CITY OF FLAGSTAFF

COMMUNITY GREENHOUSE GAS EMISSIONS REPORT

2009 & 2010

FLAGSTAFF SUSTAINABILITY PROGRAM

WORKING TOWARD COMMUNITY SUSTAINABILITY

EXECUTIVE SUMMARY

In 2009, the Flagstaff community emitted approximately 1,192,650 metric tons of Carbon Dioxide equivalent (CO2e). The transportation sector was the largest source of emissions, contributing 41 percent of the community's emissions or 519,638 metric tons of CO2e. Energy consumption in the commercial and industrial sector was the next largest source of GHG emissions, contributing 32 percent of community emissions or 410,964 metric tons of CO2e. The third largest contributor was the residential sector which generated 220,167 metric tons of CO2e, contributing 17 percent of the overall community emissions. Estimated methane emissions that result from the eventual decomposition of waste, such as food waste, account for 6 percent of emissions or 68,427 metric tons of CO2e. The smallest contributor, 4 percent, of in Flagstaff is the "other" sector which includes emissions generated by trains and refrigerants.

In 2010, the Flagstaff community emitted approximately 1,045,159 metric tons of Carbon Dioxide equivalent (CO2e). The transportation sector was the largest source of emissions, contributing 40 percent of Flagstaff's community emissions or 447,109 metric tons of CO2e. Energy consumption in the commercial and industrial sector was the next largest source of GHG emissions, contributing 29 percent of community emissions or 325,425 metric tons of CO2e. The third largest contributor was the residential sector which generated 228,069 metric tons of CO2e, contributing 20 percent of the overall community emissions. Estimated methane emissions that result from the eventual decomposition of waste, such as food waste, account for 7 percent of emissions or 71,462 metric tons of CO2e. The smallest contributor makes up 4 percent and is the "other" sector which includes emissions generated by trains and refrigerants. Overall GHG emissions generated in the Flagstaff community decreased 9 percent from 2009 to 2010.

TABLE 1	CO2e (metric tons)		Percentage (%)	
	2009	**2010**	**2009**	**2010**
Residential	220,167	228,069	17	20
Commercial/Industrial	410,964	325,425	32	29
Transportation	519,638	447,109	41	40
Waste	68,427	71,462	6	7
Other	49,065	46,831	4	4
Trees	-75,611	-73,737		
Total	**1,192,650**	**1,045,159**	**100%**	**100%**

INTRODUCTION

Presented in this report are calculations of greenhouse gas (GHG) emissions generated from the Flagstaff community-at-large. The community report on GHG emissions is important for Flagstaff's climate protection initiatives and helps identify next steps for determining what types of actions the City, together with the community, can take to reduce its energy use, fuel consumption and waste. The objective of GHG reporting is to identify the sources and quantities of GHG emissions generated by the Flagstaff community. This report is essential in addressing GHG emissions, creating a tool to measure future progress and allowing the City to understand the scale of emissions from various sources. Furthermore, the report is a foundation for which the City will identify strategies to respond to the social, economic, environmental and institutional impacts of the changing climate.

Preparing Flagstaff for the changing climate depends on community-wide action from individuals, businesses, schools, commuters, governments, and in short, everybody. The benefits of a climate protection initiative are shared by both the local government and the community and include reduced costs due to energy efficiencies, cleaner air and improved transportation choices.

In the phenomenon known as the greenhouse effect, naturally-occurring atmospheric gases help regulate the global climate by trapping solar radiation within the Earth's atmosphere. There is empirical evidence that suggests that modern human activity is artificially intensifying the greenhouse effect, causing global average surface temperatures to rise. This intensification is caused by activities that release carbon dioxide and other greenhouse gases into the atmosphere—most notably the burning of fossil fuels for transportation, electricity, and heating. Rising temperatures affect local and global climate patterns, and these changes are forecasted to manifest themselves in a number of ways that may impact the Flagstaff community and the northern Arizona region. These changes, in turn, will affect the health of residents and visitors, public safety, the success of businesses and institutions, the viability of our forests and wildlife and the ability of government to cope with short-term emergencies and longer-term stresses.

Recognizing the importance of local action, many communities – including Flagstaff – in the United States are taking responsibility at the local level. Since many of the major sources of GHG emissions are directly or indirectly controlled through local policies, communities have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around sustainable land use patterns, transportation planning, energy efficiency, sustainable building, waste diversion and public education; local governments and individuals can dramatically reduce emissions in their communities.

The City of Flagstaff has a long history of promoting sustainable practices through a variety of innovative programs and policies. These efforts demonstrate the City's commitment to the economic, environmental and social stewardship of its municipal operations and the Flagstaff community. Progressing toward sustainability and leading by example, the City of Flagstaff is committed to establishing clear goals, objectives, and strategies to guide the community on a long-term sustainable path.

The 2009 – 2010 Flagstaff Community Greenhouse Gas Emissions Report was completed by the City of Flagstaff Sustainability Program. The report was completed with assistance by Flagstaff City staff which provided information necessary for the completion of this report. Technical assistance for the report was provided by ICLEI – Local Governments for Sustainability. Overall GHG emissions generated in the Flagstaff community decreased 9 percent from 2009 to 2010 and 20 percent from 2006 to 2010.

METHODOLOGY

The 2009/2010 community GHG emissions report assesses community GHG emissions for the following community sectors: transportation, residential, commercial/industrial, waste and "other." The reporting period of this report includes 2009 and 2010.

LOCAL GOVERNMENT GREENHOUSE GAS EMISSIONS ANALYSIS PROTOCOL

The emissions report follows the standard outlined in the draft International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP). The basic methodology utilized in the report provides clarity on how the inventory results are reported.

GREENHOUSE GASES

According to the IEAP, local governments should assess emissions of all six internationally recognized greenhouse gases regulated under the Kyoto Protocol. These gases are outlined in Table 2, which includes the sources of these gases and their global warming potentials (GWP). GWP is a quantified measure of the globally averaged relative impacts of a particular GHG. This value facilitates a direct comparison of the impacts of emission and reductions of different GHG. Carbon dioxide (CO2) is used as a reference gas in this report; therefore, other warming potentials of other GHG are compared to CO2. This comparison is referred to as a CO2 equivalence, or CO2e as referred to throughout this report. The following four greenhouse gases released by the Flagstaff municipal organization during 2010: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and hydrofluorocarbons (HFCs). The remaining two recognized greenhouse gasses are not released by the City.

TABLE 2: Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organic Waste (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbon	Various	Leaked Refrigerants, Fire Suppressants	12–11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500–9,200
Sulfur Hexafluoride	SF_6	Distribution of Power	23,900

CALCULATING EMISSIONS

Emissions recorded in this inventory have been calculated using activity data and emission factors. To estimate emissions accordingly, the basic equation below is used:

ACTIVITY DATA X EMISSION FACTOR = EMISSIONS

Activity data refer to the relevant measurement of energy use or other GHG generating processes such as fuel consumption by fuel type, metered annual electricity consumption and tons of waste disposed. Emission factors are used to convert energy usage or other activity data into associated emissions quantities. They are usually expressed in terms of emissions per unit of activity data (e.g., lbs CO2/kWh).

GHG emissions were calculated using ICLEI's Clean Air and Climate Protection (CACP) 2009 software. CACP provides emission factors for all sector data. Previously community reports were calculated using ICLEI's CACPS 2003 software. Since 2003, many emissions factors have been updated and calculation methodologies improved.

UPDATED EMISSION CALCULATIONS

The 2009 and 2010 report incorporates changes to data collection methods used in Flagstaff's 2006 introductory GHG emission inventory. Due to available data, emissions in the residential and commercial/industrial sectors previously extrapolated estimates for natural gas usage from several northern Arizona communities, including: Ash Fork, Belmont, Parks, Seligman, Williams, Winslow and Flagstaff. Residential sector emissions previously incorporated propane usage which is not common for residences inside the Flagstaff geo-political boundaries. This report combines emissions generated by both commercial and industrial sectors in the community; whereas, the initial report on 2006 emissions separated the two sectors. Emissions from waste in the 2009 and 2010 report incorporate solid waste generated from only within Flagstaff city limits. Previous GHG reporting did not recognize for the significant impact of refueling that occurs in Flagstaff due to its adjacency to Interstate 40. Interstate 40 refueling data is now extrapolated which significantly reduces transportation related emissions. According to ICLEI guidance, emissions from plane take offs and landings at Flagstaff Pulliam Airport will be now incorporated into the City of Flagstaff's annual municipal greenhouse gas emission report.

RESULTS

TRANSPORTATION SECTOR

Transportation emissions are a result of diesel and gasoline combustion in vehicles traveling on both local roads and highways that pass through the geo-political boundaries of Flagstaff. Transportation within Flagstaff contributed 41 percent of community emissions in 2009, or 519,638 metric tons of CO2e. In 2010, they contributed 40 percent or 447,109 metric tons of CO2e (Table 3).

TABLE 3 FLAGSTAFF ESTIMATED FUEL SALES

Year	Gasoline (million gallons)	Diesel (million gallons)	Total GHG Emissions (metric tons of CO2e)
2006	50	24	784,514
2009	34	16	519,638
2010	30	13	447,109

RESIDENTIAL SECTOR

Residential sector emissions are the result of electricity consumption, the on-site combustion of natural gas and fuel wood. Energy consumption associated with Flagstaff homes produced 220,167 and 228,069 metric tons of GHG emissions in 2009 and 2010, respectively (Table 4). In 2009, Flagstaff's residential sector consumed 197,725,504 kilowatt hours (kWh) of electricity and 13,004,904 therms of natural gas. Electricity use in 2010 increased 5 percent and natural gas consumption increased 14 percent. Fuel wood use in 2009 is estimated at 18,000 tons and 19,000 tons in 2010, representing 1 percent of residential sector emissions.

TABLE 4 FLAGSTAFF RESIDENTIAL SECTOR EMISSIONS

	2006	2009	2010
Natural Gas Usage (therms)	15,124,159	13,004,904	15,107,385
Electricity (kWh)	135,683,685	197,725,504	207,931,935
Fuel Wood (tons)	18,010	18,000	19,020
Total GHG Emissions (metric tons of CO2e)	247,004	220,167	228,069

COMMERCIAL/INDUSTRIAL SECTOR

The commercial/industrial sector emissions are the result of electricity consumption and the on-site combustion of natural gas from businesses. In 2009, this sector produced 410,964 metric tons of GHG,

which is 32 percent of total community emissions. In 2010, this sector produced 325,425 metric tons accounting to of 29 percent of total emissions. Taken this into account, the commercial/industrial sector saw a 19 percent decrease in emissions from 2006 to 2009 and a 26 percent decrease from 2009 to 2010 (Table 5).

TABLE 5: COMMERCIAL/INDUSTRIAL SECTOR EMISSIONS			
	2006	**2009**	**2010**
Natural Gas Usage (therms)	9,686,608	13,832,903	10,272,720
Electricity (kWh)	422,938,163	397,562,052	397,855,009
Total GHG Emissions (metric tons of CO2e)	503,552	410,964	325,425

SOLID WASTE SECTOR

The solid waste sector constituted 6 percent (2009) and 7 percent (2010) of total emissions for the Flagstaff community. Solid waste generated within Flagstaff and disposed at the Cinder Lake Landfill in 2009 was 64,728 tons and 67,599 tons in 2010.

Recycling is measured at the Material Recovery Facility and the Cinder Lake Landfill based on the recyclable materials collected from residential, commercial and community drop off locations. Recycling rates are measured as a percentage of commercial and residential waste that is diverted for recycling. The amount of materials diverted from the landfill for recycling, reuse or other purposes is reported as the community diversion rate. The recycling rate in Flagstaff increased by 3 percent from 2009 to 2010. Waste diversion rate increased by 4 percent in 2010 as a result of increased recycling rates and diversion of materials for other uses.

TABLE 6:	Residential Recycling Rate (%)	Commercial Recycling Rate (%)	Community Diversion Rate (%)
2009	18.03	10.80	39.35
2010	21.04	10.89	43.55

OTHER SECTOR

During 2009, 49,065 metric tons of CO2e were generated from the "other" sector. The majority of these emissions were generated from air conditioning units (44,729 metric tons of CO2e). Similarly, during 2010, 46,831 metric tons of CO2e were generated. Again, the majority of these emissions, 42,495 metric tons of CO2e, were generated from air conditioning units. Another contributor to the "other" sector is trains, which emitted 4,336 metric tons of CO2e. In 2009 and 2010 emissions in the "other" sector decreased slightly from 2006; as previously discussed this due primarily to the removal of emissions from aviation traffic at the Flagstaff Pulliam Airport.

TREES

Forest ecosystems and forest products create emission reductions or "sinks." Over 90 percent of the sequestration in agriculture and forests occurs in the forest sector, with an additional 7 percent sequestered in urban trees. Emission reductions are achieved through the growth of trees. Emissions are released from forest to the atmosphere as fuel wood is burned and as trees die and decompose. Since the City of Flagstaff has a large area of forest, CO2e emissions reductions by the forest were estimated. Reductions were calculated by subtracting fuel wood carbon mass from the biomass carbon stock increase resulting from biomass growth. In 2009, the City of Flagstaff had approximately 9,760 hectares of forest area. The Hardy Fire in June of 2010 reduced the forest area by 114 hectares.

CONCLUSION AND NEXT STEPS

The main contributors to the Flagstaff community's GHG emissions were the transportation and commercial/industrial sectors. Together, these two sectors represent approximately 73 (2009) and 69 (2010) percent of the community's overall emissions. Almost 20 percent of community emissions are a result of electricity and natural gas use in residential buildings. Waste and refrigerant emissions comprise the remaining 10 percent in both 2009 and 2010. Overall GHG emissions generated in the Flagstaff community decreased 9 percent from 2009 to 2010 and 20 percent from 2006 to 2010.

By completing annual municipal greenhouse gas emissions reports, the City of Flagstaff is taking crucial steps in addressing climate change and adaptation. This leadership will allow the City to make important decisions to create and implement innovative and practical strategies to reduce its emissions; thereby reducing energy use and creating cost savings in order to promote its commitment to community sustainability.

CLIMATE ADAPTATION AND MANAGEMENT PLAN

The community GHG emission report will form the basis for Flagstaff's Climate Adaptation and Management Action Plan (CAMP). This will be an essential document for local government officials, and a tool to leverage assistance from the State and Federal governments in implementing emission reduction and climate adaptation policies. Flagstaff will continue its partnership with ICLEI – Local Governments for Sustainability to collaborate and learn from other participating municipalities as it develops CAMP while addressing adaptation and resiliency planning for a sustainable community.

CAMP will be a community based planning process and will identify strategies for integrating climate adaptation planning into existing planning frameworks such as sustainability and comprehensive planning. Developing an action plan for the community to adapt to the changing climate is an existing priority of the City of Flagstaff.

RISK AND VULNERABILITY ASSESSMENTS

For most cities, climate changes will continue to present challenges and risks that require management. Cities can no longer rely on the assumption that the prevailing climate will be more or less the same. With changes in both average conditions and the frequency and severity of extreme events, we can expect to live and

operate in a climate that is warmer, with different patterns of rainfall, less moisture retained in the soil and more severe storms. The result is a climate that progressively will become different from the current climate in many ways, including similar but more acute challenges and risks posed by this variability.

The City of Flagstaff will work with a team to undertake comprehensive, focused assessment of potential risks to the community. The risk and vulnerability assessments will be organized, systematic, documented and methodically carried out. Assessment of the risks associated with a changing climate is essential prior to selecting and initiating a plan for adapting to it.

THE FLAGSTAFF REGIONAL PLAN FOR SUSTAINABLE DEVELOPMENT

In 2009 Flagstaff City Council and Coconino County Board of Supervisors appointed a 22-member Citizen Advisory Committee (CAC) to work closely with the Core Planning Team in developing the Regional Plan 2012. The vision of the Flagstaff Regional Plan for Sustainable Development 2012 is as follows, "The Greater Flagstaff community embraces the region's extraordinary cultural and ecological setting on the Colorado Plateau through active stewardship of the natural and built environments. Residents and visitors encourage and advance intellectual, environmental, social and economic vitality for today's citizens and future generations. The updated Regional Plan will prioritize goals and develop policies based upon community input, and neighborhood needs gathered during the public process; City Council and County Board of Supervisor published priorities; as well as develop performance measures, or 'community indicators' to see if these goals are being met. As the global economic climate has reduced public capital funding significantly, the prioritization of projects and community indicators have become even more important, to provide focus and clarity as to what type of community the Flagstaff region needs to be."

Ensuring the health and safety for the Flagstaff community today and in the future requires that the City be a leader and take action to prepare for the changing climate. The impacts of climate change will affect our local economy, natural environment and community's well being. A proactive approach can reduce severity of risks and is less costly than responding to these impacts as they happen.