Appendix C:
Greenhouse Gas Inventory

City of Whitefish

2016 Local Government Operations Greenhouse Gas Emissions Inventory

Photo credit: Explore Whitefish

Produced by City of Whitefish
With Assistance from ICLEI - Local Governments for Sustainability USA

Credits and Acknowledgements

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Executive Summary

While the City of Whitefish, historically, has engaged in projects that reduce energy use, costs, and GHG emissions such as committing to uphold the Paris Agreement, Whitefish has had no comprehensive understanding of the scope of emissions produced within its bounds or resulting from the activity within our city. To this end, the City of Whitefish has undertaken a local emissions study or "greenhouse gas emissions inventory" to guide future efforts and better understand the challenges and opportunities before us. This report highlights the findings of the GHG emissions inventory and provides an emissions baseline against which Whitefish's progress in reducing emissions can be demonstrated.

The emissions inventory found that the City of Whitefish's operations were responsible for emitting 1,760 metric tons of CO_2e in 2016. The summary tables and figures below are expounded in the remainder of this report.

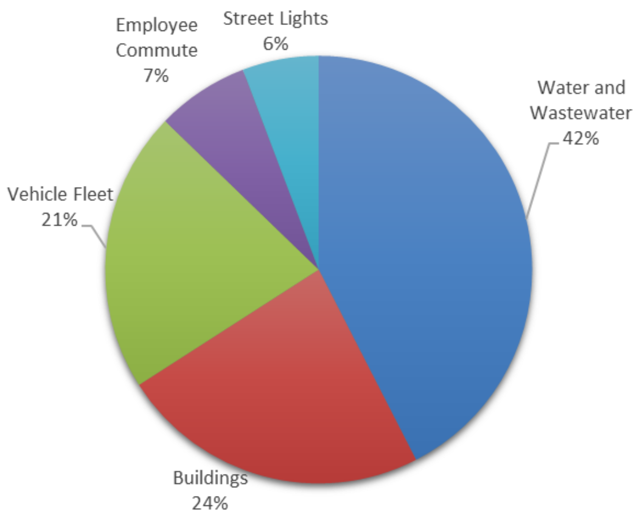


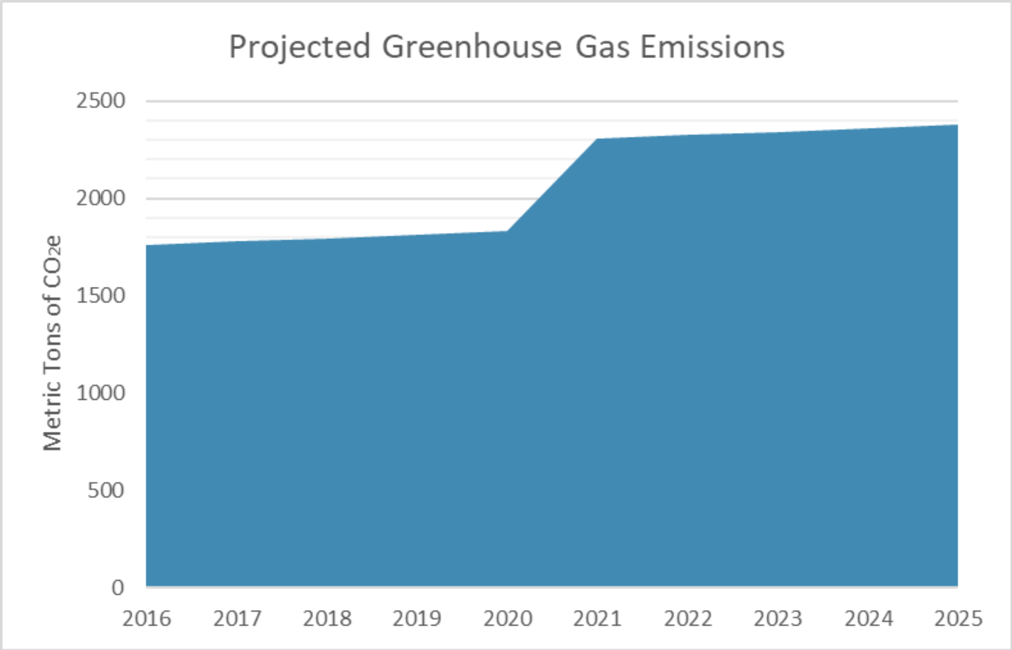
Figure ES1: Government Operations
Greenhouse Gas Emissions by Sector

Table ES1: City of Whitefish 2016 Greenhouse Gas Emissions per Capita

Estimated 2016 Population	**7,279**
Government GHG Emissions (metric tons CO_2e)	**1,760**
GHG Emissions / Resident (metric tons CO_2e)	**0.242**

These results suggest that energy use in Buildings and Water/Wastewater represents the greatest opportunities for Whitefish to reduce emissions from government operations. Water and Wastewater treatment facilities contributed the highest amount, accounting for 42% percent of the total government operations emissions. Additionally, with the city building a new wastewater treatment facility, the energy use and consequential emissions are expected to more than double by 2020. The City of Whitefish also has considerable opportunity to influence energy use through internal programs and policies.

The City also conducted a "business as usual" emissions forecast which seeks to understand future emissions trends in the absence of any new local effort to reduce those emissions. The results from the 2025 emissions forecast demonstrate that under a business-as-usual scenario, emissions will grow significantly overall and in Wastewater Treatment. The jump in emissions stems from the new wastewater treatment plant expected to come online in 2021.



Based on ICLEI methodology and guidance, the City of Whitefish is documenting emissions reducing projects that have been implemented since 2016, and Whitefish will quantify the emissions benefits of these measures to demonstrate progress made to date.

Beyond projects already implemented or underway, in the near future, Whitefish will consider additional emission reduction strategies for inclusion in its forthcoming Climate Action Plan. The City will quantify potential emission reductions from these projects as well as the other benefits of potential climate and sustainability strategies that could be implemented, including efforts to promote energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction and other strategies. Through these and other efforts, the City of Whitefish can also save money, increase their economic vitality, and improve quality of life for our citizens. Whitefish city staff will continue to update this inventory as additional data become available and use these studies to measure Whitefish's progress in reducing its contribution toward the global and local issue of a changing climate.

Introduction

The City of Whitefish recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound changes in climate and weather, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. In response, the City has taken action to understand the sources of these emissions within our community through the completion of a greenhouse gas emissions inventory. The results of that study are included in this report. Whitefish has multiple opportunities to benefit by acting quickly to reduce GHG emissions, both through local government operations and by inspiring action throughout the community. The detailed findings of this report provide a profile of emissions sources within Whitefish, information that is key to guiding local reduction efforts. This inventory is also useful in that it establishes a benchmark or emissions baseline that the city can later use to evaluate the success of our efforts and compare GHG emission levels over time.

The City of Whitefish recognized the impacts that climate change will have on the local community. These impacts range from economic impacts from tourism to Glacier National Park, recreational activity on Whitefish Mountain Resort, and availability of water. On June 19, 2017 the City of Whitefish signed onto the Paris Climate Agreement, committing to reduce GHG emissions. Additionally, on December 5, 2016, Whitefish's City Council directed staff to develop a comprehensive policy for the local government itself to lead by example; thereby stating that emissions attributable to government operations will be reduced to 26% below 2016 emission levels by 2025. This inventory supports the long-term efforts of Whitefish to reduce emissions and is critical to clearly understanding our contribution and path toward fighting the problem of climate change, here, at home.

Presented here are estimates of greenhouse gas emissions resulting from activities in Whitefish as a whole and from the city's government operations in 2016. These data will provide a baseline against which the city will be able to compare future performance and demonstrate progress in reducing emissions.

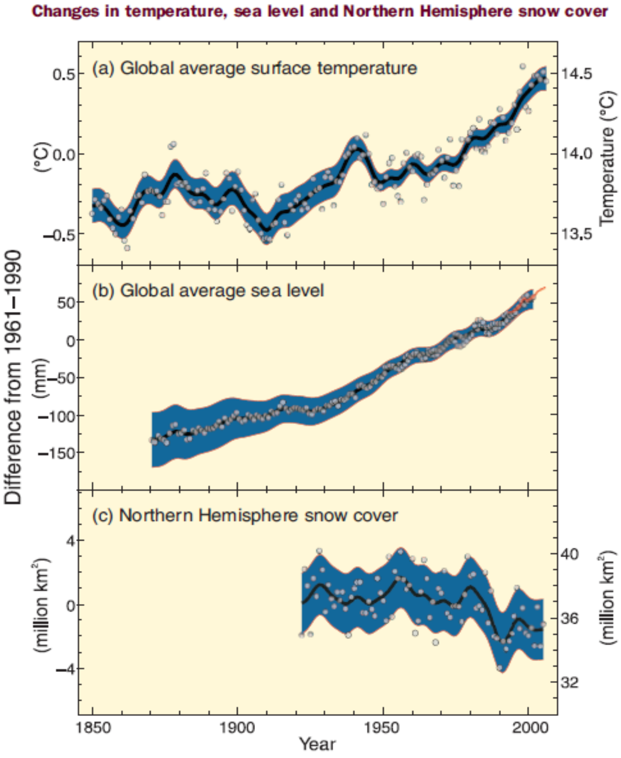
Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence suggests that human activities are increasing the concentration of greenhouse gases, most notably the burning of fossil fuels for transportation and electricity generation which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

Many communities in the United States have taken responsibility for addressing climate change at the local level for a number of reasons, in part due to historic federal inaction on the issue.[1] Foregone and expected impacts to [Jurisdiction] related to climate change are explained below. [Jurisdiction] is exploring how to adapt to these changes. Beyond [Jurisdiction], climate scientists expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and landslides, summer water shortages as a result of reduced snow pack and departures from traditional consumption levels, increased strain on public health systems due to increased temperature and changes in the distribution of vectors, and the disruption of ecosystems, habitats, and agricultural activities.

Global Changes in Climate

The Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report affirms that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level."[2] Researchers have made progress in their understanding of how the Earth's climate is changing in space and time through improvements and extensions of numerous datasets and data analyses, broader geographical coverage, better understanding of uncertainties and a wider variety of measurements.[3] These refinements expand upon the findings of previous IPCC Assessments – today, observational evidence from all continents and most oceans shows that "regional changes in temperature have had discernible impacts on physical and biological systems."[4]



Every community will experience climate change differently. The geography, ecosystems, economy, demographic makeup, and social networks of a community all influence how climate change will affect a community and its ability to cope and adapt. In Whitefish, more volatile rainfall patterns will increase the frequency and severity of droughts and flooding. More frequent extreme heat events will pose a danger to vulnerable residents. Snowpack will decrease, putting

[1] In response to the threat of climate change, communities worldwide are voluntarily reducing greenhouse gas emissions. The Kyoto Protocol, an international effort to coordinate mandated reductions, went into effect in February 2005 with 161 countries participating. The United States is one of three industrialized countries that chose not to sign the Protocol.
[2] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.
[3] IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[4] IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.

the City's water resources at risk. Plant and animal species will also be affected — some positively and negatively. Increases in temperature, combined with less consistent precipitation, will increase the frequency and severity of wildfires. The impacts of climate change will have tangible effects on public health and quality of life for Whitefish's residents and visitors. In addition to the direct dangers of wildfires, flooding, and extreme weather events made worse by climate change—including injury, death, and the destruction of property and livelihoods—there will be a variety of lesser-known impacts on Whitefish's population. Wildfire smoke, for example, can cause serious health complications, especially for those with asthma or other respiratory conditions. Similarly, more frequent and severe heat waves can be deadly, especially for young children, the elderly, and exposed persons such as outdoor workers. Other changes, such as decreased summer stream flow and reduced snowpack, could have significant quality-of-life impacts on Whitefish's residents, many of whom enjoy outdoor recreation and rely on the water supplied by the local watershed for their livelihoods. Whitefish could even experience an influx of "climate refugees" who are displaced from their homes due to climate change impacts elsewhere. Unfortunately, many of these climate risks will disproportionately affect certain groups. In the United States, communities of color, non-English speaking households, and low-income populations have historically been underserved by public programs and investments, resulting in limitations such as fewer transportation options, less resilient housing, and less reliable healthcare options. These inequities may limit the ability of these populations to respond to the impacts of climate change or benefit from new investments and actions taken to address climate pollution.

The Fourth Assessment of the IPCC asserts that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations. This is a strong advancement in terms of rigorous certainty since the Third Assessment Report's conclusion that 'most of the observed warming over the last 50 years is *likely* to have been due to the increase in GHG concentrations.'"

Put another way, "The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* that global climate change of the past 50 years can be explained without external forcing and *very likely* that it is not due to known natural causes alone. During this period, the sum of solar and volcanic forcings would *likely* have produced cooling, not warming. Warming of the climate system has been detected in changes in surface and atmospheric temperatures and in temperatures of the upper several hundred meters of the ocean. The observed pattern of tropospheric warming and stratospheric cooling is *very likely* due to the combined influences of GHG increases and stratospheric ozone depletion."[5]

[5] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

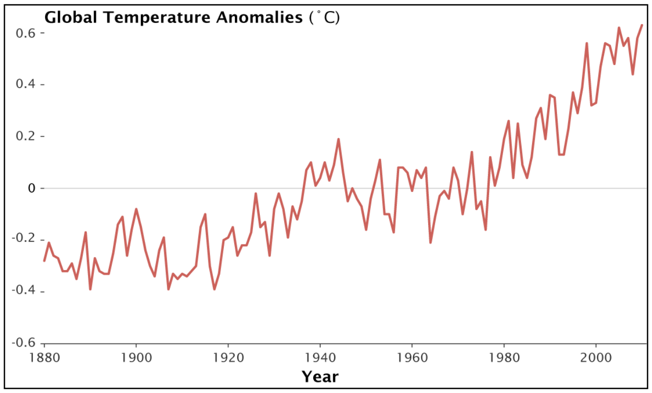
Analysis released in January 2011 by NASA's Goddard Institute for Space Studies shows that global average surface temperatures in 2010 "tied" 2005 as the warmest on record (the difference is smaller than the uncertainty in comparing the temperatures of recent years).[6] The next hottest years, also with very close average temperatures, are 1998, 2002, 2003, 2006, 2007, and 2009. The period from January 2000 to December 2009 is the warmest decade on record, followed by the 1990's, then the 1980's respectively. These remarkable yearly and decadal trends, based on the Goddard Institute's global average surface temperature analysis, GISTEMP, are charted since 1880 and closely resemble the findings of other temperature records and analyses produced by the Hadley Centre and the National Oceanic and Atmospheric Administration (NOAA).[7]

The steady uptick in average temperatures is significant and expected to continue if action is not taken to manage climatic conditions. In short, the Earth is already responding to climate change drivers introduced by mankind.

Regional and Local Impacts

Whitefish lies in the Western region of Montana and is expected to feel see several severe effects of climate change. Understanding Whitefish's geographic placement allows us to better predict the dangers that the community faces from climate change.

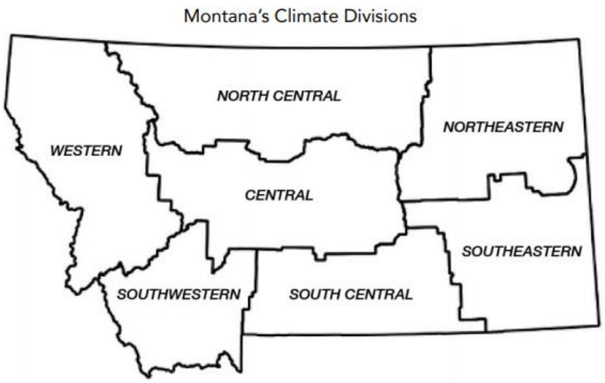
The Montana Climate Assessment (MCA) was put together to synthesize, evaluate, and share credible and relevant scientific information about climate change in Montana. To understand climate change in Montana, we must first understand Montana's unique geography. Montana is the fourth largest state in the nation and its location within North America exposes the state to a mix of diverse weather systems that originate from the Pacific Ocean, the Arctic, and sometimes subtropical regions. The Continental Divide, which has a predominantly north-south alignment in Montana, effectively splits the state into climatically distinct western wet and eastern dry regions with respect to moisture from eastward-flowing Pacific Maritime air. The state also includes the beginnings of three major river basins—the Missouri, Snake/Columbia, and Saskatchewan—two of which encompass almost one-third of the landmass of the conterminous United States. Consequently, Montana's climate influences the water supply of a large portion of the country, and its water supports communities, ecosystems, and economies far beyond its borders.



Montana's unique geography means that climate varies across the state, as it does across the nation. Throughout the MCA, we aggregate past climate trends and future climate projections into seven Montana climate divisions, as shown in

[6] Goddard Institute for Space Studies, "Research Finds 2010 Tied for Warmest Year on Record," 2011, 18 Jan. 2011, <http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>.
[7] Goddard Institute for Space Studies, "Despite Subtle Differences, Global Temperature Records in Close Agreement," 2011, 18 Jan. 2011. http://www.giss.nasa.gov/research/news/20110113/

the map below. Whitefish lies in the Western Region of this map. These seven climate divisions are a subset of the 344 divisions defined by the National Oceanic and Atmospheric Administration (NOAA) based on a combination of climatic, political, agricultural, and watershed boundaries (NOAA undated).



The results of this analysis produced several key messages, some of which are shown below, about Montana's historical and future climate (for a complete list of key messages, see the Climate chapter):

• Annual average temperatures, including daily minimums, maximums, and averages, have risen across the state between 1950 and 2015. The increases range between 2.0-3.0°F (1.1-1.7°C) during this period.[8]

• Despite no historical changes in average annual precipitation between 1950 and 2015, there have been changes in average seasonal precipitation over the same period. Average winter precipitation decreased by 0.9 inches (2.3 cm), which can largely be attributed to natural variability and an increase in El Niño events, especially in the western and central parts of the state. A significant increase in spring precipitation (1.3-2.0 inches [3.3-5.1 cm]) also occurred during this period for the eastern part of the state.

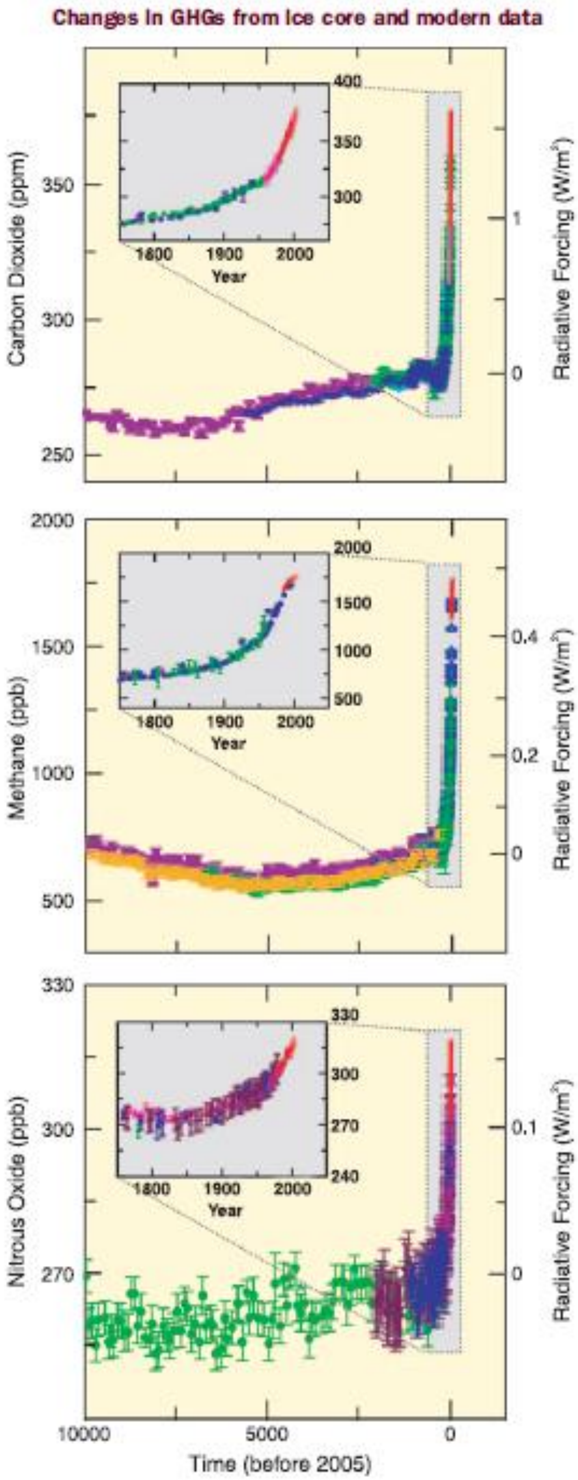
• Montana is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century. By mid-century, Montana temperatures are projected to increase by approximately 4.5-6.0°F (2.5-3.3°C) depending on the emission scenario. By the end-of century, Montana temperatures are projected to increase 5.6-9.8°F (3.1-5.4°C) depending on the emission scenario. These state-level changes are larger than the average changes projected globally and nationally.

• Across the state, precipitation is projected to increase in winter, spring, and fall; precipitation is projected to decrease in summer. The largest increases are expected to occur during spring in the southern part of the state. The largest decreases are expected to occur during summer in the central and southern parts of the state.

[8] Montana Climate Assessment, Published 2017. <http://montanaclimate.org/>

Global Greenhouse Gas Emissions

The figures included here, from the IPCC Fourth Assessment, chart atmospheric concentrations of the three most common greenhouse gases over the 10,000 years prior to 2005 (and since 1750 in the inset panels).

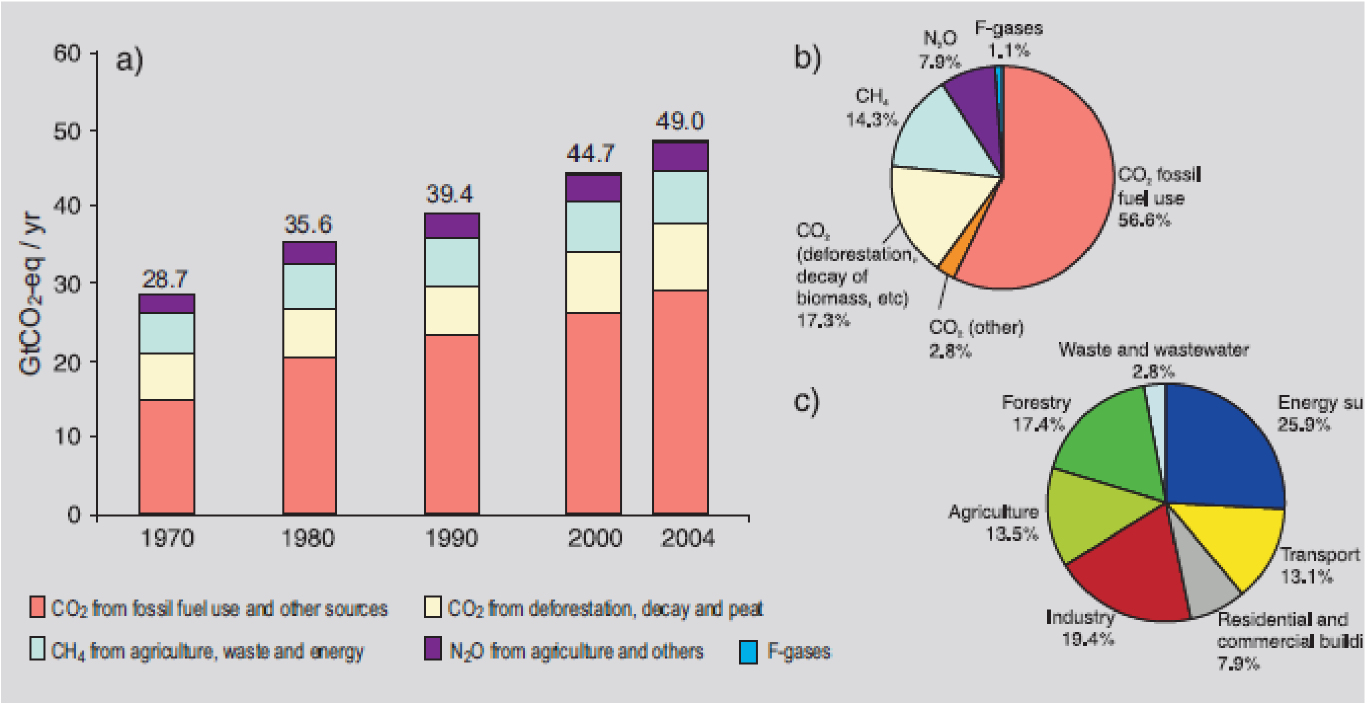


The recent and massive buildup of greenhouse gases in our atmosphere is conceivably even more extraordinary than changes observed thus far regarding temperature, sea level, and snow cover in the Northern hemisphere in that current levels greatly exceed recorded precedent going back much further than the modern temperature record. The latest monthly average atmospheric CO_2 concentration, for January 2018, as measured at Mauna Loa Observatory, Hawaii, was 407.98 parts per million (ppm).[9]

According to the Director of the Goddard Institute, Dr. James Hansen, "If the warming trend continues, as is expected, if greenhouse gases continue to increase, the 2010 [temperature] record will not stand for long."[10] In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts. While this Report is designed to identify overall greenhouse gas emissions levels with an eye towards creating a plan to reduce these emissions, as the effects of climate change become more common and severe, local government adaptation policies will be fundamental in preserving the welfare of residents and businesses.

[9] NOAA/ESRL, Dr. Pieter Tans. 2011, 18 Jan. <http://www.esrl.noaa.gov/gmd/ccgg/trends/>.
[10] Goddard Institute for Space Studies, "Research Finds 2010 Tied for Warmest Year on Record," 2011, 18 Jan. <http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>.

Global anthropogenic GHG emissions



Whitefish Climate Action Plan

In 2017, the Whitefish Climate Action Plan was requested by the Whitefish City Council to address the growing problem of climate change. The goals of this plan are to drive GHG emissions downward by offsetting energy use with energy conservation measures and cleaner fuel choices, reduce vehicle-miles-traveled through planning and building effective, intermodal transportation options, and investing in renewable energy technologies.

ICLEI Climate Mitigation Program

The City of Whitefish along with more than 1,200 local governments, including over 600 in the United States, has joined ICLEI – Local Governments for Sustainability, an association for local governments to share knowledge and successful strategies toward increasing local sustainability.[11] ICLEI members represent the most forward-thinking and adept local governments who are working to make their communities more livable, prosperous, equitable, and environmentally sound. The network is a source of continual technical and local innovative thinking designed to help local governments achieve the vision of a truly sustainable community.

[11] ICLEI was formerly known as the International Council for Local Environmental Initiatives, but the name has been changed to ICLEI – Local Governments for Sustainability. <http://www.iclei.org> and http://www.icleiusa.org

ICLEI USA, the US branch of ICLEI, provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One and provides a foundation for future work to reduce greenhouse gas emissions in Whitefish.

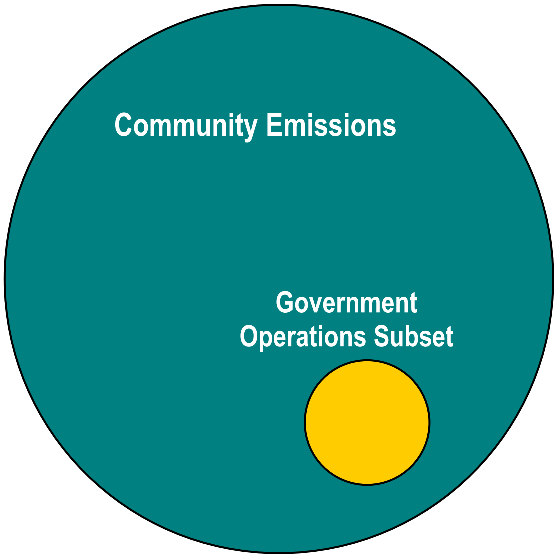
Sustainability and Climate Change Mitigation Activities in Whitefish

The City of Whitefish initiated its environmental sustainability activities with city policies designed to reduce energy use, conserve water, and reduce toxins discharged into the Whitefish sewer system. In 2017 the City of Whitefish completed an energy audit and retrofit of the City-owned Emergency Services Building to improve energy efficiency and reduce Whitefish's energy consumption.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline levels and sources of emissions in the community. As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. Standard processes of accounting for emissions have been developed to which our inventory adheres. Whitefish staff used the Local Government Operations Protocol (LGOP) to inventory GHG emissions from Whitefish internal operations and activities. The government operations inventory is a subset of the community inventory; for example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles. The government operations inventory is in this way a subset of the community-scale inventory. By analyzing emissions in this manner, Whitefish's local government is enabled to understand its own impact within the community and lead by example to reduce its impact on climate change.



Community Emissions Protocol

The IEAP, developed by ICLEI, provides guidelines for local governments in quantifying greenhouse gas emissions from both their internal operations and from the whole community within their geopolitical boundaries. However, in this specific inventory, community emissions were not considered. Though there is an established GHG emissions inventory protocol developed by ICLEI for all local governments worldwide, ICLEI USA is currently developing a Community Protocol supplement for the US which is similar in many respects to the LGOP described below. [12] In future inventories, Whitefish will use the new Community Protocol supplement.

Local Government Operations Protocol

In 2008, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released the LGOP to serve as a national appendix to the IEAP.[13] The LGOP serves as the national standard for

[12] International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP). ICLEI. <http://www.iclei.org/index.php?id=ghgprotocol>

[13] Local Government Operations Protocol (LGOP). <http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol>

quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGOP is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory. Whitefish staff used this protocol to conduct the local government emissions inventory portion of The City of Whitefish's GHG inventory.

Quantifying Greenhouse Gas Emissions

Establishing a Base Year

A primary aspect of the GHG emissions inventory process is the requirement to select a base year with which to compare current emissions. Because After considering the amount and types of data available for each of several recent years, and to clearly align these efforts with landmark local commitments such as signing on to the Paris Agreement, Whitefish's greenhouse gas emissions inventory utilizes 2016 as its base year.

Establishing Boundaries

Government: Operational Boundaries

According to the LGOP, a government can use two approaches to define its organizational boundary for reporting greenhouse gas emissions: 1) activities and operations that the jurisdiction controls operationally; and 2) activities and operations that the jurisdiction controls financially. Staff estimated Whitefish's local government emissions based on activities and facilities for which the City maintains operational control.

Emission Types

The IEAP and LGOP recommend assessing emissions from the six internationally recognized greenhouse gases regulated under the Kyoto Protocol as listed in Table 1. We chose to calculate Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Greenhouse gas emissions are commonly aggregated and reported in terms of equivalent carbon dioxide units, or CO_2e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide on a per weight basis in its capacity to trap heat, so one metric ton of methane emissions is equal to 21 metric tons of carbon dioxide equivalents. See Table 1 for the GWPs of the commonly occurring greenhouse gases.

Table 1: Greenhouse Gases

Greenhouse Gas	Chemical Formula	Global Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	Various	43-11,700
Perfluorocarbons	Various	6,500-9,000
Sulfur Hexafluoride	SF_6	23,900

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation is used: *Activity Data × Emission Factor = Emissions*

The latter was used for this inventory. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. See appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity). Table 2 demonstrates an example of common emission calculations that use this formula. See appendices for details on the emissions factors used in this inventory.

Table 2: Basic Greenhouse Gas Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kWh)	CO2 emitted/kWh	CO2 emitted
Natural Gas Consumption (therms)	CO2 emitted/therm	CO2 emitted
Gasoline/Diesel Consumption (gallons)	CO2 emitted /gallon	CO2 emitted
Vehicle Miles Traveled	CH4, N2O emitted/mile	CH4, N20 emitted

Clean Air and Climate Protection 2009 (CACP 2009) Software

To facilitate community efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection 2009 (CACP 2009) software package in partnership with the National Association of Clean Air Agencies

(NACAA) and the U.S. Environmental Protection Agency (EPA). CACP 2009 is designed for compatibility with the LGOP and determines emissions by combining activity data (energy consumption, waste generation, etc.) with verified emission factors.

The CACP software has been and continues to be used by over 600 U.S. local governments to reduce their greenhouse gas emissions. However, it is worth noting that, although the software provides governments with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. Calculating GHG emissions depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the CACP 2009 software as an approximation of reality, rather than an exact value.

Evaluating Greenhouse Gas Emissions

Greenhouse Gas Emissions by Scope

For both community and government operations, emissions sources are categorized relative to the geopolitical boundary of the community or the operational boundaries of the government. Emissions sources are categorized as direct or indirect emissions – Scope 1, Scope 2, or Scope 3. The prevention of double counting for major categories such as electricity use and waste disposal is one of the most important reasons for using the scopes framework for reporting greenhouse gas emissions at the local level.

The Scopes framework identifies three emissions scopes for community emissions:

- **Scope 1:** All direct emissions from sources located within the geopolitical boundary of the local government.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the geopolitical boundary of the local government, but that rely upon emissions-producing processes located outside of the government's jurisdiction.
- **Scope 3:** All other indirect or embodied emissions not covered in Scope 2 that occur as a result of activity within the geopolitical boundary.

Scope 1 and Scope 2 sources are the most essential components of a community greenhouse gas analysis as these sources are typically the most significant in scale, and are most easily affected by local policy making.

Similar to the community framework, the government operations scopes are divided into three main categories:

- **Scope 1:** Direct emissions from sources within a local government's organizational boundaries that the local government owns or controls.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the

organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity.

- **Scope 3:** All other indirect emissions not covered in Scope 2, such as emissions from up-stream and downstream activities that occur as a result of activities within the operational boundaries of the local government, emissions resulting from the extraction of and production of purchased materials and fuels, contracted services, and waste disposal.

As with the community inventory, Scope 1 and Scope 2 sources are the most essential components of a local government greenhouse gas analysis because these sources are usually significant in scale and are directly under the control of local governments. Local governments typically have indirect control over Scope 3 emissions. For example, solid waste generated from government operations is included as Scope 3 because of the unique circumstances in which emissions are generated – emissions from waste are generated over time as the waste decomposes and not directly in the base year.

Greenhouse Gas Emissions by Sector

In addition to categorizing GHG emissions by scope, this inventory examines emissions by sector. Many local governments find a sector-based analysis more relevant to policy making and project management, as it assists in formulating sector-specific GHG reduction measures and climate action plan components. This inventory evaluates community and government emissions by the sectors listed in Table 3.

Table 3: Government Sectors
Buildings
Streetlights
Vehicle Fleet
Employee Commute
Water / Wastewater Treatment

Government Operations Emissions Inventory Results

Greenhouse Gas Emissions by Scope

Table 4: Government Operations Emissions by Scope

Total Emissions				
	Metric Tons CO_2e	Metric Tons CO_2	Metric Tons CH_4	Metric Tons N_2O
SCOPE 1	808.5994183	720.0221838	0.04558401	0.29341488
SCOPE 2	828.624432	824.4039789	0.0156026889	0.01285364371
SCOPE 3	123.6688974	121.7794246	0.0060543517	0.00583259758
Total	1760.892748	1666.205587	0.06724105055	0.3121011213

Including all scopes, The City of Whitefish local government emitted approximately 1,760 metric tons[14] of CO_2e in the year 2016. Many inventories report only Scope 1 and Scope 2 emissions; for Whitefish this represents 1,636 metric tons of CO_2e.

Greenhouse Gas Emissions by Sector & Source

GHG emissions from local government operations are produced by a wide variety of source types, which are categorized into sectors such as those included below.

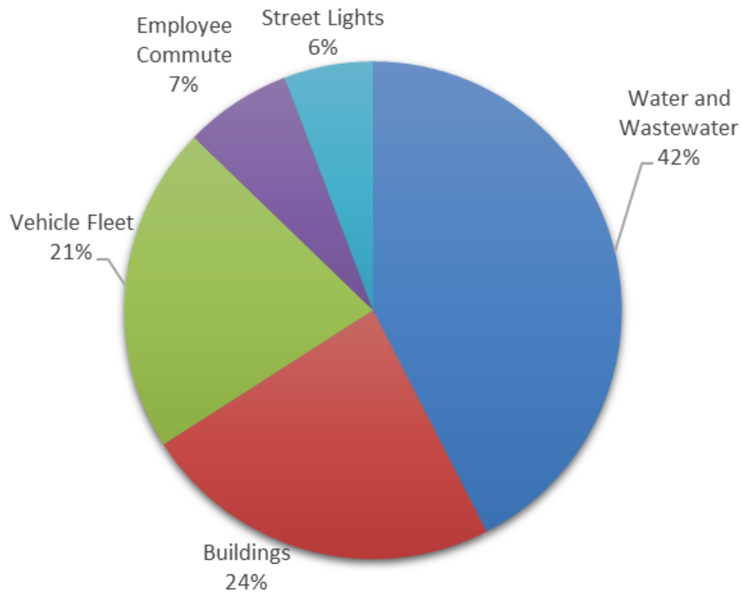
Local Government Greenhouse Gas Emissions by Sector

Table 5: Government Operations Greenhouse Gas Emissions by Sector

Sector	Metric Tons CO_2e	Metric Tons CO_2	Metric Tons CH_4	Metric Tons N_2O
Buildings and Facilities	413.3572556	411.6898032	0.02287420158	0.0036765013
Vehicle Fleet	374.6870178	374.6870178	0	0
Street Lights and Traffic Signals	101.7493133	101.231071	0.0019159016	0.00157833799
Water and Wastewater Treatment Facilities	747.4302636	656.8182707	0.03639659571	0.3010136844
Employee Commute	123.6688974	121.7794246	0.006054351654	0.00583259758

[14] All emissions estimated using ICLEI's CACP 2009 Software.

Figure 10: Government Operations Greenhouse Gas Emissions by Sector



Employee Commute

Emissions in the Employee Commute sector are due to combustion of fuels in vehicles used by government employees for commuting to work. Results from a survey designed by ICLEI and administered by [Jurisdiction] are included below. The survey itself can be found in Appendix K and was used to collect the data needed to calculate emissions. This information will help Whitefish set policy addressing this sector.

Local Government Emissions Forecast

To illustrate the potential emissions growth based on projected trends in energy use, driving habits, job growth, and population growth from the baseline year going forward, The City of Whitefish conducted an emissions forecast for the year 2025. Under a business-as-usual scenario, Whitefish's local government emissions will grow by approximately 35.17% percent by the year 2025, from 1,760 to 2,379 metric tons CO_2e. The majority of this change is due to the new wastewater treatment plant that will be coming online in 2021.

Conclusion

The inventory results included here provide a GHG emissions baseline that Whitefish will use to inform the next steps of the Whitefish Climate Action Plan. Guided by ICLEI's 5 Milestone Process for Climate Mitigation, Whitefish will evaluate and set GHG emissions reduction targets for local government operations and the community. In selecting this target, it will be important to strike a balance between scientific necessity, ambition, and what is realistically achievable. By establishing a challenging yet feasible target, Whitefish can demonstrate its goal to do its part towards addressing GHG emissions. The Climate Action Plan Committee will survey GHG reduction targets of neighboring cities and counties as well as similarly-sized cities across the US, larger-scale agreements such as the US Conference of Mayors Climate Protection Agreement, state targets, and others. The Climate Planning Team will present recommended targets to elected leadership for approval and, if accepted, formal adoption.

Creating, Implementing, and Evaluating a Climate Action Plan

The steps of studying GHG emissions and setting goals to guide Whitefish efforts lead to the development and ongoing implementation of a Climate Action Plan. The City of Whitefish Climate Action Plan will highlight the major initiatives Whitefish has already implemented and add to these initiatives to meet our GHG emissions reduction targets. Whitefish will select actions for inclusion in the Climate Action Plan that will not only comprehensively reduce energy costs and GHG emissions but also reduce the community's vulnerability towards climate change (climate adaptation). ICLEI has a program and support resources to help interested communities understand their vulnerabilities and identify actions to increase resilience (Climate Resilient Communities™ program).

The implementation of projects is, of course, the most important part of this process. By laying the groundwork through the GHG emissions inventory, reduction target, and climate action planning process, Whitefish will have the ability to select and prioritize the very best emissions reduction measures. Finally, by periodically updating inventories, creating new baselines, and adding new initiatives to the Climate Action Plan, the City will be able to track and report our progress in protecting the climate and demonstrate reductions in emissions.

Appendices

Appendix A - Detailed Government Operations Greenhouse Gas Emissions Inventory in 2016

Sector	Emissions Source	Equiv CO_2 (metric tons)	Equiv CO_2 (%)
Buildings			
	Electricity	212.6808779	12.07
	Natural Gas	200.6763777	11.39
Subtotal Buildings			
Streetlights	Electricity	101.7493133	5.77
Vehicle Fleet			
	Gasoline	236.158769	13.41
	Diesel	138.5282488	7.87
Subtotal Vehicle Fleet		374.6870178	21.27
Employee Commute			
	Gasoline	123.6686357	7.02
	Diesel	0.000261739	<1
Subtotal Employee Commute		123.6688974	7.02
Water/Sewage			
Waste Water Treatment Plant			
	Electricity	308.0550046	17.49
	Natural Gas	54.79131392	3.11
	Effluent	78.6074979	4.46
	Fugitive Emissions	8.96147775	<1
Water Treatment Plant			
	Electricity	204.5621796	11.61
	Natural Gas	90.8757332	5.16
Subtotal Water/Sewage		747.4302636	42.44
Grand Total		1760.892748	**100**

Appendix B: Detailed Government Operations Greenhouse Gas Emissions from Vehicle Fleet Sector

			PASSENGER						LIGHT TRUCK (GAS)					LIGHT TRUCK (DIESEL)				
	Employee Name	% of time	# miles	# days/wk	Type (if not gas)	VMT	Employee Name	% of time	# miles	# days/wk	VMT		Employee Name	% of time	# miles	# days/wk	VMT	1 way miles
100	[redacted]	0	8			0	[redacted]	100	8	5	2080	100	[redacted]	65	1.25	5	211.25	4
100		95	27	4		5335.2		5	27	4	280.8	100						13.5
100		99	18	5		4633.2		1	18	5	46.8	100						9
90		0				0		90	3	5	702	90						0
70		70	1.5	5		273		0	1.5	5	0	70						0.75
100		0	14	5		0		100	14	5	3640	100						7
100		100	17	5		4420			17	5	0	100						8.5
16		8	1	5		20.8		8	1	5	20.8	16						0.5
100			6	5		0		100	6	5	1560	100			13.00375			3
100		100	7.2	5		1872			7.2	5	0	100						3.6
1		1	2.4	5		6.24			2.4	5	0	1						1.2
100		100	3	5		780			3	5	0	100						1.5
100		100	4	5		1040			4	5	0	100						2
100		100	4	5		1040			4	5	0	100						2
91		91	12	4		2271.36		0	12	4	0	91						6
90			15	4		0		90	15	4	2808	90						7.5
95		20	18	5		936		75	18	5	3510	95						9
100			4	5		0		100	4	5	1040	100						2
100			28	5		0		100	28	5	7280	100						14
100		100	50	5		13000			50	5	0	100						25
100		100	30	5		7800			30	5	0	100						15
100		100	2	5		520			2	5	0	100						1
80		80	2	5		416			2	5	0	80						1
100			10	5		0		100	10	5	2600	100						5
100			20	5		0		100	20	5	5200	100						10
100			10	5		0		100	10	5	2600	100						5
100			20	5		0		100	20	5	5200	100						10
100		100	15	5		3900			15	5	0	100						7.5
40		40	1.2	5		124.8			1.2	5	0	40						0.6
100			20	5		0		100	20	5	5200	100						10
100			20	4		0		100	20	4	4160	100						10
100		90	8	5		1872		10	8	5	208	100						4
100			30	4		0		100	30	4	6240	100						15
100			30	4		0		100	30	4	6240	100						15
100			6	4		0		100	6	4	1248	100						3
95		95	5.6	4		1106.56			5.6	4	0	95						2.8
100			20	4		0		100	20	4	4160	100						10
100			6	4		0		100	6	4	1248	100						3
100			20	4		0		100	20	4	4160	100						10
						0	0		0	0	0							
			13.26026															
TOTAL	PASSENGER	39 responders				36684.96	LIGHT TRUCK (GAS)	1 responder			71432.4		LIGHT TRUCK (DIESEL)				211.25	

TOTAL # OF EMPLOYEES: 105

multiplier: 2.625

FOR 105 EMPLOYEES x2.625 — 96298.02 — 187510.05 — 554.5313

FOR ALL GASOLINE — TOTAL VMT: 283808.07

0.3 — 102.375 — 0.65

9600 — 20800

284362.601 — 5120

15.75

0.15 — 0.461538 — 5.538461538 — 0.113934146

Appendix C: City of Whitefish Employee Commute Survey

The City of Whitefish is conducting an inventory of its energy use and consequential greenhouse gas emissions. This inventory is the first step in developing a Climate Action Plan, which will recommend ways to mitigate these emissions.

To accurately account for fuel use from city operations, we need to collect information about commuting by city employees.

Please email this survey to Rachel Sussman at rsussman@cityofwhitefish.org by February 28, 2017.

Note: Many of these answers will require estimates.

How many days per week do you commute to your job with the City of Whitefish? Click here to enter text.

How many miles is this commute (roundtrip)? Click here to enter text.

Please enter your best estimate of the **percentage** of the time you make this commute by the following methods:

Click to enter %. Passenger Car

☐Gasoline (includes hybrids) or ☐Diesel

Click to enter %. Light truck

☐Gasoline (includes hybrids) or ☐Diesel

Click to enter %. Bus

Click to enter %. Bicycle/Walk

Click to enter %. No commute (worked at home)

Click to enter %. Other (please specify): Click here to enter text.

Contact Information (optional)

Name: Click here to enter text.

Email: Click here to enter text.

Thank you for your help. If you have any questions, please contact Rachel Sussman (rsussman@cityofwhitefish.org