Bloomington-Normal Greenhouse Gas Inventory

Local Government Operations and Community-Scale Emissions

Baseline Year: 2008

Inventory performed on behalf of
The City of Bloomington
and the Town of Normal
by the Ecology Action Center, Normal, Illinois
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Acknowledgements

This inventory would not have been possible without the cooperation of many local agencies and organizations and the assistance of dedicated volunteers. The Ecology Action Center is grateful for a community that makes stewardship of our local environment such a high priority.

Ameren

Amtrak

Bloomington-Normal Water Reclamation District

City of Bloomington

Connect Transit

Corn Belt Energy

McLean County Regional Planning Commission

Nicor Gas

Town of Normal

Executive Summary

The Ecology Action Center's (EAC) baseline inventory of greenhouse gas emissions for Bloomington-Normal is an important step towards combating climate change locally. By knowing the relative sources of greenhouse gas emissions, Bloomington and Normal will be better equipped to strategically and cost-effectively reduce emissions. Following similar efforts nationally and globally, the EAC adopted the International Local Government GHG Emissions Analysis Protocol (IEAP) developed by ICLEI—Local Governments for Sustainability (formerly called the International Council for Local Environmental Initiatives). This tool is used internationally for measuring and reporting greenhouse gas emissions.

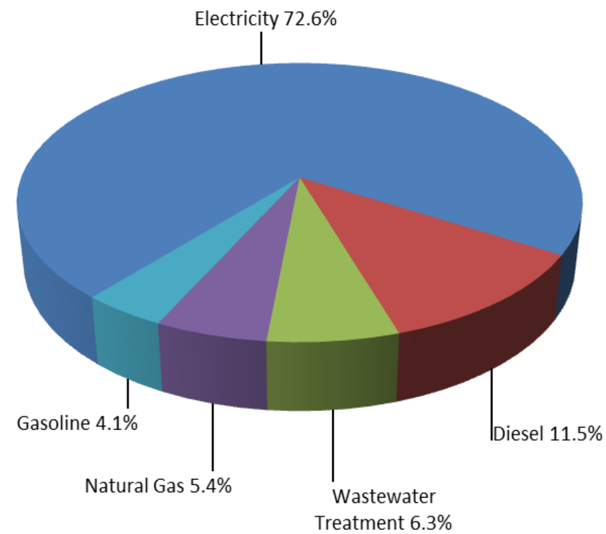

Figure i. 2008 Bloomington-Normal LGO GHG Inventory MT CO_2e by Category

Our study measured emissions through two separate analyses. The first examined the municipal government sector, specifically emissions from local government operations (LGO) of Bloomington, Normal, and related public service agencies including public transportation and wastewater treatment. The second focused on community-scale emissions for all sectors of Bloomington and Normal. We used 2008 as the baseline year because it was the earliest year for which reliable data was available.

Consistent with similar inventories at local, state, and national levels, the leading source of greenhouse gas emissions in Bloomington-Normal is stationary energy usage, which includes electricity and natural gas used for cooling, heating, and other needs in homes, businesses, industry, and local government. Vehicular transportation follows, which includes all gasoline and diesel usage in local transportation. Both the stationary energy and transportation emissions are directly attributable to the combustion of fossil fuels.

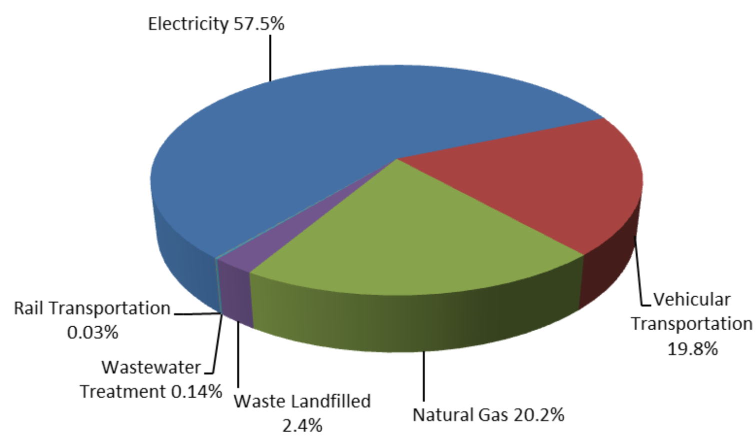

Figure ii. 2008 Bloomington-Normal Community Scale GHG Inventory MT CO_2e by Category

Introduction

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According to the US Environmental Protection Agency, global temperatures are increasing. On average, temperatures have gone up nearly one and a half degrees Fahrenheit over the past hundred years, with increases projected up to 11.5 degrees over the next century[1]. The potential ramifications of unchecked shifts in climate across the world are significant, including migrating agricultural zones[2], increasing frequency of droughts and floods[3], and stagnating economic growth[4]. A significant surge in emissions of carbon dioxide from the combustion of fossil fuels, especially from transportation and energy generation, along with other human-generated "greenhouse gases" is increasing the impact of the greenhouse effect, which results in increased average global temperatures[5].

Scientists and political leaders frequently note the need for significant steps to reduce greenhouse gas emissions. In 2008 Senator John McCain argued for urgent action[6].

> *Instead of idly debating the precise extent of global warming, or the precise timeline of global warming, we need to deal with the central facts of rising temperatures, rising waters, and all the endless troubles that global warming will bring. We stand warned by serious and credible scientists across the world that time is short and the dangers are great.*

Communities across the nation are responding with common-sense strategies that not only help reduce climate-changing greenhouse gases, but also save money, conserve energy, improve air quality, and preserve precious natural resources. However, in order to prioritize these efforts and measure their effectiveness, baseline emissions data are necessary. Combustion of fossil fuels such as coal, petroleum, and natural gas for electricity generation and transportation are key sources of these emissions. A greenhouse gas (GHG) emissions inventory is a tool that quantifies these emissions, and allows our community to both set baseline data and regularly assess the progress towards meeting local goals for reducing emissions.

1. United States Environmental Protection Agency, "Climate Change: Basic Information," March 18, 2014. http://www.epa.gov/climatechange/basics/.
2. Jason Samenow, "New USDA plant zones clearly show climate change," *Washington Post*, January 27, 2012. http://www.washingtonpost.com/blogs/capital-weather-gang/post/new-usda-plant-zones-clearly-show-climate-change/2012/01/27/gIQA7Vz2VQ_blog.html.
3. Intergovernmental Panel on Climate Change, "IPCC Fourth Assessment Report: Climate Change 2007, 3.4.3 - Floods and droughts," 2007. https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch3s3-4-3.html.
4. Tim Hume, "Report: Climate change may pose threat to economic growth." *CNN,* October 30, 2013. http://www.cnn.com/2013/10/29/world/climate-change-vulnerability-index/.
5. United States Environmental Protection Agency, "Climate Change: Basic Information," March 18, 2014. http://www.epa.gov/climatechange/basics/.
6. Michele Norris and Scott Horsley, "McCain talks climate change in Orgeon speech," May 12, 2008. http://www.npr.org/templates/story/story.php?storyId=90379943.

1.1 Background

What is a Greenhouse Gas Inventory?

A greenhouse gas (GHG) inventory identifies and quantifies greenhouse gas pollution from human activities emitted into the atmosphere over a period of one year and correlates this pollution with the activities that caused the emissions. It also provides background on the methods used to make these calculations. Policy makers use GHG inventories to track emission trends, develop strategies to reduce GHG pollution, and assess progress toward meeting reduction goals[7].

While the International Panel on Climate Change (IPCC), an internationally acknowledged authority on climate change, identifies six greenhouse gases, only three are both relevant and practical for most local inventories.

INCLUDED	EXCLUDED
carbon dioxide (CO_2)	perfluorocarbons (PFCs)
methane (CH_4)	hydrofluorocarbons (HFCs)
nitrous oxide (N_2O)	sulfur hexafluoride (SF_6)

Accurate data are not available for the measurement of perflurocarbons, hydrofluorocarbons, and sulfur hexafluoride, which are usually the result of industrial processes. Furthermore, while they are significantly more potent than carbon dioxide, the fluorinated gases, as they are collectively called, represent only 3% of our nation's total emissions[8]. Accordingly, these gases were not included in our inventory.

Figure 1.1 Greenhouse Gases Overview[9]

Gas	Abbreviation	Global Warming Potential[10]	Percentage of U.S. Emissions
Carbon Dioxide	CO_2	1	82%
Methane	CH_4	21	9%
Nitrous Oxide	N_2O	310	6%
Hydroflurocarbons	PFCs	43-11,700	3%
Perflurocarbons	HFCs	6,500-9,000	
Sulfur Hexaflouride	SF_6	23,900	

7. United States Environmental Protection Agency, "Developing a Greenhouse Gas Inventory," April 28, 2014. http://www.epa.gov/statelocalclimate/local/activities/ghg-inventory.html.
8. United States Environmental Protection Agency, "National Greenhouse Gas Emissions Data," April 15, 2014 http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html.
9. Global Warming Potential is a relative measure of how much heat a greenhouse gas traps in the atmosphere. See Appendix A for a definition.
10. United States Environmental Protection Agency, "U.S. Greenhouse Gas Emissions," 2011. http://cfpub.epa.gov/eroe/index.cfm?fuseaction=detail.viewPdf&ch=46&lShowInd=0&subtop=342&lv=list.listByChapter&r=224026

Instead, we focused our efforts to accurately calculate carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) emissions. Following standards set by the international association Local Governments for Sustainability, also known as ICLEI, these gases were aggregated and reported as carbon dioxide equivalents (CO_2e), a commonly used unit that combines greenhouse gases of differing impact on the earth's climate into one weighted unit. CO_2e volumes are expressed in metric tons (MT), which equal 1,000 kilograms, or 2,204.6 pounds.[11]

Expressing total volumes of greenhouse gases in one universal unit allows for comparisons of emissions in terms of one common "currency". While other greenhouse gases may be more potent, CO_2 represents 82% of all emissions released by human activity.

1.2 Benefits of Measurement

The value of a GHG inventory goes beyond the obvious goal of quantifying and identifying greenhouse gas emissions.

Risk Management and Voluntary Action

By measuring emissions, Bloomington and Normal will have a tool to prepare for a carbon-constrained future that will document actions to reduce GHG emissions. Voluntary reporting of GHG emissions by communities may at a later date reduce the need for more severe reduction mandates by higher levels of government.

Identification of Inefficiencies and Cost-Savings Opportunities

Accounting for emissions creates opportunities to identify ways to improve efficiency by reducing materials and energy inputs, as well as waste and emissions. The benefits include cost savings, emissions reductions, and future cost control for activities that have high carbon intensity.

Leadership

While many Illinois communities are working to reduce their carbon footprint, relatively few have completed a baseline GHG emissions inventory. Like many past initiatives, Bloomington-Normal will set an example for other central Illinois communities by taking responsibility for our impact on the climate. Sharing the lessons we learned through the experience will empower others to follow suit for even greater impact.

Mitigation and Adaptation

After completing a baseline inventory quantifying local GHG emissions, Bloomington-Normal can next identify and implement strategies to reduce those emissions. At the same time, the community can begin planning adaptive strategies for a changing environment. Examples might include using water resources more efficiently, adapting building codes to new climate conditions and extreme weather events, and choosing tree species less vulnerable to storms and drought.

11. United States Environmental Protection Agency, "U.S. Greenhouse Gas Emissions".

1.3 Principles

The ICLEI Protocol identifies five general principles to aid in the inventory process[12].

Relevance

The greenhouse gas inventory shall appropriately reflect the greenhouse gas emissions of the local government or the community within the local government area and should be organized to reflect the areas over which local governments exert control and hold responsibility in order to serve the decision-making needs of users.

Completeness

All greenhouse gas emission sources and activities within the chosen inventory boundary shall be accounted for. Any specific exclusion should be disclosed.

Consistency

Consistent methodologies to allow for meaningful comparisons of emissions over time shall be used. Any changes to the data, inventory boundary, methods, or any relevant factors in the time series, shall be disclosed.

Transparency

All relevant issues shall be addressed in a factual and coherent manner to provide a clear audit trail, should auditing be required. Any relevant assumptions shall be disclosed and include appropriate references to the accounting calculation methodologies and data sources used, which may include this Protocol and any relevant Supplements.

Accuracy

The quantification of greenhouse gas emissions should not be systematically over or under the actual emissions. Accuracy should be sufficient to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

12. ICLEI Local Governments for Sustainability, *International Local Government GHG Emissions Analysis Protocol, Version 1.0,* October 2009.

Inventory Design 2

2.1 Methodology

To estimate GHG emissions, we used the International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP) produced by the ICLEI. This Protocol provides guidance essential for estimating GHG emissions generated by energy use, solid waste disposal, and fugitive GHG emissions. Fugitive emissions are the unintended releases of gases from the transmission, processing, or transportation of fossil fuels or other materials, such as coolant leaks in HVAC systems or natural gas line leaks. While they are assumed to occur, accurate quantification is often impossible.

The IEAP Protocol also sets forth the operational boundaries we acknowledged for the community-scale inventory, aiming to include all major sources of GHG emissions within the geopolitical boundaries of Bloomington and Normal and all of the emission sources normally included in a local government analysis. We conducted two studies; the first focused on local government operations (LGO), which includes all operations owned or controlled by local government. The LGO study is important because this is the area where local governments have direct control and therefore the greater potential to implement changes. The second study analyzed the emissions of the entire community; this included all sectors—residential, commercial, industrial, and municipal.

2.2 Scopes

The emissions inventory includes the most important sources of greenhouse gas emissions within Bloomington-Normal's geopolitical and organizational boundaries. ICELI's IEAP Protocol calls for reporting of emissions by scope. Scopes are a means of categorizing emissions based on whether they are direct or indirect sources, and are then assigned to an entity relative to the degree that it controls or owns the sources that are attributable to it. It is important to note that many sources of emissions that are attributable to Bloomington-Normal may not be produced here; for example, an out-of-state coal-fueled power plant supplying electricity to the grid will generate greenhouse gases. Even though it is not located here, Bloomington-Normal is responsible for a portion of its emissions when we purchase energy from the grid. Identifying these different emissions scopes avoids double counting emissions and ensures inclusion of all relevant information. The three scopes used for the Bloomington-Normal inventory follow international standards and the IEAP Protocol.

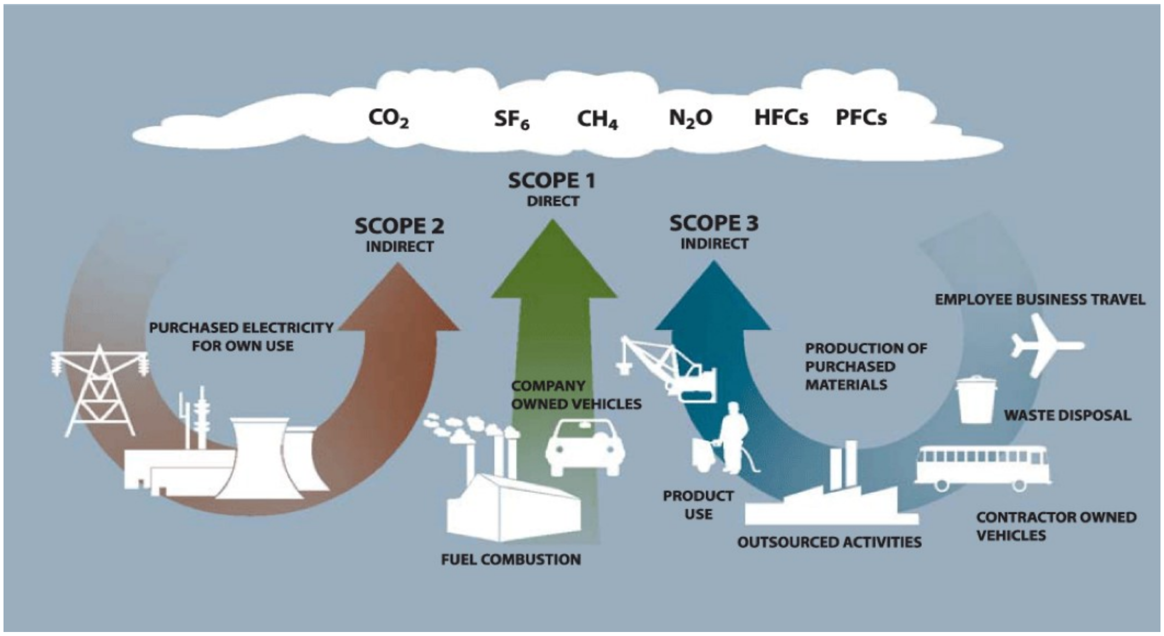


Figure 2.1 Inventory Emission Scopes[13]

Scope 1

Direct GHG emissions from sources that are owned or controlled by the local government, residents, and commercial property owners in Bloomington-Normal, such as mobile combustion of fossil fuels by fleet vehicles, personal and public transportation, and stationary combustion of fossil fuels for use of boilers, furnaces, and processing equipment.

Scope 2

Indirect GHG emission sources from purchased electricity that is generated at facilities not owned by Bloomington-Normal or private properties. Scope 2 includes all emissions generated in the production of electricity consumed by local government facilities, along with residential, commercial, and industrial properties of Bloomington-Normal.

Scope 3

Methane and nitrous oxide emissions resulting from waste landfilled or from biological wastewater treatment processes are the sole sources of emissions for Scope 3 of this inventory. Note that fuel used at these facilities is classified as Scope 1 and electricity used is classified as Scope 2.

13. United States Environmental Protection Agency, "Sources of Scope 1, 2, and 3 GHG Emissions," November 5, 2012. http://www.epa.gov/oaintrnt/practices/eo13514.htm.

2.3 Sectors

Sectors refer to classifying the entity causing the emissions. Typical sectors include residential, commercial, industrial, and municipal. Within an LGO inventory, sectors may be subdivided further—we classified LGO sectors as Bloomington, Normal, wastewater treatment, or public transportation. The waste landfilled category is normally split into residential, commercial, industrial, and municipal sectors. However, because the data we received were not segregated, these emissions were classified as a mixed-source sector under the community-scale inventory.

Figure 2.2 Emissions Inventories for LGO and Community-Scale

LGO Inventory: Municipal Emissions				
Source	**Type**	**Category**	**Sector**	**Scope**
Energy	Stationary Energy	Electricity	Bloomington LGO	2
			Normal LGO	2
			Wastewater treatment	2
		Natural Gas	Bloomington LGO	1
			Normal LGO	1
			Wastewater treatment	1
	Transportation	Gasoline	Bloomington LGO	1
			Normal LGO	1
			Wastewater treatment	1
		Diesel	Bloomington LGO	1
			Normal LGO	1
			Public Transportation	1
			Wastewater treatment	1
Waste	Wastewater treatment	Wastewater treatment	Wastewater treatment	3

Community-Scale Inventory: Residential, Commercial, Industrial, and Municipal Emissions				
Source	**Type**	**Category**	**Sector**	**Scope**
Energy	Stationary Energy	Electricity	Residential	2
			Commercial	2
			Industrial	2
			LGO	2
		Natural Gas	Residential	1
			Commercial	1
			Industrial	1
			LGO	1
	Transportation	Vehicular Transportation	Mixed Residential, Commercial, & Industrial	1
			LGO	1
		Railroad	Commercial	1
Waste		Waste Landfilled	Mixed Residential, Commercial, Industrial, & LGO	3

2.4 Data Sources

Bloomington and Normal municipal staffs and utility providers Ameren, Nicor, and Corn Belt provided access to data in the form of utility bills, fuel records, and energy usage reports. McLean County Regional Planning Commission, Connect Transit, and Amtrak supplied transit data. Solid waste generation data was supplied by the Ecology Action Center as the solid waste agency for the Bloomington-Normal and McLean County community. The Bloomington-Normal Water Reclamation District provided wastewater treatment data.

2.5 Establishing a Baseline Year

The most critical task before beginning the full data collection and examination of the inventory was to establish a baseline or analysis year. The baseline year represents the starting point of GHG data collection in our community, which lays the foundation for future inventories. The selected baseline year should provide data that is as consistent and complete as possible. Understanding that analysis of the LGO data would be a significant part of this GHG inventory, EAC staff established a protocol for spot-checking samples of utility bills and other related consumption data for Bloomington and Normal.

It is also preferable to select the relatively earliest year for which complete data is available in order to track progress made in more recent years with already implemented programs. 2008 was identified as the earliest year for which consistent and complete data was available.

Another important consideration is whether the baseline year is representative for the location. The annual average temperature for Bloomington, Illinois is 51.2° F. The average temperature for the year 2008 was 49.2° F, which indicates that the baseline year is fairly representative for the community given that it was within 4% of historical averages for Bloomington.

Local Government Operations 3

3.1 Introduction

The LGO inventory examined the GHG emissions associated with Bloomington and Normal municipal buildings and facilities, streetlights and signals, potable water production and distribution, fleet vehicles, wastewater treatment, and public transportation. Note that wastewater treatment is not provided directly by Bloomington and Normal, but rather by the Bloomington-Normal Water Reclamation District (BNWRD). Likewise, public transportation services are provided on behalf of the local municipalities by Connect Transit, formerly the Bloomington-Normal Public Transit System.

Bloomington and Normal have many municipal buildings, parks, pumps, streetlights, and traffic signals that consume electricity and natural gas. Each municipality with their various departments receives a large number of electric and natural gas utility bills. The sum of the utility bills combined with fuel bills (gasoline and diesel) depict the direct energy usage of the facilities and operations of each municipality, which can then be converted to their carbon dioxide equivalents. Combined with a representative proportion of emissions generated by BNWRD and Connect Transit, this sum represents the total GHG emissions for each municipality.

3.2 Public Transportation

In Bloomington and Normal, public transportation services are provided by Connect Transit; as a public service entity, their emissions fall within the LGO inventory.

Figure 3.1 2008 Total Emissions from Public Transportation

Source	Gallons of Diesel	MT eCO2
Fixed Routes	291,800	2,938
Requested Routes	17,500	176
TOTAL		**3,114**

In 2008 Connect Transit provided public transportation to the Bloomington-Normal community through eleven fixed routes serviced by 27 buses and vans. Determining the exact proportion of gallons of diesel (and therefore GHG emissions) attributable to Bloomington and Normal separately is impossible. As the next most accurate means of segregating emissions, we divided the total volume proportionally by the total mileage of the routes in each municipality in 2008. Route lengths were measured using GIS. These segregated emissions are reflected in the transportation and fuel emissions totals in the LGO inventory where the results are shown by municipality.

Figure 3.2 2008 Segregated Emissions from Public Transportation

Municipality	Combined MT CO2e	Proportion of Total Route Miles	MT eCO2
Bloomington	3,114	65.7%	2,046
Normal	3,114	34.3%	1,068
TOTAL			**3,114**

3.3 Wastewater Treatment

In addition to emissions related to energy and fuel usage in wastewater treatment operations, the processes used to break down sewage generate greenhouse gases, including methane (CH_4) and nitrous oxide (N_2O). Recall that the Global Warming Potential (GWP) of methane is 21 times more potent than carbon dioxide (Figure 1.1). Likewise, nitrous oxide has a GWP 310 times that of carbon dioxide.

Bloomington-Normal Water Reclamation District, which provides wastewater treatment for both Bloomington and Normal, provided data on 2008 utility and fuel usage, as well as figures that were necessary in estimating methane and nitrous oxide emissions.

Figure 3.3 2008 Total Emissions from Wastewater Treatment

Source	Quantity	Source Units	MT CO2e
Electricity	11,800,000	kWh	9,641
Nitrous Oxide Emissions	6.89	MT	2,054
Methane Emissions	29,980	MMBtu	1,061
Natural Gas	12,500	MMBtu	660
Diesel	11,750	gal diesel	118
Gasoline	3,000	gal gas	26
TOTAL			**13,560**

Wastewater treatment emissions cannot be accurately segregated by municipality by volume of wastewater treated. Instead, assuming a similar average per capita usage rate between Bloomington and Normal, the total wastewater treatment emissions were proportionally split by 2008 population for the purposes of the LGO inventory where results are shown by municipality. These segregated emissions are shown in Figure 3.4.

Figure 3.4 2008 Segregated Emissions from Wastewater Treatment

Municipality	Combined MT CO2e	2008 Population	MT eCO2
Bloomington	13,560	58.4%	7,919
Normal	13,560	41.6%	5,641
TOTAL			**13,560**

3.4 Town of Normal

Energy consumption data from the Town of Normal was made available in the form of monthly electric and natural gas bills and fuel records. The annual volumes of each energy source was calculated and converted to CO_2e. In order to illustrate the total emissions generated by the Normal LGO alone, we combined these energy emissions with Normal's share of public transportation and wastewater treatment emissions. The results are shown in Figures 3.5 and 3.6. The same total volume representing Normal's total local government operations greenhouse gas emissions is reflected in both charts, but displayed in Figure 3.5 by emissions category and in Figure 3.6 by emissions type.

Figure 3.5 2008 Normal LGO Total MT CO_2e by Category

Category	MT CO2e
Electricity	11,971
Diesel	1,729
Wastewater Treatment	1,296
Natural Gas	1,007
Gasoline	459
TOTAL	**16,461**

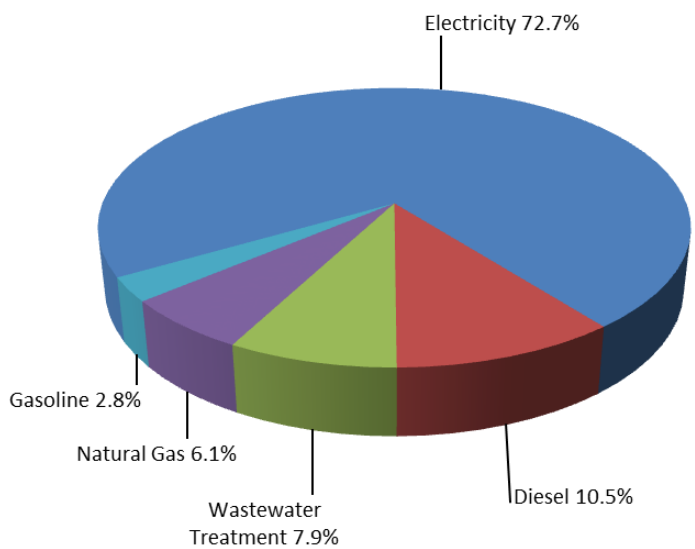
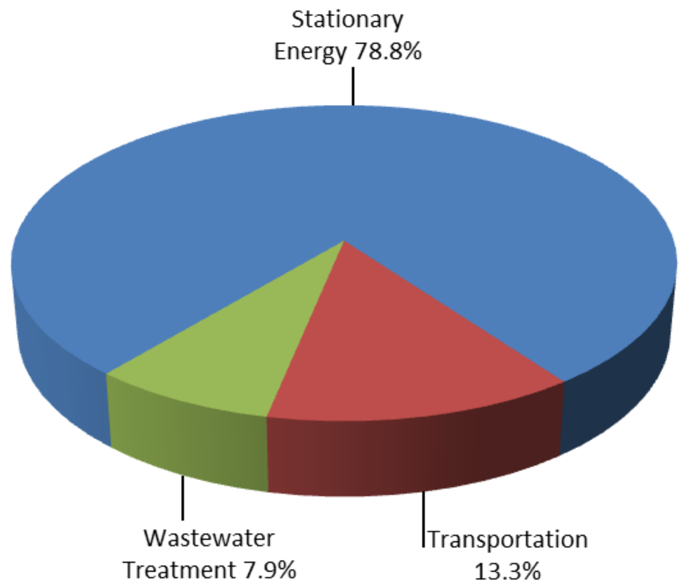


Figure 3.6 2008 Normal LGO Total MT CO_2e by Type

Type	MTe CO2
Stationary Energy	12,977
Transportation	2,188
Wastewater Treatment	1,296
TOTAL	**16,461**



3.5 City of Bloomington

Energy consumption data from the City of Bloomington was provided in the form of monthly electric and natural gas bills and fuel records. While Bloomington's records did allow for greater internal segregation of emissions than Normal's, to be consistent we chose to report all emissions in a uniform manner and therefore did not include segregated departmental-level data. The annual volume of each energy source was calculated and converted to CO_2e. In order to illustrate the total emissions generated by the Bloomington LGO alone, we combined these energy emissions with Bloomington's share of public transportation and wastewater treatment emissions. The results are shown in Figures 3.7 and 3.8. The same total volume representing Bloomington's local government operations greenhouse gas emissions is reflected in both charts, but displayed in Figure 3.7 by emissions category and in Figure 3.8 by emissions type.

Figure 3.7 2008 Bloomington LGO Total MT CO_2e by Category

Category	MTeCO2
Electricity	23,709
Diesel	3,900
Wastewater Treatment	1,819
Natural Gas	1,659
Gasoline	1,564
TOTAL	**32,652**

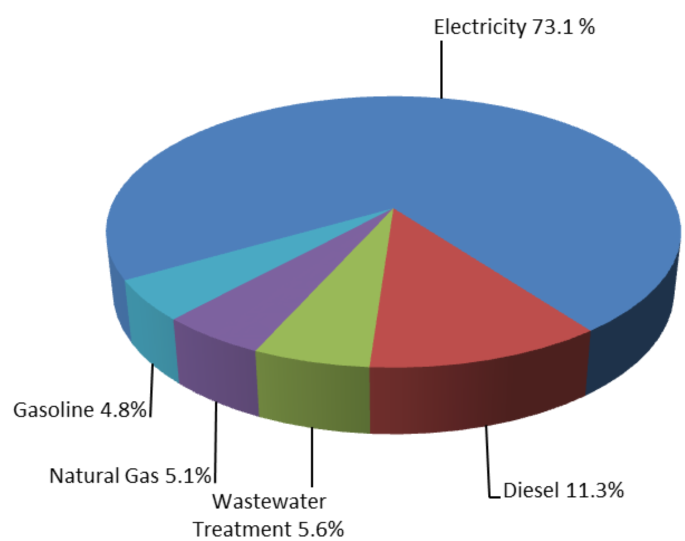
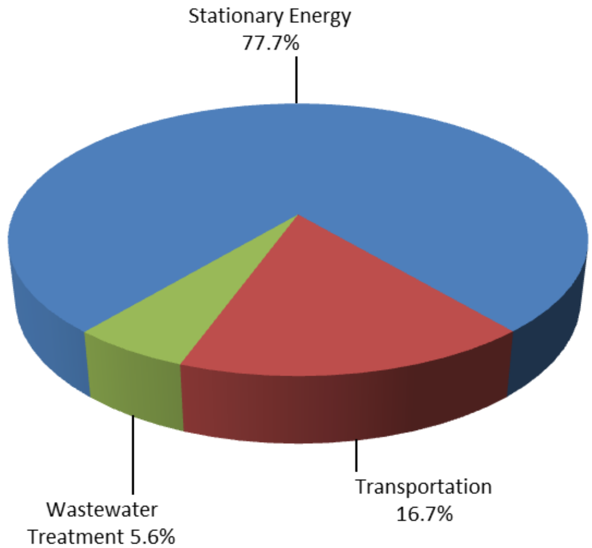


Figure 3.8 2008 Bloomington LGO Total MT CO_2e by Type

Type	MTeCO2
Stationary Energy 77.7%	25,368
Transportation 16.7%	5,465
Wastewater Treatment 5.6%	1,819
TOTAL	**32,652**



3.6 LGO Inventory Results

Total GHG emissions resulting from combined Bloomington and Normal LGO operations are reflected in the figures below, displayed by category and sector. Electricity usage is by far the leading source of GHG emissions, which is typical of other municipalities.

Figure 3.9 2008 Bloomington-Normal LGO Total MT CO_2e by Category

Category	MT CO_2e
Electricity	35,680
Diesel	5,630
Wastewater Treatment (methane and nitrous oxide emissions)	3,114
Natural Gas	2,666
Gasoline	2,023
TOTAL	**49,113**

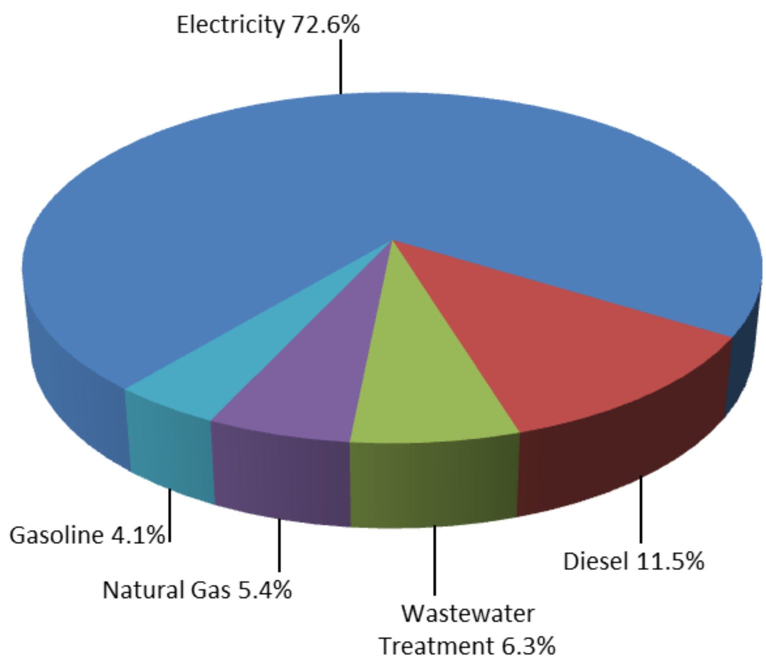
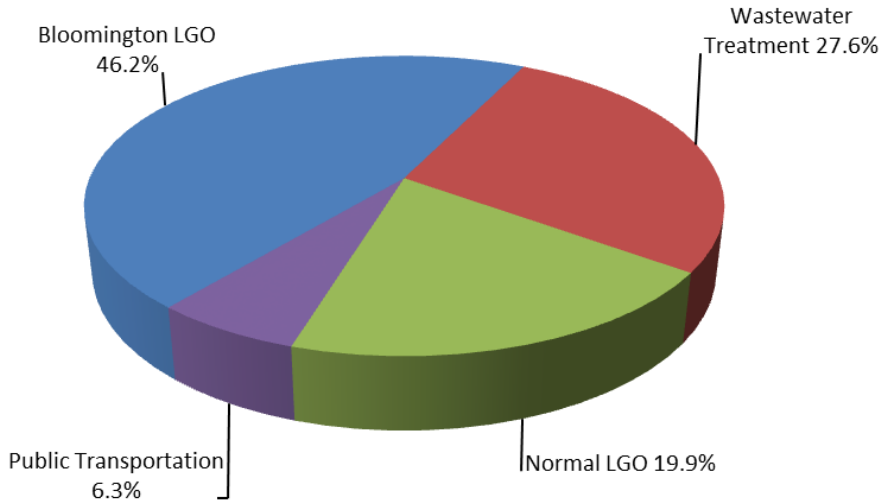


Figure 3.10 2008 Bloomington-Normal LGO Total MT CO_2e by Sector

Sector	MT CO2e
Bloomington LGO	22,687
Wastewater Treatment	13,560
Normal LGO	9,752
Public Transportation	3,114
TOTAL	**49,113**



Community-Scale Inventory

4

4.1 Introduction

The overall community-scale inventory results reflect GHG emissions produced by all activities from municipal (LGO), residential, commercial, and industrial sectors within Bloomington and Normal. Close scrutiny was required to avoid double counting of emissions from different data sources; Ameren, for example, includes municipal electricity usage within their "commercial" sector totals.

4.2 Stationary Energy

Stationary energy includes all electricity and natural gas usage in the community for purposes ranging from home and business heating and cooling to running of water treatment pumps.

The table below summarizes the data provided by the electricity utility companies Ameren and Corn Belt Energy. In the commercial and residential sectors, Bloomington's electricity usage surpassed that of Normal's. However, in the industrial sector, Normal's usage and subsequent GHG emissions were higher than Bloomington's, which is not surprising given that some major industrial entities are located in Normal.

Figure 4.1 2008 Bloomington-Normal Electric Utility Data

Bloomington Electricity Usage	Total (kWh)	MT CO2e
Commercial	608,223,893	496,919
Industrial	49,113,516	40,126
Residential	305,914,847	249,932
LGO	29,020,169	23,709
subtotals	**992,272,425**	**810,687**
Normal Electricity Usage		
Commercial	257,096,539	210,048
Industrial	84,938,884	69,395
Residential	170,853,224	139,587
LGO	14,651,338	11,970
subtotals	**527,539,985**	**431,000**
TOTALS	**1,519,812,410**	**1,241,687**

2008 natural gas usage records for the Bloomington-Normal community were provided by the gas utility, Nicor. While segregated data for Bloomington-Normal natural gas consumption was unavailable, Nicor data indicated that of the total volume, 52% represented commercial, municipal, and industrial natural gas consumption, with the remaining 48% coming from residential consumption. Using data collected as part of the LGO inventory, we were able to further segregate total LGO emissions.

Figure 4.2 2008 Bloomington-Normal Natural Gas

Sector	MMBtu	MT CO2e
Commercial/Industrial	4,239,792	223,819
Residential	3,960,273	209,063
LGO	50,504	2,666
TOTAL	**8,250,569**	**435,548**

4.3 Transportation

The McLean County Regional Planning Commission provided access to 2008 Illinois Department of Transportation data on vehicular transportation. This data includes all Vehicle Miles Traveled (VMT) for the "Greater Bloomington Urbanized Area" (GBUA)[14]. These figures include VMT for all sectors examined: municipal (LGO), residential, commercial, and industrial[15]. Because the Greater Bloomington Urbanized Area also includes Downs and Towanda, we prorated the total number of VMT for each municipality based on its proportion of linear miles. Not only is this the most reliable way of finding Bloomington's and Normal's shares of the VMT, but it also allows us to use this method to easily compare future the VMT from GHG inventories against the baseline as the boundaries of the GBUA are subject to change.

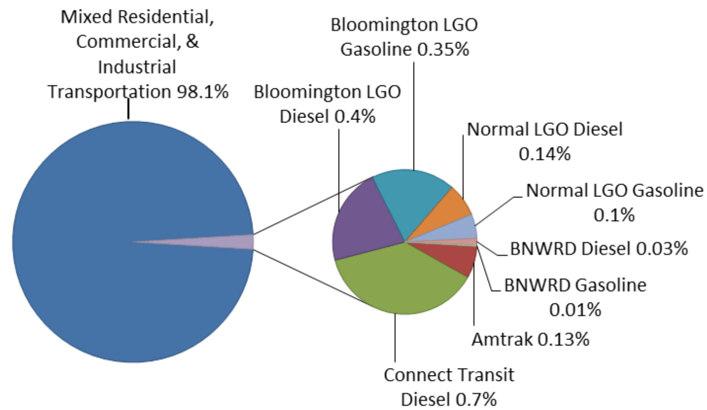
Figure 4.3 2008 Transportation Emissions[16]

Sector	MT CO2e
Mixed Residential, Commercial, & Industrial Transportation (VMT)	420,453
Amtrak	594
Connect Transit Diesel	3,114
Bloomington LGO Diesel	1,785
Bloomington LGO Gasoline	1,549
Normal LGO Diesel	612
Normal LGO Gasoline	448
BNWRD Diesel	118
BNWRD Gasoline	26
TOTAL	**428,699**

14. See Appendix F for more information on how the VMT data were calculated for Bloomington and Normal.
15. Freight rail emissions are excluded due to lack of data. Requests for information from U.S. Freight went unanswered.
16. We took the total VMT for all sectors, as defined above based on the prorated VMT from the GBUA data, and subtracted the LGO data in order to come up with the itemized list shown here. The total shown (in yellow) represents the total CO_2e from all transportation in the community.

In order to avoid double counting of LGO transportation and public transit, the volumes of CO2e for reported gasoline and diesel usage were subtracted from these mixed-sector VMT to arrive at an accurate tally for the community-scale inventory.

Figure 4.4 2008 Transportation Emissions and Bloomington-Normal LGO Fuel Usage



4.4 Solid Waste

The solid waste volumes included in the inventory represent the total amount of solid waste landfilled by Bloomington and Normal during 2008. This data was provided by the Ecology Action Center, which calculates community-wide waste and recycling statistics annually based upon an extensive survey of area waste haulers, recyclers, municipalities, corporations, and other entities[17]. This figure includes all sectors including municipal (LGO), residential, commercial, and industrial. As the raw data available also included waste landfilled by McLean County residents outside of Bloomington and Normal, that figure was prorated for the 2008 combined population of the twin cities as a percentage of the total county population. Further breakdown into separate sectors would be beneficial but is not currently possible due to waste collection and reporting practices. As such, the total volume of emissions represents all sectors--LGO, commercial, residential, and industrial.

Decomposing landfilled waste generates methane, which as discussed earlier is 21 times more potent as a greenhouse gas than CO_2. For consistency purposes, all methane emissions are reported as carbon dioxide equivalents. Waste generated but not landfilled, including materials composted or recycled, are not included as these processes typically do not result in methane emissions.

Figure 4.5 2008 Emissions from Landfilled Solid Waste

Tons Waste Landfilled	MTCO2e
123,496	51,868
TOTAL	**51,868**

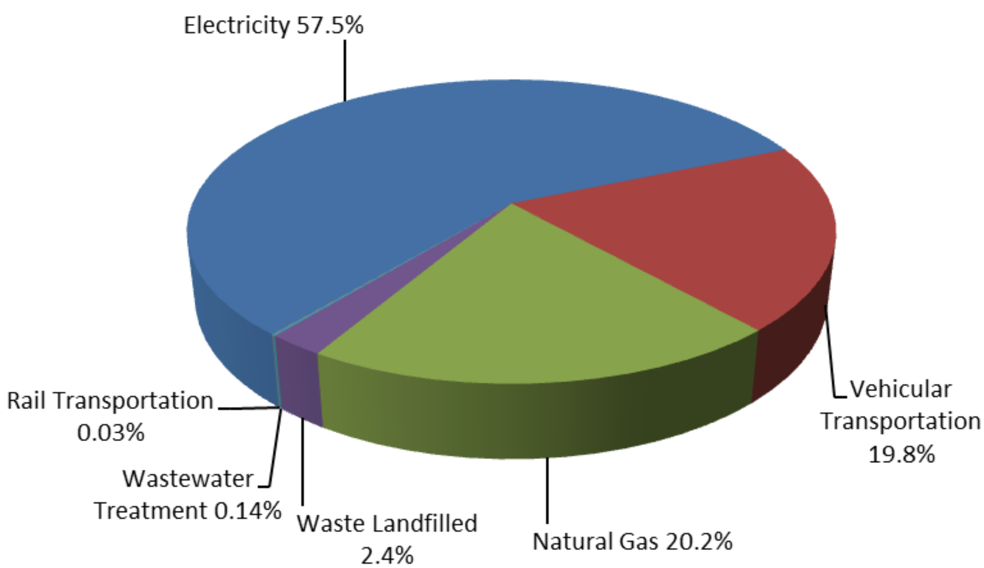
17. Recycling and waste generation rates determined by protocol set by Illinois Environmental Protection Agency and Illinois Counties Solid Waste Management Agency in *Recycling Measurements Working Group Final Report* 1997. Annual tallies available on the Ecology Action Center's website: http://www.ecologyactioncenter.org/wp-content/uploads/2014/01/1998-2012-McLean-County-Waste-Generation-and-Recycling-Rates.pdf

4.5 Community-Scale Inventory Results

The charts and graphs below show the Bloomington-Normal Community-Scale total GHG emissions organized by category[18]. The results indicate that electricity usage was by far the greatest contributor of CO_2e in our community, followed by non-rail transportation and natural gas usage[19]. These three category emissions are directly caused by the combustion of fossil fuels. Waste landfilled is also a significant source of emissions, while wastewater treatment and rail transportation are relatively insignificant sources of emissions.

Figure 4.6 Community-Scale GHG Total MT CO_2e by Category

Category	MT CO2e
Electricity	1,241,687
Vehicular Transportation	428,105
Natural Gas	435,548
Waste Landfilled	51,868
Wastewater Treatment	3,115
Rail Transportation	594
TOTAL	**2,160,917**

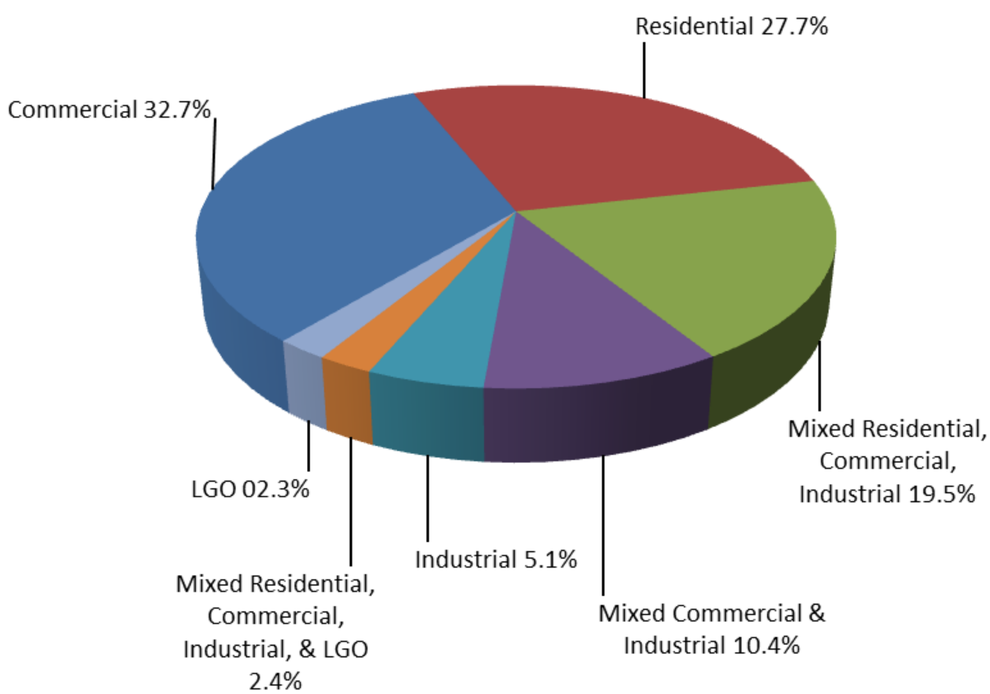


Because some data sources reported energy usage or other critical data sets as mixed, multi-sector aggregated volumes, certain emissions are shown here without further breakdown by sector. While multiple strategies for classification by sector of these combined amounts were explored, none were identified as an accurate representation. As a result, the precise sums of emissions for the commercial, residential, and industrial sectors are left unspecified.

18. Waste landfilled and total vehicle miles traveled data received in an unsegregated form.
19. Natural gas data received in an unsegregated form.

Figure 4.7 2008 Community-Scale GHG Total MT CO_2e by Sector

Sector	MT CO_2e
Commercial	707,561
Residential	598,582
Mixed Residential, Commercial, Industrial	420,452
Mixed Commercial & Industrial	223,819
Industrial	109,521
Mixed Residential, Commercial, Industrial, & LGO	51,868
LGO	49,114
TOTAL	**2,160,917**



Conclusion 5

5.1 Results

During 2008, the Bloomington-Normal community across all sectors generated a combined volume of 2,160,917 metric tons of carbon dioxide equivalents (MT CO_2e). Electricity, natural gas, and transportation were the primary sources of these emissions. Most other sources of emissions were minor.

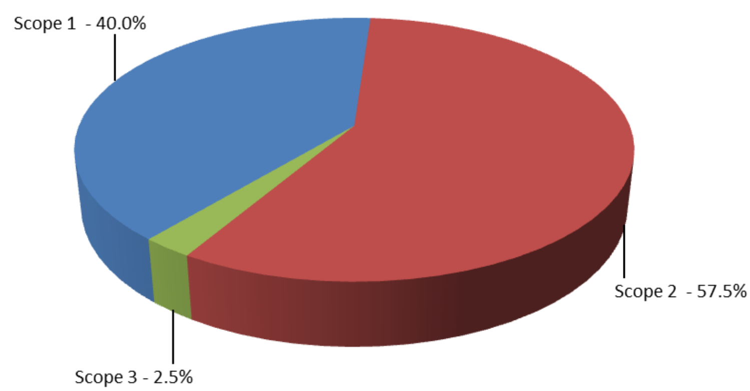


Figure 5.1. 2008 Bloomington-Normal Community Scale GHG Inventory MT CO_2e by Scope

The majority of these emissions are classified as Scope 2, which are indirect emissions largely resulting from the generation of electricity. Scope 1 emissions are second largest in volume; these include direct emissions from combustion of fuels such as gasoline engines, and natural gas for heating. Scope 3 emissions contributed only a minor volume of greenhouse gases; these come from indirect sources such as decomposition of materials in landfills or wastewater treatment operations.

On the Local Government Operations (LGO) level, Scope 2 again was the leading source of emissions, with nearly three-quarters of all municipal greenhouse gases resulting from electricity generation. Scope 1 emissions from natural gas, diesel and gasoline combustion were also significant. Scope 3 emissions from biogenic methane and nitrous oxide gases resulting from waste landfilled and wastewater treatment were minor relative to the other sources.

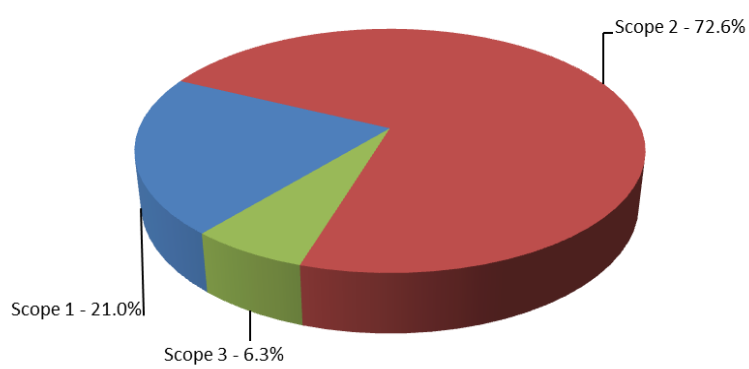


Figure 5.2 2008 Bloomington-Normal LGO Total MT CO_2e by Scope

The combined total emissions for residential, commercial, industrial, and local government sectors amount to a per capita rate of 17.3 MT CO_2e per person annually.

For purposes of comparison, the Bloomington-Normal per capita GHG emissions rate for 2008 is shown in Figure 5.2 with the 2008 Illinois per capita rate and the national per capita rate. Please note that there are multiple barriers that can prevent direct comparison of emissions rates between these levels, including differences in limitations on data collection and data inclusion. However, local trends mimic national trends: energy is the leading source of GHG emissions with transportation as the second largest source. Fossil fuel combustion is the largest single source of greenhouse gas emissions generated by human activities.

Figure 5.3 2008 Per Capita Emissions Comparative

2008 Comparisons	MT CO2e
Bloomington-Normal per capita emissions	17.3
Illinois per capita emissions[20]	18.6
United States per capita emissions[21]	22.2

5.2 Existing Initiatives

Since 2008, Bloomington and Normal have initiated numerous projects to help decrease local GHG emissions.

- 2009: WGLT and ISU's Good To Go sustainable transportation program launched
- 2009: Normal Bike and Pedestrian Master Plan completed
- 2011: EV Town electric car initiative
- 2011: Normal Sustainability Plan adopted with specific attention to greenhouse gas emissions
- Normal (2012) and Bloomington (2013) implemented Municipal Electricity Aggregation with inclusion of 100% renewable energy through Renewable Energy Credits (RECs), which offset our fossil fuel combustion by representing the environmental attributes of the power produced from renewable energy projects. RECs are sold separately from the electricity commodity and do not necessarily come from the Bloomington-Normal area.
- 2012: Bike BloNo bicycle commuter advocacy group formed
- 2014: Bloomington Bike Master Plan process initiated

20. Energy Information Administration, *State-Level Energy-Related Carbon Dioxide Emissions, 2000-2010*, May 2013.
21. United Nations Statistics Division, "Greenhouse gas emissions," July 2010. http://unstats.un.org/unsd/environment/air_greenhouse_emissions.htm.

5.3 Next Steps

The 2008 inventory serves as the baseline year against which all future increases or decreases in emissions may be contrasted. To be able to draw meaningful conclusions, regularly scheduled local inventories are necessary. Additional inventories will follow the same protocol as the 2008 inventory and will supply the relevant data necessary to track changes in emission levels for the Bloomington-Normal community.

While some communities perform an inventory on an annual or biennial basis, every five years may be a reasonable compromise between the need for frequent data collection and a cost-effective program. As six years have already passed since 2008, the baseline year, the first repeat inventory should be scheduled as soon as funding is available.

Other important next steps include the following:

- Submit results of the 2008 GHG Inventory to carbon*n* Cities Climate Registry (cCCR), the leading global reporting platform for local climate action
- Enroll Bloomington in the Illinois Cool Cities program (Normal is already enrolled)
- Register Bloomington on the U.S. Mayors Climate Protection Agreement
- Develop a Climate Action Plan (CAP) to set targets for emission reductions and strategies for reaching these targets
  - ⇒ Develop new programs and capitalize on existing programs designed to increase energy efficiency and public transportation, given that energy usage and transportation are the leading sources of most GHG emissions

Utilizing the data from this report to establish reduction goals and identify strategies to meet those goals will allow Bloomington-Normal not only to implement measures which conserve resources, improve air quality, promote healthy lifestyles, and save utility and fuel costs, but also to do our part locally to make a world of difference globally.

Appendix A Terminology

C - FAR: Carbon Footprint Assessment and Reduction software. A nonproprietary Microsoft Excel tool developed for the City of Columbus, Ohio with technical assistance from the Center for Resilience at Ohio State University. This software is designed to allow local governments to organize emissions data, track changes over time, and establish feasible reductions goals.

Community-Scale Inventory: The portion of the study encompassing all greenhouse gas emissions released within the geopolitical boundary of Bloomington and Normal combined. The local government inventory is a subset of the community inventory total, with the exception of any sources occurring outside the geopolitical boundary.

Fugitive Emissions: The unintended emissions of greenhouse gases from the transmission, processing, or transportation of fossil fuels or other materials (e.g. coolant leaks in HVAC systems or natural gas line leaks).

GHG: Greenhouse Gas, or a gas that contributes to global climate change, such as carbon dioxide.

Global Warming Potential (GWP): A relative measure of how much heat a greenhouse gas traps in the atmosphere.

ICLEI: Local Governments for Sustainability, formerly known as International Council for Local Environmental Initiatives. ICLEI is an international association of cities and counties committed to climate action, clean energy, and sustainability. They provide tools and resources to communities working on climate change initiatives.

IPCC: The Intergovernmental Panel on Climate Change (IPCC) is a scientific intergovernmental body under the auspices of the United Nations. It is an internationally acknowledged authority on climate change, producing reports which have the agreement of leading climate scientists and the consensus of participating governments.

LGO: Local Government Operations. This refers to the portion of the study that focused solely on operations that local governments either own or control. Common sectors include local government buildings and facilities, street lights and traffic signals, water delivery systems, and wastewater treatment.

MT CO_2e: Metric Tons of Carbon Dioxide Equivalents. This is the internationally accepted unit for measuring greenhouse gas emissions. While there are several greenhouse gases of concern, carbon dioxide is the most significant. Other gases within the scope of this study were converted to MT CO_2e using standardized conversions related to the potency of those gases relative to carbon dioxide.

NH_4: Methane, a greenhouse gas 21 times as potent as CO_2. Sources include decomposition of organic matter in an anaerobic (oxygen-absent) environment, such as a landfill or wastewater treatment plant, agriculture, and industry.

N_2O: Nitrous Oxide, a potent greenhouse gas with 310 times the impact of CO_2. Sources include wastewater treatment, fossil fuel combustion, agriculture, and industry.

Appendix B Software and Calculations

After reviewing available options, we chose to utilize Carbon Footprint Assessment and Reduction (C-FAR) software from Columbus, Ohio, for the Bloomington-Normal GHG Inventory. C-FAR is a free Microsoft Excel-based program specifically designed for local governments. Similarities in latitude, climate, and urban environment between Bloomington-Normal and the Columbus area, for which the software was designed, make the C-FAR software a good choice for EAC's inventory.

Direct measurement of all carbon emissions is not possible; the GHG inventory must rely upon indirect measurements which are extrapolations of emissions from consumption data such as the number of kilowatt hours of electricity used, vehicular miles traveled, tons of waste landfilled, gallons of wastewater processed, etc. C-FAR calculates these carbon emission equivalents from annual consumption data[22].

Although C-FAR simplifies our data interpretation, the interpreted units are fixed. The software only converts carbon equivalents from kWh, MMBtu, gallons of oil, gas, and diesel, Vehicle Miles Traveled (VMT), and tons of waste. Additional calculations using external formulas were required to estimate carbon equivalents from wastewater treatment and railroad locomotive engines. Our system was unable to capture certain fugitive emissions, which are the result of disposal or leaks from equipment, such as natural gas leaks.

Overall, this inventory utilized a simplified data collection strategy to encompass a fairly broad scope of emissions. While some omissions are inevitable, this approach does allow for a reliable and reproducible process that generates a dependable illustration of community-wide and LGO greenhouse gas emissions.

Appendix C Emissions Factors

With minor exceptions, we used the C-FAR software's standard emissions factors for conversion of energy usage and waste disposal data into carbon dioxide equivalents. These emissions factors originated from the US Energy Information Administration's January 2007 *Technical Guidelines: Voluntary Reporting of Greenhouse Gases (1605(b)) Program*. According to the US Energy Information Administration website, the program has been suspended since May 2011 due to budget cuts, so a recent update to this report is not available from this source[23]. However, other related sources of emissions factors show very similar rates to the 2007 document.

It is important to note that the emissions factors used in this GHG inventory are standardized as national averages and not customized specifically for local or regional energy sources, weather conditions, or other factors.

22. Note: some figures and tables may not agree completely given rounding errors inherent in the calculations processes.
23. US Energy Information Administration, "Voluntary Reporting of Greenhouse Gases Program Suspended," May 2011. http://www.eia.gov/survey/form/eia_1605/whatsnew.html

Appendix D Deviations from Protocol

LGO Employee Travel

The IEAP Protocol indicates that municipal employee commutes to and from work should be included in the LGO inventory. We did not have an accurate means of segregating this data so it was not included. However, this sector of transportation is included in the totals of the community-scale inventory.

Solid Waste

LGO solid waste landfilled should also be included in the LGO inventory but due to lack of segregated data this was not included. However, this sector of waste landfilled is included in the totals of the community-scale inventory.

Wastewater Treatment

The C-FAR software is unable to calculate biogenic emissions (those resulting from biological processes involving living organisms) from wastewater treatment facilities. While the IEAP Protocol from ICLEI provides guidance on calculating wastewater emissions, alternative formulas that better fit the available data were identified to allow for reliable results.

Methane emissions were calculated utilizing a formula recommended in the 2008 USEPA report "*Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance: Direct Emissions from Stationary Combustion Sources*." Nitrous oxide emissions were estimated utilizing formulas prescribed in the 2010 Report to the USEPA by RTI International: "*Greenhouse Gas Emissions Estimation Methodologies for Biogenic Emissions from Selected Source Categories: Solid Waste Disposal, Wastewater Treatment, Ethanol Fermentation*." It should be noted that the process for estimating nitrous oxide emissions from wastewater treatment is the subject of much discussion within the industry. It is possible that the formula may be improved for future GHG emission inventories.

Appendix E Excluded Emissions Sources

- Freight rail transportation data was unavailable for analysis despite multiple requests for information.
- Air travel data is excluded from our inventory, as in most community inventories, because of the difficulty of accurately portraying the relative share of emissions from local residents' travel and/or air travel that occurs only within our geographic boundaries.
- Refrigerants and industrial processes were not included due to unavailability of data.
- Commercial agriculture, forestry, and land use changes were not considered significant activities within the Bloomington-Normal city limits and were therefore not included.

Appendix F Data Tables

LGO INVENTORY DATA		
NORMAL DATA: 2008		
SOURCE	**Department Totals**	
UNITS	Diesel	Gasoline
DEPARTMENT		
Administration		1331.3
Facilities Management		405
Engineering		832.7
Fire	12692.3	4703.7
Inspections and Planning		4777.9
Parks and Rec		
Maintenance	3954.6	9442.1
Administration		2140
Police		10994.1
Public Works		
Maintenance		548.8
Street	30019.1	4507.4
Sewer	3076.2	2692.8
Waste	10106.9	57.5
Water		
Distribution	920.5	6187.5
Treatment	9.3	1516.3
Administration		255
TOTALS	**60778.9**	**50392.1**
SOURCE	**Department Totals**	
UNITS	KWH	MMbtu
UTILITY COMPANY		
NICOR		13,874.6
CORN BELT	967,700	
AMEREN	8,774,838	
TOTALS	**9,742,538**	**13,874.6**
BLOOMINGTON DATA: 2008		
SOURCE	**Department Totals**	
UNITS	Diesel	Gasoline
DEPARTMENT		
Administration		130.6
Building Safety		5676.8
Cultural District		927.2
Facilities Management	595	1106.8
Fleet Management	271.2	752.8
Engineering	3450.5	9775.6
Fire	14944.1	15639.4

BLOOMINGTON DATA CONTINUED: 2008

SOURCE	**Department Totals**				
UNITS	Diesel	Gasoline			
Health (Scott)	40.6	414.3			
Lake Bloomington	201.3	0			
Library	1662.3	238.7			
Parks and Rec	1147.6	938.1			
Parking	146.3	2018.3			
Police	24.5	121,608.90			
Public Works	143,593.80	5000.7			
Water Dept/Readers	11,258.30	11,742.30			
TOTALS	**177335.5**	**175970.5**			
SOURCE	**Department Totals**				
UNITS	KWH	MMbtus			
DEPARTMENT					
Facilities Managment	1,055,377	1130.946			
Fire	961,289	2562.037			
Parking	983,663	1222.664			
Library	1,242,556	4362.501			
Parks and Rec	3,328,200	9,198			
Police	13,999	0			
Public Works	5,604,251	127.991			
Water	8,939,634	5524.688			
TOTALS	**22,128,969**	**24129.09**			
Connect Transit	(gals/Diesel)	**309,300**			
Fixed Routes		291800			
Requested Routes		17500			
BNWRD		Unit			
Electrical Power	11,800,000				
Natural Gas	12,500	mmBtu			
Methane Emissions	1,061	MT eCO2			
Nitrous Oxide	2,054	MT eCO2			
Digester Gas (SE Flare)	64300	Therms			
SE Boiler estimate	45000	Therms			
W Boiler	57000	Therms			
Methane sold to Cargill	133500	Therms			
Gasoline	3,000	Gals			
Diesel	11,750	Gals			
COMMUNITY-SCALE INVENTORY DATA (INCLUDES LGO)					
Bloomington Utilities 2008	**Ameren**		**Corn Belt**		**Nicor**
Commercial	599,149,945		38,094,117		
Industrial	49,113,516				4,290,296
Residential	206,668,468		99,246,379		3,960,273
Normal Utilities 2008	**Ameren**		**Corn Belt**		
Commercial	231,983,147		39,764,730		
Industrial	84,938,884				
Residential	132,120,272		38,732,952		
B-N Transportation 2008					
Amtrak	14,600	58,000			
(8m x 5t)(365days)					
Combined (all sectors - requires subtraction of LGO gallons of fuel in C-FAR)	Total VMT in GBUA	Total miles in GBUW	Miles	% total	**Prorated VMT**
Bloomington	1,006,059,720	690	423	61.3	**616,758,350**
Normal	1,006,059,720	690	244	35.4	**355,766,046**
B-N Waste 2008	Tons of Waste				
All sectors	123,496				