CITY OF BLOOMINGTON

# 2022 Greenhouse Gas Inventory

COMMUNITY-WIDE
GREENHOUSE
GAS
INVENTORY

2019-2022

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# 01
# Letter from the Mayor

**Bloomington looks forward to serious collaborative work ahead, and hopes all of our planet's communities can innovate, share, and inspire action for the health and long-term sustainability of our world.**

We are in a climate emergency. The most recent IPCC report warns of irreversible effects to our planet. We must reduce global emissions in an effort to reduce the inevitable – and already damaging – impacts of climate change.

Cities sit as critical stakeholders in the climate movement. We face powerful and real impacts of climate change already. And we also possess tools and resources to make a positive difference. One step that matters is committing to consistent tracking and reporting of our greenhouse gas emissions, so we all can recognize and respond to our community's contribution to global emissions.

Since 2005, Bloomington has tracked and disclosed our carbon footprint with increasing confidence and transparency. The 2018 inventory served as the first official, standardized report using the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC), which would serve as the City's baseline emissions. Since this inventory, Bloomington has made significant strides towards reducing community-wide greenhouse gasses, making further commitments to climate change mitigation. Most notably, passing the city's official Climate Action Plan in 2021 has provided a framework for reducing our carbon footprint while supporting sustainable, equitable and economic development. The climate action plan set community-wide emissions reductions targets to reduce our emissions 25% by 2030 and to reach carbon neutrality by 2050. With the publishing of this 2022 greenhouse gas inventory report, I am pleased to announce that we are on track to meet those targets.

This update celebrates and reflects what we have achieved together, and it also reminds us that we are just getting started. As a leader in municipal climate action, Bloomington looks forward to serious collaborative work ahead, and hopes all of our planet's communities can innovate, share, and inspire action for the health and long-term sustainability of our world. Let's keep the momentum going.

# 02 Introduction

## Climate Change

The impacts of climate change are already threatening ecosystems across the globe and here in Bloomington. These effects will become increasingly disruptive to natural systems and society over the coming years. Emissions of greenhouse gases from fossil fuel combustion, land-use change, deforestation, and agriculture are driving increases in global average temperatures with devastating effects on air quality, ecosystem health, local food systems, energy and public health. Climate change is undeniably an emergency.

The stakes are high, both globally and locally, and the effects of a changing climate are impacting Bloomington and the world today with increasing severity. A temperature increase of 1.5 degrees Celsius (2.7 degrees Fahrenheit) will initiate and accelerate a series of cataclysmic effects including species loss, heat waves, sea level rise, flooding, and increases in ocean acidity. In the state of Indiana, we are expected to have an increased number of hot days, more frequent rain events, increased flooding, and wetter winters as a result of climate change.

Climate change will disproportionately affect individuals who are already vulnerable and least able to respond to and adapt to climate hazards such as flooding and severe heat. The livelihood of vulnerable individuals will be further stressed by increasing housing and food insecurity from a changing climate.

### Learn more

1. IPCC Sixth Assessment Report, Climate Change 2022: Impacts, Adaptation and Vulnerability
2. Purdue University's Climate Impacts Assessment
3. Indiana University's Environmental Resilience Institute reports and toolkits
4. City of Bloomington Climate Risk and Vulnerability Assessment

# Climate Change in Bloomington

There will be significant climate impacts not only globally, but also here in Bloomington and Monroe County. Based on climate modeling, the Midwest should anticipate the following:

- Increased precipitation
- Flood risks
- Increased intensity and frequency of extreme hot days and heat waves
- Increased insect pest and invasive species presence; increased vector-borne disease and increased air-borne illness.

Many of the impacts are interconnected, and thus climate impacts in one sector often result in impacts in related sectors. The IU Environmental Resilience Institute Toolkit (ERIT) and Purdue University's Climate Change Research Center provide informative resources detailing the specific challenges that Midwestern communities and Bloomington face.

By 2050, Monroe County can expect to experience the following:

- 50 days of over 95 degrees (historical: 2 days)
- An average hottest day of the year of 107 degrees (historical: 97 degrees)
- An average coldest day of the year of 1 degree (historical: -5 degrees)
- An increase in spring rainfall of 16 percent above historical averages (ERIT, 2019)

Other projected regional and state climate impacts, regarding temperature and precipitation, air quality, ecosystem health, energy, food and agriculture, public health, transportation & infrastructure, water management, and waste management, are discussed in the next section.

# Bloomington's Climate Action Plan

**In 2021, the City of Bloomington released its first Climate Action Plan (CAP) to strive towards a 25% reduction of greenhouse gasses by 2030, reaching carbon neutrality by 2050.**

In order to achieve this carbon reduction goal, the City has outlined goals for the following 8 sectors to emphasize climate change mitigation, adaptation, and resiliency:

- Transportation
- Water and Wastewater
- Energy & The Built Environment
- Waste Management
- Local Food & Agriculture
- Health & Safety
- Climate Economy
- Greenspace & Ecosystem Health

In order to best understand Bloomington's Greenhouse Gas Inventory and how it changes over time, it is important to understand the sectors that are outlined in our CAP. This section will highlight each of the sectors, how they are impacted by climate change, in what ways they influence the inventory, the goals set for each in the CAP and the progress that has been made since they were initially outlined in 2021.

# Energy & The Built Environment

Emissions from Energy and the Built Environment are all emissions associated with electricity and natural gas consumption within the city. This relates to energy consumption, and strategies for lowering emissions in this sector are related to improving energy efficiency, lowering energy consumption, and transitioning energy sources to renewable/clean energy sources,

How **Energy & The Built Environment** impacts GHG emissions:

| INITIATIVES |
| --- |
| Increase distributed renewable energy to 250,000 MWH of total generation annually by 2030 |
| Increase energy efficiency citywide 16% for electricity and 12% for natural gas of 2018 values |
| Support decarbonization of the local electricity grid |
| Promote "fuel switching" to reduce on-site fossil fuel use in the building sector by 3% of 2018 values |
| Increase financing options for Energy Efficiency and Renewable Energy projects citywide |

**Data Sources Used In Inventory:**
Duke Energy
CenterPoint Natural Gas
IU Central Heating Plant

# Transportation

Emissions from on-road vehicle traffic occurring in the community. Strategies in this sector area include reductions in vehicle miles traveled as well as shifts to public transit and alternative modes of transportation like biking and walking.

How **Transportation** impacts GHG emissions:

Public Transit

Private Transit

Air Transit

## INITIATIVES

Decrease on-road vehicle miles traveled (VMT) by 8% of 2018 values

Support and encourage electric vehicle (EV) adoption, achieve 30% of vehicles sold and 15% of VMT community-wide by 2030

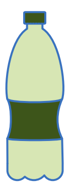
**Data Sources Used In Inventory:**
Public Transit (IU Bus System and Bloomington Transit)
Monroe County Airport
INDOT On-Road Vehicles

# Waste Management

Emissions from this sector come from all solid waste generated by residents and businesses within the community and their associated emissions, including mixed solid waste, recycling, and organic/green waste. Strategies for lowering emissions in this sector focus on diversion of food, consumer, and construction waste, as well as reduction of landfill gas generation and beneficial use of unavoidable landfill gas emissions.

How **Waste** impacts GHG emissions:

Mixed Municipal Solid Waste (MSW)



Recycling

Composting & Green Waste

## INITIATIVES

Increase landfill solid waste diversion by 30% of 2018 values (26,500 tons of waste reduction)

Educate, motivate, and empower the public to achieve waste reduction and diversion

**Data Sources Used In Inventory:**
City of Bloomington Sanitation
EarthKeepers Composting
IDEM Land Quality Office

# Water & Wastewater

Emissions from this sector are generated by potable water distribution to Bloomington residents and businesses, wastewater collection and treatment, and stormwater collection. Strategies for lowering emissions in this sector focus on water conservation, wastewater reduction and beneficial use of wastewater emissions, flood mitigation, and stormwater infiltration.

How **Water & Wastewater** impacts GHG emissions:

Treatment & Collection of Wastewater

Distribution of Potable Water

**Data Sources Used:**
City of Bloomington Utilities

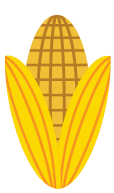
| INITIATIVES |
| --- |
| Decrease potable water consumption by 3% of 2018 values |
| Maintain source and drinking water quality through climate related challenges |
| Reduce energy use associated with treating and transporting water/wastewater by 10% of 2018 values |
| Mitigate flood hazards and impacts |

# Local Food & Agriculture

The Local Food and Agriculture sector correlates with emissions inventories and climate change through commercial and non-commercial food cultivation and distribution, food and nutrition insecurity, and food waste. Strategies for addressing climate resiliency for local food and agriculture include reduction of food waste, food system and distribution resilience, strengthening of local food production capacity, and equitable access to healthy food.

**For the emissions inventory, emissions from this sector are categorized as the Agriculture, Forestry and Land Use sector (AFOLU). At the recommendation of ICLEI, these emissions have not been calculated for our inventory due to the lack of substantial emissions contributions from this sector in Bloomington and lack of credible data sources at the local level.**

How **Local Food & Agriculture** impacts GHG emissions:



Agricultural Processes

Land Use

## INITIATIVES

- Increase food and nutrition security citywide
- Increase local agriculture resilience to climate shocks
- Increase and stabilize local food market

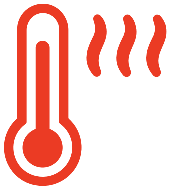
# Health & Safety

The Health and Safety category relates to community health impacts and resilience in the face of current climate impacts and projected risks. Strategies for addressing health and safety focus on community resilience to extreme heat and weather, vector-borne and water-borne disease, and air quality impacts of climate change.

**Health and Safety has an inverse relationship with the GHG inventory, in that it does not contribute to emissions but rather emissions levels contribute to the overall health and safety of the Bloomington community.**

How **Health & Safety** impacts GHG emissions:

Air Quality



Extreme Heat and Weather

## INITIATIVES

- Educate, engage, and empower the public for climate health and safety
- Prepare Bloomington for climate risks and impacts
- Respond to climate risks and impacts

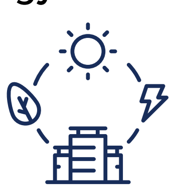
# Climate Economy

Climate Economy relates broadly to economic development, jobs, and business creation potential represented by the actions and goals of all sectors in the city's Climate Action Plan. Strategies for boosting this sector include workforce development, financing for economic development and new businesses, and resilience of businesses in the community.

**The Climate Economy sector is not a direct contributor to the GHG emissions inventory, and therefore will not be represented as an inventory category. However, the growth of and investment in the climate economy can inform an important discussion about emissions trends over time.**

How **Climate Economy** impacts the GHG inventory:

Acceleration of Clean Energy Financing



Market Development for Emissions Reductions Strategies

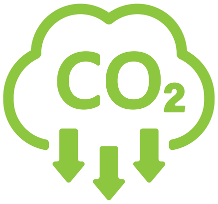
| INITIATIVES |
|---|
| Build marketplace climate resilience |
| Attract, create, and support businesses that are committed to sustainability and climate goals |
| Develop new mechanisms for financing City climate action plan implementation |

# Greenspace & Ecosystem Health

The Greenspace and Ecosystem Health sector relates to environmental, climate resilience and benefits of urban tree canopy, ground cover, community greenspace and parks, and ecosystems that rely on these natural elements. Strategies for climate action in this sector include resilience/expansion of urban tree canopy coverage and improvement of beneficial use of green spaces.

**This sector can be identified in the GHG inventory as the only source of negative emissions, as the urban tree canopy has the ability to sequester carbon. This falls within the AFOLU emissions category.**

How **Greenspace & Ecosystem Health** impacts the GHG inventory:




Tree Canopy Carbon Sequestration

**Data Sources:**
Urban Tree Canopy Assessment (2019 report)

| INITIATIVES |
| --- |
| Increase quantity and quality of greenspace within the community |
| Increase quantity and quality of climate adaptive native habitats |
| Increase citywide tree canopy coverage 3% of 2018 values |
| Reduce stormwater and micro-heat island impacts |

# 03 Findings

## About the Inventory

Greenhouse gas inventories estimate the total amount of greenhouse gas emissions over a period of time by collecting data about activities that generate emissions and calculating the quantity of greenhouse gasses released to the atmosphere as a result of that activity. Starting in 2018, the City of Bloomington began collecting data to measure the local government and community's emissions of carbon dioxide and other greenhouse gases that contribute to climate change. This activity data is collected across various community sectors that directly contribute to the release of CHG emissions. Conducting these inventories allows the City to identify the sources and activities responsible for generating greenhouse gases, to understand emission trends, to set emission reduction goals and to inform the public about our progress towards those goals. Bloomington's 2018 inventory helped to establish a baseline for outlining our goals in the 2021 Climate Action Plan. This inventory will allow the City to analyze our progress thus far and identify emission trends over time.

**Measurement Protocol**

Bloomington follows the Greenhouse Gas Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC). Following the GPC allows for the standardization and consistency of Bloomington's emissions quantification across continuous greenhouse gas inventories, while ensuring that collection and reporting methods are robust, transparent and globally accepted.

While following the GPC, the City also uses ICLEI - Local Governments for Sustainability, a nonprofit that provides support and technical assistance to local governments to accurately account for their greenhouse gas emissions. ICLEI's ClearPath tool is an online software platform for completing greenhouse gas inventories used by hundreds of local governments across the United States.

The GPC recognizes and measures emissions from all 7 GHGs, as follows:

- Carbon Dioxide
- Methane
- Nitrous Oxide
- Hydrofluorocarbons
- Perfluorocarbons
- Sulfur Hexafluoride
- Nitrogen Trifluoride

Based on ICLEI's recommendations, our inventory only accounts for emissions from carbon dioxide, methane, and nitrous oxide due to the inability to access verifiable data sources on a local scale for the remaining 4 greenhouse gasses.

## Scope of the Inventory

**The boundary of the inventory was limited to emissions within Bloomington city limits, by Bloomington's 85,000 residents for the years 2019, 2020, 2021, and 2022, and the inventory accounted for emissions from scopes 1 and 2.**

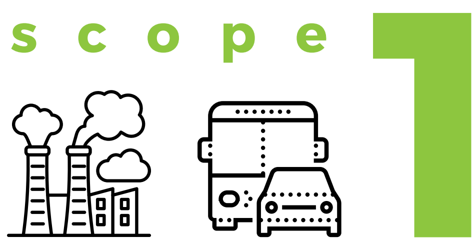
The City also conducted a back-cast of emissions from 2008-2018 which utilized consistent methodology to enable comparisons and trend analysis. This is reflected in the historical trends analysis exhibits.

There are two inventories: **community-wide emissions** and **local government emissions.**

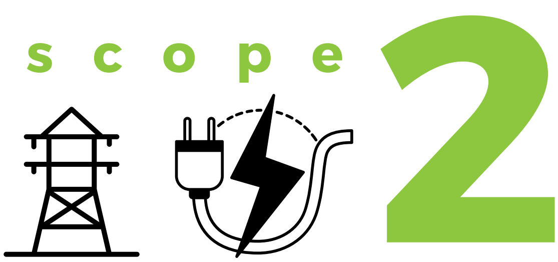
Community-wide emissions encapsulates an estimate of the total impact of all emissions generating activity in Bloomington. These emissions are broken down into six emissions sectors/sources:

- Stationary Energy (including residential, commercial, and industrial)
- Transportation
- Waste & Water
- Industrial Processes and Product Use (IPPU) - **included in stationary energy**
- Agriculture, Forestry, and Land Use (AFOLU) - **excluded**
- Process and Fugitive Emissions & Upstream Impacts

**Emissions Scopes**

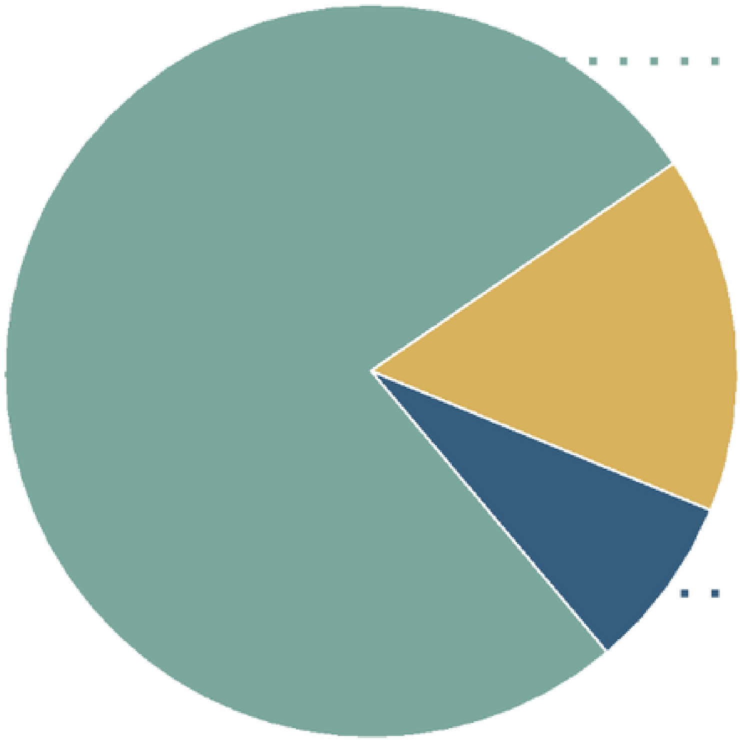



Direct Emissions from Combustion within City Limits




Indirect Emissions from Grid-Supplied Energy

# Community-wide Inventory
## By Sector




**The pie chart above shows a breakdown of Bloomington's overall emissions by sector. For 2022, Bloomington's total emissions were 1,283,331 mt CO2e (pg. 17 of technical report).**

Stationary Energy, made up of residential, commercial, industrial and government energy consumption, continues to make up the largest source of emissions in Bloomington.

- **Total 2022 Stationary Energy Emissions: 982,080 mt CO2e**

Transportation Emissions, made up of on-road passenger vehicles, public transit, air travel, and off-road passenger travel make up the second largest portion of Bloomington's emissions, responsible for 16% of the total community-wide emissions.

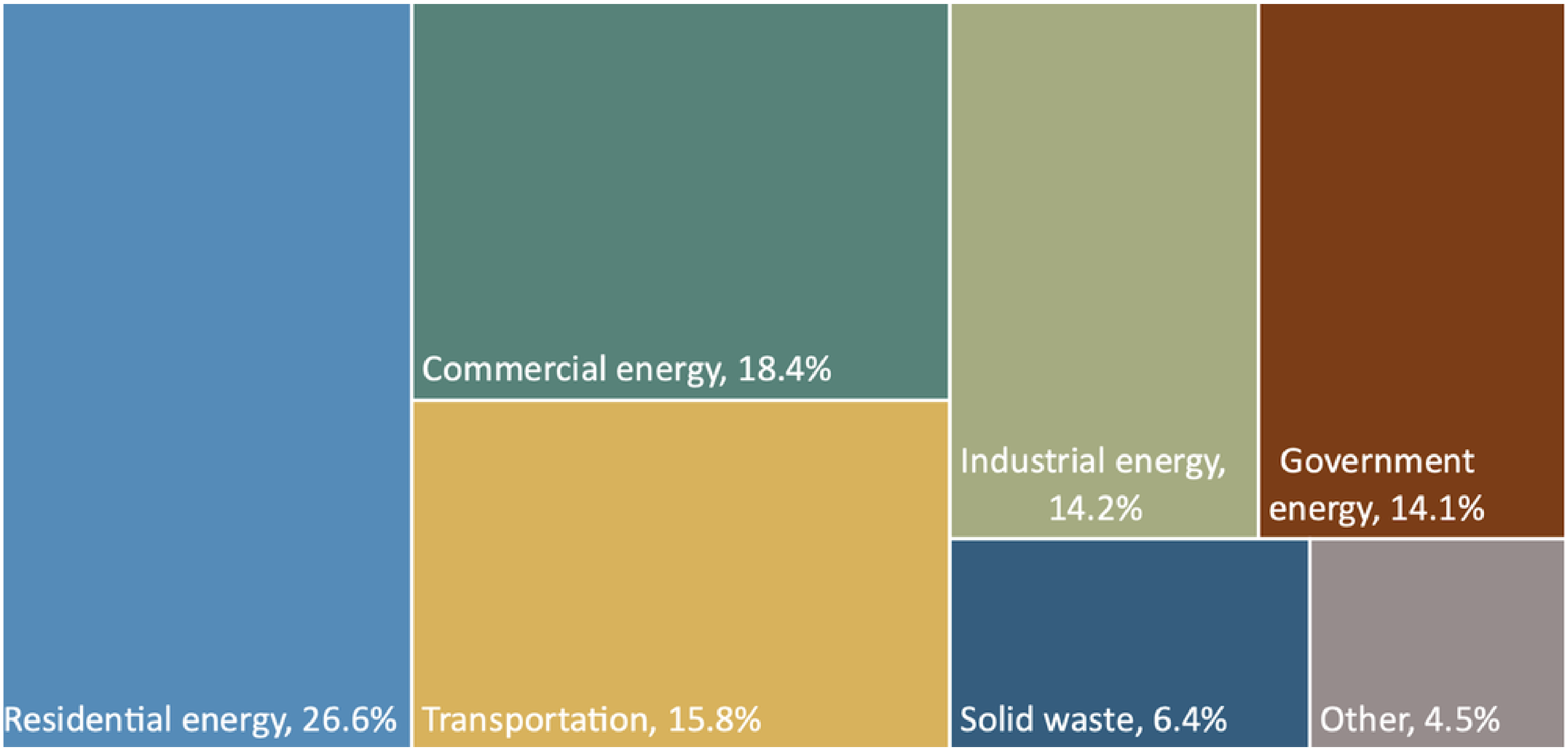
- **Total 2022 Transportation Emissions: 202,725 mt CO2e**

Waste, Water, and Wastewater combined make up 8% of Bloomington's total emissions. These emissions are generated by waste sent to the landfill or composted, electricity consumption by utilities for potable water, and wastewater treatment.

- **Total 2022 Waste/Utilities Emissions: 98,526 mt CO2e**

# Community-wide Inventory

## Overview



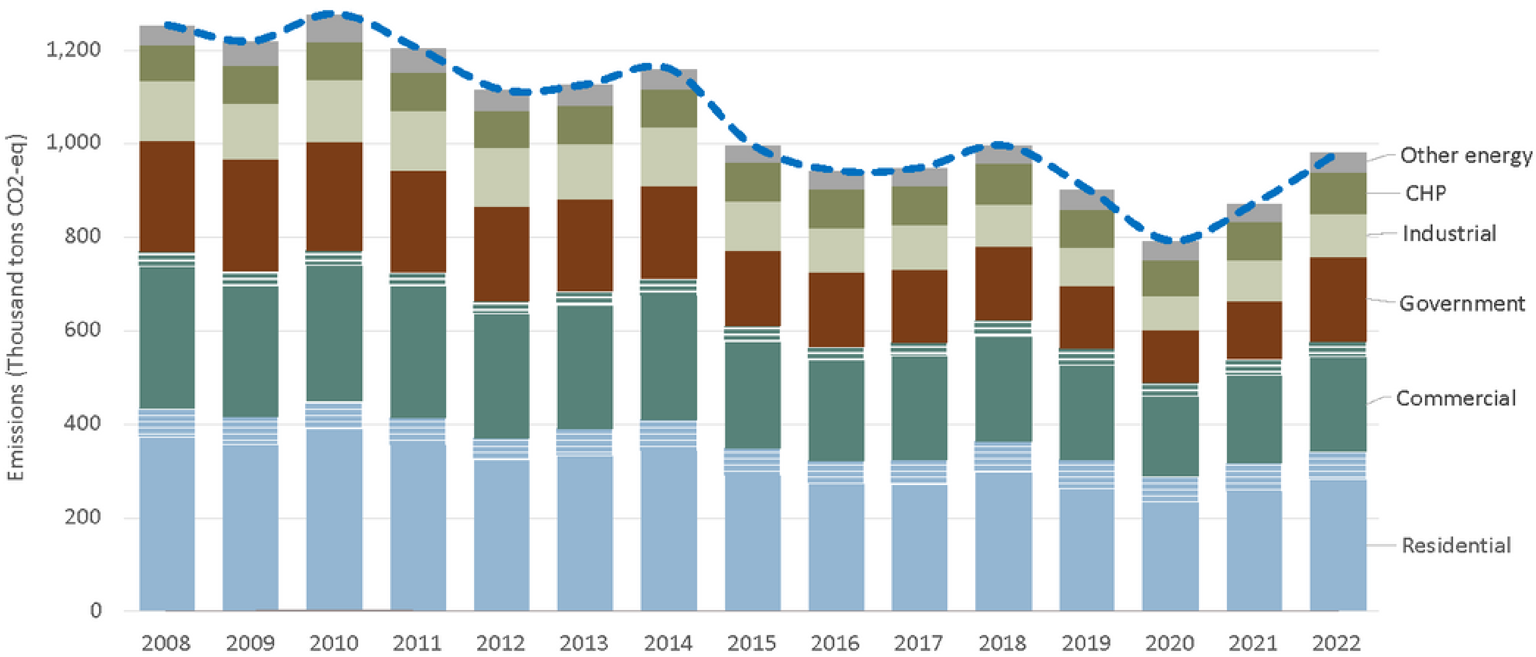

**The chart above further breaks down each sectors emissions.**

In order to better target emissions reductions, it is important to analyze which areas of each sector are generating the most emissions. The sector that has the highest emissions in Bloomington is stationary energy, of which residential energy accounts for the largest portion of it -- representing 27% of overall emissions and 36% of stationary energy emissions.

- Commercial energy represents the second highest contributor, at 18% of community-wide emissions.
- Transportation is the 3rd highest source of emissions, representing almost 16% of the overall footprint.
- Industrial and government energy consumption rank 4th & 5th, both approximately 14% of emissions.
- Solid waste, which is landfilled waste and composting waste are 6%
- All other emissions, including wastewater emissions, T&D losses, and fugitive emissions make up the remaining 4-5% of emissions collectively.

# Community-wide Inventory

## Stationary Energy Emissions Over Time




**Across all subsectors within stationary energy, emissions have decreased by 272,795 mt CO2e since 2008, representing a 22% decrease community-wide.**

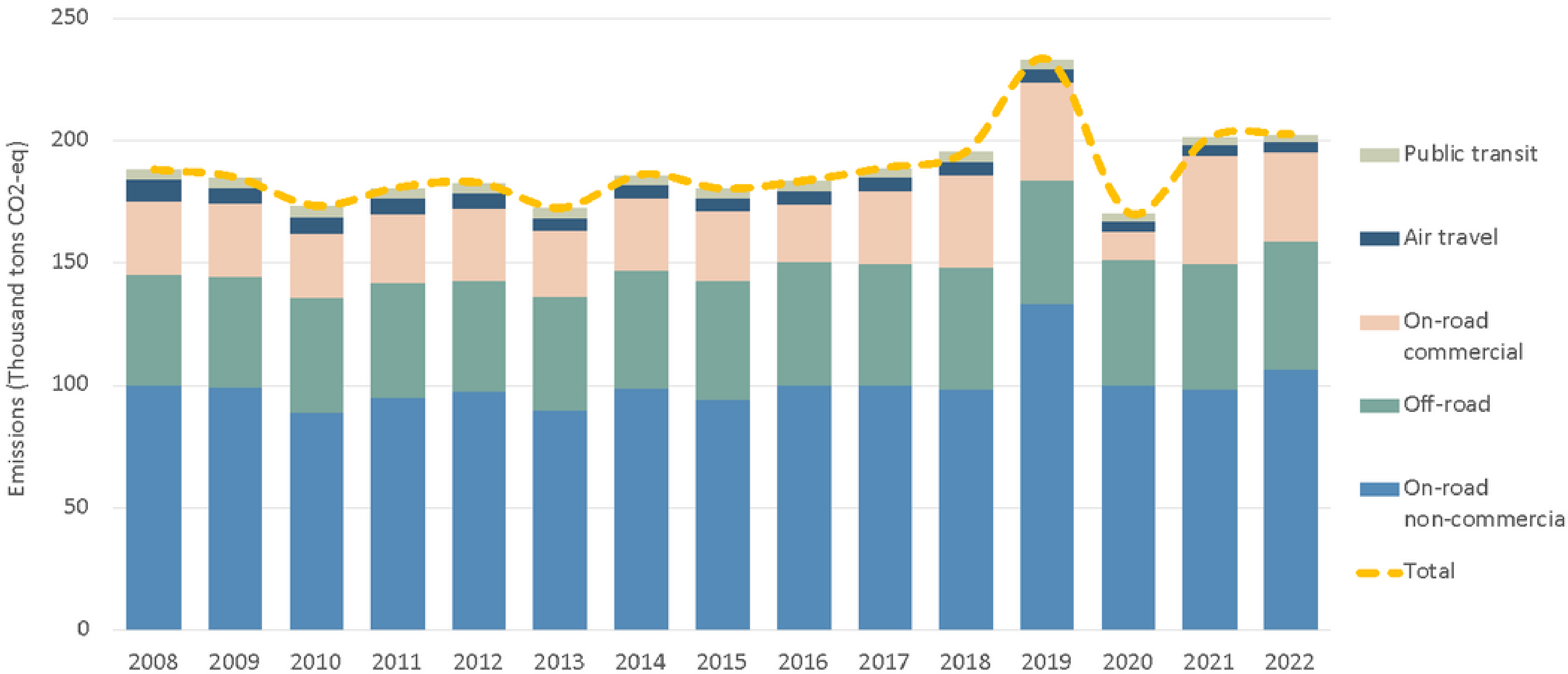
As the sector responsible for the greatest number of emissions, stationary energy plays a critical role in Bloomington's carbon footprint. Within stationary energy, each subsector has decreased its overall emissions since 2008, with commercial energy representing the biggest change in energy consumption. Stationary energy reduction strategies rely heavily on incorporating energy efficiency measures in order to reduce consumption. The next most important step in reducing stationary energy is to shift to cleaner energy sources, such as solar. One limitation of the 2022 inventory is lack of access to data on the solar generation in Bloomington. A goal for the next inventory is to work with utility vendors to improve availability and access to data on the energy mix in Bloomington, including renewable energy generation.

**Key Trend Takeaways**

| -21.5% | -29.4% | -24.2% |
|---|---|---|
| Residential Energy since 2008 | Commercial Energy since 2008 | Government Energy since 2008 |

# Community-wide Inventory

## Transportation Emissions Over Time




**Transportation emissions have increased by 14,516 mt CO2e since 2008, representing a 7.7% increase community-wide.**

As the second highest emitting sector in Bloomington, transportation habits play a big role in reducing Bloomington's emissions. Transportation emissions are one of only two areas in which emissions have increased since 2008. There are a few trends in the data to make note of, such as the increase in on-road non-commercial emissions in 2019 and the decrease in commercial on-road emissions in 2020, likely as a result of the COVID-19 pandemic. As Bloomington's population continues to increase, there will need to be a modal shift within the transportation sector to reduce reliance on single-occupancy vehicles in order to achieve community-wide emissions targets. A goal for future inventories is to better understand the breakdown of vehicle types in the community with access to more transparent data. This will help eliminate the current assumption that all private non-commercial vehicles in Bloomington are the average U.S. gas consumption vehicles.

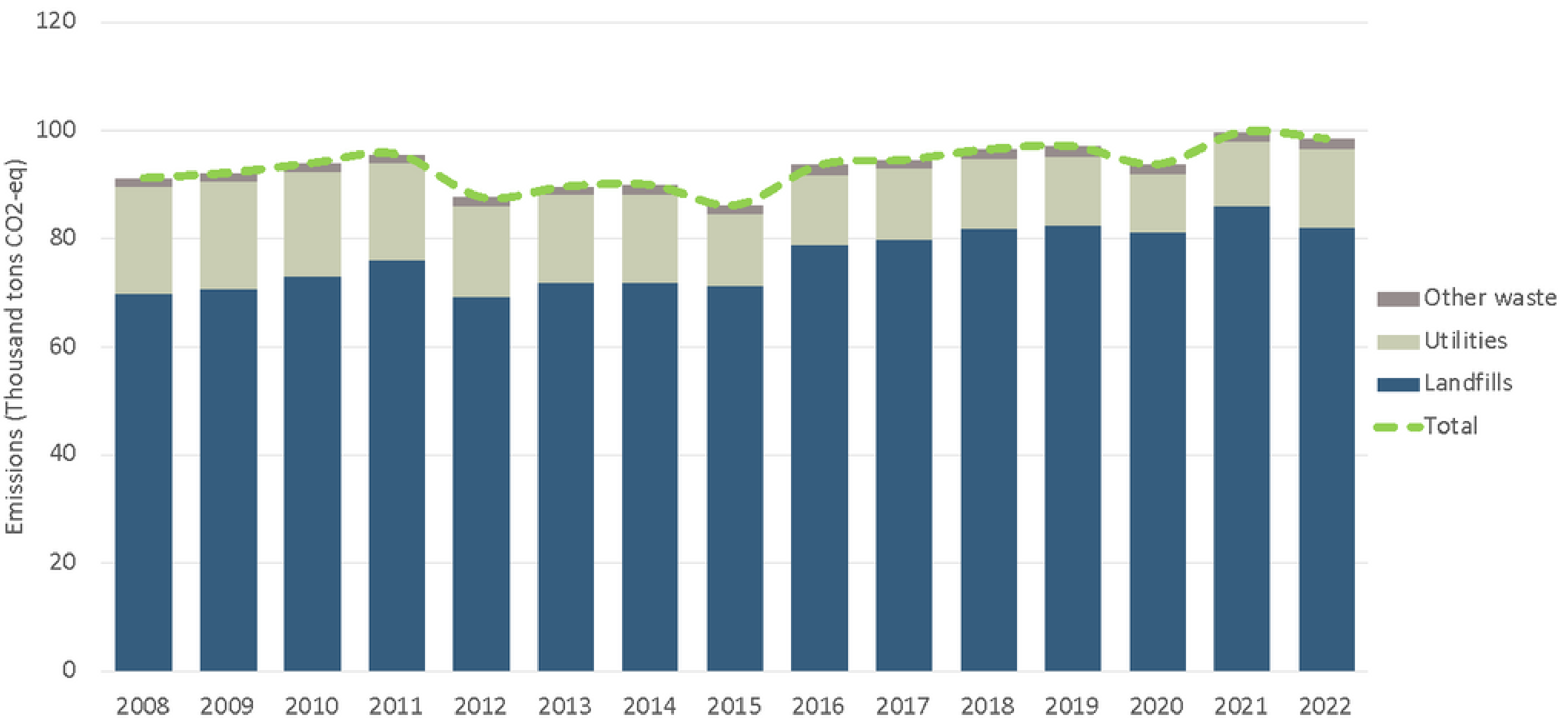
## Key Trend Takeaways

**+7.7%** Transportation emissions since 2008

**-16.3%** Public Transit emissions since 2008

**+7.9%** Non-Commercial On-road emissions since 2008

# Community-wide Inventory
## Water, Waste, and Wastewater Emissions Over Time




**Emissions associated with waste and water have increased the most out of all emission sources since 2008, with overall emissions increasing 7,246 mt CO2e.**

The waste and water category encompasses a diverse set of data, from solid waste and composting to wastewater treatment. Despite representing the sector with the lowest footprint overall, this sector's emissions have increased the most since 2008. City of Bloomington Utilities has undergone many efficiency-enhancing projects, resulting in a 23.1% decrease in emissions associated with wastewater since 2008. One goal for the next inventory is to better understand options for diverting waste from the landfill.

**Key Trend Takeaways**

**+ 8%**
Increase in overall emissions since 2008

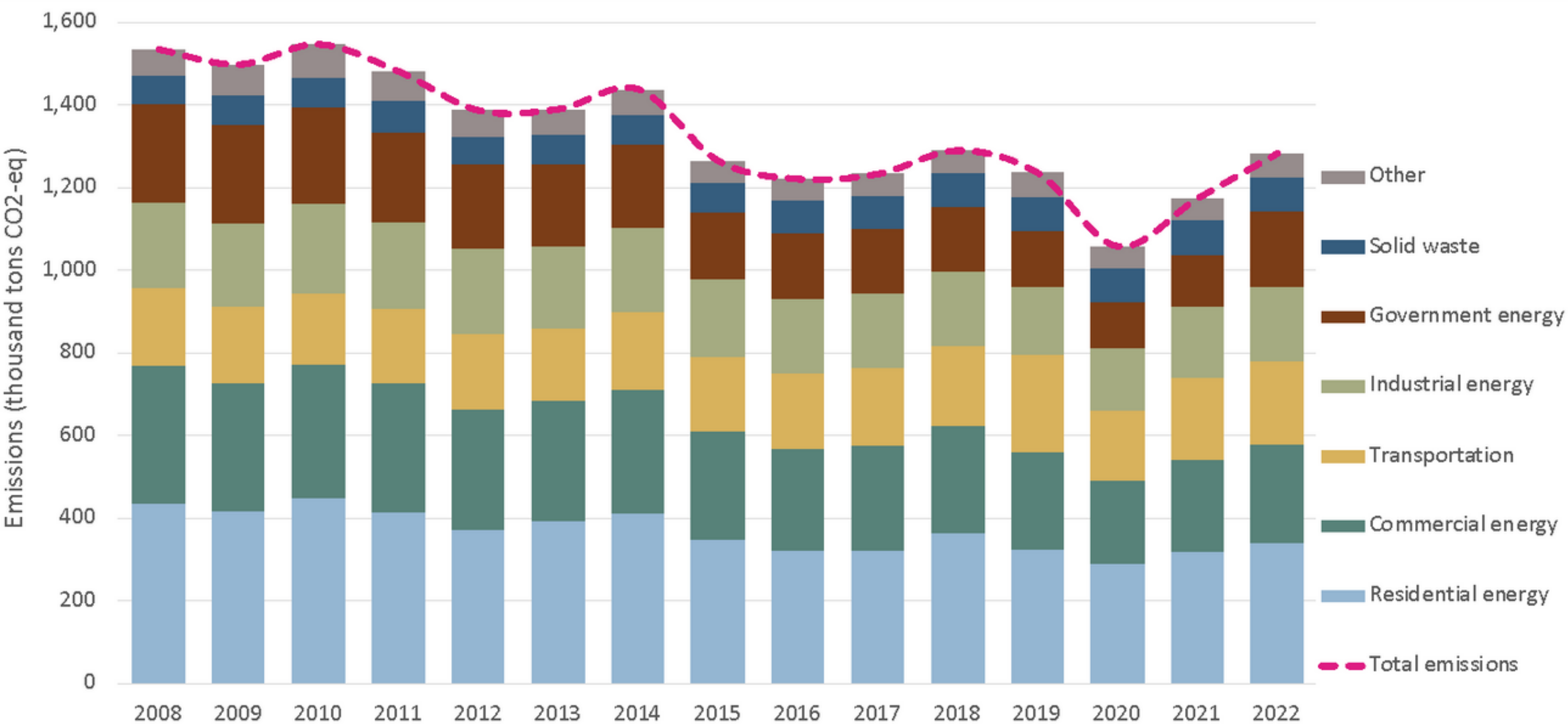
**+17.4 %**
Increase in Solid Waste Emissions

**-23.1%**
Wastewater emissions since 2008

# 04
# The Data Story

## Bloomington's Emissions Over Time

**This section will discuss key trends regarding Bloomington's overall emissions trajectory and the story that data tells**

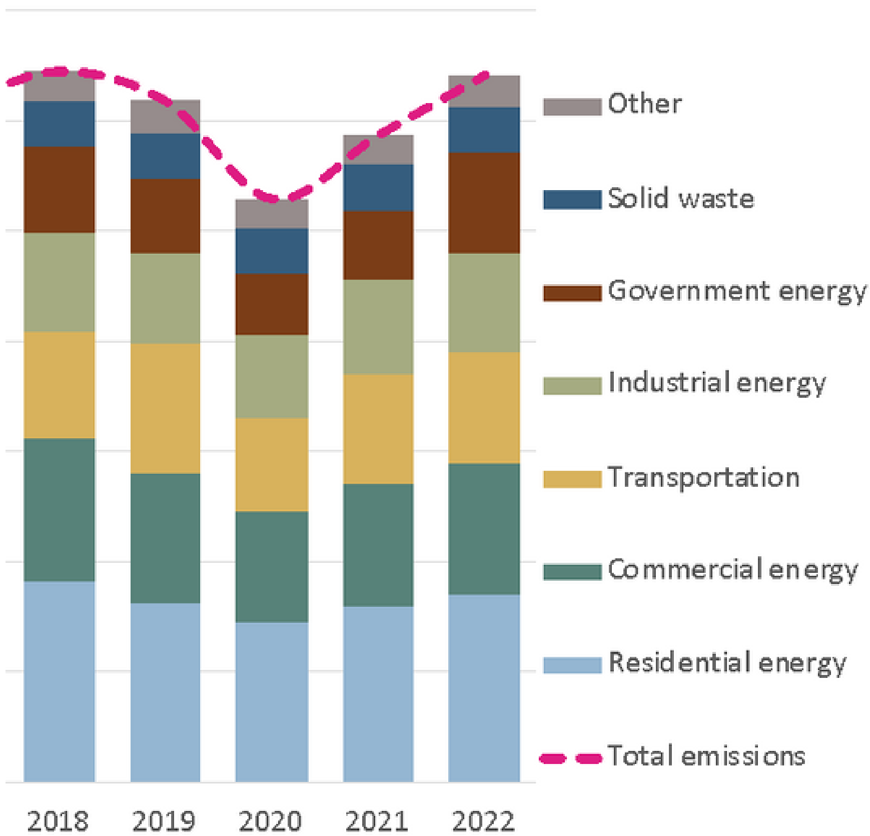



### Bloomington's community-wide emissions have decreased 16.5% since 2008

As the bar graph above indicates, Bloomington's overall emissions have decreased over time. There is an obvious dip in 2020 emissions in correlation with the COVID-19 pandemic (see page 21 for more 2020 trends), followed by a return to normal in 2021 and an increase in 2022. As community-wide operations start returning to normal, it is critical to consider how to return the community-wide emissions trajectory towards a downward trend.

# Emissions During the COVID-19 Pandemic

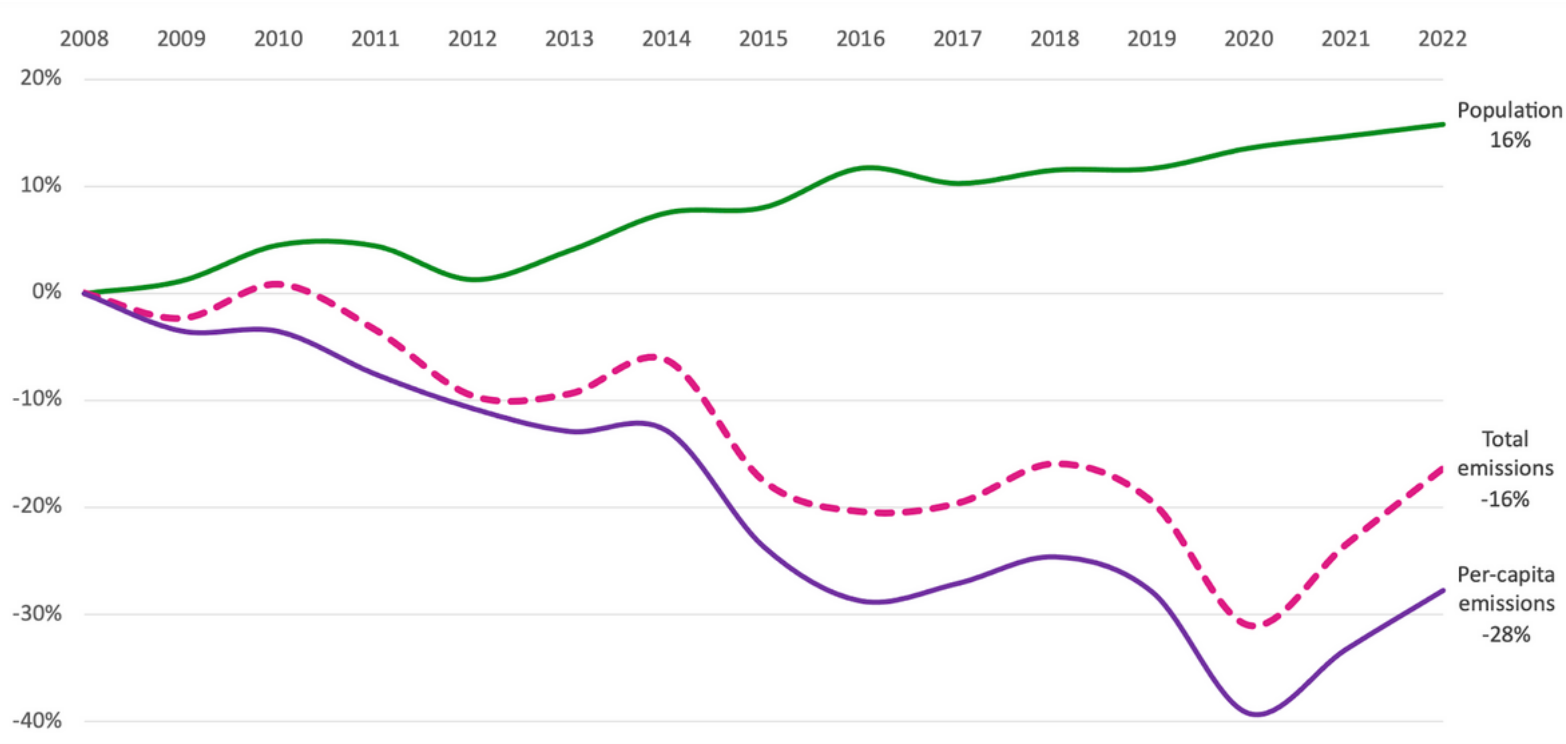
**The global COVID-19 pandemic offers insights into how emissions respond to decreased economic activity, a shifting workforce, and more time spent at home.**




**From 2019 to 2020, emissions decreased by 14.4% community-wide, representing the biggest year-to-year percent change Bloomington has experienced.**

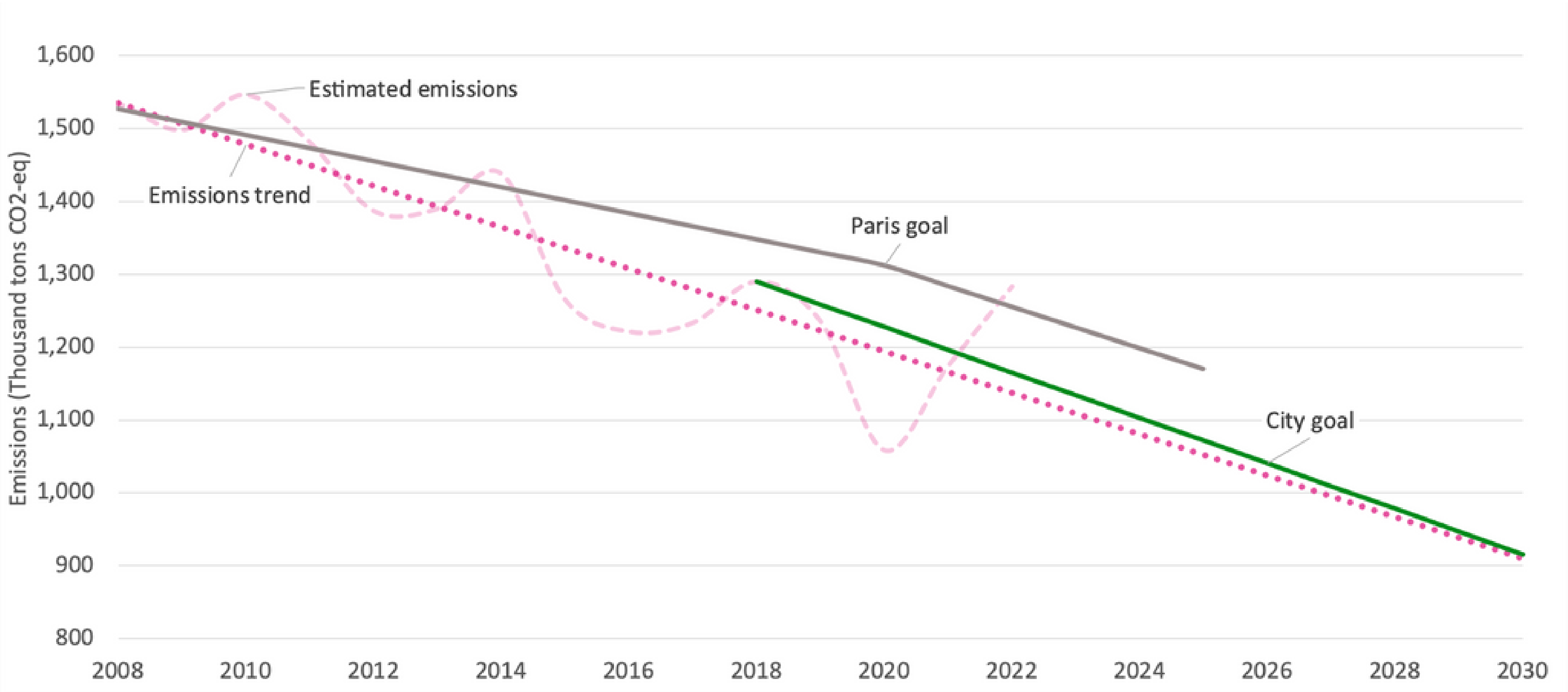
The following noteworthy changes occurred during the pandemic:

- Total actual emissions decreased by **177,061 mt CO2e**
- Emissions decreased in every sector
- Transportation emissions decreased more than all other sectors, with a roughly 26.9% decrease from 2019 to 2020
- Despite residents spending more time at home, residential energy still experienced a 10.9% decrease in emissions




**Per capita emissions have decreased 28% since 2008 community-wide, despite population growing an estimated 16%.**

An important way to gauge progress is understanding how emissions are impacted in coordination with population growth and development. Utilizing per capita emissions figures help make emissions reduction more tangible and intuitive by personalizing the footprint. Instead of thinking about just their mt CO2e as a city-wide metric, residents can begin thinking about personal carbon footprints and how and how their emissions contribute to Bloomington's overall emissions. Per capita emissions metrics can also help the City better frame reductions goals around population growth




**Bloomington is on track to meet 2030 targets, and is on a downward trajectory in alignment with the Paris Climate Agreement.**

To conclude the discussion on Bloomington's inventory, it is important to frame the progress around the City's reduction goals. With a near-term goal of reducing emissions 25% by 2030, the City is on track to meet that goal; however, it requires that efforts to reduce emissions are continued and reinforced for every sector.

# 05 Residential Resources

## Take Advantage of Local, State, & Federal Resources

Find out how much you can save on energy efficiency and renewable energy projects in your home.

**State Resources & Programs:**
www.energy.gov/scep/articles/state-and-community-energy-programs-project-map-indiana

**Utility Programs:**
www.duke-energy.com/home/products/smart-saver

**Rewiring America IRA calculator (Federal):**
www.rewiringamerica.org/app/ira-calculator

## Understand Your Carbon Footprint

Visit **zeroinbloomington.com** to calculate your households footprint to understand where you can make the biggest impact in reducing your emissions. Consider the following impact areas in your day-to-day:

1. Be Energy Smart
2. Shift Your Ride
3. Be Water Wise
4. Eat Green and Waste Less
5. Invest in a Clean Energy Home

## Engage with the City's Programs & Engagement Opportunities

**Bloomington Green Home Improvement Program**
Low-interest Financing and Rebates for Homeowners Investing in Clean Energy and Energy Efficiency
bloomington.in.gov/sustainability/BGHIP

**Solar, Energy Efficiency, and Lighting**
Energy audits and up to $25,000 grants for local small businesses and nonprofits
bloomington.in.gov/sustainability/SEEL

**Bloomington Commission on Sustainability**
Meets the second Tuesday of each month
bloomington.in.gov/boards/sustainability

**Bloomington Environmental Commission**
Meets the third Thursday of each month
bloomington.in.gov/boards/environment

# 06 The Technical Report

# Summary Report on the City of Bloomington's Greenhouse Gas Emissions Inventory 2008 to 2022

July 10, 2023

Prepared for:
City of Bloomington
Department of Economic and
Sustainable Development

GNARLY TREE
SUSTAINABILITY
INSTITUTE

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GNARLY TREE SUSTAINABILITY INSTITUTE

# 1. Introduction

This document summarizes the methods and assumptions used for the greenhouse gas emissions back-cast and inventory for the City of Bloomington over the period 2008 to 2022. The 2008 to 2018 emissions were estimated in a previous back-cast analysis (developed in 2020); this document reflects an update to that back-cast to incorporate 2019 to 2022 emissions estimates based on the same methodologies and data sources (with all exceptions as noted). All calculations are in an accompanying spreadsheet. Section 2 describes the methodology and assumptions used for the analysis, and Section 3 presents summary results.

# 2. Methodology

Each subsection presents the approach used to estimate the emissions for one sector: Stationary Energy (Section 2.1); Transportation (Section 2.2); Solid Waste, Water Supply, and Wastewater Treatment (Section 2.3), and Industrial Processes and Product Use (IPPU; Section 2.4). Each section presents a short description of data sources and extrapolation methods used and presents key calculations in exhibits. Emission factor assumptions are shown in Section 2.5.

## 2.1 Stationary Energy Sector

### *2.1.a Grid-Supplied Electricity*

For grid-supplied electricity, Duke Energy provided the total energy usage (in kWh) for the entire period, broken out by the commercial, industrial, residential, government, and unknown subsectors. For 2017 and later years, Duke provided the government sector data exclusive of electricity consumed by City utilities; for 2008 to 2016, the government subsector data encompasses all government facilities including utilities. Since the utilities' electricity consumption is counted under water supply and wastewater treatment (see Section 2.3.c), we adjusted the government-sector data for 2008 to 2016 to remove the portion of electricity attributable to utilities based on the percentage of total government energy consumed by utilities in 2018 (7.66%). Exhibit 1 shows the data provided as well as the extrapolation of government electricity consumption exclusive of utilities.

**Exhibit 1: Grid-Supplied Electricity by Subsector (kWh)**

| Year | Commercial[1] | Government[2] | Industrial[1] | Residential[1] | Unknown[1] | Utilities[3] | Government (adj)[4] |
|---|---|---|---|---|---|---|---|
| 2008 | 432,406,085 | 368,590,375 | 181,442,287 | 532,842,259 | 2,453,072 | *28,238,970* | *340,351,405* |
| 2009 | 402,799,860 | 374,353,554 | 171,191,560 | 516,200,450 | 19,686,887 | *28,680,507* | *345,673,047* |
| 2010 | 423,789,718 | 367,350,121 | 193,545,454 | 569,282,047 | 26,746,692 | *28,143,950* | *339,206,171* |
| 2011 | 427,068,987 | 358,091,166 | 192,664,588 | 541,914,288 | 16,018,804 | *27,434,590* | *330,656,576* |
| 2012 | 423,539,852 | 349,619,532 | 196,361,165 | 516,791,532 | 14,934,629 | *26,785,549* | *322,833,983* |
| 2013 | 417,209,171 | 337,260,371 | 187,425,166 | 529,684,604 | 15,896,097 | *25,838,671* | *311,421,700* |
| 2014 | 421,254,282 | 341,460,258 | 194,519,782 | 545,028,425 | 14,332,522 | *26,160,439* | *315,299,819* |
| 2015 | 383,379,382 | 292,423,947 | 175,708,111 | 483,847,521 | 11,958,777 | *22,403,599* | *270,020,348* |
| 2016 | 381,395,225 | 300,100,840 | 170,656,456 | 481,897,282 | 12,670,543 | *22,991,752* | *277,109,088* |
| 2017 | 408,075,333 | 284,647,430 | 173,125,539 | 495,916,646 | 8,438,601 | *23,617,209* | 284,647,430 |
| 2018 | 420,638,053 | 294,425,924 | 173,471,915 | 562,270,593 | 10,058,642 | 24,428,531 | 294,425,924 |

| Year | Commercial[1] | Government[2] | Industrial[1] | Residential[1] | Unknown[1] | Utilities[3] | Government (adj)[4] |
|---|---|---|---|---|---|---|---|
| 2019 | 416,636,574 | 277,022,755 | 170,731,329 | 541,833,065 | 17,506,480 | 27,047,274 | 277,022,755 |
| 2020 | 380,655,086 | 248,101,595 | 162,721,378 | 520,573,557 | 16,403,091 | 24,217,854 | 248,101,595 |
| 2021 | 395,136,698 | 259,320,211 | 182,903,966 | 537,918,927 | 15,882,296 | 25,843,110 | 259,298,666 |
| 2022 | 427,791,465 | 379,363,730 | 195,429,800 | 590,486,711 | 17,000,562 | 31,296,209 | 379,275,764 |

1. Data provided by Duke Energy.
2. Data provided by Duke Energy; for 2008 to 2016, inclusive of electricity consumed by utilities; for 2017 to 2022, exclusive of utilities' electricity.
3. For 2018, data provided by Duke Energy; for 2008 to 2017, extrapolated based on 2018 utilities' electricity consumption as a percent of total government electricity consumption (7.66%).
4. For 2017 to 2022, data provided by Duke Energy; for 2008 to 2016, Government minus Utilities. For 2021 and 2022, reflects removal of electricity for Bloomington Transit electric busses (21,545 kWh and 87,966 respectively; see Exhibit 7).

To estimate the emissions associated with electricity consumption, we used the eGrid emission factors from the U.S. Environmental Protection Agency (EPA) for the RFC West subregion, varying the eGrid emission factors over the period based on periodic releases of new emission factors that reflect year-to-year changes in the resource mix used to generate electricity in the region. Exhibit 2 shows the emission factors for the analysis period.

Note that EPA changed its methodology for estimating the CH4 emission factor in 2014, resulting in a substantial increase in that factor relative to earlier years. As such, the back-cast model applies the 2014 CH4 emission factor for the earlier period to avoid an artificial jump in CH4 emissions in that year that is actually attributable to a methodological change rather than a true increase in emission rates.

### Exhibit 2: eGrid Emission Factors for Grid-Supplied Electricity[1]

| Year | $CO_2$ (lbs/MWh) | $CH_4$ (lbs/GWh)[2] | $N_2O$ (lbs/GWh) |
|---|---|---|---|
| 2007 | 1551.52 | 150.20 | 25.93 |
| *2008* | *1536.06* | 150.20 | *25.53* |
| 2009 | 1520.59 | 150.20 | 25.13 |
| 2010 | 1503.47 | 150.20 | 24.75 |
| *2011* | *1441.48* | 150.20 | *23.21* |
| 2012 | 1379.48 | 150.20 | 21.67 |
| *2013* | *1380.19* | 150.20 | *21.84* |
| 2014 | 1380.90 | 150.20 | 22.00 |
| *2015* | *1312.15* | *129.10* | *20.50* |
| 2016 | 1243.40 | 108.00 | 19.00 |
| *2017* | *1204.75* | *112.50* | *18.00* |
| 2018 | 1166.10 | 117.00 | 17.00 |
| 2019 | 1067.70 | 99.00 | 14.00 |
| 2020 | 985.00 | 86.00 | 12.00 |
| 2021 | 1046.10 | 95.00 | 14.00 |
| *2022* | *1046.10* | *95.00* | *14.00* |

| Year | CO2 (lbs/MWh) | CH4 (lbs/GWh)[2] | N2O (lbs/GWh) |
|---|---|---|---|

Source: eGrid emission factors for the RFC West subregion from the United States Environmental Protection Agency.
1. Rows in italics with grey shading are extrapolated based on the average of the preceding and (if available) following year.
2. To account for a change in methodology, 2008 to 2013 use the 2014 MH4 emissions factor.

### *2.1.b Natural Gas Use*

The natural gas provider for Bloomington (Vectren for 2008 to 2018 and Centerpointe for 2019 to 2022) provided the total natural gas consumption data for the analysis period, broken out by the subsectors residential, commercial, and industrial, at the Monroe County level. We adjusted the natural gas usage data to scale down the county-level data to reflect the City of Bloomington based on a population ratio. Exhibit 3 shows the calculation of the adjustment factor based on population data,[1] and the calculation of Bloomington natural gas consumption is shown in Exhibit 4.

**Exhibit 3: Population Data for Bloomington and Monroe County**

| Year | Monroe County[1] | Bloomington[1] | Adjustment Factor[2] |
|---|---|---|---|
| 2008 | *136,443* | *77,592* | 0.569 |
| 2009 | *137,565* | *78,500* | 0.571 |
| 2010 | 138,422 | 81,096 | 0.586 |
| 2011 | 139,799 | 81,033 | 0.580 |
| 2012 | 141,019 | 78,592 | 0.557 |
| 2013 | 141,888 | 80,693 | 0.569 |
| 2014 | 143,339 | 83,423 | 0.582 |
| 2015 | 144,705 | 83,815 | 0.579 |
| 2016 | 145,496 | 86,654 | 0.596 |
| 2017 | 146,986 | 85,551 | 0.582 |
| 2018 | 146,917 | 86,522 | 0.589 |
| 2019 | 148,431 | 86,630 | 0.584 |
| *2020* | *149,765* | *88,111* | *0.588* |
| *2021* | *150,867* | *88,967* | *0.590* |
| *2022* | *151,970* | *89,824* | *0.591* |

1. United States Census Bureau (Decennial Census and American Community Survey 1-year estimates) for 2010 to 2019; for other years, extrapolated based on best fit to available data.
2. Adjustment factor calculated as Bloomington population divided by Monroe County population.

[1] The 2020 Census reported a Bloomington population of 79,168, which represents an 8 percent decrease relative to the 2019 1-year estimate from the American Community Survey (ACS); additionally, the Census Bureau changed its methodology for population estimates under the ACS thereafter. The decreased population may be the result of methodology changes, the impact of the COVID pandemic on the City's student population, or an actual decrease in the population. For this analysis, we assume that the sharp decrease between 2019 and 2020 does not reflect actual trends; for consistency with the previous back-cast analysis, we instead project the population for the 2020 to 2022 years based on the 2010 to 2019 period.

**Exhibit 4: Natural Gas Consumption by Subsector**

| Year | Monroe County[1] | | | Adj[2] | Bloomington[3] | | |
|---|---|---|---|---|---|---|---|
| | Residential | Commercial | Industrial | | Residential | Commercial | Industrial |
| 2008 | 19,958,673 | 10,436,463 | 103,352 | 0.569 | *11,349,967* | *5,934,939* | *58,773* |
| 2009 | 19,049,368 | 10,226,887 | 85,487 | 0.571 | *10,870,316* | *5,835,863* | *48,782* |
| 2010 | 18,778,711 | 9,956,783 | 305,940 | 0.586 | *11,001,708* | *5,833,287* | *179,238* |
| 2011 | 18,591,976 | 10,007,362 | 76,637 | 0.580 | *10,776,641* | *5,800,660* | *44,422* |
| 2012 | 15,454,449 | 8,444,924 | 64,933 | 0.557 | *8,612,996* | *4,706,483* | *36,188* |
| 2013 | 19,184,576 | 10,180,592 | 74,749 | 0.569 | *10,910,443* | *5,789,795* | *42,511* |
| 2014 | 21,679,820 | 11,746,503 | 75,174 | 0.582 | *12,617,610* | *6,836,441* | *43,751* |
| 2015 | 18,885,471 | 10,378,083 | 70,866 | 0.579 | *10,938,708* | *6,011,119* | *41,047* |
| 2016 | 15,437,766 | 8,741,491 | 61,267 | 0.596 | *9,194,371* | *5,206,227* | *36,489* |
| 2017 | 16,194,544 | 9,046,084 | 62,498 | 0.582 | *9,425,792* | *5,265,138* | *36,376* |
| 2018 | 20,731,079 | 11,144,690 | 76,565 | 0.589 | *12,208,896* | *6,563,304* | *45,091* |
| 2019 | 19,652,076 | 10,779,653 | 78,592 | 0.584 | *11,469,702* | *6,291,417* | *45,869* |
| 2020 | 17,751,146 | 9,383,559 | 64,481 | 0.588 | *10,443,515* | *5,520,621* | *37,936* |
| 2021 | 19,363,356 | 10,745,730 | 90,857 | 0.590 | *11,418,677* | *6,336,816* | *53,579* |
| 2022 | 18,813,948 | 10,264,080 | 101,522 | 0.591 | *11,120,208* | *6,066,707* | *60,006* |

1. Data provided by Vectren for 2008 to 2018 and by Centerpointe for 2019 to 2022.
2. See Exhibit 3.
3. For each subsector, Monroe County consumption times the adjustment factor.

### *2.1.c IU CHP*

Indiana University's Central Heating Plant (IU CHP) provided data on the fossil fuels used for 2017 to 2021, including natural gas, coal, and fuel oil. We extrapolated the fuel usage over the period 2008 to 2016, and for 2022 based on changes in IU Bloomington enrollment over the back-cast period, as shown in Exhibit 5.

**Exhibit 5: IU CHP Fuel Usage Data and Extrapolation**

| Year | IU CHP Fuel Usage[1] | | | IU Enrollment[2] | Extrapolation Factor[3] |
|---|---|---|---|---|---|
| | Coal (tons) | Natural Gas (dekatherms) | Fuel Oil (gallons) | | |
| 2008 | *8,594* | *1,087,894* | *4,481* | 40,351 | 0.925 |
| 2009 | *9,018* | *1,141,654* | *4,702* | 42,345 | 0.971 |
| 2010 | *9,042* | *1,144,701* | *4,714* | 42,458 | 0.974 |
| 2011 | *9,098* | *1,151,710* | *4,743* | 42,718 | 0.980 |
| 2012 | *8,973* | *1,135,938* | *4,678* | 42,133 | 0.966 |
| 2013 | *9,020* | *1,141,816* | *4,703* | 42,351 | 0.971 |
| 2014 | *9,088* | *1,150,497* | *4,738* | 42,673 | 0.979 |
| 2015 | *9,194* | *1,163,924* | *4,794* | 43,171 | 0.990 |
| 2016 | *9,317* | *1,179,480* | *4,858* | 43,748 | 1.003 |

| Year | IU CHP Fuel Usage[1] | | | IU Enrollment[2] | Extrapolation Factor[3] |
|---|---|---|---|---|---|
| | Coal (tons) | Natural Gas (dekatherms) | Fuel Oil (gallons) | | |
| 2017 | 10,521 | 1,114,422 | 9,684 | 43,710 | |
| 2018 | 8,053 | 1,236,908 | 0 | 43,503 | |
| 2019 | 6,406 | 1,239,898 | 0 | 43,260 | |
| 2020 | 5,999 | 1,196,433 | 0 | 43,064 | |
| 2021 | 6,803 | 1,261,947 | 0 | 45,328 | |
| 2022 | *8,114* | *1,299,257* | *0* | 47,005 | 1.074 |
| Average, 2017/2018 | 9,287 | 1,175,665 | 4,842 | 43,607 | |
| Average, 2017-2021 | 7,556 | 1,209,922 | 1,937 | 43,773 | |

1. Data for 2017 to 2021 provided by IU CHP. For other years, extrapolated based on average values (for 2017/2018 for earlier years, and for 2017 to 2021 for 2022) times the extrapolation factor.
2. Source: Indiana University Historical Student Enrollment, Bloomington campus (fall term).
3. For 2008 to 2016, calculated as the year's enrollment divided by the average of the 2017 and 2018 enrollment. For 2022, calculated as the year's enrollment divided by the average enrollment for 2017 to 2021.

## 2.2 Transportation Sector

### *2.2.a Public Transit*

Bloomington Transit provided fuel data broken out by type (diesel vs. gas and fixed routes vs. access) and vehicle miles travelled (VMT) broken out by fixed route versus access for the period 2008 to 2018. To further break out the VMT into diesel and gas vehicles, we assumed that the proportion of miles in each category is proportional to the share of fuel in each category, as shown in Exhibit 6.

For 2019 to 2022, Bloomington Transit provided the VMT and fuel consumption for diesel (including fixed route and paratransit vehicles) and gasoline (for fixed route and support vehicles), as shown in Exhibit 7.

**Exhibit 6: Bloomington Transit Fuel Usage and Vehicle Miles Travelled**

| Year | Diesel (gallons)[1] | | Gas (gallons)[1] | | Total Miles[1] | | | |
|---|---|---|---|---|---|---|---|---|
| | Fixed | Access | Fixed | Access | Fixed[1] | Access[1] | Diesel[2] | Gas[3] |
| 2008 | 283,343 | 0 | 2,659 | 0 | 1,047,382 | 0 | 1,037,644 | 9,738 |
| 2009 | 277,123 | 279 | 2,441 | 1,994 | 1,033,727 | 18,627 | 1,026,983 | 25,371 |
| 2010 | 276,612 | 871 | 2,823 | 17,442 | 1,033,208 | 148,543 | 1,029,831 | 151,920 |
| 2011 | 277,948 | 1,174 | 3,338 | 16,118 | 1,052,559 | 138,808 | 1,049,494 | 141,873 |
| 2012 | 282,035 | 900 | 3,529 | 18,052 | 1,066,252 | 154,063 | 1,060,392 | 159,923 |
| 2013 | 274,676 | 142 | 3,184 | 20,803 | 1,056,764 | 162,041 | 1,045,750 | 173,055 |
| 2014 | 285,846 | 270 | 0 | 21,533 | 1,053,200 | 158,597 | 1,055,166 | 156,631 |
| 2015 | 286,995 | 1,285 | 5,275 | 23,107 | 1,071,784 | 165,955 | 1,061,183 | 176,556 |
| 2016 | 288,675 | 6 | 7,600 | 25,145 | 1,081,252 | 158,155 | 1,053,550 | 185,857 |

| Year | Diesel (gallons)[1] | | Gas (gallons)[1] | | Total Miles[1] | | | |
|---|---|---|---|---|---|---|---|---|
| | Fixed | Access | Fixed | Access | Fixed[1] | Access[1] | Diesel[2] | Gas[3] |
| 2017 | 277,394 | 0 | 6,496 | 25,281 | 1,057,488 | 153,766 | 1,033,291 | 177,963 |
| 2018 | 274,914 | 0 | 6,163 | 28,757 | 1,104,341 | 174,809 | 1,080,129 | 199,021 |

1. Data provided by Bloomington Transit.
2. For each category (fixed and access), calculated as total miles times the percent diesel (calculated as diesel gallons divided by the sum of diesel and gas gallons), then summed across fixed and access.
3. For each category (fixed and access), calculated as total miles times the percent gas (calculated as gas gallons divided by the sum of diesel and gas gallons), then summed across fixed and access.

### Exhibit 7: Bloomington Transit Fuel Consumption and Vehicle Miles Travelled by Fuel[1]

| Year | Diesel | | Gas | | Electricity | |
|---|---|---|---|---|---|---|
| | Gallons | VMT | Gallons | VMT | kWh | VMT |
| 2018 | 274,914 | 1,080,129 | 34,920 | 199,021 | | |
| 2019 | 289,314 | 1,163,850 | 9,239 | 64,575 | | |
| 2020 | 208,297 | 983,416 | 6,304 | 47,908 | | |
| 2021 | 221,538 | 1,016,371 | 6,855 | 48,896 | 21,545 | 614 |
| 2022 | 240,053 | 996,122 | 6,941 | 45,710 | 87,966 | 15,121 |

1. Data provided by Bloomington Transit, including fixed route (diesel, gas, and electric), paratransit (diesel), and support vehicles (gas).

For IU busses, the diesel gallons used each year was provided by IU for the 2008 to 2018, as well as VMT for 2018. Because the emission factors for diesel busses are based on VMT, we extrapolated this variable over the 2008 to 2017 period by assuming the mileage varies proportionally to the amount of diesel used.

For 2019 to 2022, fuel consumption and mileage data were not available. We assumed that the variation in IU Bus activity would be similar to variation in Bloomington Transit's diesel bus activity during this period and calculated an extrapolation factor relative to 2018. These calculations are shown in Exhibit 8.

### Exhibit 8: IU Bus Fuel Usage and Vehicle Miles Travelled

| Year | Diesel (gallons)[1] | VMT[2] | Extrapolation Factor[3] |
|---|---|---|---|
| 2008 | 123,597 | *461,357* | 1.236 |
| 2009 | 124,957 | *466,433* | 1.250 |
| 2010 | 132,738 | *495,478* | 1.327 |
| 2011 | 119,048 | *444,376* | 1.190 |
| 2012 | 118,997 | *444,186* | 1.190 |
| 2013 | 128,470 | *479,546* | 1.285 |
| 2014 | 112,219 | *418,885* | 1.122 |
| 2015 | 103,089 | *384,805* | 1.031 |
| 2016 | 94,856 | *354,074* | 0.949 |
| 2017 | 91,760 | *342,517* | 0.918 |

| Year | Diesel (gallons)[1] | VMT[2] | Extrapolation Factor[3] |
|---|---|---|---|
| 2018 | 100,000 | 373,275 | 1.000 |
| 2019 | *107,751* | *402,208* | *1.078* |
| 2020 | *91,046* | *339,853* | *0.910* |
| 2021 | *94,097* | *351,241* | *0.941* |
| 2022 | *92,223* | *344,244* | *0.922* |

1. Data provided by IU Bus for 2008 to 2018. For 2019 to 2022, calculated as 2018 gallons times the extrapolation factor.
2. For 2018, data provided by IU Bus; for 2008 to 2017, extrapolated by multiplying the diesel gallons by the extrapolation factor; for 2019 to 2022, calculated as 2018 VMT times the extrapolation factor.
3. For 2008 to 2017, diesel gallons divided by 2018 diesel gallons; for 2019 to 2022, Bloomington Transit diesel VMT divided by 2018 Bloomington Transit diesel VMT (see Exhibit 7).

### *2.2.b On-Road Vehicles*

The Indiana Department of Transportation (INDOT)[2] provides historical data on VMT at the county level over the period 2006 to 2018 and at the city and county level for 2016 to 2021. For 2016 to 2021, the inventory analysis relies on the city-level Bloomington data to estimate the total miles travelled by on-road vehicles. For prior years when city-level data are not available, we extrapolated Bloomington-level VMT based on the county-level data times the assumed percent of all VMT that occurred within Bloomington. We used a similar method to subdivide all Bloomington VMT into the commercial and non-commercial subsectors, since the INDOT city-level data also provides the data broken out by commercial vehicle travel. For 2022, we projected Bloomington total and commercial VMT based on best fit to the 2016 to 2021 data. Exhibit 9 shows these calculations.

**Exhibit 9: Calculation of Daily On-Road Vehicle Miles Travelled**

| Year | Bloomington[1] | Bloomington Commercial[2] | Percent Bloomington Commercial[3] | Monroe County[4] | Percent Bloomington[5] |
|---|---|---|---|---|---|
| 2008 | *750,445* | *51,583* | *6.9%* | 2,825,000 | *26.6%* |
| 2009 | *747,788* | *51,401* | *6.9%* | 2,815,000 | *26.6%* |
| 2010 | *676,596* | *46,507* | *6.9%* | 2,547,000 | *26.6%* |
| 2011 | *730,787* | *50,232* | *6.9%* | 2,751,000 | *26.6%* |
| 2012 | *753,633* | *51,802* | *6.9%* | 2,837,000 | *26.6%* |
| 2013 | *697,316* | *47,931* | *6.9%* | 2,625,000 | *26.6%* |
| 2014 | *760,832* | *52,297* | *6.9%* | 2,864,100 | *26.6%* |
| 2015 | *743,698* | *51,120* | *6.9%* | 2,799,600 | *26.6%* |
| 2016 | 784,338 | 43,130 | 5.5% | 2,938,870 | 26.7% |
| 2017 | 803,408 | 53,689 | 6.7% | 3,011,696 | 26.7% |
| 2018 | 802,760 | 67,497 | 8.4% | 3,048,334 | 26.3% |
| 2019 | 1,078,979 | 72,371 | 6.7% | | |
| 2020 | 778,187 | 23,750 | 3.1% | | |

[2] https://www.in.gov/indot/2469.htm

| Year | Bloomington[1] | Bloomington Commercial[2] | Percent Bloomington Commercial[3] | Monroe County[4] | Percent Bloomington[5] |
|---|---|---|---|---|---|
| 2021 | 848,373 | 81,344 | 9.6% | | |
| 2022 | *885,264* | *60,281* | 6.8% | | |

1. For 2016 to 2021, data from INDOT provided at the city level; for 2008 to 2015, calculated as Monroe County daily VMT times the percent Bloomington. For 2022, forecasted based on best fit to 2016 to 2021 data.
2. For 2016 to 2021, data from INDOT provided at the city level; for 2008 to 2015, calculated as Bloomington daily VMT times the percent Bloomington commercial. For 2022, forecasted based on best fit to 2016 to 2021 data.
3. For 2016 to 2022, calculated as Bloomington commercial daily VMT divided by Bloomington total VMT; for 2008 to 2016, calculated as average of 2016 to 2018 percent.
4. Data from INDOT provided at the county level.
5. For 2016 to 2018, calculated as Bloomington daily VMT divided by Monroe County VMT; for 2008 to 2015, calculated as average of 2016 to 2018 percent.

INDOT's VMT data for commercial vehicles encompasses public transit vehicles. As such, for the back-cast, we further adjusted the commercial mileage to subtract the total public transit miles (for IU Bus and Bloomington Transit, described in Section 2.2.a) from the commercial VMT total to avoid double-counting.

### Exhibit 10: Annual Vehicles Miles Travelled

| Year | Total[1] | Non-Commercial[2] | Commercial[3] | Public Transit[4] | Commercial adj[5] |
|---|---|---|---|---|---|
| 2008 | 273,912,394 | 255,084,470 | 18,827,923 | 1,508,739 | 17,319,185 |
| 2009 | 272,942,792 | 254,181,517 | 18,761,276 | 1,518,787 | 17,242,489 |
| 2010 | 246,957,475 | 229,982,353 | 16,975,122 | 1,677,229 | 15,297,894 |
| 2011 | 266,737,343 | 248,402,612 | 18,334,732 | 1,635,743 | 16,698,988 |
| 2012 | 275,075,915 | 256,168,015 | 18,907,900 | 1,664,501 | 17,243,399 |
| 2013 | 254,520,366 | 237,025,393 | 17,494,973 | 1,698,351 | 15,796,622 |
| 2014 | 277,703,535 | 258,615,020 | 19,088,515 | 1,630,682 | 17,457,833 |
| 2015 | 271,449,606 | 252,790,968 | 18,658,639 | 1,622,544 | 17,036,094 |
| 2016 | 286,283,233 | 270,540,693 | 15,742,540 | 1,593,481 | 14,149,059 |
| 2017 | 293,243,920 | 273,647,435 | 19,596,485 | 1,553,771 | 18,042,714 |
| 2018 | 293,007,400 | 268,370,995 | 24,636,405 | 1,652,425 | 22,983,980 |
| 2019 | 393,827,335 | 367,411,920 | 26,415,415 | 1,630,633 | 24,784,782 |
| 2020 | 284,038,255 | 275,369,505 | 8,668,750 | 1,371,177 | 7,297,573 |
| 2021 | 309,656,145 | 279,965,585 | 29,690,560 | 1,416,508 | 28,274,052 |
| 2022 | 329,016,131 | 304,350,848 | 24,665,283 | 1,386,076 | 23,279,207 |

1. Total daily VMT from Exhibit 9 times 365.
2. Total annual VMT minus commercial annual VMT.
3. Daily commercial miles from Exhibit 9 times 365.
4. Sum of public transit miles from Exhibit 6 and Exhibit 7.
5. Total commercial VMT minus public transit VMT.

The emissions inventory uses the National Default Vehicle Fuel Efficiency and Emission Factors provided by ICLEI in ClearPath for the years 2011 through 2021. For the years 2008 to 2010, we extrapolated MPG values based on best fit of the data provided. The MPG values are shown in Exhibit 11.

**Exhibit 11: Miles Per Gallon Assumptions for On-Road Vehicles**

| Year | Miles Per Gallon | |
|---|---|---|
| | Gas Passenger Vehicle | Diesel Heavy Truck |
| 2008 | *22.5522* | *5.9175* |
| 2009 | *22.7231* | *5.9475* |
| 2010 | *22.8939* | *5.9774* |
| 2011 | 23.1588 | 6.0462 |
| 2012 | 23.2824 | 6.0462 |
| 2013 | 23.4104 | 6.0415 |
| 2014 | 23.2033 | 6.0619 |
| 2015 | 23.8602 | 6.0998 |
| 2016 | 23.9569 | 6.1542 |
| 2017 | 24.2149 | 6.2247 |
| 2018 | 24.2149 | 6.2247 |
| 2019 | 24.3771 | 6.3925 |
| 2020 | 24.3771 | 6.4781 |
| 2021 | 25.3000 | 6.5616 |
| 2022 | 25.3000 | 6.5616 |
| Source: Based on United States National Default values (provided by ICLEI in ClearPath). 2008 to 2010 calculated on best fit to data from 2011 to 2018. | | |

### *2.2.c Off-Road Vehicles*

For the 2018 inventory, ICLEI provided emissions estimates for the off-road vehicle sector based on EPA's MOVES model. To estimate emissions over the analysis period, we adjusted the 2018 emissions values based on the change in Bloomington's population relative to 2018. This calculation is shown in Exhibit 12.

**Exhibit 12: Calculation of Off-Road Vehicle Emissions**

| Year | Emissions from MOVES Model (MT)[1] | | | Bloomington Population[2] | Adjustment Factor[3] |
|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | | |
| 2008 | *44,669* | *13* | *0* | 77,592 | 0.897 |
| 2009 | *45,192* | *13* | *0* | 78,500 | 0.907 |
| 2010 | *46,686* | *13* | *0* | 81,096 | 0.937 |
| 2011 | *46,650* | *13* | *0* | 81,033 | 0.937 |
| 2012 | *45,245* | *13* | *0* | 78,592 | 0.908 |
| 2013 | *46,454* | *13* | *0* | 80,693 | 0.933 |
| 2014 | *48,026* | *13* | *0* | 83,423 | 0.964 |

| Year | Emissions from MOVES Model (MT)[1] | | | Bloomington Population[2] | Adjustment Factor[3] |
|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | | |
| 2015 | *48,252* | *14* | *0* | 83,815 | 0.969 |
| 2016 | *49,886* | *14* | *0* | 86,654 | 1.002 |
| 2017 | *49,251* | *14* | *0* | 85,551 | 0.989 |
| 2018 | 49,810 | 14 | 0 | 86,522 | 1.000 |
| 2019 | *49,872* | *14* | *0* | 86,630 | 1.001 |
| 2020 | *50,725* | *14* | *0* | 88,111 | 1.018 |
| 2021 | *51,218* | *14* | *0* | 88,967 | 1.028 |
| 2022 | *51,711* | *15* | *0* | 89,824 | 1.038 |

1. For 2018, MOVES model output provided by ICLEI for 2018 inventory; for other years, extrapolated based on 2018 emissions times the adjustment factor.
2. See Exhibit 3.
3. Bloomington population divided by 2018 Bloomington population.

### *2.2.d Air Travel*

Bloomington Airport provided data on the amount of jet fuel and aviation gas used over the 2008 to 2019 period. For 2020 to 2022, fuel quantities are projected based on best fit to the available data. Consistent with the 2018 GHG inventory and back-cast, we assume that 43.51% of travel in each year is Scope 1 and 52% is Scope 3. Exhibit 13 shows the calculations.

**Exhibit 13: Calculation of Scope 1 and Scope 3 Fuel Usage for Air Travel**

| Year | Fuel Quantity (Gallons)[1] | | Scope 1[2] | | Scope 3[3] | |
|---|---|---|---|---|---|---|
| | Jet Fuel | Aviation Gas | Jet Fuel | Aviation Gas | Jet Fuel | Aviation Gas |
| 2008 | 843,214 | 139,538 | 366,882 | 60,713 | 438,471 | 72,560 |
| 2009 | 624,410 | 103,942 | 271,681 | 45,225 | 324,693 | 54,050 |
| 2010 | 631,987 | 113,987 | 274,978 | 49,596 | 328,633 | 59,273 |
| 2011 | 645,082 | 63,313 | 280,675 | 27,547 | 335,443 | 32,923 |
| 2012 | 599,408 | 97,162 | 260,802 | 42,275 | 311,692 | 50,524 |
| 2013 | 436,578 | 110,699 | 189,955 | 48,165 | 227,021 | 57,563 |
| 2014 | 511,465 | 78,458 | 222,538 | 34,137 | 265,962 | 40,798 |
| 2015 | 503,409 | 68,853 | 219,033 | 29,958 | 261,773 | 35,804 |
| 2016 | 547,160 | 64,880 | 238,069 | 28,229 | 284,523 | 33,738 |
| 2017 | 551,344 | 55,953 | 239,890 | 24,345 | 286,699 | 29,096 |
| 2018 | 525,416 | 55,733 | 228,609 | 24,249 | 273,216 | 28,981 |
| 2019 | 580,155 | 44,015 | 252,425 | 19,151 | 301,681 | 22,888 |
| 2020 | *468,488* | *37,585* | 203,839 | 16,353 | 243,614 | 19,544 |
| 2021 | *450,825* | *30,591* | 196,154 | 13,310 | 234,429 | 15,908 |
| 2022 | *433,161* | *23,598* | 188,468 | 10,267 | 225,244 | 12,271 |

| Year | Fuel Quantity (Gallons)[1] | | Scope 1[2] | | Scope 3[3] | |
|---|---|---|---|---|---|---|
| | Jet Fuel | Aviation Gas | Jet Fuel | Aviation Gas | Jet Fuel | Aviation Gas |

1. Data provided by Bloomington Airport for 2008 to 2019; for 2020 to 2022, forecasted based on best fit to available data.
2. Quantity of fuel times 43.51% (percent of travel that is Scope 1).
3. Quantity of fuel times 52.00% (percent of travel that is Scope 3).

## 2.3 Solid Waste, Water Supply, and Wastewater Sector

### *2.3.a Landfill*

The Indiana Department of Environmental Management (IDEM) provides data on the total quantity of solid waste at the county level for 2011 to 2021.[3] To identify the facilities that represent waste generated from Bloomington, we established a cutoff of 100 tons reported (on a quarterly basis) and restricted the facilities to include the following that serve Bloomington: Medora Sanitary Landfill, Sycamore Ridge Landfill, Ray's Resource Recovery and Transfer Station, 96th Street Transfer and Recycling, and Lawrence County SWMD Transfer Site. We excluded Hoosier Disposal and Recycling transfer station since the majority of waste tonnage is accounted for in the Sycamore Ridge landfill and other included facilities.

We extrapolated Bloomington-level quantities based on the ratio of the Bloomington population to the Monroe County population, which was applicable for the years 2011 to 2021. For 2008 to 2010, we multiplied the Bloomington population by an assumed rate of 0.972 tons per person, which is the average for 2011 to 2018. For 2022, we multiplied the population by an assumed rate of 0.985 tons per person, which is the average for 2011 to 2021. Exhibit 14 shows this calculation.

**Exhibit 14: Calculation of Landfill Solid Waste Tonnage**

| Year | Monroe County Tons[1] | Census Population[2] | | | Bloomington Tons/ person[3] | Bloomington Tons[4] |
|---|---|---|---|---|---|---|
| | | Monroe County | Bloomington | Adj | | |
| 2008 | | 136,443 | 77,592 | 0.569 | *0.972* | *75,386* |
| 2009 | | 137,565 | 78,500 | 0.571 | *0.972* | *76,269* |
| 2010 | | 138,422 | 81,096 | 0.586 | *0.972* | *78,791* |
| 2011 | 141,274 | 139,799 | 81,033 | 0.580 | 1.011 | *81,888* |
| 2012 | 134,076 | 141,019 | 78,592 | 0.557 | 0.951 | *74,722* |
| 2013 | 136,122 | 141,888 | 80,693 | 0.569 | 0.959 | *77,414* |
| 2014 | 133,057 | 143,339 | 83,423 | 0.582 | 0.928 | *77,439* |
| 2015 | 132,507 | 144,705 | 83,815 | 0.579 | 0.916 | *76,750* |
| 2016 | 142,935 | 145,496 | 86,654 | 0.596 | 0.982 | *85,129* |
| 2017 | 148,008 | 146,986 | 85,551 | 0.582 | 1.007 | *86,146* |
| 2018 | 149,759 | 146,917 | 86,522 | 0.589 | 1.019 | *88,196* |
| 2019 | 152,257 | 148,431 | 86,630 | 0.584 | 1.026 | *88,863* |
| 2020 | 149,031 | 149,765 | 88,111 | 0.588 | 0.995 | *87,679* |

[3] https://www.in.gov/idem/landquality/2406.htm

| Year | Monroe County Tons[1] | Census Population[2] | | | Bloomington Tons/ person[3] | Bloomington Tons[4] |
|---|---|---|---|---|---|---|
| | | Monroe County | Bloomington | Adj | | |
| 2021 | 157,200 | 150,867 | 88,967 | 0.590 | 1.042 | *92,702* |
| 2022 | | 151,970 | 89,824 | 0.591 | *0.985* | *88,480* |

1. Data provided by Indiana Department of Environmental Management (IDEM) for 2011 to 2021; based on sum of relevant landfills and transfer stations reporting over 100 tons on a quarterly basis.
2. For Monroe County and Bloomington populations, see Exhibit 3. Adjustment factor calculated as Bloomington population divided by Monroe County population.
3. Calculated as Monroe County tons times adjustment factor divided by Bloomington population.
4. For 2011 to 2021, Monroe County tons times adjustment factor; for 2008 to 2010, Bloomington population times average tons per person for 2011 to 2018 (0.972); for 2022, Bloomington population times average tons per person for 2011 to 2021 (0.985).

### *2.3.b Composting*

Exhibit 15 shows the tons of composting reported by the City of Bloomington Landscaping and Sanitation departments (which practice green composting) and Green Camino (EarthKeepers as of 2018; which practices bio-waste composting) for 2016 to 2021. Based on information provided, we assume that no composting was practiced prior to 2016, and that 2022 levels were similar to 2021. We were not able to obtain data on bio-waste composting for 2019 to 2022.

**Exhibit 15: Tons of Composting**

| Year | Green Waste Composting[1] | Bio-Waste Composting[2] |
|---|---|---|
| 2016 | 8 | |
| 2017 | 26 | |
| 2018 | 128 | 15 |
| 2019 | 650 | |
| 2020 | 640 | |
| 2021 | 700 | |
| 2022 | *700* | |

1. Data provided by City of Bloomington.
2. Data provided by Green Camino.

### *2.3.c Water Supply and Wastewater*

The 2018 inventory accounts for electricity used for water supply and wastewater treatment (24,428,531 kWh), as well as $N_2O$ emissions associated with wastewater treatment (6.58 MT). For this analysis, equivalent data were not available. As such, for the electricity use, we extrapolated based on the percentage of government electricity usage was associated with the facilities in 2018, assuming that the changes would be proportional. For the $N_2O$ emissions from wastewater treatment, we assumed that changes over the analysis period would be proportional to changes in Bloomington's population. These calculations are shown in Exhibit 16.

**Exhibit 16: Water Supply and Wastewater Treatment Calculations**

| Year | Grid-Supplied Electricity (kWh) | | Denitrification Emissions ($MT N_2O$)[3] | Bloomington Population[4] | Population Adjustment Factor[5] |
|---|---|---|---|---|---|
| | Government[1] | Water/ Wastewater[2] | | | |
| 2008 | 368,590,375 | *28,238,970* | *5.901* | *77,592* | 0.897 |
| 2009 | 374,353,554 | *28,680,507* | *5.970* | *78,500* | 0.907 |
| 2010 | 367,350,121 | *28,143,950* | *6.168* | 81,096 | 0.937 |
| 2011 | 358,091,166 | *27,434,590* | *6.163* | 81,033 | 0.937 |
| 2012 | 349,619,532 | *26,785,549* | *5.977* | 78,592 | 0.908 |
| 2013 | 337,260,371 | *25,838,671* | *6.137* | 80,693 | 0.933 |
| 2014 | 341,460,258 | *26,160,439* | *6.345* | 83,423 | 0.964 |
| 2015 | 292,423,947 | *22,403,599* | *6.375* | 83,815 | 0.969 |
| 2016 | 300,100,840 | *22,991,752* | *6.590* | 86,654 | 1.002 |
| 2017 | 284,647,430 | *23,617,209* | *6.507* | 85,551 | 0.989 |
| 2018 | 294,425,924 | 24,428,531 | 6.580 | 86,522 | 1.000 |
| 2019 | 277,022,755 | 27,047,274 | *6.589* | 86,630 | 1.001 |
| 2020 | 248,101,595 | 24,217,854 | *6.701* | 88,111 | 1.018 |
| 2021 | 259,320,211 | 25,843,110 | *6.766* | 88,967 | 1.028 |
| 2022 | 379,363,730 | 31,296,209 | *6.831* | 89,824 | 1.038 |

1. Data provided by Duke Energy; for 2008 to 2016, inclusive of electricity consumed by utilities; for 2017 to 2022, exclusive of utilities' electricity.
2. For 2018 to 2022, data provided by Duke Energy; for 2008 to 2017, extrapolated based on 2018 utilities' electricity consumption as a percent of total government electricity consumption (7.66%).
3. Data for 2018 provided by the City of Bloomington 2018 inventory; other data extrapolated based on 2018 value times the population adjustment factor.
4. See Exhibit 3.
5. Calculated as Bloomington population divided by 2018 Bloomington population.

## 2.4 Industrial Processes and Product Use Sector

### *2.4.a Fugitive Natural Gas Emissions*

To estimate emissions from fugitive natural gas emissions, the analysis uses the same methodology and assumptions as the 2018 inventory, which assumes a leakage rate of 0.3% from all natural gas in the residential, commercial, and industrial subsectors. We used the same emissions factors that account for this leakage rate, applying them directly to the natural gas data from described in Section 0. Note that this approach excludes natural gas usage at IU CHP.

### *2.4.b Transmission and Distribution Losses from Electricity*

As in the 2018 inventory, this analysis uses the grid loss factors for Indiana from the Energy Information Administration's (EIA's) Annual Electric Generator Report to estimate the transmission and distribution (T&D) losses and associated emissions. To account for changes in loss rates over the period of the analysis, we downloaded the underlying data from the EIA[4] and calculated the loss factor for each year based on estimated losses, direct use, and total disposition. This calculation is shown in Exhibit 17.

### Exhibit 17: Grid Loss Rate Calculation

| Year | Total Disposition[1] | Direct Use[1] | Estimated Losses[1] | Loss Rate[2] |
|---|---|---|---|---|
| 2008 | 129,533,013 | 7,896,332 | 6,814,723 | 0.0560 |
| 2009 | 116,677,008 | 7,502,074 | 6,321,934 | 0.0579 |
| 2010 | 125,187,219 | 7,997,274 | 6,548,096 | 0.0559 |
| 2011 | 122,132,166 | 8,110,579 | 6,538,887 | 0.0573 |
| 2012 | 121,028,706 | 8,344,927 | 5,695,557 | 0.0505 |
| 2013 | 121,345,712 | 8,577,181 | 5,666,744 | 0.0503 |
| 2014 | 121,854,906 | 7,958,621 | 5,568,490 | 0.0489 |
| 2015 | 119,683,883 | 8,352,553 | 5,212,499 | 0.0468 |
| 2016 | 115,135,895 | 4,928,602 | 5,412,467 | 0.0491 |
| 2017 | 109,966,194 | 4,958,199 | 5,383,593 | 0.0513 |
| 2018 | 116,858,605 | 6,819,691 | 5,373,968 | 0.0488 |
| 2019 | 115,311,661 | 7,416,064 | 5,536,487 | 0.0513 |
| 2020 | 109,765,214 | 7,344,405 | 5,411,018 | 0.0528 |
| 2021 | 112,475,762 | 7,406,286 | 4,692,418 | 0.0447 |
| 2022 | *112,475,762* | *7,406,286* | *4,692,418* | *0.0447* |

1. Source for 2008 to 2018: United States Energy Information Administration. 2020. State Electricity Profiles: Indiana Electricity Profile 2018: Table 10. For 2019 to 2021: United States Energy Information Administration. 2022. State Electricity Profiles: Indiana Electricity Profile 2021: Table 10. For 2022, assumed equivalent to 2021.
2. Calculated as Estimated Losses/(Total Disposition – Direct Use).

## 2.5 Emission Factors

### Exhibit 18: Emissions Factors

| Activity | Emissions Factor Denominator | | | Emissions Factor (lbs) | | |
|---|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Natural Gas Use | MMBtu | MMBtu | MMBtu | 116.8891868 | 0.0110231 | 0.0002205 |
| CHP Natural Gas Use | MMBtu | MMBtu | MMBtu | 116.8891868 | 0.0022046 | 0.0002205 |
| Coal Use | MMBtu | MMBtu | MMBtu | 205.9119208 | 0.0220462 | 0.0035274 |
| Fuel Oil Use | MMBtu | MMBtu | MMBtu | 161.4887388 | 0.0066139 | 0.0013228 |
| Non-commercial gas | MMBtu | miles | miles | 154.8528193 | 0.0000412 | 0.0000243 |
| Commercial diesel | MMBtu | miles | miles | 162.9977662 | 0.0000112 | 0.0000106 |
| Public transit gas | MMBtu | miles | miles | 154.8528193 | 0.0000443 | 0.0000375 |
| Public transit diesel | MMBtu | miles | miles | 162.9977662 | 0.0000022 | 0.0000033 |

[4] https://www.eia.gov/tools/faqs/faq.php?id=105&t=3

| Activity | Emissions Factor Denominator | | | Emissions Factor (lbs) | | |
|---|---|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Air travel aviation gas | gallons | gallons | gallons | 18.3204289 | 0.0155206 | 0.0002425 |
| Air travel jet fuel | gallons | gallons | gallons | 21.0982557 | 0.0005952 | 0.0006834 |
| Landfill | tons | tons | tons | 0.0000000 | 73.0055733 | 0.0000000 |
| Bio-waste composting | tons | tons | tons | 0.0000000 | 0.4850174 | 0.2932150 |
| Green waste composting | tons | tons | tons | 0.0000000 | 1.2257712 | 0.4497434 |
| T&D Losses | MMBtu | MMBtu | MMBtu | 364.3169304 | 0.0316441 | 0.0055670 |
| Fugitive emissions | MMBtu | MMBtu | MMBtu | 0.0014620 | 0.1365519 | 0.0000000 |

# 3. Summary Results

This inventory of community GHG emissions from 2008 to 2022, developed using a consistent GHG reporting protocol and equivalent data for each year, enables the City to compare emissions over a 15-year period and track progress toward its emission mitigation commitments. The exhibits below summarize the community level results of the analysis described in Section 2 (additional detailed results and graphs can be found in the accompanying spreadsheet model).

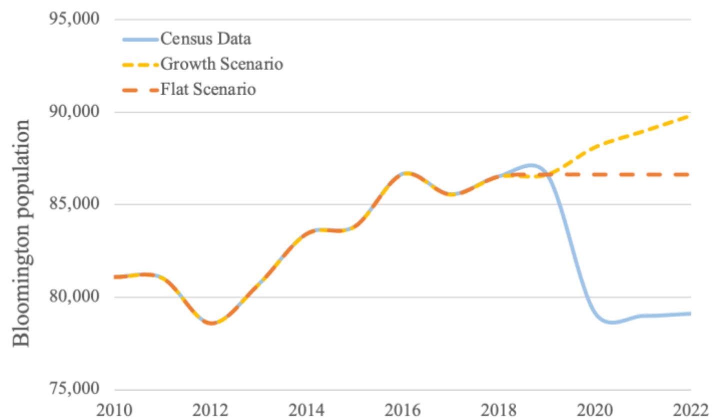
While a detailed contribution analysis would be needed for a full assessment of the drivers of changes in emissions over the period, some overall trends are notable. For example, while community GHG emissions have seen an overall decrease between 2008 and 2022, they have been particularly variable over the last three years, with annual increases of over 9 percent in each of the last two years following a 14 percent decrease in 2019.

Additional observations include:

- Total emissions decreased by approximately 16 percent over the 15-year period, while population increased by 16 percent, yielding overall per-capita emissions decreases of almost 28 percent.
- Commercial energy emissions realized the largest overall decrease in emissions (almost 30 percent) and accounted for the largest share in overall community reductions over the period.
- Government emissions decreased significantly (by over 50 percent) between 2008 and 2020 before seeing sharp increases in 2021 and 2022; overall, government energy decreased by over 24 percent between 2008 and 2022.
- Transportation emissions varied over the period and realized a slight overall increase in absolute terms but decreased by seven percent on a per-capita basis. On-road vehicles had a high degree of variation in later years, with a spike in non-commercial vehicle traffic in 2019 and a significant decrease in commercial vehicle traffic in 2020.
- While most sectors had overall decreases in absolute and per-capita emissions over the period, emissions from the solid waste sector saw an overall increase on both an absolute value and per-capita basis.

It is important to note that results and trends summarized in this document are based on assumptions and extrapolation methods as described in Section 2. In some cases, these assumptions have important implications for the interpretation of the results. For example, the model varies the emission factors for grid-supplied electricity over the analysis period based on region-specific emission factors provided by the U.S. Environmental Protection Agency. The year-to-year changes in these emission factors reflect underlying changes in the mix of resources used to generate electricity for the region, resulting in an overall decrease in emissions per kWh of electricity generated over the period. While the energy mix used by energy providers is largely outside of the control of the City, this emission factor variation is a significant driver of the overall decreasing absolute emissions in the stationary energy sector.[5]

**Exhibit 19: City of Bloomington population data**




Additionally, as noted in Section 2.1.b, the 2020 Census and subsequent American Community Survey (ACS) estimates used a different methodology relative to the 2010 Census and 2011 to 2019 ACS estimates and reflect a significant decrease in the population figures starting in 2020. Exhibit 19 illustrates this trend for the City; a similar trend occurs in the Census data for Monroe County. The decreased population may be the result of methodology changes, the impact of the COVID pandemic on the City's student population, or an actual decrease in the population. For this analysis, we assume that the sharp decrease between 2019 and 2020 does not reflect actual trends; for consistency with the previous analysis (and to avoid an artificial impact to the emissions estimates for the later years in the analysis period), we instead project the population for the 2020 to 2022 years based on the best fit to the 2010 to 2019 population trends (the "growth scenario" in Exhibit 19). However, as a result of this assumption, it is important to note that the population data used to extrapolate some key inputs does not reflect the U.S. Census Bureau's current population estimates for Monroe County and Bloomington. This represents a source of uncertainty in this analysis.

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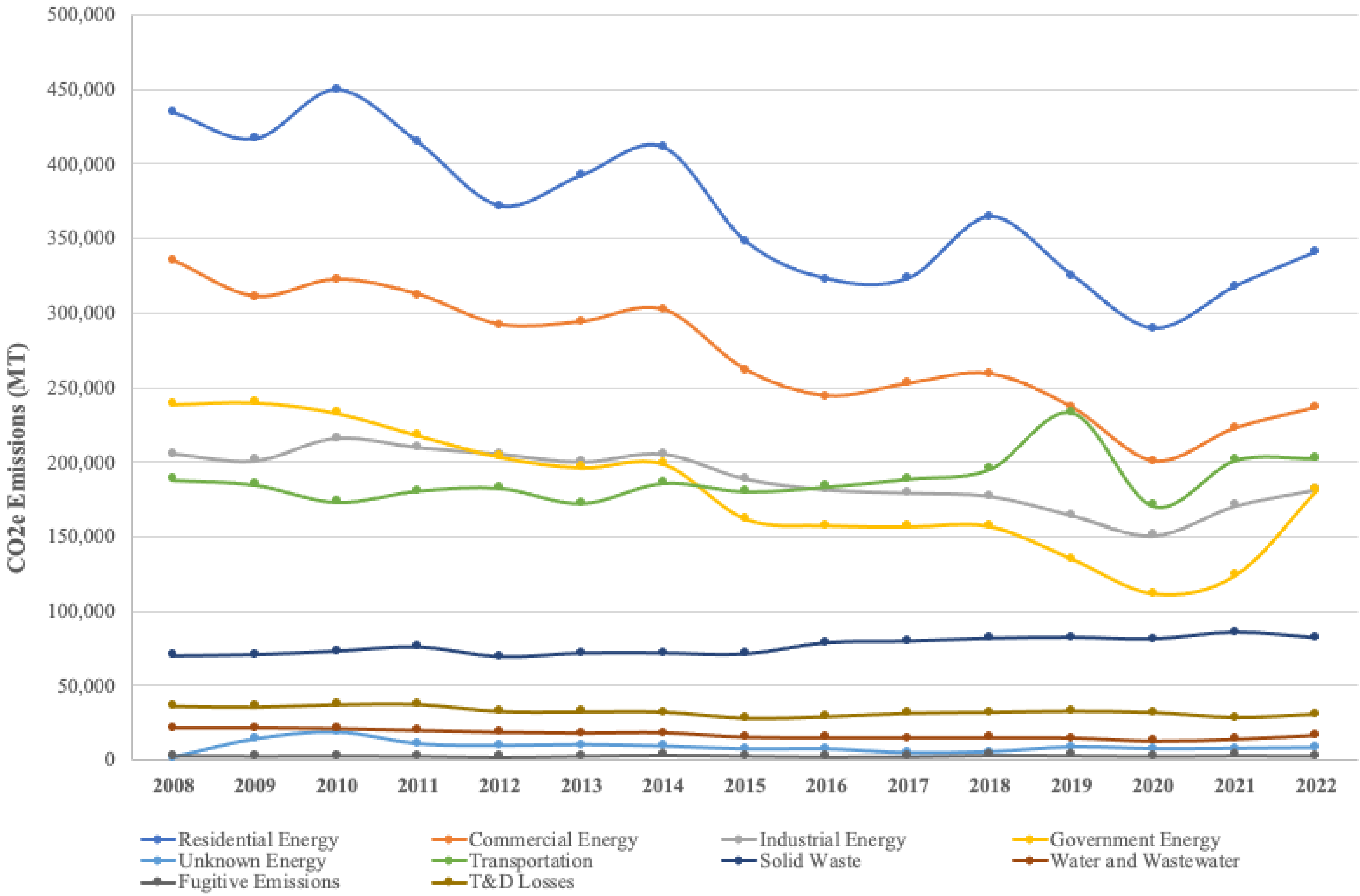
5 For example, the $CO_2$ eGrid emission factor decreased by 32 percent between 2008 to 2022, while electricity consumption in Bloomington increased by 8 percent (with a population increase of 16 percent).

### Exhibit 20: Summary of Community-Level Emissions (MT CO2e) by Sector/Sub-Sector

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Residential Energy | 434,272 | 416,397 | 449,523 | 414,189 | 371,509 | 392,035 | 410,977 | 348,142 | 322,452 | 322,915 | 364,322 | 325,006 | 289,451 | 317,530 | 341,038 |
| Commercial Energy | 334,993 | 310,846 | 322,103 | 312,093 | 291,961 | 293,876 | 302,137 | 261,724 | 244,190 | 252,468 | 258,881 | 236,464 | 200,399 | 222,339 | 236,491 |
| Transportation | 188,209 | 185,015 | 173,324 | 180,974 | 182,844 | 172,508 | 186,196 | 180,513 | 183,635 | 189,012 | 195,602 | 233,328 | 170,504 | 201,479 | 202,725 |
| Industrial Energy | 205,580 | 200,977 | 215,905 | 209,632 | 205,334 | 200,222 | 205,390 | 188,911 | 181,576 | 179,350 | 177,149 | 164,267 | 150,890 | 170,539 | 181,610 |
| Government Energy | 238,831 | 240,124 | 232,982 | 217,750 | 203,461 | 196,375 | 198,928 | 161,819 | 157,301 | 156,572 | 156,770 | 134,977 | 111,478 | 123,787 | 181,063 |
| Solid Waste | 69,899 | 70,717 | 73,056 | 75,928 | 69,284 | 71,779 | 71,803 | 71,163 | 78,871 | 79,877 | 81,786 | 82,440 | 81,342 | 86,003 | 82,088 |
| T&D Losses | 36,468 | 35,835 | 37,637 | 37,816 | 32,614 | 32,357 | 32,216 | 27,718 | 28,825 | 31,347 | 32,058 | 32,892 | 31,908 | 28,291 | 30,769 |
| Water and Wastewater | 21,380 | 21,505 | 20,965 | 19,700 | 18,465 | 17,920 | 18,186 | 15,115 | 14,798 | 14,715 | 14,751 | 14,627 | 12,441 | 13,703 | 16,437 |
| Unknown Energy | 1,721 | 13,676 | 18,371 | 10,549 | 9,412 | 10,024 | 9,043 | 7,167 | 7,192 | 4,642 | 5,356 | 8,530 | 7,370 | 7,582 | 8,116 |
| Fugitive Emissions | 3,009 | 2,907 | 2,952 | 2,884 | 2,317 | 2,905 | 3,383 | 2,948 | 2,505 | 2,555 | 3,265 | 3,089 | 2,776 | 3,090 | 2,992 |
| Total Emissions | **1,534,363** | **1,498,000** | **1,546,818** | **1,481,515** | **1,387,202** | **1,390,000** | **1,438,259** | **1,265,222** | **1,221,345** | **1,233,454** | **1,289,940** | **1,235,621** | **1,058,560** | **1,174,343** | **1,283,331** |
| *Change from 2008* | | *-2.4%* | *0.8%* | *-3.4%* | *-9.6%* | *-9.4%* | *-6.3%* | *-17.5%* | *-20.4%* | *-19.6%* | *-15.9%* | *-19.5%* | *-31.0%* | *-23.5%* | *-16.4%* |
| *Change year-to-year* | | *-2.4%* | *3.3%* | *-4.2%* | *-6.4%* | *0.2%* | *3.5%* | *-12.0%* | *-3.5%* | *1.0%* | *4.6%* | *-4.2%* | *-14.3%* | *10.9%* | *9.3%* |

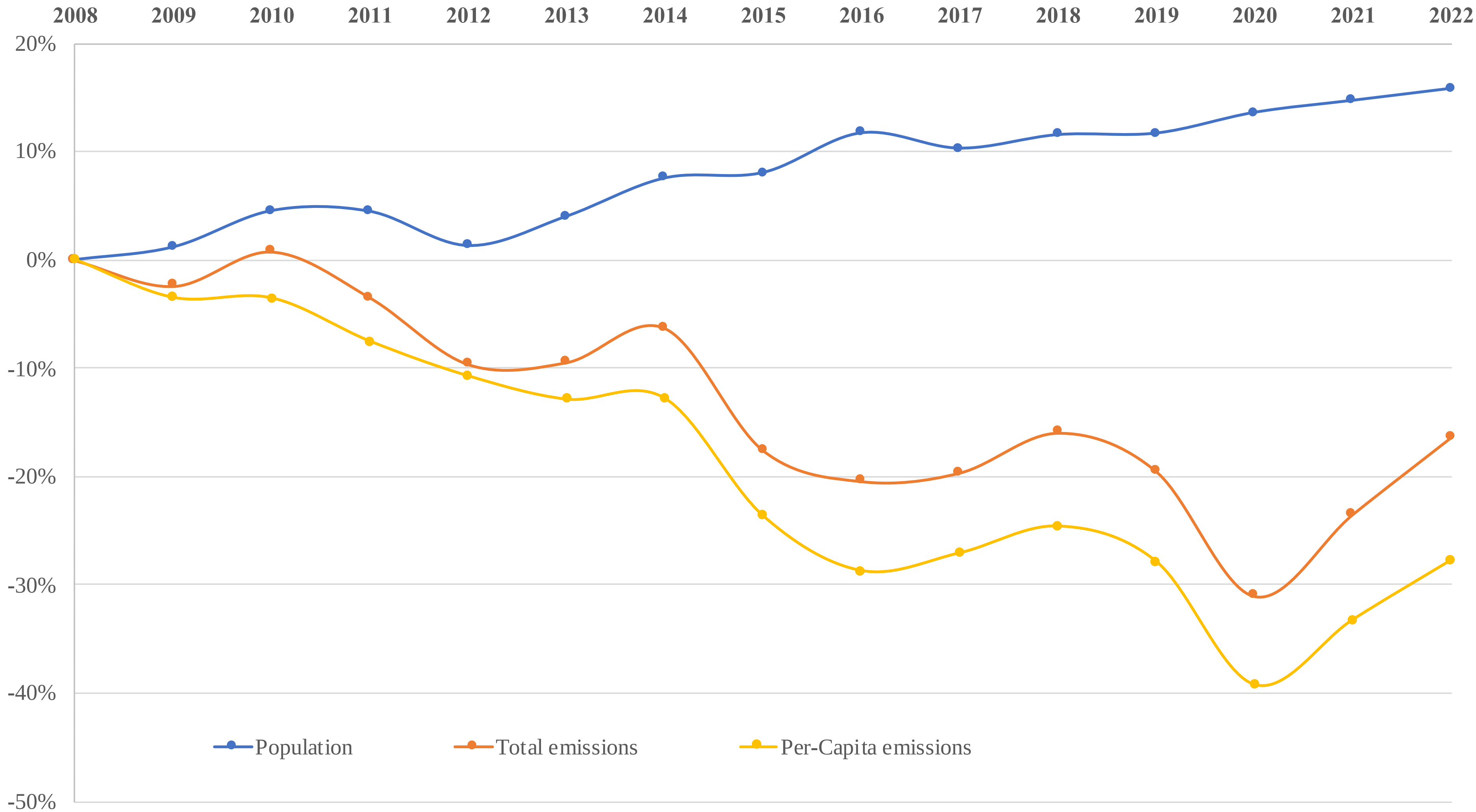
**Exhibit 21: Graph of Community-Level Emissions by Sector/Sub-Sector**



### Exhibit 22: Summary of Per-Capita Community-Level Emissions by Sector/Sub-Sector

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Residential Energy | 5.6 | 5.3 | 5.5 | 5.1 | 4.7 | 4.9 | 4.9 | 4.2 | 3.7 | 3.8 | 4.2 | 3.8 | 3.3 | 3.6 | 3.8 |
| Commercial Energy | 4.3 | 4.0 | 4.0 | 3.9 | 3.7 | 3.6 | 3.6 | 3.1 | 2.8 | 3.0 | 3.0 | 2.7 | 2.3 | 2.5 | 2.6 |
| Transportation | 2.4 | 2.4 | 2.1 | 2.2 | 2.3 | 2.1 | 2.2 | 2.2 | 2.1 | 2.2 | 2.3 | 2.7 | 1.9 | 2.3 | 2.3 |
| Industrial Energy | 2.6 | 2.6 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 | 2.3 | 2.1 | 2.1 | 2.0 | 1.9 | 1.7 | 1.9 | 2.0 |
| Government Energy | 3.1 | 3.1 | 2.9 | 2.7 | 2.6 | 2.4 | 2.4 | 1.9 | 1.8 | 1.8 | 1.8 | 1.6 | 1.3 | 1.4 | 2.0 |
| Solid Waste | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 0.9 | 1.0 | 0.9 |
| T&D Losses | 0.5 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 |
| Water and Wastewater | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 |
| Unknown Energy | 0.0 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Emissions** | **19.8** | **19.1** | **19.1** | **18.3** | **17.7** | **17.2** | **17.2** | **15.1** | **14.1** | **14.4** | **14.9** | **14.3** | **12.0** | **13.2** | **14.3** |
| *Change from 2008* | | *-3.5%* | *-3.5%* | *-7.5%* | *-10.7%* | *-12.9%* | *-12.8%* | *-23.7%* | *-28.7%* | *-27.1%* | *-24.6%* | *-27.9%* | *-39.2%* | *-33.2%* | *-27.8%* |
| *Change year-to-year* | | *-3.5%* | *0.0%* | *-4.1%* | *-3.5%* | *-2.4%* | *0.1%* | *-12.4%* | *-6.6%* | *2.3%* | *3.4%* | *-4.3%* | *-15.8%* | *9.9%* | *8.2%* |

**Exhibit 23: Graph of Percent Change in Population and Emissions**



# We thank you for your ongoing support of our program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