



greenhouse gas emissions

INVENTORY REPORT



CITY OF FAIRFIELD, IOWA
JULY 2010

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Executive Summary

Fairfield’s Mayor, Ed Malloy, signed the U.S. Mayors Climate Protection Agreement in October 2009, committing Fairfield to targeted reductions of Green House Gas Emissions which contribute to climate change. After signing this agreement, Fairfield City Council voted to join the International Council for Local Environmental Initiatives (ICLEI)-Local Governments for Sustainability, funded by the Iowa Power Fund Grant. Through ICLEI, Fairfield received the Clean Air and Climate Protection (CACP) software to facilitate a baseline inventory of the City’s greenhouse gas emissions. This software is an internationally recognized standard used by cities across the US.

The Green House Gas (GHG) inventory deeply examined the emission outputs of the residential, commercial and industrial sectors within Fairfield’s City limits; as well as a separate examination of Fairfield’s municipal operations. We also examined Fairfield’s transportation data provided by the DOT and French-Reneker-Associates, Inc to account for fossil fuel usage and emissions. The completion of this inventory marks the first step in ICLEI’s “Cities for Climate Protection Campaign”, which involves the following milestones:

- Milestone 1. Conduct a baseline emissions inventory and forecast
- Milestone 2. Adopt an emissions reductions target for the forecast year

- Milestone 3. Develop a local climate action plan
- Milestone 4. Implement policies and measures
- Milestone 5. Monitor and verify results

Following an examination of the baseline results for 2008, the City of Fairfield will adopt specific reduction targets as an amendment to the City of Fairfield Go Green Strategic Plan. Management of those reductions will involve collaborative work with the Sustainability Coordinator, Department Heads, the City Administrator, and the City's Green Commission. General GHG reductions in residential, commercial and industrial sectors are currently outlined in the Go-Green Plan, which will be amended to accommodate more specific reduction targets and strategies based on this baseline data.

Multiple greenhouse gasses were tabulated (**CO₂, CH₄, N₂O, HFCs, PFCs, SF₆**), and then converted to a total greenhouse gas equivalent (CO₂e in metric tonnes) for ease of comparison. One metric tonne equals one thousand kilograms, or approximately 2,205 lbs. Data gathered from these six gasses within specific sectors of the city allow for accurate reporting on resource consumption, and its direct impact on the environment. **The baseline greenhouse gas inventory for Fairfield shows that the total greenhouse gas emission equivalent (CO₂e) for the community in 2008 was 144,971 metric tonnes. Based on census data for the City, the CO₂e emission tonnes *per capita* is 15.73.** Although this less than the average per capita for the US (19.6), world average carbon emissions are 4 metric tonnes per capita and sustainable limits are estimated to be near 2 metric tonnes per capita (International Energy Agency, Key World Energy Statistics, 2006). ICLEI, the Iowa Climate Change Advisory Council and proposed federal legislation have recommend reducing emissions 80% by 2050. The largest contributors to GHG emissions in Fairfield are energy use through buildings and transportation (consumption of fossil fuels), electricity usage and fossil fuel consumption respectively.

Methods

The methods used to complete Fairfield's Greenhouse Gas inventory were provided by ICLEI, an internationally recognized organization dedicated to improving global environmental conditions through cumulative local action. ICLEI's protocol was developed in partnership with the California Air Resources Board (ARB), California Climate Action Registry (CCAR), in collaboration with The Climate Registry, and is also consistence with the Kyoto Protocol. ICLEI's Clean Air and Climate Protection Software (CACP 2009) was used to generate the Greenhouse Gas Inventory for the City of Fairfield.

The greenhouse gases accounted for in Fairfield's inventory are the six Kyoto Protocol regulated, internationally-recognized greenhouse gases:

- Carbon Dioxide (CO₂): A naturally occurring gas in the atmosphere, posing a threat at unnatural high levels. The largest source of CO₂ emissions is combustion of fossil fuels, such as coal, oil and gas in power plants, automobiles, industrial facilities and deforestation sequestration.

- Methane (CH₄): Methane gas emissions sources are 60% due to human activities. In the United States, the largest methane emissions come from waste in landfills and domestic livestock as well as natural gas, oil and coal. Over a period of 100 years, methane has 21 times the warming effect on global warming compared to CO₂.
- Nitrous Oxide (N₂O): Nitrous oxide's main emission source is both agriculture and the combustion of fossil fuels. Nitrous oxide is especially prevalent in fertilizers. Over a period of 100 years, N₂O has a 310 times stronger effect on global warming compared to CO₂.
- Hydroflourocarbons (HFCs), Perflourcarbons (PFCs) and Sulfur Hexaflouride (SF₆): These powerful greenhouse gases and are emitted mainly from a variety of industrial processes, and refrigerants. Over a period of 100 years, these gases are up to 23,900 times more dangerous than CO₂. These gases are typically emitted in smaller quantities, but because they are so potent, they are referred to as "High Global Warming Potential" gases.

The above gases are tracked separately, allowing for transparency in reporting, and providing concrete data on the emission source and environmental impact of each individual gas. Each gas is measured in standard greenhouse gas units of metric tons (tonnes); one metric tonne is equal to 2,205 pounds.

For final reporting, the five non-CO₂ gases are converted to units of CO₂ equivalent (CO₂e) using global warming potential (GWP) units as developed by the Intergovernmental Panel on Climate Change (IPCC). CO₂e represents the heat-trapping ability of each GHG relative to that of CO₂.

ICLEI's protocol also requires reporting emissions by "scope" which separately accounts for direct and indirect emissions, and improves GHG reporting transparency:

- Scope 1: Includes all direct GHG emissions (with the exception of direct CO₂ emissions from biogenic sources), including emissions from all combustion fossil fuels, and methane produced both from landfills and wastewater treatment.
- Scope 2: Includes indirect GHG emissions associated with the consumption of purchased or acquired electricity, which may be produced outside the municipal limits.
- Scope 3: All other indirect emissions not covered in Scope 2, such as transport-related activities in vehicles not owned or controlled by the city (employee commuting and business travel), any outsourced activities, waste disposal, etc.

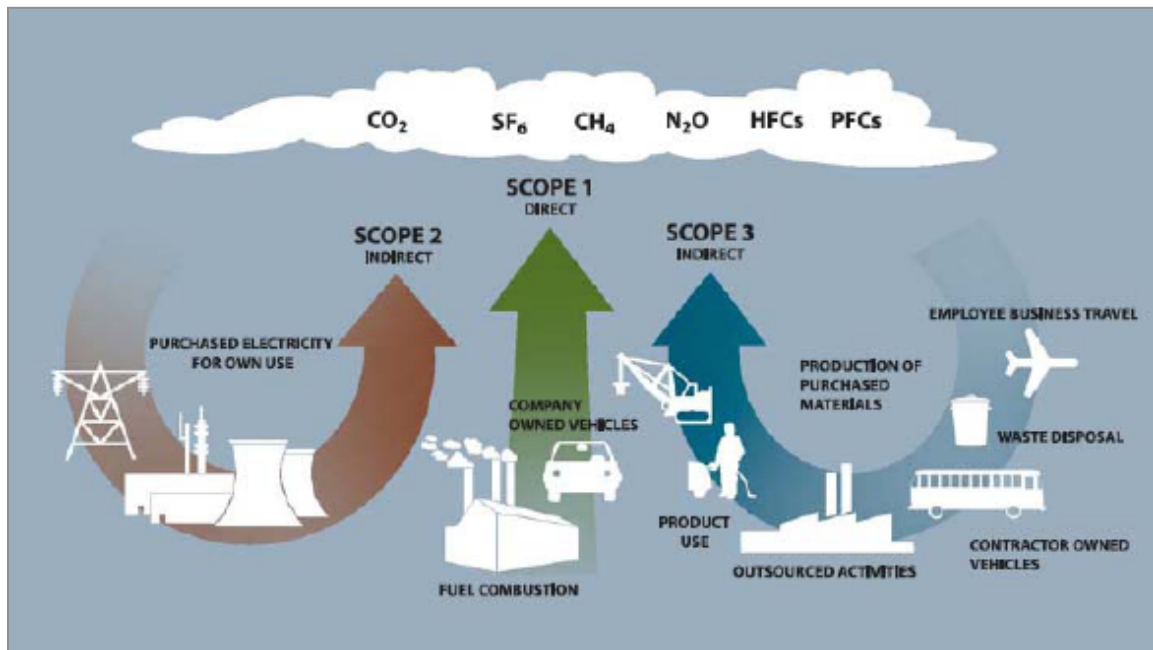


Figure 1. ICLEI's protocol for reporting emissions is based on three direct and indirect scopes. Source: WRI/WBCSD GHG Protocol Corporate Standard, Chapter 4 (2004).

The three scopes provide a comprehensive accounting framework for managing and reducing direct and indirect emissions, and help prevent double-counting emission source information.

Data for Fairfield's inventory is collected in two separate streams: the entire Fairfield Community, which includes local government operations, residential, commercial, and industrial sectors, and also a separate stream for the City of Fairfield's municipal operations. The two streams allow the local government to assess the big picture of the city, and also provide concrete information on areas where the local government has direct financial control.

According to the ICLEI protocol, emissions inventory should include all GHG emissions for a selected calendar year. Reporting on the calendar year is considered standard internationally according to UNFCCC, the Kyoto Protocol, EU ETS, The Climate Registry, and the California Climate Action Registry. The year 2008 was chosen for Fairfield's baseline because accurate records were readily available in the needed data sources. Additionally, the year 2008 predates the initiation of the Go Green Strategic Plan for the City of Fairfield, and any efficiency upgrades that have been made to government buildings and traffic lights, which may have a significant impact on the GHG emissions in the future.

Community Analysis

The community analysis covers GHG emission totals from all activities within the city limits of Fairfield. This includes the following emission sources:

- Residential Energy Consumption

- Commercial Energy Consumption
- Industrial Energy Consumption
- Transportation
- Waste

Data on energy consumption (both Kilowatt Hours and Therms) for residential, commercial, and industrial sectors was obtained from Alliant Energy, Fairfield's primary utility provider within the city limits.

Transportation data for Jefferson County was provided by the Iowa Department of Transportation and French-Reneker-Associates, Inc. Fairfield's population of 9,215 is 59.6% of Jefferson County's total population of 15,463. The total vehicle miles traveled (VMT) for Jefferson County was determined to be 130,709,000. By taking 59.6% of this number, Fairfield's VMT was calculated to be 77,196,000. The emission data was calculated from this number.

Waste data was calculated to determine the percentage of greenhouse gas emissions from the City of Fairfield attributable to the privately owned landfill. Waste Management provided the data in this report. Because specific data was not available on the percentages of waste type, the default percentage of waste streams was calculated using ICLEI national averages.

Hydroflourocarbons (HFCs), Perflourcarbons (PFCs) and Sulfur Hexaflouride (SF₆) were eliminated from the community sector report, due to the complexity of the sources of these gases, and the lack of available data. Sources of these gasses include refrigerants. Future reports may include these gases as protocol is developed to support the data collection.

Community Results 2008

The total CO₂e emissions produced by the city of Fairfield for the calendar year 2008 was 144,971 metric tonnes. United States Census data was available for the Fairfield population for the year 2009 only, with a total population of 9,215. This makes the CO₂e emission tonnes per capita 15.73. According the Union of Concerned Scientists (UCSUSA), the national average of emissions per capita in 2006 was 19.78 metric tonnes CO₂e. Although Fairfield is below the national average, it's important to note that the United States has one of the highest CO₂e emissions per capita globally.

The main greenhouse gas emission source for the City of Fairfield was Carbon Dioxide (CO₂) at 143,053 metric tonnes, followed by Nitrous Oxide (N₂O) at 58,544 lbs, and Methane (CH₄) at 8,410 lbs. However, N₂O is about 310 times more powerful than carbon dioxide on a per molecule basis, thus has a much higher global warming potential (GWP) than carbon dioxide. CH₄ has a GWP 21 times greater than CO₂.

While transportation accounts for the largest community sector CO₂e contribution at 50,170 metric tonnes (Figure 2), it is important to note that the majority of the combined residential, commercial, and industrial contributions are a result of electricity use; nearly twice that of fossil fuel use (Table 2).

Fairfield’s total energy consumption for 2008 was 1,089,135 MMBTUs (Million British Thermal Units), with 100% of the power supplied by Alliant Energy. 59% of total emissions are from electrical use, emitting 85,993 metric tonnes CO₂e (Fig. 3, Fig. 4). This is followed by gasoline emitting 42,050 tonnes CO₂e, natural gas at 8,286 tonnes CO₂e, and Diesel at 8,120 tonnes CO₂e. Waste to the landfill totaled 522 tonnes CO₂e.

Community Sector Contributors to CO₂e Totals by Percentage

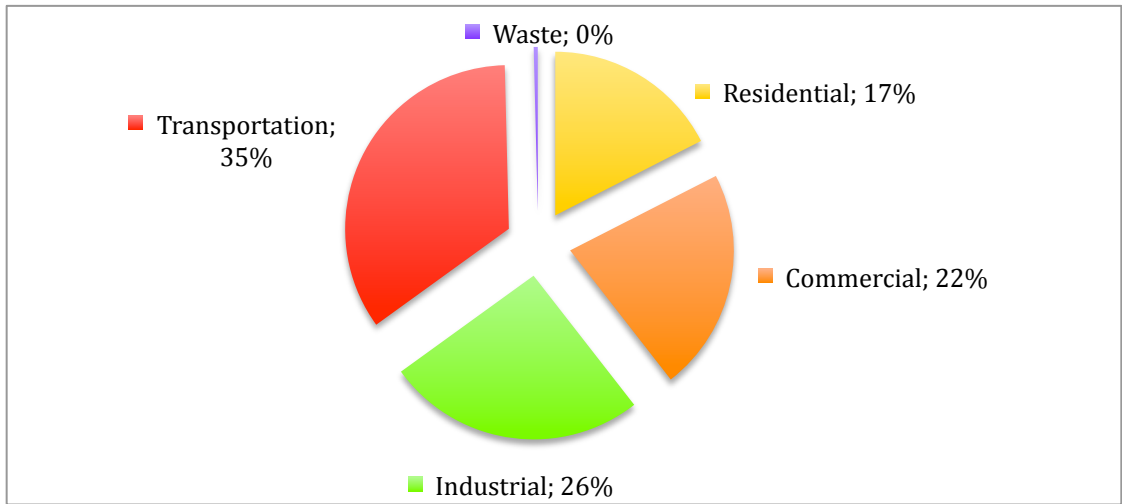


Figure 1. Illustrates each of the various sectors of the Fairfield community and their percentage contribution to 2008 CO₂e totals. Waste percentages are derived from the city of Fairfield’s annual contribution to a privately owned landfill.

Community Sector Contributors to CO₂e Totals in Metric Tonnes

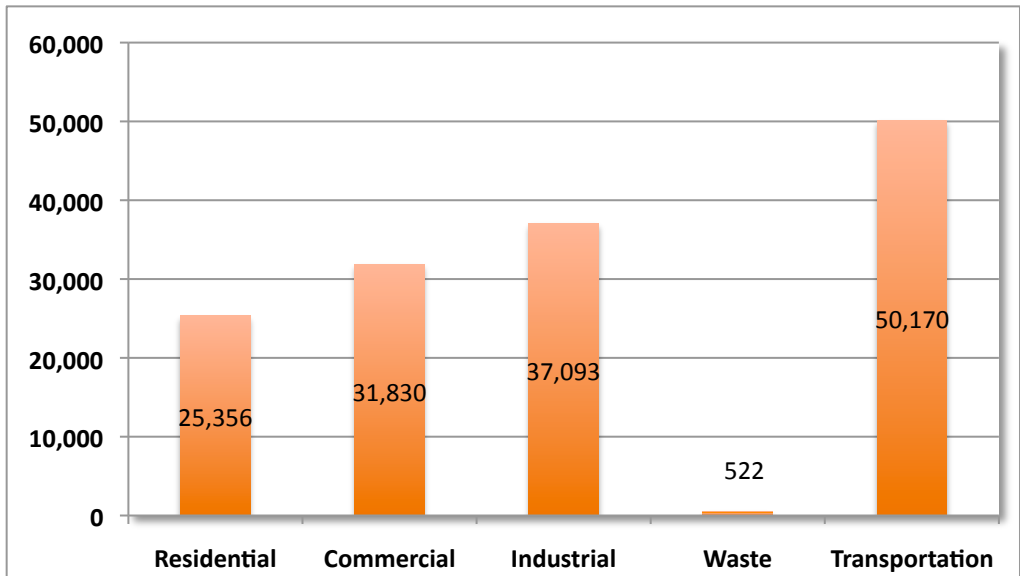


Figure 2. Illustrates the amount of CO₂ equivalent in metric tonnes from each of the community sectors in 2008. The source of these emissions can be found in Table 2 (p14). Waste percentages are derived from the city of Fairfield’s annual contribution to a

privately owned landfill.

Energy Source Contributors to Community CO₂e by Percentage

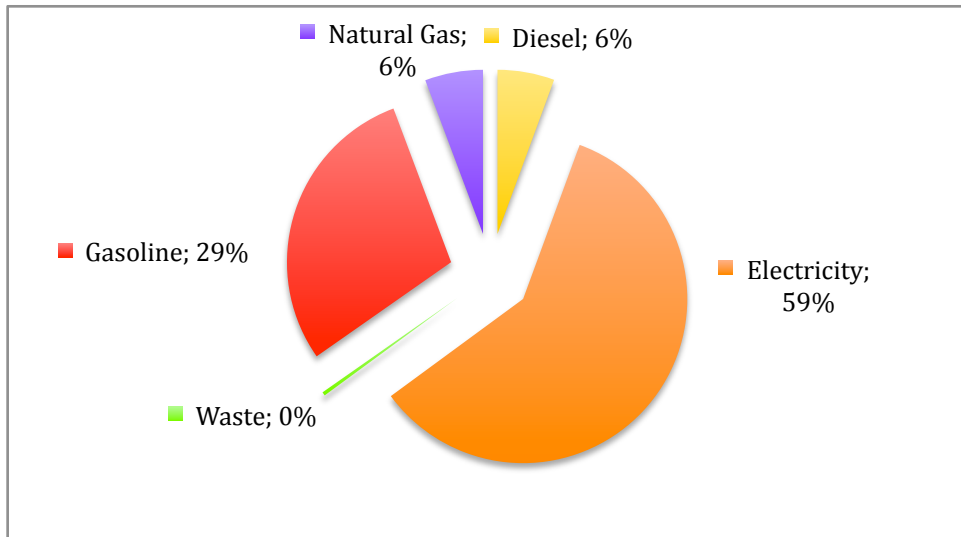


Figure 3. Illustrates the percentage that each fuel type contributes to the Fairfield community's CO₂e emissions total in 2008.

Energy Source Contributors to Community CO₂e in Metric Tonnes

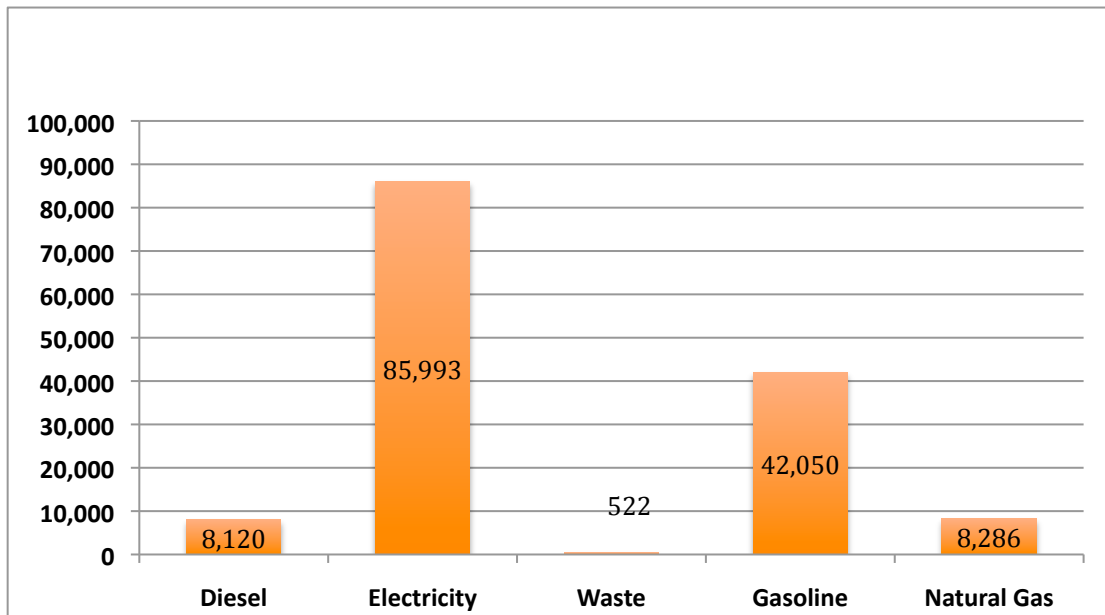


Figure 4. Illustrates the energy sources of CO₂e for the Fairfield Community and their total contribution in metric tonnes.

Fairfield Government Analysis

Data collected from the city government sector included any buildings and operational activities over which the city of Fairfield has financial control. This included the following areas:

- Buildings & Facilities
- Streetlights & Traffic Signals
- Water Delivery Services
- Wastewater Facilities
- Vehicle Fleet
- Fugitive Emissions
- Optional Scope 3 Emissions: Employee Commute

Data was provided and verified by the following departments:

- Fairfield Park & Recreational Department
- Fairfield Law Center/Police Department
- Fairfield Fire Department
- Wastewater Treatment
- Fairfield Waterworks
- Public Library

Alliant Energy provided the data on energy usage including buildings, facilities, streetlights, traffic signals and weather alert sirens. Wastewater treatment systems were analyzed, including emissions from anaerobic digesters and lagoons. The City of Fairfield's contribution to the landfill was assessed in specific waste streams. Each city department was given a survey to complete, which included average daily employee commutes. The entire city vehicles fleet was assessed for mileage and fuel usage. Records were taken of all refrigerants within the city buildings, which potentially can contain Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulfur Hexafluoride (SF₆) - greenhouse gases which are 23,900 times more dangerous than CO₂.

Fairfield Government Results 2008

The total metric tonnes of emissions calculated for the Fairfield Government in the year 2008 were 7,644 CO₂e (Table 3). The largest greenhouse gas emission source was Methane (CH₄) at 405,779 lbs (Table 3, Figure 7). This is largely due to the city's wastewater processing and treatment, which alone totaled 405,590 lbs CH₄. Carbon Dioxide (CO₂) emissions totaled 3,341 metric tonnes, followed by Nitrous Oxide (N₂O) at 208 lbs (Table 3).

The City of Fairfield consumed 20,782 MMBTUs energy in 2008, most of which came from electricity use in buildings and facilities (Tables 3 and 4). Methane was the most prevalent greenhouse gas emitted at a total 56%, mainly from wastewater facilities (Figure 5). Wastewater from the industrial sector may be contributing to higher methane emissions, but accurate data were not available at the time of this study. Records of HFCs

was also collected for fire retardants and refrigerants. The Fairfield Fire Department uses a Type A and B foam which is similar to a detergent, and does not contain harmful greenhouse gases. The refrigerant most commonly found was R-410A, which does not contain PFCs or SF.

Government Operations Contributors to CO₂e Totals by Percentage

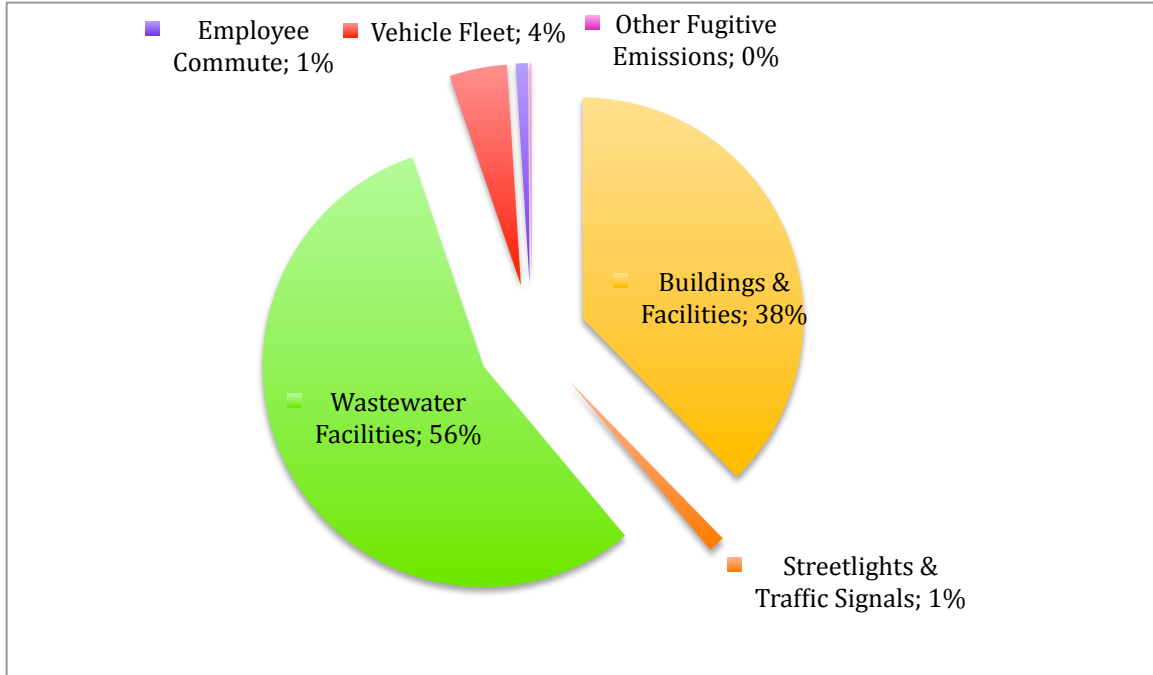


Figure 5. Illustrates the contribution of the local government facilities, buildings, lights, signals, and fleet to CO₂e totals.

Government Operations CO₂e Totals by Metric Tonnes

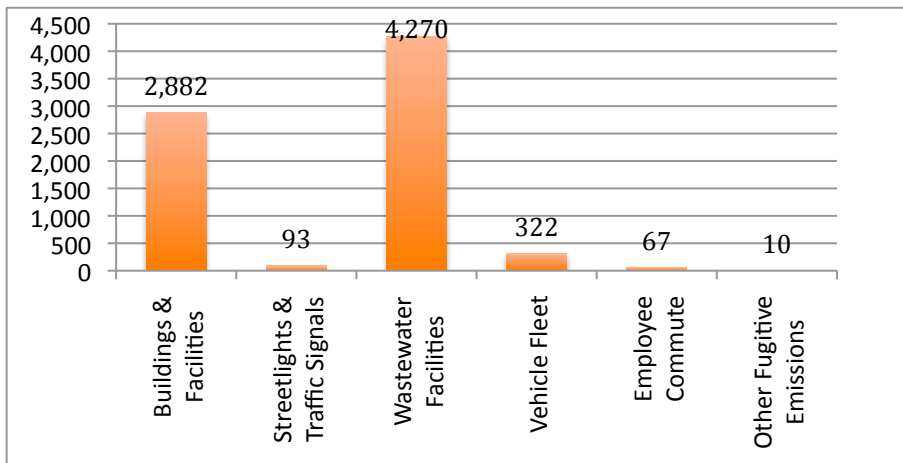


Figure 6. Illustrates the actual contribution of CO₂e metric tonnage of government operations by Fairfield City Government operations.

Government Source Contributors to CO₂e Totals by Percentage

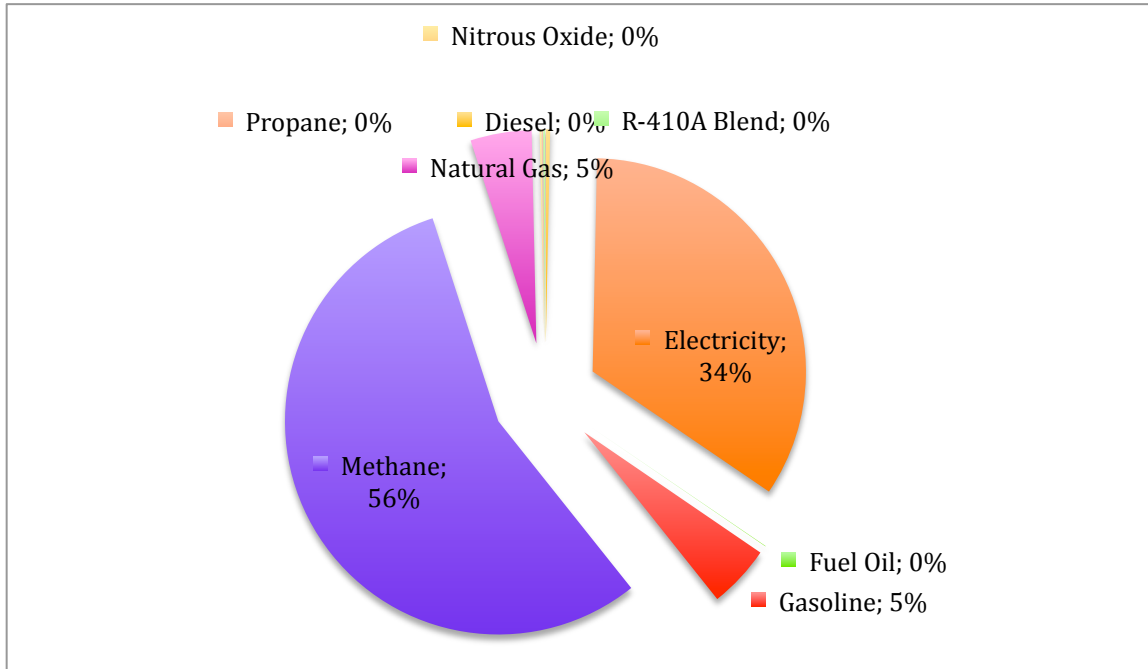


Figure 7. Illustrates the percentage each source of GHG emissions, for the local government operations, contributes to the overall CO₂e tonnage.

Government Operations Contributors to CO₂e Totals by Metric Tonnes

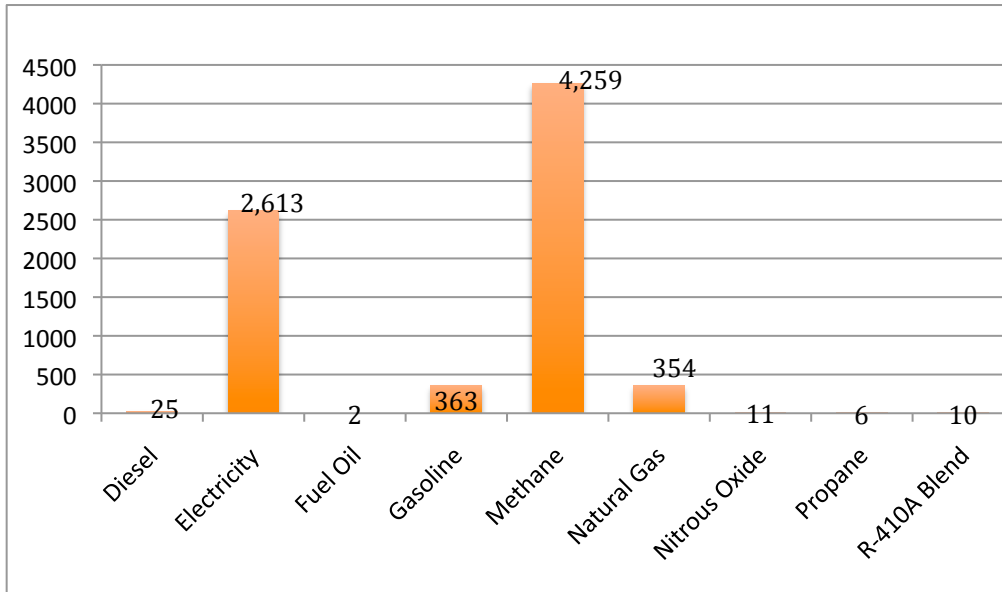


Figure 8. Illustrates the actual metric tonnes of CO₂e produced by source for the Fairfield Government operations in 2008

Conclusion and Recommendations

Fairfield, Iowa, has established a baseline inventory for greenhouse gas emissions within the city limits – and this baseline data should be utilized to target specific areas for emissions reductions. While below national average in terms of our per capita GHG emissions, Fairfield still has a challenge ahead to meet a sustainable level of emissions according to world averages and scientifically-accepted opinions.

The greatest contributor to CO₂e for the community of Fairfield is electricity usage, accounting for 59% of our emissions with 85,993 tons annually released into the atmosphere (Figure 3 and 4). In the government sectors, the Recreation Center, Waterworks and Wastewater Treatment Center were the largest contributors to emissions in the government sectors, with electricity as a major source of CO₂e emissions. This trend holds true for industrial and commercial sectors as well. This would suggest that, in order to have a significant impact on GHG emissions, efficiency and energy management programs should be developed for all areas of the community. Fairfield should continue to implement programs such as the City Building Retrofit Program to reduce consumption, and furthermore work more closely with businesses and residents to encourage similar retrofits of existing structures. Once the retrofit work is completed, Department Heads should work closely with an energy management team to monitor usage and performance of the new technology. Fairfield should also explore methane capture technologies to better utilize methane production from Wastewater facilities and the landfill. In addition, we would recommend a re-calculation of the methane levels at the wastewater treatment plant, as they are high compared to other cities' levels.

Energy audits should be performed on every structure in the Fairfield Community, and financing options for residents and business owners should be developed to support those efficiency measures and encourage clean energy options such as solar and solar hot water. The Green Business Council is currently developing a program for the business community. While current residential programs and initiatives are focused on education and outreach, a more comprehensive program, focused on a research-based behavioral-change model, should be implemented to achieve maximum results.

In addition, while it is important for Fairfield to become more efficient and manage our energy use, addressing the source of our energy would also produce significant reductions in GHG emissions. Development of a clean energy portfolio for the City, including wind, solar and solar hot water would reduce our dependence on coal-based electricity for our energy needs. Focused projects in the industrial and commercial sector, supported by revised City ordinances and enforcement of the States new energy codes, would result in the greatest impact on GHG reduction measures.

Transportation is the second largest community emitter of green house gasses. Gasoline and Diesel combined account for 35% of the total community CO₂e emissions at 50,170 tonnes (Figure 4). A comprehensive and cohesive strategy to reduce gas usage and promote/increase carpooling, bicycling, and use of Fairfield's Trail system needs to be developed for Fairfield in order to achieve a significant reduction in this source of CO₂e emissions. Measures could also be taken to encourage citizen use of electric and hybrid

vehicles, including installation of charging stations and alternative fuel sourcing for city fleets.

Specific to Fairfield City operations, the following recommendations will help to monitor emissions data in the future and reduce unnecessary GHG emissions:

1. Department Heads should keep all records for more than two years, or store old records permanently in a secure location.
2. All sectors should make sure to dispose of refrigerants properly. This includes old air conditioners, refrigerators, and cooling fluids for AC units for both vehicles and the built infrastructure.
3. Departments should keep accurate records of fuel usage for each vehicle in their respective vehicle fleet.
4. For more accurate data, the Wastewater Department should track industrial output: ammonia, bod5, emissions in wastewater
5. Waste Management, Wastewater and Waterworks should develop a clear breakdown for residential, commercial and industrial streams for emission outputs.

It is further recommended that the Green Commission, working with the Sustainability Coordinator and City Administrator, develop specific emissions reductions targets for the upcoming years as part of the Go Green Strategic Plan. Working together as a community, partnered in our efforts to reduce consumption and increase efficiency, we can achieve results that meet our shared goals and common interests.

Tables

Table 1. 2008 Community Greenhouse Gas Emissions by Sector

	CO ₂	N ₂ O	CH ₄	Equiv CO ₂		Energy
	(tons)	(lbs)	(lbs)	(tons)	(%)	(MMBtu)
Residential	25,230	703	1,589	25,356	17.5	163355
Commercial	31,662	986	1,452	31,830	22	159149
Industrial	36,887	1,253	1,134	37,093	25.6	139210
Transportation	49,273	5,468	4,651	50,170	34.6	627420
Waste	0	0	49,718	522	0.4	
Total	143,053	8,410	58,544	144,971	100	1089135

Table 2. 2008 Community Greenhouse Gas Emissions by Source

	CO ₂	N ₂ O	CH ₄	Equiv CO ₂		Energy
	(tons)	(lbs)	(lbs)	(tons)	(%)	(MMBtu)
Diesel	8,112	48	49	8,120	5.6	100,602
Electricity	85,515	2,910	2,629	85,993	59.3	320,407
Food Waste	0	0	7,361	77	0.1	
Gasoline	41,161	5,420	4,602	42,050	29	526,817
Natural Gas	8,265	31	1,546	8,286	5.7	141,308
Paper Products	0	0	38,015	399	0.3	
Plant Debris	0	0	3,209	34	0	
Wood or Textiles	0	0	1,133	12	0	
Total	143,053	8,410	58,544	144971	100	1,089,135

Table 3. 2008 Government Greenhouse Gas Emissions by Sector

	CO ₂	N ₂ O	CH ₄	Equiv CO ₂		Energy	Cost
	(tons)	(lbs)	(lbs)	(tons)	(%)	(MMBtu)	(\$)
Buildings & Facilities	2,867	87	146	2,882	37.7	15,537	271,597
Streetlights & Traffic Signals	93	3	3	93	1.2	347	12,402
Wastewater Facilities	0	72	405,590	4,270	55.9	0	0
Vehicle Fleet	316	39	35	322	4.2	4,056	80,285
Employee Commute	65	7	5	67	0.9	841	16,767
Other Process Fugitive	0	0	0	10	0.1		
Total	3,341	208	405,779	7,644	100	20,782	381,051

Table 4. 2008 Government Greenhouse Gas Emissions by Source

	CO ₂	N ₂ O	CH ₄	Equiv CO ₂		Energy	Cost	
	(tons)	(lbs)	(lbs)	(tons)	(%)	(MMBtu)	(\$)	
Diesel		21	0	0	21	0.3	264	4,751
Electricity		2,598	88	80	2,613	34.2	9,735	198,498
Ethanol (E100)		0	1	1	0	0	28	830
Fuel Oil (#1 2 4)		2	0	1	2	0	21	0
Gasoline		355	45	39	363	4.7	4,549	90,442
Methane		0	0	405,590	4,259	55.7	0	0
Natural Gas		353	1	67	354	4.6	6,043	85,501
Nitrous Oxide		0	72	0	11	0.1	0	0
OFF ROAD Diesel		4	0	1	4	0.1	51	917
Propane		6	0	2	6	0.1	85	0
R-410A Blend		0	0	0	10	0.1		0
Total		3,341	208	405,779	7,644	100	20,782	381,051

Appendix 1. Fairfield Profile

City of Fairfield
P.O. Box 850
118 South Main Street
Fairfield, IA 52556
Jefferson County, Iowa
Website Address: www.cityoffairfieldiowa.com

Size: 9,215

(from: www.census.gov)

CO₂e per capita (tonnes): 15.73

Annual Total Energy Budget, 2008: \$19,168,929.32

FTE's:

CO₂e per employee (tonnes):

EIA Climate Zone for Commercial Buildings: Zone 2

(from: www.eia.doe.gov/emeu/cbecs/climate_zones.html)

Ave. Annual Heating Degree Days: 6,052

Ave. Annual Cooling Degree Days: 1,134

(from: <http://cdo.ncdc.noaa.gov/climatenormals/clim81/IAnorm.pdf>)

Latitude: 41.01N

Longitude: 91.97W

Elevation: 764.89

Contact:

Scott Timm

Sustainability Coordinator

City of Fairfield/ISU Extension

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Appendix 2. Definition of Terms

CACP2009: 2009 Clean Air and Climate Protection software supplied by ICLEI used in this inventory to calculate greenhouse gas emissions.

CCX: The Chicago Climate Exchange. A voluntary, but legally binding, GHG emissions reduction cap and trade system. (www.chicagoclimatex.com/)

CH₄ (Methane): A hydrocarbon that is a greenhouse gas with a global warming potential 21 times that of carbon dioxide (CO₂). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

CO₂ (Carbon Dioxide): A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas.

CO_{2e} (Carbon Dioxide Equivalent): A measure of the global warming potential of all greenhouse gasses emitted including CH₄, NO₂ and other gasses in addition to CO₂.

EPA: U.S. Environmental Protection Agency. EPA leads the nation's environmental science, research, education and assessment efforts. The mission of the Environmental Protection Agency is to protect human health and the environment. (www.epa.gov/)

GHG (Greenhouse gases): In this report include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).

GWP (Global Warming Potential): The GWP-weighted emissions of direct greenhouse gases in the inventory are presented in terms of equivalent emissions of carbon dioxide (CO₂). GWP factors represent the ratio of the heat-trapping ability of each greenhouse gas relative to that of carbon dioxide.

HFCs (Hydrofluorocarbons): 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 of Climate Change is 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. (<http://www.ipcc.ch/>)

ICLEI: 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 has now changed their name to Local Governments for Sustainability. (<http://www.icleiusa.org/>)

KWh: Kilowatt hour, a unit of electricity.

LED Lights: A high efficiency lighting technology that reduces lighting energy consumption by as much as 80% compared to traditional incandescent lighting. In 2009 the City of Fairfield employed this technology in a retrofit of the city's traffic lights.

MMBTU: One million British Thermal Units, or 10 therms. A unit of energy measurement.

Metric Tonne: One thousand kilograms, or approximately 2,205 lbs.

Natural Gas: Underground deposits of gases consisting of 50 to 90 percent methane (CH₄) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C₃H₈) and butane (C₄H₁₀). Most prevalent fuel used for home and water heating in Iowa City.

NO₂ (Nitrous Oxide): A powerful greenhouse gas with a global warming potential of 310 times that of carbon dioxide (CO₂). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

PFCs (Perfluorocarbons): A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF₄ and C₂F₆) 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: The first stage of GHG analysis in the ICLEI analysis protocol. Scope 1 includes 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: The second stage of GHG analysis in the ICLEI analysis protocol. Scope 2 includes emissions produced outside the city that are induced by consumption of

electrical energy within the city limits.

Scope 3: The third stage of GHG analysis in the ICLEI analysis protocol. Scope 3 includes 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 and employee commute.

SF₆ (Sulfur Hexafluoride): A very powerful greenhouse gas used primarily in electrical transmission and distribution systems and as a dielectric in electronics. The global warming potential is roughly 23,000 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: A unit used to measure vehicle travel made by a 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 3. Report Contributors

A great debt is owed to those who contributed time, energy, and resources to the production of this analysis and report. The following members of our local and professional community gave generously. Thank you!

Alliant Energy

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City of Fairfield Departments

Public Works

Wastewater

Waterworks

Fire Department

Police Force/Law Department

Public Library

Park & Recreation

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Waste Management

Appendix 4. Emissions Factors

The factors used to calculate 2000 electricity emissions in the CACP2009 software were determined by guidance from ICLEI staff using the information in the Local Government Operations Protocol, Version 1.0 For the calendar year 2008, the most current eGRID emissions factors (2005) were used for the subregion that Fairfield falls within (MROWEST) and were 1,821.8 lbs CO₂/MWH for CO₂, 0.028 lbs/MWh for CH₄ and 0.031 lbs/MWh for N₂O. All other emissions factors used were the default factors provided in the software.