to Inventorying Local Emissions

This report encompasses two distinct but related GHG inventories: a community-wide inventory and a municipal operations inventory. Each provides valuable insights into different aspects of Bloomington's emissions profile.

Community-Wide Inventory

The community-wide inventory, conducted according to the *Global Protocol for Community-Scale (GPC) Emissions*, offers a comprehensive view of all GHG emissions within the City's geographic boundaries. This includes emissions from residential and commercial energy use, transportation, industrial processes, and waste management. By capturing the full scope of emissions associated with city-wide activities, this inventory helps identify broad trends and opportunities for community-wide climate action.

Municipal Operations Inventory

The municipal operations inventory, following ICLEI's *Local Government Operations (LGO) Protocol*, focuses specifically on emissions from the City of Bloomington's own governmental activities. This includes emissions from City-owned buildings, vehicle fleets, streetlights, water treatment facilities, and other municipal operations. While typically a smaller portion of a city's overall emissions, this inventory is crucial for demonstrating leadership and identifying opportunities for the local government to "walk the talk" on climate action.

Together, these two inventories provide a comprehensive picture of Bloomington's GHG emissions, enabling the City to develop holistic strategies that address both community-wide and government-specific emission sources. By undertaking both inventories, Bloomington demonstrates its commitment to thorough and transparent climate action planning.

In the following sections, the specific methodologies, findings, and implications of both the 2024 community-wide and municipal operations inventories are discussed in detail.

About the City

Incorporated Name
City of Bloomington

County of Incorporation
Monroe County, IN

Year of Incorporation
1818

Population
79,986

Land Area
23.43 mi^2

A Brief History

Established in 1818, Bloomington has a rich history that spans over two centuries. Originally settled by pioneers from Kentucky, Tennessee, the Carolinas, and Virginia, the City was named for its abundance of blooming wildflowers. Over time, Bloomington evolved from a frontier settlement reliant on farming, limestone quarrying, and furniture manufacturing to become a vibrant, progressive community known for its cultural diversity, educational institutions, and commitment to sustainability.

Today, Bloomington is home to Indiana University, founded in 1820, which has played a significant role in shaping the City's character. The presence of the University has contributed to Bloomington's reputation as a center for education, research, and innovation, attracting a diverse population and fostering a culture of intellectual curiosity and civic engagement.

A Leader in Local Climate Action

Bloomington has emerged as a leader in municipal climate action, demonstrating a commitment to addressing global environmental challenges at the local level. In April 2021, the Bloomington City Council unanimously passed Resolution 21-08, formally adopting the City of Bloomington Climate Action Plan (CAP).

This comprehensive plan set ambitious targets for reducing greenhouse gas emissions within the community:

- Aiming for a 25% reduction below 2018 levels by 2030
- Setting a target for carbon neutrality by 2050

What sets Bloomington apart is not just the adoption of these goals, but the City's dedication to regular assessment and transparency to help meet them. Unlike many municipalities that conduct greenhouse gas inventories every few years, Bloomington has committed to annual inventories. This frequent data collection and analysis allows for more responsive policy-making and demonstrates the City's serious approach to climate action.

Funding the Local Climate Transition

Bloomington's commitment to climate action is further evidenced by its innovative approach to funding sustainability initiatives. The City has established a dedicated budget for climate action, funded by a portion of the Economic Development Local Income Tax (ED-LIT). This allocated funding stream of $1.6 million annually is a rarity among U.S. cities and positions Bloomington as a pioneer in sustainable urban development.

The Economic and Sustainable Development (ESD) Department is responsible for spearheading the City's climate initiatives and managing sustainability-related programs. ESD's staff and a small number of programs are funded by the General Fund, while the majority of the City's high-impact sustainability programs are funded by the aforementioned climate action budget.

The City also pursues state, federal, and nonprofit funding opportunities for climate action implementation. Since 2023, the City has been awarded $1,023,914.59 in grants, rebates, and federal direct pay reimbursements for energy audits, energy efficiency, renewable energy, electric vehicle (EV) and EV charging station investments.

Engaging the Community

Bloomington recognizes that effective climate action requires community-wide engagement and transparency. To this end, the City has developed a comprehensive Climate Action Dashboard, accessible at bloomington.climatenavhub.com. This interactive tool allows residents, businesses, and other stakeholders to:

- Explore the details of the Climate Action Plan
- Track the City's progress towards its emissions reduction goals
- Learn about current sustainability initiatives
- Find ways to get involved in local climate action programs
- Learn about how to reduce your individual carbon footprint and identify relevant financial rebates and incentives

The Dashboard has already been updated to include the emissions data presented in this inventory report. Residents are encouraged to visit the Dashboard to explore an interactive version of the inventory and learn about Bloomington's different sustainability initiatives. Additionally, the Dashboard provides an extensive list of actions that individual residents can take to reduce their own carbon footprints, along with funding and educational resources to help guide action.

Inventory Methodology

Community-Wide Inventory Protocol
Global Protocol for Community-Scale Greenhouse Gas Inventories (v1.1)

Community-Wide Reporting Level
BASIC+

Municipal Operations Inventory Protocol
Local Government Operations Protocol (v1.1)

Inventory Boundaries
Official Municipal Boundaries

Reporting Year
2024

Community-Wide Inventory Methodology

Bloomington's community-wide GHG inventory adheres to the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)*. Developed by ICLEI - Local Governments for Sustainability, the World Resources Institute, and C40 Cities Climate Leadership Group, the GPC is the most widely used international accounting and reporting standard for cities.

Key Features of the GPC Protocol

1. **Comprehensive Scope:** The GPC requires cities to account for emissions from key sectors within their geographical boundaries, including:
    - Stationary Energy (i.e., energy used to power buildings, fixed infrastructure, and other parts of the City's built environment)
    - Transportation
    - Waste
    - Industrial Processes and Product Use (IPPU)
    - Agriculture, Forestry, and Other Land Use (AFOLU)

2. **Emissions Scopes:** The GPC categorizes emissions into three scopes:
    - Scope 1: Direct emissions from sources within the city boundary
    - Scope 2: Indirect emissions from grid-supplied electricity, heat, steam, and cooling consumed within the city boundary
    - Scope 3: Other indirect emissions that occur outside the city boundary as a result of activities taking place within the city boundary

3. **Flexible Reporting Levels:** The GPC offers two reporting levels:
    - BASIC: Covers scope 1 and scope 2 emissions from stationary energy and transportation, as well as scope 1 and scope 3 emissions from waste.
    - BASIC+: Includes BASIC sources plus more complex scope 1 and scope 3 emissions.

4. **Standardized Reporting:** The GPC provides a standardized format for reporting emissions, facilitating comparison between cities and tracking progress over time.

By following the GPC, Bloomington ensures that its community-wide inventory is comprehensive, internationally recognized, and comparable with analyses conducted in other cities worldwide.

Municipal Operations Inventory Methodology

For its municipal operations inventory, Bloomington utilizes the *Local Government Operations (LGO) Protocol*. This protocol, developed by ICLEI - Local Governments for Sustainability USA, provides a standardized approach for local governments to quantify and report GHG emissions resulting from their operations.

Key Features of the LGO Protocol

1. **Focus on Government Control:** The LGO Protocol specifically addresses emissions from sources that local governments own or control, such as:
    - Buildings and other facilities
    - Streetlights and traffic signals
    - Vehicle fleet
    - Water delivery and treatment facilities
    - Wastewater treatment plants
    - Solid waste operations
    - Urban forestry

2. **Operational and Financial Control Approaches:** The protocol allows for reporting based on either operational control (activities the government operates) or financial control (activities the government funds).

3. **Detailed Guidance:** The LGO Protocol provides specific methodologies for calculating emissions from various municipal activities, ensuring consistency and accuracy.

4. **Integration with Community-Wide Inventories:** While focused on government operations, the LGO Protocol is designed to be compatible with community-wide inventories, allowing cities to understand how their operations contribute to overall community emissions.

5. **Policy Relevance:** By isolating government operations, the LGO Protocol helps cities identify opportunities for emissions reductions in their own activities, supporting lead-by-example initiatives.

How the Inventory Data Was Collected

The data collection process for the greenhouse gas inventory was designed to be comprehensive, methodical, and tailored to the City's specific context. The process began by identifying all required and recommended emissions sources using the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)* for the community-wide inventory and the *Local Government Operations (LGO) Protocol* for the municipal operations inventory. For each emissions source, the most appropriate in-boundary data provider was determined, such as the local electric utility for grid-supplied electricity data or municipal waste management services provider for waste data.

A crucial step in the process was building strong relationships with key personnel within these organizations, primarily engaging with their sustainability, procurement, and data analytics teams. These relationships were instrumental in facilitating pulling the requisite data for the inventories, as well as understanding the different assumptions and constraints associated with each organization's provided datasets.

However, limitations with data providers' ability to query and transform the data exactly as required by the inventory protocols is a common occurrence. ClimateNav worked with each data provider to obtain the highest quality data possible within the data providers' system constraints and carefully documented the parameters used in internal queries to ensure replicability in future years. Where exact data wasn't available, a proxy was identified to use as an alternative data source instead. In cases where a suitable proxy couldn't be identified, this was clearly notated in the inventory, with a detailed explanation for why the data was unavailable.

The ClimateNav Approach

ClimateNav is a public-benefit startup committed to tackling climate change and improving sustainability within local communities. Founded in 2020 by former public servants, the ClimateNav Team has direct experience working in and with local government and deeply understands the challenges and constraints faced by them. Our mission is to build tools and technology to help local governments and public agencies reduce their emissions and create more sustainable communities in a data-driven and equitable way.

We've spoken with hundreds of municipal leaders over the years, and we've seen firsthand many of the challenges faced by local government staff trying to utilize and update local greenhouse gas inventories. To this end, we've developed a unique approach to provide a more cost-effective and useful way to approach the GHG inventory process. We detail this approach and its benefits below.

Ensuring Consistency and Actionability

While standardized protocols like the GPC and LGO provide a framework for compiling greenhouse gas inventories, the field of emissions accounting still faces significant challenges in achieving true year-over-year comparability. ClimateNav addresses these challenges through an innovative, three-pronged approach that sets a new standard for consistency, accuracy, and policy relevance in conducting GHG inventories.

A persistent issue in the field of GHG accounting is the lack of consistency between inventories, even when they follow the same protocols. Different consultants often employ varying technical approaches to estimate emissions within each sector, leading to discrepancies that can obscure real trends in emissions data. This inconsistency can make it difficult for cities to accurately track their progress and make informed policy decisions.

To address these challenges and provide Bloomington with a truly robust and actionable inventory, ClimateNav has implemented a three-fold approach:

1. **Back-Casting for Consistency:** ClimateNav doesn't just start with the current year's data. Instead, we apply our specific technical approach to estimating emissions retroactively to prior inventory years. This back-casting ensures that all numbers, regardless of the year, are calculated using the same methodology. The result is a dataset that allows for genuine year-over-year comparisons, revealing true trends in a city's emissions profile.

2. **Streamlined Annual Process:** Recognizing the importance of regular, consistent data collection, ClimateNav has developed proprietary technology that streamlines the inventory calculation process. This system is designed to be repeatable on an annual basis, allowing Bloomington to maintain its commitment to yearly inventories without an overwhelming administrative burden.

Moreover, ClimateNav works to build deep relationships with data providers, integrating as closely as possible with their systems. This approach not only ensures data consistency but also improves the efficiency and accuracy of data collection over time.

3. **Transparent Documentation:** ClimateNav places a strong emphasis on documenting every technical detail of the inventory process. This level of transparency serves two crucial purposes:
   - It allows the City of Bloomington and other interested stakeholders to fully understand the methodology behind their inventory, fostering trust in the results.
   - It enables the City or other consultants to replicate the analysis in the future, ensuring continuity even if there are changes in who conducts the inventory or the underlying data provider's own staff.

A Pragmatic Approach to Data Gaps

Another significant challenge in constructing GHG inventories is dealing with missing or incomplete data. ClimateNav addresses this issue with a pragmatic approach focused on maximizing the policy relevance of the final report.

When exact data is unavailable, we carefully select proxies that align with the City's policy needs and control. For instance, in the case of Bloomington's municipal fleet, detailed per-vehicle mileage data was not available. Instead of relying on broad estimates that might not reflect the City's actual operations and could not realistically capture changes in emissions year-over-year, ClimateNav utilized the aggregate amount of fuel — both gasoline and diesel — combusted across all vehicles in the fleet. The municipal fleet department tracks fuel purchasing data, providing a consistent and reliable proxy for estimating fleet emissions.

By focusing on choosing a proxy metric grounded in actual operational data that the City already tracks, the inventory becomes a practical tool for policy-making rather than just a compliance exercise founded on inaccurate estimations and assumptions. Pragmatic decisions like this were made throughout the inventory process, allowing Bloomington to set targeted and actionable goals and measure progress on them using the annual inventory report.

Independent Review Process

The greenhouse gas inventory presented in this report underwent a comprehensive independent review conducted by Dr. Valère Lambert, Principal Investigator at the University of California, Santa Cruz. This third-party verification process strengthened the reliability and credibility of the inventory findings and consisted of a detailed evaluation of the methodological framework used to construct the inventory.

The review encompassed an analysis of the appropriateness of emissions factors and calculation methodologies, a scrutiny of key assumptions underpinning the inventory estimates, an examination of how graphs and data visualizations were constructed, and other technical aspects of the report's development. This independent assessment provides an additional layer of confidence in the rigor and integrity of the inventory process.

Community-Wide Inventory

A comprehensive inventory of greenhouse gas emissions generated by all activities taking place within the City's geographic boundaries.

Overview

Introduction

A community-wide greenhouse gas (GHG) inventory is a comprehensive accounting of GHG emissions produced within a defined geographic boundary over a specified time period. For the City of Bloomington, this inventory encompasses all GHG emissions occurring within the city limits during the 2024 calendar year.

There are several motivators for why a local government conducts a community-wide greenhouse gas inventory:

- They establish a baseline understanding of emission sources and quantities.
- They enable tracking of emissions trends over time.
- They inform the development of targeted climate action plans and policies.
- They allow for benchmarking and comparison with other communities.

Inventory Methodology

This inventory was completed using the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)*, which is the most widely used international accounting and reporting standard for cities. The GPC provides a robust, transparent and globally-accepted framework for consistently identifying, calculating and reporting city-wide GHG emissions.

Emissions Scopes and Reporting Levels

The GPC categorizes emissions into three "scopes":

SCOPE 1

Direct emissions from sources within the city boundary (e.g., fuel combustion in buildings, vehicles)

Example: Emissions from natural gas combustion in homes

SCOPE 2

Indirect emissions from grid-supplied electricity, heat, steam and cooling consumed within the city boundary

Example: Emissions from electricity produced at a coal-fired power plant outside of the City's boundaries but used within the City to power homes

SCOPE 3

All other indirect emissions that occur outside the city boundary as a result of activities taking place within the city

Example: Emissions from the disposal of waste generated inside of the City but landfilled elsewhere

The GPC offers two levels of reporting: BASIC and BASIC+. This inventory was conducted at the more comprehensive BASIC+ level, aiming to include as many emission sources as possible for a complete picture of Bloomington's carbon footprint.

Prior GHG Inventories

The City of Bloomington has commissioned a number of greenhouse gas inventories prior to 2024 as well. Prior to this report, the most recently conducted GHG inventory was based on calendar years 2019–2023 and can be found on the City's website. Before that, a 2018 GHG inventory was also conducted and is available.

A Word of Caution When Comparing With Prior Inventories

While these prior reports provide valuable insights into the City's emissions at a specific point in time, it is important to exercise caution when comparing data between different inventories.

Different consultants often use varying methodologies when calculating GHG inventories, which can make year-over-year comparisons challenging. Even when the same consultant is conducting the analysis across multiple years, discrepancies can arise due to differences in how data providers generate and deliver information. For example, internal data query processes within a utility or government agency may change, resulting in variances in the numbers reported from one year to the next, even if the emissions activities themselves haven't shifted significantly.

To address this issue, ClimateNav has taken a more comprehensive and innovative approach in compiling Bloomington's 2024 GHG inventory. In addition to calculating emissions for 2024, ClimateNav requested data for prior years wherever possible to create a more consistent, year-over-year emissions trend. This reduces the likelihood of methodological inconsistencies and ensures a higher level of accuracy across the datasets.

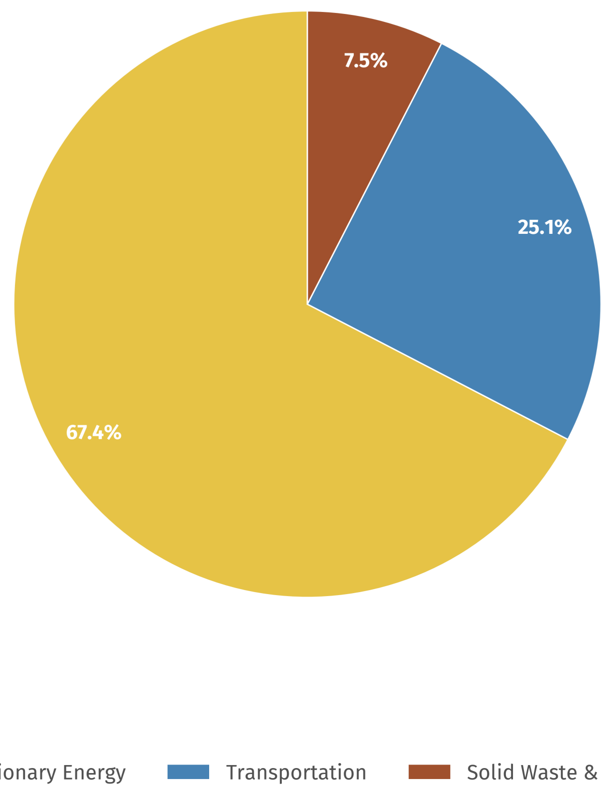
The good news is that ClimateNav's methodology, as described in the introduction to this report, is designed to overcome the common challenges of data inconsistency and comparison across years. Looking forward, ClimateNav will continue to support future community-wide inventories with a streamlined process that maximizes the comparability and reliability of the data, ensuring Bloomington can better track its progress in reducing emissions.

Overall Trends

A Breakdown of Community-Wide Emissions

The City of Bloomington is estimated to have contributed 1,273,915 in metric tons of CO_2e emissions in the calendar year of 2024. As shown in the pie chart below, 67.4% of these emissions came from the Stationary Energy sector, followed by 25.1% in the Transportation sector and 7.5% for Solid Waste & Wastewater.

Community-Wide GHG Emissions by Sector (2024)



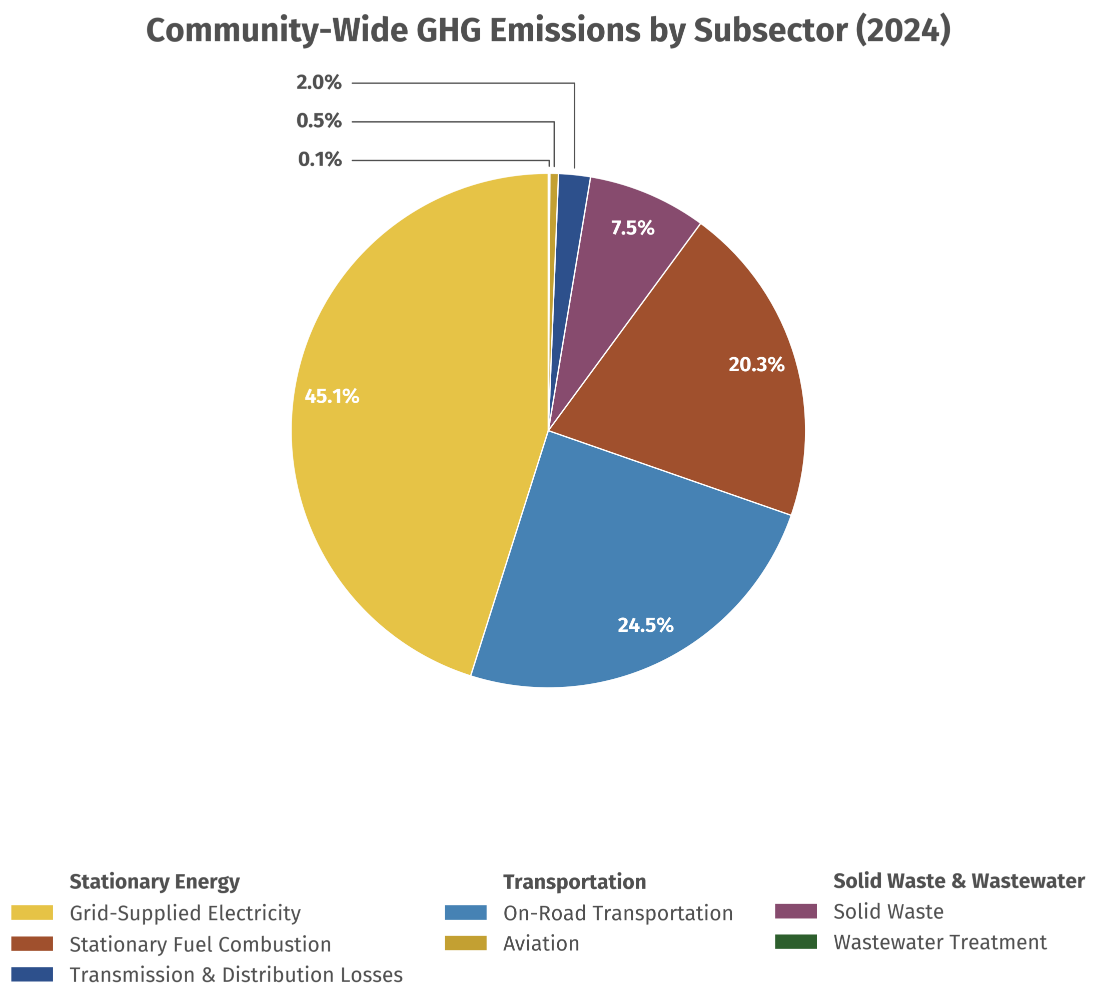
Emissions from each sector can be further segmented by their constituent sub-sectors which describe the different types of emission sources within each sector.

The following are some high-level observations about the breakdown of emissions on a sub-sector level for the community-wide inventory:

- **Grid-supplied electricity and stationary fuel combustion together account for nearly two-thirds of all community-wide emissions, at 45.1% and 20.3% respectively.** Duke Energy supplies the City's electricity while CenterPoint Energy provides natural gas for on-site fuel combustion. Indiana's grid remains more carbon-intensive than the national average, with EPA estimates placing it at 22.7% above the U.S. mean, largely due to the state's continued reliance on coal-fired generation. This helps explain why grid-supplied electricity alone constitutes nearly half of Bloomington's total emissions.

- **On-road transportation is the second-largest sub-sector at 24.5% of total community-wide emissions, while aviation accounts for just 0.5%.** The small share attributable to aviation reflects the limited scale of operations at Monroe County Airport, with most regional air traffic routed through Indianapolis International Airport, located within an hour's drive of Bloomington.
- **Solid waste and wastewater together represent a relatively small share of emissions at 7.5% and 0.1% respectively, but solid waste poses outsized decarbonization challenges.** Unlike grid-supplied electricity, where the shift to renewables can lower costs and generate returns for developers, reducing waste emissions requires capital-intensive interventions: cutting the total volume of waste disposed, installing landfill methane capture systems, or diverting material to reprocessing facilities. These approaches rarely produce net savings, making progress in this sub-sector inherently slower and more costly.

A pie chart of community-wide emissions broken out by each sub-sector is included below.



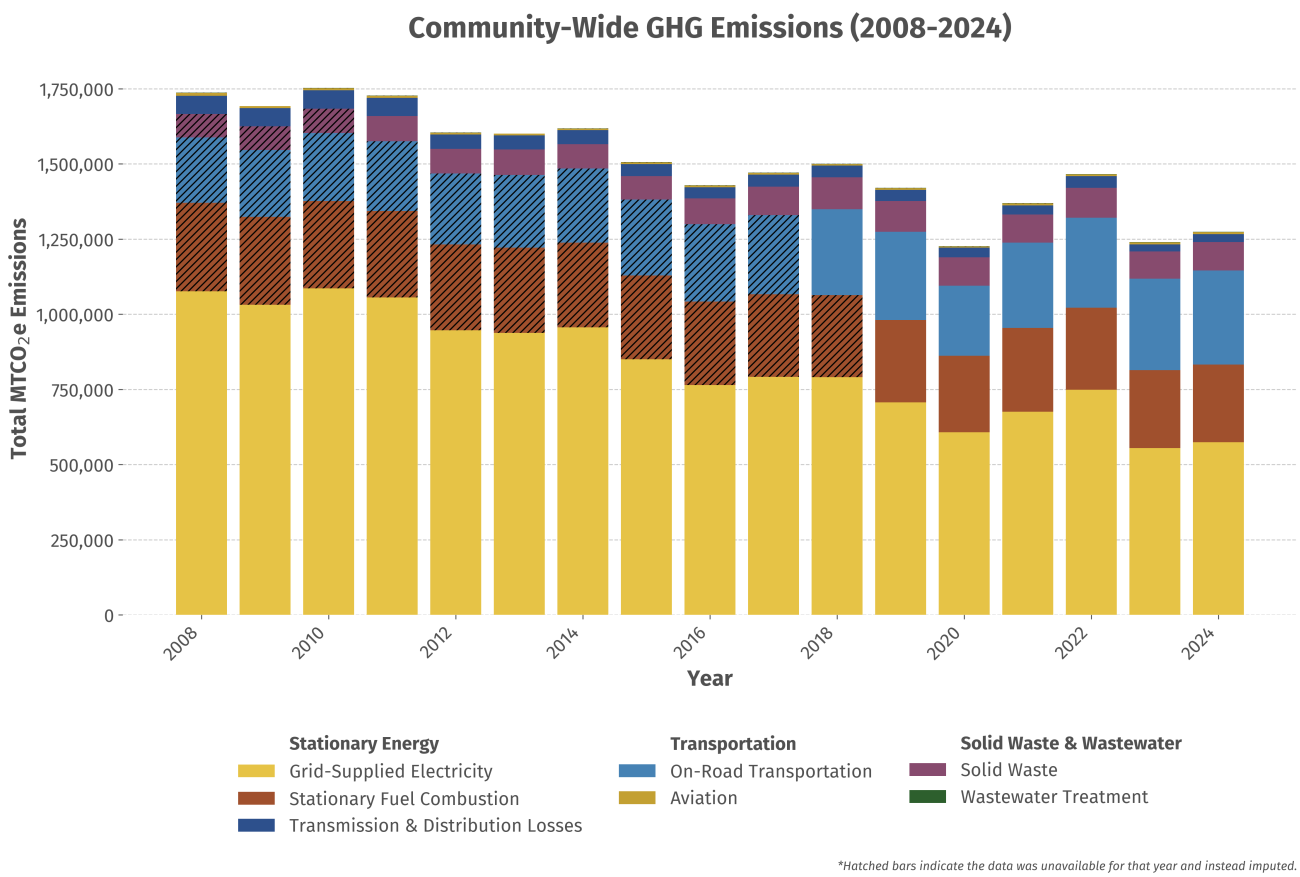
Understanding Historical Emissions

A useful exercise—and indeed a primary motivation for updating a greenhouse gas inventory—is to compare the emissions year-over-year to understand trends, as well as to ascertain the impact of federal, state, and local regulations in mitigating emissions over time.

As was mentioned in the Introduction to this report, a number of data limitations and methodological challenges make comparing emissions year-over-year quite difficult. Fortunately, these challenges will be resolved in future years due to the methodology developed and employed by ClimateNav in calculating emissions, starting with this 2024 inventory. This will make future year-over-year comparisons highly accurate and useful in driving consequential policy decisions.

However, in the meantime, an estimate of historical emissions can be calculated by interpolating trends in the existing data that is available. In practice, this means if data from 2008–2017 is unavailable but 2018–2024 data is, those prior years can be estimated based on the trendlines present in the available data.

This interpolation process was conducted and the resulting graph is provided below. Please note that this is a rough estimation given the data limitations and should not be taken as exact emissions numbers for each historical year.



The above graph demonstrates a few trends in Bloomington's community-wide inventory over the years:

- **Grid-supplied electricity has been the single largest source of emissions in every year inventoried, but it is also the sub-sector showing the most significant decline.** Total emissions from grid-supplied electricity have fallen steadily since 2008, consistent with EPA data indicating that Indiana's electric grid reduced its carbon intensity by approximately 35.5% between 2007 and 2024.

- **Stationary fuel combustion and on-road transportation, the second and third largest sources of emissions historically, have seen far less reduction over the same period.** Progress in these sub-sectors is harder to achieve than in grid-supplied electricity. Supply-side interventions such as electrifying vehicles and buildings are capital-intensive, while demand-side measures like expanding public transit ridership or reducing heating consumption require sustained behavioral change. The persistence of emissions in these two sub-sectors underscores the scale of the challenge Bloomington faces beyond grid decarbonization.

- **Solid waste emissions have risen slightly since 2008, even as Bloomington's population has remained relatively stable over the same period.** This trend is not unique to Bloomington. The EPA reports that per capita municipal solid waste generation has grown fairly consistently nationwide since 1960, suggesting that local increases are part of a broader structural pattern rather than a Bloomington-specific issue.

The rest of this chapter goes into depth in analyzing emissions from each sub-sector and exploring the different drivers of Bloomington's community-wide emissions in 2024 and years prior.

Progress Toward Emissions Reduction Targets

Overview of Emissions Reduction Targets

The City of Bloomington formally adopted its Climate Action Plan in April 2021 by a unanimous vote. The Plan established two specific emissions reduction targets to help guide the City's efforts to reduce its emissions and contribution toward global warming:

1. To reduce community-wide greenhouse gas emissions by 25% below the 2018 baseline by 2030
2. To reduce community-wide greenhouse gas emissions by 100% below the 2018 baseline by 2050 (i.e., carbon neutrality)

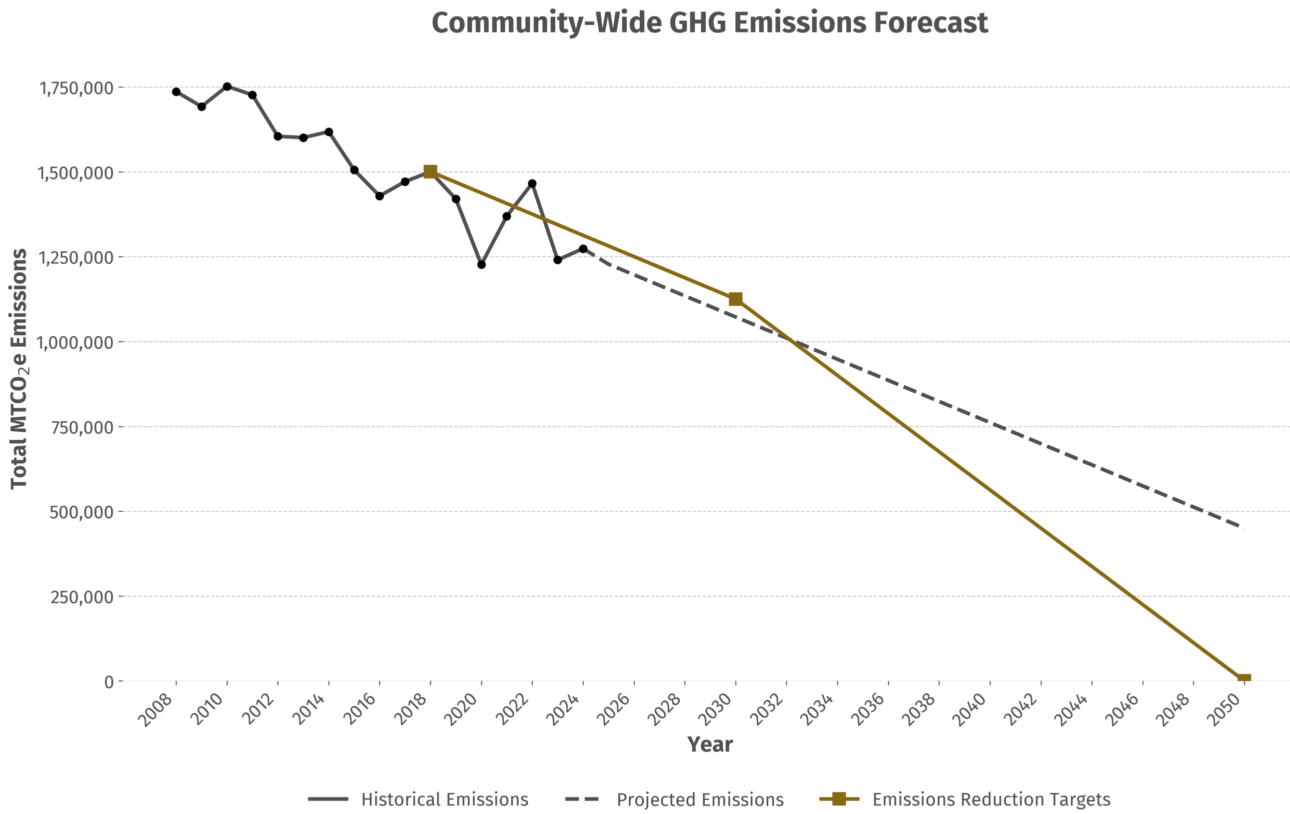
The **2018 official baseline** was determined to be 1,290,493 $MTCO_2e$ in the 2021 Climate Action Plan formally adopted by Council. However, as mentioned previously, this 2024 community-wide inventory was conducted using an updated methodology based on the latest climate science. Therefore, a "backcast" which estimates what the inventory would be in prior years results in a **2018 adjusted baseline** of 1,501,874 $MTCO_2e$.

In this analysis, the City's emissions targets will be evaluated against the adjusted baseline as it provides a more consistent and accurate picture of the City's progress toward achieving its emissions reduction goals.

Note: The trajectories, projected dates, and "on track" assessments presented throughout this chapter are derived by extrapolating historical emissions trends from 2008 through 2024 forward in time. They assume the observed pace of decarbonization continues at the same rate and do not incorporate forward-looking factors such as updated utility resource plans, evolving corporate climate commitments (e.g., Duke Energy's recent revisions to its interim targets), federal or state policy changes, or anticipated shifts in technology adoption. Actual future emissions may diverge meaningfully from these trendlines if underlying conditions change, and these projections should be interpreted as illustrative of the current trajectory rather than as forecasts of guaranteed outcomes.

Overall Emissions Reduction Targets

The chart below provides a visual overview of the City's progress toward achieving its overall, community-wide emissions reduction targets.



Here are some observations based on the chart and the City's current emissions reduction targets:

- **Bloomington's near-term reduction trajectory exceeds its 2030 goal.** The City aims to cut community-wide emissions by 25% relative to the 2018 baseline by 2030. As illustrated in the chart above, the projected emissions path (dotted black line)—derived from historical data spanning 2008 through 2024—falls well below the target trajectory (orange line) through 2030. If the average rate of decline observed over this period holds, the City will surpass its 2030 milestone with room to spare.

- **Reaching carbon neutrality by 2050 will require a significant acceleration in the rate of emissions reductions.** The linear trend from 2008 to 2024 yields an average annual reduction of roughly 28,962 $MTCO_2e$, but the path to carbon neutrality by 2050 demands approximately 46,934 $MTCO_2e$ per year —a gap of nearly 18,000 $MTCO_2e$ annually. The projected trendline accordingly crosses above the target trajectory before 2050. Much of this gap stems from higher transportation emissions now captured under the updated GPC-compliant methodology, which accounts for transboundary trips not included in prior inventories.

- **Past progress is heavily concentrated in a single sub-sector, making the current trajectory fragile.** The bulk of Bloomington's emissions reductions to date are attributable to the decarbonization of grid-supplied electricity as Duke Energy has shifted toward renewable generation. As the easiest grid-side gains are realized, the pace of decline in this sub-sector is likely to moderate. Sustaining the overall downward trend will depend on meaningful progress in stationary fuel combustion, on-road transportation, and solid waste—areas where reductions have so far been more limited.

Overall, the City is on track to meet its 2030 emissions reduction target but is not currently on pace to achieve carbon neutrality by 2050. The updated GPC-compliant transportation methodology, which now accounts for transboundary trips, reveals a larger emissions footprint that will require accelerated reductions across all sectors—particularly transportation and stationary fuel combustion—to close the gap.

Sub-Sector Emissions Reduction Targets

The following is an overview of progress toward the emissions reduction targets on a sub-sector-specific basis, based on historical data (sometimes imputed via a backcast) for the years 2008 through 2024 and extrapolated out to 2050.

Here are some observations based on a sub-sector analysis of the City's emissions targets:

- **Grid-supplied electricity is the clear bright spot, with carbon neutrality projected by 2041, but stationary fuel combustion lags well behind.** Duke Energy's ongoing transition to renewable generation has driven rapid decarbonization in the electricity sub-sector, putting it far ahead of the reduction targets. Stationary fuel combustion, by contrast, is not on pace to meet either the 2030 or 2050 goals, highlighting a growing divergence between the two components of stationary energy.

- **On-road transportation accounts for 24.5% of total emissions and is not on track to meet either of the City's reduction targets.** As the second-largest source of community-wide emissions, this sub-sector represents one of the widest gaps between the current trajectory and the required reduction path. Closing this gap will require coordinated action across vehicle electrification, transit expansion, and land use strategies aimed at reducing vehicle miles traveled.

- **Solid waste presents a proportionally larger decarbonization challenge than its share of total emissions would suggest.** Although it ranks fourth among sub-sectors by absolute emissions, the ratio of its current reduction rate to the rate required for carbon neutrality is the worst of any sub-sector. This reflects the inherent difficulty of abating landfill methane and other waste-related emissions, and signals that the City will need to explore more ambitious diversion, capture, or offset strategies to bring this sub-sector into alignment with its targets.

The above analysis shows that gains in the decarbonization of grid-supplied electricity are driving the majority of overall, community-wide emissions reductions. Historically, this has been the largest source of emissions for most communities, so it's promising to see such significant progress in this area. However, decarbonizing the other sub-sectors will be crucial if the City wants to remain on track to meet its future reduction targets.

Stationary Energy

Overall Emissions from Stationary Energy

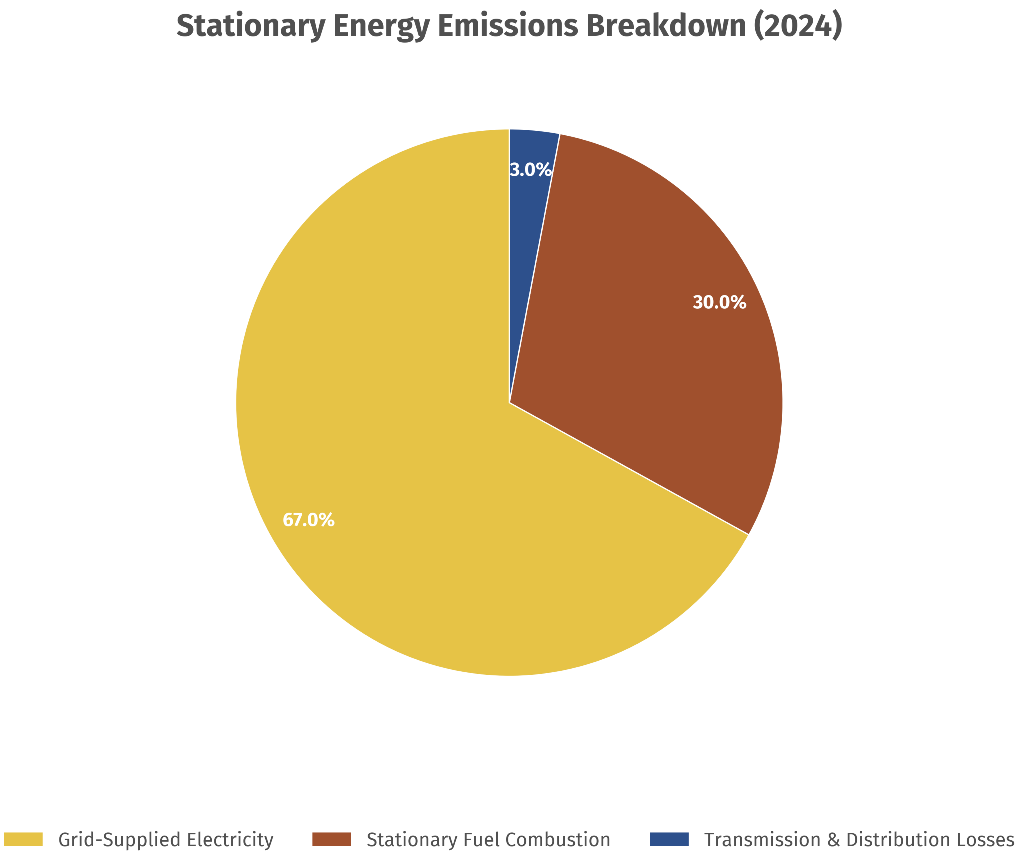
Emissions from the Stationary Energy sector represent 67.4% of Bloomington's total overall emissions—meaning it is the largest source of emissions in the City. Stationary Energy refers broadly to emissions from energy used to power residential, commercial, and industrial buildings, as well as other facilities that consume energy for heating, cooling, lighting, and powering appliances and machinery. These emissions primarily stem from the combustion of fossil fuels, such as natural gas and coal, as well as electricity generated from non-renewable sources.

Overall emissions from this sector, by year, are shown in the chart to the right and the table below. Note that emissions from this sector are broadly split into three different sub-sectors:

- **Grid-Supplied Electricity:** Emissions from the combustion of fossil fuels to generate electricity and transmit it via the power grid for use in powering buildings, facilities, and machinery. For example, Duke Energy generates a significant portion of Bloomington's electricity using coal-fired power plants.

- **Transmission and Distribution:** Emissions resulting from energy losses that occur during the transmission and distribution of electricity from power plants to end users. These losses are mainly due to resistance in power lines and equipment inefficiencies.

- **Stationary Fuel Combustion:** Emissions generated directly from burning fossil fuels such as natural gas, propane, or oil on-site in homes, businesses, or industrial facilities for heating, cooking, or other energy needs.



As shown in the pie chart, the majority of Bloomington's emissions are due to grid-supplied electricity which is the case for most urbanized cities in the United States. This is followed by Stationary Fuel Combustion which makes up around a third of stationary energy emissions. Transmission and distribution losses constitute a relatively much smaller share of overall emissions but are still significant enough to merit their inclusion in the inventory.

Actual data values for the Stationary Energy sector are shown below. Note that historical data for the Stationary Fuel Combustion sub-sector from 2008–2018 is not available, as the City's stationary fuel utility, CenterPoint Energy, was unable to provide the historical data.

Stationary Energy Emissions, by Sub-Sector and Year ($MTCO_2e$)

Year	Grid-Supplied Electricity	Stationary Fuel Combustion	T&D Losses
2008	1,076,318	–	60,301
2009	1,031,594	–	59,736
2010	1,086,305	–	60,698
2011	1,055,410	–	60,525

Year	Grid-Supplied Electricity	Stationary Fuel Combustion	T&D Losses
2012	946,256	–	47,828
2013	937,576	–	47,114
2014	956,841	–	46,781
2015	850,042	–	39,797
2016	764,492	–	37,478
2017	791,230	–	40,553
2018	790,861	–	38,561
2019	706,566	274,124	36,256
2020	607,556	254,183	32,098
2021	676,060	278,272	30,193
2022	748,433	272,935	38,472
2023	555,007	259,321	23,424
2024	574,783	258,008	25,432

Grid-Supplied Electricity and Transmission & Distribution Losses

Grid-supplied electricity is the sub-sector which refers to emissions generated in supplying electricity to power buildings, facilities, and machinery within the inventory boundaries. Closely related to this sub-sector are emissions resulting from energy lost in the transmission and distribution (T&D) of that electricity to its end destination.

T&D losses are an inevitable result of energy dissipating as heat when electricity travels through power lines and transformers, causing inefficiencies in the electric grid. These losses mean that for every kilowatt-hour of energy consumed within Bloomington, some additional percentage of energy had to be generated to compensate for the lost energy during transmission. As a result, the actual emissions associated with electricity use in the City are slightly higher than the amount of electricity consumed would suggest, due to these grid inefficiencies. Those emissions are accounted for as “T&D Losses” within the greenhouse gas inventory.

The methodology for calculating these emissions is as follows:

1. **Gather Raw Data:** Total annual energy consumption in kilowatt-hours (kWh) for each year and category (residential, commercial, industrial, etc.) is collected. For the City of Bloomington, this data was obtained from the local utility, Duke Energy.

2. **Calculate Emissions:** The EPA’s eGRID emissions factors are used to calculate total emissions for Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). eGRID provides region-specific emissions factors that reflect the energy mix (e.g., coal, natural gas, renewable energy) used to generate the electricity consumed in Bloomington.

3. **Convert to Metric Tons:** The emissions calculated in pounds (lbs) for each greenhouse gas are converted to metric tons, as metric tons are the standard unit used in greenhouse gas reporting.

4. **Convert to CO_2 Equivalents:** The metric tons of each gas are converted to metric tons of CO_2 equivalent ($MTCO_2e$). This step accounts for the global warming potential (GWP) of each gas, where methane (CH_4) and nitrous oxide (N_2O) have a higher GWP than carbon dioxide (CO_2).

5. **Aggregate Emissions:** The $MTCO_2e$ values for each greenhouse gas are summed to obtain the total standardized emissions by year and category. This aggregated data provides a comprehensive view of Bloomington’s grid-supplied electricity emissions and helps identify trends over time.

A breakdown of emissions from the grid-supplied electricity sub-sector is shown in the table below.

Grid-Supplied Electricity Emissions, by Category and Year ($MTCO_2e$)

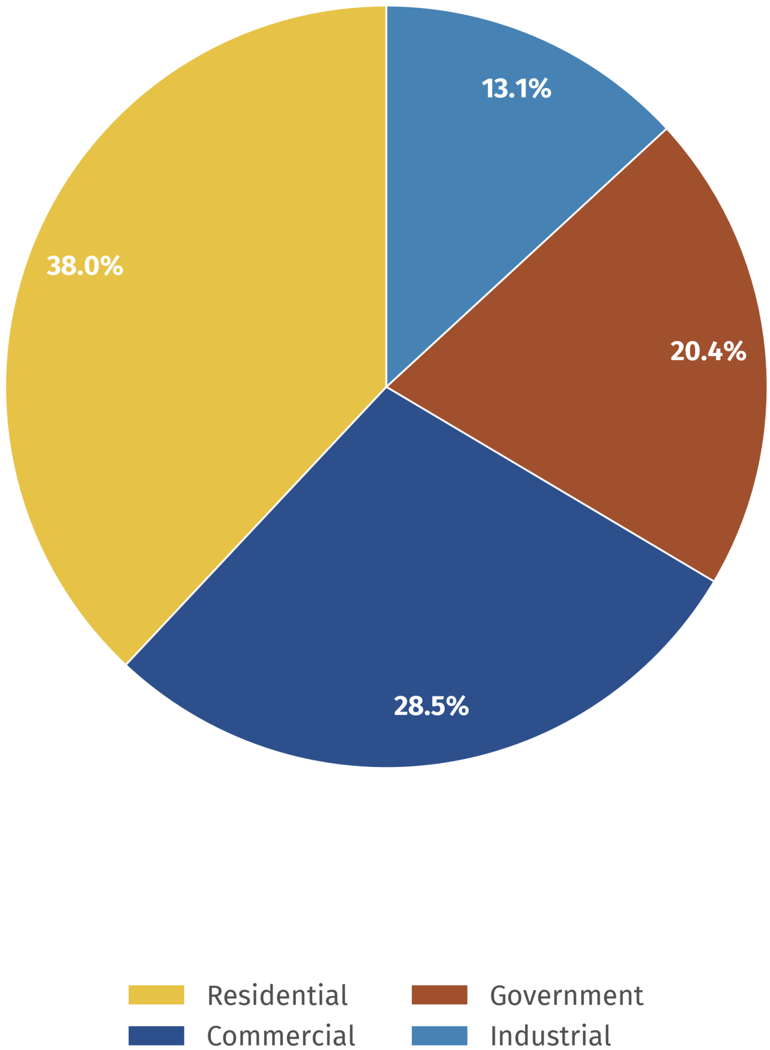
Year	Residential	Commercial	Industrial	Government
2023	208,391	159,038	72,970	114,608
2024	218,510	163,567	75,592	117,114

Next, emissions from transmission and distribution losses were calculated for each category described above to provide a better picture of total emissions stemming from the consumption of grid-supplied electricity within the City. The following methodology was applied:

1. **Calculate the T&D Loss Rate:** Table 10 from the Energy Information Administration's (EIA) *State Electricity Profile for Indiana* was used. Using the Energy Information Administration (EIA)'s preferred formula, the estimated rate for T&D losses was calculated by dividing the estimated losses by the result of total disposition minus direct use. For 2024, the EIA data gives a total disposition of 111,855,804 MWh, direct use of 7,221,008 MWh, and estimated losses of 4,629,542 MWh, yielding a T&D loss rate of approximately 4.42%.

2. **Apply the Loss Rate:** After determining the T&D loss rate, it was applied to each category of $MTCO_2e$ emissions for grid-supplied electricity. This allowed for the calculation of the proportional increase in emissions due to energy lost during transmission and distribution, which occurs upstream of actual stationary energy consumption within the inventory boundaries.

Grid-Supplied Electricity by Category (2024)

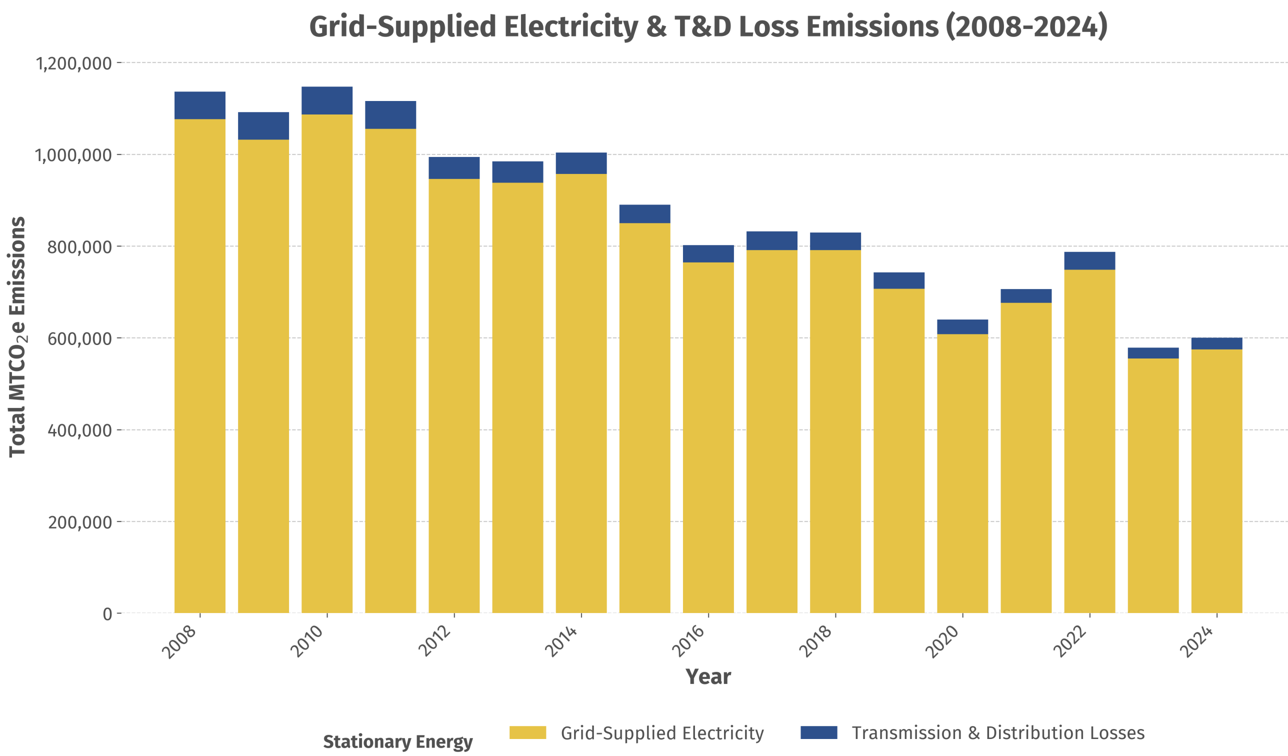


As you can see in the chart, the majority of emissions from the Grid-Supplied Electricity sub-sector are from the residential category, accounting for 38.0% of total emissions. This category includes electricity used in homes for heating, cooling, lighting, appliances, and electronic devices. Close behind is the commercial category, contributing 28.5% of emissions. This category encompasses electricity use by businesses, offices, retail spaces, and service providers. Common uses include lighting, HVAC systems, computers, and machinery required for operations.

The government category represents 20.4% of emissions. This includes public buildings, schools, and other government facilities that consume electricity for essential services such as lighting, public infrastructure, and administration. Note that the government category refers to all levels of government (federal, state, and local) and not just emissions from the City of Bloomington's operations.

Lastly, the industrial category accounts for 13.1%, reflecting electricity consumption by factories, warehouses, and manufacturing plants. This category typically includes energy-intensive operations such as production machinery, industrial lighting, and facility maintenance systems. As expected, this is the smallest category of grid-supplied electricity emissions in the City, which makes sense given that Bloomington is not a major location for industrial facilities or mass production.

Another useful way to analyze emissions from this sector is to look at the historical trends of how emissions have changed over the years due to these two sub-sectors. As you can see in the chart below, total emissions from both grid-supplied electricity and T&D losses have decreased steadily over the years.



From 2008 to around 2013, emissions remained relatively high and stable. However, starting in 2014, there has been a gradual decline in emissions from grid-supplied electricity. This decrease is largely attributed to Duke Energy's adoption of renewable and low-carbon sources of energy, such as wind and solar. While the shift to cleaner energy has played a primary role in reducing emissions, improvements in energy efficiency, such as more efficient appliances and lighting, have also contributed as a smaller but still important secondary driver.

T&D losses, represented by the darker section at the top of each bar, follow the same pattern, with a slight decline in recent years, proportional to the overall reduction in grid-supplied electricity emissions. Since T&D losses are directly proportional to emissions from grid-supplied electricity, the two are tightly correlated and it's expected that their trendlines follow one another closely.

Stationary Fuel Combustion

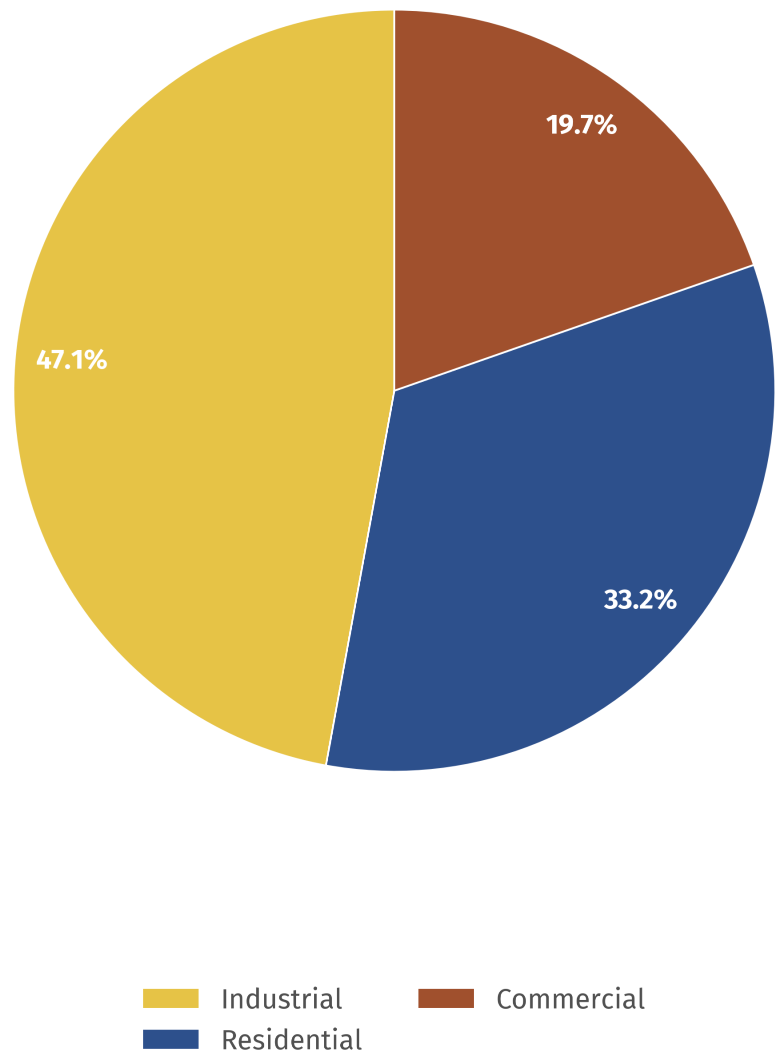
The other major contributor to stationary energy emissions is the Stationary Fuel Combustion sub-sector. This sub-sector primarily consists of emissions from the combustion of fuels used on-site, with the majority of emissions coming from the combustion of natural gas. Natural gas is commonly used in heating, cooking, and for various uses in residential, commercial, and industrial buildings.

A table showing a breakdown of emissions from this sub-sector, using data provided by CenterPoint Energy, is included below:

Stationary Fuel Combustion Emissions, by Category and Year ($MTCO_2e$)

Year	Residential	Commercial	Industrial
2019	104,381	57,256	112,487
2020	94,284	49,840	110,059
2021	102,848	57,075	118,350
2022	99,963	54,523	118,449
2023	90,489	50,336	118,496
2024	85,737	50,683	121,588

Stationary Fuel Combustion by Category (2024)

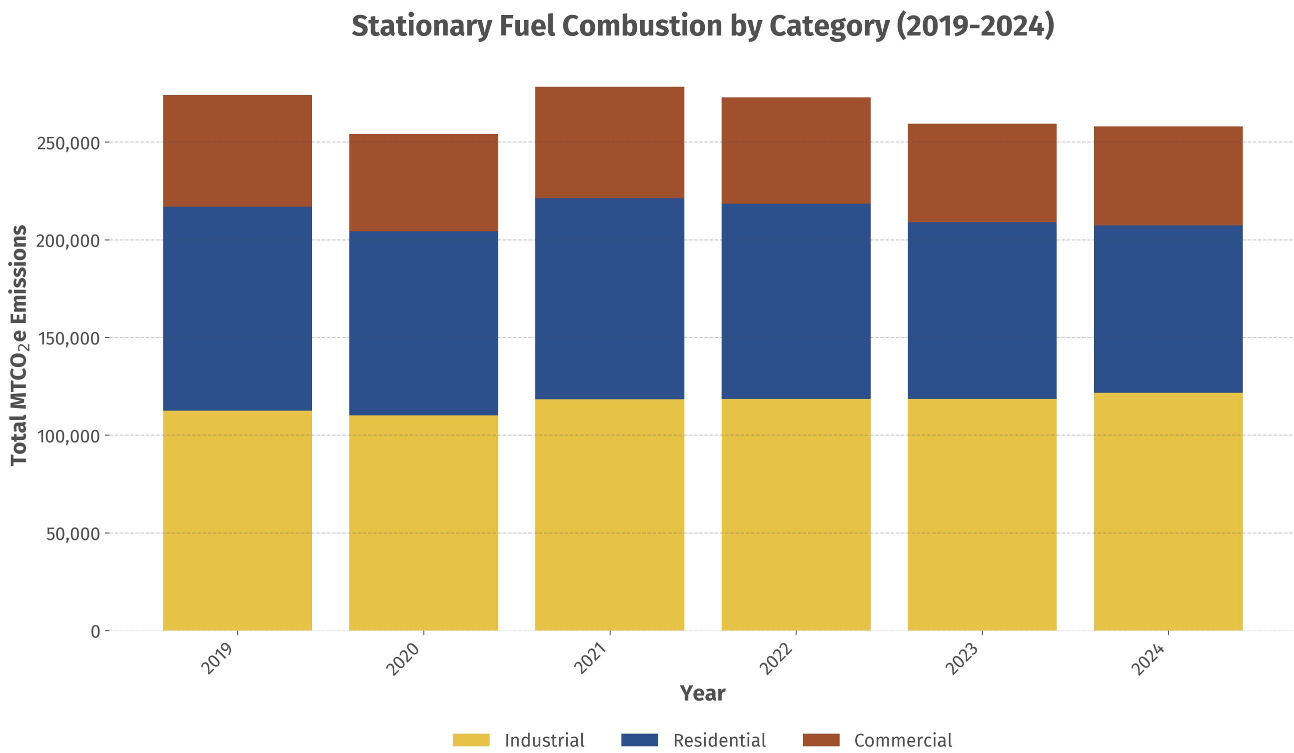


The pie chart of stationary fuel combustion emissions for 2024 demonstrates that the largest share comes from the industrial category, accounting for 47.1%. This reflects the heavy reliance of industrial facilities on natural gas for powering machinery, heating, and other industrial processes.

The residential category contributes 33.2% of emissions, which includes emissions from natural gas use in homes for heating, cooking, and water heating.

The commercial category makes up 19.7% of emissions. This includes emissions from natural gas used in businesses, office buildings, and other commercial operations for similar needs such as heating, water heating, and cooking.

A stacked bar chart which visualizes historical emissions from 2019–2024 for the stationary fuel combustion sub-sector is included below. The relative ratio of emissions contributed by each category is fairly constant year-over-year, suggesting that the customer base which consumes stationary fuel within the City of Bloomington has not changed significantly over the past few years.



The methodology for calculating emissions from stationary fuel combustion is as follows:

1. **Gather Raw Data:** Data for total annual natural gas consumption in therms was retrieved from CenterPoint Energy. Due to limitations in CenterPoint's internal database systems, the data could not be perfectly segmented into the exact categories required by the *Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC)*.

2. **Calculate Emissions:** Using the EPA's annually-released Emissions Factors Hub spreadsheet, emissions factors for the combustion of natural gas were applied to the consumption data to calculate total CO_2, CH_4, and N_2O emissions in pounds (lbs) for each category.

3. **Convert Emissions to Metric Tons:** The calculated emissions in pounds were then converted to metric tons, which is the standard unit for reporting greenhouse gas emissions.

4. **Convert to CO_2 Equivalents:** The metric tons for each greenhouse gas were converted to their respective metric tons of CO_2 equivalent ($MTCO_2e$) using their global warming potential (GWP). This ensures that the emissions reflect the different warming impacts of methane and nitrous oxide compared to carbon dioxide.

5. **Aggregate Emissions:** Finally, all the $MTCO_2e$ values for each category and year were aggregated to calculate the overall standardized emissions for stationary fuel combustion. This aggregation provides a complete emissions profile by category, allowing for year-to-year comparisons and overall trends.

Transportation

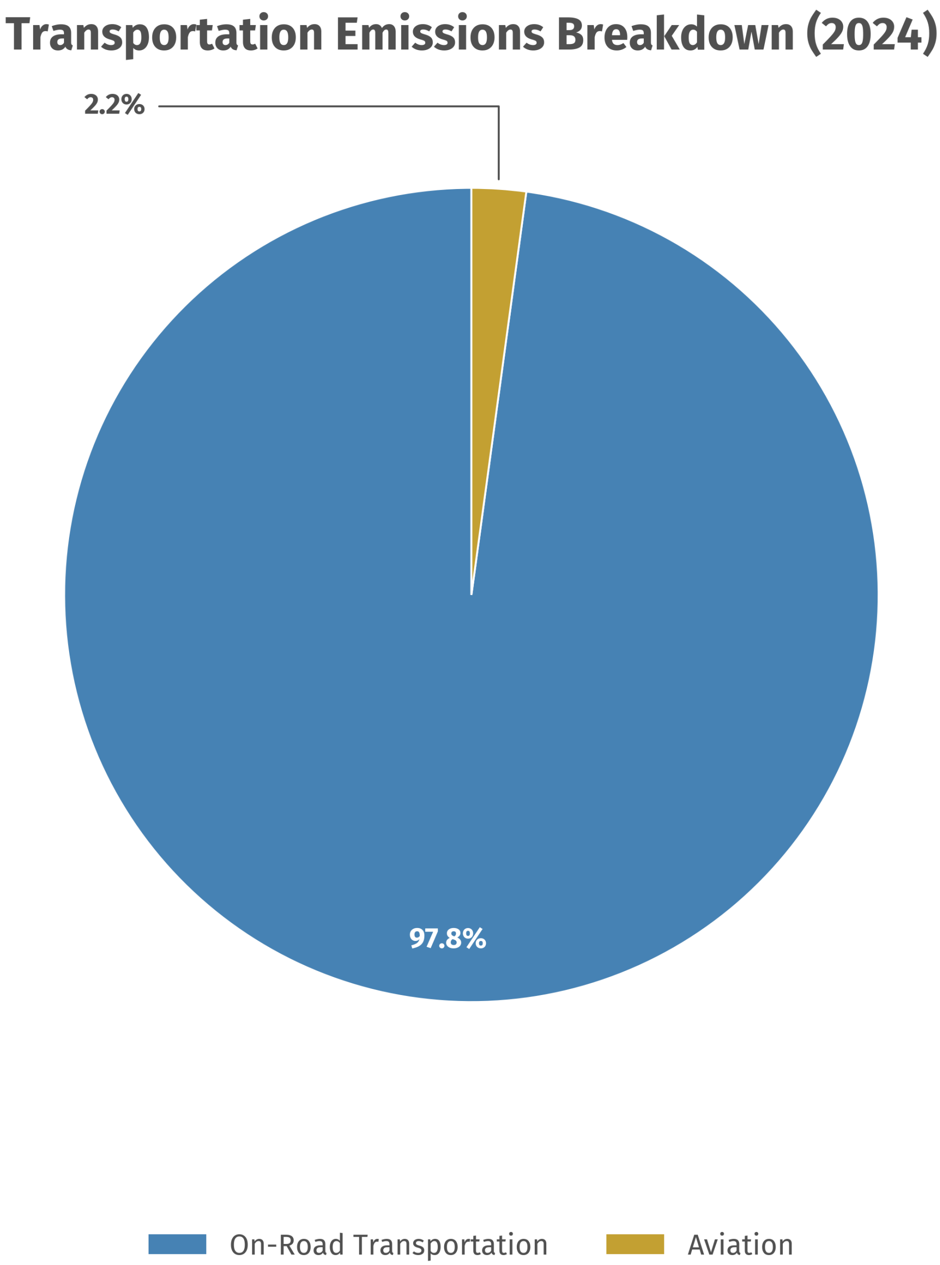
Overall Emissions from Transportation

Emissions from the Transportation sector represent 25.1% of Bloomington's total overall emissions—making it the second largest source of emissions in the City. Transportation refers broadly to emissions generated from powering mobile vehicles that provide transportation throughout the City, including passenger, commercial, and government vehicles.

A breakdown of emissions from this sector are included in the pie chart below. Note that Bloomington's transportation-related emissions are primarily split into the following two sub-sectors:

- **On-Road Transportation:** Emissions from passenger and commercial cars, trucks, buses, and other motorized vehicles that use public roadways.
- **Aviation:** Emissions from air travel and local airport operations, including fuel combustion from aircrafts departing from Bloomington.

There are other types of transportation-related emissions as well, including off-road transportation (such as construction equipment and agricultural vehicles), railways, and water transport. However, due to a lack of available data, emissions from these other sub-sectors have not been included in this inventory. However, the vast majority of emissions for this sector are accounted for by on-road transportation, so the exclusion of these other sub-sectors does not prevent this inventory from providing an accurate, overall view of transportation-related emissions.



As shown in the pie chart, the vast majority of transportation emissions are due to on-road transportation (97.8%), which is expected. Aviation makes up about 2.2% of transportation emissions, and note that this only accounts for the refueling of airplanes within the inventory boundaries and not for other types of aviation-related emissions such as in-boundary helicopter flights.

The table below includes the raw data for emissions for each of these sub-sectors, by year, in terms of metric tons of CO_2e.

Transportation Emissions, by Sub-Sector and Year ($MTCO_2e$)

Year	On-Road Transportation	Aviation
2018	285,155	5,587
2019	293,795	6,024
2020	232,755	4,317
2021	284,160	6,364
2022	299,590	6,309
2023	303,444	7,488
2024	312,624*	6,884

**On-road value estimated by linearly extrapolating the 2018–2023 EIE trend; see the methodology note in the On-Road Transportation section. Actual EIE data was available only through 2023.*

On-Road Transportation

On-Road Transportation is a sub-sector which refers to emissions from the use of vehicles on public roadways, including both passenger and commercial vehicles. Beginning with this 2024 inventory, Bloomington has adopted Google Environmental Insights Explorer (EIE) as the primary data source for estimating on-road transportation emissions. This represents a significant methodological improvement over the prior approach, which relied on Indiana Department of Transportation (INDOT) traffic sensor data and Bureau of Motor Vehicles (BMV) vehicle registration records.

Why the Methodology Changed

The prior methodology estimated emissions based solely on **in-boundary** vehicle miles traveled (VMT)—that is, only miles driven on roads physically within city limits. This approach significantly undercounted Bloomington's true transportation footprint because any portion of a trip that crossed the city boundary was excluded. For example, a resident commuting from Bloomington to a neighboring community would only have the miles driven within city limits counted, with the remainder attributed to no jurisdiction at all.

The Global Protocol for Community-Scale GHG Emission Inventories (GPC) addresses this gap through its **induced traffic model**, which attributes transportation emissions as follows:

- **In-boundary trips** (start and end within the city): 100% of miles counted
- **Transboundary trips** (start or end outside the city): 100% of in-boundary miles + 50% of out-of-boundary miles
- **Through trips** (neither start nor end in the city): not counted

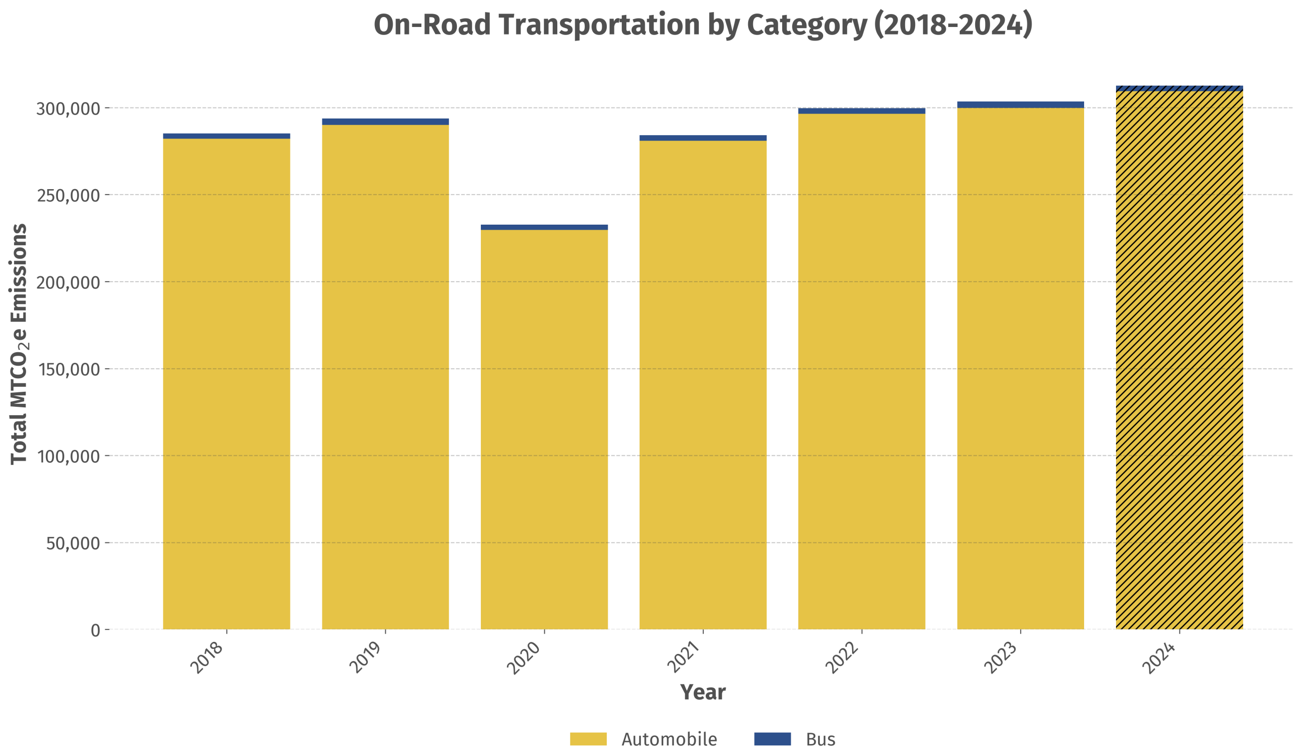
This approach splits responsibility between origin and destination cities, ensuring trips are neither double-counted nor left unaccounted for. Google EIE provides pre-calculated GPC-compliant VMT and emissions estimates using this induced traffic model.

About Google Environmental Insights Explorer

Google EIE estimates VMT using aggregated, anonymized location data from users who have opted into Google Location History. The dataset has been ground-truthed against physical road sensors with a 0.9 average correlation, and ICLEI—the organization that helped develop the GPC protocol—has issued a report recommending EIE as a viable data source for municipal transportation emissions inventories. EIE data is updated annually; at the time of this inventory, published figures were available for 2018 through 2023 (see the methodology note on how the 2024 figure was estimated).

Bloomington joins a growing number of peer cities that use EIE for their community-wide GHG inventories, including Boulder, CO; Madison, WI; Berkeley, CA; and Lawrence, KS. In all of these cities, EIE serves as the primary VMT source for the entirety of on-road transportation—it is not used as a supplement to state DOT data, but as a replacement.

The graph below shows on-road transportation emissions broken down by automobile and bus modes:



Hatched bars indicate the data was unavailable for that year and instead estimated.

As shown above, emissions from automobiles dominate on-road transportation, accounting for over 98% of the total. Bus emissions represent a small but measurable share. The adoption of the GPC-compliant induced traffic model results in significantly higher emissions estimates compared to the prior in-boundary-only methodology. This is consistent with the experience of peer cities: nationally, transportation accounts for 28% of GHG emissions (EPA), and Bloomington's updated figure of 25.1% is now much more closely aligned with this benchmark.

Note that the EIE data includes emissions from all vehicle fuel types, including the tailpipe emissions from gasoline and diesel vehicles. Emissions associated with charging electric vehicles are captured separately in the grid-supplied electricity sub-sector.

The methodology for calculating emissions from this sub-sector is described below:

1. **Data Source:** On-road transportation emissions were sourced from Google Environmental Insights Explorer (EIE), which provides GPC-compliant estimates of vehicle miles traveled and associated CO_2e emissions for the City of Bloomington. EIE uses aggregated, anonymized location data to estimate trip counts, distances, and emissions by mode (automobile and bus) and trip type (in-boundary, inbound, and outbound).
2. **GPC-Compliant Attribution:** The EIE data applies the GPC induced traffic model, counting 100% of in-boundary trip miles and 50% of the out-of-boundary portion of transboundary trips. The

pre-calculated `gpc_co2e_tons` field was used directly, as it already incorporates this attribution methodology and accounts for fleet composition, fuel economy, and emission factors.

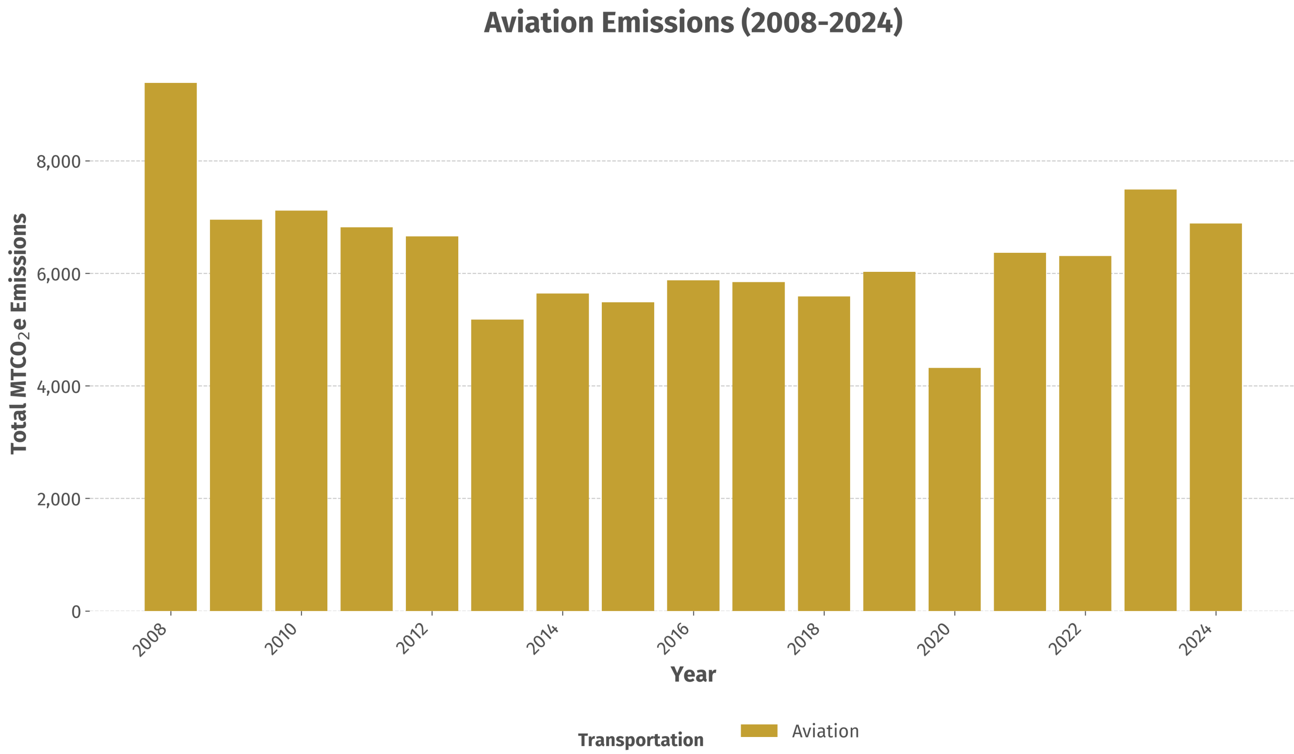
3. **Aggregate Emissions:** For each year, the GPC-compliant CO_2e values for automobile and bus modes were summed to determine total on-road transportation emissions. This approach provides a consistent, year-over-year emissions profile from 2018 through 2024, with all years calculated using the same GPC-compliant methodology for comparability.

Note: At the time this inventory was conducted, Google EIE had published data through 2023 only. The 2024 on-road transportation figure was therefore estimated by linearly extrapolating the 2018–2023 EIE trend forward by one year, separately for automobile and bus modes. This figure will be replaced with the actual EIE-reported value in a future inventory update once 2024 data becomes available from Google.

Aviation

The Aviation sub-sector refers to emissions from passenger and commercial cargo aircraft. Emissions from this sub-sector were determined based off of fuel sales by the fixed-based operator (FBO) serving the Monroe County Airport, the primary airport within the City of Bloomington's inventory boundaries. Refueling operations which occur at the airport are an accurate proxy for emissions from flights both landing and departing from the airport and therefore provide a fairly holistic account of Scope 3 aviation-related emissions.

The Monroe County Airport refuels aircraft using two different types of fuels: Jet A and AVGAS. As the graph below shows, the majority of fuel sales at the airport are from Jet A, which in turn means the majority of fuel combustion and therefore emissions are the result of JET A fuel usage. Jet A is a kerosene-based fuel used in larger and faster-moving aircraft, whereas AVGAS is a gasoline-based jet fuel that smaller, slower planes with piston engines primarily use. Therefore, it's expected that Jet A would account for the majority of emissions since it is used in higher quantities by much larger aircraft for commercial passenger and cargo flights.



The table below provides a breakdown of emissions from the aviation sub-sector by fuel type:

Aviation Emissions, by Category and Year ($MTCO_2e$)

Year	Jet A	AVGAS
2008	8,223	1,160
2009	6,089	864
2010	6,163	947
2011	6,291	526
2012	5,846	807
2013	4,258	920
2014	4,988	652
2015	4,909	572
2016	5,336	539
2017	5,377	465

Year	Jet A	AVGAS
2018	5,124	463
2019	5,658	366
2020	4,050	267
2021	5,872	492
2022	5,697	612
2023	6,754	734
2024	6,355	529

The methodology for calculating emissions for this sub-sector are described below:

1. **Gather Raw Data:** Data on aviation emissions was sourced from Monroe County Airport, which provided a report detailing the amount of jet fuel and aviation gas sold by their fixed base operator (FBO) within the calendar year. This data serves as the basis for estimating aviation-related emissions within the inventory boundaries.
2. **Calculate Emissions:** The volume of jet fuel sold was used as an approximation for the amount of fuel combusted for Scope 3 emissions, which includes transboundary flights originating or ending within the City. The amount of fuel was multiplied by the respective emissions factor for jet fuel to calculate the pounds of CO_2 emitted during combustion. The emissions factors were sourced from the U.S. Energy Information Administration (EIA).
3. **Convert Emissions to Metric Tons:** The calculated pounds of CO_2 emissions were converted to metric tons using the standard conversion factor for each type of aviation fuel, ensuring consistency with reporting standards.
4. **Aggregate Emissions:** Finally, emissions from jet fuel and aviation gas were summed to determine the total emissions from aviation for the given year. This provides an aggregate estimate of aviation-related greenhouse gas emissions within the inventory boundaries.

Solid Waste & Wastewater

Overall Solid Waste & Wastewater Emissions

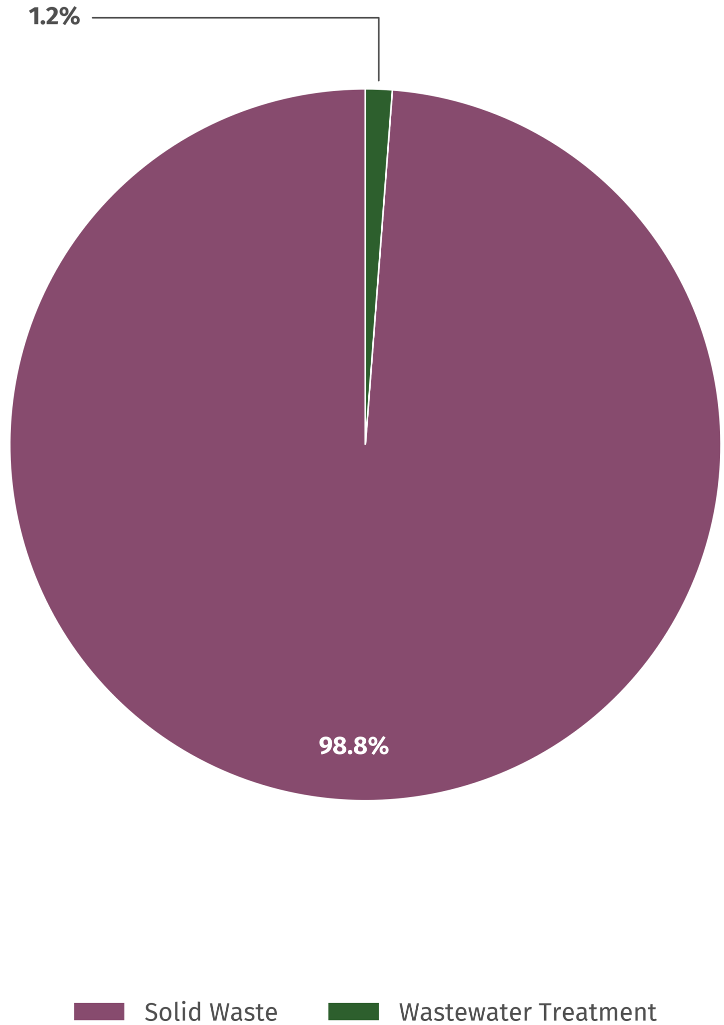
Emissions from the Solid Waste and Wastewater sector represent 7.5% of Bloomington's total overall emissions. This sector encompasses the greenhouse gas emissions associated with the disposal and treatment of solid waste, as well as the treatment and transport of wastewater throughout the City.

As shown in the pie chart below, the majority (98.8%) of emissions in this sector come from solid waste, with wastewater treatment contributing the remaining 1.2%. The total emissions from this sector in 2024 were 96,184 $MTCO_2e$.

Solid waste emissions primarily result from the decomposition of organic matter in landfills. When waste decomposes in anaerobic conditions (without oxygen), it produces methane (CH_4), a potent greenhouse gas.

Wastewater treatment processes contribute to emissions primarily through three mechanisms. First, methane (CH_4) emissions can occur during secondary treatment, where organic matter is biologically broken down under conditions that may produce methane. Second, anaerobic digestion, commonly used to process sewage sludge, generates methane, which can be captured for energy or flared to reduce emissions. Third, the nitrification and denitrification processes, used to remove nitrogen from wastewater, produce nitrous oxide (N_2O), a potent greenhouse gas. Additionally, the energy required to operate wastewater treatment facilities contributes to electricity-related emissions, which are accounted for separately in the Stationary Energy sector.

Solid Waste & Wastewater Emissions Breakdown (2024)

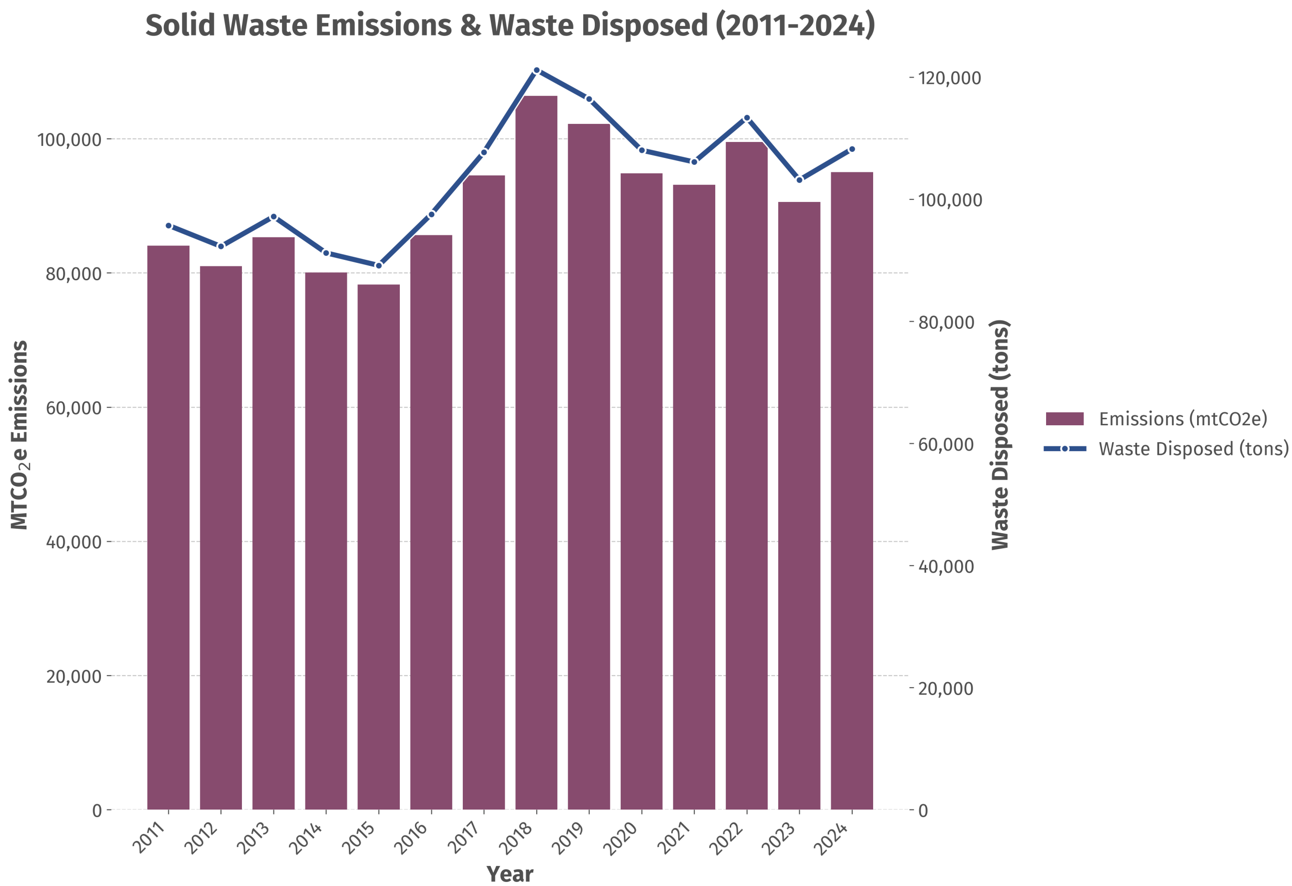


Below is a table showing an overview of solid waste and wastewater emissions, by year, dating back to 2011. Additionally, a stacked bar chart is included to provide a relative view of how emissions from this sector have evolved over time.

Solid Waste & Wastewater Emissions, by Sub-Sector and Year ($MTCO_2e$)

Year	Solid Waste	Wastewater Treatment
2011	84,043	–
2012	81,017	–
2013	85,305	–

Year	Solid Waste	Wastewater Treatment
2014	80,076	–
2015	78,276	–
2016	85,646	–
2017	94,549	–
2018	106,396	–
2019	102,232	–
2020	94,846	–
2021	93,157	–
2022	99,540	1,070
2023	90,568	1,106
2024	95,019	1,166


Solid Waste Emissions & Waste Disposed (2011-2024)
MTCO$_2$e Emissions
Waste Disposed (tons)
Year
0
20,000
40,000
60,000
80,000
100,000
120,000
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Emissions (mtCO2e)
Waste Disposed (tons)

Solid Waste

As mentioned at the beginning of this chapter, solid waste is a significant contributor to Bloomington's greenhouse gas emissions, and the primary driver of emissions within this sector.

The City of Bloomington's greenhouse gas inventory for solid waste disposal follows the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)*. The GPC provides two primary methods for estimating methane emissions from solid waste disposal: the First Order of Decay (FOD) model and the Methane Commitment (MC) approach.

- **First Order of Decay (FOD):** Estimates emissions based on waste decomposition over time, accounting for the fact that organic waste in landfills continues to emit methane for several decades after disposal. While this method provides a more accurate representation of annual emissions, it requires extensive historical waste disposal data, which can be challenging to obtain.
- **Methane Commitment (MC):** Calculates emissions based on the total amount of waste disposed in the inventory year, assuming all future emissions from that waste occur in the current year. While this method tends to overestimate short-term emissions, it offers advantages in simplicity, consistency with waste reduction efforts, and future-oriented decision-making.

For this inventory, the Methane Commitment approach was utilized. The primary advantage of this method is that it requires only current-year waste disposal data which was a requirement given limitations in the data available for this project. It is also the primary way the majority of municipalities in the United States calculate emissions from solid waste disposal for their community-wide greenhouse gas inventories, ensuring greater interoperability between this inventory and Bloomington's peer cities.

Solid Waste Disposed and Associated Emissions, by Year

Year	Solid Waste Disposed (City-Adjusted Tons)	Associated Emissions ($MTCO_2e$)
2011	95,723	84,043
2012	92,277	81,017
2013	97,160	85,305
2014	91,205	80,076
2015	89,155	78,276
2016	97,550	85,646
2017	107,689	94,549
2018	121,183	106,396
2019	116,441	102,232
2020	108,027	94,846

Year	Solid Waste Disposed (City-Adjusted Tons)	Associated Emissions ($MTCO_2e$)
2021	106,104	93,157
2022	113,375	99,540
2023	103,156	90,568
2024	108,224	95,019

Tonnage figures are City-adjusted. IDEM reports waste disposal only at the county level, so each year's Monroe County total is multiplied by Bloomington's share of the Monroe County population to estimate the City-level tonnage (see the methodology below). This is the same City-adjusted basis used for the associated emissions in this table and for the waste-disposed trend line in the "Solid Waste Emissions & Waste Disposed" chart shown earlier in this section.

Despite year-to-year fluctuations, there appears to be a slight upward trend in both waste disposal and associated emissions, especially since 2018. This suggests that population growth or economic factors may be offsetting waste reduction efforts. This is despite the fact that Bloomington's population has actually declined very slightly in the past few years, suggesting that either commercial/industrial waste generation and/or residential waste generated on a per capita basis have been increasing.

The methodology for calculating the City's emissions from solid waste disposal were as follows:

1. **Gather Raw Data:** Data was retrieved from the Indiana Department of Environmental Management (IDEM) for the years 2011–2024. The data was specifically filtered to only include waste originating from Monroe County, Indiana, and was limited to waste processed at "Municipal Solid Waste Landfills" and "Non-Municipal Solid Waste Landfills." The tonnage of solid waste received from Monroe County was collected for each year.

2. **Adjust for City-Level Estimation:** To approximate the amount of solid waste disposed of in landfills specifically at the City level, a population-based adjustment factor was applied to the Monroe County tonnage. This adjustment was calculated based on Bloomington's share of the population within Monroe County.

3. **Calculate Methane Emissions:** The total amount of methane (CH_4) emissions was calculated using the methane commitment estimate approach as described in the *Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC)*. Equation 8.4 was applied to calculate L_0, which represents the methane generation potential. The following parameters were used:
   - *Methane Correction Factor (MCF):* Assumed to be 1.0, indicating that landfills are anaerobic.
   - *Degradable Organic Carbon (DOC):* Set at 0.161 based on relevant literature.
   - *DOC Fraction (DOC_f):* Set at 0.6.
   - *Fraction of Methane in Landfill Gas (F):* Set at 0.5.
   - *Methane Recovery Fraction (f_{rec}):* Assumed to be 0.85 based on EPA recommendations for well-managed systems. However, since not all landfills have methane recovery systems, this recovery factor was not universally applied. Based on EPA data published in the Federal Register, it was assumed that 54% of U.S. landfills have methane recovery systems.

4. **Apply Oxidation Factor:** An oxidation factor of 0.1 was used, assuming all landfills in the dataset are well-managed. This accounts for the fraction of methane that is oxidized before it escapes into the atmosphere.

5. **Convert to CO_2 Equivalents:** The calculated metric tons of methane were then converted to metric tons of CO_2 equivalent ($MTCO_2e$) using the standard Global Warming Potential (GWP) value for methane provided by the IPCC. This conversion standardizes methane emissions based on their comparative impact on global warming relative to carbon dioxide.

Wastewater Treatment

Approximately 1.2% of Bloomington's emissions for the Solid Waste & Wastewater sector are due to emissions generated from the treatment and transport of wastewater throughout the City.

Emissions generated from the wastewater treatment process are highly dependent upon the specific industrial processes utilized during the treatment process. Wastewater is generally treated in a three-stage process. First, during primary treatment, physical processes like screening and sedimentation remove solid waste and larger particles from the water. Secondary treatment then employs biological processes where microorganisms break down organic matter and remove dissolved pollutants. Finally, tertiary treatment, also known as advanced treatment, uses additional chemical or physical processes such as filtration, disinfection, or nutrient removal to further polish the water to meet specific quality standards before discharge.

Emissions can be generated or mitigated at each stage of the treatment process. In the context of conducting a greenhouse gas inventory, generally three different possible sources of emissions are evaluated:

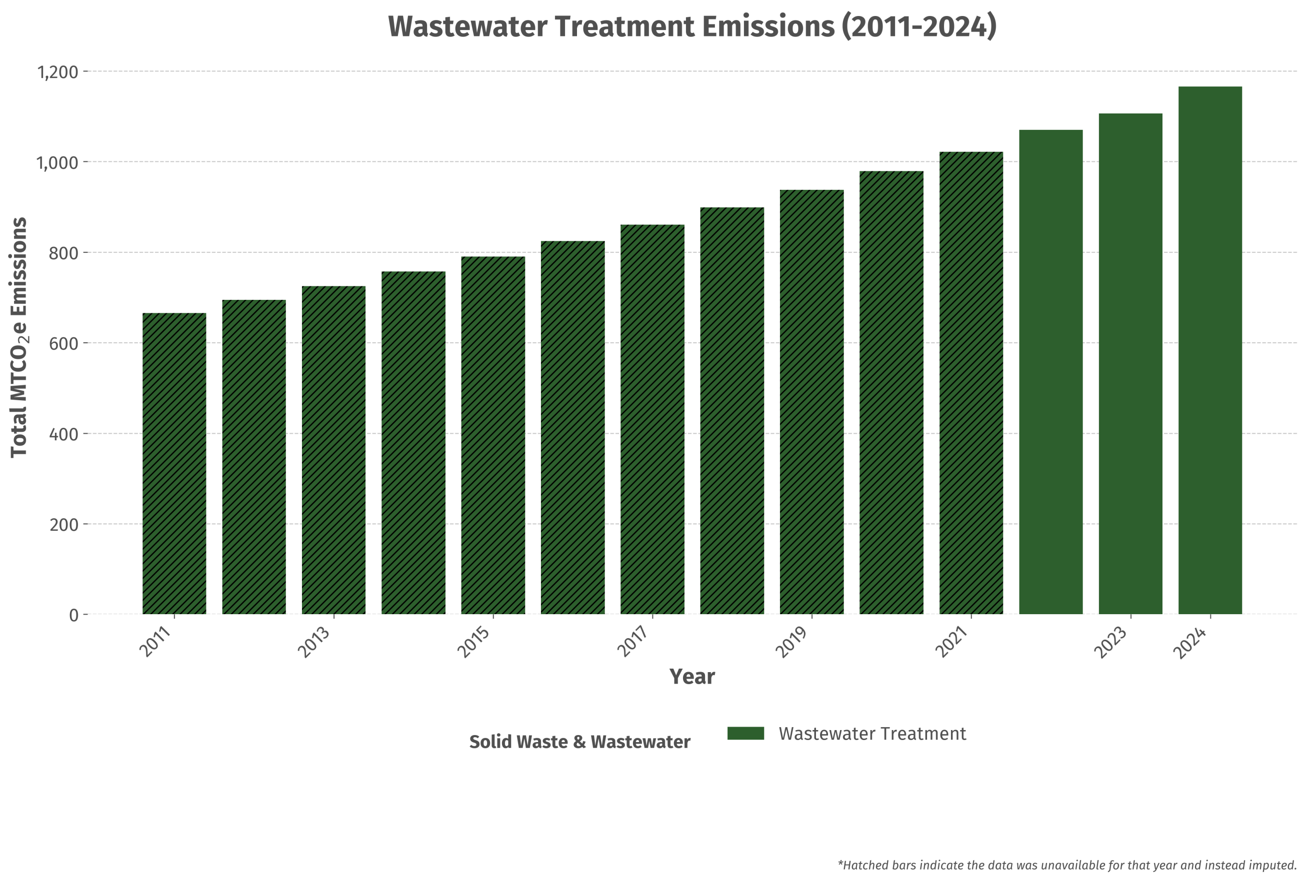
- **Methane (CH_4) Emissions from Secondary Treatment:** Carbon dioxide and methane are produced during the biological processes used to break down organic matter in the secondary treatment phase. Secondary treatment can be divided into either aerobic or anaerobic treatment processes, based on the amount of oxygen that is present during the decomposition process. Aerobic treatment, occurring in the presence of oxygen, is generally preferred as it produces primarily biogenic CO_2 and minimal methane emissions. In contrast, anaerobic treatment occurs without oxygen and produces significant methane emissions which are more potent in their contribution to global warming.

- **Methane (CH_4) Emissions from Use of an Anaerobic Digestor:** Some wastewater treatment plants employ the use of an anaerobic digestor to break down solid organic waste (sludge) and reduce its volume. Anaerobic digestors produce biogas which can be used as a fuel source (e.g., to be combusted and provide power to wastewater treatment plant or other biogas-powered systems in the area) or flared to prevent direct methane emissions to the atmosphere. Emissions are produced as a result of both the combustion and flaring processes and must be accounted for accordingly.

- **Nitrous Oxide (N_2O) Emissions from Nitrification/Denitrification:** Nitrification and denitrification are biological processes used to remove nitrogen from wastewater. Nitrification converts ammonia to nitrate under aerobic conditions, while denitrification converts nitrate to nitrogen gas under anoxic conditions. These processes can produce nitrous oxide as a by-product, which is a potent greenhouse gas that must be accounted for within the greenhouse gas inventory.

The City of Bloomington Utilities (CBU) operates two wastewater treatment facilities—the Dillman Road and Blucher-Poole plants—that contribute to the City's greenhouse gas emissions profile. At both facilities, CBU employs aerobic digestion for secondary treatment, which helps minimize methane emissions compared to anaerobic alternatives. Neither facilities utilize anaerobic digestors to process solid waste, so associated emissions from this category were excluded from the calculations. Additionally, like all wastewater treatment plants, CBU's facilities emit nitrous oxide as a byproduct of removing nitrogen from the wastewater stream, which is then discharged in the treated effluent. The utility follows standard industry practices for sludge management, with no additional emissions from processes such as incineration.

Beginning with this inventory, the City adopted a more accurate, measurement-based methodology for these N_2O emissions. Rather than estimating emissions from population and assumed per-capita protein consumption, CBU now reports the actual nitrogen load discharged in each plant's treated effluent, drawn directly from the plants' monitoring surveys. This empirical approach yields a more reliable estimate that is specific to Bloomington's two facilities.



As the chart demonstrates, N_2O emissions are the primary driver of emissions at these plants, whereas CH_4 emissions from aerobic treatment result in effectively zero net emissions due to the more environmentally friendly nature of this treatment method.

Direct effluent measurements are available for 2022 through 2024, over which emissions rose modestly from approximately 1,070 to 1,166 $MTCO_2e$. Earlier years, for which survey data was not collected, are estimated through interpolation and shown with hatching in the chart above.

Wastewater Treatment Emissions and Measured Effluent Load, by Year

Year	Blucher-Poole WWTP (kg N/day)	Dillman Road WWTP (kg N/day)	N_2O Emissions ($MTCO_2e$)
2022	141	563	1,070
2023	189	539	1,106
2024	186	581	1,166

Because both facilities use aerobic digestion and neither operates an anaerobic digestor, CH_4 emissions from secondary treatment are effectively zero, and emissions resulting from the use of an anaerobic digestor are not applicable. The City's wastewater treatment emissions therefore consist entirely of N_2O. The methodology for calculating these N_2O emissions was as follows:

1. **Gather Raw Data:** The nitrogen load discharged in each plant's treated effluent (in kilograms of nitrogen per day) was obtained directly from CBU for both of its wastewater treatment plants—Blucher-Poole and Dillman Road—for 2022 through 2024, as measured in the plants' monitoring surveys.

2. **Apply the Effluent Emission Factor:** The IPCC emission factor for N_2O from nitrogen discharged to wastewater (0.01 kg N_2O-N per kg N) was applied to the measured nitrogen load to estimate the quantity of nitrogen emitted as N_2O-N.

3. **Convert N_2O-N to N_2O:** The N_2O-N was converted to N_2O using the molecular weight ratio of 1.57 (44/28), and the daily rate was scaled to an annual total.

4. **Convert to CO_2 Equivalents:** The resulting annual N_2O emissions in metric tons were converted to CO_2 equivalents ($MTCO_2e$) using the global warming potential (GWP) factor for nitrous oxide, which accounts for its higher warming potential compared to CO_2.

This effluent-based approach replaces the prior methodology, which estimated N_2O from the City's population and assumed per-capita protein consumption using Equation 8.12 of the GPC. Because the new method relies on empirical, plant-specific measurements rather than population proxies, it produces a substantially more accurate estimate of the City's wastewater emissions.

Industrial Processes & Product Use

Explanation for Exclusion from Inventory

The Industrial Processes & Product Use (IPPU) sector within the *Global Protocol for Community-Scale Emissions (GPC)* framework includes two sub-sectors: industrial processes and product use, which focus solely on scope 1 (direct) emissions occurring within a city's boundaries.

Industrial Processes refer to emissions resulting from chemical or physical transformations during manufacturing and other industrial activities. Common examples include emissions from cement production or chemical manufacturing. However, in Bloomington, large-scale industrial processes that can be distinctly accounted for are minimal. Much of the emissions activity from industrial operations is already captured under other sectors, particularly stationary energy, where emissions from fuel combustion and grid-supplied electricity are included. Isolating additional emissions from industrial processes separately was neither feasible nor necessary when compiling this inventory.

Product Use includes emissions from the use of products that contain or release greenhouse gases, such as solvents and refrigerants like hydrofluorocarbons (HFCs). Obtaining reliable data for product use proved challenging due to the decentralized nature of the activities, as well as concerns around privacy and confidentiality, particularly for small businesses and residential users. This made it impossible to gather the necessary data to quantify emissions in this sub-sector.

Given these limitations, neither sub-sector could be calculated for the 2024 GHG inventory. As a result, no data is presented for the Industrial Processes & Product Use sector in this report.

Agriculture, Forestry, & Other Land Use

Explanation for Exclusion from Inventory

The Agriculture, Forestry, and Other Land Use (AFOLU) sector under the *Global Protocol for Community-Scale Emissions (GPC)* is divided into three sub-sectors: livestock, land, and aggregate sources and non-CO_2 emission sources on land. This sector generally tracks emissions from activities related to agriculture and land management, both of which contribute to greenhouse gas emissions through various mechanisms. However, given Bloomington's urbanized nature, this sector is largely irrelevant in the context of the City's emissions profile.

Livestock emissions refer to methane (CH_4) and nitrous oxide (N_2O) produced by animal digestion (enteric fermentation) and manure management. These emissions are significant in areas with large agricultural activity, particularly in rural regions with high concentrations of livestock such as cattle or poultry. Since Bloomington is primarily a residential and commercial college town with minimal agricultural activity, there are no significant livestock emissions to account for in this inventory.

Land emissions capture the carbon fluxes associated with changes in land use, such as deforestation, afforestation, or reforestation. Changes in vegetation cover, whether through clearing forests for development or adding green spaces, impact carbon storage. However, as Bloomington is a highly urbanized environment, there is limited land-use change of this nature, making emissions from this sub-sector negligible.

Aggregate sources and non-CO_2 emission sources on land include emissions from the use of synthetic fertilizers, soil cultivation, and the management of organic soils. These activities are typically associated with agricultural areas that require intensive land management, but Bloomington lacks the large-scale farming operations that would contribute to emissions from these sources.

For these reasons, emissions from the AFOLU sector have been marked as "not occurring" using GPC's notation system and excluded from the 2024 GHG inventory. The City's predominantly urban landscape and lack of significant agricultural activities make this sector unnecessary to evaluate for this report.

Municipal Operations Inventory

An inventory of greenhouse gas emissions due to the operations and activities of the municipal local government.

Overview

Introduction

The Municipal Operations Greenhouse Gas (GHG) Inventory focuses on emissions from government-owned and operated facilities, vehicles, and infrastructure within the City of Bloomington. This inventory covers all GHG emissions resulting from the City's local government operations for the 2024 calendar year.

The term "local government" can encompass a variety of entities serving different purposes, such as special districts, school boards, and other public authorities. However, in the context of this inventory, it specifically refers to the general-purpose government that is officially incorporated to serve the residents of Bloomington ("the City government").

This inventory focuses on emissions from activities and assets over which the local government has **operational control**—those areas where it has the authority and ability to drive emissions reductions. While this includes obvious areas such as City-owned buildings like City Hall, it also extends to other government-led organizations like City of Bloomington Utilities (CBU). As the owner and operator of public-sector organizations like CBU, the local government is responsible for emissions from these organizations too. Given the high energy use of many these organizations' infrastructure and facilities, accounting for their emissions is critical in providing a full picture of how municipal operations contributes to global emissions.

Municipal inventories are vital tools for several reasons:

- They help the local government understand its direct environmental impact.
- They identify opportunities for emissions reduction in government-managed activities.
- They guide policy decisions to improve operational efficiency and sustainability.
- They provide benchmarks for future performance, helping the city meet climate goals.

Inventory Methodology

This municipal operations inventory was completed using ICLEI's *Local Government Operations (LGO) Protocol*, which provides a clear and standardized approach for calculating GHG emissions from local government activities. The LGO Protocol ensures that all emission sources tied to government functions are comprehensively captured, offering a robust framework for consistent tracking and reporting.

The Municipal Operations Inventory covers emissions from city-owned buildings, vehicle fleets, water treatment facilities, streetlights, and waste management services. By isolating municipal activities from broader community emissions, this report provides actionable insights specific to the City's own carbon footprint.

Emissions Scopes

Similar to the community-wide inventory, the municipal operations inventory categorizes emissions into three distinct scopes based on the type and location of the emissions source.

- **Scope 1** covers direct emissions from sources owned or controlled by the local government, such as fuel combustion in City-owned vehicles or the natural gas used to heat municipal buildings.

- **Scope 2** includes indirect emissions from the consumption of purchased electricity, steam, or heating and cooling services for government operations, such as the electricity used in City Hall or at city-run facilities like water treatment plants.
- **Scope 3** accounts for other indirect emissions that occur as a consequence of government activities but are produced by sources not owned or controlled by the city. This includes emissions from waste generated by government operations and employee commutes to city offices.

These three scopes provide a comprehensive framework for understanding the full extent of emissions resulting from municipal operations.

Prior Inventories

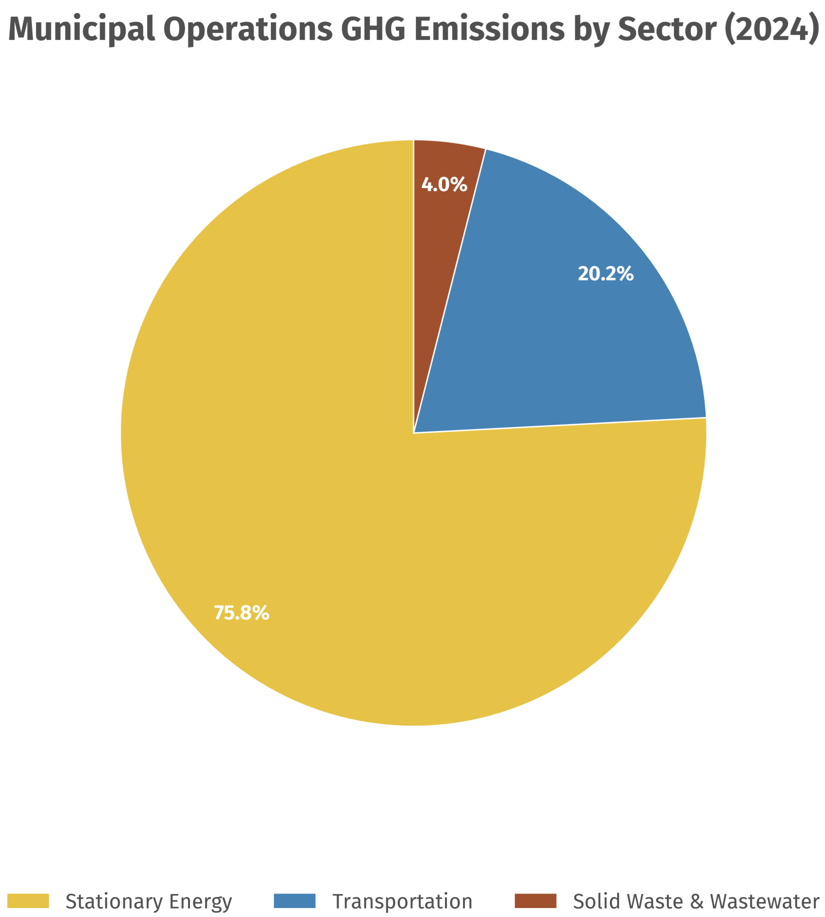
The City of Bloomington first conducted a municipal operations inventory in 2023, so this inventory now serves as the second year of data and enables initial year-over-year comparisons. The 2023 baseline inventory established a comprehensive understanding of the City's operational emissions for the first time.

By building upon that foundation, this 2024 inventory allows municipal leaders to begin identifying key sources of emissions and tracking whether emissions reduction strategies are having an effect. It also continues to strengthen the framework for tracking municipal emissions on a year-over-year basis and aligning municipal operations with the broader City-wide climate goals.

Overall Trends

A Breakdown of Municipal Operations Emissions

The City of Bloomington is estimated to have contributed approximately 29,422 metric tons of CO_2e emissions due to its municipal operations in the calendar year of 2024. As shown in the pie chart below, the majority of emissions (75.8%) are from the stationary energy sector. The remaining emissions came from the transportation (20.2%) and solid waste & wastewater (4.0%) sectors respectively.



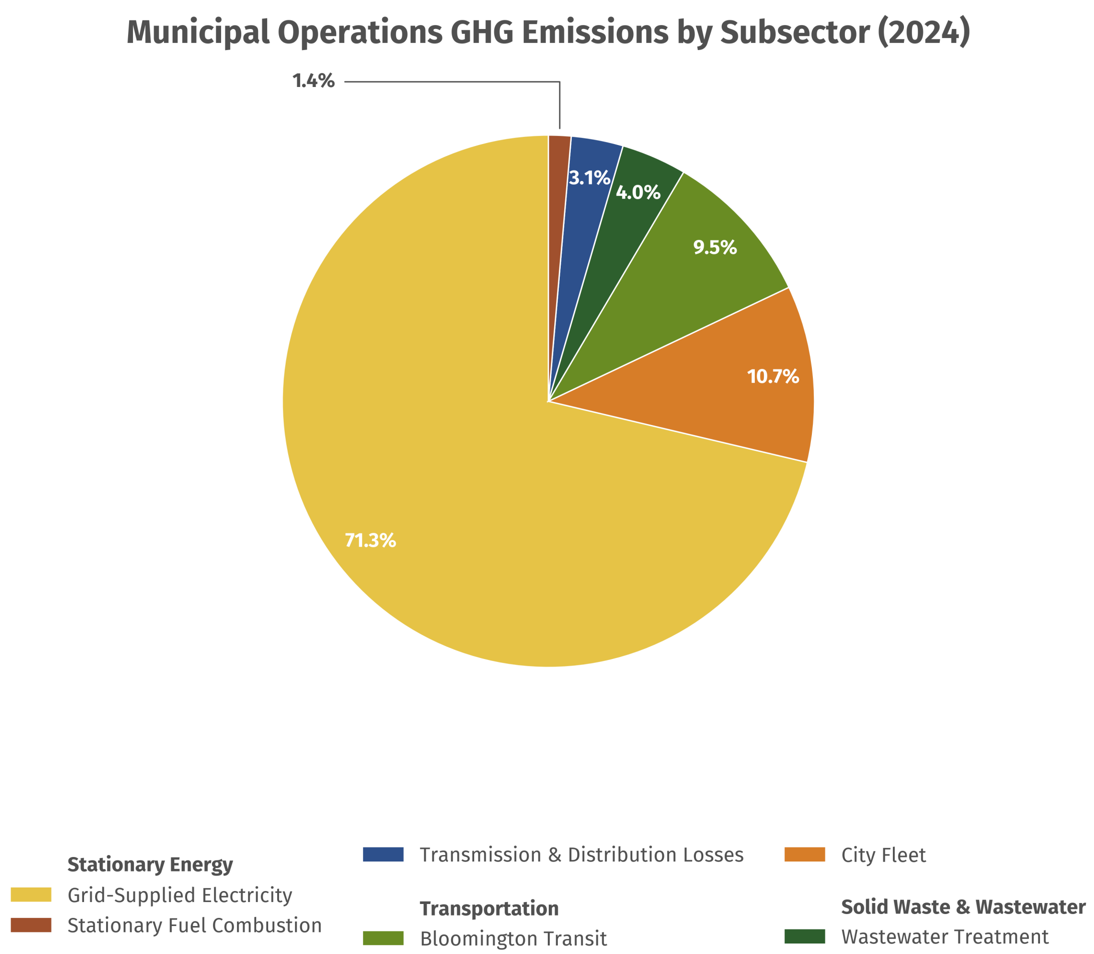
Emissions from each sector can be further segmented by their constituent sub-sectors which describe the different types of emission sources within each sector.

The following are some high-level observations about the breakdown of emissions on a sub-sector level for the municipal operations inventory:

- **The stationary energy sector accounts for the vast majority of municipal operations emissions (75.8%), driven largely by the grid-supplied electricity (GSE) consumed at the City's wastewater treatment plants and drinking water treatment plant.** These are large, industrial facilities that provide essential services to essentially all of the City's residents and produce a significant number of emissions through their energy-intensive processes. Both facilities already host on-site solar PV systems that offset a portion of their electricity demand, but their overall energy needs remain substantial. Further reducing electricity consumption or expanding renewable generation capacity at these plants would be a consequential and high-leverage way to continue driving down municipal operations emissions.

- **The transportation sector is the second-largest source of municipal emissions at 20.2%, which is similar to these sectors' relationship in the community-wide inventory.** About a fifth of municipal emissions are attributable to the City's operational fleet and public transit system run by Bloomington Transit. In the community-wide inventory, the same is the case with stationary energy generating nearly three times the number of emissions as the transportation sector.
- **Within the Transportation sector, most emissions can be attributed to the municipal fleet, but public transportation is not far behind.** The municipal fleet refers to the City's operational fleet of vehicles used by local government departments in their everyday work such as the police's patrol vehicles and the landscaping team's trucks. The municipal fleet makes up 10.7% of overall emissions, whereas Bloomington Transit which facilitates the local bus and paratransit system in the City generates 9.5% of municipal emissions.

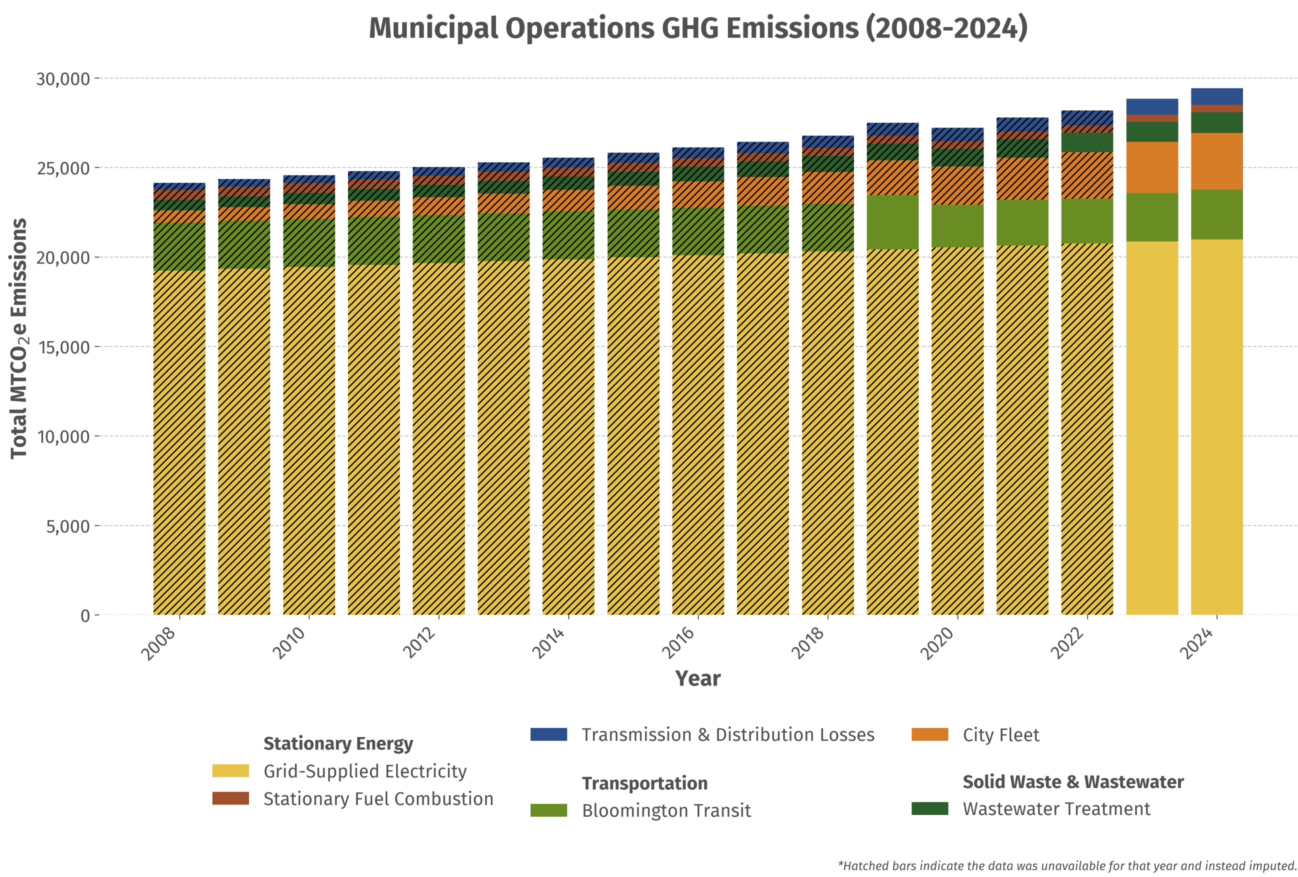
A pie chart of municipal operations emissions broken out by each sub-sector is included below.



Understanding Historical Emissions

Just like with the community-wide inventory, comparing year-over-year emissions for the municipal operations inventory is a powerful way to understand how emissions have changed over time. With the addition of 2024 data alongside the 2023 baseline, the City can now begin to identify emerging trends. For years prior to 2023, significant data limitations made it difficult to retrieve historical data for the municipal operations inventory.

However, an estimate of historical emissions has been provided below. It relies on an interpolation method similar to the one employed in the community-wide inventory. One difference is that a number of sub-sectors for municipal emissions contained only a single data point (i.e., the data for calendar year 2023), which makes this interpolation method infeasible. To resolve this problem, a slope approximation method based on the community-wide inventory was employed for these specific sub-sectors instead.[1]



The above graph demonstrates a few trends in Bloomington's municipal operations inventory over the years:

[1] To explain in more detail: the graph estimates historical emissions data for years where it was unavailable, using two methods: (1) Interpolation: When at least two data points were available, the graph uses interpolation to estimate values for the missing years. (2) Slope approximation: For sub-sectors with only one data point (e.g., 2023 data for municipal grid-supplied electricity), the graph uses the rate of change from the corresponding community-wide sub-sector (where historical data was more readily available) to estimate earlier years' emissions. This method assumes that municipal operations emissions changed at a similar rate to community-wide emissions in the same sub-sector. These techniques allow the graph to show a complete historical emissions trend, even when data for some years or sub-sectors was limited.

- **The City's wastewater treatment plants are consistently the greatest source of emissions for every year inventoried.** The historical emissions graph further underpins the importance of this effort and how high-leverage the opportunity it is for reducing municipal emissions.
- **Most sub-sectors have seen a gradual decrease in emissions year-over-year, except for those attributed to the energy used in powering streetlights and traffic signals.** The City is currently undergoing the process of transitioning to LED streetlights which are both more cost-effective and require less energy to power. This will hopefully reduce what has been an otherwise relatively constant and non-declining source of emissions since 2008.
- **The Transportation sector will likely be the most difficult sector to decarbonize in the coming years.** Transportation, made up by the municipal fleet and operational fleet administered by Bloomington Transit, are significant contributors to municipal emissions. Whereas the City's grid-supplied electricity sub-sectors have decarbonized gradually over the years without significant City-led investment (due to investment in renewables by the upstream utility companies like Duke Energy), the transportation sector will require significant capital investment to electrify the City's large fleet of operational vehicles. This will require significant budgetary foresight and financial prudence and will be a much more fragmented transition than just installing a single anaerobic digestor system at Dillman Wastewater Treatment Plant or procuring renewable energy via the centralized utility company.

The rest of this chapter explores each sector and sub-sector described in this overview section in more detail, providing a more in-depth understanding of the drivers of Bloomington's emissions from municipal operations in 2024 and years prior.

Stationary Energy

Introduction

Emissions from the Stationary Energy sector represent 75.8% of Bloomington's total emissions from municipal operations. Unlike the community-wide inventory where stationary energy was the largest sector by overall share of emissions, in the municipal operations context, stationary energy is driven almost entirely by the electricity consumed at the City's large water treatment facilities.

Stationary Energy is primarily broken down into three sub-sectors, just as it is for the Community-Wide Inventory:

- **Grid-Supplied Electricity:** Emissions from the combustion of fossil fuels to generate electricity and transmit it via the power grid for use in powering municipal buildings and facilities.
- **Transmission and Distribution:** Emissions resulting from energy losses that occur during the transmission and distribution of electricity from power plants to municipal end users. These losses are mainly due to resistance in power lines and equipment inefficiencies.
- **Stationary Fuel Combustion:** Emissions generated directly from burning fossil fuels such as natural gas, propane, or oil on-site in municipal buildings and facilities for heating or other energy-related needs.

Stationary fuel combustion for municipal operations is measured directly from the natural gas consumed across the City of Bloomington Utilities facilities supplied by CenterPoint Energy. The bulk comes from the three most energy-intensive sites—the Blucher-Poole and Dillman Road wastewater treatment plants and the Monroe drinking water treatment plant—with the remainder from several smaller CBU accounts. As in the community-wide inventory, grid-supplied electricity and its associated transmission and distribution losses remain by far the dominant components of the sector, but on-site fuel combustion is now accounted for explicitly rather than estimated as a proxy.

Grid-Supplied Electricity and Transmission & Distribution Losses

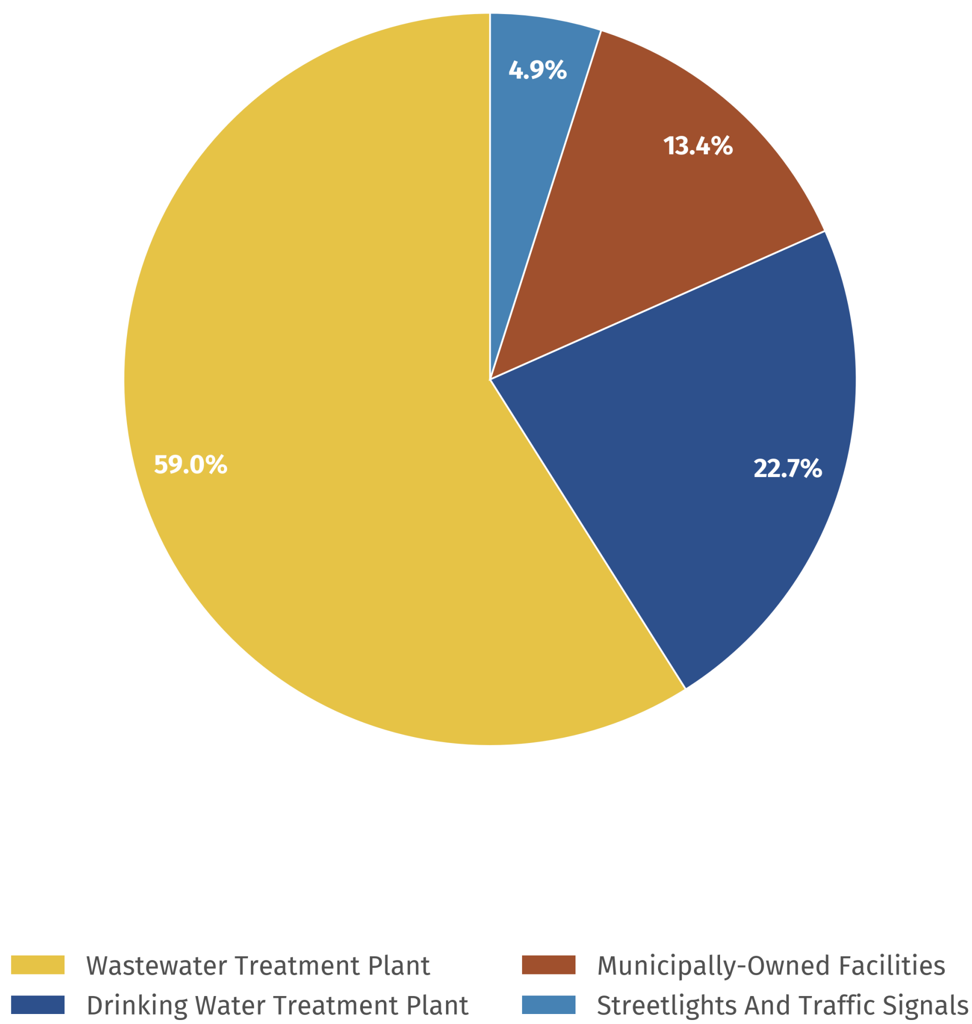
As previously mentioned, grid-supplied electricity is the sub-sector which refers to emissions generated in supplying electricity to power buildings, facilities, and machinery within the inventory boundaries —in this case, just for municipal operations purposes. Closely related to this sub-sector are emissions resulting from losses during the transmission and distribution (T&D) of that electricity to its end destination.

T&D losses are an inevitable result of energy dissipating as heat when electricity travels through power lines and transformers, leading to inefficiencies in the grid. These losses mean that for every kilowatt-hour of energy consumed within Bloomington, some additional percentage of energy had to be generated to compensate for the lost energy during transmission. As a result, the actual emissions associated with electricity use by municipal end users are slightly higher than the amount of electricity consumed would suggest, due to these grid inefficiencies. Those emissions are accounted for as "T&D Losses" within the inventory.

A breakdown of emissions from the grid-supplied electricity sub-sector is shown in the pie chart below. The majority of electricity-related emissions for municipal operations are the result of powering the

City's wastewater treatment facilities. These are large, industrial facilities (and some of the only, major industrial facilities within the City boundaries), so it's sensible that they account for a majority of electricity-related emissions. The wastewater treatment figure reflects both of CBU's plants—the Dillman Road facility, served by Duke Energy, and the Blucher-Poole facility north of the City, served by the rural electric cooperative SCI REMC—along with a small number of additional CBU accounts served by UDWI.[2]

Municipal Grid-Supplied Electricity by Facility (2024)



The remaining amount of emissions are from providing electricity to power municipally-owned buildings, streetlights & traffic lights, and the Monroe Water Treatment Plant.

[2] The Blucher-Poole plant and the UDWI accounts lie outside Duke Energy's service territory and the City limits, so they do not appear in the community-wide inventory. They are nonetheless owned and operated by City of Bloomington Utilities, and the Local Government Operations Protocol calls for accounting for all emissions from owned and controlled assets regardless of location.

The table below provides a breakdown of emissions from sub-sector broken down by category and year.

Grid-Supplied Electricity Emissions from Municipal Operations, by Category and Year ($MTCO_2e$)

Year	Municipally-Owned Facilities	Wastewater Treatment Plants	Streetlights & Traffic Signals	Drinking Water Treatment Plant
2023	3,085	12,084	1,061	4,636
2024	2,822	12,371	1,029	4,758

Note that while the Monroe Water Treatment Plant services not just the City of Bloomington but also nearby jurisdictions, the entirety of the plant's estimated emissions are included in this municipal operations inventory. This is because the City of Bloomington owns and controls 100% of the water treatment plant, and the Local Government Operations Protocol calls for accounting for all emissions from owned and controlled assets, regardless of where the end users are located.

The methodology for calculating emissions from this sub-sector was identical to the analysis utilized in the Community-Wide Inventory, except adapted to use only consumption data from municipal operations:

1. **Gather Raw Data:** Total annual energy consumption in kilowatt-hours (kWh) for each year and category (municipally-owned facilities, wastewater treatment plants, the local drinking water treatment plant, and streetlights & traffic signals) is collected. For the City of Bloomington, the bulk of this data was obtained from the local utility, Duke Energy. Electricity consumption for the Blucher-Poole wastewater treatment plant and a small number of other CBU accounts located outside Duke's service territory was obtained from their respective providers—SCI REMC and UDWI—and folded into the wastewater treatment plants category.

2. **Calculate Emissions:** The EPA's eGRID emissions factors are used to calculate total emissions for CO_2, CH_4, and N_2O. eGRID provides region-specific emissions factors that reflect the energy mix (e.g., coal, natural gas, renewable energy) used to generate the electricity consumed in Bloomington.

3. **Convert to Metric Tons:** The emissions calculated in pounds (lbs) for each greenhouse gas are converted to metric tons, as metric tons are the standard unit used in greenhouse gas reporting.

4. **Convert to CO_2 Equivalents:** The metric tons of each gas are converted to metric tons of CO_2 equivalent ($MTCO_2e$). This step accounts for the global warming potential (GWP) of each gas, where methane (CH_4) and nitrous oxide (N_2O) have a higher GWP than carbon dioxide (CO_2).

5. **Aggregate Emissions:** The $MTCO_2e$ values for each greenhouse gas are summed to obtain the total standardized emissions by year and category. This aggregated data provides a comprehensive view of Bloomington's grid-supplied electricity emissions from municipal operations and helps identify trends over time.

Next, emissions from transmission and distribution losses were calculated for each category described above to provide a better picture of total emissions stemming from the consumption of grid-supplied electricity for municipal operations. The following methodology was applied:

1. **Calculate the T&D Loss Rate:** Table 10 from the Energy Information Administration's (EIA) *State Electricity Profile for Indiana* was used. Using the Energy Information Administration (EIA)'s preferred formula, the estimated rate for T&D losses was calculated by dividing the estimated losses by the result of total disposition minus direct use. For 2024, the EIA data gives a total disposition of 111,855,804 MWh, direct use of 7,221,008 MWh, and estimated losses of 4,629,542 MWh, yielding a T&D loss rate of approximately 4.42%.

2. **Apply the Loss Rate:** After determining the T&D loss rate, it was applied to each category of $MTCO_2e$ emissions for stationary energy. This allowed for the calculation of the proportional increase in emissions due to energy lost during transmission and distribution, which occurs upstream of actual stationary energy consumption within the inventory boundaries.

The table below provides an estimate of transmission and distribution losses which occurred in the use of grid-supplied electricity for municipal operations.

Transmission & Distribution Losses Emissions from Municipal Operations, by Category and Year ($MTCO_2e$)

Year	Municipally-Owned Facilities	Wastewater Treatment Plants	Streetlights & Traffic Signals	Drinking Water Treatment Plant
2023	130	510	45	196
2024	125	547	46	211

As the table shows, stationary energy emissions increase a small amount due to these transmission and distribution losses. For the calendar year 2024, the estimated T&D loss rate was approximately 4.42%, resulting in an aggregate of approximately 929 additional metric tons of CO_2 emissions.

Stationary Fuel Combustion

In addition to grid-supplied electricity, the City combusts fossil fuels directly on-site to meet the energy needs of its operations. For municipal operations, these emissions come entirely from natural gas, supplied by CenterPoint Energy, and are concentrated at the three most energy-intensive facilities the City operates—the Blucher-Poole and Dillman Road wastewater treatment plants and the Monroe drinking water treatment plant—though a number of smaller City of Bloomington Utilities accounts contribute as well. Natural gas is used at these facilities for purposes such as space and process heating.

Stationary fuel combustion contributed approximately 403 $MTCO_2e$ in 2024, a small share (roughly 1.4%) of total municipal operations emissions but a meaningful component of the stationary energy sector. The Dillman Road wastewater treatment plant is the largest single source, reflecting its higher natural gas consumption. The table below breaks down emissions by facility and year; the smaller City of

Bloomington Utilities accounts—the Service Center, the SC Booster station, the Tamarron lift station, and the S. Washington storage facility—are grouped together under “Other CBU facilities.”

Stationary Fuel Combustion Emissions from Municipal Operations, by Source and Year ($MTCO_2e$)

Year	Blucher-Poole WWTP	Dillman Road WWTP	Monroe Drinking Water Plant	Other CBU facilities	Total
2023	86	182	71	72	411
2024	107	163	63	70	403

The methodology for calculating these emissions mirrors the approach used for stationary fuel combustion in the community-wide inventory:

1. **Gather Raw Data:** Total annual natural gas consumption, in therms, was collected for each facility from CenterPoint Energy for both 2023 and 2024.
2. **Convert to Energy Units:** Consumption in therms was converted to millions of British thermal units (mmBtu), the unit basis for the EPA emissions factors.
3. **Calculate Emissions:** The EPA’s emissions factors for natural gas combustion were applied to determine emissions of CO_2, CH_4, and N_2O, which were then converted to their CO_2 equivalent ($MTCO_2e$) using the appropriate global warming potential factors and summed by facility and year.

Note that only natural gas combustion could be quantified at the municipal operations level; emissions from any other on-site fuels (such as propane or fuel oil) were not separately available and are assumed to be negligible relative to natural gas at these facilities.

Transportation

Introduction

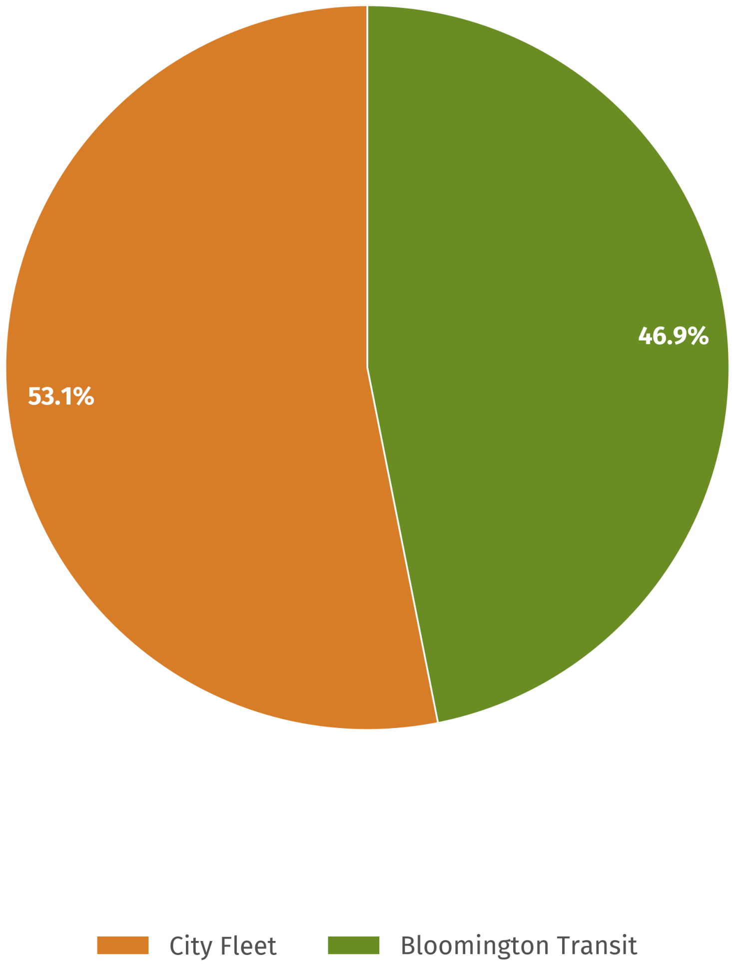
Emissions from the Transportation sector represent 20.2% of Bloomington's total emissions from municipal operations—making this the second largest source of emissions for the local government.

Transportation-related emissions can stem from a variety of different sources, but the majority of these emissions are attributable to two sub-sectors:

- **Local Government Operational Fleet:** Vehicles used by various city departments, such as public works, police, and other administrative services.
- **Public Transportation:** Vehicles used for facilitating public transportation services, which includes fixed-route buses, paratransit vehicles, and shuttles used by residents.

The pie chart below shows a breakdown of transportation-related emissions from municipal operations and the relative percentages of the two sub-sectors described above. For the City of Bloomington, the majority of emissions (53.1%) originate from the City's operational fleet, whereas public transit makes up the remaining number of emissions (46.9%).

Municipal Transportation Emissions Breakdown (2024)



The table below includes a breakdown of transportation-related emissions from municipal operations on a year-by-year basis.[3]

Transportation Emissions from Municipal Operations, by Sub-Sector and Year ($MTCO_2e$)

Year	City of Bloomington Fleet	Bloomington Transit
2019	–	3,027
2020	–	2,372

[3]Historical emissions dating back to 2019 were able to be calculated for Bloomington Transit. However, only emissions from 2023 onwards were calculated for the City of Bloomington's Fleet, as fuel-transaction records were not available for earlier years.

Year	City of Bloomington Fleet	Bloomington Transit
2021	–	2,546
2022	–	2,505
2023	2,868	2,696
2024	3,158	2,786

Local Government Operational Fleet

The City of Bloomington's fleet encompasses over 500 different vehicles used by various departments and government authorities under the City's operational control.

While detailed historical data and vehicle-level mileage information could not be gathered due to limitations with the City's fleet maintenance software, a breakdown of the fleet by class (light, medium, or heavy-duty) and engine type (traditional combustion vs. electric) was calculated.

The majority of Bloomington's operational fleet consists of light-duty vehicles such as sedans or lightweight pickup trucks. Around a fifth of the vehicles are medium-duty in nature such as large vans or trailers. Heavy-duty vehicles, while the largest producers of emissions, make up a small percentage of the City's overall fleet (5.4%).

The City has only recently begun to explore vehicle electrification in recent years, so just 2.1% of the overall fleet is electric. However, vehicle electrification is significantly picking up in pace in municipalities across the US and the City of Bloomington's long-term plans aim toward full vehicle electrification. This means the percentage of vehicles which are electric should increase in the years to come. This is important because vehicle electrification is the primary way that the City can reduce its transportation-related emissions, so this will be an important metric to track in the coming years.

The methodology for calculating emissions from this sub-sector was as follows:

1. **Data Collection:** Total annual fuel consumption for the City's fleet—gallons of unleaded gasoline and diesel (the latter inclusive of off-road diesel)—was obtained from the City of Bloomington's Fleet Department for both 2023 and 2024, sourced from the "Product Summary for All Transactions" in the Fleet Department's fuel-transaction records. Separately, a vehicle list exported from the Fleet Department's tracking system was used to characterize the composition of the fleet by class (light, medium, or heavy-duty) and engine type (combustion vs. electric). Because per-vehicle fuel use and vehicle-level mileage were not consistently available, this list informed the fleet-composition breakdown rather than the emissions calculation itself. Data from years prior to 2023 was not available, as historical fuel records were not accessible.

2. **CO_2 Emissions Calculation:** The total gallons of gasoline and diesel consumed were multiplied by the Environmental Protection Agency's (EPA) emissions factors for mobile combustion—8.78 kg CO_2 per gallon of motor gasoline and 10.21 kg CO_2 per gallon of diesel fuel—to calculate carbon dioxide (CO_2) emissions by fuel type. Because emissions track fuel combustion directly, this metered fuel consumption is the primary driver of the fleet's emissions.

3. **Estimation of Vehicle Miles Traveled:** Because the EPA's CH_4 and N_2O emissions factors for mobile combustion are expressed on a per-mile basis, vehicle miles traveled (VMT) were derived by dividing the total fuel consumption by an assumed average fuel economy. These fuel-economy assumptions were applied by vehicle class (light, medium, and heavy-duty), consistent with the assumptions used for community-wide on-road transportation emissions.

4. **CH_4 and N_2O Emissions Calculation:** The resulting VMT was multiplied by the EPA's per-mile emissions factors for methane (CH_4) and nitrous oxide (N_2O) to determine the quantity of each gas generated annually, by fuel type.

5. **Global Warming Potential Conversion:** Emissions of CH_4 and N_2O were converted to their respective carbon dioxide equivalent ($MTCO_2e$) using the global warming potential (GWP) factors. This conversion ensured that emissions were comparable across gases with different climate impacts.

6. **Aggregation of Results:** Finally, emissions of CO_2, CH_4, and N_2O were aggregated across both fuel types to produce a total emissions figure for the City of Bloomington's municipal fleet, expressed in metric tons of CO_2 equivalent ($MTCO_2e$), providing a clear picture of the fleet's impact on greenhouse gas emissions.

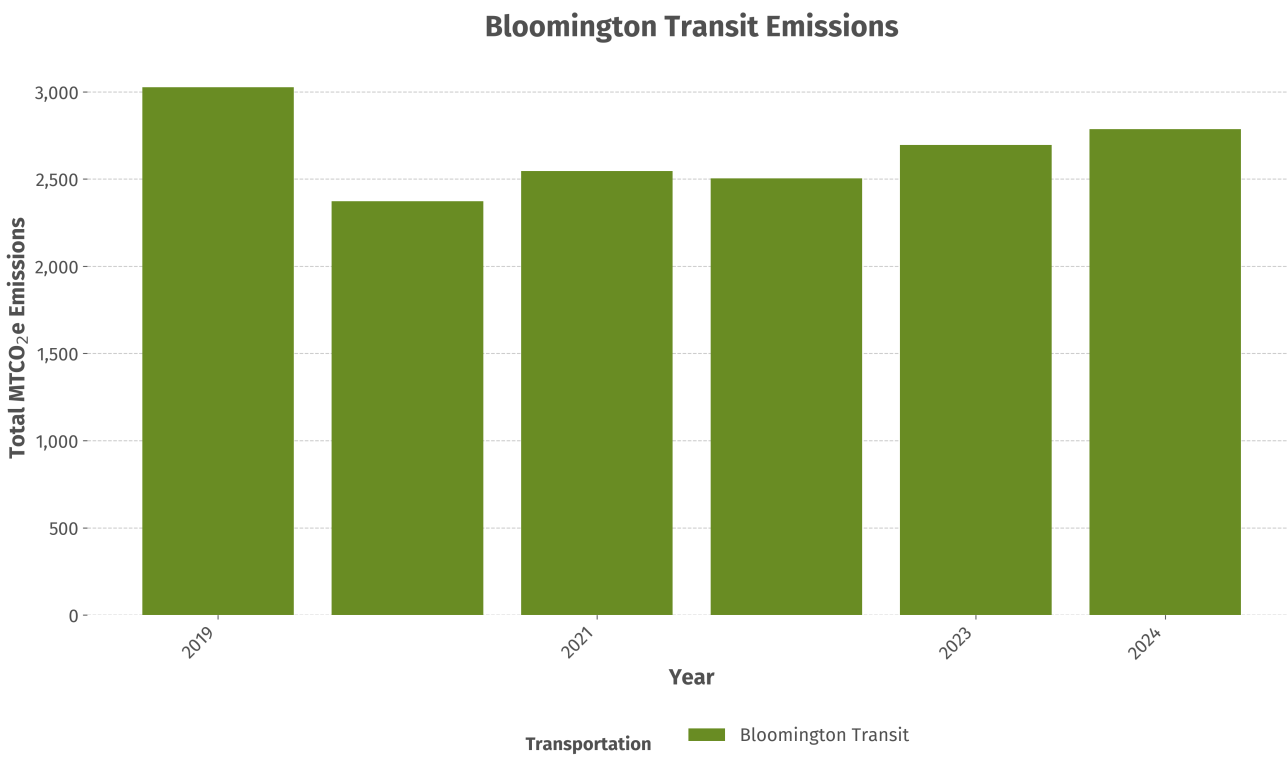
Public Transportation

Public transportation accounts for a substantial portion (46.9%) of Bloomington's transportation-related emissions from municipal operations. Decarbonizing this sub-sector is a priority, as electric buses offer cleaner air and improved fuel efficiency. Although electric bus technology isn't as far along as that for electric sedans and SUVs—posing challenges like higher upfront costs, limited range, and charging infrastructure needs—ongoing advancements continue to make the transition to sustainable public transit increasingly feasible.

Bloomington Transit, the primary provider of public transportation within the City, offers a variety of different transportation services for residents, including both fixed-route and paratransit vehicles.

- **Fixed-route vehicles** follow predetermined routes and schedules, serving high-traffic areas with frequent stops, making them a reliable option for commuters and daily riders.
- **Paratransit vehicles** provide flexible, on-demand transportation for individuals with disabilities or mobility challenges, offering door-to-door service to ensure accessibility for all residents.

The bar chart below shows total emissions from Bloomington Transit's operations since 2019, broken out by year.[4] Since the primary driver of vehicle emissions is the mobile combustion of fuel, emissions track fuel consumption closely.



Bloomington Transit's emissions dropped sharply from 2019 to 2020 and have since risen modestly through 2024, from 2,546 $MTCO_2e$ in 2021 to 2,786 $MTCO_2e$ in 2024. The agency began purchasing electric

[4]The metric for total gallons of fuel consumed each year accounts for the mobile combustion of both gasoline and diesel fuel.

buses in 2021 and as of the end of 2024 operates 41 fixed-route buses, 18 of which are electric—representing approximately 44% of its fixed-route fleet.

The methodology for calculating emissions from this sub-sector was as follows:

1. **Data Collection:** Data was sourced from Bloomington Transit, which provided annual fuel consumption figures as well as vehicle counts by year. The fuel consumption data was disaggregated by type of service provided. Since the shuttles operated in partnership with Indiana University were not consistent with Bloomington Transit's other data, they were excluded from the analysis.

2. **Assumption of Fuel Economy:** The assumptions used for the community-wide on-road transportation emissions were applied to estimate the fuel economy by vehicle class. Specifically, Bloomington Transit's fixed-route buses and paratransit vehicles were classified as medium-duty, while staff cars were categorized as light-duty vehicles.

3. **CO_2 Emissions Calculation:** The total fuel consumption for each vehicle class (medium and light-duty) was combined with the Environmental Protection Agency (EPA) emissions factors for the combustion of gasoline or diesel fuel. This enabled the calculation of carbon dioxide (CO_2) emissions by year and by vehicle class.

4. **CH_4 and N_2O Emissions Calculation:** To estimate the vehicle miles traveled (VMT) for each class, the fuel consumption was divided by the assumed average fuel economy per vehicle class. The resulting VMT was multiplied by the EPA's emissions factors for methane (CH_4) and nitrous oxide (N_2O) to determine the quantities of each gas generated annually by vehicle class.

5. **Global Warming Potential Conversion:** The emissions of CH_4 and N_2O were converted to their carbon dioxide equivalent (CO_2e) values using the global warming potential (GWP) factors, allowing for consistent comparison of the greenhouse gas impacts across different gases.

6. **Aggregation of Results:** The emissions were aggregated across vehicle classes and types of gas (CO_2, CH_4, N_2O) to produce a total emissions profile for Bloomington Transit's vehicle operations in a given year, expressed in metric tons of CO_2 equivalent ($MTCO_2e$).

Solid Waste & Wastewater

Introduction

Emissions from the Solid Waste and Wastewater sector represent 4.0% of Bloomington's total municipal operations emissions. This sector encompasses the greenhouse gas emissions associated with the disposal and treatment of solid waste generated from City operations, as well as the treatment and transport of wastewater managed by City of Bloomington Utilities.

It's important to note that while the City has the ability to reduce its emissions from its own facilities, solid waste disposal emissions data for this sub-sector could not be collected from the City's Sanitation Department due to data availability limitations. This gap in data should be considered when interpreting the overall emissions picture for municipal operations.

Wastewater emissions, on the other hand, are fully accounted for in the municipal operations inventory, as the City of Bloomington Utilities are owned and operated by the City and were able to provide the necessary data.

As with community-wide emissions, solid waste emissions in municipal operations primarily result from the decomposition of organic matter in landfills. When waste decomposes in anaerobic conditions (without oxygen), it produces methane (CH_4), a potent greenhouse gas.

Wastewater treatment processes contribute to emissions through three main mechanisms. First, methane (CH_4) emissions can occur during secondary treatment, where the biological breakdown of organic matter produces both carbon dioxide and methane, depending on the presence or absence of oxygen. Second, anaerobic digestion, used to treat sewage sludge, generates additional methane, which can be captured for energy recovery or flared to reduce emissions. Third, nitrification and denitrification processes, used to remove nitrogen from wastewater, produce nitrous oxide (N_2O), a potent greenhouse gas. Additionally, electricity consumed in operating wastewater treatment facilities contributes to emissions, which are already accounted for in the Stationary Energy sector of the Municipal Operations Inventory.

The distribution of emissions between solid waste and wastewater treatment in the municipal operations context may differ from the community-wide data due to the specific nature of city-controlled operations and the aforementioned data limitations for solid waste. A precise breakdown of these emissions sources for municipal operations would require further data collection and analysis.

The table below includes the relevant emissions data for this sector. Note that the emissions from wastewater treatment are identical to the emissions listed in the community-wide inventory since the City has full operational control over wastewater treatment facilities through the City of Bloomington Utilities (CBU), meaning all of these emissions must be accounted for in the municipal operations inventory.

Solid Waste & Wastewater Emissions from Municipal Operations, by Sub-Sector and Year ($MTCO_2e$)

Year	Solid Waste	Wastewater Treatment
2022	–	1,070
2023	–	1,106
2024	–	1,166

Wastewater Treatment

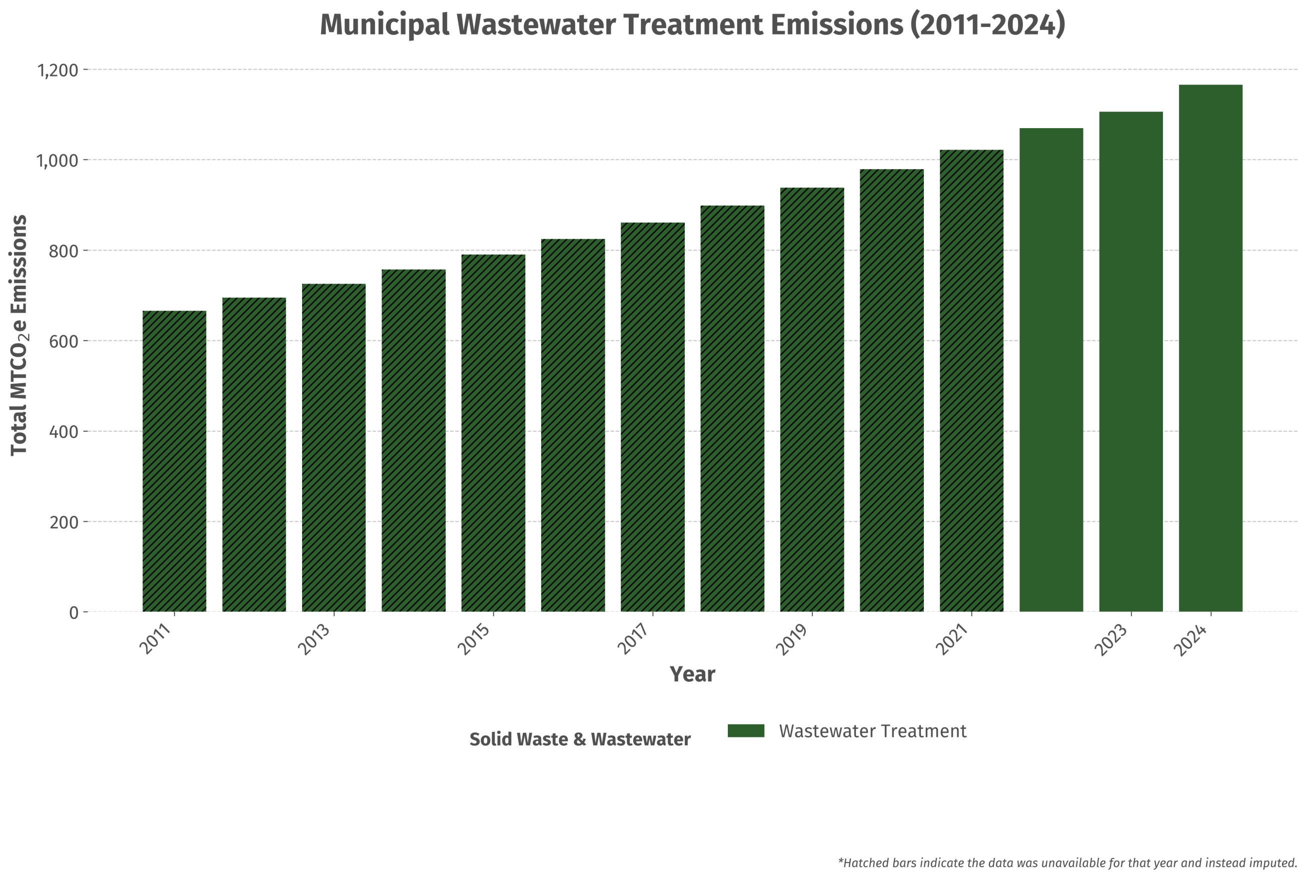
In the context of Bloomington's municipal operations inventory, wastewater treatment emissions are identical to those reported in the community-wide inventory. This is because the City of Bloomington Utilities, which manages wastewater treatment, is entirely controlled by the local government. Consequently, all emissions from this sector must be fully accounted for in the municipal operations inventory.

As previously discussed in the community-wide inventory, emissions from this sub-sector come from three sources primarily:

- **Methane (CH_4) Emissions from Secondary Treatment:** Carbon dioxide and methane are produced during the biological processes used to break down organic matter in the secondary treatment phase. Secondary treatment can be divided into either aerobic or anaerobic treatment processes, based on the amount of oxygen that is present during the decomposition process. Aerobic treatment, occurring in the presence of oxygen, is generally preferred as it produces primarily biogenic CO_2 and minimal methane emissions. In contrast, anaerobic treatment occurs without oxygen and produces significant methane emissions which are more potent in their contribution to global warming.
- **Methane (CH_4) Emissions from Use of an Anaerobic Digestor:** Some wastewater treatment plants employ the use of an anaerobic digestor to break down solid organic waste (sludge) and reduce its volume. Anaerobic digestors produce biogas which can be used as a fuel source (e.g., to be combusted and provide power to wastewater treatment plant or other biogas-powered systems in the area) or flared to prevent direct methane emissions to the atmosphere. Emissions are produced as a result of both the combustion and flaring processes and must be accounted for accordingly.
- **Nitrous Oxide (N_2O) Emissions from Nitrification/Denitrification:** Nitrification and denitrification are biological processes used to remove nitrogen from wastewater. Nitrification converts ammonia to nitrate under aerobic conditions, while denitrification converts nitrate to nitrogen gas under anoxic conditions. These processes can produce nitrous oxide as a by-product, which is a potent greenhouse gas that must be accounted for within the greenhouse gas inventory.

The City of Bloomington Utilities (CBU) operates two wastewater treatment facilities—the Dillman Road and Blucher-Poole plants—that contribute to the City's greenhouse gas emissions profile. At both facilities, CBU employs aerobic digestion for secondary treatment, which helps minimize methane emissions compared to anaerobic alternatives. Neither facilities utilize anaerobic digestors to process solid waste, so associated emissions from this category were excluded from the calculations. Additionally, like all wastewater treatment plants, CBU's facilities emit nitrous oxide as a byproduct of removing nitrogen from the wastewater stream, which is then discharged in the treated effluent. The utility follows standard industry practices for sludge management, with no additional emissions from processes such as incineration.

The bar chart below shows aggregate emissions from wastewater treatment in the City of Bloomington. There are two primary wastewater treatment plants, one located on Dillman Rd and another on Blucher Poole Rd, which together treat the entirety of Bloomington's wastewater.



As discussed in the community-wide section, N_2O emissions are the primary driver of emissions at these plants, whereas CH_4 emissions from aerobic treatment result in effectively zero net emissions. Direct effluent measurements are available for 2022 through 2024, with earlier years estimated through interpolation and shown with hatching above.

For the municipal operations inventory, it's crucial to note that these emissions represent a significant portion of the City's direct operational impact. Efforts to reduce these emissions through improved treatment technologies could have a substantial effect on the City's overall emissions profile.

The methodology for calculating emissions from this sub-sector is identical to that used in the community-wide inventory. Because both plants use aerobic digestion and neither operates an anaerobic digestor, CH_4 emissions are effectively zero, so the City's wastewater emissions consist entirely of N_2O. Beginning with this inventory, those N_2O emissions are calculated directly from the nitrogen load measured in each plant's treated effluent—reported by CBU from its wastewater treatment plant surveys—rather than estimated from population and assumed per-capita protein consumption. The measured nitrogen load is multiplied by the IPCC effluent emission factor (0.01 kg N_2O-N per kg N), converted from N_2O-N to N_2O using the 1.57 molecular-weight ratio, annualized, and converted to $MTCO_2e$ using the global warming potential for nitrous oxide. This empirical, plant-specific approach yields a more accurate estimate than the prior population-based method.

Industrial Processes & Product Use

Explanation for Exclusion from Inventory

The Industrial Processes and Product Use (IPPU) sector within the *Local Government Operations (LGO) Protocol* includes two sub-sectors: industrial processes and product use. For municipal operations, this sector primarily focuses on fugitive emissions from specific equipment and systems used in city-owned facilities and operations.

In the context of Bloomington's municipal operations, the primary sources of IPPU emissions are:

- **Fugitive Emissions from Refrigerants:** These emissions are associated with Heating, Ventilation, and Air Conditioning (HVAC) systems in city-owned buildings and facilities. Refrigerants, such as hydrofluorocarbons (HFCs), can leak during operation, maintenance, or disposal of these systems.

- **Fugitive Emissions from Fire Suppression Equipment:** This includes emissions from fire extinguishers and other fire prevention systems installed in municipal buildings and vehicles. These systems often contain gases that can contribute to greenhouse gas emissions if released.

Similar to the community-wide inventory, calculating emissions for this sector in municipal operations presents several challenges related to data availability. The City's Public Works Department does not currently track the data required to calculate fugitive emissions, and the methods which can be used to calculate proxies of these emissions were also missing the required inputs to be considered accurate and meet the inventory's required quality standards.

For these reasons, specific calculations for the IPPU sector have not been included due to these data collection and quantification challenges.

A Note Regarding Emissions from Fire Suppression Equipment

While the City's Public Works Department does not have data available to estimate fugitive emissions, they noted that the City has entirely transitioned away from conventional fire extinguishers toward water-vapor-based equipment.

These eco-friendly fire extinguishers do not release fugitive emissions compared to their traditional counterparts which use foam, carbon dioxide, or other emissions-generating chemicals for fire suppression. As a result, while approximate fugitive emissions from municipal operations cannot be estimated, the City likely has lower fugitive emissions than its peers of equivalent size.

Concluding Remarks & Appendices

Some remarks to conclude this report and a set of appendices including a detailed breakdown of emissions sources and accompanying glossary.

Concluding Remarks

This 2024 Greenhouse Gas Inventory Report represents the most exhaustive and comprehensive analysis of emissions ever conducted for the City of Bloomington. Notably, this report marks a significant milestone, as it includes, for the second consecutive year, a dedicated Municipal Operations Inventory alongside the Community-Wide Inventory. This achievement underscores the City's commitment to understanding and addressing its environmental impact at all levels.

This report is part of a broader effort to establish a yearly reporting mechanism around greenhouse gas emissions in the City of Bloomington.

Changes and Improvements from the 2023 Inventory

The most significant methodological change in this year's inventory is the adoption of Google Environmental Insights Explorer (EIE) as the primary data source for on-road transportation emissions. The 2023 inventory relied on traffic sensor data from the Indiana Department of Transportation (INDOT) and vehicle registration records from the Indiana Bureau of Motor Vehicles (INBMV) to estimate vehicle miles traveled within city boundaries. That approach counted only miles driven on roads physically within the city limits, which systematically undercounted emissions by excluding the out-of-boundary portions of trips that originated or terminated in Bloomington.

The updated methodology uses Google EIE's GPC-compliant induced traffic model, which attributes 100% of in-boundary trip miles and 50% of the out-of-boundary portion of transboundary trips to the city. This is consistent with the Global Protocol for Community-Scale GHG Emission Inventories and aligns Bloomington with a growing number of peer cities, including Boulder, CO; Madison, WI; Berkeley, CA; and Lawrence, KS. The result is a more complete and accurate picture of transportation-related emissions, which now account for 24.5% of total community-wide emissions compared to 14.8% under the prior methodology.

This year's inventory also adopts a more accurate, measurement-based methodology for wastewater treatment emissions. In prior inventories, the nitrous oxide (N_2O) emissions that make up effectively all of the City's wastewater footprint were estimated indirectly from the City's population and an assumed per-capita protein consumption, following the default GPC equation. For this inventory, City of Bloomington Utilities provided direct measurements of the nitrogen load discharged in each treatment plant's effluent, drawn from the plants' monitoring surveys. Applying the IPCC effluent emission factor to these empirical, plant-specific loads produces a substantially more reliable estimate. The new method revises the City's 2024 wastewater emissions to approximately 1,166 $MTCO_2e$, down from the roughly 2,116 $MTCO_2e$ that the population-based approach would have estimated, underscoring how much more precise direct measurement can be.

Opportunities for the Future

While this report represents a significant step forward in understanding Bloomington's emissions profile, there remain opportunities for future improvement, particularly in data collection and analysis. Several data sources, especially for the Municipal Operations Inventory, were unavailable or incomplete, which limited the ability to calculate emissions for all sub-sectors that the relevant emissions protocols recommend.

Although the bulk of emissions from major sources in both the Community-Wide and Municipal Operations inventories was successfully accounted for, there is potential to further refine and expand upon the analysis included here. Building stronger partnerships with data providers and implementing more comprehensive data tracking systems where they don't already exist will be crucial in addressing these gaps in future years.

Some specific areas for future improvement for the community-wide inventory include:

- More detailed data on industrial processes and product use within city limits
- Improved estimates of emissions from urban green spaces and small-scale agriculture
- Enhanced data on off-road vehicle and equipment usage
- Detailed waste characterization studies for more precise methane generation estimates

And some areas of improvement for the municipal operations inventory are:

- Detailed mileage data for the City's vehicle fleet
- Comprehensive data on refrigerant use in municipal HVAC systems located in City-owned facilities
- Data on the volume and type of solid waste generated in municipal operations
- Enhanced data collection on employee commuting patterns and other Scope 3-related emissions sources

By addressing these data gaps, future inventories can provide an even more comprehensive picture of Bloomington's emissions, further enhancing the City's ability to target and reduce its carbon footprint effectively.

Acknowledgments

This report reflects the collective effort of many individuals and organizations whose contributions were essential to its completion. The ClimateNav Team wishes to recognize and thank the following:

- Our external data partners, including Duke Energy, CenterPoint Energy, Google Environmental Insights Explorer, the Indiana Department of Environmental Management, and the Monroe County Airport, for providing reliable data and continuing to build the streamlined reporting infrastructure that makes annual inventories possible.
- City departments across Public Works, Fleet, Utilities, and Bloomington Transit, whose staff devoted time and resources to compiling the operational data that underpins the Municipal Operations Inventory.
- The City of Bloomington Sustainability Team, whose consistent focus on evidence-based policymaking and close collaboration with ClimateNav shaped every stage of this report.
- Zachary Ammerman, a member of the Bloomington Commission on Sustainability and Resilience, for researching peer-city transportation methodologies and advocating that the community-wide inventory additionally leverage Google Environmental Insights Explorer data.
- Mayor Kerry Thomson and the City Council, whose continued leadership on climate policy ensures that emissions accounting remains a core municipal priority.

ClimateNav looks forward to deepening these partnerships in the years ahead as Bloomington's annual inventory program matures.

Above all, we encourage residents, businesses, and community organizations to engage with this data and join the City in advancing meaningful climate action for the benefit of current and future generations.

Appendix A: Breakdown of Emissions for Community-Wide Inventory

The table below provides an overview of the sectors, sub-sectors, and categories included in the community-wide inventory, along with the data provider and applicable GPC reporting notation for each.

The GPC reporting notations used in the tables below are defined as follows:

- **Included (I):** The emissions source is estimated and included in the inventory.
- **Included Elsewhere (IE):** The emissions source is estimated but included in aggregate in another category of the inventory.
- **Not Estimated (NE):** The emissions source cannot be estimated due to data limitations.
- **Not Occurring (NO):** The emission source does not exist within the City of Bloomington, or it produces a relatively small number of emissions that are difficult to quantify in aggregate.
- **Confidential (C):** The emissions data is confidential and not able to be publicly reported.

This structured breakdown allows for a clear understanding of which emission sources are included, where data gaps exist, and what potential opportunities exist for expanding reporting in future inventories.

STATIONARY ENERGY

Category	Scope	Description	Notation	Data Provider	Reporting Level
Residential buildings	1	On-site natural gas combustion in residential buildings.	Included (I)	CenterPoint Energy	BASIC
Residential buildings	2	Grid-supplied electricity consumption in residential buildings.	Included (I)	Duke Energy	BASIC
Residential buildings	3	T&D losses from grid-supplied electricity consumption in residential buildings.	Included (I)	Duke Energy	BASIC
Commercial and institutional buildings and facilities	1	On-site natural gas combustion in commercial and institutional buildings.	Included (I)	CenterPoint Energy	BASIC+

Category	Scope	Description	Notation	Data Provider	Reporting Level
Commercial and institutional buildings and facilities	2	Grid-supplied electricity consumption in commercial and institutional buildings. Voluntarily reporting the sub-categories of Commercial & Non-Government Institutional and Government separately.	Included (I)	Duke Energy	BASIC
Commercial and institutional buildings and facilities	3	T&D losses from grid-supplied electricity consumption in commercial and institutional buildings. Voluntarily reporting the sub-categories of Commercial & Non-Government Institutional and Government separately.	Included (I)	Duke Energy	BASIC+
Manufacturing industries and construction	1	On-site natural gas combustion in industrial buildings.	Included (I)	CenterPoint Energy	BASIC
Manufacturing industries and construction	2	Grid-supplied electricity consumption in industrial facilities.	Included (I)	Duke Energy	BASIC
Manufacturing industries and construction	3	T&D losses from grid-supplied electricity consumption in industrial facilities.	Included (I)	Duke Energy	BASIC+
Energy industries	1	Included elsewhere in Scope 3, Stationary Energy: Commercial and institutional buildings and facilities and Scope 3, Stationary Energy: Manufacturing industries and construction. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Energy industries	2	Included elsewhere in Scope 2, Stationary Energy: Commercial and institutional buildings and facilities and Scope 2, Stationary Energy: Manufacturing industries and construction. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC

Category	Scope	Description	Notation	Data Provider	Reporting Level
Energy industries	3	Included elsewhere in Scope 3, Stationary Energy: Commercial and institutional buildings and facilities and Scope 3, Stationary Energy: Manufacturing industries and construction. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC+
Energy generation supplied to the grid	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	Territorial
Energy generation supplied to the grid	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Energy generation supplied to the grid	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Agriculture, forestry, and fishing activities	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Agriculture, forestry, and fishing activities	2	Included elsewhere in Scope 2, Stationary Energy: Commercial and institutional buildings and facilities. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Agriculture, forestry, and fishing activities	3	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Non-specified sources	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Non-specified sources	2	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC

Category	Scope	Description	Notation	Data Provider	Reporting Level
Non-specified sources	3	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC+
Fugitive emissions	1	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–	BASIC
Fugitive emissions	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Fugitive emissions	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

TRANSPORTATION

Category	Scope	Description	Notation	Data Provider	Reporting Level
On-Road Transportation	1	GPC-compliant induced traffic emissions from on-road transportation using the Google Environmental Insights Explorer.	Included (I)	Google Environmental Insights Explorer	BASIC
On-Road Transportation	2	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
On-Road Transportation	3	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–	BASIC+
Railways	1	N/A – Emissions from this category could not be calculated due to reasons of data confidentiality and privacy.	Confidential (C)	–	BASIC
Railways	2	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Railways	3	N/A – Emissions from this category could not be calculated due to reasons of data confidentiality and privacy.	Confidential (C)	–	BASIC+
Water Transport	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Water Transport	2	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Water Transport	3	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC+

Category	Scope	Description	Notation	Data Provider	Reporting Level
Aviation	1	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable. This category encompasses flights which start and stop within the inventory boundaries (e.g., short helicopter rides) which are fairly rare, so emissions from this category are insignificant.	Not Estimated (NE)	–	BASIC
Aviation	2	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Aviation	3	Aviation fuel consumption by flights with an origin or destination point within the inventory boundaries.	Included (I)	Monroe County Airport	BASIC+
Off-Road Transportation	1	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–	BASIC
Off-Road Transportation	2	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy	BASIC
Off-Road Transportation	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

SOLID WASTE & WASTEWATER

Category	Scope	Description	Notation	Data Provider	Reporting Level
Solid waste generated in the city disposed in landfills or open dumps	1	Included elsewhere in Solid Waste & Wastewater, Scope 3: Solid waste generated in the city disposed in landfills or open dumps.	Included Elsewhere (IE)	Indiana Department of Environmental Management	BASIC
Solid waste generated in the city disposed in landfills or open dumps	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated in the city disposed in landfills or open dumps	3	Municipal solid waste (MSW) and non-MSW disposed in landfills within the state of Indiana (inside or outside of the City boundaries). Includes waste generated both inside and outside of the city—cannot be disaggregated further due to data limitations.	Included (I)	Indiana Department of Environmental Management	BASIC
Solid waste generated outside the city disposed in landfills or open dumps	1	Included elsewhere in Solid Waste & Wastewater, Scope 3: Solid waste generated in the city disposed in landfills or open dumps.	Included Elsewhere (IE)	Indiana Department of Environmental Management	Territorial
Solid waste generated outside the city disposed in landfills or open dumps	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated outside the city disposed in landfills or open dumps	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

Category	Scope	Description	Notation	Data Provider	Reporting Level
Solid waste generated in the city that is treated biologically	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Solid waste generated in the city that is treated biologically	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated in the city that is treated biologically	3	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	–
Solid waste generated outside the city that is treated biologically	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	Territorial
Solid waste generated outside the city that is treated biologically	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated outside the city that is treated biologically	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated in the city incinerated or burned in the open	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC
Solid waste generated in the city	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

Category	Scope	Description	Notation	Data Provider	Reporting Level
incinerated or burned in the open					
Solid waste generated in the city incinerated or burned in the open	3	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–	BASIC
Solid waste generated outside the city incinerated or burned in the open	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	Territorial
Solid waste generated outside the city incinerated or burned in the open	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Solid waste generated outside the city incinerated or burned in the open	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Wastewater generated in the city	1	CH_4 and N_2O emissions from wastewater treatment at in-boundary wastewater treatment plants, with N_2O calculated from the measured nitrogen load in treated effluent.	Included (I)	City of Bloomington Utilities	BASIC
Wastewater generated in the city	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Wastewater generated in the city	3	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC

Category	Scope	Description	Notation	Data Provider	Reporting Level
Wastewater generated outside the city	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	Territorial
Wastewater generated outside the city	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Wastewater generated outside the city	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

INDUSTRIAL PROCESSES & PRODUCT USE

Category	Scope	Description	Notation	Data Provider	Reporting Level
Industrial Processes	1	N/A – Emissions from this category could not be calculated due to reasons of data confidentiality and privacy.	Confidential (C)	–	BASIC+
Industrial Processes	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Industrial Processes	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Product Use	1	N/A – Emissions from this category could not be calculated due to reasons of data confidentiality and privacy.	Confidential (C)	–	BASIC+
Product Use	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Product Use	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

AGRICULTURE, FORESTRY, & OTHER LAND USE

Category	Scope	Description	Notation	Data Provider	Reporting Level
Livestock	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC+
Livestock	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Livestock	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Land	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC+
Land	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

Category	Scope	Description	Notation	Data Provider	Reporting Level
Land	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Aggregate sources and non-CO_2 emission sources on land	1	N/A – No emissions of this type are substantially present within the inventory boundaries.	Not Occurring (NO)	–	BASIC+
Aggregate sources and non-CO_2 emission sources on land	2	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–
Aggregate sources and non-CO_2 emission sources on land	3	Non-applicable emissions for this scope according to GPC guidelines.	–	–	–

Appendix B: Breakdown of Emissions for Municipal Operations Inventory

The table below provides an overview of the sectors, sub-sectors, and categories included in this municipal operations inventory, along with the data provider and applicable GPC-inspired reporting notation for each.

While the *Local Government Operations (LGO) Protocol* does not dictate nor require a specific notation format, this inventory uses a derivative of GPC's notation format to provide maximal reporting clarity. The reporting notations used in the tables below are defined as follows:

- **Included (I):** The emissions source is estimated and included in the inventory.
- **Included Elsewhere (IE):** The emissions source is estimated but included in aggregate in another category of the inventory.
- **Not Estimated (NE):** The emissions source cannot be estimated due to data limitations.
- **Not Occurring (NO):** The emission source does not exist within the City of Bloomington, or it produces a relatively small number of emissions that are difficult to quantify in aggregate.
- **Confidential (C):** The emissions data is confidential and not able to be publicly reported.
- **Non-Controlling (NC):** The City of Bloomington does not have operational control over this emissions source, so it should be counted as part of the Community-Wide Inventory but not included in the Municipal Operations Inventory.

Note that this expands upon the GPC notation format by adding a category for Non-Controlling (NC) to specify cases where the City does not have operational control over a given emissions source. Without operational control, the City has a different scope of authority and policy control to mitigate these emissions, so the inventory excludes emissions from these sources and chooses to count them solely as part of the community-wide inventory instead.

STATIONARY ENERGY

Scope 1: Emissions from fuel combustion and fugitive emissions due to municipal operations.

Emissions Source	Description	Notation	Data Provider
Municipally-owned facilities, natural gas combustion	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–

Emissions Source	Description	Notation	Data Provider
Wastewater treatment plant, natural gas combustion	On-site natural gas combustion at the municipally-operated wastewater treatment plants on Dillman Road and Blucher Poole.	Included (I)	CenterPoint Energy
Water delivery facilities, natural gas combustion	On-site natural gas combustion at the municipally-operated Monroe drinking water treatment plant.	Included (I)	CenterPoint Energy
Power generation facilities, natural gas combustion and fugitive emissions	N/A – The City of Bloomington does not have operational control over power generation facilities.	Non-Controlling (NC)	–
Solid waste facilities, natural gas combustion	N/A – The City of Bloomington does not have operational control over solid waste facilities.	Non-Controlling (NC)	–
Port facilities, natural gas combustion	N/A – The City of Bloomington does not have operational control over port facilities.	Non-Controlling (NC)	–
Airport facilities, natural gas combustion	N/A – The City of Bloomington does not have operational control over airport facilities.	Non-Controlling (NC)	–

Scope 2: Emissions from consumption of grid-supplied energy due to municipal operations.

Emissions Source	Description	Notation	Data Provider
Municipally-owned facilities, electricity usage	Grid-supplied electricity consumption in municipally-operated facilities.	Included (I)	Duke Energy
Wastewater treatment plant, electricity usage	Grid-supplied electricity consumption at the municipally-operated wastewater treatment plants on Dillman Road and Blucher Poole.	Included (I)	Duke Energy; SCI REMC; UDWI
Streetlights and traffic signals, electricity usage	Grid-supplied electricity consumption for municipally-operated streetlights and traffic signals.	Included (I)	Duke Energy
Municipally-owned vehicle fleet, electricity usage	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy

Emissions Source	Description	Notation	Data Provider
Municipally-owned transit fleet, electricity usage	Included elsewhere in Scope 2, Stationary Energy: All categories. Unable to disaggregate the data further due to the data limitations.	Included Elsewhere (IE)	Duke Energy
Water delivery facilities, electricity usage	Grid-supplied electricity consumption at the municipally-operated Monroe drinking water treatment plant.	Included (I)	Duke Energy
Port facilities, electricity usage	N/A – The City of Bloomington does not have operational control over port facilities.	Non-Controlling (NC)	–
Airport facilities, electricity usage	N/A – The City of Bloomington does not have operational control over airport facilities.	Non-Controlling (NC)	–
Power generation facilities, electricity usage	N/A – The City of Bloomington does not have operational control over power generation facilities.	Non-Controlling (NC)	–
Power generation facilities, transmission & distribution losses	N/A – The City of Bloomington does not have operational control over power generation facilities.	Non-Controlling (NC)	–
Solid waste facilities, electricity usage	N/A – The City of Bloomington does not have operational control over solid waste facilities.	Non-Controlling (NC)	–
Steam purchased from third parties	N/A – The City of Bloomington does not purchase steam from third parties.	Not Occurring (NO)	–
District heating and cooling from third parties	N/A – The City of Bloomington does not purchase district heating and/or cooling from third parties.	Not Occurring (NO)	–

Scope 3: Not applicable.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

TRANSPORTATION

Scope 1: Emissions from fuel combustion and fugitive emissions in municipally-owned vehicles.

Emissions Source	Description	Notation	Data Provider
Municipally-owned vehicle fleet, fuel consumption	Fuel consumption for the municipally-owned vehicle fleet used in City operations. This includes CO_2, CH_4, and N_2O emissions.	Included (I)	City of Bloomington Fleet Department
Municipally-owned transit fleet, fuel consumption	Fuel consumption for the municipally-owned transit fleet used in public transportation. This includes CO_2, CH_4, and N_2O emissions.	Included (I)	Bloomington Transit
Municipally-owned vehicle fleet, fugitive emissions	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–
Municipally-owned transit fleet, fugitive emissions	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–

Scope 2: Not applicable.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

Scope 3: Not applicable.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

SOLID WASTE & WASTEWATER

Scope 1: Emissions from fuel combustion and fugitive emissions due to municipal operations.

Emissions Source	Description	Notation	Data Provider
Solid waste disposed of in municipally-operated landfills	N/A – The City of Bloomington does not have operational control over solid waste facilities.	Non-Controlling (NC)	–

Emissions Source	Description	Notation	Data Provider
Organic waste disposed of in municipally-operated composting facilities	N/A – The City of Bloomington does not have operational control over composting facilities.	Non-Controlling (NC)	–
Process emissions in municipally-operated wastewater treatment plants	CH_4 and N_2O emissions from wastewater treatment at municipally-operated wastewater treatment plants, with N_2O calculated from the measured nitrogen load in treated effluent.	Included (I)	City of Bloomington Utilities

Scope 2: Emissions from consumption of grid-supplied energy due to municipal operations.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

Scope 3: Not applicable.

Emissions Source	Description	Notation	Data Provider
Solid waste from municipal operations	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–
Organic waste from municipal operations	Organic waste from municipal operations disposed at composting facilities outside of the City's boundaries.	Not Occurring (NO)	–

Industrial Processes & Product Use

Scope 1: Emissions from fuel combustion and fugitive emissions due to municipal operations.

Emissions Source	Description	Notation	Data Provider
Fugitive emissions from refrigerants	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–
Fugitive emissions from fire suppression equipment	N/A – Emissions from this category could not be calculated due to the required data not existing or being unavailable.	Not Estimated (NE)	–

Scope 2: Emissions from consumption of grid-supplied energy due to municipal operations.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

Scope 3: Not applicable.

Emissions from this scope are not applicable to the Municipal Operations Inventory under the Local Government Operations Protocol.

Appendix C: Glossary

Aerobic Digestion
A biological wastewater treatment process that uses oxygen to break down organic matter. In the presence of oxygen, aerobic digestion primarily produces biogenic carbon dioxide (CO_2) and minimizes methane (CH_4) emissions, making it a preferred option for secondary treatment in well-managed facilities.

Anaerobic Digestor
An enclosed tank or system used to break down sewage sludge and other organic waste in the absence of oxygen. This process produces biogas, a mixture of methane (CH_4) and carbon dioxide (CO_2), which can be captured and combusted for energy recovery or flared to reduce greenhouse gas emissions.

BASIC/BASIC+ Reporting
Two levels of reporting under the GPC, with BASIC+ being more comprehensive and including more complex emissions sources.

Carbon Dioxide Equivalent (CO_2e)
A standard unit for measuring carbon footprints, usually expressed in metric tons ($MTCO_2e$). It expresses the impact of each different greenhouse gas in terms of the amount of CO_2 that would create the same amount of warming.

Category
A grouping of the end consumers who engage in emissions-generating activities (e.g., Residential buildings is a category that groups similar consumers of grid-supplied electricity and stationary fuel combustion). Note that this is the equivalent of the *Global Protocol for Community-Scale Emissions*'s use of the term "sub-sector," which has a different definition within this inventory.

Community-Wide Inventory
An inventory that accounts for all GHG emissions occurring within the city's geographic boundaries, from residential and commercial activities to industrial processes and transportation.

Degradable Organic Carbon (DOC)
A parameter in the calculation of methane emissions from waste disposal, representing the portion of organic carbon in waste that can degrade into methane under anaerobic conditions.

eGRID
The Emissions & Generation Resource Integrated Database, providing emissions factors for calculating electricity-related emissions and maintained by the US EPA. It divides the U.S. into regions based on grid interconnections, allowing for more accurately estimating emissions on a regional basis.

First Order of Decay (FOD)
An alternative method to calculate methane emissions from solid waste, accounting for the fact that organic waste emits methane over several decades as it decomposes. This method is more accurate than other approaches but requires historical waste data that is generally not available in most jurisdictions.

Fugitive Emissions
GHG emissions that are released during the use, maintenance, or disposal of equipment, such as leaks from HVAC systems, fire suppression systems, or on-site natural gas systems within inventory boundaries.

Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC)
The international standard for calculating and reporting city-scale GHG emissions. The GPC defines emissions into three "scopes" (Scope 1, 2, and 3) and provides levels of reporting such as BASIC and BASIC+.

Global Warming Potential (GWP)
A measure of how much heat a greenhouse gas traps in the atmosphere over a specific time period compared to carbon dioxide (CO_2). Methane (CH_4) and nitrous oxide (N_2O) have higher GWP values, reflecting their greater heat-trapping ability.

Greenhouse Gas (GHG) Inventory
A comprehensive accounting of GHG emissions produced by an entity over a specified period. It serves as a tool to understand emissions sources and develop climate action plans.

Local Government Operations (LGO) Protocol
A framework for calculating GHG emissions from local government activities, ensuring consistency and accuracy in tracking municipal emissions.

Methane Commitment (MC) Approach
A method for estimating methane emissions from solid waste disposal that assumes all future methane emissions from waste occur in the year the waste is deposited. This simplifies calculations by using current-year disposal data.

Methane Correction Factor (MCF)
Used in waste disposal emissions calculations to adjust for landfill conditions. An MCF of 1.0 is used for anaerobic landfills.

Municipal Operations Inventory
A separate inventory focusing on emissions from government-owned and operated facilities, vehicles, and infrastructure. It specifically only focuses on emissions which the local government has operational control over.

Nitrification/Denitrification
Biological processes used in wastewater treatment to remove nitrogen, producing nitrous oxide as a by-product.

Oxidation Factor
Applied in solid waste disposal calculations to account for the fraction of methane oxidized in landfills before it escapes into the atmosphere. In this report, an oxidation factor of 0.1 was used for well-managed landfills.

Sector
A broad grouping of emissions sub-sectors that share a function or activity (e.g., Stationary Energy or Transportation). Each sector represents a major contributor to global greenhouse gas emissions.

Scope 1 Emissions
Direct emissions from sources within the city boundary, such as fuel combustion in buildings or vehicles. An example of Scope 1 emissions would be the emissions resulting from natural gas combustion in residential homes.

Scope 2 Emissions
Indirect emissions from the consumption of grid-supplied electricity, heat, or steam within the city boundary. An example of Scope 2 emissions would be the emissions resulting from generating electricity at a coal-fired power plant outside of the city's boundaries but used within the city to power homes.

Scope 3 Emissions
Other indirect emissions that occur outside the city boundary due to activities taking place within the city, such as emissions from the upstream production and transportation of fuel. An example of Scope 3 emissions would be the emissions resulting from the disposal of waste generating inside of the City boundaries but landfilled elsewhere.

Stationary Energy
Emissions from energy used to power residential, commercial, and industrial buildings, as well as

other facilities that consume energy for heating, cooling, lighting, and powering appliances and machinery.

Stationary Fuel Combustion
Emissions resulting from the burning of fuels (such as natural gas, oil, or coal) in fixed equipment or facilities, including boilers, furnaces, and engines, primarily for purposes like heating, industrial processes, or power generation within buildings or plants.

Sub-Sector
A more granular description of where emissions within a given sector originate from (e.g., grid-supplied electricity is a sub-sector of the stationary energy sector). Note that the *Global Protocol for Community-Scale Emissions* has a different definition of sub-sector, but the definition shown here is used throughout the report instead as it more commonly reflects the way inventories are presented in the United States.

Transmission and Distribution (T&D) Losses
Energy lost during the process of delivering electricity from power plants to end users.

Vehicle Miles Traveled (VMT)
A measure of the total miles driven by vehicles within the city boundary. VMT data is used to estimate emissions from transportation, typically multiplied by emissions factors for CO_2, CH_4, and N_2O.

Contact

City of Bloomington
bloomington.in.gov/sustainability
sustain@bloomington.in.gov

ClimateNav
climatenav.com
info@climatenav.com