Iowa City Municipal Greenhouse Gas Emissions

August 2017

Inventory Update

Prepared by the City of Iowa City

City of IOWA CITY

A UNESCO CITY OF LITERATURE

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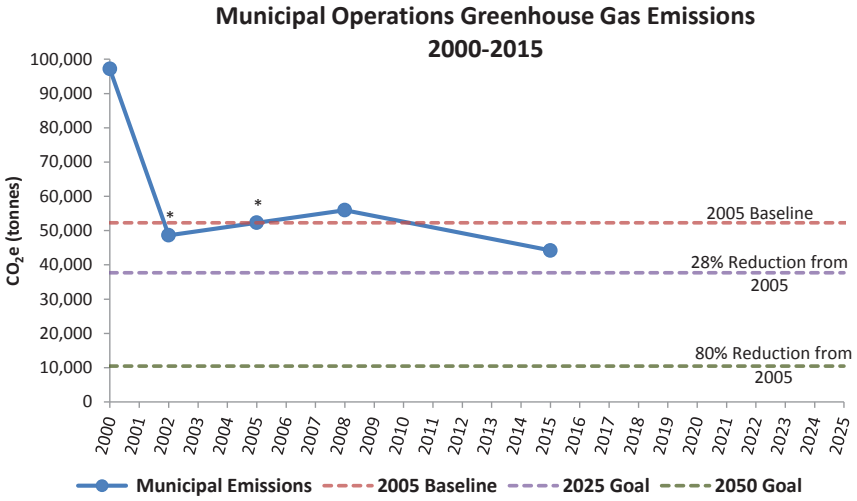
Executive Summary

The City has made substantial progress since 2000 in reducing greenhouse gas (GHG) emissions, increasing energy efficiencies and reducing energy costs in city operations. The goal of this report is to update the past municipal GHG inventory (completed in 2009) using updated data for our new benchmark. In comparing past inventories, we can gain understanding of trends over time to learn what has been successful, as well as understand how to interpret what efforts might be most impactful in reducing future GHG emissions. This report will also provide baseline information for creating a plan to reduce municipal GHG emissions.



* 2002 and 2005 emissions estimated based on average annual emissions change from 2000 to 2008 combined with the reduction in solid waste emissions that began in May 2001.

Figure 1. *Municipal GHG Emissions (2000-2015)*

Municipal GHG inventories have been completed for the years 2000, 2008, and 2015, with estimates calculated for 2002 and 2005. Results are graphed to the right (Figure 1). In 2015, municipal operations generated 44,194 metric tonnes CO_2e, roughly 4.5% of the Iowa City community's total emissions. Just over half of all of the municipal emissions were generated by waste in the Iowa City Landfill. Wastewater treatment generated 15.0%, buildings and facilities generated 12.3%, water treatment generated 5.7%, the vehicle fleet generated 5.0%, the transit fleet generated 4.5%, streetlights and traffic signals generated 3.0%, and airport facilities generated less than 1%.

The baseline year and targets for GHG reductions used here match those set for the community, though the city council has not yet set specific reduction targets for municipal operations. In the baseline year of 2005, Iowa City's municipal operations emitted an estimated 52,304 metric tonnes CO_2e. Emissions have dropped 15.5% from 2005 to 2015.

Emissions have dropped 54.5% from 2000's total of 97,173 metric tonnes CO_2e. Capturing and flaring methane generated by the Iowa City Landfill began in 2001 and provided the majority of this reduction. Emissions reductions since 2008 have been driven by increasing renewable energy production, reduced energy use, and increased energy efficiency.

As our local utility increases renewable energy production in the coming years, municipal operations are projected to meet a 26-28% reduction in emissions from 2005 levels by 2025. Meeting an 80% reduction in emissions by 2050 will require significant work, and such a reduction will not be possible with renewable energy alone.

This report reviews trends in GHG emissions, energy usage, and costs of fossil fuels used and produced from municipal operations. Each of these can vary due to different factors, such as utility and fuel pricing, annual weather patterns, efficiency measures, and electricity emission factors due to increased renewable energy. In looking to reduce GHG emissions, cost and feasibility will need to be considered if efforts are to be successful.

Introduction

Decades of scientific research have concluded that human activities are changing our climate. In Iowa, climate change causes more frequent extreme storms and floods, increases soil erosion, and creates a more favorable environment for pathogens and pests (Iowa Greenhouse Gas Inventory & Reference Case Projections 1990-2025, October 2008). The reduction of greenhouse emissions has become a serious and pressing matter not just for the planet, but for the Iowa City community as well.

This municipal inventory summarizes the GHG emissions generated by the City of Iowa City's municipal operations and supplements the community-wide GHG inventory. A GHG inventory allows the City to track changes in emissions, identify where reductions can be made, and design plans to reduce emissions.

Background

Iowa City began formally working on climate issues in 2007, when Mayor Ross Wilburn signed the Mayor's Climate Protection Agreement. In 2008, Iowa City joined the "Cities for Climate Protection Campaign," which prompted the creation of a community and municipal GHG inventory that was completed in August 2009. Iowa City was the first city in the state of Iowa to complete a GHG inventory. This report is an update to the 2009 GHG inventory report, which calculated municipal GHG inventories for the years 2000 and 2008.

On Feb. 17, 2016, Mayor Jim Throgmorton reaffirmed the City's continued commitment to addressing climate change by signing a letter to join the U.S. Compact of Mayors. The Compact of Mayors recently joined with the European Union's Covenant of Mayors to form the Global Covenant of Mayors for Climate and Energy. While cities can work towards climate mitigation independently, joining the Covenant of Mayors offers a recognized framework, provides city staff with information and support, and connects Iowa City with other cities around the globe committed to taking actions to reduce GHG emissions.

By formally committing to the Global Covenant of Mayors for Climate and Energy, Iowa City agreed to complete the following milestones over a three-year period:

At engagement:

- Mayor makes a formal commitment to reduce GHG emissions and address climate change risks (signed Feb. 17, 2016)

Within 1 Year:

- Complete a Community-wide GHG inventory, using the Global Protocol for Community-Scale GHG Emissions (submitted December 2016)
- Report local hazards related to climate change (submitted December 2016)

Within 2 years:

- Set a GHG Reduction Target (Resolution signed Dec. 6, 2016)
- Complete a climate risk vulnerability assessment

Within 3 Years:

- Complete a Climate Action and Adaptation Plan

While the Covenant of Mayors agreement focuses on community-wide emissions, many local governments follow these same reductions goals in their municipal operations to demonstrate their commitment and to lead by example.

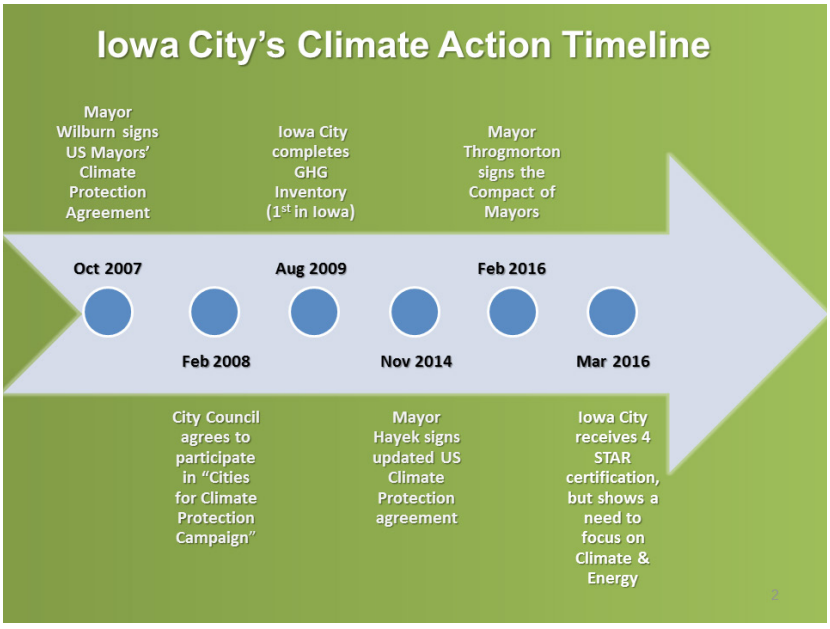


Figure 2. *Iowa City's Climate Action Timeline*

Introduction

STAR Community Rating

On March 9, 2016, Iowa City was awarded a 4-STAR Community Rating for sustainability excellence by being formally certified in the STAR (Sustainability Tools for Assessing and Rating Communities) Community Rating System. Although Iowa City was the highest-scoring city in the state and achieved high rankings in most goal areas, the City scored lowest in its Climate and Energy goals. The creation of the Climate Action and Adaptation Plan, appointment of the Climate Action Steering Committee, and climate actions undertaken by City staff have been a focus of the City Council. The STAR framework is a tool that communities can use to quantify these efforts. City staff held a workshop July 2016 and identified STAR actions items to undertake before recertifying. This report will fulfill one of the actions identified at a workshop: Conduct a municipal GHG inventory at least every five years. Iowa City plans on recertifying with STAR in 2020. More information about Iowa City's STAR rating can be found at icgov.org/STAR and in Appendix 5.

Purpose and Goals

The purpose of this report is to summarize the results of the municipal GHG inventory using the Local Government Operations Protocol (LGOP). This data is made available to the Climate Action and Adaptation Steering Committee and Iowa City residents in order to inform future actions to be taken by the municipality and community. Emissions-reducing actions will be included in a forthcoming municipal plan that focuses on emissions from local government operations. Some of these prioritized actions may be also be included in the community-wide Climate Action and Adaptation Plan, especially those relating to community services such as waste, water, and wastewater treatment.

On Dec. 7, 2016, the City Council approved a resolution setting community GHG reduction goals of 26-28% by the year 2025 and 80% by 2050. The baseline year for these reductions is 2005. At the time the reduction goals were set, they were in alignment with the United States' targets set by the Paris Agreement and agreed upon for the United States by President Obama in 2016 (unfccc.int/paris_agreement/items/9485.php). Despite the United States withdrawal from the Paris Agreement in 2017, Iowa City remains committed to meeting the reduction targets set by the agreement. The development and implementation of the Climate Action and Adaptation Plan will assist in meeting these targets.

As the Council has not yet set specific goals for reductions in municipal operations emissions reductions, this report assumes reductions targets matching the overall community emissions reductions targets.

Introduction

Methods

The methods used in this inventory are consistent with guidelines outlined by the Local Government Operations Protocol (LGOP). LGOP was developed by the California Air Resources Board, the California Climate Action registry, ICLEI (Local Governments for Sustainability), and The Climate Registry. The protocol was designed to provide a consistent methodology for the quantification and reporting of municipal GHG emissions across U.S. municipalities.

LGOP groups GHG emissions into three categories: Scope 1, 2, and 3. Scope 1, or direct GHG, includes emissions generated directly from sources owned and operated by an organization. Scope 2, or energy indirect GHG, includes emissions from the use of energy sources generated outside of the organization (such as electricity purchased from local utilities). Scope 3, or other indirect GHG, includes emissions generated as a consequence of an organization's activities, but are not directly owned or controlled by the organization, such as employee commuting, business travel, and production of goods purchased by the City.

This report takes into account all emissions generated by Scope 1 and Scope 2 activities. Scope 3 emissions are outside of the purview of this report and are not taken into account.

For this report, City staff totaled GHG emissions generated from municipal operations by calculating emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from acquired data on energy use and waste generation. CH_4 and N_2O were converted to CO_2 equivalent (CO_2e), then multiplied by global warming potential (GWP) units developed by the Intergovernmental Panel on Climate Change (IPCC). GWPs were taken from the IPCC Fifth Assessment Report (2013), and the 100-year GWP units were used in calculations. The total units of CO_2e then represent the sum total of the global warming potential of calculated GHGs. Electricity emissions factors were provided by MidAmerican Energy, Eastern Iowa Light and Power (EILP), and the Environmental Protection Agency's Emissions & Generation Resource Integrated Database (eGRID). This municipal analysis did not calculate hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), or other GHGs. All GHGs are reported in the standard GHG units of metric tonnes CO_2e. One metric tonne is equivalent to 2,205 U.S. pounds.

Data

Municipal operations GHG totals included emissions from all City of Iowa City government activities. This report includes the total combined energy usage and emissions from the following sectors:

- Airport Facilities
- Buildings and Facilities
- Solid Waste
- Streetlights and Traffic Signals
- Transit Fleet
- Vehicle Fleet
- Wastewater Treatment
- Water Treatment

Data for this analysis was provided and verified by various City departments and staff. Energy usage was collected from City of Iowa City utility bills for sum totals of electrical, natural gas, and propane usage and cost. The City has a total of almost 300 natural gas and electricity accounts from the two local utilities. MidAmerican Energy supplied two-thirds of electricity and all of the natural gas for the City of Iowa City. Just under one-third of electricity was supplied by Eastern Iowa Light and Power for the wastewater treatment plant and other facilities located in the southern portion of Iowa City. Vehicle and transit fuel usage data was provided by the City Equipment Division and includes all fuel (gasohol, diesel and propane) for 280 fleet vehicles and 29 transit vehicles. The Iowa City Landfill provided data on waste collected throughout Johnson County. Information from the City's wastewater treatment plant was analyzed for CH_4 and N_2O produced from treatment procedures. Total electricity and natural gas usage data for City facilities can be found in Appendix 1.

Municipal Results Summary

2015 Municipal Results:

- Total municipal operations CO_2e emissions: 44,194 metric tonnes
  - ~4.5% of Iowa City community's total GHG emissions
- Municipal CO_2e emissions by source:
  - 54.0% from methane production from waste in the Iowa City Landfill (which is captured and flared)
  - 26.4% from electricity use
  - 9.5% from vehicle fuel use
  - 7.3% from natural gas use
  - 2.5% from nitrous oxide generated during wastewater treatment
  - Less than one percent from methane (from wastewater treatment) and propane (for heating landfill buildings and fuel for forklifts)

Municipal Emissions Dropped:

- 21.0% since 2008
- 15.5% since 2005
- 54.5% since 2000

Major City Energy Use & Emission Reduction Initiatives 2000-2015

Since 2000, staff across multiple departments have been working on projects to lower energy use and emissions:

- Capturing and flaring methane generated by the Iowa City Landfill beginning in May 2001, which was EPA-mandated as an operational requirement
- Traffic signals converted to LED (2002-present)
- Stimulus funding assisted in the $1.2 million project to install LED lighting in all five City parking ramps (2010)
- Iowa City was awarded $692,300 in stimulus funding in 2011-2014 and completed the following projects:
  - Energy audits for all facilities over 25,000 sq ft (eight facilities)
  - Efficient lighting replacements at Mercer Park, the Robert A. Lee Recreation Center, and the water and wastewater treatment plants
  - Efficient aeration blower installed at wastewater treatment plant
  - Variable frequency drive (VFD) motors with higher efficiencies installed at Mercer Aquatic Center
  - Purchased energy tracking software to track municipal energy usage
  - Hired temporary personnel to track energy usage and write facility reports
  - Created a revolving loan fund with energy cost savings to continue energy retrofits
- Three LEED certified buildings - East Side Recycling Center Education Building (Platinum), Fire Station #2 (Gold), Fire Station #4 (Gold)
- Geothermal heat source pumps (no natural gas is used for building, only electricity) for three facilities: East Side Recycling Center Education Building, Fire Station #2, and Fire Station #4
- Ongoing LED replacement of City-owned streetlights (since 2013)
- Contract to replace MidAmerican-owned streetlights with LEDs over 10-year period (2015)
- One hybrid vehicle (2008) and three electric wastewater vehicles (2015, 2016) for the vehicle fleet
- Energy audits for additional City-owned buildings (2015)

MidAmerican Energy Emission Reduction Initiatives

- 35.5% renewable energy in 2015, which increased from 0% in 2000
- Approved by Iowa Utility Board to generate 89% renewable electricity by 2019
- 100% renewable electricity goal, sometime after 2019

Eastern Iowa Light and Power Emission Reduction Initiatives

- 60% of electricity generation was carbon-free in 2015; however, the majority of carbon-free generation was sold as carbon credits and cannot be claimed in this report
- In 2015, 25% of EILP's electrical generation was wind/hydro, and 35% was nuclear energy. While EILP plans to add solar and wind installments over the next few years, they currently project their overall carbon-free generation percentage to remain steady at 60% through 2031

These combined initiatives resulted in a 54.5% reduction in city operations' GHG emissions during the period of 2000 to 2015.

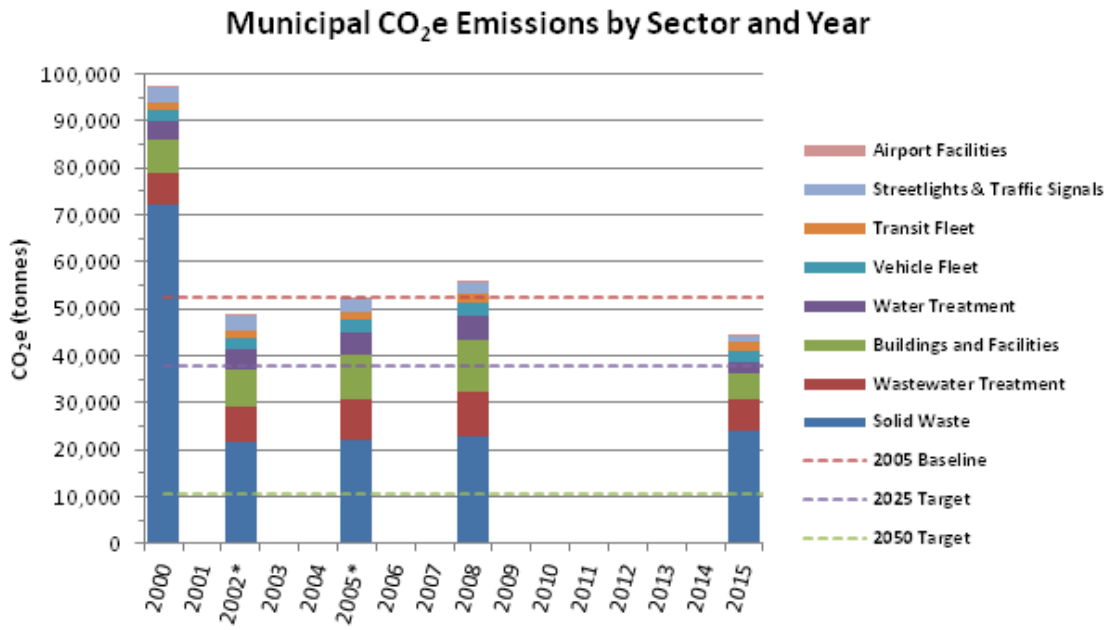
Municipal Greenhouse Gas Inventory

Overview

Municipal GHG inventories have been completed for 2000, 2008, and 2015. Inventories for 2002 and 2005 are estimates, as complete data for those years was not available at the time of this report. The only sectors not showing significant emissions reductions from 2008 to 2015 are the solid waste facilities, the vehicle fleet and the transit fleet. Emissions data is summarized in Table 1 and Figure 3.

City of Iowa City municipal activities generated 44,194 metric tonnes CO_2e in 2015, or roughly 4.5% of the Iowa City community's total for the year. Since 2000, emissions from municipal operations have dropped 54.5%, in large part due to capturing and flaring methane at the Iowa City Landfill beginning in 2001. Since 2005, emissions have dropped 15.5%, even with increases in energy use and waste production. Increased energy use has been offset by efficiency improvement projects and increased renewable energy production. Emissions dropped 21.0% between 2008 and 2015 due to increased renewable energy production and reduced energy use (Table 1; Figure 3).

The City has not set specific reduction targets for municipal operations, so placeholder reduction targets have been set to match goals made for the Iowa City community and the Paris Agreement. Municipal operations generated an estimated 52,304 metric tonnes CO_2e in the baseline year of 2005. Municipal operations emissions will need to amount to 37,659 metric tonnes CO_2e (or less) per year in 2025 to meet a 28% reduction goal, and to amount to 10,461 metric tonnes CO_2e (or less) per year in 2050 to meet an 80% reduction goal (Figure 3).



* 2002 and 2005 emissions estimated based on average annual emissions change from 2000 to 2008 combined with the reduction in solid waste emissions that began in May 2001.

Figure 3. *Municipal Operations Emissions and Reduction Targets (2000-2015)*

Municipal Greenhouse Gas Inventory

Sector	CO_2e Emissions (metric tonnes)				
	2000	2002*	2005*	2008	2015
Solid Waste	72,053	21,470*	22,054*	22,638	24,001
Wastewater Treatment	7,042	7,741*	8,789*	9,837	6,621
Buildings and Facilities	6,779	7,765*	9,245*	10,724	5,426
Water Treatment	4,077	4,381*	4,836*	5,291	2,523
Vehicle Fleet	2,445	2,519*	2,629*	2,739	2,209
Transit Fleet	1,524	1,598*	1,708*	1,819	1,976
Streetlights and Traffic Signals	3,064	2,974*	2,839*	2,704	1,314
Airport Facilities	189	195*	205*	214	124
Totals:	**97,173**	**48,642***	**52,304***	**55,966**	**44,194**

* 2002 and 2005 emissions estimated based on average annual emissions change from 2000 to 2008 combined with the reduction in solid waste emissions that began in May 2001.

Table 1. *Municipal CO_2e Emissions by Sector and Year*

Emissions by Source

The Iowa City municipal GHG inventory breaks down emissions sources into seven categories:

- Landfill Carbon Dioxide (CO_2)
  - Waste generates methane, which when captured and flared is converted to CO_2
- Electricity
  - Emissions generated by electricity used in municipal operations
- Diesel, Gasoline, & Ethanol
  - Emissions from burning fuels for the vehicle fleet, transit fleet, and backup generators
- Natural Gas
  - Emissions generated by burning natural gas in city facilities, primarily for heating
- Nitrous Oxide (N_2O)
  - Primarily emissions generated from wastewater operations, but small amounts also generated by the burning of fossil fuels
- Methane (CH_4)
  - Primarily emissions generated by wastewater treatment operations, but small amounts are also generated by the burning of fossil fuels
- Propane
  - Emissions generated by burning propane (heating, forklifts)

Breaking municipal emissions down by emission source, landfill CO_2 accounts for 54.0% of total emissions in 2015. Electricity use accounts for 26.4% of the total, followed by fuels at 9.5%, natural gas at 7.3%, nitrous oxide at 2.5%, and propane and methane with less than 1% each (Table 2; Figure 4).

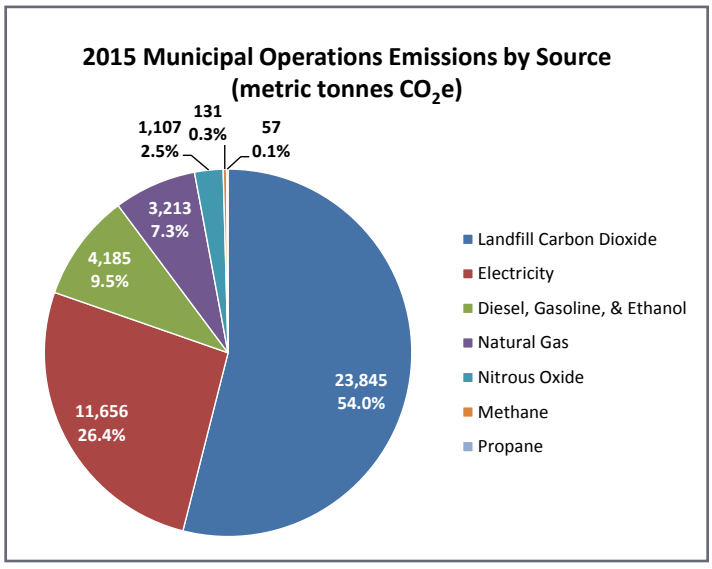


Figure 4. *2015 Municipal Operations CO_2e Emissions by Source*

Municipal Greenhouse Gas Inventory

The Iowa City vehicle and transit fleets run on a variety of fuel types, and emitted a total of 4,185 metric tonnes CO_2e in 2015. Off-road vehicles refer to heavy duty machinery (such as dump trucks, garbage trucks, landfill equipment, etc.). Vehicles running on gasoline are fueled with a 10% ethanol blend (E10).

Breaking down emissions by fuel type, diesel for on-road vehicles accounted for 66.2% of all vehicle greenhouse emissions, with off-road diesel accounting for 17.4%. Gasoline and ethanol for on-road and off-road vehicles combined comprise 16.3% of the total (Table 3).

Source	CO_2e (Tonnes)	% of Total
Landfill CO_2	23,845	54.0%
Electricity	11,656	26.4%
Diesel, Gasoline, & Ethanol	4,185	9.5%
Natural Gas	3,213	7.3%
Nitrous Oxide	1,107	2.5%
Methane	131	0.3%
Propane	57	0.1%
Totals:	**44,054**	**100%**

Table 2. *Municipal CO_2e Emissions by Source*

Diesel, Gasoline, & Ethanol Breakdown:		
Type	CO_2e (Tonnes)	**% of Total**
Diesel	2,771	66.2%
Off road diesel	728	17.4%
Gasoline	621	14.8%
Ethanol	47	1.1%
Off road gasoline	18	0.4%
Fuel Totals	4,185	**100%**

Table 3. *Vehicle & Transit CO_2e Emissions by Fuel Type*

Emissions by Sector

The Iowa City municipal GHG inventory breaks down city operations into eight sectors:

- Solid Waste
  - Iowa City Landfill facilities, operations, and emissions from waste
- Wastewater Treatment
  - Wastewater treatment, lift stations, sanitary sewers
- Buildings and Facilities
  - All buildings and facilities not under another sector
- Water Treatment
  - Water treatment and distribution
- Vehicle Fleet
  - Vehicles used for City of Iowa City activities (except Transit)
- Transit Fleet
  - Vehicles used by Iowa City Transit including buses and other vehicles
- Streetlights and Traffic Signals
  - Streetlights and traffic signals within city limits
- Airport Facilities
  - Iowa City Municipal Airport buildings (does not include aircraft fuel use)

These sectors were defined in the first municipal inventory as divisions created within the software used to calculate municipal emissions (CACP). To remain consistent and to compare across inventory years, these categories were retained.

Municipal Greenhouse Gas Inventory

2015 Emissions by Sector

Solid waste accounted for 54.3% of municipal operations' GHG emissions in 2015. Unlike many local governments, the City of Iowa City owns and operates the Iowa City Landfill, which services the entire Johnson County community. Since the municipal analysis includes all City operations, waste-generated CO_2 emissions for Iowa City, ten smaller municipalities, and the rural community are included in this total. The population for Johnson County in 2015 was 139,436, nearly twice the size of Iowa City's 2015 population of 74,220. For this reason, Iowa City's municipal operations waste emissions may be higher compared to other cities of similar size, as well as having a much higher percentage in the municipal GHG inventory in comparison to the community-wide inventory.

Treatment of wastewater comprised the second largest source of GHG (15.0%), followed by energy use at buildings and facilities (12.3%). Water treatment comprised 5.7% of the total. The Iowa City vehicle fleet emitted 5.0% of the total, and Iowa City Transit fleet emitted 4.5%. Streetlights and traffic signals were 3.0% of emissions, and the Iowa City Municipal Airport generated less than one percent of total emissions in 2015 (Table 1; Figure 5).

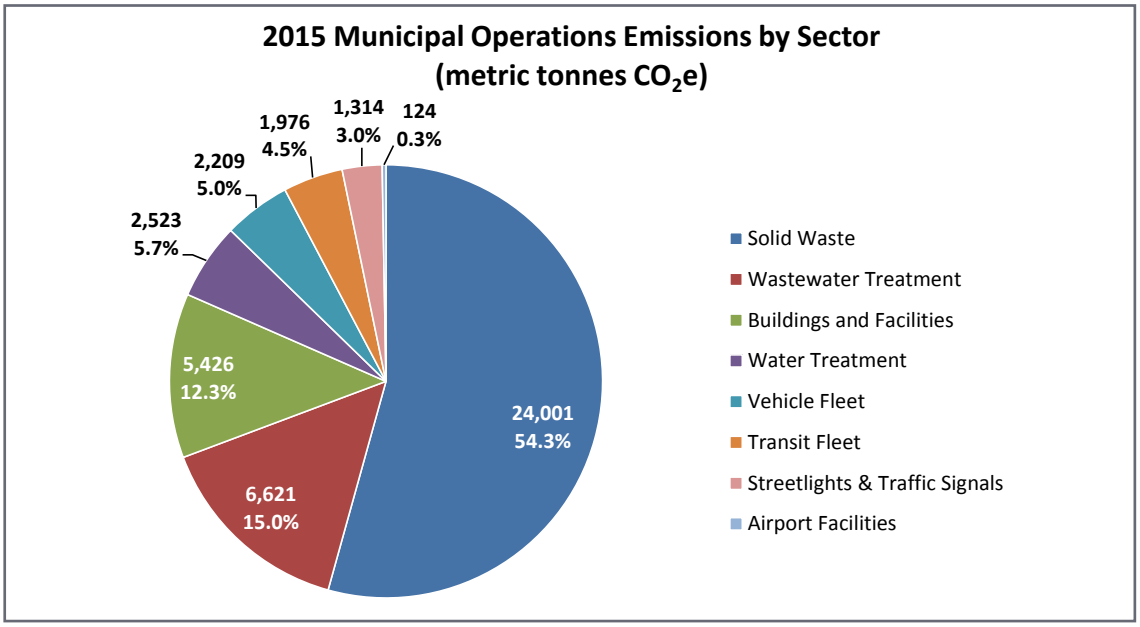


Figure 5. *2015 Municipal Operations* CO_2e *Emissions by Sector*

Annual Emissions Comparison by Sector

Since 2000, all sectors, except the transit fleet, have seen reductions in emissions. During this time period, the transit fleet increased services to the public by operating more buses and increasing the number of routes. Solid waste has seen the largest drop in emissions with a 66.7% reduction in emissions over the past 15 years, due to EPA requirements to capture and flare methane created within the landfill.

Since 2008, all sectors, except solid waste and transit, have seen reductions in emissions. Wastewater treatment, water treatment, buildings and facilities, streetlights and traffic signals, and airport facilities saw emissions reductions of 30% or more from 2008 levels. Reductions in emissions since 2008 are due to a combination of increased renewable energy, decreased energy use, and numerous energy efficiency improvement projects (Table 1; Figures 6 & 7).

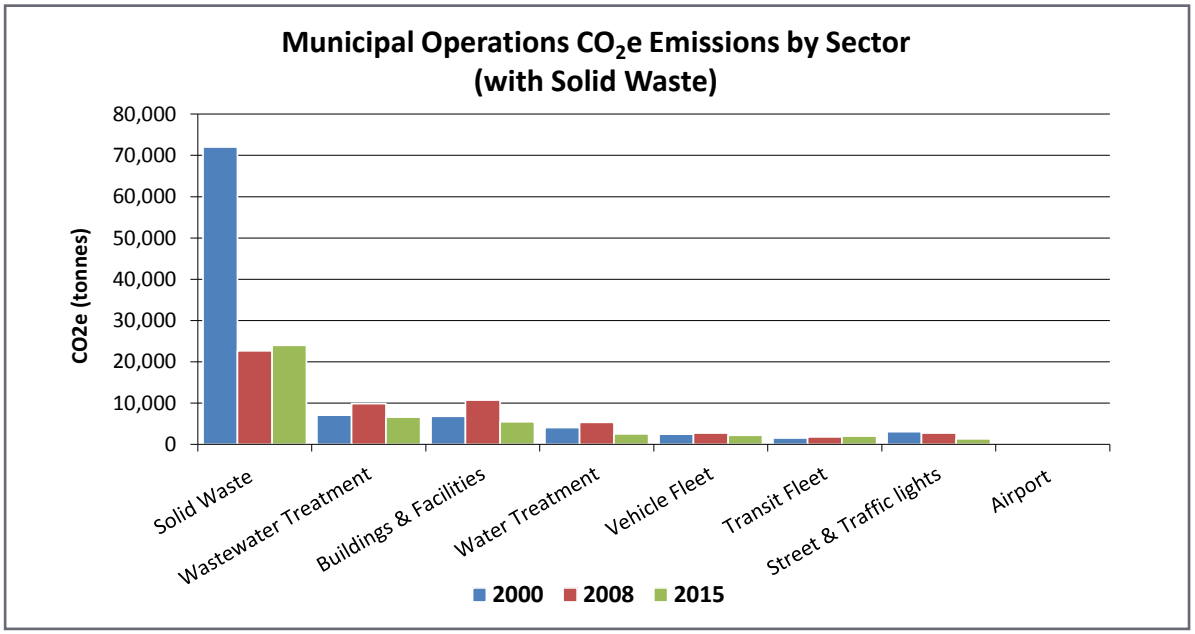


Figure 6. *Municipal Operations* CO_2e *Emissions by Sector, with Solid Waste (2000, 2008, 2015)*

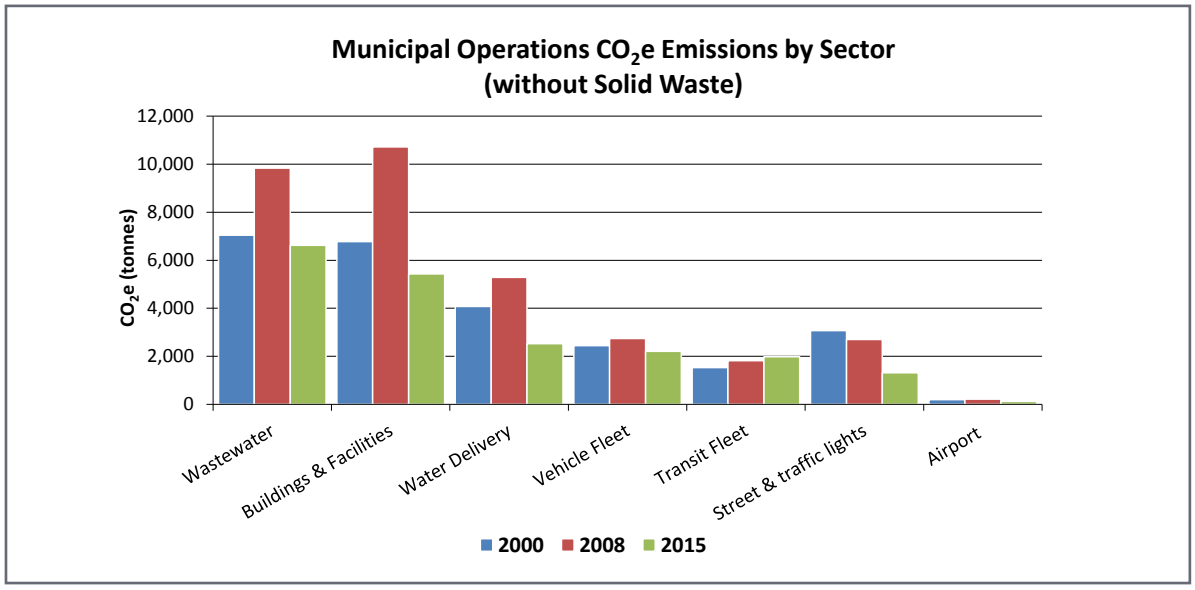


Figure 7. *Municipal Operations* CO_2e *Emissions by Sector, without Solid Waste (2000, 2008, 2015)*

Solid Waste Emissions

Emissions from the landfill dropped dramatically after capturing and flaring methane began in May 2001. Since 2001, emissions have gradually increased as total waste placed in the landfill increases with increasing population in Iowa City and Johnson County. In 2012, the shredded tire liner of a new landfill cell caught on fire. The emissions from the burning of tires have not been quantified and are not included in these numbers. Note that emissions are calculated based on the cumulative waste in place. Although annual landfill tonnages may decrease, GHG emissions may still show an increase due to ongoing methane production from prior waste in place (Table 1; Figure 8).

Municipal Greenhouse Gas Inventory

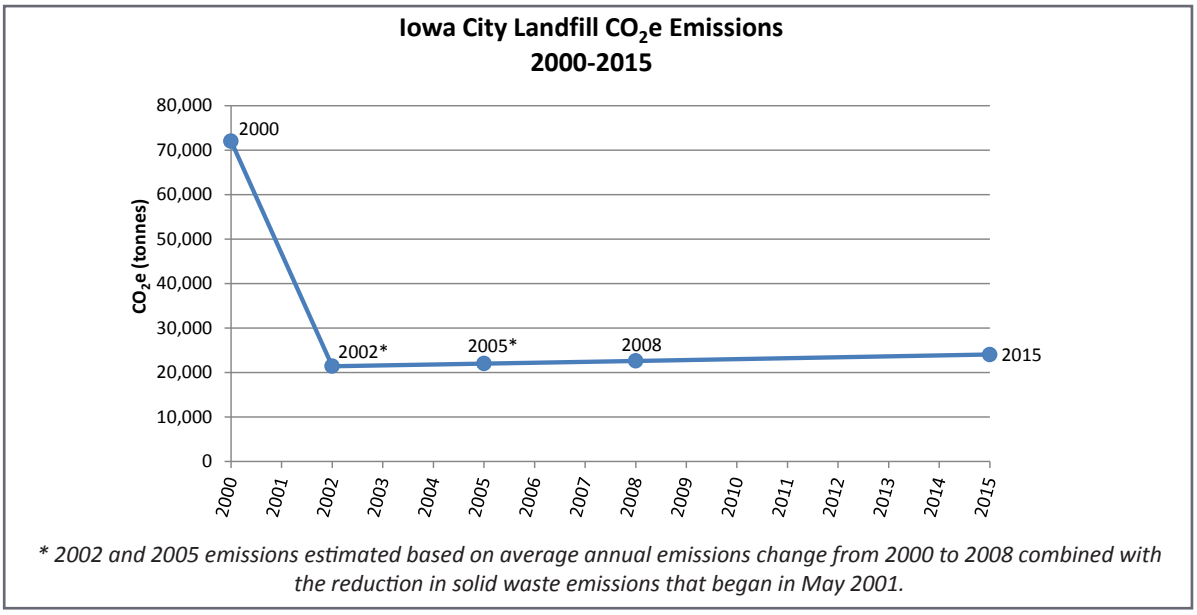


Figure 8. *Solid Waste* CO_2e *Emissions (2000-2015)*

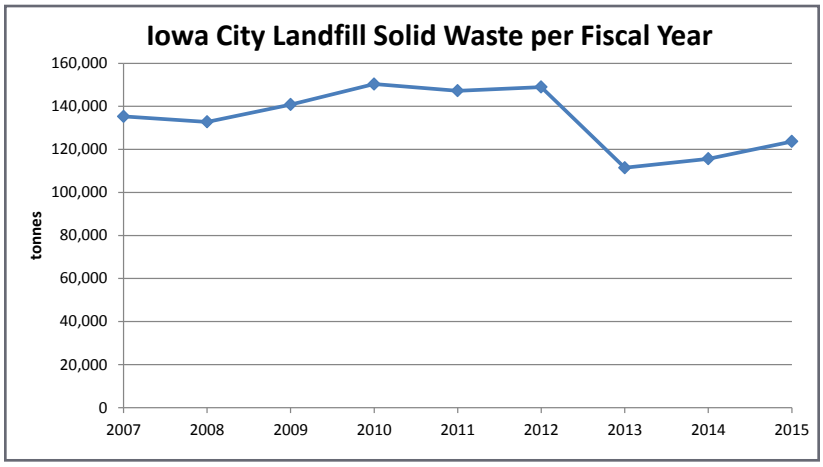


Figure 9. *Solid Waste Tonnage per Year*

Waste placed in the landfill has varied between 110,000 and 150,000 tons per fiscal year during the period of 2007-2015. Landfill tonnage varies during this reporting period due to several factors. The summer of 2008 flood resulted in higher rates due to residential, commercial and public building demolitions, ruined household and property items, and used sandbags. The local economy also influences landfill tonnage per year. In a 2013 study, the EPA found that for every $5,000 increase in GDP, the tons of municipal solid waste increase by approximately 130 lbs. (0.065 tons) per year. Waste tonnage dropped in 2013, but has been steadily increasing since then. Since 2015, five new landfill initiatives have been passed by City Council: curbside food waste collection, electronics waste ban, mandatory multi-family recycling, cardboard ban at the landfill, and single stream recycling. Once in place, these initiatives are estimated to divert over 15,000 tons from the landfill annually. It is estimated that by the end of 2018, landfill tonnage will decrease by about 15% due to the implementation of these initiatives (Table 4; Figure 9).

Solid Waste per Year										
Fiscal Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Tonnage	135,315	132,760	140,810	150,369	147,265	148,953	111,445	115,624	123,692	126,875

Table 4. *Solid Waste Tonnage per Fiscal Year*

Energy Usage by Sector

2015 Energy Use

City energy use was measured in KWh, terms, and gallons and converted to MMBTUs for comparison purposes. In 2015, Iowa City municipal operations consumed a total of 207,169 MMBTUs (one million British thermal units 'BTU') worth of energy. This figure includes electricity, vehicle fuels, natural gas, methane, and propane use. Buildings and facilities consumed the most energy, at 62,873 MMBTUs, or 30.3% of the total. Wastewater facilities used the second most (25.6%), followed by the vehicle and transit fleets (14.5% and 13.0%, respectively), water treatment facilities (10.1%), streetlights and traffic signals (5.0%), and solid waste and airport facilities (less than 1% each).

The combined energy use of water and wastewater treatment consumed the most energy, at 35.7%, a larger percentage than all other City buildings and facilities combined (30.3%); (Table 5; Figure 10).

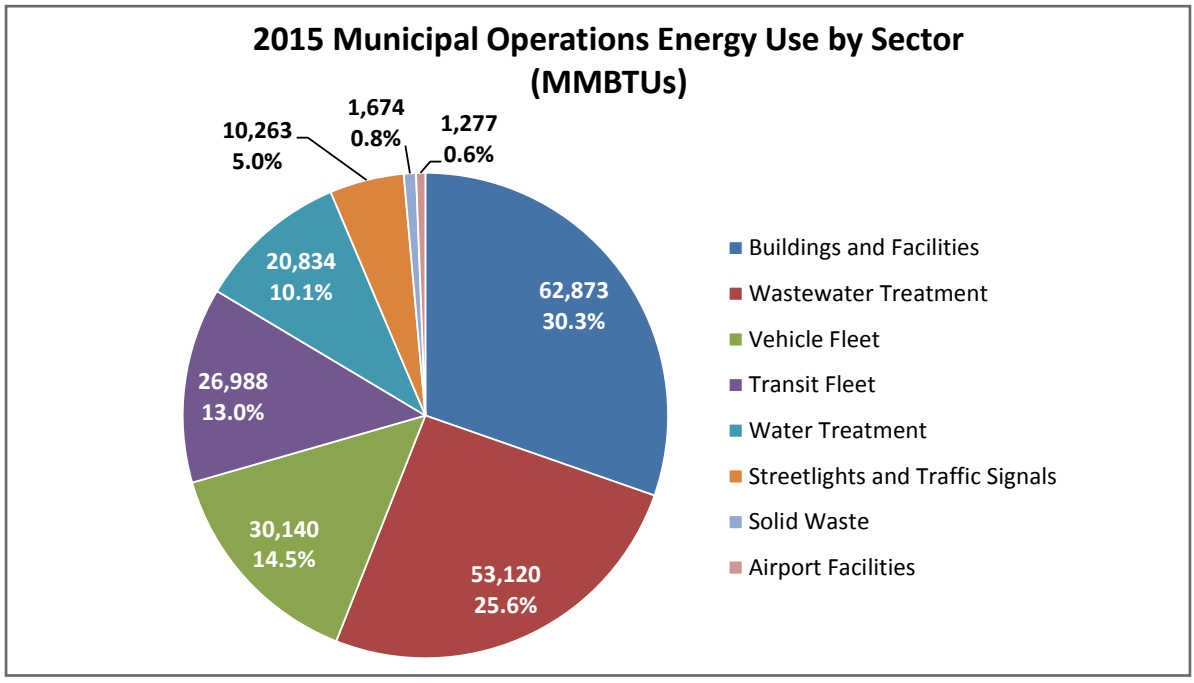


Figure 10. *2015 Municipal Operations Energy Usage by Sector*

Sector	MMBTUs 2000	2008	2015
Buildings and Facilities	51,243	70,842	62,873
Wastewater Facilities	45,477	57,985	53,120
Vehicle Fleet	33,260	37,131	30,140
Transit Fleet	20,816	24,162	26,988
Water Treatment Facilities	18,940	25,440	20,834
Streetlights and Traffic Signals	12,515	11,157	10,263
Solid Waste	541	1,285	1,674
Airport Facilities	1,345	1,683	1,277
Totals:	**184,137**	**229,685**	**207,169**

Table 5. *Municipal Energy Usage by Sector and Year*

Energy Usage by Sector

Annual Energy Use Comparison

Since 2000, total municipal energy use has increased 12.5%, from 184,137 MMBTUs to 207,169 MMBTUs. During this time period, Iowa City's population increased 12%. As Iowa City's population increases, we can expect municipal energy use to parallel this growth. Buildings and facilities, wastewater treatment, transit fleet, water treatment, and solid waste facilities have all seen increases in energy use over the past 15 years. Decreases were seen in the vehicle fleet, streetlights and traffic signals, and at the airport facilities.

Since 2008, energy use has decreased 9.8%, from 229,685 MMBTUs to 207,169 MMBTUs. All sectors, except for transit and solid waste, have seen decreases in energy use since 2008. All sectors, except the vehicle and transit fleets, have worked on significant efficiency improvement projects during this time (Table 5; Figure 11).

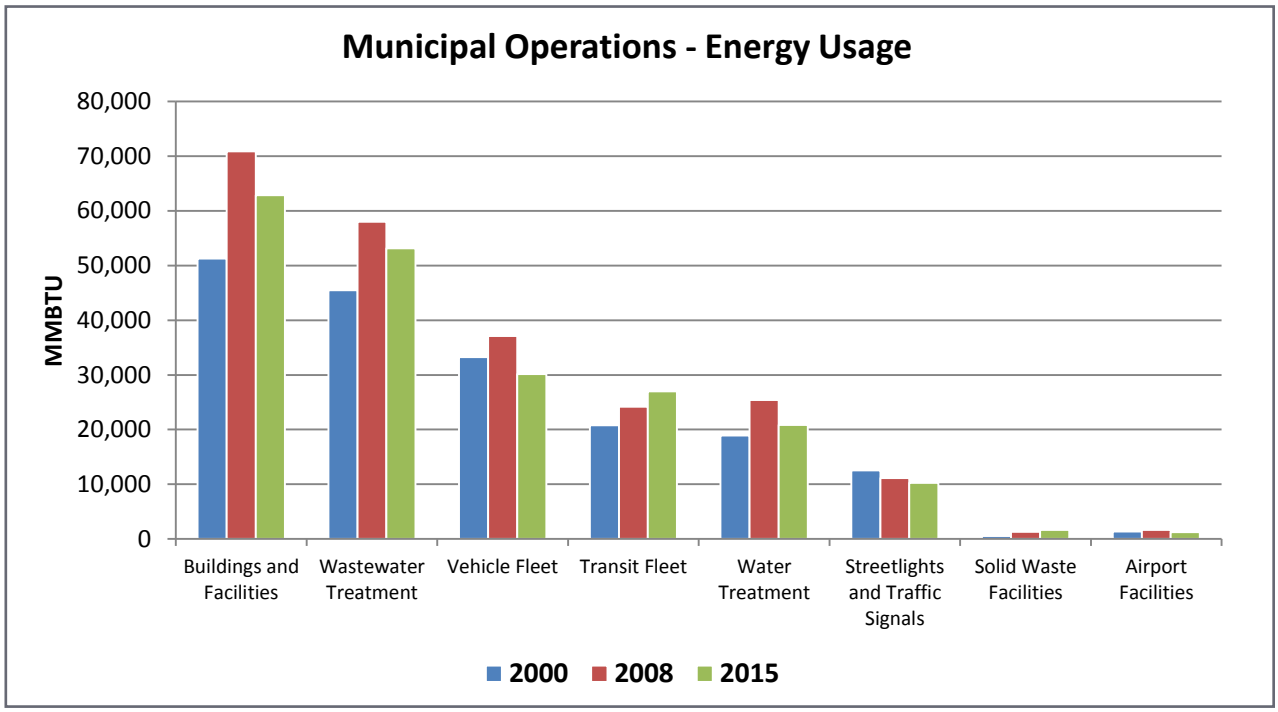


Figure 11. *Municipal Operations Energy Usage by Sector (2000, 2008, 2015)*

Energy usage varies year-to-year due to a variety of factors:

- Variations in weather
- Changes in demand for services
- Changes in wastewater and drinking water regulations
- Efficiency improvements (higher efficiency appliances and equipment)
- Changes in facilities operations by facilities managers
- Employee behaviors (turning off lights, running water, idling cars, etc.)
- Adoption of energy codes for new buildings

Energy Usage by Sector

Heating and Cooling Days

Variations in energy usage are partially attributable to variations in climate year-to-year. The annual sum of heating degree days (HDD) and cooling degree days (CDD) provides an approximation of the energy required to heat and cool a building during a year. Heating and cooling degree days are calculated by taking the difference between the mean daily temperature and 65 degrees Fahrenheit (F). Daily temperature means above 65 degrees F are CDD, while daily means below 65 degrees F are HDD. For example, if the average temperature on a given day was 45 degrees, that day had 20 HDD. The more total heating and cooling degree days there are in a year, the more energy is required to heat and cool buildings. Typically, natural gas is used for heating on HDD, and electricity is used for cooling on CDD.

Iowa City's total combined heating and cooling degree days has varied between just under 6,000 to nearly 8,500 per year during the period of 2000-2015. Heating degree days make up the majority of degree days in Iowa City. Average annual temperature ranged from 47 degrees Fahrenheit to 54 degrees Fahrenheit over the same period. In 2008, high energy usage in buildings and facilities is partially attributable to the high number of heating degree days that year (7,659), necessitating considerably more heating energy (Table 6; Figure 12).

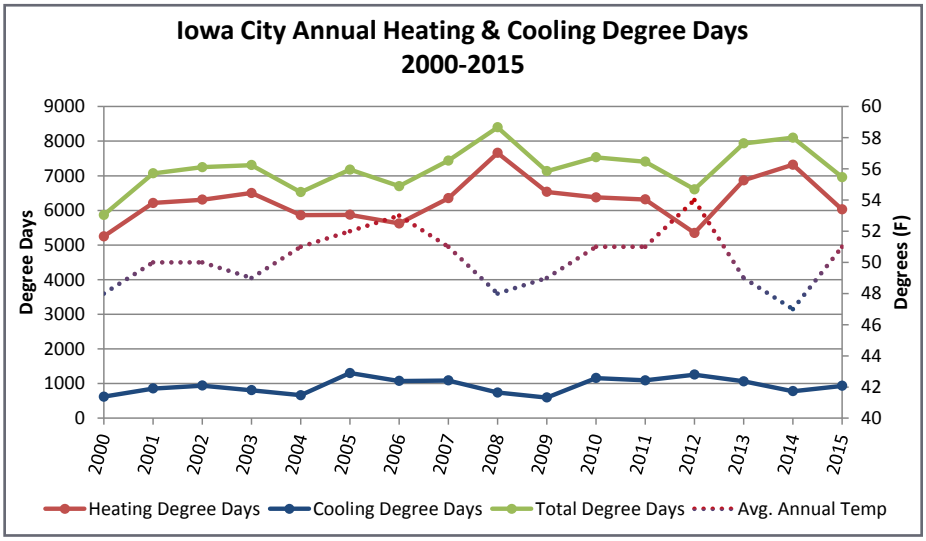


Figure 12. *Annual Degree Days & Average Annual Temperature (2000-2015)*

Year	Avg. Annual Temp	Heating Degree Days	Cooling Degree Days	Total Degree Days
2000	48	5249	622	5871
2001	50	6214	856	7070
2002	50	6308	940	7248
2003	49	6502	807	7309
2004	51	5864	662	6526
2005	52	5874	1303	7177
2006	53	5625	1074	6699
2007	51	6353	1087	7440
2008	48	7659	741	8400
2009	49	6536	597	7133
2010	51	6375	1158	7533
2011	51	6316	1092	7408
2012	54	5350	1257	6607
2013	49	6869	1064	7933
2014	47	7320	779	8099
2015	51	6027	934	6961

Table 6. *Annual Heating and Cooling Degree Days (2000- 2015)*

Energy Usage by Sector

Vehicle and Transit Fuel Use

In 2015, the combined City vehicle and transit fleets used 342,947 gallons of diesel, 79,887 gallons of gasohol (E10, a blend of 10% ethanol and 90% gasoline), and 201 gallons of propane. Transit diesel fueled a fleet of 26 buses, each consuming an average of nearly 7,500 gallons of diesel in 2015. Diesel fueled roughly 130 fleet vehicles, consisting of heavy-duty equipment and trucks, while gasohol fueled roughly 150 fleet vehicles. Propane fueled three forklifts (Table 7).

2015 Transit & Fleet Fuel Use (gallons)			
Sector	**Diesel**	**Gasohol (E10)**	**Propane**
Transit	195,247	971	-
Fleet	147,700	78,915	201
Totals:	**342,947**	**79,887**	**201**

Table 7. *2015 Transit & Fleet Fuel Use*

Energy Costs by Sector

2015 Energy Costs

In 2015, Iowa City municipal operations total energy cost was $2,951,347. This figure includes electricity, vehicle fuels, natural gas, and propane use. Buildings and facilities had the highest energy costs, at $751,004, or 25.4% of the total. Wastewater treatment cost the second most (20.3%), followed by the vehicle fleet (14.6%), streetlights and traffic signals (13.7%), transit fleet (12.6%), water treatment (11.6%), solid waste (1.1%), and airport facilities (less than 1%); (Table 8; Figure 13).

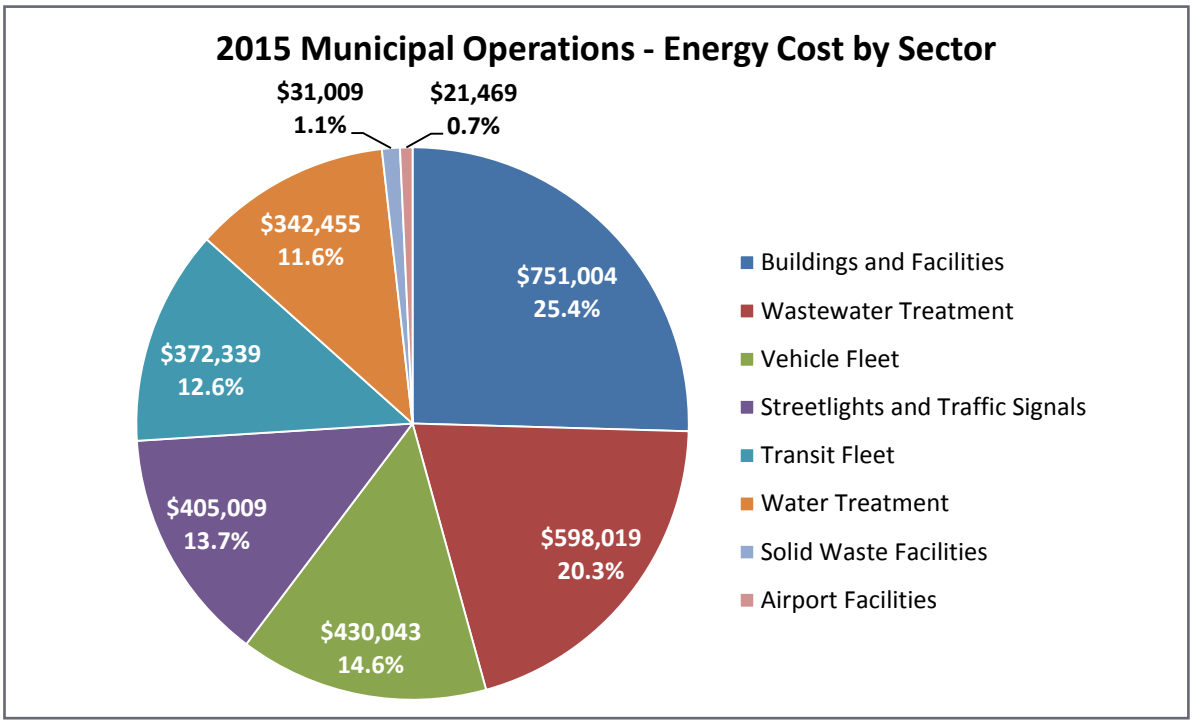


Figure 13. *2015 Municipal Operations Energy Cost by Sector*

Sector	Energy Cost		
	2000	2008	2015
Buildings and Facilities	$514,937	$981,753	$751,004
Wastewater Facilities	$381,229	$752,408	$598,019
Vehicle Fleet	$246,320	$678,213	$430,043
Streetlights and Traffic Signals	$417,767	$411,329	$405,009
Transit Fleet	$144,699	$593,033	$372,339
Water Treatment Facilities	$257,103	$370,836	$342,455
Solid Waste Facilities	$8,604	$28,232	$31,009
Airport Facilities	$17,080	$24,229	$21,469
Totals:	**$1,987,739**	**$3,840,033**	**$2,951,347**

Table 8. *Municipal Energy Costs by Sector and Year*

Energy Costs by Sector

Annual Energy Costs Comparison

Since 2000, municipal operations total energy costs have risen from $1,987,739 to $2,951,347, a 48.5% increase. Costs have risen in all sectors except for streetlights and traffic signals, which have decreased in cost by 3.1%. Increases in energy costs have outpaced increases in energy use since 2000.

Since 2008, municipal operations total energy costs have dropped $888,686, or 23.1%. All sectors saw decreases in costs except solid waste facilities (Table 8; Figure 14).

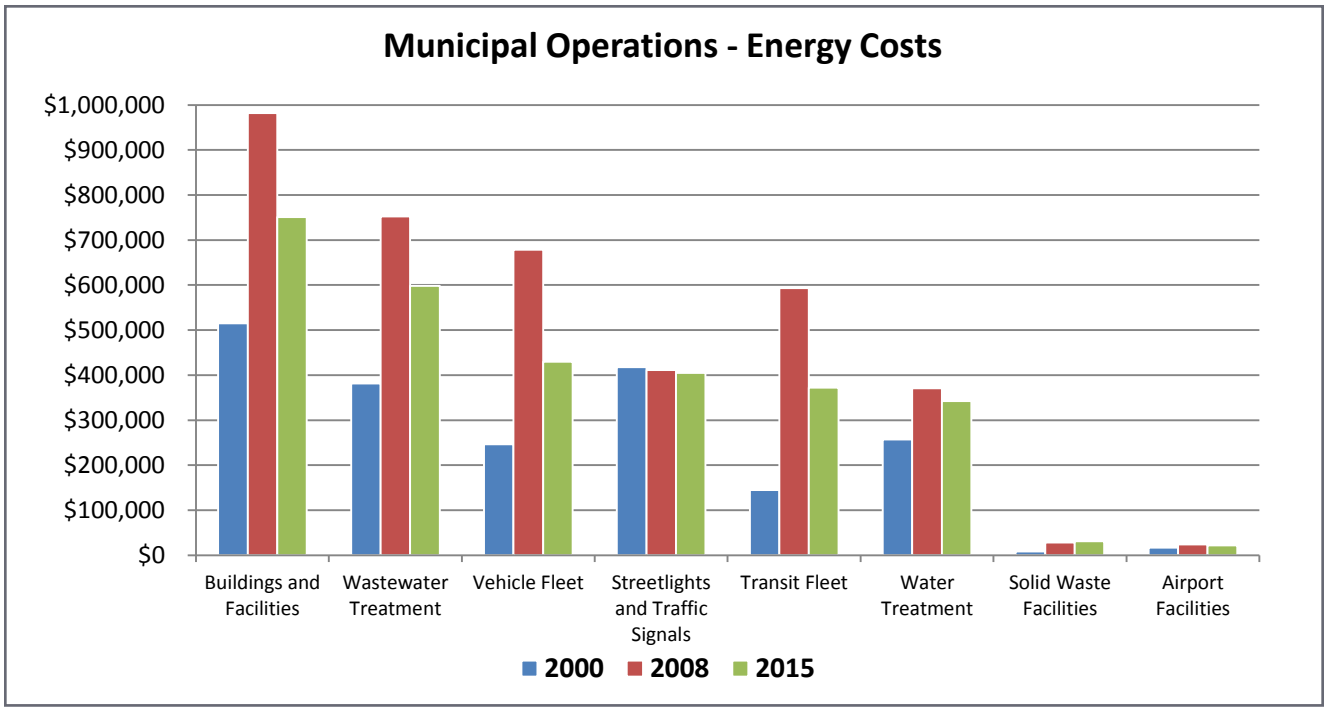


Figure 14. *Municipal Operations Energy Cost by Sector (2000, 2008, 2015)*

Energy Costs by Source

2015 Energy Costs and Usage by Source

Electricity accounted for the majority of energy costs in 2015, at 63.6% of the total, followed by diesel (22.5%), natural gas (8.5%), gasohol (4.8%), and propane (0.7%); (Table 9; Figure 15).

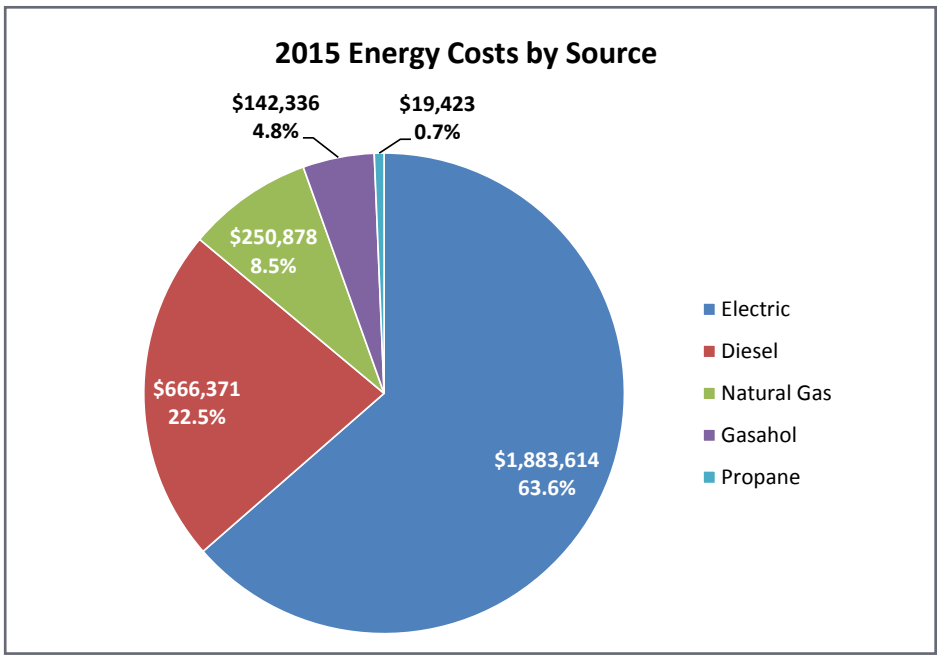


Figure 15. *2015 Energy Costs by Source*

Energy Source	Usage		Cost	Ave. Cost per unit
Electric	25,999,570	kWh	$1,883,614	$0.07
Natural Gas	604,009	Therm	$250,878	$0.42
Diesel	344,774	gal	$666,371	$1.93
Gasahol	79,887	gal	$142,336	$1.78
Propane	11,992	gal	$19,423	$1.62

Table 9. *2015 Municipal Energy Usage and Costs by Source*

Energy Costs by Source

Annual Energy Costs by Source Comparison

All energy sources rose in price over the period from 2000 to 2015, with the exception of natural gas. Natural gas prices fluctuate year-to-year, with the average price in 2015 being roughly equivalent to costs in 2000. Fuel prices for gasoline and diesel are roughly double their costs in 2000. The high energy costs in 2008 are attributable to a combination of high energy prices and high energy use (Table 10).

Energy costs vary year-to-year due to a number of variables:

- Market price for electricity and fuel
- Variations in climate
- Usage

Average Energy Cost per Unit by Year			
Source	**2000**	**2008**	**2015**
Electricity (per kWh)	$0.05	$0.05	$0.07
Natural Gas (per ccf)	$0.42	$0.81	$0.42
Gasohol (E10) (per gallon)	$0.97	$2.28	$1.78
Diesel (per gallon)	$0.88	$3.02	$1.93

Table 10. *Average Energy Cost per Unit (2000, 2008, 2015)*

Comparison to Iowa City Community

In 2015, Iowa City municipal operations accounted for just 4.5% (44,194 metric tonnes CO_2e) of the Iowa City Community's total GHG emissions (987,735 metric tonnes CO_2e). Note that this is an imperfect comparison, as this municipal GHG inventory includes landfill emissions for waste from all Johnson County residents, while the community inventory only includes emissions from waste produced by residents in Iowa City. Although we can work towards lowering local government emissions, collaboration with the community to lower community-wide waste emissions will be essential for Iowa City to reach emissions reduction goals (Table 11; Figure 16).

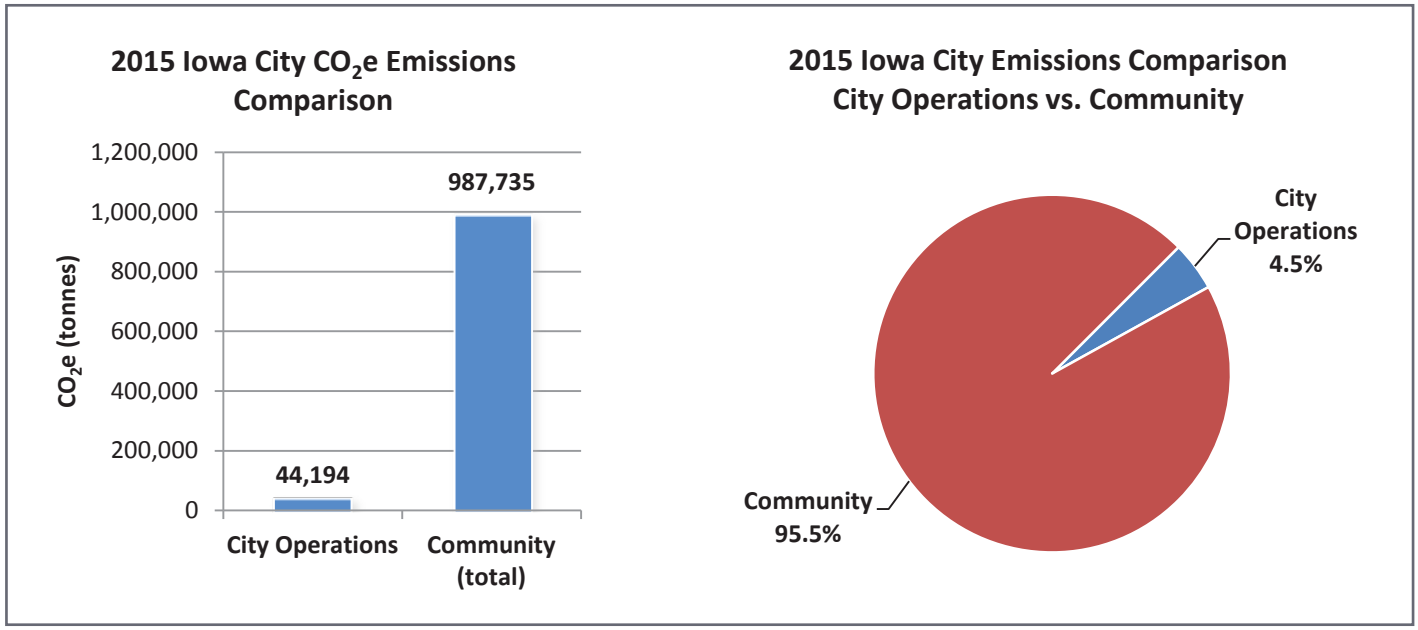


Figure 16. *2015 Municipal Operations and Community CO_2e Emissions Comparison*

Sector	2015	
	CO_2e (tonnes)	Percent of Total
City Operations	44,194	4.5%
Community	943,541	95.5%
Community (total)	**987,735**	**100%**

Table 11. *2015 Community Emissions Comparison*

Population Projections

Iowa City's population has been steadily increasing, and Census projections anticipate that the population will continue to increase; necessitating increased municipal services in the future. Increased services will, without increased efficiency, require greater energy usage and cause potentially higher GHG emissions (Table 12; Figure 17).

Year	Population
2000	62,220
2005	65,641
2006	66,085
2007	66,529
2008	66,974
2009	67,418
2010	67,862
2011	69,094
2012	70,133
2013	71,591
2014	73,415
2015	74,220
2020	77,970
2025	80,700
2030	84,450
2035	88,200
2040	91,950
2045	95,700
2050	99,450

***Table 12**. Iowa City Population Growth & Projection (2000-2050)*

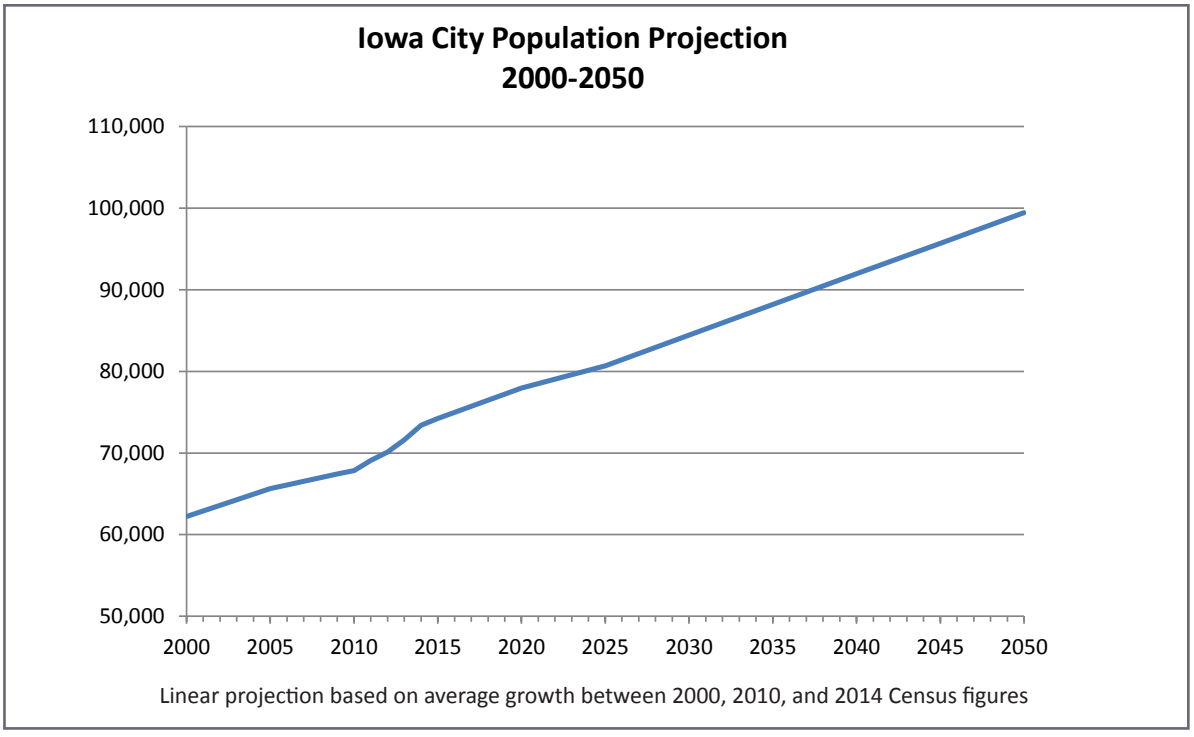


***Figure 17.** Iowa City Population Growth & Projection (2000-2050)*

Electricity Emissions Projection

MidAmerican Energy produced just over two-thirds of Iowa City's municipal operations electricity in 2015 and has been increasing renewable wind energy production since 2004. Prior to 2015, the majority of the carbon emission reductions had been sold as carbon credits; meaning that entities could purchase the carbon credits to perceptually (but artificially) offset their carbon emissions. Due to this, Iowa City municipal operations could not claim the lowered emissions from the wind and renewable generation until 2015.

In 2015, 35.5% of MidAmerican's electricity in Iowa was generated using renewable wind energy. Going forward, MidAmerican Energy projects 89% of its electricity production to be renewable by 2019, and 100% to be renewable sometime after 2019. Current projections set 2025 as the goal for 100% renewable energy generation, but this date is not currently finalized and subject to change. For more information on MidAmerican's renewable energy goals, visit their website at www.midamericanenergy.com/our-renewable-energy-vision.aspx.

Eastern Iowa Light and Power (EILP) provided just under a third of the local government's purchased electricity in 2015, and 98.5% of the electricity provided by EILP is used for wastewater treatment. While 60% of EILP's energy sources were carbon-free in 2015, EILP sold a large portion of its emissions reductions as carbon credits. While EILP plans to add solar and wind installments over the next few years, it currently projects its overall carbon-free generation percentage to remain steady at 60% through 2031.

The projected increase in MidAmerican Energy's renewable energy production will drastically reduce municipal emissions from electricity use. Compared to a scenario with no renewable electricity production, municipal operations will produce roughly 10,500 fewer metric tonnes CO_2e per year by 2019 (assuming electricity usage and the ratio of electricity generated by MidAmerican and EILP remains constant at 2015 levels). If MidAmerican's electricity generation becomes 100% renewable by 2025, municipal operations will produce 12,000 fewer metric tonnes CO_2e per year when compared to a scenario with no renewable generation. All remaining emissions from electricity use would come from electricity generated by EILP (Figure 18).

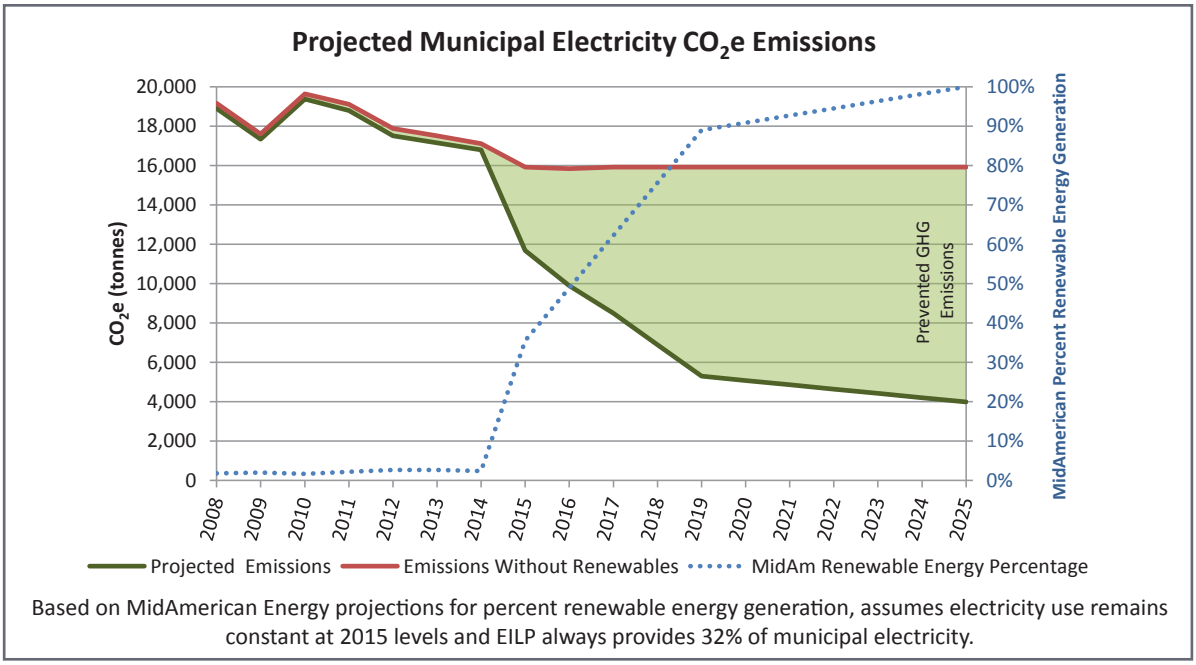


Figure 18. *Projected CO_2e Electricity Emissions with Increasing Renewable Energy (2005-2025)*

Projections

Municipal Operations 2025 Total Emissions Projection

Provided MidAmerican becomes 100% renewable by 2025, municipal operations would be on track to reduce total emissions by 30% from 2005 levels in 2025 (assuming other emissions sources follow 2015 trends). This reduction would exceed the goal of a 28% reduction from 2005 levels, but more effort will be needed to reach the goal of an 80% emissions reduction by 2050. This allows the opportunity to focus efforts in the areas of natural gas usage, fleet and transit vehicles, and landfill gas to energy options (Figure 19).

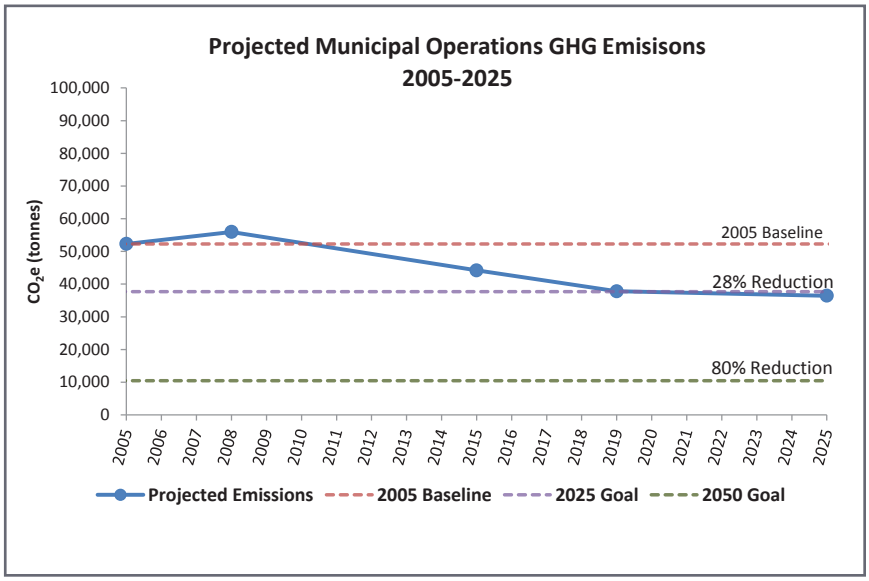


Figure 19. *Projected Municipal* CO_2e *Emissions (2005-2025)*

Projected Municipal Operations Emissions by Source (2019 & 2025)

With MidAmerican Energy's increase to 89% renewable electricity in 2019, electricity GHG emissions will drop from 26.4% to 14.0% of total municipal emissions (assuming other emissions sources follow 2015 trends). CO_2 generated by waste at the Iowa City Landfill will increase from 54.0% to 63.1% of the total. Total municipal emissions will have dropped roughly 28% from 2005 levels (Figure 20).

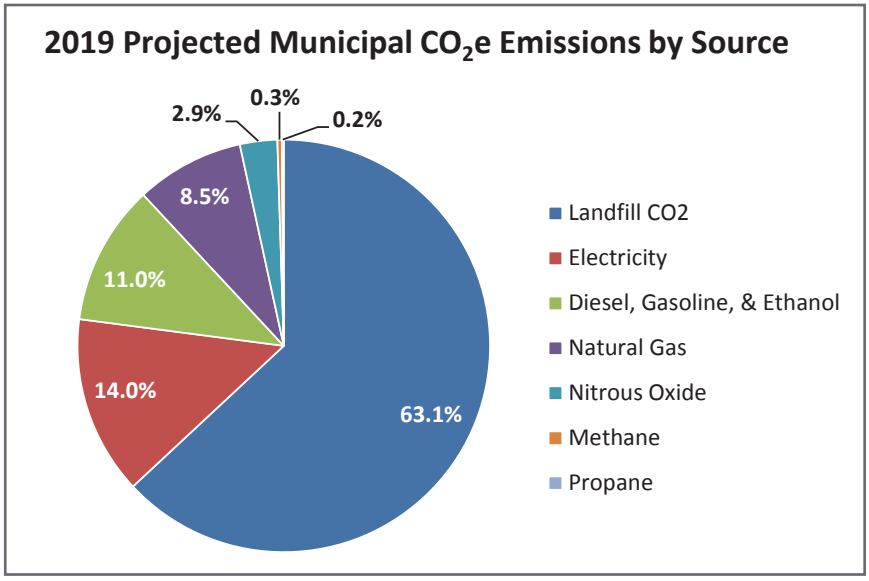


Figure 20. *Projected Municipal Operations* CO_2e *Emissions by Source in 2019*

Projections

If MidAmerican becomes 100% renewable by 2025, electricity emissions will drop to 10.9% of the toal, reducing annual emissions from 2005 levels by roughly 30% (assuming other emission sources follow 2015 trends). Landfill CO_2 will produce nearly two-thirds of all municipal emissions (Figure 21).

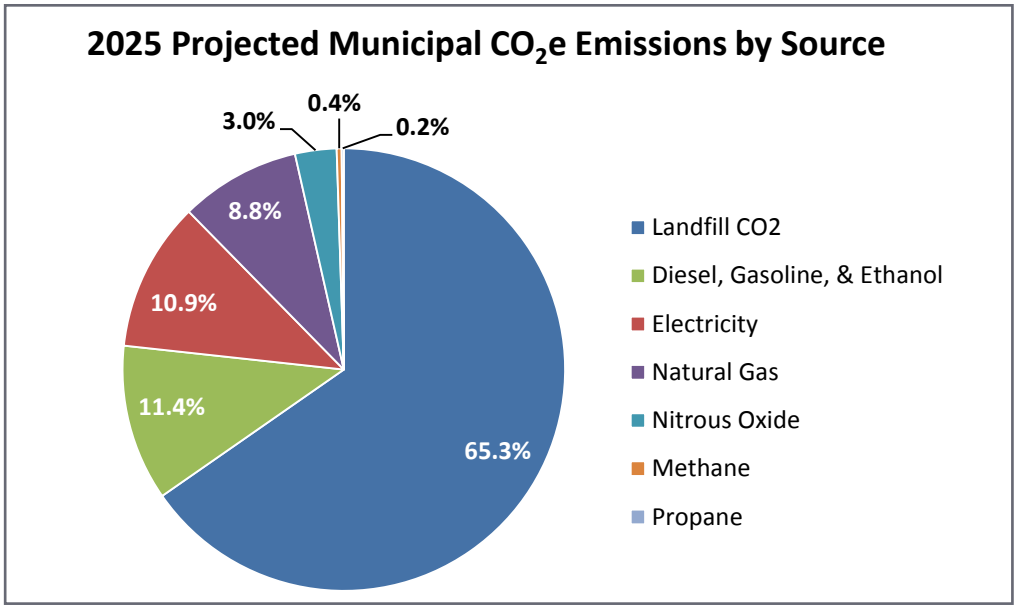


Figure 21. *Projected Municipal Operations* CO_2e *Emissions by Source with 100% Renewable Energy*

Completed, Ongoing and Future Emissions Reduction Projects by Department

Public Works

- *Proposed:* A new Public Works Facility which would establish a central location for City fleet vehicles, would increase route efficiencies, decrease driving time and mileage, and eliminate the storage of vehicles in numerous locations; the new buildings would also be built to higher efficiency standards than the current facilities

Equipment Division

- One hybrid vehicle, three electric trucks
- *Proposed:* Modern technology vehicle telematics system implementation to track idle times, usage, route optimization

Landfill Division

- Capturing and flaring methane generated at the landfill
- Wind feasibility study (in 2002, DNR and HR Green documented not feasible)
- LEED certified building: East Side Recycling Center Education Building (Platinum) with geothermal unit, no natural gas usage, only electricity (which is largely renewable)
- Solar and wind pilot installations at East Side Recycling Center
- EPA "Food too Good to Waste" Pilot
- Recently approved recycling initiatives: mandatory multi-family recycling, cardboard ban, electronic waste ban, curbside food waste collection and single stream recycling

Wastewater Division

- Biogas used to replace a portion of natural gas in digesters
- Wind feasibility study (in 2002, DNR and HR Green documented not feasible)
- High efficiency aeration blowers installed
- Efficient lighting replacements
- Two electric golf carts (uses three electric trucks, listed under Equipment)
- *Proposed:* Explore cost benefit of heat recovery from boiler exhaust stack

Water Division

- Replacement of eight variable frequency drives with more efficient up-to-date technology at four ground storage reservoirs and four collector wells
- Right-sized motor and pump and variable frequency drives in Collector Well #1
- Right-sized motor and pump in Silurian Well #2
- Lighting replacements to LED (ongoing)
- Creation of wellhead protection areas and establishing 370 acres of prairie and timber to protect water resources and reduce mowing
- Construct bike path to improve pedestrian and bicycle access to Water Plant
- Wind feasibility study (in 2002, DNR and HR Green documented not feasible)
- *Proposed:* Future distribution growth study which may allow reduce pumping costs

Streets Division

- Traffic signals converted to LED
- Ongoing LED replacement of City-owned streetlights
- Contract to replace MidAmerican-owned streetlights over 10-year period
- *Proposed:* Improved traffic signal coordination, actuated traffic signals (installing vehicle detection)

Transportation Services

- LED lighting in all six City parking ramps
- ZipCar car share program
- Bongo-Bus on the Go bus location system
- Bike Share program (in progress)
- Electric vehicle (EV) charging station installations (in progress)
- Two EV charging stations in Harrison Street Ramp
- *Proposed:* Route optimization study for transit buses
- *Proposed:* Exploration of CNG or hybrid/electric buses (may be cost prohibitive)
- *Proposed:* Explore solutions to Iowa Avenue railroad bridge height challenge. It is too low for energy efficient buses and most routes access UI Hospitals

Parks and Recreation

- Efficient lighting replacements at Mercer Aquatic and Robert A. Lee Recreation Centers
- VFD motors with higher efficiencies installed at Mercer Aquatic pool

Reducing Emissions

- Big Belly solar trash compactors installed in Downtown Iowa City
- Contract to design Building Automation System (BAS) for three facilities to detect program efficiencies
- Energy audit for Terry Trueblood Recreation Area Park Lodge
- Installation of energy efficient boiler and HVAC systems at Mercer Aquatic Center
- Replacement of propane tank at H_2O building at Terry Trueblood Recreation Area with natural gas line for improved efficiency
- Installed digital regulating values for Robert A. Lee Recreation Center and Mercer Aquatic Center pools for more efficient temperature regulation
- Replaced Robert A. Lee Recreation Center boilers with high efficiency boilers
- Small installation of solar used to circulate pond water at Thornberry Dog Park

Fire

- LEED certified buildings Fire Station #2 (Gold) and Fire Station #4 (Gold) which use geothermal heat sources for heating and cooling

Police

- Geothermal heat sources for heating and cooling at the Iowa City Animal Care and Adoption Center

Library

- New bookmobile was designed with solar panel to help charge the batteries and cut down on generator use at stops
- HID lighting replacement with LED lights
- New recycling contract with alley waste pickup service eliminates driving to deliver recycling to remote sites

Senior Center

- High efficiency boiler replacement
- Roof replacement to white reflective roof
- Digital control of mechanical systems
- *Proposed:* Window treatment project to increase energy efficiency

Neighborhood and Development Services Building Inspection

- Energy code inspections
- Tracking city-wide building stock (energy use per square footage)

Metropolitan Planning Organization

- Long Range Transportation Plan
- Bike Master Plan

Housing Authority

- Blower door energy audits and utility and water efficiency installments on 91 public housing units

Sustainability Services

- Revolving loan fund from energy cost saving to continue energy retrofits
- Administer City's energy and climate grant programs
- Completion of municipal GHG inventories
- Tracking of energy usage in municipal operations
- *Proposed:* Formalized plan for municipal operations reductions

Airport

- Converted exterior halogen/mercury based lights to LED lighting.
- Installed LED lighting in New Parallel Taxiway
- LED lighting added to South Apron Taxiway
- Ongoing replacement of incandescent lights in T-hangar buildings with LED lighting
- *Proposed:* Convert HID style lighting in hangar buildings to LED lighting

Reducing Emissions

Emissions Reduction Background Information

- As MidAmerican works towards 100% renewable energy generation, the majority of electricity consumed by municipal operations will be carbon-free. Electricity GHG emissions will come almost entirely from electricity purchased from EILP, which services the wastewater treatment plant, the animal shelter, and a few smaller facilities in the southern portion of Iowa City.
- Regulations in Iowa prevent net metering, preventing solar panel installations from selling excess energy production back to the grid. Additionally, solar only operates during daylight hours when the sun is shining, and might only produce 25-30% of a building's energy needs.
- MidAmerican will be increasing costs for customers with solar installations in order to account for infrastructure needs when solar is not producing electricity.

Emissions reduction plans will need to focus on other areas in order to see any long-term emissions reductions.

Potential Municipal Emission Reduction Projects

1. Set municipal GHG emission reduction goals, identify measures to undertake to reach those goals, and monitor progress on a regular basis.
2. The Iowa City Landfill, with the largest share of municipal GHG emissions, is a critical aspect to reducing emissions. Potential options to reduce landfill CO_2 include:
   - Landfill gas to energy project
     - Convert captured landfill methane to energy. Two opportunities to convert landfill gas to energy have been considered in recent years, a collaboration with the University of Iowa and with the company Fiberight. Neither option turned out to be feasible. Other options may be complicated and expensive, and landfill gas contains siloxanes which must be removed to be useable
   - Increased organic material waste diversion
     - Organic material, such as food waste, cardboard, and paper, generate the majority of a landfill's GHGs
   - Expand recycling availability and capability
     - Reduces waste placed in the landfill, reducing emissions. Enables re-use of materials, reducing their overall carbon footprint
   - Expand reuse and repair options in the community
     - Reduces short lifespans of items that would otherwise end up in the landfill
3. Increase efficiency in the treatment of wastewater and drinking water.
   - Maximize the use of biogas in the wastewater digester for offsetting natural gas or electricity use. It should be noted that due to industry in town, the large amount of siloxanes in biogas make it harder to make wastewater gas useable, and may not be cost effective
4. Invest in and require a more efficient vehicle and transit fleet. Potential options to reduce vehicle and transit emissions include:
   - Reduce mileage
     - Fewer miles driven reduce GHG emissions. Efficient driving techniques, reducing idling time, and optimizing routes to destinations can reduce GHG emissions
   - Transition to high efficiency, hybrid, and electric vehicles
     - As old vehicles go out of service, replace with high mile per gallon vehicles. If feasible, replace with electric vehicles Electric vehicles will emit very few GHG emissions as Iowa City's electricity becomes increasingly carbon-free. Grant funding from the State may be available
     - Explore feasible options to increase efficiencies in diesel operated vehicles or options to convert to CNG (compressed natural gas) or RNG (renewable natural gas)
5. Reducing natural gas use, currently the fourth largest source of municipal emissions provides another potential avenue to reduce GHG emissions. Increased building heating efficiency would reduce energy usage, as would replacing current natural gas systems with alternatives, such as electric furnaces or geothermal.

Next Steps

1. A realistic target reduction percentage should be identified and a target year chosen in which the reduction target should be achieved. Target reductions for community and city government do not have to be the same. Local governments have control over all of their operations which create emissions, and local governments can choose to have a higher target reduction percentage. Local governments therefore may be able to initiate, publicize, and lead the community by example in these endeavors. ICLEI, the State and Federal government all recommend 80% emissions reductions by the year 2050. Small incremental reductions over a shorter time period are necessary to reach this goal.

2. Work with staff, consultant, the Climate Action and Adaptation Steering Committee, and the public in parallel with community-wide mitigation plan to identify municipal reduction strategies.

3. Review possible opportunities to undertake at a municipal level:
   - Explore landfill gas to energy project
   - Explore wastewater gas potential
   - Consider additional waste and recycling initiatives
   - Review renewable fleet and transit options
   - Benchmark City facility energy use annually and set targets to reduce energy intensity in local government building stock
   - Increase sub-metering to facilities that will collect better information on energy and water use
   - Consider energy and water consumption in new or retrofitted investments
   - Evaluate feasibility of web-based interface that provides the local government energy data to the public
   - Consider fleet idle policy, use location devices, and driving practices to reduce usage
   - Adopt alternative fuel guidelines or targets
   - Reduce water usage within City facilities
   - Insure all City facilities have recycling and composting opportunities
   - Look into possible building code policies for new buildings
   - Consider energy efficiency policies for community buildings and residences, i.e. when sold
   - Energy efficiency policies for employee behaviors
   - Waste policies (consider a zero waste plan)
   - Update antiquated BAS, HVAC and boiler equipment in City facilities with efficient systems that meet the current Energy Code
   - Update all lighting to LEDs
   - All new purchased equipment should be Energy Star rated or energy efficient
   - Increase tree canopy, particularly for heat island implications
   - Continue to increase building efficiencies (for energy and cost savings)
   - Explore district energy using heat from wastewater pipes in the Riverfront Crossings or other districts
   - Explore other additional options not listed here

   After considering possible municipal opportunities, staff can prioritize implementing strategies that are reasonable and financially feasible. It will also be necessary to accurately calculate GHG reduction scenarios for any proposed projects or action in order to meet future targets.

4. Incorporate recommendations into a community-wide action plan, and include specific projects the City and community plan to undertake to reduce GHG emissions. The creation of an action plan specific to municipal operations may also be useful.

5. Commit to updating the municipal GHG inventory at least every five years or less to monitor results.

Conclusion

Several decades of climate research has concluded that human activities are changing our climate. The impact of climate change within Iowa was summarized by the Iowa Climate Change Advisory Council (Iowa Greenhouse Gas Inventory & Reference Case Projections 1990-2025, October 2008). Effects of climate change in Iowa include increased frequency of extreme storms, floods, higher rates of soil erosion, and damage to the economy, ecosystems, and human health. These effects have been linked to the rise of GHG emissions due to human activities. The reduction of GHG emissions is a serious and pressing matter since the U.S. is one of the largest emitters per capita in the world, averaging about 20 metric tonnes of GHG per capita per year. Annual world-wide average emissions are 4 metric tonnes per capita and the estimated sustainable annual limit is 2 metric tonnes per person.

In 2015, the City of Iowa City government operations activities totaled 44,194 metric tonnes CO_2e, or 4.5% of the community total of 987,735 metric tonnes CO_2e. These amounts were calculated using the Local Government Operations Protocol.

Using the estimated baseline of 2005, analysis was done for government operations for the most recent year that data was available (2015). Municipal emissions dropped 15.5% over the past ten years. MidAmerican Energy's transition to wind energy production is significant in driving the reduction in emissions for Iowa City. Based on MidAmerican projections for renewable energy production, Iowa City municipal operations are on track to narrowly meet the goal of 26-28% emissions reduction by 2025. Reducing emissions 80% by 2050, however, will require measures beyond reducing emissions from electricity use. Further steps can be taken to move forward on the process to reduce these emissions, which can have positive effects on the local and global environment and economy.

In addition to this inventory, a consumption-based inventory for the Iowa City community will be completed by the fall of 2017. The consumption-based inventory will include additional emissions due to food and materials consumed in the community. Iowa City was awarded grant funding from the Urban Sustainability Directors Network (USDN) for a pilot project to complete this work, which will give additional insight into how community behavior can impact global emissions through consumption. Consumption-based inventories are becoming more mainstream as cities want a better understanding of economic consumption and emissions which are created from consumable items and materials.

With direct control over less than 5% of the community's GHG emissions, cooperative partnerships will be needed to make a significant impact on emissions. Cooperation with the University of Iowa, residents, local industries, businesses, and local government will be necessary to make community-wide GHG reductions. Reducing emissions from waste, vehicles, and wastewater would provide the greatest effect. The City Council has appointed a Climate Action and Adaptation Steering Committee to work towards identifying and prioritizing specific actions for community-wide reductions. The Steering Committee, assisted by a consultant hired by the City, will be soliciting input from the public to develop an action plan to achieve the community-wide goals, whereas City staff will be involved in creating a plan to reach goals for City operations.

In closing, this quote is a reminder of the importance of this work in our community to ensure quality of life for future Iowa City residents:

"Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions."

— Intergovernmental Panel on Climate Change, Fifth Assessment Report, 2013

Appendix 1

Municipal Facilities Energy Use, Emissions, and Cost by Site

2015 Municipal Facilities Natural Gas and Electricity Use and Emissions							
	Natural Gas		Electricity		Metric		
	Use	Tonnes	Use	Tonnes	Tonnes	Emissions	
Sector	(therms)	CO_2	(kWh)	CO_2	Total CO_2	% of Total CO_2	Total Cost
Wastewater Treatment	228,199	1,214	8,877,886	4,170	5,384	36.2%	$ 598,019
Water Treatment	19,397	103	5,536,062	2,419	2,523	17.0%	$ 342,455
Streetlights	-	-	2,723,917	1,190	1,190	8.0%	$ 368,655
Mercer	115,597	615	1,069,920	468	1,083	7.3%	$ 111,459
Library	33,957	181	1,538,400	672	853	5.7%	$ 118,366
Parking Ramps	26,125	139	1,550,914	678	817	5.5%	$ 120,472
City Hall	30,341	161	1,169,040	511	672	4.5%	$ 90,298
Rec Center	45,872	244	481,920	211	455	3.1%	$ 56,679
Parks	9,686	52	551,695	243	294	2.0%	$ 64,162
Senior Center	18,580	99	381,120	167	265	1.8%	$ 38,876
City Transit	20,055	107	225,997	99	205	1.4%	$ 51,386
Fire Stations	5,780	31	327,833	143	174	1.2%	$ 27,014
Streets	19,350	103	95,885	42	145	1.0%	$ 20,535
Equipment	11,281	60	197,023	86	146	1.0%	$ 6,649
Other Sites	4,736	25	229,236	100	125	0.8%	$ 21,549
Airport	5,285	28	219,361	96	124	0.8%	$ 21,469
Traffic Signals	-	-	283,228	124	124	0.8%	$ 36,354
Refuse	8,754	47	156,460	68	115	0.8%	$ 5,098
Landfill	-	-	225,430	99	99	0.7%	$ 16,536
Animal Shelter	-	-	66,662	32	32	0.2%	$ 7,434
East Side Recycling Center	-	-	63,295	28	28	0.2%	$ 5,377
Cemetery	1,014	5	18,488	8	13	0.1%	$ 2,984
Weather Siren	-	-	9,798	4	4	0.0%	$ 2,837
Totals:	**604,009**	**3,213**	25,999,570	**11,656**	**14,869**	100.0%	$ 2,134,660

*Data is for facilities only

**Electricity CO_2 emissions calculated using 2015 MidAmerican & EILP emission factors

***Does not include fuel use for backup generators

Appendix 2

2015 Emissions Factors

Units	Emission Factor				Description	Source
	CO_2	CH_4	N_2O	Total CO_2e		
kg / kWh	*0.4822*	*0.003*	*0.0029*		*Average emission factor for national electricity grid*	*National emissions factor database*
lb / kWh	9.58E-01	1.78E-02	2.63E-02	9.65E-01	MidAmerican	MidAmerican
lb / kWh	1.04E+00	1.78E-02	2.63E-02	1.04E+00	EILP	MidAmerican
g / VMT	4.32E+02	2.78E-02	2.94E-02	4.40E+02	19.64 lbs CO2/gal &20.386mi/gal	eia.gov
kg / Person	0.00E+00	4.45E-02	2.55E-02	8.00E+00	Iowa City South WWTP	Iowa City South WWTP
kg / scf/yr	0.00E+00	2.37E-06	0.00E+00	6.62E-05	Landfill	Landfill
lb / hr	3.49E+01	0.00E+00	0.00E+00	3.49E+01	34.85 lbs/h for small gas engines (lawnmowers &lawncare)	eia.gov
kg / hr	6.09E+01	0.00E+00	0.00E+00	6.09E+01	2.68kg/L for large diesel engines	eia.gov
kg / L	2.68E+00	0.00E+00	0.00E+00	2.68E+00	2.68kg/L for large diesel engines	eia.gov

Appendix 3

Global Warming Potentials

Common Name	Chemical Formula	Global Warming Potential (100-yr) [1]
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_20	265
Sulfur hexaflouride [2]	SF_6	23,500
Hydrofluorocarbons [2]	Various	Varies
Perfluorocarbons [2]	Various	Varies

[1] Values take from Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 2013 (AR5)
[2] Not taken into account in this inventory

Appendix 4

Definitions

ADT	Average Daily Traffic count: the total volume of traffic past a single point over a 24-hour period.
BAU	Business as usual scenario: assumes no strategies are employed to reduce GHGs.
Biogas	The gas produced from decomposition of landfill waste or sewage consisting of methane, carbon dioxide, nitrogen and other trace gases such as hydrogen sulfide, ammonia and hydrogen.
CACP2009	2009 Clean Air and Climate Protection software supplied by ICLEI, used by Iowa City to calculate past years municipal GHG emissions inventories. Municipal categories are grouped according to this software, which most U.S. cities used for consistency in reporting.
CH_4	Methane: A hydrocarbon that is a greenhouse gas with a global warming potential 28 times that of carbon dioxide (CO_2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, the treatment of wastewater, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.
CO_2	Carbon Dioxide: A naturally occurring gas, and also a by-product of burning fossil fuels, methane, and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic GHG.
CO_2e	Carbon Dioxide Equivalent: A measure of the global warming potential of greenhouse gases emitted including CH_4, N_2O and other gasses in relation to CO_2.
Consumption-Based inventory	A consumption-based inventory refers to an emissions inventory that in addition to traditional emissions created within the city limits, evaluates emissions associated with all consumption, regardless of where it is produced. Many local governments are pursuing this type of inventory to better understand how food and other materials purchased and consumed by the community or municipality have an impact on the environment and economy.
GHG	Greenhouse gas: Absorbs and emits thermal radiation in the atmosphere and cause the greenhouse effect. Examples include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), and many others. Only CO_2, CH_4, and N_2O were considered in this report.
GPC	Global Protocol for Community-scale Greenhouse Gas Emissions Inventories: The first global standard to measure GHG emissions from cities created as a joint project by ICLEI-Local Governments for Sustainability, the World Resources Institute (WRI) and C40 Cities Climate Leadership Group, with additional collaboration by the World Band, UNEP, and UN-Habitat.
GWP	Global Warming Potential: The GWP-weighted emissions of direct GHGs in the inventory are presented in terms of equivalent emissions of carbon dioxide (CO_2). GWP factors represent the ratio of the heat-trapping ability of each GHG relative to that of carbon dioxide over a 100-year period.

Appendix 4

HFCs	Hydroflorocarbons: Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 to 11,700 times that of carbon dioxide by weight.
IPCC	The Intergovernmental Panel on Climate Change: The leading body for the assessment of climate change, established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. (www.ipcc.ch/)
ICLEI	Local Governments for Sustainability: An international non-profit organization providing software and assistance for communities to calculate their emissions. ICLEI was formerly known as International Council for Local Environmental Initiatives. (www.icleiusa.org/)
KWh	Kilowatt hour, a unit of electricity use.
LED Lights	Light-emitting diode lights: A high efficiency lighting technology that reduces lighting energy consumption by as much as 80% compared to traditional incandescent lighting. The City of Iowa City has employed this technology in a retrofit of the City's traffic lights, street lights, and facility lighting, to reduce consumption of fossil fuel derived energy.
LGOP	Local Government Operations Protocol: Guidelines designed to provide a standardized set of procedures for local governments to quantify and report GHG emissions associated with their government operations. Developed by the California Air Resources Board, the California Climate Action Registry, ICLEI, and the Climate Registry. Used by the City of Iowa City to report municipal emissions.
MMTBTU	One million British Thermal Units, or 10 therms. A unit of energy measurement.
Metric Tonne	One thousand kilograms, or approximately 2,205 U.S. lbs.
Natural Gas	Gases consisting of 50 to 90 percent methane (CH_4) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C_3H_8) and butane (C_4H_{10}). Most prevalent fuel used for home and water heating in Iowa City. Some natural gas in the U.S. is recovered from underground using the process of "fracking."
N_2O	Nitrous Oxide: A powerful GHG with a 100-year global warming potential of 265 times that of carbon dioxide (CO_2). Sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, wastewater treatment, fossil fuel combustion, nitric acid production, and biomass burning.

Appendix 4

PFCs	Perfluorocarbons: A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 5,700 to 11,900 times that of carbon dioxide.
Scope 1	Emissions being released within the city limits resulting from combustion of fossil fuels and from waste decomposition in the landfill and wastewater treatment plant.
Scope 2	Emissions produced outside city limits but are induced by consumption of electrical energy within the city limits.
Scope 3	Emissions of potential policy relevance to local government operations that can be measured and reported but do not qualify as Scope 1 or 2. This includes, but is not limited to, outsourced operations, employee commutes, and emissions from purchased goods.
SF_6	Sulfur hexafluoride: A very powerful GHG used primarily in electrical transmission and distribution systems and as a dielectric in electronics. The 100-year global warming potential is roughly 23,500 times that of carbon.
Therm	A unit of measure for energy that is equivalent to 100,000 British Thermal units, or roughly the energy in 100 cubic feet of natural gas. Often used for measuring natural gas usage for billing purposes.
VMT	Vehicle Miles Traveled: A unit used to measure vehicle travel made by private vehicles, including passenger vehicles, truck, vans and motorcycles. Each mile traveled is counted as one vehicle mile regardless of the number of persons in the vehicle.

Appendix 5

Summary of Iowa City's STAR Rating