(Photo courtesy of Jennyfer Mesa)

Greenhouse Gas Inventory Report for 2010-2012

June 27, 2016

Acknowledgements

I thank Mayor Condon, the City Council and Division of Public Works and Utilities for providing the resources with which to accomplish this report. Many City staff contributed data and review time. In particular I need to thank my staff, Deborah Bisenius and Doug Greenlund, for working diligently not only on sections of the report but also for the ongoing data gathering effort that is necessary to bring all the pieces together. Thanks are due also to the outside agencies and businesses that provided necessary data. Of course the groups, ICLEI, EPA and others, who have worked up the protocols used are deserving of our thanks as well. It is good here to thank those in our community, both businesses and individuals, who are stepping up and helping us all discover the best paths forward.
Please take the time to read the following perspectives of the college interns who have cycled through our program and without whose assistance this document would not exist.

Lloyd R. Brewer
Environmental Programs Manager

A. Intern Paragraphs

This report would not be possible without the help of the following college graduates. We think their perspectives are worth taking note of and we thank them for their help.

Karl Almgren
“Regardless of political parties, religious beliefs, or even skepticism, society must identify that our environment is not immune to our actions. The pure belief that society’s actions won’t harm something as big as the Earth is identical to our thinking that we couldn’t ever negatively affect the fish population. As we continue to accept that the environment is changing, and that humankind has affected the environment, we must be willing to accept new practices and policies that will limit our footprint on this lifeboat called Earth. The success of our battle against climate change is not about becoming more resilient or efficient, but our success will be based on how fast we are willing to change.”

Emma Flott
“Climate change is an omnipresent issue. It is one of the most challenging and complex problems our global society faces today. Climate change affects everyone, making it one of the most important issues people must continue to confront. We are already seeing the many detrimental impacts of climate change in the environment around us. From extreme weather to species extinction, the effects are far and wide. It is well known that humans are contributing to the problem of climate change and thus it is crucial that we continue the effort to better understand the causes of climate change and most importantly, any consequences of anthropogenic activity. I believe that individuals have a big role to play when it comes to making a difference in the movement to combat global warming. We can work with each other, our communities, or our local governments, to push for a continued effort into climate change research on the city, state, national, and international levels. Together we can make effective change in the fight against global warming.”

Dallin Jensen
"Climate change is often presented as a distant catastrophe impacting future generations, but the deleterious impacts of anthropogenic greenhouse gas emissions are being felt now. In my hometown, Fairbanks, Alaska, the signs of a changing climate are evident everywhere. The growing season has lengthened by 45 days which has led to increased evapotranspiration decreasing total water availability to forests and streams. This has caused increasingly intense forest fire seasons, with 4 times as much forest burning annually when compared to the 1970s. The decreased available water has begun leading to heat stress among all tree species, with the conifers increasingly threatened by invasive insects, and the deciduous trees sometimes shriveling up before the end of summer. Current climate projections show the verdant forests I grew up in are supposed to decline and become supplanted by a mix of woodland and grassland by the end of the century. With this knowledge my visits home are now filled with a sense of urgency and melancholy as I am increasingly aware of the gradual degradation of the most arid boreal forest in the world in which I first learned my love of the delicate ecosystems on which our modern society relies."

Katie Kirdahy
“Over the course of my High School and University education climate change was an ever present topic. A great importance was placed on it by my teachers. However, I did not see it valued as much in the public sphere. Today it is refreshing to see climate change become such a central topic for many more agencies, businesses, organizations, and nonprofits. With a greater understanding of the issue we are able to take stock of our greenhouse gas emissions, to see where we can trim back, and to celebrate the areas where we are limiting our emissions. As time passes the need to consciously limit greenhouse gas emissions is increasingly urgent. Yet I have grown more hopeful, for if we choose to recognize the real threat climate change poses we will have the research and tools to address a solution.”

Eric Martin
“The facts are in on climate change; discussion has shifted from questions of scientific validity to actionable possibilities. Sadly though, short-sighted economic and political motivations regularly take precedence over our long-term decision making abilities. Even when favorable options for the environment are chosen it is after a cost-benefit analysis in units of the present-tense. This type of thinking only perpetuates our current dilemma. The climate will continue to change until we do.”

Jennyfer Mesa
“Climate change is often perceived as a distant problem in coastal cities that are experiencing impacts of sea level rise, places with extreme drought and unusual storms, or our Earth’s melting ice caps. We’ve become accustomed to hearing daily warnings in the news about global warming and environmental degradation, yet we don’t fully receive its message or change our harmful habits. 2015 changed our local perspective on climate change as we experienced extreme weather conditions through wildfires, windstorms, drought emergencies, reduced snow pack and lower groundwater tables in our State. All of these environmental conditions are delicately intertwined with our community, built environment and our health. Understanding the effects of climate change and how our community plays a role in contributing to these environmental patterns can help us take action to mitigate and reduce worsening impacts. Part of starting this process is through our GHG inventory. With this report we have the opportunity to utilize the collected information to help guide us on how to plan for carbon emission reduction while building a resilient and environmentally proactive Spokane.”

Andy Nicodemus
"As the questioning of the legitimacy of climate change and its causes continue to decrease, the endeavors to cope with and decrease future impacts of climate change remain a focus for many. Climate change will always be an important issue, but the most effective solutions cannot be achieved without the efforts of many. Fortunately methods for reducing environmental impact also fall in line with sustainable business practices and movements to reduce operating costs through resource management. It's there within the commonalities and shared goals of both environmentalists and other organizations that the effects of climate change can be addressed directly without encountering financial cost barriers. Climate change is a large issue, one that cannot be successfully engaged by the actions of one organization alone."

Mollie Picha
"Although some people argue that global climate change, especially anthropogenic climate change, is not occurring, the evidence is stacked against them. Climate change on a global scale is a natural phenomenon, but the changes we are experiencing now are more intense than any others seen throughout history. The drastic increase in greenhouse gases emitted since the industrial revolution correlates with the global climate changes we have seen in recent decades. Rising sea levels, more intense storms and species extinction are all correlated to increased greenhouse gas emissions. The greenhouse effect is miraculous in that it keeps us alive by keeping the earth warm. But, too many greenhouse gases and the consequences could be severe. Although only time will tell if the correlation between anthropogenic greenhouse gases and global climate change is in fact causation, we have the responsibility to do what we can to prevent negative effects from human-caused climate change. Reducing greenhouse gas emissions along with other polluting practices will only increase the quality of life of all plants, animals and humans who inhabit earth."

Jessica Reed
"Through interning with the City of Spokane Environmental Programs department, I have been given the opportunity to become familiar with the changes occurring in this city. I have lived in Spokane for 11 years, and have begun to see the changes first hand. The winters are warmer, the summers are dryer, and there's less snow on the mountains. In my first few years in Spokane, I was used to seeing snow from Halloween to Easter. Now, the snow tends to only fall for a few months, and last year it was too warm to stick. Working with the city gave me a new perspective on climate change because it showed me the numbers that are proof that climate change really is happening. It also demonstrated that governments are taking necessary steps to help reduce this problem which should give the community hope and inspiration to do the same."

Sam Roberts
"Cities are significant contributors to climate change, but they are also the solution. A report produced by the United Nations in 2011 stated that the world's cities are responsible for up to 70 percent of harmful greenhouse gases, while only occupying just 2 percent of the land. Understanding how cities contribute to climate change will help us combat greenhouse gas emissions at the local level. Climate change is a global problem, one that does not adhere to any type of political boundary. And while global problems call for global solutions, real change begins at the local level, from the bottom-up. With population trends indicating that an increasing number of people are migrating to cities every year, the responsibility to combat climate change lies in the hands of the citizens of those cities, from the policy-makers to the business owners to the climate activists. By tracking greenhouse gas emissions and setting reduction goals, the City of Spokane can more adequately direct our efforts on lowering our carbon footprint and provide a sustainable future for Spokanites to live, work, and play."

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Progress Related to Goals

Target 7% describes the goal to achieve seven percent GHG emissions reduction from 1990 by 2012. Target 2030 goal is to achieve 30% GHG emissions reduction from baseline 2005 by 2030.

Progress toward these goals was evaluated for Government and Community for both years 2010 and 2012. Also, for information purposes, back-casting analysis was performed with Waste-To-Energy facility included in 2005 and 2010.

One goal was met: Measured progress for City of Spokane government in 2012 was below 7% of 1990 estimated greenhouse gas emissions.
For information purposes, Spokane City, or "Community," measured progress for the residential, commercial and industrial economic activities within the boundary of "Spokane City" were below 8.4% of 2005 adjusted emissions. The arrow ↓ indicates "decrease;" ↑ means "increase."

- Government Met Target 7%: 11%↓

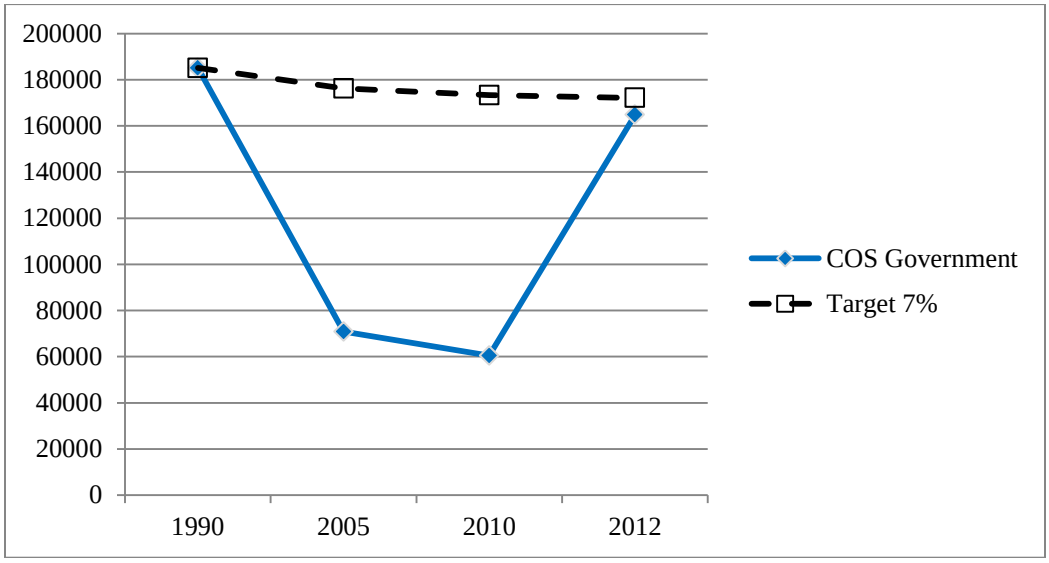

Figure 0-1 City of Spokane Government Total GHG Emissions vs. 7% Reduction Target

- Target 7%: Not met by community 2%↑.

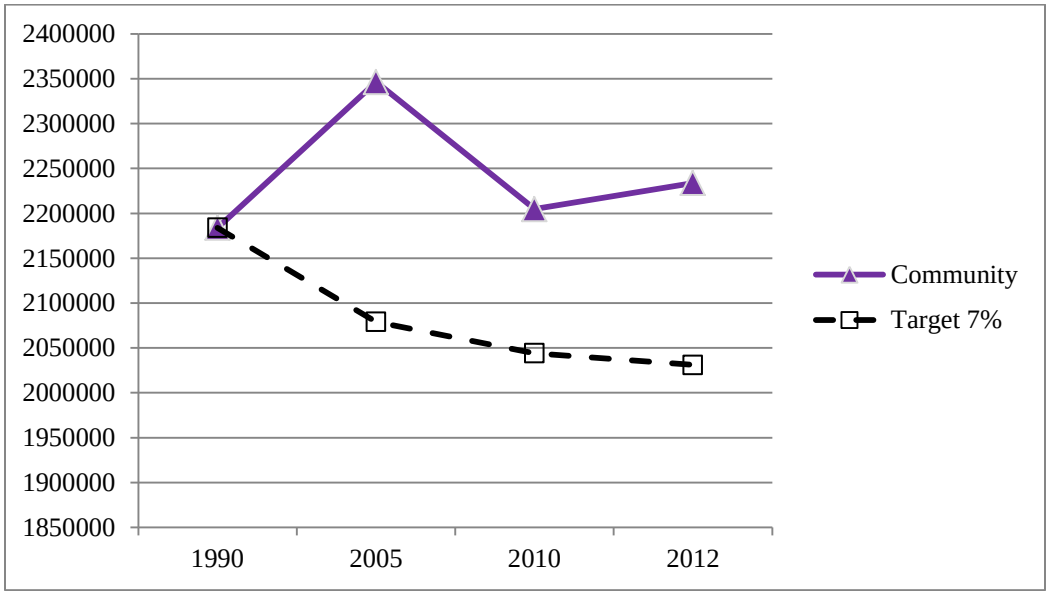

Figure 0-2 Spokane City Total GHG Emissions vs. 7% Reduction Target

- **Progress toward Target 2030: 1) to Achieve 8.4% Reduction from 2005 by 2012 and 2) Annual Reduction of 1.2%** Note: These targets have the same trend line.

1) Target 2030: 8.4% decrease from 2005 by 2012 – not met by government 133%↑,
2) Annual Reduction: 2.4% decrease from 2010 to 2012 – not met by government 173%↑.

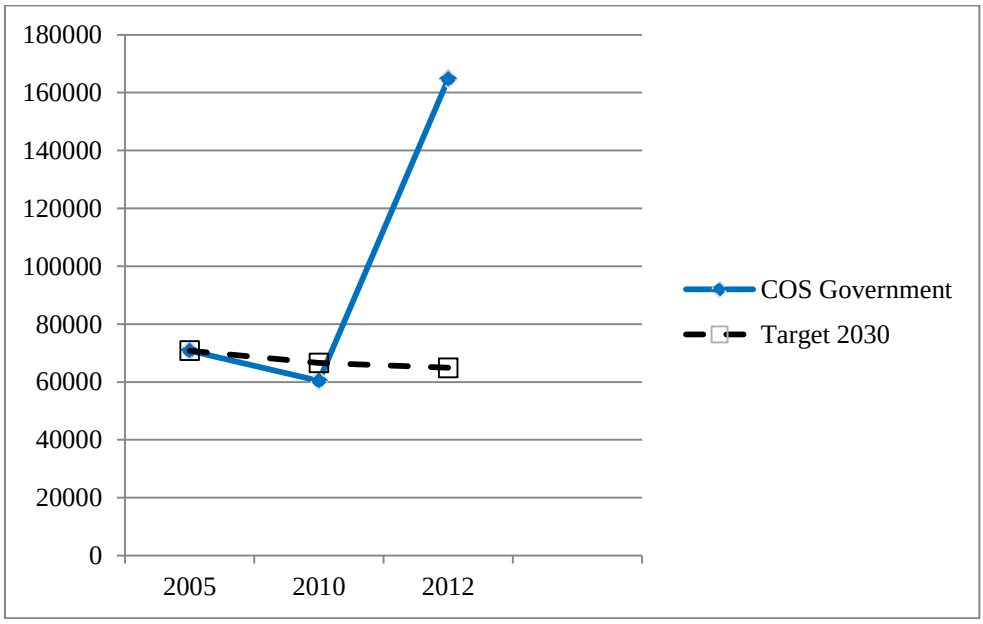

Figure 0-3 City of Spokane Government Total GHG Emissions vs. Target 2030

1) Target 2030: 8.4% decrease from 2005 by 2012—not met by community 5% ↓
2) Annual Reduction: 2.4% decrease from 2010 to 2012 – not met by community 1%↑.

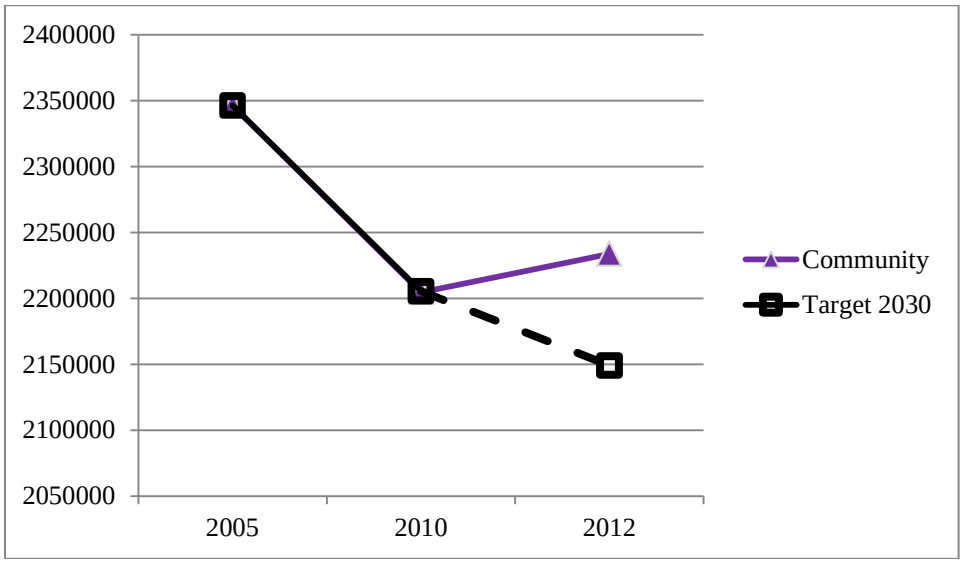

Figure 0-4 Spokane City Total GHG Emissions vs. Target 2030

- For informational purposes, the addition of Waste-to-Energy (WTE) Facility emissions made a difference in 2005 and 2010 Government emissions figures.

1) Target 2030: 8.4% decrease from 2005 by 2012 – not by government 7.7%↑,
2) Annual Reduction: 2.4% decrease from 2010 to 2012 –not by government 2.0% ↑

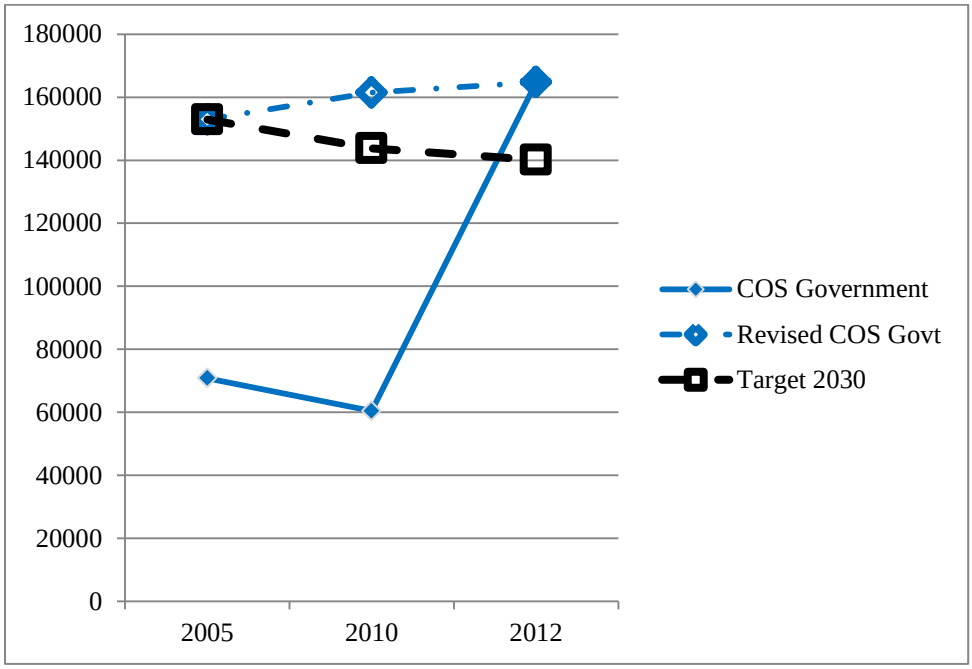

Figure 0-5 Revised City of Spokane Government Total GHG Emissions vs. 2030 Target

Year	Government GHG Total	Revised Govt GHG Tot.	Target 2030
2005	70,835	152,909	152,909
2010	60,425	161,448	143,734
2012	164,743	164,743	140,065

Table 0-1 Revised City of Spokane Government Total GHG Emissions vs. 2030 Target statistics

- For informational purposes, the addition of Waste-to-Energy (WTE) Facility emissions made a difference in 2005 and 2010 Community emissions figures.

1) Community Met Target 2030: 8.4% decrease from 2005 to 2012—8.7%↓
2) Annual Reduction: 2.4% decrease from 2010 to 2012—not by community 1.1%↓.

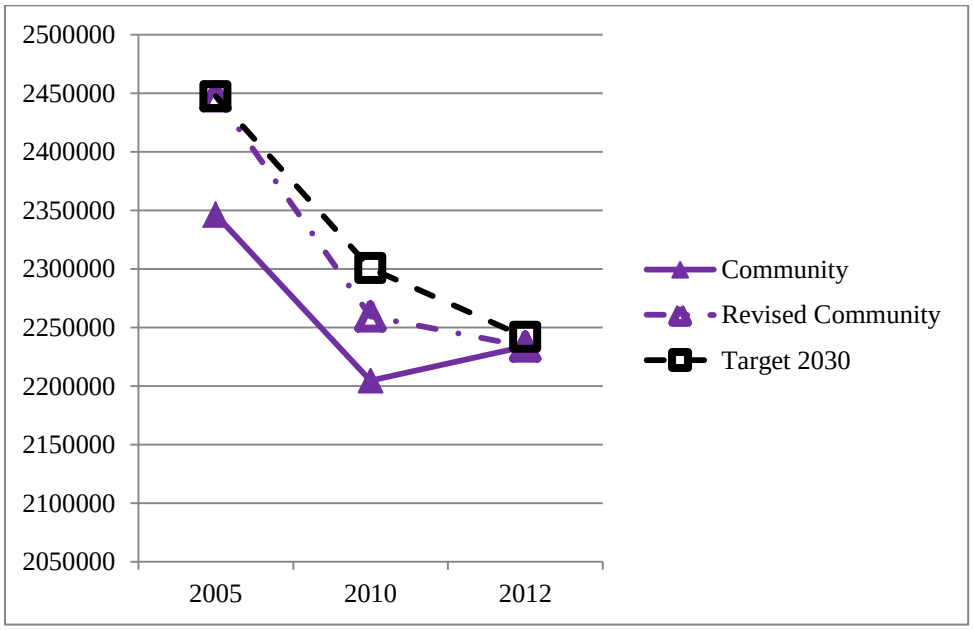

Figure 0-6 Revised Spokane City Community Total GHG Emissions vs. Target 2030

Year	Community GHG Total	Revised Com. GHG Total	Target 2030
2005	2,346,251	2,447,419	2,447,419
2010	2,204,685	2,259,425	2,300,574
2012	2,233,721	2,233,721	2,241,836

Table 0-2 Revised Spokane City Community Total GHG Emissions vs. Target 2030 statistics

Key Findings- Spokane City Greenhouse Gas Emissions

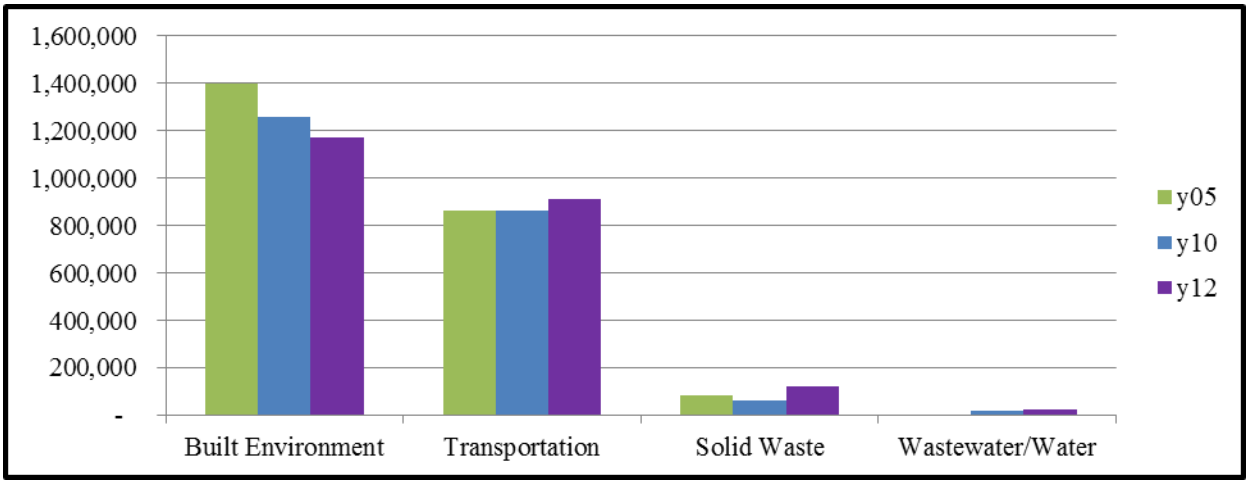

Figure 0-7 Graph Spokane City Community Greenhouse Gas Emissions 2005-2010-12

Table 0-3 Spokane City Community GHG Emissions Annual Comparison Summary Table

Year	Built Environment	Transportation	Solid Waste	Water and Wastewater	Total Emissions $MTCO_2e$
2005	1,396,731	864,551	84,587	382	**2,346,251**
2010	1,258,376	865,841	63,465	17,003	**2,204,685**
2012	1,173,336	914,370	120,120	25,895	**2,233,721**

Two events made major impacts on GHG emissions reduction progress. First, the Great Recession, December 2007 through June 2009, had a positive impact to the community and government GHG reduction efforts. Community building energy use dropped during the Great Recession; down 16% in 2012 compared to 2005. Second, in 2012 Spokane City annexed area southwest of the City center, bringing the Waste-to-Energy (WTE) facility and Spokane International Airport (SIA) into the City. This addition made a negative impact on greenhouse gas emissions inventory. The WTE facility was operating in 2005 as it does today. The 2005 and 2010 inventories only counted GHG emissions from incinerating City-caused waste. The 2012 inventory counts all of the WTE GHG emissions because they are now occurring within the City limits.

The GHG community transportation emissions for 2005 were over estimated as the transportation data used was for the carbon monoxide (CO) non-attainment area which included a large portion of the valley. The adjusted 2005 community transportation sector value is half (50%) of the reported value in 2009 report, explained in more detail in the transportation sector section. This resulted in a smaller percentage of the community greenhouse gas inventory, 36.8% instead of 53.5%. It also decreased the total greenhouse gas emissions from 3,229,308 $MTCO_2e$ to 2,346,251 $MTCO_2e$. While Vehicle Miles Traveled (VMT) increased 1.9% between 2010 and 2012, GHG emissions only went up by 1%, a change that may be from improved vehicle efficiencies. The average age of vehicles registered in Spokane County in 2012 was 12 years.

Water and Wastewater GHG emissions increased by more than 66 times from 2005 because of two major changes. First, the protocol used in the City of Spokane 1990 & 2005 Greenhouse Gas Inventory did not

segregate Water and Wastewater as a specific community sector and in such detail. Emissions from energy use for this sector were included in the Residential, Commercial and Industrial Buildings section of the Community Inventory. Total emissions for combined water and wastewater sectors in 2005 were estimated to be 15,259 $MTCO_2e$. The value used here, "382" $MTCO_2e$, is attributed to wastewater digester gas methane loss, about one percent (1%). Second, Avista Utilities changed the contractual agreement for Upriver Dam generated electricity energy in 2012. The 84% increase in emissions from 2010 to 2012 is primarily due to a change in how electrical power at the water department was purchased and sold.

Key Findings- City of Spokane Government Greenhouse Gas Emissions

The graphs of government emissions dramatically demonstrate the impact of claiming all of the Waste-to-Energy Facility's emissions as the City's. This occurred as a consequence of annexation and the fact that power generation at Upriver Dam is considered a zero emitter. The graphs also highlight how large the Waste-to-Energy Facility emissions are as compared to the other City government emission sources. Of the other government sectors the Solid Waste, Wastewater, Fleet, Buildings, and Water sectors are the highest in that order. The City government Wastewater sector declined in 2012 as a consequence of the new Airway Heights and Spokane County treatment plants coming on line. Information on refrigerants was kept the same because it was provided for only a few facilities, vehicle air conditioning and white goods recycled by Solid Waste Management. Refrigerants are potent sources of greenhouse gas emissions; HFC-134a and R-410a were the compounds required to be reported. Refrigerants were not reported in the 2005 GHG Inventory Report.

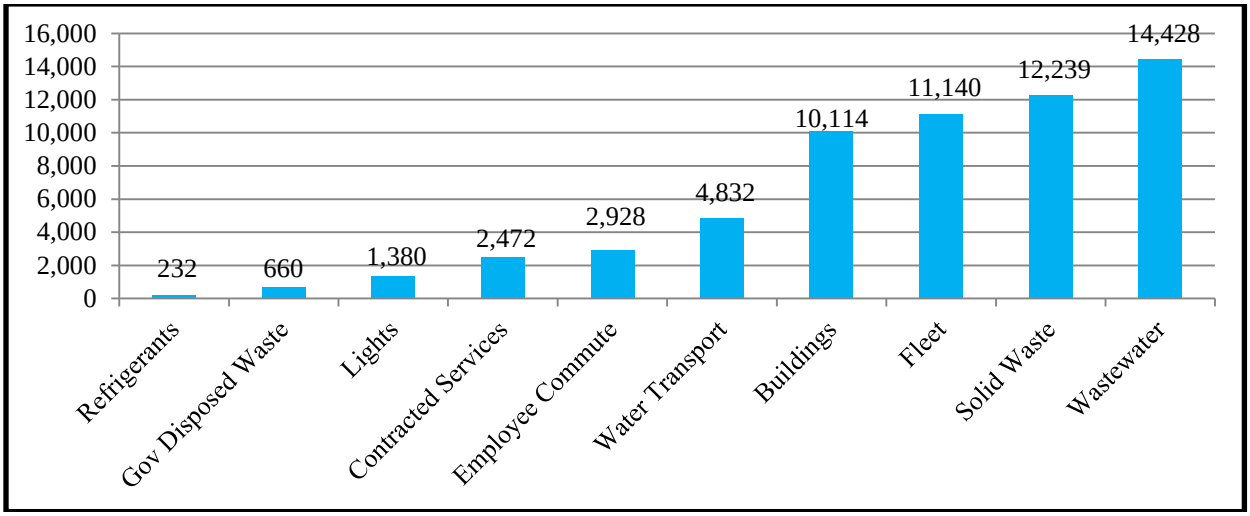

Table 0 2: 2010 City of Spokane Government Emissions by Sector –CO2e

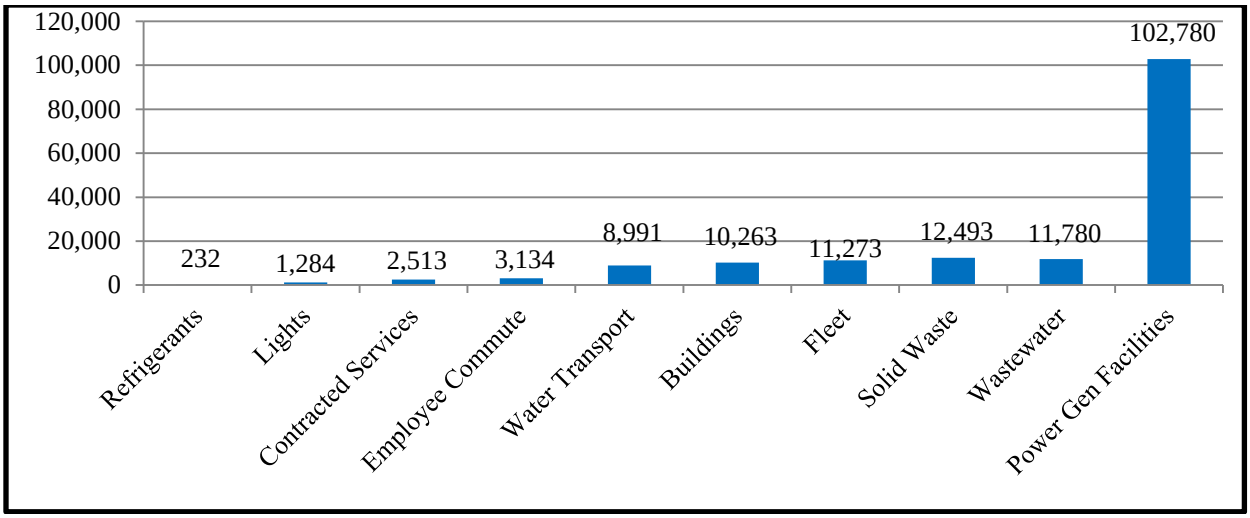

Table 0 3: 2012 City of Spokane Government Emissions by Sector –CO2e

Background: Fuel Combustion and Reported Gases

The Earth's atmosphere is naturally composed of a number of gases that act like the glass panes of a greenhouse, retaining heat that keeps the temperature of the Earth stable and hospitable for life at an average temperature of 16 degrees Celsius (60.8 degrees Fahrenheit). Water and carbon dioxide (CO_2) are the most prolific of these gases. Other contributing gases include methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and man-made halocarbons. Without the natural warming effect of these gases, the Earth's surface temperature would be too cold to support life.

Biogenic sources of carbon like wood, paper, and bio-fuels contain carbon that is part of the natural carbon cycle. Combustion of biogenic fuel serves to simply return carbon that the process of plant growth had recently taken out of the atmosphere. So the biogenic carbon dioxide figures are not included in total emissions in this inventory; only the fossil fuel derived carbon dioxide is.

Refrigerants used in City of Spokane Government buildings were documented using HFC-134a (1300 GWP) and R-410a (1725 GWP). No refrigerant use was documented in 2005 GHG Inventory.

Greenhouse Gas	100 year Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (NH_4)	21
Nitrous Oxide (N_2O)	310
HFC-134a	1,300
Sulfur hexafluoride (SF_6)	23,900
R-410a refrigerant blend	1,725

Table 0-4 Table GWP.1: Global Warming Potentials (GWP) of greenhouse gases [1]

[1] Source: IPCC: Climate Change, 1995, The Science of Climate Change, Contribution of the First Working Group to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Technical Summary, Table 4. Source: ICLEI: Local Government Operations Protocol, version 1.1, May 2010, Table E.2, page 199.

Climate Change Impacts in Washington State

"Climate change is a global issue, but the impacts are being felt locally in Washington state: acidifying oceans; increased risk of wildfires; drought; and reduced snowpack threatening water supplies for fish, crops, power generation – and people.

University of Washington research projects average annual temperatures in our state will rise 3 degrees by 2045. Three degrees sounds small, but it is enough to upset the balance of our state, impacting public health and damaging our environment, infrastructure, and economy."[i]

Government Actions Being Taken

In December 2015 world leaders reached an agreement in Paris to combat climate change. This agreement of nearly 200 countries including the US, China, and India includes commitments to reduce carbon pollution, review goals and set more stringent reductions every five years and regularly report progress. In the United States the Federal government has taken a number of actions to address climate change including a Clean Power Plan and fuel economy standards for vehicles.

"In 2008, the Washington Legislature adopted emission reduction targets that called for our state to limit our greenhouse gases, returning to 1990 levels by 2020, cutting emissions 25 percent below the 1990 level by 2035, and reaching 50 percent below 1990 levels by 2050.

In 2015, Governor Jay Inslee directed the Department of Ecology to develop a rule to cap and reduce greenhouse gases in Washington under our state's Clean Air Act. The Clean Air Rule, which is now open for public review and comment, will address activities responsible for about two thirds of carbon pollution in Washington, such as transportation, refining and manufacturing."[2]

The Spokane City Council, on 28 June 2010, passed resolution 2010-0038 setting GHG emissions reduction goals for both the City government and for the Community.
The Great Recession, and behavior changes in reaction to it, brought us close to achieving the first goal. The significant economic stress reduced transportation and building energy use. The 2012 annexation, on the other hand, worked against meeting the goal.
The City has moved from less efficient buildings and consolidated operations. In 2015, the Fleet Department moved to a new building at Spokane Central Services Center. Low impact development standards have reduced the need for energy intensive water treatment systems. The City is monitoring government energy and water use monthly. The City continues to report on its emissions and annually generates Departmental Energy and Water Use reports.

The Inventories

This one report covers three areas of interest and two years for each, resulting in six inventories.
1) There were two years to be considered for each aspect: 2010, a United States Census year, and 2012, a greenhouse gas reductions target year.
2) The City government inventory focused on operations where the City has ownership and control.
3) The City boundary changed between 2010 and 2012. The City annexation had the result of including the emissions from the Waste-to-Energy Facility in the inventory. Spokane City Community GHG emissions inventories have focused on those emissions occurring within the Spokane City limits. In

[2] Washington Department of Ecology statements accessed http://www.ecy.wa.gov/climatechange/CAROverview.html on June 16, 2016.

addition, City Community emissions are reported as they relate to the larger region. Spokane County data and some estimated County emissions levels are provided for comparison with the City Community numbers.

A number of differences exist between these inventories and the 2005 inventory, and between these inventories and the protocols. The important differences are noted in the document under *Errors and Modifications.* 1) The GHG community transportation emissions for 2005 were over estimated. The transportation data used was for the region designated by air pollutant carbon monoxide (CO) non-attainment area, including a large portion of the valley. In this report we adjusted 2005 community transportation sector value to half (50%) of the previously reported value. This is explained in more detail in the transportation sector section. 2) The emissions in this report, also in 2005, are based on GHG warming potential factors for methane and nitrous oxide that were called for in the protocol. Since 2012 updated factors have been adopted. The factor for methane has gone from 21 (used in this report) to 25. Now Washington State and EPA have changed nitrous oxide factor from 310 to 298.
Doing a greenhouse gas inventory presents a number of challenges. What protocol to follow was the first and we had to make some compromises. Then there were some data issues: lack of good annual mileage data on the City fleet, lack of regional transportation models that conform to the protocol standards, lack of consistent and available annual data on Spokane Clean Air permitted facilities energy use, and our failure to identify for both the government and community reliable sources of information on refrigerant use. Making clear how the results were derived and from what input data was also a challenge. Finally this work takes time, and getting the results out in a timely manner is challenging.
These inventories have taken years to finish. The results are not complete from a protocol perspective and not all have been calculated using the preferred method and input data. Never-the-less we are confident that the results provide a good measure of how the City government and Community GHG emissions have changed over time.

Potential Emission Reduction Efforts

Potential reduction efforts are given for each of the sectors, both for community and government.
The reduction efforts suggested revolve around several key concepts:
1) To reduce Scope 1 emissions we need to use renewable alternative energy.
2) The most efficient way to make energy available and to reduce waste is to conserve.
3) Since public transit is necessary we should use it and help improve it.
4) Minimize energy conversions and energy transport as they result in energy loss.
5) Fighting climate change requires cooperation, communication, and consideration.

Conclusion

It is clear, looking at the direct emissions (Scope 1) for both the Community and City government; the trend is not in the downward direction. This is a problem if we hope to be part of the solution to the challenge of climate change. Actions to make adaptation to and mitigation of climate change effects are proposed to decrease emissions from the "business as usual" case. Let us not forget, while man is being impacted, most other living things which lack our adaptability are suffering very significant environmental change as well.
The City of Spokane's goals, set in 2010, appear to be in-line with the State and Federal goals. These goals are not recommended to be changed at this time. Instead, taking action to meet the goals sooner rather than later is strongly encouraged. At some point our ability to make positive change may be constrained by the cost of adapting to and recovering from the negative changes that come.

I. Introduction

A. Local Impacts of Climate Change

Climate change is a global problem influenced by an array of interrelated factors that have significant consequences for the Pacific Northwest. A 2013 report by the University of Washington's Climate Impacts Group found that climate change will significantly challenge the region's natural and built systems.[3]

There is very little variability in short-term predictions of the average global temperature over the next twenty to thirty years. This is due to the significant lag time inherent in the climate system: the impact of gases already in the atmosphere will determine the impacts felt in the near term. However, longer-term outcomes, meaning those relating to outcomes that will be felt between 2040 and 2100, will be shaped by the actions taken today.

B. Action Being Taken on Climate Change

1. Regional Actions

Many states are considering the effects of climate change. As of February 2015, 32 states have completed or are working on comprehensive Climate Action Plans.[4] The most common state laws call for studies of the impacts of climate change and require inventories of the states' GHG emissions and the creation of commissions to study the possible implications of GHG trading systems. 20 of these states have passed legislation setting GHG targets.[5]
29 states have also established renewable portfolio standards, mandating portions of electricity be generated from renewable energy, while another 9 states have renewable portfolio goals.[6]

In addition to these individual state actions, regional coalitions are coordinating interstate agreements to mitigate climate change in North America. The Western Regional Climate Action Initiative was announced in February 2007, by the governors of Arizona, California, New Mexico, Oregon and Washington. Since that time, Utah, British Columbia, Montana, Ontario, Quebec and Manitoba have joined the Initiative with the goal of forming an interstate carbon market.
Under the initiative, California and Quebec have established and implemented a market based carbon cap and trade system, while the other participating states have decided to pursue emissions reductions goals independently, with British Columbia establishing its own carbon pricing scheme.[7] [8]

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[3] Dalton, M.M., P.W. Mote, and A.K. Snover [Eds.]. 2013. Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities. Washington, DC: Island Press.
[4] Pew Center on Global Climate Change (2011) "Climate Action Plans." http://www.pewclimate.org/what_s_being_done/in_the_states/action_plan_map.cfm
[5] Center For Climate And Energy Solutions (2015) "Greenhouse Gas Emissions Targets" http://www.c2es.org/us-states-regions/policy-maps/emissions-targets
[6] Database of State Incentives for Renewables & Efficiency (2014) "Renewable Portfolio Standards" http://www.dsireusa.org/documents/summarymaps/RPS_map.pdf
[7] Center For Climate And Energy Solutions (2015) "Western Climate Initiative" http://www.c2es.org/us-states-regions/regional-climate-initiatives/western-climate-initiative
[8] Clearing the air about the Western Climate Initiative. (2015, January 11). Montreal Gazette. Retrieved from http://montrealgazette.com/business/clearing-the-air-about-the-western-climate-initiative?__lsa=2c8f-52fe

Since then, in 2013, Washington, Oregon, and California have formed the less ambitious Pacific Coast Action Plan on Climate and Energy which, while not legally binding, is an agreement to harmonize greenhouse gas targets, account for the cost of carbon, implement low-carbon fuel standards, embrace clean energy, and to research and monitor ocean acidification while allowing for increased flexibility of independent action.[9]

2. Washington State Actions

"In 2008, the Washington Legislature adopted emission reduction targets that called for our state to limit our greenhouse gases, returning to 1990 levels by 2020, cutting emissions 25 percent below the 1990 level by 2035, and reaching 50 percent below 1990 levels by 2050.

In 2015, Governor Jay Inslee directed the Department of Ecology to develop a rule to cap and reduce greenhouse gases in Washington under our state's Clean Air Act. The Clean Air Rule, which is now open for public review and comment, will address activities responsible for about two thirds of carbon pollution in Washington, such as transportation, refining and manufacturing."[10] Washington State requires large emitters to report on their GHG emissions, as does Environmental Protection Agency.

3. Local Actions

"Spokane is located in the heart of the Inland Northwest and is the second most populous city in Washington. The Spokane River runs through the city and beautiful Riverfront Park in downtown Spokane. An array of enjoyable outdoor activities are right out our back door; including ski resorts, white-water rafting, camping areas, hiking trails, lakes, and the Centennial trail.

Spokane has been selected as an All-America City three times in the past 41 years, including in 2015 when it was one of 10 honored throughout the country. The city hosts many great community events, festivals and gatherings, and is home to the Lilac Bloomsday Run, the largest timed road race in the nation, and the largest three-on-three basketball tournament, Hoopfest. Spokane ranked #4 in the country for metropolitan areas with the highest published employment concentrations and wages in the health care industry according to the Bureau of Labor Statistics.[11]"

The City has made policy and programmatic efforts towards reducing climate impacts. Since 2007, several mayors have signed agreements, such as "Cool Cities," started by Mayor Greg Nickels in Seattle, Washington, and formalized in The U. S. Conference of Mayors Climate Protection Agreement,[12] pledges to make GHG reductions. City Council has made resolutions supporting efforts to make City of Spokane more sustainable also. City departments have moved from less efficient buildings and made more consolidated operations, particularly with the recent move of the Fleet Department to a new building at the City Central Services Center. The City is replacing its Solid Waste diesel fleet with cleaner burning natural gas vehicles. Lighting is gradually being transitioned to more efficient LED. Large concrete tanks to contain storm and wastewater overflow volumes are being designed and built, while low impact development standards have been provided that will reduce the need for energy intensive treatment systems. The City is monitoring government energy and water use monthly. Exceedances and savings

[9] California, Oregon, Washington, and British Columbia Agree to Cooperate On Reducing Carbon Pollution (2015, October 28). Climateprogress. Retrieved from http://thinkprogress.org/climate/2013/10/28/2850021/california-oregon-washington-british-columbia-agreement/

[10] Washington Department of Ecology statements accessed http://www.ecy.wa.gov/climatechange/CAROverview.html on June 16, 2016.

[11] https://my.spokanecity.org/about/spokane/ on June 17, 2016.

[12] http://www.yaleclimateconnections.org/2008/03/sierra-club-prodding-local-actions-through-cool-cities-climate-campaign/ and http://www.usmayors.org/climateprotection/cities.asp?state=WA on June 17, 2016.

are noted and information is sought regarding the cause of the change from the departments. The City continues to report on its emissions and annually generates Departmental Energy and Water Use reports.

C. City of Spokane Goals

The Spokane City Council, on 28 June 2010, passed resolution 2010-0038 setting GHG emissions reduction goals for both the City government and for the Community such that:
1. By 2012 the City's GHG emissions will be at least seven percent (7%) below the calculated 1990 level; and
2. By 2030 the City's GHG emissions will be at least thirty percent (30%) below the 2005 level; and
3. To foster continuous improvement and as a measure of appropriate progress at least a one and two tenths percent (1.2%) reduction should be made below the previous year's GHG emission each year;

These goals were recommended in the initial Inventory document, and it was known then that the first goal--seven percent (7%) reduction from 1990 levels by 2012, would be difficult to achieve. It was recommended and retained because there was recognition that early action could accrue significant benefit, such as less impactful outcomes, with technological and economic advantages. This inventory report has been prepared to document the City's position via the goals at the 2010 and 2012 points in time as compared to the previously documented 2005 status.

D. Meeting Goals

As mentioned, meeting the goals is challenging, particularly as needed technological advances appear on the horizon but have not yet been fully developed. It is challenging too, to get approval to spend money on reduction measures where the long term benefit is not clear.
On the other hand nothing we could have imagined would have gotten us as close to achieving the first goal, seven percent (7%), as did the Great Recession. The significant economic stress reduced transportation and building energy use.
Another challenge for both City government and the community with regard to GHG reduction goals is that when the City expands, as it did in 2012, service needs are increased and the area of operations is increased. The reduction goal with a comparison year of 2005 does not change. We cannot adjust the goal to every expansion or new demand put on government. Instead, it becomes more difficult to achieve.

There are three possible ways generally recognized to meet the climate change challenge: reduction of emissions, mitigation of the emissions or consequences resulting from them, and/or adaptation to the consequences of the emissions. Because the impacts are global, of varying type and location, and not all particularly predictable, we think it best to focus energy and resources on the first way, reduction of emissions. Certainly man has great capacity to adapt, but we must consider how we are part of, and dependent on, a web of life, much of which has significantly less capacity to adapt.

E. Units and Underlying Assumptions

GHG inventories traditionally only account for emissions resulting from burning fossil fuels, excluding CO_2 emitted from biogenic sources. Biogenic sources of carbon like wood, paper, and bio-fuels contain carbon that is part of the natural carbon cycle. Combustion of biogenic fuel serves to simply return carbon that the process of plant growth had recently taken out of the atmosphere, theoretically resulting in net zero carbon emissions.

Fossil fuel sources contain carbon excluded from the carbon cycle for thousands or millions of years. Combustion of these sources adds carbon to the atmosphere that the natural carbon cycle is not used to

accounting for, leading to imbalance in the planet's carbon cycle. Other greenhouse gases than carbon dioxide, like methane or nitrous oxide, are also emitted from biogenic sources depending on the human caused conditions of decay or combustion.

These emissions are included in a GHG inventory even though they are biogenic in origin, as "information items." Greenhouse gas emissions inventories are typically reported in units of measurement: carbon dioxide equivalents (CO2e, used in this report) or CDE. If the measurement units are not specified, the reader can assume the numeric meaning is "Metric Tons of Carbon Dioxide Equivalents" (MTCO2e).

City population and number of households are basic statistics that provide context to the emissions described in this report. In the table below, Washington Office of Financial Management April 1 figures are for the two years, 2010 and 2012, and the two political boundaries, Spokane City and Spokane County, obtained in June 2014 to make 'community' calculations. After that time, figures were officially adjusted downward. Calculations for regional wastewater treatment facility, Riverside Park Water Reclamation Facility, were modified from official figures, due to the service area being outside the City of Spokane political boundary in 2010. The service area was reduced in 2012 when Spokane County Water Reclamation Facility (SCWRF) was placed into service.

Table I-1 Population and Household figures for 2010 and 2012 used in this Report

Year	Spokane City Population[13]	Spokane City Households	Spokane County Population	Spokane County Households	Census for Regional Wastewater Treatment
2010	208,916	94,291	471,221	201,434	303,025
2012	210,000	94,901	475,600	203,920	241,300

[13] http://www.ofm.wa.gov/localdata/spok.asp on June 23, 2014.

II. Emissions Inventory Background

A. Challenges Doing an Inventory

This report is describing information to evaluate two different targets, ere are a number of challenges regarding the process of doing a GHG emissions inventory. This is mentioned to inform individuals who may play a role in providing data, or specifying methods, to assist in reducing the hurdles that are faced by those doing the inventory. The first challenge is to determine what reporting protocol is to be followed. There are a number of options. Our goal in choosing protocols was to have an inventory that would be comparable to other US City inventories, but also one that was available at minimum cost. For this inventory there was a primary protocol we followed for the government inventory and another for the community inventory. We used other protocols, such as from EPA, for particular pieces. The protocols often have strings attached to their availability including the protocols the City used. Thus, we cannot be sure that the methods used are the very latest.

Getting the data for an inventory is also challenging. Since this was our second time through the inventory process, we recognized the need for particular data sets. We went about collecting them, but protocol changes required additional data sets as well. Four areas where information was lacking are: 1) verified annual mileage data for the City fleet; 2) regional transportation models that conform to the protocol standards; 3) consistent and available annual energy use data for facilities with Spokane Clean Air Agency permits; and 4) reliable sources of information on refrigerant use in both government and community facilities. While there are problem areas, people and entities that provided data deserve thanks and appreciation. These inventories would not be possible without their help.

Identifying the data, calculations and factors from which the inventory results are derived is also a significant hurdle but a very important one. There are a number of protocols and a wide variety of potential starting data and data quality variability. For these inventories we strived to keep the workbook calculations as transparent as possible. They are provided here for those who wish to delve deeper.

The time it takes to get good data, analyze and perform calculations as required by the protocols was a significant hurdle for us in terms of reporting out in a timely manner. This second inventory took more time than the first in part because of data differences and calculation differences.

B. Scope

1. City of Spokane Government Inventories

The focus on City government operations is where the City has ownership and control. One exception to this was the inclusion of the street lights (other than traffic control), a majority of which are owned and operated by Avista under contract to the City. The protocol used was “Local Government Operations Protocol, version 1.1., May 2010, ICLEI-Local Governments for Sustainability USA. The City boundary changed between 2010 and 2012 and as a consequence the City’s portion of the emissions from the Waste-to-Energy Facility changed from a proportional amount based on waste delivered from the City to the full emissions amount when the Facility was brought into the City with an annexation. We do not include other non-City government facilities which are located in the City in this inventory (e.g. Spokane County and Federal facilities). Because the City does not control Spokane Transit or the Airports they too are not included in the City inventories. We are providing data on upstream emissions and travel and commute emissions for information purposes but do not include those results in the reported total.

2. City Community Inventories

The Spokane Community GHG emissions inventories have focused on those emissions occurring within the Spokane City limits. The protocol used was new, U.S. COMMUNITY PROTOCOL FOR ACCOUNTING AND REPORTING OF GHG EMISSIONS, version 1.1, July 2013, ICLEI-Local Governments for Sustainability USA. These inventories are intended to include City government emissions and all other known Community GHG emissions. Emissions that occur outside of the City limits but as a direct result of Spokane Community activities are also captured (e.g. landfill emissions in Klickitat County). As mentioned earlier, the refrigerant loss emissions have not been addressed. The purpose of conducting this inventory was to document five areas over which City government may have an influence:

1) Use of Electricity by the Community;
2) Use of Fuel in Stationary and Combustion Equipment;
3) On-Road Passenger and Freight Motor Vehicle Travel;
4) Use of Energy in Potable Water and Wastewater Treatment and Distribution; and
5) Generation of Solid Waste by the Community.

The first two are summarized in the "Built Environment" tables and summarized in the text. The remaining topics are, "Community Transportation," "Community Solid Waste," and "Community Water and Wastewater."

3. Spokane County Community Inventories

Available data for inventories has not always been City of Spokane specific. For example, the City provides regional wastewater treatment at Riverside Park Water Reclamation Facility. As a result regional data, frequently Spokane County data, is acquired. It may be helpful to give the reader some perspective on the reported City Community emissions as they relate to the larger region. For those reasons we have purposefully gathered available County data, especially for 2012, and estimated County emissions levels, for comparison with the City numbers. For the most part the County emissions numbers will be found in the data spreadsheets and only summary comparison information will be in the report text.

C. Errors & Modifications

The GHG community transportation emissions for 2005 were over estimated as the transportation data used was for the carbon monoxide (CO) non-attainment area which included a large portion of the valley. In this report we use an adjusted 2005 community transportation sector value (half of the reported value) as explained in more detail in the transportation sector section. Emissions from the City landfills and the Waste-to-Energy Facility followed the current reporting protocol from EPA and the State of Washington. However the values reported for the Northside Landfill were not those originally reported to EPA and currently on their website. Rather the reported values were those provided from Solid Waste Management as being modified and subsequently reported to EPA.

Much of the Fire Department's annual vehicle miles travelled was not available and so an estimate was made based on Police Department vehicle miles travelled. The largest portion of the GHG emissions from vehicles comes from the fuel used and we have good Fire Department numbers for fuel use. We just lacked the fuel use per vehicle type which predicts the nitrous oxide and methane emissions.

The protocol for determining projected lifetime emissions from waste placed in landfills was not used in determining the potential emissions from wastewater grit placed in the Northside Landfill MFS Cell.

Rather a single total and volatile solids analysis of grit in 2015 was used in setting a number as described in the Government Waste Disposed from City of Spokane Operations section.
For community airport emissions, not all necessary data was available and we modified the final step in determining Spokane's and the County's emissions. The protocol provided a path to set a portion of emissions aside and attribute them to the air travelers passing through. Also the protocol provided a way to allocate the remaining emissions amongst localities based on where passengers were coming from and going to.

We did not have this information and so instead used an apportionment that assumed one third of the passengers had a nexus to Spokane City, another third to Spokane County, and the final third to regions beyond. In recognition that SIA International was brought into the City limits in 2012, we attributed two thirds of the emissions in that year to the City of Spokane.

As a consequence of the new protocols a number of differences exist between the 2005 inventory and the inventories reported in this document. In particular the wastewater treatment portion of the protocol was expanded and incorporates more emission sources than before. As the protocol suggested, we added off road mobile emission source data from EPA. City government emissions associated with travel outside the region were calculated and provided for information. Other new data pieces are the life-time emissions from waste going to landfills and the "upstream" emissions that result from our use of fuels and energy.

The emissions in this report as in 2005 are based on GHG warming potential factors for methane and nitrous oxide that were called for in the protocol. Since 2012 updated factors have been recognized so that the factor for methane has gone from 21 (used in this report) to 25 now used by Washington State and EPA. The nitrous oxide factor also changed from 310 to 298. In following the protocol, we have provided the emissions of each of these gases so the emissions values can be recalculated as needed.

D. Terminology

Avista	Avista Corporation doing business as Avista Utilities provides natural gas distribution and electricity utility in Spokane, Washington area.
Biogenic CO_2	Is Carbon Dioxide that results from the burning of plant derived materials and which is therefore not counted as a greenhouse gas emission. The emitted carbon dioxide is considered part of the natural carbon cycle as it is not derived from what were sequestered fossil fuels.
CO_2e	Carbon Dioxide Equivalent, a common unit for comparing emissions of different greenhouse gases in terms of greenhouse warming potential of one unit of carbon dioxide.
GHG	Short for Greenhouse Gas which is any of a number of gases which when subject to sunlight absorb some of the energy and re-emit some portion back into the atmosphere much in excess of what oxygen or nitrogen would do. The result is an overall warmer climate and more energetic atmosphere. Important Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, and a number of refrigerants.
GWP	Global Warming Potential is a factor which is calculated for each GHG and can then be used to derive the CO_2e. These factors have changed over time as research has improved the understanding. Methane for example had a GWP of 21 in 2010 but now in 2016 it is recognized as 25.
Life Cycle Emissions	Total of all emissions that occur in the production, use, and disposal of a product.
MMBTU	Is a Million British Thermal Units. A BTU is the quantity of power needed to raise the temperature of one pound of water one degree Fahrenheit at a constant pressure of one atmosphere.
Sectors	Are categories of emissions from common sources such as government buildings, community transportation, solid waste, water/wastewater, etc.
Seven Percent (7%)	Target to reduce GHG emissions from 1990 levels seven percent (7%) by 2012
Scopes	Provide three categories to distinguish CO_2e emissions based on the source of emissions. Scope 1 emissions are all direct emissions except biogenic CO_2. Scope 2 emissions are indirect emissions from the purchase of electricity, heating, cooling, or steam. Scope 3 emissions comprise all other indirect emissions.
Target 2030	Target to reduce GHG emissions from 2005 levels 30 percent (30%) by 2030.
Upstream Emissions	Emissions that occur in the production of goods and services that are purchased or acquired. When counted these are counted as Scope 3 emissions.

III. Findings

A. Related To Progress Meeting Goals

1. Related to Goals

1) 7% Target – met by government 11%↓, not by community 2%↑
2) Target 2030--8.4% decrease from 2005 by 2012 – not by government 133%↑, or community 5%↓
3) Annual Target-2.4% decrease from 2010 to 2012 – not by government 173%↑, or community 1%↑

For informational purposes, the addition of Waste-to-Energy (WTE) Facility in 2005 and 2010
2) Target 2030--8.4% decrease from 2005 by 2012 –not by government 7.7%↑**,** met by community 8.7%↓
3) Annual Target-2.4% decrease from 2010 to 2012–not by government 2.0% ↑**,** not by community 1.1%↓

2. Other Key Findings

The 2008 Great Recession and the 2012 annexation (bringing the WTE facility and SIA into the City) made major impacts on progress, positive and negative respectively, to the community and government efforts. The WTE facility was operating in 2005 as it does today but the 2005 and 2010 inventories only counted City waste caused emissions whereas the 2012 inventory counts all of the emissions since they are now occurring within the City limits. If all WTE emissions are considered the WTE emissions increased by 17% from 2005 to 2012. Community building energy use dropped during the Great Recession and was down 16% in 2012 as compared to 2005. An Avista contract change and the new reporting protocol increased water and wastewater emissions accounted for by more than 66 times.

B. Emissions Summary

1. Scopes

Scopes provide a way to separate emissions an entity is solely responsible for as opposed to those it is not directly responsible for and/or in control of generating. Scope 1 emissions are those that result directly from burning fossil fuels or directly emitting greenhouse gases such as methane and refrigerants. Scope 2 emissions are those that are emitted usually in other locations by those producing the electricity which has been purchased and used. Scope 3 emissions are those which are less directly controlled and caused by the reporting entity. Examples of Scope 3 emissions here would include the commute trip emissions caused by employees, business travel outside the City by employees on City business, and emissions from landfills not in the City.

Compared to corrected 2005 data the 2012 Scope 1 emissions for the community increased by 2%, while the Scope 1 emissions for City government increased by 232%. This City government increase in Scope 1 emissions is driven primarily by the annexation of the area containing the Waste-to-Energy Facility and the Spokane International Airport. "Corrected 2005 data" refers to the replacement of the 2005 reported community transportation value with half as much. Our understanding now is that the 2005 community transportation value was twice the size it should have been because of the transportation model area the result was based on.

Scope 2 government emissions were 10% lower in 2012 as compared to 2005, while the community emissions were 17% lower. Reported 2012 Scope 3 emissions were greater than the 2005 emissions -

three times for government, and 26 times for the community. This primarily indicates a broader look at emission relationships presented in this inventory as compared to the first.
Between 2010 and 2012 Scope 1 and 2 emissions for both city government and the community generally increased (189% and 1% respectively) although not in all categories. Detailed emissions by scope and sector are included in **Appendix A**.

Table III-1: 2010 SPOKANE COMMUNITY SCOPE TOTALS - Gases

SCOPE 1			**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Stationary Combustion			504,106	126	8	510,035
Mobile Combustion			851,849	78	40	868,626
Fugitive Emissions			7	621	5	19,773
Process Emissions			0	0	3	822
Total Direct Emissions			1,355,962	825	55	1,399,256
SCOPE 2			CO_2	CH_4	N_2O	CO_2e
Purchased Electricity			801,255	15	12	805,428
Purchased Steam			-	-	-	-
District Heating & Cooling			-	-	-	-
Total Indirect Emissions			801,255	15	12	805,428
SCOPE 1 & 2 TOTALS			2,157,217	840	68	2,204,684
SCOPE 3						CO_2e
Electricity T&D						55,092
Upstream Emissions						229,445
Other WTE						55,318
SSLF						3,616
INDICATORS	Population	208,916				
	City Area	60.03	Square Miles			

Table III-2: 2012 SPOKANE COMMUNITY SCOPE TOTALS – Gases

SCOPE 1			**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Stationary Combustion			540,778	190	13	550,340
Mobile Combustion			900,100	80	40	916,989
Fugitive Emissions			7	643	6	22,084
Process Emissions			0	0	3	889
Total Direct Emissions			1,440,885	913	62	1,490,302
SCOPE 2			CO_2	CH_4	N_2O	CO_2e
Purchased Electricity			739,565	14	11	743,419
Purchased Steam			-	-	-	
District Heating & Cooling			-	-	-	
Total Indirect Emissions			739,565	14	11	743,419
SCOPE 1 & 2 TOTALS			2,180,450	927	74	2,233,721
SCOPE 3						**CO_2e**
Electricity T&D						50,850
Upstream Emissions						251,122
Other WTE						650
SSLF						3,571
INDICATORS	Population	209,525				
	City Area	69.53	Square Miles			

Table III-3: 2010 City of Spokane Government Scope Grand Totals

SCOPE	**Gases**						
SCOPE 1	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	5,166	3,939	27	0	0.0	0.0	0.0
Mobile Combustion	10,988	10,938	0	0			
Fugitive Emissions	12,312	0	568	0	0.1	0.0	0.0
Process Emissions	4,198	0	0	14	0.0	0.0	0.0
Total Direct Emissions	32,664	14,877	595	14	0.1	0.0	0.0
SCOPE 2	**CO_2e**	**CO_2**	**CH_4**	**N_2O**			
Purchased Electricity	21,909	21,795	0.415	0.338			
Transmission & Distribution	-	-	-	-			
Purchased Steam	453	451	0.043	-			
District Heating & Cooling	-	-	-	-			
Total Indirect Emissions	22,362	22,246	0.458	0.338			
SCOPE 3	**CO_2e**						
	112,182						

Table III-4: 2012 City of Spokane Government Scope Grand Totals

SCOPE	Gases						
SCOPE 1	**CO_2e**	**CO_2**	**CH_4**	**N_2O**	**HFCs**	**PFCs**	**SF_6**
Stationary Combustion	106,674	101,379	86	11	0.0	0.0	0.0
Mobile Combustion	11,073	11,033	0	0	-	-	0
Fugitive Emissions	13,327	0	614	0	0.2	0.0	0.0
Process Emissions	3,515	0	0	11	0.0	0.0	0.0
Total Direct Emissions	134,589	112,412	700	23	0.2	0.0	0.0
SCOPE 2	**CO_2e**	**CO_2**	**CH_4**	**N_2O**			
Purchased Electricity	24,144	24,019	0.456	0.373			
Transmission & Distribution	-	-	-	-			
Purchased Steam	363	362	0.034	0.001			
District Heating &	-	-	-	-			
Total Indirect Emissions	24,507	24,381	0.490	0.374			
SCOPE 3	**CO_2e**						
	10,275						

2. Sectors

Sectors are relatively discrete activities or operations with similar sources of emissions. They are reported on individually as the computation of the emissions is done in a similar manner in each sector and the potential mechanisms to lower the emissions would be similar as well.

Figure III-1: 2005, 2010, & 2012 Community Emissions by Sector –CO_2e

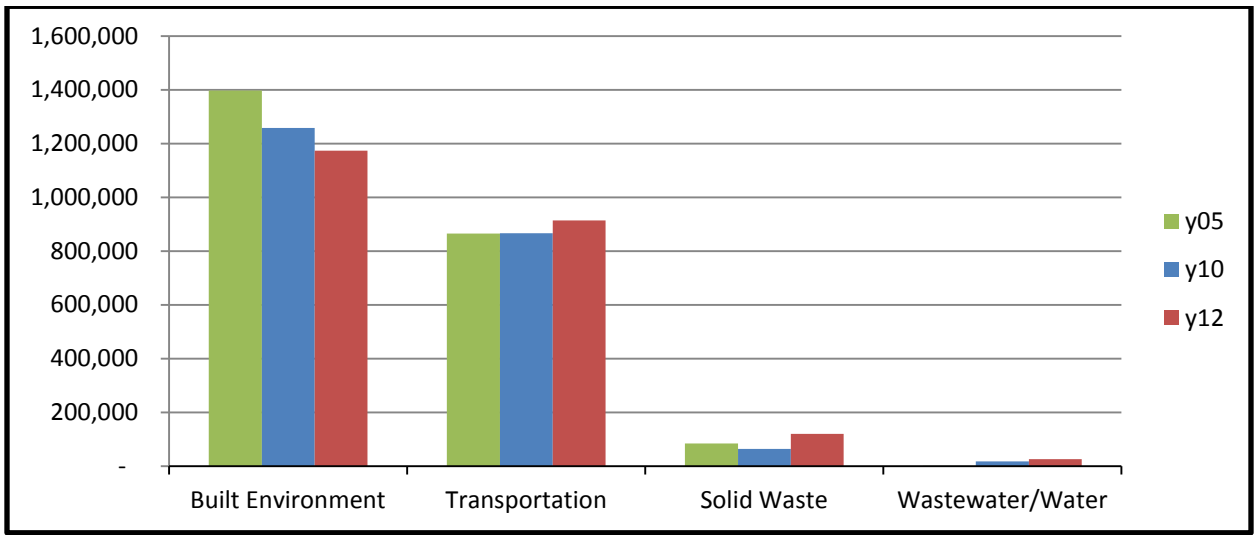


Figure III-2: 2010 Government Emissions by Sector –CO_2e

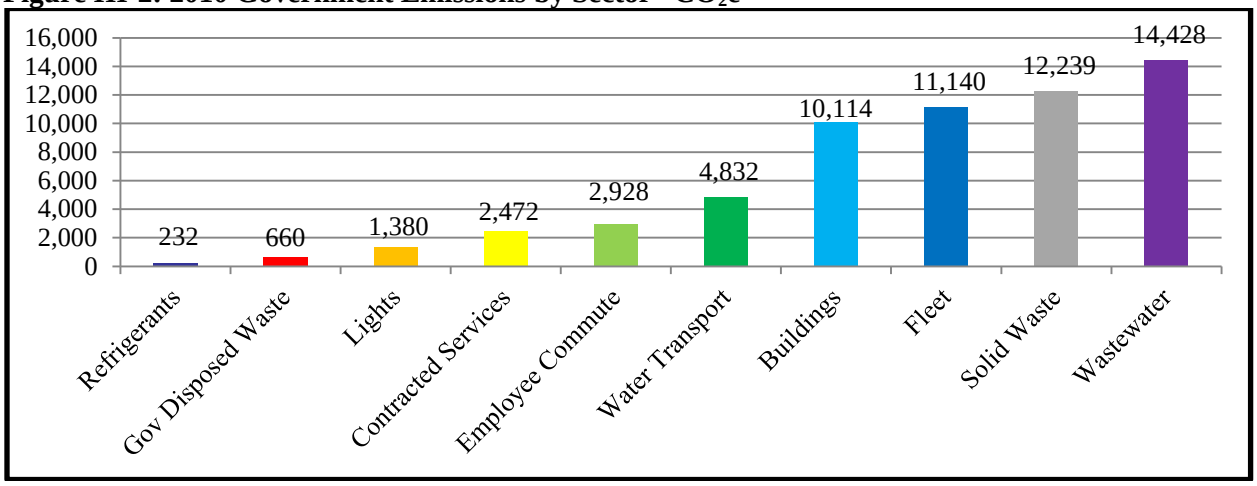
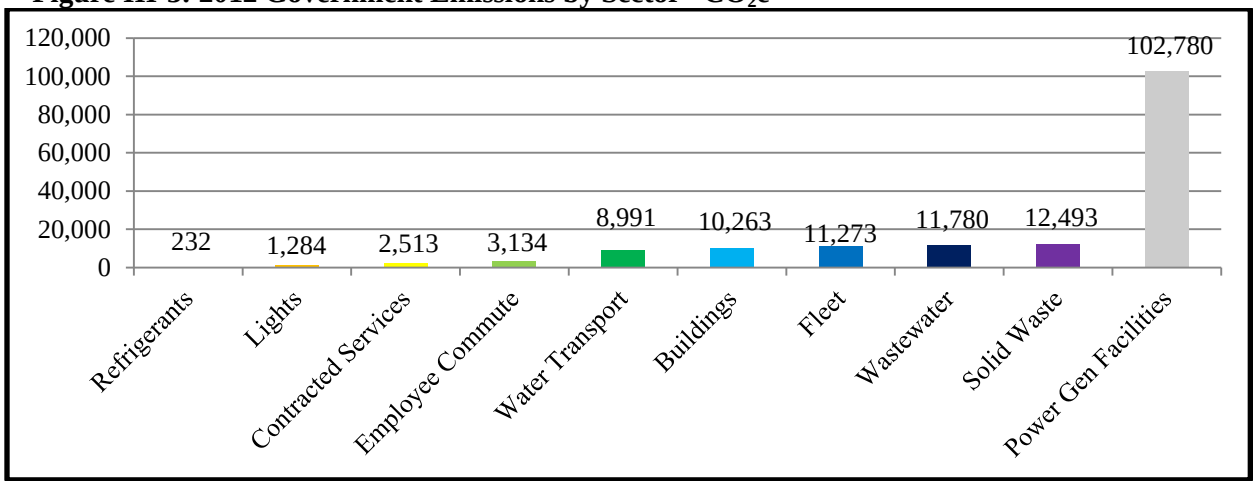


Figure III-3: 2012 Government Emissions by Sector –CO_2e



As can be seen in the graphs above the buildings and transportation sectors are the highest emitting sectors for the community. The building sector emissions have been declining while the transportation sector emissions have been climbing. As far as utilities go, the solid waste utilities have higher emissions than the water/waste water utilities. Both are relatively small compared to the buildings and transportation sectors, but both have increased.

The graphs of government emissions dramatically demonstrate the impact of claiming all of the Waste-to-Energy Facility's emissions as the City's. This occurred as a consequence of annexation and the fact that Upriver Dam is considered a zero emitter. The graphs also highlight how large the Waste-to-Energy Facility emissions are as compared to the other City government emission sources. Of the other government sectors the Solid Waste, Wastewater, Fleet, Buildings, and Water sectors are the highest in that order. The City government Wastewater sector declined in 2012 as a consequence of the new Airway Heights and Spokane County treatment plants coming on line.

Table III-5: Spokane City Community Comparison Years Emissions- CO_2e

Sector	1990 est.	2005*	2010	2012
Built Environment	1,189,691	1,396,731	1,258,376	1,173,336
Transportation and Other Mobile	790,678	864,551	865,841	914,370
Solid Waste	203,570	84,587	63,465	120,120
Wastewater and Water	218	382	17,003	25,895
Upstream Impacts of Community-Wide Activities**	-		645,993	504,663
Community Total	2,183,939	2,346,251	2,204,685	2,233,721

*2005 Transportation values here are half of those reported in 2005. We know the 2005 numbers were inflated due to the transportation model we used for values.
** Upstream impacts are not included in the Community Total but are provided for information. Upstream impacts are GHG emission estimates of the energy used in providing fuels & electricity.

Table III-6: City of Spokane Government Comparison Years Emissions- CO_2e

					Informational Totals***	
Sector	1990 est.	2005	2010	2012	2010	2012
Buildings	11,938	11,938	10,114	10,263		
Lights	5,910	4,290	1,380	1,284		
Water Transport		6,201	4,832	8,991	-	-
Wastewater	11,670	9,440	14,428	11,780	25,289	21,645
Solid Waste	145,289	24,991	12,239	12,493	18,610	18,069
Power Gen Facilities			-	102,780	253,135	249,064
Fleet	6,284	10,399	11,140	11,273	11,374	11,501
Gov Disposed Waste		285	660	-	1,490	1,201
Employee Commute	4,018	3,139	2,928	3,134	6,625	6,504
Refrigerants		152	232	232	301	288
Contracted Services**					2,472	2,513
Government*Totals	185,109	70,835	60,425	164,743	335,622	331,323

*We have combined the Facilities and Buildings Sector under the Buildings heading; Airports and Transit were not addressed as they are not under direct City control; District Heating & Cooling was not addressed.
** The only contracted service that is addressed here is the Avista street lighting contract.
*** Informational totals include amounts not directly attributable to City government. This includes items like the full non-biogenic amount of WTE emissions and upstream emissions for purchased fuels and electricity. The Informational Totals result after addition of the supplementary values. Only those that would change are shown.

More detail on sector emissions is provided in Appendix A, and in the following chapters.

C. Community Inventory

What follows is a chapter for each of the community sectors. Most of these chapters contain a second portion which addresses the source of data, the methods and protocol used, and in some cases calculation details. Where calculation details are not addressed in this document, they can be found in the referenced workbooks and reporting protocols.

1. Community Built Environment

a) Introduction

Table III-7: 2010 Totals Spokane City - Gases

Emissions Type	CO_2	CH_4	N_2O	SF_6	CO_2e
Residential/Commercial Stationary	428,151	76.6	1.45		430,209
Industrial Stationary Combustion	30,658	0.984	0.174		30,733
Use of Electricity by the Community	787,560	15	12.2		791,662
District Heating & Cooling (1)					
Electric Power Transmission & Distribution Losses (2)	53,870	1.03	0.84		54,150
Upstream Emissions from Energy Use (2)					257,657
Emissions from Electric Power Generation (3)	0	0	0	0.049	1,176
Refrigerant Leakage & Fire Suppressant (4)					
Industrial Process Emissions (5)	7	219			4,596
TOTAL**	1,246,376	311	14	0.049	1,258,376

Source: "Built Environment20150817a.xlsx, DataSummary" **See notes below

(1) Emissions from District heating and cooling were not separately identified.
(2) Upstream emissions and electricity T&D emissions are quantified here but are not added to the final total.
(3) Hydroelectric power is considered "zero-emissions." Electric power production from the Waste-to-Energy Facility is reported under Solid Waste incineration.
(4) Refrigerant leakage & fire suppressant were not quantified.
(5) Beyond those with stationary combustion, no large industrial process emissions were identified in the City.

Table III-8: 2012 Totals Spokane City - Gases

Emissions Type	CO_2	CH_4	N_2O	SF_6	CO_2e
Residential/Commercial Stationary	413.069	103.9	1.75		415.793
Industrial Stationary Combustion	29,913	0.869	0.144		29,975
Use of Electricity by the Community	717,617	13.67	11.1		721,355
District Heating & Cooling (1)					
Electric Power Transmission & Distribution Losses (2)	49,086	0.94	0.76		49,341
Upstream Emissions from Energy Use (2)					202,691
Emissions from Electric Power Generation (3)	0	0	0	0.067	1,611
Refrigerant Leakage & Fire Suppressant (4)					
Industrial Process Emissions (5)	7	219			4,602
TOTAL**	1,160,605	337	13	0.067	1,173,336

Source: "Built Environment20150817a.xlsx, DataSummary" ** See notes under Table 1

The built environment is comprised of human-made surroundings constructed for human living and working activities, ranging in scale from personal shelter and buildings to neighborhoods and cities that include supporting infrastructure, such as pipelines and energy networks. Greenhouse gas (GHG) emissions attributed to the built environment include those from residential, commercial and industrial buildings, and the operational processes and human activities associated with those buildings. Government building emissions are included in each of the appropriate categories.

Emissions here are limited to those resulting from energy used within buildings, refrigerants, fire suppressants, and industrial processes. In addition, some very limited electrical vehicle use is also captured here as it is not typically metered separately. Sources of energy covered in this report are natural gas, electricity, propane, some petroleum distillates, and wood. The gases categorized in this section are carbon dioxide, methane, nitrous oxide and sulfur hexafluoride. This report does not distinguish "district heating and cooling," and does not provide "refrigerant leakage and fire suppressant" emissions. District heating and cooling energy use was captured under the fuel use but not as a separate category. Information on refrigerant leakage and fire suppressant emissions was not captured. Upstream emissions are identified in the above table but not included in the total. Also not included here, but addressed below in a separate paragraph are the carbon dioxide emissions associated with energy directly derived from organic materials such as the burning of wood and paper.

In 2012 the built environment made up 52.5% of the overall community GHG emissions. As can be seen in the tables above, the overall 'built environment' CO2e emissions for the City declined about 6.8% from 2010 to 2012. In comparison to the 2005 inventory, 2010 and 2012 emissions were down by 10 % and 16 % respectively. After 2005, the 1.2% per year reduction goal was met for this sector. Emissions in this sector were only 1.4% lower than 1990, contrary to the goal of 7% below 1990 levels. The recession of 2008 has likely played a significant role in helping move us closer to achieving the greenhouse gas emission reduction goals despite actions which would make it more difficult such as the annexation of Spokane International Airport and surroundings in 2012, which included the Waste-to-Energy Facility.

The following table provides the estimate of Spokane County built environment emissions in 2012. By this measure the City of Spokane built environment CO_2e emissions represent about 28% of the full County built environment emissions - with the City having significantly lower industrial emissions (about 9% of full County Industrial emissions).

Table III-9- 2012 Spokane County - Gases

Emissions Type	CO_2	CH_4	N_2O	SF_6	CO_2e
Residential/Commercial Stationary Combustion	1,243,174	452.40	7.12		1,254,881
Industrial Stationary Combustion	123,427	6.63	0.64		123,766
Use of Electricity by the Community	2,693,308	51.30	41.78		2,707,337
District Heating & Cooling (1)					
Electric Power Transmission & Distribution Losses (2)	184,224	3.51	2.86		185,184
Upstream Emissions from Energy Use (2)					699,187
Power Generation in the Community (3)	0	0	1.00	0.220	8,068
Refrigerant Leakage & Fire Suppressant (4)					
Industrial Process Emissions (5)	235,422	431	1.25		258,547
TOTAL	4,295,331	941	52	0	4,352,598

Source: "Built Environment20150817a.xlsx, Data Summary"

(1) Emissions from District heating and cooling were not separately identified.
(2) Upstream emissions and electricity T&D emissions are quantified here but are not added to the final total.
(3) Electric power production by the Waste-to-Energy Facility is reported under solid waste incineration.
(4) Refrigerant leakage & fire suppressant were not quantified.
(5) Fairchild CO_2e included here, but without CO_2, CH_4, and N_2O detail.

b) Residential/Commercial Stationary Fuel Combustion

Table III-10- 2010 Summary of Residential/Commercial Stationary Fuel Combustion

Source	MMBTU	CO_2	CH_4	N_2O	Annual Total 2010
Natural Gas residential	4,360,662	231,183	21.80	0.436	231,776
Natural Gas commercial	3,170,777	168,101	15.85	0.317	168,532
Fuel Oil	348,678	25,661	3.84	0.209	25,807
Propane	48,123	3,206	0.529	0.029	3,226
Wood	109,442		34.58	0.460	869
TOTALS	8,037,683	428,151	76.61	1.45	430,209

Source: "Built Environment20150817a.xlsx, Res_Comm_Stat_Equip"

Table III-11- 2012 Summary of Residential/Commercial Stationary Fuel Combustion

Source	MMBTU	CO_2	CH_4	N_2O	Annual Total 2010
Natural Gas residential	4,228,496	224,176	21.14	0.423	224,751
Natural Gas commercial	3,208,901	170,122	16.04	0.321	170,558
Fuel Oil	203,314	14,973	2.24	0.122	15,058
Propane	57,014	3,798	0.627	0.034	3,822
Wood	202,068		63.85	0.849	1,604
TOTALS	7,899,795	413,069	103.90	1.75	415,793

Source: "Built Environment20150817a.xlsx, Res_Comm_Stat_Equip"

Overall natural gas use in residences dropped slightly in 2010 compared to 2005, and dropped even further in 2012 for about a 4 % reduction. This is remarkable since the 85,594 housing units in 2005 increased to 87,271 in 2010 and 94,901 in 2012. Commercial natural gas use fell even more dramatically, down 22 % in 2010 and then rebounding about 1 % in 2012. The use of fuel oil also declined. Wood use for residential heating, while making up less than one percent in residential GHG emissions, nearly doubled in use from 2010 to 2012. The economic downturn begun in 2008 could explain more frugal energy use. In addition, the move to more fluorescent lighting, the gradual impact of more energy conserving building codes, and the warmer winters all have likely made some difference. The State in cooperation with utilities such as Avista and non-profits (SNAP and Sustainable Works in Spokane) offered energy conservation audits and incentives in the period between 2009 and 2012 both to residents and commercial entities. This resulted in more insulation in building envelopes and homeowners putting in high-efficiency natural gas furnaces.

One measure of winter severity is heating degree days. Please refer to Table 6, below. In 2010, there were three percent (3.2%) fewer heating degree days than in 2005. For 2012, there were even less heating degree days than 2005. This indicates the winter seasons for 2010 and 2012 were warmer than 2005. Thus, less fuel would be used to heat buildings.

Table III-12- Calculated Differences in Heating Degree Days/ Cooling Degree Days versus 2005

YEAR	Heating Degree Days base 65	Cooling Degree Days base 65	% HDD Change	%CDD Change
2005	6538	409		
2010	6320	380	-3.2%	-7.4%
2012	6256	535	-4.3%	+27.9 %

Source: "7 ResComIndBuildings outline2010&2012DBmp.6.23.15.docx"

Since wood is a non-fossil fuel, the carbon dioxide which results from its burning is referred to as "biogenic" and does not count as a greenhouse gas in this inventory process. Only other chemical emissions from the burning of wood are counted (methane and nitrous oxide) because the amount of those chemicals released is dependent on the manner and equipment in which the wood is burned. The biogenic CO_2 emission from wood burning in 2010 was 10,266 metric tons and 17,489 MTs in 2012.
Industrial Stationary Fuel Combustion

Table III-13- 2010 Spokane City Industrial Stationary Combustion Energy Use

Type of Energy	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Natural Gas	225,390	11,949	0.225	0.023	11,961
Distillate Fuel	252,878	18,709	0.597	0.152	18,772
Industrial Energy Total	478,268	30,658	0.98	0.17	30,733

Source: "Built Environment20150817a, Indus_Stat_Equip"

Table III-14- 2012 Spokane City Industrial Stationary Combustion Energy Use

Type of Energy	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Natural Gas	299,265	15,866	0.299	0.030	15,881
Distillate Fuel	189,859	14,047	0.570	0.114	14,094
Industrial Energy Total	489,124	29,913	0.87	0.14	29,975

Source: "Built Environment20150817a, Indus_Stat_Equip"

We do not have good comparable numbers for industrial stationary fuel combustion from 2005. This sector was combined in the 2005 inventory with the commercial sector and included industrial uses which are not included here, such as natural gas used for electricity generation. What we can see with this data is that the rate of emissions is climbing from 2010 to 2012, which is probably indicative of recovery from the great recession. We also see that for the City of Spokane, industrial stationary combustion only makes up about 6.7 % of the overall stationary combustion GHG emissions.

c) Use of Electricity by the Community

Table III-15- 2010 Spokane City Electricity Use and Emissions

Place of Use	MWh	CO_2	CH_4	N_2O	CO_2e
Residential	992,301	379,246	7.22	5.87	381,221
Commercial	1,027,652	392,756	7.48	6.09	394,802
Industrial	40,709	15,558	0.30	0.24	15,639
Total	2,060,662	787,560	15.00	12.22	791,662

Source: "Built Environment20150817a, Elec_Use_Comm" 1MWh = 3.415 MMBTUs

Table III-16- 2012 Spokane City Electricity Use and Emissions

Place of Use	MWh	CO_2	CH_4	N_2O	CO_2e
Residential	889,696	340,031	6.48	5.27	341,802
Commercial	931,785	356,117	6.78	5.52	357,972
Industrial	56,174	21,469	0.41	0.33	21,581
Total	1,877,655	717,617	13.67	11.13	721,355

Source: "Built Environment20150817a, Elec_Use_Comm" 1 MWh = 3.415 MMBTUs
In 2005, 234,939 metric tons of CO2e was attributed to residential electric use. There was a ten percent reduction in electricity used in residences from 2010 to 2012 and the factors at play causing this reduction are the same as mentioned in the residential/commercial stationary combustion section of this report.

For summer months, cooling degree days indicate the amount of cooling required to keep the building envelope comfortable. 2010 was cooler than 2005: there were seven percent (7.4%) fewer cooling degree days. But, Spokane was hotter in 2012: 27.9% more cooling degree days than 2005. Heating buildings is usually accomplished with natural gas and/or electricity whereas cooling is almost exclusively achieved with electricity. Along with pumping water for irrigation, using electricity for cooling buildings creates an electrical demand in summer months. River flows of course are lower in the summer thus limiting hydropower for electricity production.

City of Spokane commercial energy use decreased during the economic downturn. The 2005 commercial electricity use was 1,063,354 MWh. For 2010, this same statistic was 1,027,652 MWh. In 2012 the trend continued downward: 931,785 MWh. Some of this decrease can be attributed to Avista Utilities providing compact fluorescent lightbulbs. "During the summer of 2011, Avista distributed 2.3 million compact fluorescent lights (CFLs) to residential and commercial customers for an estimated energy savings of 39,005 MWh…Current Avista-sponsored conservation reduces retail loads by nearly 10 % or 115 aMW (avoided Megawatts)." (2013 Integrated Resource Plan, page 75)

Industrial energy use in City of Spokane increased from 2010 through 2012 in all types, stationary combustion as well as electricity. The problem with comparing with 2005 figures is that there was limited information in 2005. Industrial electricity use, obtained from Avista Utilities in 2010 and 2012, was not separately documented in 2005.

District Heating & Cooling

While there are some locations in Spokane where heating and cooling are done from a central plant we are not aware of circumstances where that service is provided to other entity's facilities as a utility. In addition if such does exist we believe the data from Avista & Inland Power would already include the primary energy component. We know the City had a central plant that served various buildings for several City departments at Normandie Street and Mission Avenue. The County's Public Safety building is served from a central plant with the City paying via rent or lease for space which includes utilities. Colleges and hospitals are other facility types that may have central plant heating and cooling.

d) Electricity Transmission & Distribution Loss

Table III-17- 2010 Spokane City Electricity T & D Loss and Emissions

Place of Use	MWh	CO_2	CH_4	N_2O	CO_2e
Residential	67,873	25,941	0.49	0.40	26,076
Commercial	70,291	26,865	0.51	0.42	27,005
Industrial	2,784	1,064	0.02	0.02	1,070
Total	140,949	53,870	1.03	0.84	54,150

Source: "Built Environment20150817a, Elec_T&DLosses" 1 MWh = 3.415 MMBTUs

Table III-18- 2012 Spokane City Electricity T & D Loss and Emissions

Place of Use	MWh	CO_2	CH_4	N_2O	CO_2e
Residential	60,855	23,258	0.44	0.36	23,380
Commercial	63,734	24,359	0.46	0.38	24,486
Industrial	3,842	1,469	0.03	0.02	1,476
Total	128,432	49,086	0.94	0.76	49,341

Source: "Built Environment20150817a, Elec_T&DLosses" 1MWh = 3.415 MMBTUs

When electrical power is moved from the place of generation to the place of use some of the power is lost as heat in the wiring and transformers. The smaller and longer the wires and the higher the load the more loss occur. It is avoidance of this loss that drives the research into super conductors and that provides benefit from power generation close to place of use. The emissions that are given above represent the estimated losses based on an EPA e-GRID value of 6.84% western US average for 2010. Because the use of electricity declined in Spokane between 2010 and 2012, the estimated transmission and distribution losses also declined. For comparison, the estimated County electricity transmission and distribution loss emissions value for 2012 was 135,842 $MTCO_2e$. T&D emissions are not included in summary totals but are discussed here for informational purposes.

e) Upstream Impacts of Fuels & Electricity Purchased

Table III-19- 2010 & 2012 Spokane City Upstream Impacts Combined

Year	CO2e Total
2010	257,705
2012	202,726

Source: "Built Environment20150817a, Upstream Elec&Combustion"

The upstream impacts of stationary combustion fuels and electricity purchased are given in the above table for both 2010 and 2012, with more detail in the following tables. As in the preceding section, these emissions are reduced as a consequence of reduction in use of the fuels and/or electricity. These "upstream" emissions are not totaled in this inventory but are provided for information. Generally these emissions are actually released where the fuel production is occurring which is one reason they are not added to the totals in this community inventory. Our estimated County values for comparison are 577,588 and 471,858 for 2010 and 2012 respectively.

Table III-20- 2010 & 2012 Spokane City Upstream Impacts of Electricity Purchased

Year	Utility	MWh Generated	$MTCO_2e$ per MWh	CO_2e Total
	Avista	1,376,368	.1118	153,927
	Inland Power & Light	354	.0790	28
2010 Total		1,376,721		153,955
	Avista	910,092	.1120	101,905
	Inland Power & Light	229	.0201	5
2012 Total		910,321		101,910

Source: "Built Environment20150817a, Upstream Elec&Combustion"

Avista and Inland Power & Light are the electric power providers in the City, with Avista being the main supplier within the City. During this inventory period, Avista provided a higher percentage of its electrical power derived from fossil fuels as compared to Inland Power & Light. An indicator of this can be seen in the larger $MTCO_2e$ per megawatt hour value in the table above.

Table III-21 – 2010 & 2012 Spokane City Upstream Impacts of Stationary Combustion Fuels

Year	Natural Gas (CO_2e)	Distillate Fuel Oil (CO_2e)	Liquid Petroleum Gas (CO_2e)	Energy (MMBTUs)	CO_2e Total
2010	95,045	8,094	612	8,407,845	103,751
2012	94,797	5,294	725	8,187,985	100,816

Source: "Built Environment20150817a, Upstream Elec&Combustion"

The above emissions are an estimate of the emissions that occur in producing and delivering the purchased power sources to the community.

f) Emissions from Electric Power Production in the Community

Table III-22- 2010 & 2012 Community Electric Power Production Emissions

Source: Avista -electrical equipment	CO_2	CH_4	N_2O	SF_6	CO_2e
2010	0	0	0	0.049	1,176
2012	0	0	0	0.067	1,611

Source: "Built Environment20150817a, Elec Pwer Gen Comm"

The carbon dioxide equivalent emissions detailed in the table above and the County tables below pertain to emissions that occur within the boundaries of the City and the County. These tables do not include emissions from the City of Spokane's Waste-to-Energy Facility as those emissions (102,180 $MTCO_2e$ in 2010) are addressed in the solid waste section of this report. The City of Spokane's Waste-to-Energy Facility was outside the City limits in 2010, and due to annexation, inside the City limits in 2012.

A significant portion of the power generation within these boundaries comes from hydroelectric dams on the Spokane River operated by Avista and one, Upriver Dam, operated by the City of Spokane.
For the purposes of this inventory, the hydroelectric facilities are considered to have no emissions except those attributed to the use and loss of sulfur hexafluoride.

This is a chemical which controls arcing and the potential of fire in high voltage/amperage switching equipment. Sulfur hexafluoride is greater than twenty thousand times more active a greenhouse gas than carbon dioxide. Outside of the City of Spokane but in the County are two Avista natural gas based electricity generating plants whose emissions are added into the table below.

Table III-23- 2012 Spokane County Electric Power Production Emissions

Source	CO_2	CH_4	N_2O	SF_6	CO_2e
Avista –natural* gas	-	-	1	0	2,803
Avista – electrical equipment	0	0	0	0.153	3,654
Total	0	0	1	0.153	6,457

Source: "Built Environment20150817a, Elec_Pwer Gen Comm" *Avista did not report CO_2 or CH_4 emission from this facility.

g) Refrigerant Leakage and Fire Suppressant Emissions in the Community

The City of Spokane Environmental Programs staff did not locate data sufficient for calculation of this section. We looked at other communities' data where they reported these emissions but did not see any correlation that could be made based on community area or population. The CO_2e emissions from this category may be significant since many of these chemicals are significantly more active GHGs than carbon dioxide. This is an area that deserves more attention when the next inventory is taken. It is important to take all reasonable precautions to prevent the unnecessary release of these chemicals into the environment and to avoid their use when possible. We were able to estimate at least 122 $MTCO_2e$ from three City government buildings. It is clear that larger refrigeration units using refrigerants with higher global warming potential (GWP) can result in significant emissions. But it is also the case there are significant amounts of Montreal Protocol regulated refrigerants still in use. They are not counted by the GHG reporting protocol we follow here. The Montreal Protocol regulated refrigerants are catalysts of ozone depletion and linked to increased skin cancer risk. We did not add the 122 $MTCO_2e$ to this community inventory because it would be misleading as an under estimation.

h) Industrial Process Emissions in the Community

Table III-24- 2011 & 2012 Spokane City Industrial Process Emissions

Avista Natural Gas Distribution System	Fuel Type	CO_2	CH_4	N_2O	CO_2e
2011	Natural Gas	6.5	218.5	0	4,596
2012	Natural Gas	6.5	219.0	0	4,602

Most industrial process emissions occurring in the City are either captured under the stationary combustion section or the solid waste sections of this report. There are no industrial process emitters within the City limits required report to the State or EPA besides the Waste-to-Energy Facility, the Northside Landfill, and Avista.
Avista reported methane and carbon dioxide emissions from loss of natural gas in 2011. This information for 2010 was not available.

Table III-25- 2012 Spokane County Industrial Process Emissions

Place of Use	Fuel Type	CO_2	CH_4	N_2O	CO_2e
Kaiser Aluminum Trentwood	Natural Gas	108,252	2.04	0.204	108,358
Inland Empire Paper	Natural Gas	17,755	6.48	0.838	18,151
Goodrich Landing Systems	Natural Gas/ Propane	35,534	0.61	0.070	35,569
Northwest Gas Pipeline	Natural Gas	73,869	1.39	0.139	73,941
Total		235,410	10.52	1.251	236,019

Source: "Built Environment20150817a, Indus_Proces_Emiss_Comm"

There were several more reporting entities in the County which are given in the above table. Northwest Gas Pipeline emissions are the only emissions in the above table which were not included in the natural gas use data from Avista. The Goodrich Landing Systems emissions are an example of emission factors alone not being an accurate way of measuring emissions. In this case the emissions are lower because all of the carbon in the propane and 20% of it in the natural gas are said to be contained in the product – carbon brake pads.

Figure III-4 Community Buildings Source Notes

Buildings Source & Method Notes

Contacts & Sources

Kevin Booth, Avista- Electrical and natural gas use within the City and County of Spokane less City; and the estimated GHG emissions from natural gas loss and sulfur hexafluoride loss.
Ian Swan, Inland Power & Light- Electricity use in the City and County of Spokane for 2010 & 12
Brian Dilts & Jim Fields, Vera Water & Power- Electricity sold 2010 & 2012
Steve Boorman, City of Cheney- Electricity sold 2010 & 2012
Iowa State Ag Extension- Biomass Measurements and Conversions; File C6-88, Oct 2008
Ron Edgar & April Westby, PE, Spokane Clean Air Agency- Emissions and activities reported for air operating permits within Spokane City and Spokane County.
US Census- American Community Survey 2010 & 2012, House Heating Fuel, WA State
US Energy Information Administration –Federal statistics on fuel use by type & State
Residential Sector Energy Consumption Estimates, 1960-2012, Washington
Washington State, Spokane City, & Spokane County Energy consumption data
USEPA- Emissions reported to EPA for facilities in Spokane, Spokane County, and others.
E-Grid 9th addition, NWPP (WECC Northwest) 2010 GHG annual rates per unit power
WA State Dept. of Ecology- GHG emissions reported to the State for facilities in Spokane City, County, & other.
WA State Dept. of Commerce- Electric Utility Fuel Mix Annual Reports

Table III-26- Summary of Built Environment Greenhouse Gas Emission Sources Used

GHG Source	Data Used	Method
1) Stationary Fuel Combustion	Avista residential, commercial, and industrial natural gas use, Other fuel use from US Energy Information Administration combined with American Community Census Data.	BE.1.1 & BE.1.2
2) Electricity Use	Avista electricity use in Spokane City & County Inland Power & Light electricity use in Spokane City & County City of Cheney electrical sales & use Modern Electric Power & Water electrical sales Vera Water & Power electrical sales	BE.2.1 (Equation BE.2.2)
3) District Heating & Cooling	No district heating and/or cooling utilities known	
4) Electric Power T & D Losses	Electricity Used (see No. 2 above) US EPA E-Grid NW regional electric GHG emission factor and Regional T&D loss factor	BE.4.1
5) Upstream Emissions from Energy Use	Residential, Commercial, and Industrial Fuel used (No.1 above) Electricity used per Utility (see No. 2 above) Utility Fuel Mix from WA State Dept. of Commerce Protocol factors from tables B.13, B.14,B.15, B.16, B.17	BE.5.1 BE.5.2
6) Emissions from Electric Power Production	Avista Emissions data for Northeast & Boulder Park facilities; Avista emissions of sulfur hexafluoride City of Spokane's Waste-to-Energy Facility emissions	Alternate BE.6.1.A. 2
8) Industrial Process Emissions	Large Emitters in Spokane County reported emissions to USEPA and/or WA State	BE.8

Figure III-5 Community Buildings Method Notes

Residential/Commercial Stationary Fuel Combustion

Residential and commercial natural gas use was taken from Avista reported use, both in the City and in the County. The City natural gas use was not included in the County use as reported from Avista; however in this report the County emissions numbers include City of Spokane emissions. The natural gas usage was multiplied by protocol emissions factors to derive the annual emissions.

The quantity of other fuels burned (distillate fuel oil, liquefied petroleum gas, and wood) was derived by using US Energy Information Administration State statistics in combination with occupied housing and heating fuel use data from the US Census gathered by the American Community Census Data surveys. These fuel quantities were then multiplied by emission factors from the protocol to derive the emitted quantities of CO2, CH4, & N2O. For wood a conversion factor from cords to short tons was obtained from an Iowa State extension office paper "Ag Decision Maker, Biomass Measurements and Conversions", File C6-88, Oct. 2008. Only the wood CH4 and N20 components of CO2e were included in the totaled CO2e value. The wood CO2 was reported separately for information per the protocol.

Industrial Stationary Fuel Combustion

Industrial natural gas use was taken from Avista supplied data. Distillate fuels and liquefied petroleum gas use data was gathered from Spokane Clean Air Agency 2012 air operating permit registration data.

Use of Electricity by the Community

Avista and Inland Power & Light provided electrical use data by category: residential, commercial, and industrial; and by City boundary and County. The City of Cheney Utilities, Modern Electric Power & Water, and Vera Water & Power also provided power use numbers by category used in determining the County emissions. GHG emission factors were taken from e-GRID version 9 2010, sub region WECC Northwest and multiplied times the power use numbers. The resulting emissions numbers were then converted to metric tons CO2e.

District Heating & Cooling - No such utilities were identified.

Electricity Transmission & Distribution Loss

The community electrical use data was multiplied by a factor of 6.84% to identify the transmission and distribution loss quantities. The emission rate factors and CO2e factors were then applied to the loss quantities to arrive at the CO2e metric tons. The loss and resulting emissions values may be slightly inflated as we choose to use the 2010 e-Grid Western US T&D loss percentage. The Federal Energy Information Administration values for WA State were 5.34 and 4.3 for 2010 and 2012 respectively. Avista identified a T&D loss value of 6.1% in their August 2015 Integrated Resource Plan.

Upstream Impacts of Stationary Combustion Fuels & Electricity Purchased

Upstream impacts from electrical use was calculated from the electricity used times the source fraction of generation by fuel type which was taken from the utilities fuel mix percentages reported to

the Washington State Department of Commerce by year. The resulting power quantity was multiplied by a fuel use per kilowatt hour factor and then by an upstream emissions factor by fuel type. The factors were contained in the protocol in tables B-13 & B-17 except for the nuclear energy upstream emissions factor of 65 g CO2e/kWh which came from a paper by Manfred Lenzen titled "Life cycle energy and greenhouse gas emissions of nuclear energy: A review"; made available online on 8 April 2008 by Energy Conversion & Management an ELSEVIER Ltd. company.
The fuels identified with stationary combustion were also multiplied by factors from table B-13 to derive the upstream impacts values. The upstream impacts were identified in terms of metric tons of carbon dioxide equivalents. The upstream impacts values were not added into the total emissions for the City or County but rather supplied for information only.

Emissions from Electric Power Production in the Community
Emissions from non-hydroelectric derived electricity in the City and County were addressed in this section. The City Waste-to-Energy Facility run by Wheelabrator-Spokane was not in the Spokane City limits in 2010. It is located in area annexed in 2012. Two Avista generating facilities operated in the county, the Northeast Facility and the Boulder Park Facility in Spokane Valley. Avista identified GHG emissions for their facilities in a "Shared Value" pdf document in 2013 which we used for their Northeast and Boulder Park facilities numbers. They also provided us information on their system wide sulfur hexafluoride emissions which we counted as in the City of Spokane. Wheelabrator-Spokane filed emission reports for the Waste-to-Energy Facility with EPA for 2010 and 2012 with those values used here as well.

Refrigerant Leakage and Fire Suppressant Emissions in the Community
We do not have data for these type emissions from community buildings. There was very limited information from City government buildings which we provided in the text but have not added them to the reported total emissions. This is an area that needs significantly more time investment in future inventories in order to report on it appropriately.

Industrial Process Emissions in the Community
Industrial process emissions were summarized from activities and sources in Spokane County. The information was gleaned from Environmental Protection Agency (EPA) Mandatory Greenhouse Gas Emissions Reporting reports for 2010 and 2012. There were no emissions reported to EPA within the city except for City solid waste facilities, reported in other sections, and Avista natural gas distribution loss, which we report in this section, and the sulfur hexafluoride losses reported under the electric power production section. Those reported in the County ended up being primarily natural gas uses, so while reported in this section the quantities were subtracted from the quantities of natural gas reported as industrial in the stationary combustion section. This except for natural gas use by the Gas Transmission Northwest Rosalia Pipeline which we assume was not supplied by Avista and so is included here without subtraction.

2. Community Transportation

Table III-27 - 2010 Spokane Community Transportation Emissions

GHG Source	CO2	CH4	N2O	CO2e
1) Passenger vehicles	412,335	52.000	30.000	422,683
2) Freight & service trucks	280,593	24.000	9.400	284,018
3) Freight Rail	20,864	1.600	0.530	21,064
4) Transit Operation	9,796	0.160	0.040	9,811
5) Inter-City Passenger Rail	224	0.020	0.010	226
6) Air travel – Aircraft*	27,655			27,655
7) Air travel – Ground Support*	107	0.001	0.003	108
8) Other Off-Road Equipment	100,275			100,275
9) Fuel Upstream Lifecycle**				226,747
2010 Totals	851,932	77	41	865,841

*In 2010, only a third of total Aircraft and Ground Support emissions are attributed to the City of Spokane.
**Provided for information but not included in 2010 Totals.

Table III-28 - 2012 Spokane Community Transportation Emissions

GHG Source	CO2	CH4	N2O	CO2e
1) Passenger vehicles	420,121	53.000	30.000	430,664
2) Freight & service trucks	288,388	25.000	9.700	291,907
3) Freight Rail	19,640	1.550	0.500	19,829
4) Transit Operation	9,602	0.160	0.040	9,617
5) Inter-City Passenger Rail	223	0.020	0.010	225
6) Air travel – Aircraft*	57,732			57,732
7) Air travel – Ground Support*	397	0.011	0.005	399
8) Other Off-Road Equipment	103,997			103,997
9) Fuel Upstream Lifecycle**				247,978
2012 Totals	900,100	80	41	914,370

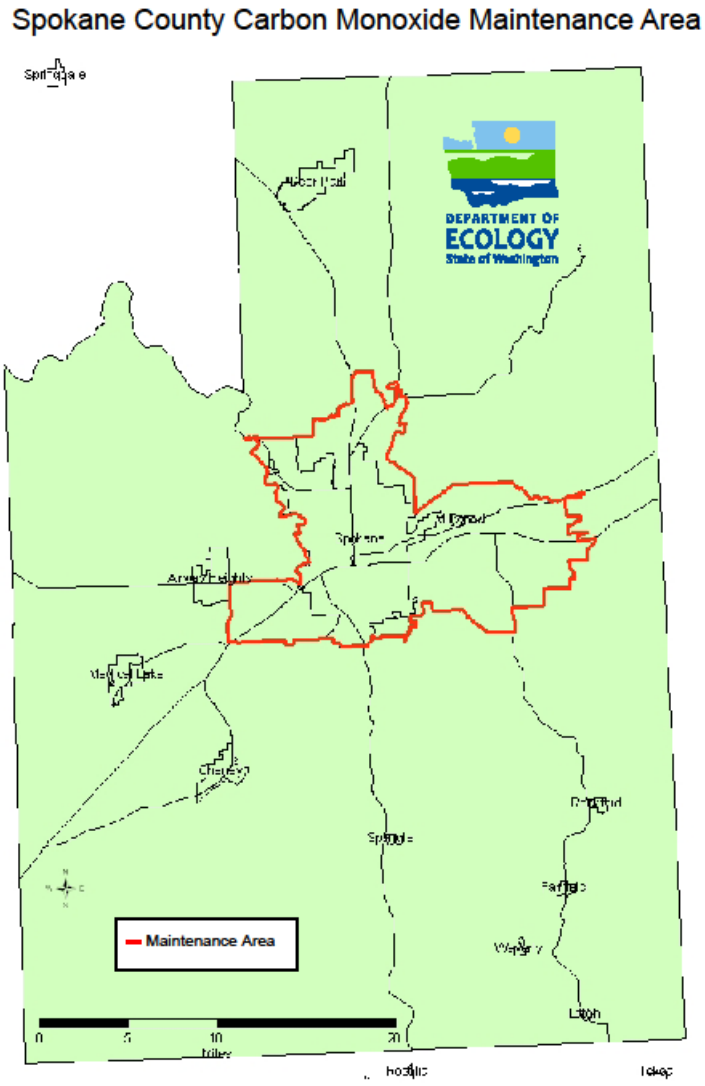
*In 2012 annexation of the SIA places more airport emissions under City community responsibility. We have attributed 2/3 of the emissions calculated from passenger movement.
**Provided for information but not included in 2012 Totals.

a) Introduction

The preceding tables show the 2010 and 2012 calculated greenhouse gas emissions due to transportation in the community of Spokane. Emissions data are provided for passenger vehicles, freight and service vehicles, public transportation, rail freight, inter-city passenger rail, off-road equipment, air travel, and fuel upstream lifecycle emissions. The community transportation sector resulted in the emission of approximately 865,922 metric tons of CO_2e in 2010 and 914,369 $MTCO_2e$ in 2012. These totals include air travel related emissions and off-road equipment emissions, both of which were not accounted for in the 2005 inventory. Fuel upstream lifecycle emissions were also calculated and included in the above table for informational purposes but are not included in the final totals. These transportation emissions totals make up 39% and 41% of all community wide emissions for 2010 and 2012 respectively.

The previous 2005 greenhouse gas inventory was based on the carbon monoxide non-attainment area Vehicle Miles Traveled (VMT). Spokane County Carbon Monoxide Maintenance Area, formerly the nonattainment area, is outlined in red in the figure map below.

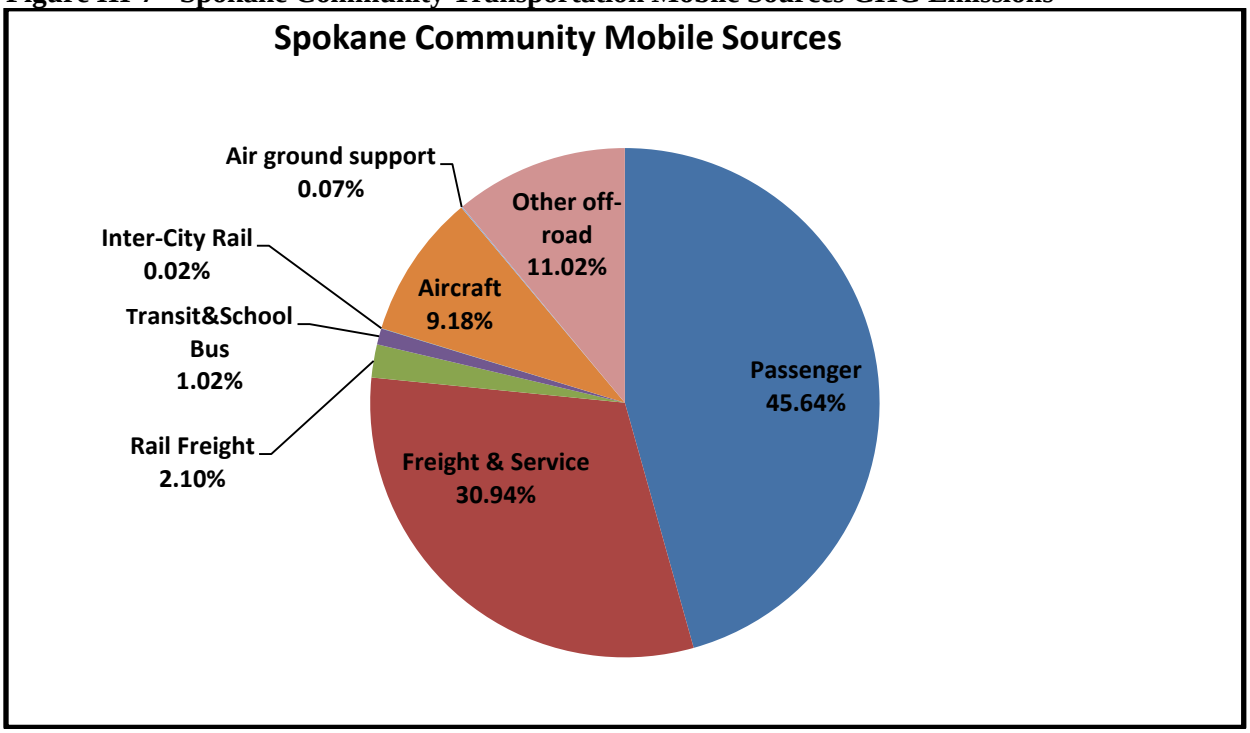
Figure III-6 Spokane County Carbon Monoxide Maintenance Area from



(Carbon Monoxide Maintenance Area Map)

In 2010 SRTC data indicated the non-attainment area VMT was equal to about two thirds of the County VMT and about twice the City of Spokane's. The 2005 inventory transportation sector calculated emissions were 1,729,102 $MTCO_2e$ and only took into account on-road and rail emissions. Comparing half of that value (to account for the 2005 report using double the City's non-attainment area) with the 2010 and 2012 City of Spokane results for on-road and rail emissions only equates to a 15% and a 13% decrease in emissions, respectively. The 2012 community transportation sector is ahead of the -1.2% yearly goal made in the 2005 report by 4.6%. In order for the community transportation sector to achieve the goal of 30% below 2005 levels by 2030, there needs to be an additional 17% reduction.

Figure III-7 - Spokane Community Transportation Mobile Sources GHG Emissions



b) On-Road Vehicle Transportation

Table III-29-2010 On-Road Vehicle Emissions - CO_2e

Vehicle Class	City Streets	City Highways	City Total	County Total
Motorcycles	1,443	396	1,839	5,436
Cars/Light Trucks	314,054	86,233	400,287	1,183,124
Freight/Service	222,832	61,186	284,018	615,286
Public Transport	6,864	1,885	8,749	16,991
Motor Homes	16,129	4,429	20,557	60,761
Totals	561,321	154,129	715,450	1,881,597

Table III-30- 2012 On-Road Vehicle Emissions- CO_2e

Vehicle Class	City Streets	City Highways	City Total	County Total
Motorcycles	1,470	404	1,874	5,587
Cars/Light Trucks	319,892	87,953	407,845	1,215,991
Freight/Service	228,957	62,951	291,907	632,378
Public Transport	7,543	2,074	9,616	18,003
Motor Homes	16,429	4,517	20,945	62,449
Totals	574,289	157,899	732,188	1,934,408

Total on-road VMT (vehicle miles traveled) in the community for 2010 was 2,844,794 and 2,898,506 in 2012, an increase of 1.9 percent. A majority of the VMT (78.4 percent for both years) was associated with travel on surface streets with the remaining 21.6 percent located on highways and freeways.

In 2010, the community's on-road vehicles accounted for 715,451 metric tons of CO_2e emissions. That number increased to 732,188 in 2012. While VMT increased 1.9% between 2010 and 2012, CO2e emissions only went up by 1%, a change that may have resulted from improved vehicle efficiencies. The average age of vehicles registered in Spokane County in 2012 was 12 years.

Passenger vehicles (motorcycles, cars, light trucks, and motor-homes) produced 49% and 46% of total community transportation emissions in 2010 & 2012. Freight and service vehicles (light commercial trucks, short and long-haul trucks, inter-city buses, refuse trucks, etc.) produced 33% and 31% of total transportation emissions. Transit and school buses accounted for 1% of total transportation emissions each year. From SRTC VMT estimates, I-90 pass-through traffic accounts for about 0.5 to 0.6% of City on-road emissions in 2010 and 2012. Without accounting for the changes in emission standards described in the next paragraph, we estimate that the community's on-road vehicles will emit 786,460 metric tons of CO_2e in the year 2020 and 895,338 metric tons of CO_2e in 2030.

The Environmental Protection Agency (EPA) estimated that passenger vehicles were responsible for 17 percent of all U.S. greenhouse gas emissions in 2011. In April of 2010, the federal government adopted an emission standard raising the average fuel economy of new passenger vehicles to 34.1 miles per gallon (mpg) for model year 2016. A second standard, finalized in August 2012, will raise the average fuel economy in passenger vehicles to 54.5 mpg for model year 2025. These standards were adopted by the National Highway Traffic Safety Administration (NHTSA) and the EPA, with cooperation from major automakers. Along with reducing carbon intensity in our vehicles, these standards will improve U.S. energy security, decrease our dependence on foreign oil, and save drivers money.

c) Public Transportation

The Spokane Transit Authority (STA) runs bus, vanpool, paratransit, and demand response services throughout the City of Spokane and Spokane County. In 2012, STA buses alone in the entire County traveled a total of 5,928,528 miles, a decrease of 7.4% from 2010 (6,405,238 miles). All STA buses in the County consumed 1,106,166 gallons of diesel fuel in 2012 and 1,192,189 gallons of diesel fuel in 2010, a decrease of 7.2%. STA buses' average mile per gallon (MPG) dropped slightly in 2012 from 2010, decreasing from 5.37 MPG to 5.36 MPG. With route, schedule, and GIS information, we approximated bus VMT within the City. In 2010 the in-City STA mileage portion was 55.9 % and in 2012 it was 58.2 %. These percentages place 2012 in-City bus only emissions at 6,540 metric tons of CO_2e, a decrease of 2.5 percent from 2010 (6,705 $MTCO_2e$).

All County public transportation including vanpool, paratransit, and demand response service CO_2e emissions were reported by STA to be 14,520 metric tons in 2012. Adjustment by in-City transit VMT

results in 8,448 $MTCO_2e$ for the full STA system in-City. Adding the modeled school bus emissions of 1,168 gives a final in-City public transportation total of 9,617 metric tons of CO_2e in 2012. Estimated emissions for 2010 were placed at 8,664 $MTCO_2e$ for in-City public transportation. Adding the 1,147 $MTCO_2e$ attributed to school buses results in total in-City public transportation emissions to be 9,811 $MTCO_2e$ in 2010. In-City public transportation emissions fell 2 % between 2010 and 2012.

Cities the size of Spokane need adequate transportation systems in place to accommodate citizens who do not, or cannot drive and to help reduce congestion and capital expense of highways and streets. In and around Spokane, Spokane Transit Authority (STA) is the public system that has been established to serve this purpose. Those who choose to utilize public transportation reduce their carbon footprint and conserve energy by eliminating travel that would have otherwise been made in a passenger vehicle while using a service which would need to run to serve others whether they used it or not. The American Public Transportation Association (APTA) estimates that a single person commuting alone by car, who switches a 20-mile round trip commute to public transportation, can reduce their annual CO_2 emissions by 4,800 pounds per year. STA is continually working on becoming more efficient and reducing their carbon footprint. STA experienced a major service change in 2011 which included the consolidation of routes, numerous routing adjustments, and improved frequency on some routes. In 2007, STA added their first three diesel/electric hybrid busses. As of 2014, their fleet includes 28 diesel/electric buses on the road today. In May 2014, STA revised their comprehensive plan "Connect Spokane". The revised plan contains a "Sustainability" chapter (pg. 87) which contains, among other things, policy to minimize fuel use, reduce GHG emissions, and review opportunities for alternative fuel sources. The plan also contains Annex 1 performance standards which are to be reported on annually by April. Performance Standard 2 'Comparable Energy Consumption' says that no route should be worse in energy use per passenger mile than a single passenger car when judged by the cumulative service provided. Spokane County and the City of Spokane should continue to support the efforts of STA to become more energy efficient and less fossil fuel dependent. Citizens of the County and City should continue to utilize this system to help reduce greenhouse gas emissions produced by passenger vehicles and to help reduce the need for additional expensive road miles of pavement.

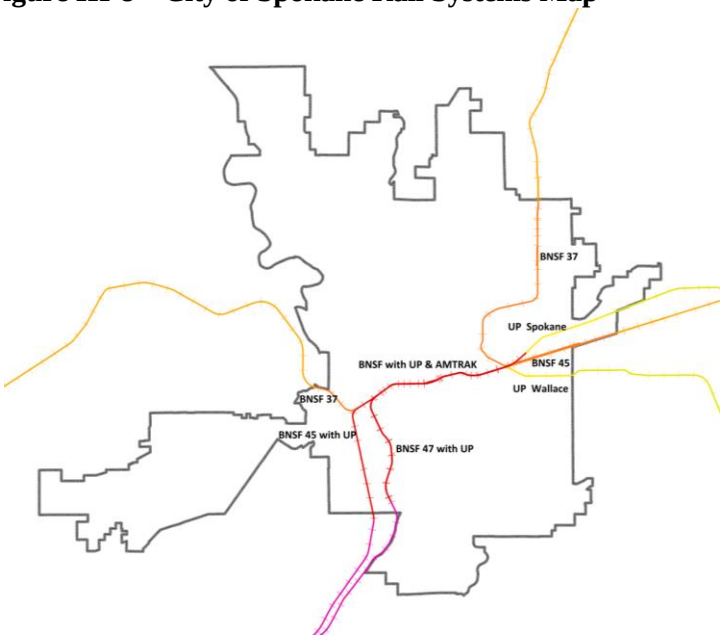
d) Freight and Passenger Rail

The City of Spokane has two freight rail companies running through its area on a daily basis (Burlington Northern Santa Fe Railway and Union Pacific Railroad) and one passenger rail company (Amtrak). These three rail companies emitted 20,054 metric tons of CO_2e in 2012, a decrease of 5.9 percent from 2010 (21,290 $MTCO_2e$) and a decrease of 3.5% from 2005 (21,173 $MTCO_2e$). This includes emissions within the rail yards as well as travel on the rail lines. Freight rail produced 98.9 percent of all rail emissions in the years 2010 and 2012. 3,893,401 gallons of diesel was used for freight rail in 2010 and 3,874,053 gallons in 2012, a decrease of 0.5 percent. Amtrak used 22,089 gallons of diesel in 2010 and 21,933 gallons in 2012.

Washington's rail system is expected to handle more than 260 million tons of cargo by 2035. This amount is more than double the volume carried on the system in 2010, representing a compound annual growth of 3.4 percent for all commodities carried on Washington's rail system. As a result of this growth, several rail segments are going to require capital improvements and operational changes to manage the increased volume. This includes segments along the Spokane-Pasco, Seattle-Spokane, and Spokane-Hauser Junction, Idaho routes.
The top rail commodity in Washington State (originating or terminating) in 2010 was cereal grains including seeds with 25 percent of the total annual tonnage. Coal accounted for 12 percent of the total tonnage in 2010. The most significant factor that could affect future rail volumes in Spokane would be the possible increase in coal and oil trains passing through Spokane, headed to ports on the west side of the state and eventually to Asia. Proposals are currently under consideration to enhance port capacity on

the west side, which in turn could ultimately lead to more coal and/or oil trains coming through Spokane daily.

Figure III-8 – City of Spokane Rail Systems Map



e) Off-road Vehicles and Equipment

Off-road equipment or 'non-road' vehicle emissions apply to emissions from fuel combustion in agricultural, commercial, construction, industrial, lawn and garden, and recreational vehicle and equipment engines. This includes everything from a tractor to a leaf blower. The source data for this calculation comes from federal statistics by County and the protocol gives CO_2 amounts, which would make up the majority of the CO_2e emissions. The Off-road vehicle and equipment types of emissions in 2010 in the City of Spokane accounted for 100,275 $MTCO_2$. 2012 accounted for 103,997 $MTCO_2$, an increase of 3.7%. In Spokane County, agricultural tractors had easily the highest percentage of emissions for both years, hovering around 17.6% of emissions in this category. Heavy equipment construction loaders had the second highest emissions at 4.8% for both years.

f) Air Travel

As of 2012, the City of Spokane has two airports within the city limits: Spokane International Airport (SIA) and Felts Field. SIA is a 6,000-acre airport currently servicing seven passenger airlines and two cargo carriers. SIA saw a total of 3,005,315 passengers in 2012, a 5.4 percent decrease from 2010 (3,176,204 passengers). Comparable Felts Field data were not available. While passenger numbers decreased, total cargo in tons increased at SIA significantly by 28.7 percent in 2012. Air travel emissions for the City of Spokane include emissions from aircraft and airport ground fleet operating at the SIA. We estimated that in 2010, SIA operations emitted 146,726 metric tons of CO_2e into the community. That number increased in 2012 to 151,249 metric tons of CO_2e, an increase of 3.1 percent. The GHG reporting protocol we are following provides a way to allocate airport emissions based on fuel dispensed and used and numbers of passengers who get on and off the planes.

In 2010 SIA was not located in the City of Spokane nor was it under the operational control of the City so we have counted only the emissions that would be attributed to the local region (83,287 MTCO2e) and allocated a third of that to the City of Spokane (27,763 MTCO2e). In 2012, with SIA annexed into the

City of Spokane, we have counted two-thirds of the regional attribution including ground support emissions (58,131 MTCO2e).

Comparing 2005 to 2012 fuel use, there was an 8.6 percent decrease in aviation fuel use (jet fuel and aviation gas), but a 17.9 percent increase in ground support fuel use (diesel and unleaded gasoline). Listed below are the quantities of fuel dispensed in gallons at Spokane International in 2012, 2010, and 2005:

Table III-31- Comparison 2005, 2010 & 2012 Spokane International Airport Fuel Usage (gallons)

	Jet Fuel	Aviation Gas	Diesel	Unleaded
2005	16,990,458	107,122	34,806	26,953
2010	15,083,698	95,638	24,337	35,953
2012	15,584,495	44,281	35,714	37,067

g) Lifecycle of Transportation Fuels

The transportation emissions described throughout this report include only direct emissions from combustion of fuels by different vehicles. This section includes emissions associated with the production and delivery of transportation fuels. The lifecycle of a transportation fuel consists of five steps: (1) feedstock recovery, (2) feedstock transportation, (3) fuel production, (4) fuel transportation, and (5) in-vehicle combustion. Fuel lifecycle emissions takes the direct greenhouse gas emissions that we calculated throughout this report (step 5) and applies a scaling factor to the direct emissions to account for steps 1-4, representing the upstream portion of the total fuel 'life-cycle'.

Aircraft run on jet fuel and aviation gas, both for which we lacked scaling factors. We treated aviation gas as conventional gasoline and jet fuel as diesel for purposes of the calculation. For 2010 we estimate the upstream emissions related to gasoline accounted for 136,721 $MTCO_2e$, for diesel 87,050 $MTCO_2e$ produced, for compressed natural gas 242 $MTCO_2e$, and for liquefied petroleum gas 2,734 $MTCO_2e$ resulting in a total of 226,747 $MTCO_2e$ for the production and delivery of transportation fuels for 2010.

In 2012, the production and delivery of gasoline for the community's vehicles accounted for 139,704 $MTCO_2e$, 105,253 $MTCO_2e$ for diesel, 251 $MTCO_2e$ for compressed natural gas, and 2,769 $MTCO_2e$ for liquefied petroleum gas resulting in a total of 247,978 $MTCO_2e$ for the production and delivery of transportation fuels for 2012.

Figure III-9 Transportation Sources and Methods

The ICLEI Community Protocol was followed as closely as possible to determine emissions data. Particularly, Appendix D of the Community Protocol, 'Transportation and Other Mobile Emission Activities and Sources' which provides the necessary equations and emission factors to produce emission numbers for each mode of transportation. The street and highway emission numbers reported in the previous section are generally based on the Ecology model with transit bus data adjusted based on Spokane Transit Authority data. We did the 2005 comparison with the SRTC VMT based data as that was the method type most similar to the type used in producing the original 2005 value. Emissions of greenhouse gases due to passenger and freight rail travel within the Spokane City limits was quantified and included in this inventory. In contrast to 2005wehave additional data from Spokane International Airport (SIA) beyond fuel use so have calculated and attributed greenhouse gas emissions from air travel. Also in contrast to the 2005 inventory we have estimated off-road equipment emissions and fuel upstream lifecycle emissions.

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Table III-32- Passenger Vehicle Protocol - Input Data Conditions

Passenger Vehicle Protocol - Input Data Conditions				
	Models:	Ecology	SRTC	Preferred
Input Categories				
Travel Activity		T4	T2	T1
Emissions or Energy		E1	E3	E1
Local Adjustments		L3 & L4	L3 +	L1

In comparing the end result of following the protocol using the data from each of the models and reviewing other community transportation data we are aware of three types of problems. One is an overestimate of emissions from motorcycles, school buses, and motor homes when we use SRTC VMT data with County vehicle license vehicle-type percentages to do GHG emissions calculations. This error is because these vehicle types are not on the road year-round. Ecology's model run corrects for this. The second error has to do with the way Ecology's model handled transit buses. The Ecology model outputs under-predict VMT and emissions from transit buses by a factor of three. Ecology modelers feel the combined inter-city bus number and the transit bus number should be fairly accurate.

Transportation Source & Method Notes

They suggested this is because the model only allows for number and types of buses to be input and then allocates the transit portion of that number in a fixed and arbitrary way. In addition, some compressed

natural gas use is attributed in the Ecology model to the transit buses but we are not aware that any was used. Finally, we are aware now that the VMT data used in 2005 significantly over predicted City of Spokane on-road VMT GHG emissions, as the data that was used was for the carbon monoxide non-attainment area. The value reported for 2005 in the 2009 inventory document is nearly double what is now believed to have been correct for on-road vehicles.

The roadway transportation emissions data for Spokane County in 2011 was provided directly by the Ecology model. We checked the Ecology output data against our calculated data which was based on roadway VMT provided by the Spokane Regional Transportation Council (SRTC). SRTC provided us with the modeled vehicle miles traveled (VMT) for all roads and highways for 2010 and 2012, plus forecasted VMT numbers for 2020 and 2030. The State Department of Licensing's data for Spokane County was used to set percentage of vehicles on the road by type of vehicle by year, and also to determine the average vehicle age on the road by year.

In doing the calculations we had to derive VMT conversion ratios for 2011 based on 2010 and 2012 SRTC model data. Using SRTC jurisdiction specific VMT data, STA data, and employment ratios, we derived City of Spokane specific GHG emissions data from the Ecology County wide data.
The formulas and factors that were used in our calculations are provided in the accompanying workbook (**Appendix)**.

The federal emission standards came from the Center for Climate and Energy Solution's website addressing federal vehicle standards: http://www.c2es.org/federal/executive/vehicle-standards#ldv_2012_to_2025.

The forecasted emission numbers for the years 2020 and 2030 were calculated by using the same process we used for calculating 2010 and 2012. That is using Ecology's 2011 County data as a base and then adjusting by SRTC VMT percentage change.

Public Transportation
The Spokane Transit Authority (STA) provided information for total vehicle miles traveled, fuel consumption, and the buses average mile per gallon. We calculated emission numbers by mobile combustion using data that STA provided and by using the equations from the protocol. In the end we determined that STA's own GHG emissions calculations done for 2012 had been done in a manner that was consistent with what the ICLEI protocol required. Further, our results and STA's were quite different than what came from Ecology's model. We have used STA's results and have added to them the estimated contribution from school buses.

Freight and Passenger Rail
Emissions data for freight and passenger rail was calculated with the help of Burlington Northern Santa Fe Railway (BNSF), Union Pacific Railroad (UP), and the National Railroad Passenger Corporation (Amtrak). All three companies provided us with information such that total fuel use for both years could be derived. The equations to calculate rail emissions based on fuel use were taken from the protocol. BNSF sent us their rail data for Spokane County by rail segments. They broke their rail lines into various segments that make up the lines along with the fuel use for each direction of travel over the segments. There were certain segments that were both in and out of the City boundaries.
For those segments, we used ArcGIS mapping to pull out the percentage of that segment that is located in the City boundary.

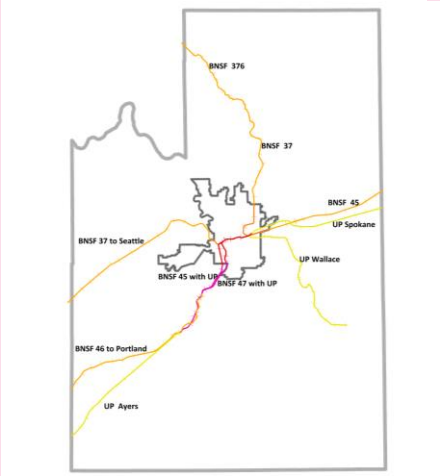
The ArcGIS data itself has the rail lines segmented and in a manner not consistent with that furnished by the railroads. There was a need to match up segments which involved using maps from the railroads to identify which of the ArcGIS lines matched the railroad furnished segments. The fuel use was added up

for each segment and partial segment of line in the City and also for those in the County outside of the City of Spokane. Then the calculations for the two geographic areas for CO_2, CH_4, N_2O, and CO_2e were made using protocol factors.

To calculate Union Pacific's and Amtrak's emissions, we used similar methodology and equations as for BNSF. Union Pacific provided their fuel use data by rail segment for both the full County and for the City separately. To extract the City portion of Amtrak's rail lines in Spokane County, we used ArcGIS to identify the length of the various line segments Amtrak used in the City and in the County. We multiplied the average gallons per route mile and the average gallons per locomotive mile to identify a fuel volume. We used the average gallons per route mile result which is about 25 percent higher than the locomotive specific factor provided in 2008. In 2008 Amtrak staff suggested it would be best to use the locomotive value, but for 2010 and 2012 they just provided the average gallons per route mile.

The information provided relating to the future of rail use in the State of Washington came from the Washington State Department of Transportation's March 2014 rail plan. http://www.wsdot.wa.gov/rail/staterailplan.htm.

Figure III-10 – State Rail Plan



Off-road Vehicles and Equipment

To calculate emissions from off-road vehicles and equipment, we used the Environmental Protection Agency's (EPA) NONROAD model. http://www.epa.gov/otaq/nonrdmdl.htm. This version 2008a, 07/06/09 model provided us with CO_2 numbers in short tons which we then converted into metric tons of CO_2. The model provided data for gas/oil mix 2-stroke engines, gasoline, diesel, LPG, and CNG fueled equipment. The emission numbers that this model provided us with were for Spokane County. To scale the numbers down to the City of Spokane, we multiplied the emission numbers by the percent of households in the City to get a final total. The 2010 housing numbers for the City of Spokane were taken from the U.S. Census Bureau's 2010 Census. The 2012 housing numbers were taken from the U.S. Census Bureau's American Community Survey 1-year estimates 2012.

Air Travel

The information related to number of annual passengers and cargo tonnage was found on the Spokane International Airport website: http://www.spokaneairports.net/pass_data.htm. Fuel dispensed was provided by the Spokane International Airport. Emissions for Air Travel were broken up between the emissions from the aircraft operating at Spokane International Airport and the fleet vehicles that operate there. Data for Spokane's Felts Field and other small County airports was not available. In 2010 Spokane International Airport was outside of the Spokane City limits and was annexed in 2012. It was and continues to be jointly owned by the City of Spokane and Spokane County. In 2010wecredited to

the City only those regional emissions, both ground and air, proportional to the City's share of County roadway emissions (one third). In 2012 with the annexation, we credited to the City of Spokane two-thirds of ground emissions and regional air emissions as allocated by deplaning and emplaning passengers as a percent of all passengers. To find the aircraft emissions, we used the reported quantities of the two types of fuel that pertained to air travel: Jet Fuel and Aviation Gas. Other fuel use was attributed to ground support operations.

Fuel Upstream Lifecycle Emissions

We calculated the upstream lifecycle emissions by using the calculated CO2e emissions and applying fuel dependent factors. The fuel dependent factors used were derived as suggested in the protocol from federal data (derived from AFLEET_Tool_2013©; "Background Data" tab; GREET Fleet Specifications, Table1 "GREET1_2013 (10/24/2013)"). One exception to this was the use of an older factor in the protocol for gasoline with low level ethanol content. Two other exceptions were the use of the regular gasoline factor in place of a lacking aviation gasoline factor and the use of the diesel factor in place of a jet fuel factor. Understanding the uncertainties associated with the upstream lifecycle emissions, we are providing the results for information but are not including the results in the final CO_2e sum.

Outside Contacts

Anna Ragaza-Bourasa – Spokane Regional Transportation Council (SRTC)
Sally Otterson – Washington State Department of Ecology
Matt Breen – Spokane International Airport
Karl Otterstrom – Spokane Transit Authority (STA)
Charlie Phillips – Spokane Transit Authority (STA)
Jon Germer – Union Pacific Railroad
Jeff White – National Railroad Passenger Corporation (Amtrak)
Kevin Maggay – Burlington Northern Santa Fe Railway Corporation (BNSF)

Table III-33 - Summary of Transportation Greenhouse Gas Emission Sources Used

GHG Source	Data Used	Method Used
1) Passenger vehicles	Ecology's Spokane County 2011 travel demand model outputs with SRTC's 2013 model annual City/County VMT projections	Combination TR.1.A & B
2) Freight & service trucks	As above with City/County allocation based on jobs in truck generating industries from 2010 federal data	Combination TR.2.A, B & C
3) Freight Rail	Data from BNSF & UPRR	TR.3
4) Transit Operation	Used STA 2012 GHG calculated system emissions after verifying the method and inputs were protocol consistent	TR4.A & B
5) Attribution of Transit Emissions	Used GIS route maps and schedules to determine % annual bus VMT in City; used this % to allocate total system emissions	TR4.D & E
6) Inter-City Passenger Rail	Data from the National Railroad Passenger Corporation(Amtrak)	TR.5
7) Air travel aircraft emissions	Data from Spokane International Airport	TR.6.B.1
8) Air travel ground support	Data from Spokane International Airport	TR.6.C.1
9) Attribution of Air travel emissions	Used the % of passengers who enplaned and deplaned in Spokane and multiplied that % by total emissions then allocated one third to two thirds of this sum to City of Spokane	TR.6.D
10) Other off-road equipment	Used EPA Non-Road Model with Spokane County data; City of Spokane portion based on # households from Census data	TR.8.A
11) Fuel upstream lifecycle emissions	CO2e emissions calculated above and factors derived from AFLEET_Tool_2013©; "Background Data" tab; GREET Fleet Specifications, Table1 "GREET1_2013 (10/24/2013); and from Table TR.9.1	TR.9

3. Community Solid Waste

Table III-34 - 2010 Spokane City Community Solid Waste Emissions

GHG Source	CO2	CH4	N2O	CO2e
Solid Waste Facilities Located in the City				
1) Methane Emissions From Landfills*		396		8,312
2) Waste Combustion Facilities**	96,316	104	11	101,893
Community-Generated Waste Emissions				
3) Waste to Landfills***		650		13,655
4) Process Emissions				5,214
5) Waste Transportation Emissions				2,786
6) Waste to Combustion Facility	44,573	48	5	47,153
2010 Totals	**44,573**	**444**	**5**	**63,465**

*Annual escaped emissions from landfill resulting from all waste deposited to date.
**WTE plant located outside the City in 2010. Reported for informational purposes but not included in 2010 Totals.
***Life-time estimate of all decomposition emissions of waste deposited in landfill this year. Not included in totals.

Table III-35 2012 Spokane City Community Solid Waste Emissions

GHG Source	CO2	CH4	N2O	CO2e
Solid Waste Facilities Located in the City				
1. Methane Emissions From Landfills*		419		8,796
2. Waste Combustion Facilities	96,932	85	11	102,054
Community Generated Waste Emissions				
3. Waste to Landfills**		434		2,206
4. Process Emissions				6,651
5. Waste Transportation Emissions				2,619
6. Waste to Combustion Facility ***	43,355	38	5	45,646
2012 Totals	**96,932**	**504**	**11**	**120,120**

*Annual escaped emissions from landfill resulting from all waste deposited to date.
** Life-time estimate of all decomposition emissions of waste deposited in landfill this year. Not included in totals.
***Already included in reported Waste Combustion Facilities value. This reported for informational purposes only and not included in 2012 total.

a) Introduction

Reported above are the 2010 and 2012 calculated greenhouse gas emissions from City of Spokane community solid waste. Data is provided for emissions generated by landfills and waste combustion facilities located within the community, emissions generated by community waste sent to landfills and waste combustion facilities regardless of disposal location, and emissions associated with processing and transporting waste sent to landfills. The City community solid waste sector resulted in the emission of approximately 63,465 metric tons of CO_2e in 2010 and 120,120 metric tons of CO_2e in 2012. These totals do not include emissions associated with biogenicCO_2. The 89 % increase in emissions between reporting years is largely due to the inclusion of all of WTE plant emissions in 2012 because of its new location inside the City boundary. In 2010, WTE emissions from City waste only were included in the total. If the boundary were not considered the WTE emissions increased 17% between 2005 and 2012. About 6% of this increase occurred between 2010 and 2012 and in both cases mostly resulted due to changes in proportion of biogenic waste.

The City of Spokane currently contains two landfills, of which one is operating, and one Waste-To-Energy facility. Spokane County contains five other landfills, not within the city boundaries, and no other waste combustion facilities. When municipal solid waste (MSW) is sent directly to the Spokane Waste to Energy (WTE) facility and burned, the ash resulting from this process is transported about 200 miles to Rabanco Landfill located in Klickitat, WA. Waste was also sent to Rabanco when the WTE Facility was not able to handle the quantities received. Because MSW is transported outside of the community boundary, transportation and collection emissions have also been calculated.

Reuse, recycling, and composting are of high importance in reducing the amount of emissions produced through landfilling and combustion. There is currently no methodology yet to estimate direct emissions from the act of composting. However, there is methodology in the ICLEI Compost and Recycling Community Protocol published in 2013 for estimating avoided emissions from composting and recycling instead of incinerating and landfilling. These values are calculated and discussed in this report, though not included in section totals.

In 2005, 65,930 $MTCO_2e$ were emitted due to solid waste. 2010 saw a 3.7% reduction in emissions while 2012 saw an 82% increase from 2005. Note that the 2010 and 2012 totals include municipal solid waste (MSW) that bypassed the incineration facility and went directly to landfills, which was not included in the 2005 report. Landfill emissions calculation methods changed with a new EPA reporting protocol. This resulted in significantly higher emission rates for the old, long closed Southside Landfill where the emissions control equipment is now oversized for the amount of methane produced. The County of Spokane community emitted an estimated 171,717 $MTCO_2e$ in 2010 and 175,863 $MTCO_2e$ in 2012 from solid waste activities. The City of Spokane accounting for community solid waste emissions was 50 % and 82 % of County community solid waste emissions in 2010 and 2012 - this difference more a matter of changed boundaries than changed level of activity.

b) Methane Emissions from City Landfills

This section calculates all methane emissions from landfills in the City community regardless of where the waste came from. The City of Spokane only has two landfills that produce fugitive methane: the Northside and Southside Landfills. Fugitive methane emissions generated from these landfills accounted for 30 % of total City solid waste CO_2e generated in 2010 and 22 % of generated emissions in 2012. In 2010, the Northside Landfill generated 396 metric tons of methane or 8,312 $MTCO_2e$. In 2012, the Northside Landfill generated 419 metric tons of methane or 8,796 $MTCO_2e$. For the Southside Landfill, the total methane generated in 2010 was 903 metric tons of methane or 18,956 $MTCO_2e$. In 2012, the Southside Landfill had total methane generated at 1,113 metric tons of methane or 23,364 $MTCO_2e$ as compared to 6,334 MTCO2e calculated in 2005.

The Northside Landfill was opened in 1931 and was the largest refuse disposal site in the county. In December 1991, the landfill stopped receiving waste. Construction of an extraction well, landfill cap, and a new solid waste cell was completed in 1994. The MSW cell at the Northside Landfill is the only operating landfill permitted to receive MSW in Spokane County. This disposal cell was developed in phases, and was constructed for two reasons. The first reason was for the disposal of material that could not be processed at the WTE facility, and second, to serve as an emergency facility in an event that the WTE facility was inoperable. Phase 1 of the disposal cell is approximately 400,000 cubic yards.
The Phase 2 expansion gives an additional 1 million cubic yards of lined MSW cell area, giving the total area about 1,500,000 cubic yards remaining in the lined MSW cell. Based on previous years' annual tonnages, the Phase 1 disposal area has a remaining capacity of 4 to 6 years.
The Southside Landfill opened in 1960 and operated until 1988 when it was closed in compliance with Washington State landfill closure requirements. The landfill is secured around its entire perimeter, and has a cover system in place which consists of a landfill gas collection and treatment system, a

geomembrane cover, drainage and vegetation layers, and storm water control berms and ditches. The public is unable to access the covered areas of the landfill and have limited access to certain portions of the landfill. The City of Spokane hosts an onsite caretaker, and the operations involved in protecting the site include erosion control, grading control and repair, maintenance, site security, operation of a landfill gas flare station, internal and external methane control, cap maintenance, and ongoing gas and groundwater monitoring. The City of Spokane is also in the process of converting the landfill from an active flare system to an active Bio-filtering system.

c) Combustion of Municipal Solid Waste

This section is specific to in-boundary waste-to-energy facilities. In 2010, the Spokane Waste-to-Energy facility was located outside of the city limits but within the county boundary, excluding it from the City emissions inventory. 2010 WTE emissions data is still reported for informational purposes only. However, by 2012 the city boundary had changed, placing the WTE facility within the city limits of the City of Spokane and including the WTE plant in the City community inventory. The Spokane Waste-to-Energy facility began operation in 1991. It processes municipal solid waste from mixed residential, commercial, and industrial sources. Using two 400 ton/day combustion units, the WTE facility incinerates MSW to generate steam and then electricity from a 26 megawatt turbine generator.

The Spokane Waste-to-Energy (WTE) facility runs 24 hours a day, processes about 800 tons per day, seven days a week. The ash generated is collected and transported to the Roosevelt Regional Landfill, while any ferrous metals that can be recovered are recycled. In 2012, the WTE facility produced 76,222 short tons of ash and recycled 8,702 tons of ferrous metals retrieved from the ash.

In 2010, the WTE facility generated 101,893 $MTCO_2e$ while in 2012 it generated 102,963 $MTCO_2e$. For comparison we estimate the comparable 2005 emissions at 82,074 MTCO2e, twenty five percent (25%) less than 2012 value. Please note the total $MTCO_2$ does not include biologic CO_2 because the ICLEI Community Protocol states that it should not be included. This is because fossil CO_2 and biologic CO_2 have vastly different origins. Fossil CO_2 describes emissions from materials manufactured from fossil fuels, such as plastics, rubber, etc., while biologic CO_2 comes from paper products, yard waste, etc. In 2010, emission of biologic CO_2 was 150,949 $MTCO_2$. In 2012 emission of biologic CO_2 was 146,284 $MTCO_2$. The breakdown of WTE GHG in terms of $MTCO_2e$ from each inventory year is listed below.

Table III-36 – 2010 & 2012 WTE Facility GHG Emissions ($MTCO_2e$)

Year	Fossil CO_2	CH_4	N_2O	CO_2e Total
2010	96,318	2,174	3,401	101,893
2012	97,470	2,142	3,351	102,963

d) Emission Reductions from Composting

Advantages of composting include reduction in volume of waste, destruction of pathogens in the MSW, and greatly decreased methane and nitrous oxide emissions compared to landfills. Once composted, the material can either be used as a fertilizer or sent to a landfill. Compost piles that are currently being correctly and adequately aerated result in compost emissions of almost entirely biogenic CO_2 with trace amounts of CH_4 andN_2O. Since the composting is performed by others outside of the city of Spokane we assume they are doing the job correctly and so have very limited GHG emissions. If we assume zero composting GHG emissions, then emissions from other waste disposal methods for the amount of waste composted directly gives an emissions reduction estimate.
There is ICLEI Community methodology (Recycling and Composting Emissions Protocol, version 1.0, July 2013) on how to estimate avoided emissions from using composting as an alternative to other waste disposal methods like land filling or combusting. At this time the method only addresses avoided emissions from fertilizer savings, and so does not address water savings, erosion control, and herbicide savings. In 2010, 19,632 tons of City clean green material was sent from the WTE plant to Royal City Organics for composting. In 2012, 8,953 tons of City clean green material was sent to Barr-Tech for composting. If this waste had not been composted, it likely would have been combusted for energy at the WTE plant.

If the clean green had been combusted instead of composted, the methodology leads us to estimate one to three thousand more $MTCO_{2e}$ were emitted per year. The protocol is not clear on assumptions behind the emissions factors used for incineration facilities. It may be taking into account energy generation from combustion while not fully addressing the compost savings. This protocol states "Thus, while the methods in this protocol are unable to show the emissions benefits of composting over combustion at this time, the best available science indicates that composting (or anaerobic digestion) is the preferable policy option for reducing GHG emissions."

e) Emission Reductions from Recycling

Recycling typically provides greenhouse gas benefits in three ways. The first is that it eliminates emissions from the process of disposal through landfill or incineration. The second is that recycling avoids emissions from raw "virgin" material acquisition, manufacture, and transportation. The last benefit is that it preserves the amount of carbon stored in forests that may otherwise have been harvested. Calculating emissions reductions from recycling using the ICLEI Community protocol takes these three benefits into account.

In 2010, 3,356 tons of recycled materials contributed to a total emission reduction of 6,065 $MTCO_2e$ avoided. In 2012, 2,924 tons of recycled materials contributed to 5,499 $MTCO_2e$ avoided. Recycling has proven to be a very important way to reduce greenhouse gas emissions from community waste.

Table III-37 – 2010 & 2012 GHG Reduction from Recycling-($MTCO_2e$)*

Type of Material	2010 Tons Recycled	Emissions from recycling	2012 Tons Recycled	Emissions from recycling
Steel Cans-Ferrous Metals	9,921.26	(2,261.35)	9,369.37	(2,150.83)
Glass	593.97	(195.94)	639.00	(210.79)
PET #1			100.46	(234.63)
Corrugated Containers	825.42	(3068.29)	745.15	(3040.21)
Magazines/3rd Class Mail/Newspaper	712.11	(1941.01)	582.80	(1304.54)
Mixed Paper (general)			69.16	(210.24)
Mixed Metals (Tin and Aluminum Cans)& Non-ferrous metals	141.01	(412.05)	109.86	(321.14)
Mixed Plastics (Plastics)	100.81	(223.46)	3.64	(8.06)
Mixed Recyclables			6.87	(16.41)
TOTAL	12,294.58	(8,102.11)	11,626.31	(7,496.87)

*Parentheses indicate a reduction.

f) Community-Generated Waste Sent to Landfills

While the Methane Emissions from Landfills section only focused on landfills located in the City community regardless of waste origin, this section focuses on emissions that result from disposed municipal solid waste that was produced by the Spokane City community, regardless of where the waste disposal facility is located. The protocol requires both sections to be included in the reported total. However, it should be kept in mind that there is double counting between the two.

The landfills that are currently being utilized for MSW include the Northside Landfill (NSLF) and Rabanco Landfill, also known as Roosevelt Regional Landfill (RRLF). Both of these landfills had a gas collection system in place for both 2010 and 2012. Ash from the WTE plant sent to Rabanco is not considered to emit methane. The Graham Road Disposal site does receive waste from the City community but because it only accepts demolition debris and other special waste, it is not included in the calculations for municipal solid waste emissions.

We found that the total emissions from community generated MSW waste sent to landfills in 2010 was 13,655 $MTCO_2$, while in 2012, the value was 9,116 $MTCO_2e$. The fugitive methane produced in 2010 was 650 metric tons, and in 2012 was 434 metric tons. Of the waste that was landfilled in 2010, 968 $MTCO_2e$ was generated from MSW sent directly to Rabanco from the City of Spokane, and 12,687 $MTCO_2e$ was generated from waste that was sent directly to the Northside Landfill. In 2012, 887 $MTCO_2e$ was generated from MSW sent directly to Rabanco from Spokane. 8,229 $MTCO_2e$ was generated from waste that was sent directly to the Northside Landfill. These values were calculated based on the tonnage sent to the landfill in that inventory year and may be seen in the following table.

Table III-38- 2010 & 2012 Landfill Waste and Methane Emissions by Inventory Year

Year	Units	Ash to RRLF	MSW to RRLF	MSW to NSLF
2010	Short Tons	81,898	3,414	11,188
	CH_4 ($MTCO_2e$)	0	968	12,687
2012	Short Tons	76,222	3,127	7,257
	CH_4 ($MTCO_2e$)	0	887	8,229

RRLF: Roosevelt Regional Landfill (Rabanco), NSLF: Northside Landfill

g) Process Emissions Associated with Landfilling

The emissions associated with powering the equipment necessary to manage a landfill are known as process emissions. Process emissions for landfills located within the city are not included in the community emissions total as they are already included in other sections of the report. However, process emissions should be included for landfills that are located outside of the City of Spokane to appropriately attribute emissions to the community of origin. Therefore, the only process emissions that are reported here are emissions associated with powering Rabanco Landfill in Klickitat, WA and Graham Road Disposal. Process emissions are calculated with emissions factors for diesel and compressed natural gas equipment based on City community waste disposed in each landfill.

In 2010, of the total 5,214 $MTCO_2e$ produced through process emissions, 2,244 $MTCO_2e$ can be attributed to ash transported to Rabanco from the WTE plant, 2,876 $MTCO_2$ to waste sent to Graham Road Disposal, and 94 $MTCO_2e$ can be attributed to waste that bypassed incineration and was sent directly to Rabanco. In 2012, of the total 6,651 $MTCO_2e$ process emissions, 2,088 $MTCO_2e$ was due to ash sent to Rabanco, 4,477 $MTCO_2e$ due to waste sent to Graham Road Disposal, and 86 $MTCO_2e$ can be attributed to waste that bypassed incineration and was sent directly to Rabanco. The increase in process emissions between 2010 and 2012 are mostly due to an increase of 58,404 tons of waste sent to Graham Road Disposal in 2012.

While process emissions from landfills within the community boundary were not included in the reported total due to double counting concerns, these values may be used as indicators or informational purposes. In 2010, total process emissions generated from the Northside Landfill within the City boundary were 307 $MTCO_2e$ and in 2012, NSLF generated 199 $MTCO_2e$ through process emissions. Graham Road landfill is a landfill located outside the City of Spokane but within Spokane County. It is a special waste facility, accepting items such as asbestos, tires, wood, concrete, etc. Because this facility is also outside the Spokane City boundary but inside the Spokane County boundary, its values have been added to the City process emissions total but not the County community totals.

h) Collection and Transportation Emissions

Collection emissions are the direct emissions from powering equipment necessary to collect municipal solid waste in the community. Transportation emissions are similar, but instead cover the emissions produced from transporting community waste to waste disposal facilities. Collection emissions result in double counting if included in the total because waste collection vehicles are already included in the community transportation sector of the report. Transportation emissions also have a double counting conflict when landfills are located within the community. Therefore, emissions calculations have only been completed for transportation emissions to facilities located outside of the community.
For the City of Spokane, transportation emissions are calculated for waste and incinerator ash transport to the Rabanco Landfill and the Graham Road Landfill. Transport to the WTE plant is included in 2010 because the facility was located outside the City in this reporting year.

Transportation emissions for the County are only calculated for waste and ash sent to the Rabanco Landfill. Only the diesel factor was used for these calculations as waste was transported primarily by rail and diesel truck.

Collection emissions should only be used for informational purposes. They are not included in the total emissions generated by the City of Spokane. The protocol gives a factor of 0.02 $MTCO_2e$/short ton for collection emissions. In 2010, the total collection emissions for the City community were 5,132 $MTCO_2e$. In 2012 this value was 5,963 $MTCO_2e$.

In both 2010 and 2012, transportation emissions accounted for about two percent (2%) of the total emissions due to solid waste activities for the City of Spokane. The protocol gives a factor of 0.00014 $MTCO_2e$/short ton/mile for transportation emissions. In 2010, emissions generated by transporting Spokane City waste to facilities outside the community were 2,786 $MTCO_2e$. In 2012, this value was 2,619 $MTCO_2e$.

i) Community-Generated Waste Sent to Combustion Facilities

While emissions generated by the incineration facility located in Spokane have previously been calculated, it is also important to calculate emissions that can be specifically attributed to the community's generation of waste. For example, an incineration facility may receive waste from various cities, counties, and states. This is the situation for the WTE waste incineration plant located in Spokane. According to the 2012 Annual Report for the Waste-to-Energy facility in Spokane, this facility also received waste from Lincoln County, Stevens County, Pend Oreille County, Whitman County, Idaho, and "Other". This section only reports WTE emissions due to Spokane City community and Spokane County community waste.

In 2010, half (50%) of the 279,602 short tons of waste incinerated at the WTE plant was waste generated by the Spokane City community. In 2012, this portion was 47%. The city generated 51,174 $MTCO_2e$ in 2010 and 47,935 $MTCO_2e$ in 2012. These values were also calculated for Spokane County. In 2010, Spokane County generated 110,129 $MTCO_2e$, and less in 2012: 107,171 $MTCO_2e$. Again, note that biologic CO_2 is listed in the tables but not included in the totals because the ICLEI Community Protocol specifically excludes it. Below are the tables for both the City and County of Spokane listing metric tons of GHG emitted.

Table III-39 – 2010 & 2012 Spokane City Community Generated Incineration Emissions

Year	*Fossil CO_2*	*CH_4*	*N_2O*	*Biologic CO_2**	*Total CO_2e*
2010	48,374	52	6	75,811	51,174
2012	45,377	47	5	68,103	47,935

*Biologic CO_2 not included in total

Table III-40 – 2010 & 2012 County Community Generated Incineration Emissions

Year	*Fossil CO_2*	*CH_4*	*N_2O*	*Biologic CO_2**	*Total CO_2e*
2010	104,103	112	12	163,150	110,129
2012	101,454	106	11	152,263	107,171

*Biologic CO_2 not included in total

j) Spokane County Landfills

Spokane County has several landfills, four of which are closed, and one that is still in operation. These landfills include Colbert Landfill, Greenacres Landfill, Mica Landfill, Marshall Landfill, and Graham Road. Graham Road is the only landfill in the county that currently accepts waste, and has been in

operation since 1991. It is a limited purpose facility and only accepts construction and demolition debris, asbestos, tires, wood, concrete, etc. Graham Road also processes and markets recycled asphalt and concrete.
This landfill has an estimated remaining capacity of 11,588,000 tons, and based on average annual disposal has a remaining capacity of approximately 90 years. Emissions generated were not calculated for all five of these landfills due to a lack of information. In addition, because Graham Road is not a MSW disposal facility, the normal EPA landfill emissions calculation tools do not apply. However, emissions were calculated based on the FOD model for Mica Landfill, Marshall Landfill. The table below depicts the metric tons of methane and CO_2e for these landfills for 2010 and 2012.

Table III-41 – 2010 & 2012 Mica and Marshall Landfill Emissions

Year	Mica		Marshall	
	CH_4	CO_2e	CH_4	CO_2e
2010	858	18,009	906	19,021
2012	824	17,302	870	18,276

4. Community Wastewater and Water

Table III-42 - 2010 Wastewater and Water Emissions

	CO2	CH4	N20	CO_2e
Water	4,761	0.11	0.07	4,785
Water Electricity T&D*				306
Water Upstream*				877
Wastewater	9,657	0.68	7.80	12,101
Wastewater Electricity T&D*				636
Wastewater Upstream*				1,821
Septic Systems		6.00		117
2010 Totals	14,418	6.79	7.87	17,003

*Upstream and T&D emissions are not included in the 2010 total.

Table III-43 - 2012 Wastewater and Water Emissions

	CO2	CH4	N20	CO2e
Water	8,758	0.19	0.13	8,803
Water Electricity T&D*				579
Water Upstream*				1,205
Wastewater	14,054	.82	9.40	16,977
Wastewater Electricity T&D*				930
Wastewater Upstream*				1,939
Septic Systems		5.00		115
2012 Totals	22,812	6.01	9.53	25,895

*Upstream and T&D emissions are not included in the 2012 total.

Table III-44 -2010 & 2012 Emission Rates by Sector

Water	CO2e (g) per gallon pumped	CO2e (kg) per MMBTU
2010	0.23	34.1
2012	0.42	108
Wastewater	CO2e (g) per gallon treated	CO2e (kg) per MMBTU
2010	.87	66.2
2012	.97	77.1

Introduction

The U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions includes Wastewater and Water Emissions Activities and Sources. The tables above show the CO_2 equivalent emissions for the Water and Wastewater sectors. The community results shown above are for all facilities within the jurisdictional boundary of the City of Spokane.

The Water sector consists of emissions by City of Spokane Water Department within the city limits. These emissions are based on the electricity and natural gas used by the department, including maintenance and administrative facilities.
As described in more detail below, the 45.6 % increase in emissions from 2010 to 2012 is primarily due to a change in how electrical power at the water department was purchased and sold.

There are a few well-owner, self-supplied residential and commercial locations within the City of Spokane. The emissions from energy to supply water at these locations are included in the built environment section of this report. In general, energy use is low for self-supplied users because the water is used near the location it was withdrawn.

The wastewater sector includes the emissions from treatment plants located within the jurisdictional boundary of the City of Spokane. For 2010 this is the City of Spokane's Riverside Park Water Reclamation Facility (RPWRF) and in 2012 the RPWRF and the Spokane County Regional Water Reclamation Facility (SCRWRF). Wastewater treatment can create process, stationary and fugitive greenhouse gas emissions. Methane (CH_4) is produced by treatment lagoons, septic systems, and the combustion of anaerobic digester gas. Nitrous Oxide (N_2O) is also produced from the combustion of anaerobic digester gas as well as treatment plant operations and effluent discharge.

The electricity and natural gas used by all of the City of Spokane Wastewater Department facilities are included in this section; this includes collection pumping and lift stations, the RPWRF, and administration and maintenance facilities. The wastewater collection for this facility is primarily located in Spokane County. The 2012 emissions are lower than in 2010 because of reduced energy use at RPWRF. There are corresponding emissions from purchased energy used at the new SCRWRF but these emissions are included in the built environment section of this report. There are a few residents within the city limits that utilize onsite septic systems to treat their waste.

In the City of Spokane 1990 & 2005 Greenhouse Gas Inventory, emissions from this sector were included in the Residential, Commercial and Industrial Buildings section of the Community Inventory. Total emissions for combined water and wastewater sectors in 2005 were estimated to be 15,259 metric tons of CO_2e. 2010 combined totals increased 17.6 % and 2012 totals increased 79.6 %. These emissions are also included in the local government inventory of this report under the Wastewater Water sector.

The 2010 wastewater emissions in this section used the same raw data as the local government section. The protocol used in these two sections has different equations to calculate the stationary, process and

fugitive emissions. The largest differences are in the calculation of stationary methane and nitrous oxide. The local government protocol estimates more methane was released and does not have a calculation for nitrous oxide emissions from the combustion of anaerobic digester gas.

Table III-45 – 2010 & 2012 Water Sector Emissions

	CO_2	CH_4	N_2O	CO_2e
2010 Electricity	4,451	0.09	0.07	4,474
2010 Natural Gas	310	0.03	0.0006	311
Total	4,761	0.11	0.07	4,785
2012 Electricity	8,421	0.16	0.13	8,466
2012 Natural Gas	337	0.03	0.0006	337
Total	8,758	0.19	0.13	8,803

a) Water Sector

The water sector includes emissions from purchased electricity and combusted natural gas used during Water Department operations. The City of Spokane Water Department provides wholesale water to other purveyors, and water within its service area but outside of the city limits. 89.7 % of the water was consumed by customers within the city in both 2010 and 2012. From 2010 to 2012 there was an 84 % increase in water sector emissions. This increase is largely due to how electrical consumption was calculated. In 2010, the electrical contract had the additional electricity generated at the Upriver Hydro Electric facility wheeled to outlaying pumping and distribution facilities. This was electrical power which was not considered to generate emissions. In 2012, the new Avista electrical contract sold all of the generated power left after power used at the Upriver facility and Parkwater pumping station. The remaining pumping and distribution facilities purchased electricity which has emissions calculated with the Northwest eGRID emission factors. Emissions due to natural gas usage increased 8 % between reporting years.

In 2005, total emissions attributed to the water sector were estimated to be 6,201 metric tons of CO_2e. 2010 water emissions decreased 23 % from 2005 while 2012 water emissions were up 42 % from 2005.

Table III-46 – 2010 & 2012 Water Department Electricity Use Due to Pumping and Distribution

	2010			2012		
	Water MGY	kWh	kWh/MG	Water MGY	kWh	kWh/MG
Extraction and Transmission*	20,608.8	31,079,760	1,508	21,022.9	29,604,880	1,408.2
Distribution**	9,510.8	8,154,645	857	9,991.8	8,575,120	858
Totals		39,234,405			38,180,000	

*This is actually the power used to pump the water from the ground into the appropriate lower pressure systems as the reservoir water levels varied with demand.
**This is the power used to move water into the upper pressure systems as their reservoir levels varied with demand.

The above table includes all power used in the pumping and distribution of water within the City of Spokane, regardless if it was electricity generated at Upriver Dam or purchased power. The total gallons amount of water withdrawn from the Rathdrum-Spokane aquifer and distributed through pumping stations decreased by two percent (2%) between 2010 and 2012.
Total power used associated with the distribution of water to locations of higher elevation increased by 0.1 %, while power use due to pumping water from the aquifer decreased by 6.6 %. Changes in power used per MGY are largely due to changes in the static head required to transport water to end use

locations. The City also tracks the amount of water that is pumped from the ground but not accounted for in terms of use, which is termed Distribution System Leakage (DSL). In 2010 the DSL was found to be 18.1 % while in 2012 it was 19.9 %.

b) Wastewater Sector

Table III-47 - 2010 Wastewater Sector Emissions

Source	CO_2	CH_4	N_2O	CO_2e
Purchased Electricity	9,244	0.18	0.14	9,292
Natural Gas Combustion	414	0.04	0.0008	415
Stationary Flared Digester Gas		0.46	0.09	38
Fugitive Emissions			4.95	1,534
Process Emissions			2.65	822
2010 Totals	9,657	.68	7.80	12,101

Table III-48 - 2012 Wastewater Sector Emissions

Source	CO_2	CH_4	N_2O	CO_2e
Purchased Electricity	13,527	0.26	0.21	13,598
Stationary Natural Gas Combustion	527	0.05	0.001	528
Stationary Flared Digester Gas		0.51	0.10	42
Fugitive Emissions			6.20	1,920
Process Emissions			2.87	889
2012 Totals	14,054	.82	9.40	16,977

Wastewater sector emissions come from purchased electricity, natural gas combustion, flared digester gas, fugitive emissions, and process emissions of all wastewater operations within the Spokane City limits. The City of Spokane operates an advanced wastewater treatment plant called the Riverside Park Water Reclamation Facility (RPWRF). This is a regional facility receiving wastewater from the City of Spokane, Airway Heights, Fairchild Air Force Base, Millwood, Spokane Valley and portions of Spokane County.

In 2010, approximately 76.0 % of the wastewater treated was attributable to City of Spokane residents. The City of Spokane Valley portion was estimated at 16.6 %, Spokane County 4.6 %, Fairchild Air Force Base 1.5 %, Airway Heights 1.4 %, and Geiger Heights less than 1 %. In December of 2011, Spokane County started operation of a wastewater treatment facility treating the flow from Spokane Valley.

The Spokane County treatment plant is located within the Spokane City limits with treatment emissions included in this community report. In May of 2012 Airway Heights began operation of a facility treating their wastewater, reducing some of the flow to the RPWRF. 89.1 % of the emissions from the RPWRF were attributable to City of Spokane residents in 2012.
Spokane County portion was estimated at 5.1 %, Fairchild Air Force Base 1.9 %, and Geiger Heights less than 1 %. Even though the Spokane County treatment plant was operating for all of 2012, the RPWRF received 2.6 % of its total flow from this region.

Emissions for the wastewater sector grew 40 % between 2010 and 2012, mostly due to the addition of the new County treatment plant in 2011. In 2005, total emissions from the wastewater sector were estimated to be 9,058 metric tons of CO_2e. 2010 wastewater emissions increased 34 % and 2012 emissions increased 87 % since 2005.

(1) Treatment Plant Energy Emissions

Electricity and natural gas usage for all treatment plants within the City of Spokane are included in the summary table. Emissions from purchased electricity usage rose 46 % between 2010 and 2012. Natural gas usage grew 27 % between 2010 and 2012.

(2) Treatment Plant System Emissions

The system of treating wastewater produces emissions of nitrous oxide (N_2O) and methane (CH_4). Different treatment methods produce different levels of emissions. The protocol has 3 different categories. There are stationary emissions, process emissions and fugitive emissions. Stationary emissions are methane and nitrous oxide from the combustion of gas produced by anaerobic digesters. Methane emissions can be calculated directly when the volume of anaerobic digester gas and the fraction of methane are known, or from the population served by the facility. This methane is due to small inefficiencies in the combustion of anaerobic digester gas. Nitrous oxide is not generated in significant amounts in anaerobic digesters, but the combustion of the digester gas does produce it. Nitrous oxide emissions are calculated in the same manner as methane emissions, directly from the volume of anaerobic digester gas and the fraction of methane. All centralized treatment using conventional processes have nitrous oxide emissions called process emissions. There are different formulas based on whether the treatment plant is designed to utilize nitrification/denitrification or not. The RPWRF performs nitrification and denitrification. The discharge of wastewater effluent produces fugitive nitrous oxide emission when the effluent enters the receiving water body.

Table III-49 – 2010 & 2012 Wastewater Biogenic CO_2 Emissions

Year	2010	2012
Biogenic CO_2	10,861	8,850

The combustion of anaerobic digester gas produces CO_2. These emissions are considered part of the short-term carbon cycle and are not included in the total emission total. They are presented here as general information.

c) Septic Systems

The majority of property in the City of Spokane is connected to the centralized wastewater collection system, but there are some septic tanks in use. Septic tanks typically contain underground stagnant and un-aerated tank(s) where the treatment occurs by physical settling and biological activity. These systems typically do not have other wastewater unit operations associated with them. Emissions are mainly CH_4 with very little N_2O generated. Septic tanks are usually gravity systems therefore there is no energy use emissions. For 2010 there were 512 locations serving an estimated 1280 people. There were 504 locations with septic tanks serving an estimated 1260 people in 2012.

d) Transmission and Distribution Loss Emissions

The Community protocol includes calculations to determine the emissions from the transmission and distribution of electricity. A certain amount of electricity is lost to heat when electricity is transmitted through power lines. These losses are called transmission and distribution (T&D) losses, and they represent a significant portion of our total electricity generation. For the Spokane region the loss is 6.84 %. Transmission and distribution loss emissions are not included in yearly totals because such loss is attributed to the power company.

e) Upstream Emissions from Energy Use

In addition to estimating GHG emissions that result from combusting fuel to produce electricity and heat, this report includes GHG emissions that result from the use of energy required to extract, process, and

deliver the fuel to either an electricity generation facility or other points of combustion. These GHG emissions are considered upstream emissions. For this report, the upstream emissions were considered for the natural gas used, the purchased electricity and the electricity in the transmission and distribution losses. These emissions are reported in the introductory summary table but are not included in the 2010 or 2012 total per the community protocol.

Table III-50 – 2010 & 2012 Spokane County Emissions (includes Spokane City emissions)

Sector	2010 CO2e	2012 CO2e
Water	20,006	24,377
Wastewater	15,738	21,305
Septic systems	12,416	12,553
County Total	48,159	58,235

Table III-51 2010 & 2012 Spokane County Emissions Factors

Water	CO2e (g) per gallon pumped	CO2e (kg) per MMBtu
2010	.30	114.39
2012	.35	114.19
Wastewater	CO2e (g) per gallon treated	CO2e (kg) per MMBtu
2010	1.00	79.71
2012	1.08	89.13

For comparison to City of Spokane emissions, the emissions for extracting and distributing water and collecting and treating wastewater in Spokane County including the City of Spokane are shown above.

Water sector emissions are for all water use including public water systems, self-supplied residential, agricultural, and self-supplied industrial commercial uses. The amount of water is estimated using the Spokane County Water Demand Model.

There was an estimated 67.4 billion gallons of water used in the County in 2010 and 68.9 billion gallons consumed in 2012. The grams of CO_2e per gallon pumped falls between the values reported previously for the community. The greenhouse gas emissions for electricity used at City of Spokane Water Department facilities in the County are included in the tables above.

For the Wastewater sector, the list of Washington State Department of Ecology permitted municipal treatment plants within Spokane County was used. There are three industrial treatment facilities that are not included in these emissions. In 2010 there were 14 facilities. In June of 2012 Airway Heights started up a new facility.

Therefore 15 treatment plants were included in the 2012 emission calculations. Wastewater emissions include both the treatment facilities and estimated energy use in the collection and treatment of wastewater.

The Spokane Regional Health District provided the number of active septic systems in 2010 and 2012. In 2010 there were 53,989 systems serving an estimated 134,972 people. There were 54,599 systems in 2012 serving approximately 136,497 people.

Figure III-11 Community Wastewater and Water Methods

Wastewater Sector

The Wastewater Sector information came from the City of Spokane Wastewater Management Department, the 2010 and 2012 Riverside Park Water Reclamation Facility Annual Assessments, and Environmental Programs Utility Manager Database. All of the purchased electricity and natural gas used in all of the wastewater facilities are included in this section. This includes the Riverside Park Water Reclamation Faculty (RPWRF), all pumping and lift stations, administrative buildings and maintenance facilities. The emissions from purchased energy were calculated using the same equations as the water sector.

The operation of the RPWRF creates a unique set of process and fugitive greenhouse gas emissions. Stationary methane emissions from the incomplete combustion of anaerobic digester gas were calculated using equation ww.1a. Stationary nitrous oxide emissions were calculated using equation ww2.a. Process nitrous oxide emissions from the nitrification and denitrification of the nitrogen present were calculated from equation ww.7. Equation ww.12 was used to calculate fugitive nitrous oxide emissions created by discharging effluent to the Spokane River. The Spokane County Regional Water Reclamation Facility emissions were calculated from the population served by the facility provided by Ben Brattebo, an engineer with Spokane County Utilities. The alternative version, based on population served, of equations ww1, ww2, ww7, and ww12 was used.

T&D Emissions

For both the wastewater and water sectors transmission and distribution losses equation BE.4.1.1 from Appendix C: Built Environment Emission Activities and Sources U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Version 1.0, October 2012 was used. The eGRID electricity emission factors from eGRID 9th edition Version 1.0 Year 2010 for sub region NWPP were used. The regional transmission and distribution loss factor for the Western Region also came from the USEPA eGRID 9th edition Version 1.0. This value is reported only as CO_2e. The transmission and distribution system losses from this sector are also included in the built environment values.

Upstream Emissions

The Upstream emissions are reported for electrical and natural gas use in both the wastewater and water sectors. The electricity associated with the transmission and distribution loss is included in the upstream emissions calculation. The upstream emissions associated with stationary fuel use were determined using equation BE.5.1.1 from Appendix C: Built Environment Emission Activities and Sources U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Version 1.0, October 2012. The Upstream emissions for electricity were calculated separately for the two suppliers; Avista, and Inland Power. The fuel mix for each utility came from the Washington State Department of Commerce 2011 Utility Fuel Mix Report, for 2010 data, and the 2013 Utility Fuel Mix Report, for 2012 data. Note that even though the electrical utilities report 13 categories in the Fuel Mix tables the protocol only uses 4 categories; coal, natural gas, petroleum fuel, and nuclear, to calculate the upstream emissions.

Septic Emissions

The community septic systems within the City of Spokane jurisdictional boundary for 2012 were determined from the table for the Septic Tank 2_19_13 shapefile. The entries in the table that were within the city limits were counted. This was 504 entries. To calculate the number of septic systems in 2010 the number of systems that were removed were added in and the number of new systems were subtracted from the 2012 result. 10 systems had been eliminated and 2 systems added. 512 systems were in the city at the end of 2010. The City of Spokane sewer maintenance department provided the shapefile and the list of eliminated septic systems. The Spokane Regional Health District provided the number of new systems within the city. The population per septic service came from the City of Spokane's residential density of 2.5 people per household.

Biogenic CO_2 Emissions

The biogenic CO_2 reported was calculated from equation ww.3 from Appendix F: Wastewater and Water Emissions Activities and Sources, U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0, October 2012. Only the RPWRF biogenic carbon emissions were determined. The protocol does not have a population based alternative method.

Comparison to Spokane County Emissions

For comparison, the water use and wastewater treatment for all of Spokane County excluding the City of Spokane are presented. The water use was determined from the Spokane County Water Demand Forecast Model Version 3.0 June 30, 2013. The County water use for 2012 was interpolated between the 2010 and 2015. Method ww.14 from Appendix F: Wastewater and Water Emissions Activities and Sources, U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0, October 2012 was used to calculate the emissions associated with groundwater extraction, conveyance and distribution. The low value for the energy intensity of groundwater extraction in Table ww.14.2 was used. The median values in tables' ww.14.3 and 14.5 were used. Water treatment facilities were considered negligible. The Washington State Department of Health lists 1 active community system and 3 active transient non community systems in Spokane County with surface water as the source. This was considered negligible and all of the water energy consumption was assumed to be from groundwater.

The wastewater emissions were calculated from those municipal treatment facilities listed for Spokane County in the Department of Ecology's water quality permit database accessed with the Permit and Reporting Information System (PARIS). There are 17 facilities listed as of November 2014 including the RPWRF and SCRWRF.

There are 3 industrial facilities listed. Emissions were calculated for the municipal facilities only. Treatment plant process, fugitive and stationary greenhouse gas emissions were calculated with the methods in Appendix F: Wastewater and Water Emissions Activities and Sources, U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0, October 2012. Eight facilities utilized lagoons. Equation WW.6. (alternative) was used to determine the methane emissions, and equation WW.12. (alternative) was used to calculate the N_2O emissions from effluent conversion. In 2010 there were 6 facilities with conventional treatment. Equations WW.8 and WW.12. (alternative) were used to calculate the N_2O process and effluent conversion emissions respectively. For 2012 there was one additional conventional treatment facility.

The population served by eight of the treatment plants was determined from the April 1, 2014 population of cities, towns, and counties by the Washington State Office of Financial Management for each year, 2010 and 2012.

The population served by three of the plants was determined from the permit application to the Department of Ecology. Three additional figures from the fact sheets for the State Waste Discharge Permit associated with the facilities. The population served could not be ascertained for one facility, Badger Lake Estates. The sum of these estimated populations served was larger than the figure from

Washington state of Spokane County population by approximately six percent (5.7%) in 2012.

Outside Contacts
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Ben Brattebo – Spokane County Utilities
Steve Holderby – Spokane Regional Health District
Angela Cline – City of Spokane Accounting
Louis Meuler – City of Spokane Planning Department
John Lines – City of Spokane Wastewater Maintenance
Nathan Kujawa - City of Spokane Wastewater Maintenance
Mike Hermanson – Spokane County Water Resources

D. City of Spokane Government Inventory

1. Buildings

The Buildings sector includes administrative facilities, public venues, libraries, parks and recreation facilities, storage facilities, Community Oriented Policing (COPS) shops, fire stations and facilities. Buildings and facilities that are described elsewhere are not included, such as "Water delivery facilities; Power generation facilities; Solid Waste disposal facilities; Wastewater facilities; and Airport facilities".

Table III-52 - 2010 Total Buildings Emissions by Source

	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion-Natural Gas	3,250.5	0.306	0.006	3,258.9
Purchased Electricity	6,368.7	0.121	0.099	6,401.9
Purchased Steam Heat	550.4	0.052	0.001	551.8
Reported Total	10,170.0	0.480	0.106	10,212.6

Table III-53 - 2010 Total Buildings Emissions by Department

Department	Number of buildings	MMBTU	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation-Community Centers	42	39,876	3,092.6	0.152	0.031	3,105.4
Fire	16	17,653	1,335.7	0.069	0.013	1,341.1
Multiple, City Hall	1	12,147	1,164.9	0.035	0.016	1,170.5
Public Library	7	11,618	1,029.2	0.038	0.013	1,033.9
Police	17	15,763	1,092.0	0.066	0.009	1,096.1
Fleet Services	5	13,625	831.3	0.063	0.005	834.0
Solid Waste	5	5,327	565.4	0.013	0.008	568.2
Asset Management	3	6,301	564.0	0.020	0.007	566.6
Street	5	3,270	253.4	0.012	0.003	254.5
Public Defender/Prosecutor	1	1,406	118.6	0.005	0.001	119.2
Municipal Court/Probation	1	1,399	122.6	0.006	0.001	123.1
Total	103	128,545	10,070	0.480	0.106	10,213

Table III-54 - 2012 Total Buildings Emissions by Source

	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion-Natural Gas	3,025	0.285	0.006	3,032.9
Purchased Electricity	6,832	0.130	0.106	6,867.6
Purchased Steam Heat	441	0.042	0.001	442.2
Reported Total	10,298	0.457	0.113	10,342.7

Table III-55 - 2012 Total Buildings Emissions by Department

Department	Number of buildings	MMBTU	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation-Community Centers	42	36,020	2,867.1	0.134	0.030	2,879.2
Fire	17	19,806	1,606.1	0.072	0.017	1,613.1
Police	19	17,669	1,247.7	0.073	0.010	1,252.5
Multiple, City Hall	1	11,081	1,097.2	0.031	0.015	1,102.6
Library	7	11,940	1,055.2	0.039	0.013	1,060.0
Fleet Services	5	11,943	738.0	0.055	0.004	740.4
Asset Management	3	6,985	653.5	0.021	0.009	656.6
Solid Waste	5	6,110	617.8	0.016	0.009	620.8
Street	5	2,200	200.2	0.007	0.003	201.1
Municipal Court/Probation	1	1,365	112.4	0.005	0.001	112.9
Public Defender/Prosecutor	1	1,249	103.0	0.004	0.001	103.5
Total	106	126,368	10,298.2	0.457	0.113	10,342.7

Overall Buildings sector emissions increased 130 $MTCO_2e$ (1.3%) between 2010 and 2012. Stationary combustion saw a 226 $MTCO_2e$ decrease while purchased electricity grew by 463.3 $MTCO_2e$. Five of the eleven departments increased overall emissions between the two reporting years. Parks and Recreation had a 226 $MTCO_2e$ overall emission decrease while the Fire department increased amount of 272 $MTCO_2e$. The Police department had a relatively large increase for the size of its emissions of 256 $MTCO_2e$, a 43 % increase from 2010 to 2012. This large relative increase may be due to the addition of two more Police buildings in 2012.

Table III-56 – 2010 & 2012 Comparison with 2005 Building Sector Emissions

Year	Total CO2e	Total MMBTU	Total Energy Cost	CO2e % from 2005
2005	11,938.0	132,279	1,890,247	
2010	10,113.2	126,667	2,058,437	-15.3
2012	10,263.1	124,871	2,245,208	-14.0

Since 2005, overall carbon dioxide equivalents had decreased by 15.3 % in 2010, and 14.0 % in 2012. The associated total energy (MMBTU) decreased 4.3 % in 2010, and 5.6 % in 2012.

a) Stationary Combustion

This describes fuel used in buildings and facilities in stationary combustion devices such as furnaces, boilers, burners and internal combustion engines. City of Spokane stationary combustion devices in this section use only natural gas. In both 2010 and 2012, natural gas for the vehicle fleet's two natural gas vehicles are accounted for in this sector and not under the Vehicle Fleet sector of the report. These vehicles are fueled at fleet services and do not have separate metering data from the rest of the building's natural gas.

Table III-57 - 2010 Stationary Combustion Emissions by Department

Department	Natural Gas	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation	232,925	23,292.0	1,235.0	0.116	0.002	1,238.1
Fleet Services	117,777	11,778.0	624.5	0.059	0.001	626.1
Fire	108,775	10,878.0	576.7	0.054	0.001	578.2
Public Library	46,141	4,614.1	244.6	0.023	0.001	245.3
Multiple, City Hall	33,180	3,318.0	175.9	0.017	0.0003	176.4
Asset Management	24,051	2,405.1	127.5	0.012	0.0002	127.8
Police	19,179	1,917.9	101.7	0.010	0.0002	102.0
Street	19,139	1,913.9	101.5	0.010	0.0002	101.7
Public Defender, Prosecutor	6,594	659.4	35.0	0.003	0	35.1
Solid Waste	5,316	531.6	28.2	0.003	0	28.3
Municipal Court/Probation	0	0	0	0	0	0
2010 Total	613,077	50,708	3,250.5	0.307	0.006	3,258.9

Table III-58 - 2012 Stationary Combustion Emissions by Department

Department	Natural Gas	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation	197,917	19,791.7	1,049.4	0.099	0.002	1,052.0
Fire	103,815	10,381.5	550.4	0.052	0.001	551.8
Fleet Services	101,677	10,167.7	539.1	0.051	0.001	540.5
Public Library	47,845	4,784.5	253.7	0.024	0.001	254.3
Police	47,676	4,767.6	252.8	0.024	0.001	253.4
Multiple, City Hall	24,411	2,441.1	129.4	0.012	0.0002	129.8
Asset Management	21,859	2,185.9	115.9	0.011	0.0002	116.2
Solid Waste	11,294	1,129.4	59.9	0.006	0.0001	60.0
Street	7,831	783.1	41.5	0.004	0.0001	41.6
Public Defender, Prosecutor	6,244	624.4	33.1	0.003	0.0001	33.2
Municipal Court/Probation	0	0	0	0	0	0
2012 Total	570,569	57,056.9	3,025.2	0.28528	0.006	3,032.9

Emissions due to stationary natural gas combustion in buildings decreased 7 % between 2010 and 2012. Four out of the 11 departments decreased natural gas combustion and the rest were close to even or only have a small increase in emissions. The department with the largest absolute decrease was the Parks and Rec Department with a reduction of 186 metric tons of CO_2e between the two reporting years.

b) Purchased Electricity

This describes electricity used in buildings. It does not include electricity use that is elsewhere described, such as "Streetlights and traffic signals; Water delivery facilities; Airport facilities; Power generation facilities; Solid Waste facilities; Wastewater facilities." However, purchased electricity used in electric vehicles is accounted for in this section instead of the Vehicle Fleet section because of metering limitations. The vehicle fleet's one electric vehicle received its electricity from City Hall in 2012 and its usage is included under that department in the appropriate table below. No plug-in electric vehicles were in use in 2010.

Emissions due to purchased electricity increased 7 % between 2010 and 2012. Six of the ten departments increased their electricity use. The Fire Department increased their electricity use the most by 776,460 kWh and increased emissions by 289 metric tons of CO_2e between 2010 and 2012.

Table III-59 - 2010 Purchased Electricity Emissions by Department

Department	kilowatt hours	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation	4,860,421	16,584.0	1,857.6	0.035	0.029	1,867.3
Multiple, City Hall	2,587,680	8,829.2	989.0	0.019	0.015	994.1
Public Library	2,052,760	7,004.0	784.5	0.015	0.012	788.6
Fire	1,985,840	6,775.7	759.0	0.014	0.012	762.9
Solid Waste	1,405,505	4,795.6	538.0	0.010	0.008	540.0
Police	1,273,106	4,343.8	486.6	0.009	0.008	489.1
Asset Management	1,141,920	3,896.2	436.4	0.008	0.007	438.7
Fleet Services	541,300	1,846.9	206.9	0.004	0.003	208.0
Street	397,570	1,356.5	152.0	0.003	0.002	152.7
Public Defender, Prosecutor	218,928	747.0	83.7	0.002	0.001	84.1
Municipal Court/Probation	198,822	678.4	76.0	0.001	0.001	76.4
2010 Total	16,663,852	56,857.0	6,368.7	0.121	0.099	6,401.9

Table III-60 - 2012 Purchased Electricity Emissions by Department

Department	kilowatt hours	MMBTUs	CO_2	CH_4	N_2O	CO_2e
Parks and Recreation	4,756,093	16,228	1,817.7	0.035	0.028	1,827.2
Fire	2,762,300	9,425	1,055.7	0.020	0.016	1,061.2
Multiple, City Hall	2,532,160	8,640	967.8	0.018	0.015	972.8
Public Library	2,097,240	7,156	801.5	0.015	0.012	805.7
Police	1,544,514	5,270	590.3	0.011	0.009	593.4
Solid Waste	1,459,742	4,981	557.9	0.011	0.009	560.8
Asset Management	1,406,640	4,799	537.6	0.010	0.008	540.4
Fleet Services	520,450	1,776	198.9	0.004	0.003	199.9
Street	415,135	1,416	158.7	0.003	0.002	159.5
Municipal Court/Probation	198,822	678	79.0	0.001	0.001	76.4
Public Defender, Prosecutor	182,968	624	69.9	0.001	0.001	70.3
2012 Total	17,876,064	60,993	6,832	0.130	0.106	6,867.6

c) Purchased Steam Heat

Two County buildings with City employees, the Public Safety Building (PSB) and the County Courthouse/ Courthouse Annex, used steam heat from the County Central Steam Plant in 2010 and 2012. The Police Department and the Municipal Court account for 24.9 % of steam use in the PSB (determined by area), resulting in 529 and 425 $MTCO_2e$ in 2010 and 2012 respectively. City use of the County Courthouse and Courthouse Annex resulted in 23 and 17 $MTCO_2e$, 20110 and 2012 respectively from 4.29% of area.

Table III-61 1 Steam Heat Indirect Emissions by Year

Year	Contracted Cost	Natural Gas	CO_2	CH_4	N_2O	CO_2e
2010	$19,614	29,074	154	0.015	0.0003	155
2012	$22,806	23,162	123	0.012	0.0002	123

Figure III-12 Buildings Methods and Sources

Methods and Sources

In 2005, electricity and natural gas information was compiled from Avista Utilities billing information, usually paper bills, provided by departments. In 2010 and 2012, Avista Utilities sent billing information that was electronically conveyed by spreadsheet into a software database, Utility Manager Pro. The 2005 information may have contained associated area lighting.

The recommended approach (6.1.1) from the ICLEI protocol for calculating emissions from stationary natural gas combustions was used for both reporting years. Carbon dioxide, methane, and nitrous oxide emission factors for natural gas were obtained from tables G.1 and G.3 of the ICLEI protocol. The recommended approach (6.2.1) from the ICLEI protocol for calculating emissions from electricity use was used for both reporting years. Carbon dioxide, methane, and nitrous oxide emission factors for electricity came from the EPA published eGRID 9th edition, V.1, 2010 data. Emission factors for 2012 have not been published yet so the 2010 factors were used for both reporting years.

Emissions associated with City steam heat purchases were calculated with an altered approach from that detailed in section 6.3 of the ICLEI protocol. Natural gas usage was obtained from the Central Steam Plant (CSP) for each reporting year. According to Ron Oscarson, Spokane County Facilities Director, the plant determined that 13.32 % of total natural gas therms were used on the Courthouse and Annex in 2010 and 10.14 % were used on the Courthouse and Annex in 2012. The plant also determined that in 2010, the Public Safety Building (PSB) used 53.34 % of total CSP natural gas therms. In 2012, the PSB used 42.98 % of CSP natural gas therms. The plant determines these percentages based on return of condensate from each building. Using these percentages, it was found that the PSB used 81,607 and 6,555 therms of natural gas in 2010 and 2012. The Courthouse and Courthouse Annex used 3,512 and 2,665 therms of natural gas in 2010 and 2012.

The PSB, Courthouse and Courthouse Annex are only partially filled with City employees. To determine the percentage of each building complex's steam heat usage that the City is responsible for, a simple ratio of square footage of City usage to total building square footage was calculated. The PSB was found to be 24.9 % City with 4.5 % of City usage belonging to City Municipal Court and 96.5 % of City usage belonging to the Police Department. The County Courthouse and Courthouse Annex was found to be 4.3 % City with all of the City usage belonging to the Municipal Court/Probation. These percentages, along with an 81 % efficiency factor of the steam plant, were applied to the previously calculated total natural gas usage for each building complex. These steam heat calculations can be found in the "Buildings Final Data Rec Method" tab of the "2010_Gov_MasterCalc" and "2012_GovMasterCalc" Excel sheets.

2. Street Lights and Other Outdoor Lighting

This section includes emissions from traffic signals and controllers, street lights, park lighting, and other outdoor lighting at parks and recreation facilities, storage facilities, administrative facilities, public venues, libraries, Community Oriented Policing Services (COPS) shops, fire stations and facilities. All emissions are due to purchased electricity. The Street Department itself, for street lights and traffic control, used 9,727 MW in 2012, costing $2.48 million dollars (including contracted lighting).

Table III-61 - 2010 Street Lights Emissions by Use

	CO_2	CH_4	N_2O	CO_2e
Traffic Signals and Controllers	433	0.0082	0.0067	435
Street Lights less Avista's	879	0.0167	0.0136	884
Park Lighting	49	0.0009	0.0008	50
Other Outdoor Lighting	12	0.0002	0.0002	12
2010 Total	**1,373**	**0.026**	**0.021**	**1,380**

Table III-62 - 2012 Street Lights Emissions by Use

	CO_2	CH_4	N_2O	CO_2e
Traffic Signals and Controllers	618	0.0118	0.0096	621
Street Lights less Avista's	600	0.0114	0.0093	603
Park Lighting	48	0.0009	0.0007	48
Other Outdoor Lighting	12	0.0002	0.0002	12
2012 Total	**1,277**	**0.024**	**0.020**	**1,284**

Traffic Signals and Controllers describe electrical systems and lighting used to control vehicle traffic at intersections throughout the City of Spokane. Such devices include traditionally red, yellow and green-colored traffic control signals, computers, Ethernet communication switches, pan-tilt zoom cameras, and dynamic message signs (DMS).

In 2012, the Street Department began working with Avista Utilities to change from "flat rate" to intersection traffic control devices that have individual electricity meters. By July and August 2013, the account had decreased "daily average electricity use by 58 % lower than the same month in 2012." Valla Melvin, Senior Traffic Engineer, Street Signals and Lighting, wrote in February 2015 that, "prior to 2011,wehad only 14 intersections that were metered – everything else was flat rated based upon a guestimate…[T]he total accounts we currently monitor is 228 – this has grown since 2012 due not only to metering signalized intersections, but also new lighting installations, new DMS and brand new signalized intersections (Trent/Havana, Regal/44th, Regal/Palouse, US2/Flint, Cedar/CHB, MLK/Pine and Broadway/Havana (inherited from Spokane County). " Valla Melvin wrote: "Since 2011wehave also added more electronic equipment to most of our intersections that would increase the draw (Ethernet communication switches, pan-tilt zoom cameras, etc.), but we also performed a city-wide replacement of red signal indication LED lamps – some were older LED's and some were incandescent which would result in a lower power draw. We also replaced many incandescent pedestrian signal indications with LED pedestrian indications."

Street Lights describes electricity used for lighting along roadways and sidewalks, around buildings and the built environment, not elsewhere described as "Traffic signals; Water delivery facilities; Airport facilities; Vehicle fleet; Power generation facilities; Solid Waste facilities; Wastewater facilities."

The fixtures provide light at streets, bridges, tunnels and open areas. The majority of the lighting is owned by Avista and is provided as a service to the City via a rate schedule (042) which takes into account the type and power of the light, what it is mounted on, and how it is mounted. Street Department electricity use for "Street Lights" decreased 1.4 % from 2010 to 2012. The decline since 2005 (10,304 MWh, 35,168 MMBTUs) is more significant, a 4.1 % decrease.
We have removed the Avista owned lighting emissions from the summary table above but have left them in the tables below. In the Government Total summary tables the Avista lighting emissions will be counted under Contracted services.

Park Lighting is as described above but used around buildings and the built environment in Parks. The devices furnish light for roadways, parking lots, tennis courts, play fields, and open areas.

Other Outdoor Lighting is again as described above but used around Solid Waste and Street Department properties.

Table III-63 - 2010 Street Lights Emissions by Department

Department	MWh Used	MMBTU	CO_2	CH_4	N_2O	CO_2e
Street*	9,895.2	33,762	3,782	0.0720	0.0587	3,802
Parks and Recreation	129.1	440	49	0.0009	0.0008	50
Solid Waste	1.4	5	1	0.0000	0.0000	1
Total	10,026	34,208	3,832	0.0730	0.059	3,852

Table III-64 - 2012 Street Lights Emissions by Department

Department	MWh Used	MMBTU	CO_2	CH_4	N_2O	CO_2e
Street*	9,756.9	33,291	3,729	0.0710	0.0578	3,748
Parks and Recreation	124.6	425	48	0.0009	0.0007	48
Solid Waste	1.4	5	1	0.0000	0.0000	1
Total	9,883	33,720	3,777	0.072	0.059	3,797

* includes contracted street lighting through Avista

Table III-65 – 2010 & 2012 Comparison with 2005 Street Lights Sector

Year	Total CO2e	Total MMBTU	Total Energy Cost $	MTCO2e % Change
2005	4,290	35,742	$2,405,160	
2010	3,852	34,208	$2,335,604	-10.2%
2012	3,797	33,721	$2,530,018	-11.5%

Overall, greenhouse gas emissions from electricity in street lights decreased since 2005: 10% in 2010, and 11.5% in 2012. The associated Total Energy (MMBTU) decreased 4.3% in 2010, and 5.6% in 2012. The Total Cost decreased 2.9% in 2010, but increased 5.2% in 2012.

Figure III-13 Street Lights Methods and Sources

Methods and Sources

The above categories result in part from the reporting protocol, and in part from descriptive codes furnished by Avista Utilities on bills and with billing data. All emissions in this section are associated with combustion due to purchased electricity. Emissions due to purchased electricity are determined using conversion ratios based on the local power mix from eGRID 9th editionV.1, 2010 data. These ratios are 842.58 lbs. CO_2/MWh, 0.01605 lbs. CH_4/MWh, and 0.01307 lbs. N_2O/MWh. The conversion ratio to total energy in MMBTU is 3.421 MMBTU/MWh.

In 2005, electricity usage information was compiled from Avista Utilities billing information, usually paper bills, provided by departments. The electricity associated with lighting for "Water and Hydroelectric Department" also was included in 2005. Due to billing data discreteness the 2005 Street Lights inventory did not separate outdoor lighting from the building power to the extent done this time.

For 2010 and 2012, billing information was electronically conveyed by spreadsheet from Avista Utilities into Utility Manager Pro, a software database. The individual line items were analyzed for "codes" that indicated the end use of the electricity.

3. Fugitive Emissions from Refrigerants and Fire Suppression Equipment

Table III-66 - 2010 & 2012 Emissions from Refrigerants and Fire Suppression Equipment

Source	HFC-134a	R-410a	CO_2e
Buildings, 2010 & 12*	0.170		222
Buildings, 2010 & 12		0.0056	10
Vehicle Air Conditioning, '10	0.1165	-	151.5
Vehicle Air Conditioning, '12	0.1685	-	199.6
Recycled Appliances, '10	0.388735	-	505.36
Recycled Appliances, '12	0.199584	-	259.46

*Emissions from Buildings are the only reported inventory item in this sector.

Three areas identified in City of Spokane government operations that may be sources of fugitive emissions from refrigerants and fire suppression equipment are: 1) buildings and facilities, 2) air conditioning units in fleet vehicles, and 3) recycling solid waste household appliances, "white goods," that already contain refrigerants. Fugitive emissions due to air conditioning refrigerants in fleet vehicles are counted under the Vehicle Fleet sector of the inventory but are included here again for informational purposes only. Emissions from recycled home appliances are considered "Scope 3," as they are not under the direct control of City of Spokane, and are thus not included in the reported government emissions total. They are provided in this sector for informational purposes only. Only the compounds listed in the Local Government Operations Protocol are required to be reported.
The compounds that apply to the City of Spokane are HFC-134a (1300 GWP) and R-410a (1725 GWP).

Refrigerants were not reported in the 2005 inventory report.

a) Buildings

In government buildings, air conditioners, chillers and refrigerators may be sources of fugitive emissions. "These systems may use refrigerants that contain or consist of Hydrofluorocarbon, HFC, compounds that are to be reported…Through the installation, use and disposal of these systems, refrigerant leaks are likely

to occur." [14]Not all Hydrofluorocarbons are classified as "greenhouse gas emissions." For example, R-22, more commonly known as Freon, was recognized as a compound causing the depletion of the ozone layer in earth's atmosphere. Because of this, it is being phased out under the Montreal Protocol, and is not counted in this inventory.[15]

Although this information is "Scope 1,"direct emissions,[16] only a few facilities responded to inquiry about building refrigeration equipment. For the information provided, an estimation of the HFC emissions was made using default emission factors for refrigeration/air conditioning equipment.[17] This is alternate method #2; data used to estimate leaked stationary sources refrigerants and fire suppressants. This information was summarized for both the years 2010 and 2012.

Table III-67- 2010 & 2012 Estimations of Leaked Refrigerants in Buildings and Facilities

Location	Sector	Type of Equipment	HFC-134a,	R-410a	CO_2e
Riverside Park Water Reclamation Facility	Wastewater Facilities	Chiller	0.065725		85.443
Fire Combined Communications, Fire Training Center	Buildings and Facilities	Two Chiller units	0.131453		170.889
Riverside Park Water Reclamation Facility	Wastewater Facilities	Window Air Conditioner		0.000050	0.001
Fire Combined Communications, Fire Training Center	Buildings and Facilities	50 Window Air Conditioners		0.500000	9.0
Riverside Park Water Reclamation Facility	Wastewater Facilities	33 Domestic Refrigerators	0.000471		0.612
All Fire buildings	Buildings and Facilities	24 Domestic Refrigerators and 3 refrigerated vending machines	0.000121		0.157
Totals			0.197771	0.500050	266.102

[14] Local Government Operations Protocol, version 1.1, Chapter 6, Facilities, page 56
[15] Local Government Operations Protocol, version 1.1, Chapter 6, Facilities, box on page 57
[16] Local Government Operations Protocol, version 1.1, Chapter 6, Facilities, 6.6.2.2 Estimation Based on Equipment Inventory and Refrigerant Use, page 61
[17] Table 6.4 Default Emission Factors for Refrigeration/Air Conditioning Equipment, Local Government Operations Protocol, version 1.1, Chapter 6, page 62.

There was interest in quantifying fugitive emissions at Riverside Park Water Reclamation Facility, due to impending regulation of mandatory greenhouse gas emissions reporting in Washington State and by Environmental Protection Agency. In August 2011, Jeffery Donovan, Chemist, went throughout the facility, documenting the various air conditioners, chillers and refrigerators in use. The main refrigerant identified was HFC-134a.

Arthur Nichols, Fire Equipment Chief, sent another response to this inquiry in August 2011. He briefly summarized his knowledge of Fire buildings and facilities. Two Halon fire extinguishers were included in the description. "Halon or 93% "HCFC-123" was not on the list for types of refrigerants to be included in this report. In addition, he described two chillers, "50 window air conditioners," 24 domestic-type refrigerators, and three refrigerated (soda pop) vending machines. The detailed information provided from the Riverside Park Water Reclamation Facility was used as "proxy data."

b) Vehicle Fleet Air Conditioning

Fugitive emissions due to air conditioning refrigerants in fleet vehicles are counted under the Vehicle Fleet sector of the inventory but are included here again for informational purposes only. From a communication with Gene Jakubczak, Fleet Services Director, it is assumed that vehicles manufactured after model year 1996 contain air conditioning units. Emissions from mobile air conditioning units are considered "Scope 1," direct emissions. For the purpose of this inventory the mass balance approach was used, with information from Fleet Services garage, and Solid Waste Management.

Table III-68 - 2010 Vehicle Fleet Fugitive Refrigerant Emissions

Refrigerant Type/Global Warming Potential	Base Inventory (kg)	Purchases (kg)	Net Increase in Full Charge/Nameplate Capacity(kg)	Estimated Total Refrigerant Leakage	Carbon Dioxide Equivalents
HFC-134a/1300	-15.88	189.43	57	0.1165	151.5

Table III-69- 2012 Vehicle Fleet Fugitive Refrigerant Emissions

Refrigerant Type/Global Warming Potential	Base Inventory (kg)	Purchases (kg)	Net Increase in Full Charge/Nameplate Capacity(kg)	Estimated Total Refrigerant Leakage	Carbon Dioxide Equivalents
HFC-134a/1300	-24.34	185.04	7.5	0.1685	199.6

c) Recovered Refrigerants - White Goods Recycling

Finally, a detailed inventory from Solid Waste Management concerning refrigerant recovered from solid waste household appliances, "white goods," was received. In the process of recycling these materials, various refrigerants are captured and recycled. This information is listed as "Scope 3," for materials intended for recycling and not under the direct control of City of Spokane. These statistics are from recycled household appliances collected at three places, North County in Colbert, Valley in Spokane Valley, and Waste-To-Energy facility.

Refrigerant Type/Global Warming Potential	Location	Recovered Pounds	Converted to metric tons	Carbon Dioxide Equivalents, metric tons
R-134a/1300	North County	277	0.125647	163.34
R-134a/1300	Valley	241	0.109318	142.11
R-134a/1300	Waste-To-Energy	339	0.153770	199.90
	TOTAL	857	0.388735	505.36

Table III-70 2012 Recovered Refrigerant from Household Appliances

Refrigerant Type/Global Warming Potential*	Recovered Tons	Converted to metric tons	Carbon Dioxide Equivalents, metric tons
R-134a/1300	0.22	0.199584	259.46

*2012 recycling location not specified.

4. Vehicle Fleet

Table III-71 2010 City of Spokane Vehicle Fleet Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Highway Vehicles*	10,257	.148	.128	10,300
Non-Highway Vehicles*	668	.044	.017	675
Alternate-Fuel Vehicles**	13	0	0	13
Mobile Combustion Total	10,938	.192	.145	10,988
Electric Vehicle Emissions Total***	0	0	0	0
Fugitive Emissions Total	0	0	0	152
2010 Reported Totals	10,938	.192	.145	11,140

Table III-72 2012 City of Spokane Vehicle Fleet Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Highway Vehicles*	9,885	.132	.103	9,920
Non-Highway Vehicles*	1,126	.029	.013	1,131
Alternate-Fuel Vehicles**	22	0	0	22
Mobile Combustion Total	11,033	.168	.116	11,073
Electric Vehicle Emissions Total***	0	0	0	0
Fugitive Emissions Total	0	0	0	200
2012 Reported Totals	11,034	.168	.116	11,273

*Highway and non-highway vehicles include only diesel and gasoline (including up to 10% ethanol) fuel sources.
**Alternate-fuel vehicles in this table include only propane. Natural gas vehicle emissions are accounted for under the Buildings section of this report due to metering limitations and as such are not included in these tables. Natural gas vehicles were responsible for .21 MT and .27 MT of CO_2e in 2010 and 2012. Biodiesel and ethanol concentrations greater than 10% were not implemented by the City of Spokane during these years. Methane and Nitrous Oxide emissions from alternate-fuel vehicles were too small for significance in our calculations.
***Electric vehicle emissions are accounted for under the Buildings section of this report due to metering limitations and as such are not included in these tables. No electric vehicles were in use in 2010 and the City's one Nissan Leaf was responsible for .33 MT of CO_2e in 2012.

Introduction

The preceding tables show the greenhouse gas emissions from the City of Spokane government vehicle fleet for the years of 2010 and 2012. Calculated emissions are provided for mobile combustion by highway, non-highway, and alternative fuel vehicles. Alternate fuels are defined in these tables as propane and natural gas. Emissions from natural gas vehicles are included in the Buildings sector of this report because separate metering for the natural gas vehicles was unavailable. Likewise, emissions from the City's one electric vehicle are covered in the Buildings section due to metering limitations. Natural gas and electric vehicles are still relevant to the vehicle fleet and are thus still discussed later in this section despite their absence from the section totals. Fugitive emissions from leaked refrigerants used in vehicle air conditioning systems are also reported.

The vehicle fleet of the City of Spokane emitted 11,140 metric tons of CO_2e ($MTCO_2e$) in 2010 and 11,273 $MTCO_2e$ in 2012. This constitutes a 0.6 % increase annually. Vehicle fleet emissions made up 18.4% and 6.8% of all city government related emissions for the City of Spokane in 2010 and 2012 respectively. In 2005, Spokane's vehicle fleet emitted 10,059 $MTCO_2e$, representing 14.7 % of all government emissions. From 2005 to 2010, total vehicle fleet emissions increased by 10.7 %. From 2005 to 2012, vehicle fleet emissions increased by 12.1 %. Alternatively, nitrous oxide and methane emissions fell 19.9% and 15.2% respectively between 2010 and 2012. This is partly due to decreased emissions factors for nitrous oxide and methane for newer vehicles as a result of improved engine technology.

a) Mobile Combustion

Table III-73 2010 & 2012 City of Spokane Fleet Vehicles Numbers by Fuel Type

	Diesel Fuel	Petroleum Gasoline	Hybrid Car	Propane	CNG	Electric	Total
2010	471	758	13	12	2	0	1256
2012	501	720	12	13	2	1	1249

Figure III-14 – 2010 Fuel Emissions by Source

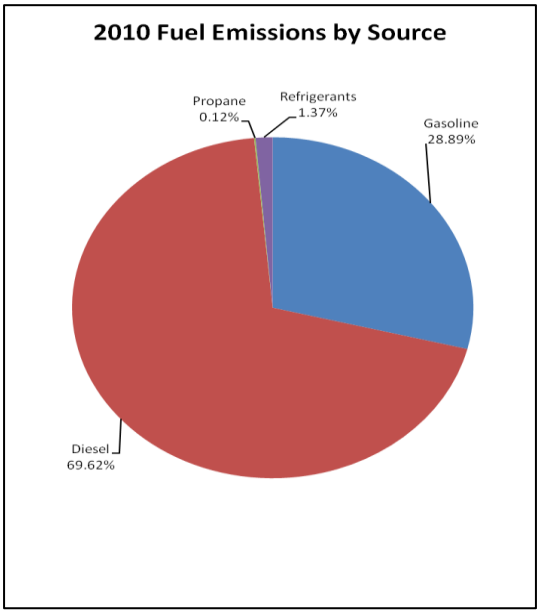


Figure III-15 – 2012 Emissions by Source

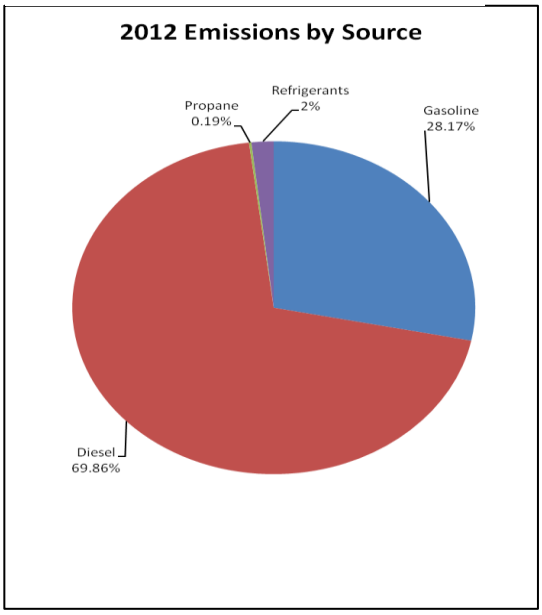


Table III-74 2010 & 2012 Fuel Use by City of Spokane Vehicle Fleet (gallons)

	Diesel	Petroleum Gasoline	Ethanol	Propane	CNG*	Total Fuel Use
2010	755,406	364,558	40,652	2,288	-	1,162,905
2012	768,314	360,704	40,050	3,778	-	1,172,846
Percent Change	1.7%	-1.1%	-1.5%	65.1%	-	0.85%

*Natural gas usage accounted for under the Buildings section of the report. Due to metering limitations, exact mobile combustion due to natural gas is unknown.

The burning of fuels results in the direct production of carbon dioxide, nitrous oxide, and methane, the quantities of which are related to the type and quantity of fuel burned. The vehicle fleet for the City of Spokane consumed a total of 1,162,905 gallons of fuel in 2010 (31.3 % gas, 65.0 % diesel, and 3.7 % propane and ethanol) and 1,172,846 gallons of fuel in 2012 (30.8 % gas, 65.5 % diesel, and 3.7 % propane and ethanol).

As shown in the preceding 2010 and 2012 fuel use table, diesel and propane increased in use while petroleum gasoline and ethanol decreased, with total fuel consumption increasing by 0.85%. Interestingly, fuel usage increased from 2010 to 2012 while total vehicle travel appears to have decreased by over 100,000 miles. These trends are reflected by an increase of 30 new diesel vehicles entering the fleet (many of which were large heavy duty vehicles) and a decrease of 38 gasoline vehicles over this period.

Beginning in August 2010, the EPA mandated particulate emissions control equipment on newer heavy diesel vehicles that required extra fuel use. This decrease in engine efficiency in new heavy diesel vehicles and the increased use of heavy diesel vehicles may explain the rise in diesel fuel usage despite fewer miles driven. The Solid Waste department alone recorded an increase of 18,000 gallons of diesel despite driving 21,000 miles less between 2010 and 2012. In 2005, fleet vehicles consumed 1,041,408 gallons of diesel (68.6 %) and gasoline (31.4 %). Total fuel consumption increased by 11.7 % from 2005 to 2010 and 12.6% from 2005 to 2012.

Methane (NH_4) and nitrous oxide (N_2O) emissions make up the second part of mobile combustion emissions after CO_2. These chemicals result from incomplete combustion of fuel. The CO_2e resulting from methane and nitrous oxide was 50 MT in 2010 and 40 MT in 2012. The decrease in emissions between 2010 and 2012 from these sources is most likely due to improved engine combustion efficiency in newer vehicles. The quantity of methane and nitrous oxide emitted depends on the type of equipment used and how it is operated. We have fairly detailed vehicle type information but there are quality concerns about vehicle miles travelled (VMT) data for reasons described in the Methods section. 2012 saw a decrease of vehicle miles traveled (VMT) from 2010 for government vehicles in the City of Spokane. 2012 government vehicles accounted for 6,676,767 VMT compared to 6,777,723 VMT for 2010, a decrease of 1.5 %.

Highway Vehicles are comprised of any vehicle licensed for legal use on state highways including heavy trucks, SUVs, pickups, passenger cars, and motorcycles. Transit buses from the STA are included in the Transit section of the report and not reported here. These calculations assume that ethanol is ten percent (10%) of the gasoline fuel we use. The Washington State Legislature mandated in WAC 173-492 that gasoline fuel must contain on average a minimum of 2.7 % oxygen which translates into a minimum of 7.8 % ethanol. Oxygenates besides ethanol have been used in the past, but due to environmental concerns about water contamination, ethanol is now the primary oxygenate used.
By late 2010 virtually every gallon of gasoline sold in the United States was between 9% and 10% ethanol by volume. While there is some uncertainty about how much ethanol comprises the gasoline blend used, we believe that 10 % ethanol is a good estimate for the purposes of this report.

Nitrous oxide and methane emissions due to combustion of the gasoline blend are included in the Highway Vehicles category. Carbon dioxide from ethanol use is not included in the reported total because it is considered biogenic emission source. Instead, it is included in the informational total. There were 234 metric tons of biogenic CO_2 from ethanol emitted in 2010 and 228 metric tons emitted in 2012.

Non-Highway or “off road” vehicle emissions are emissions from agricultural, construction, industrial, lawn and garden, and recreational vehicle and equipment engines. This includes everything from a tractor to a forklift to a leaf blower. The emissions attributed to non-highway vehicles and equipment owned by the City of Spokane was 675 metric tons of CO_2e in 2010 and 1131 metric tons of CO_2 in 2012.

Alternate-Fuel Vehicles are comprised of any propane vehicles owned by the City of Spokane. Ideally, this category would include emissions from the two natural gas vehicles in use. However, fuel use by these vehicles was not metered separately from the natural gas usage of the buildings where they were housed. Therefore, emissions from natural gas vehicles were included in the Buildings section of the report and not in the Alternate-Fuel Vehicles category. It is estimated that the two natural gas vehicles were responsible for .21 $MTCO_2$ in 2010 and .27 $MTCO_2$ in 2012. Propane saw a 1,490 gallon increase in usage between 2010 and 2012.
Electric vehicles saw very minimal use by the City of Spokane. In 2010, the City did not use any electric vehicles. In 2011, the City purchased one electric Nissan Leaf for use in 2012. The Nissan Leaf charges at City Hall and its greenhouse gas emissions from electricity consumption are included under the Buildings section of this report. Using mileage data, fuel economy information from the federal fuel

economy website, and electricity emissions data, it was possible to estimate the total power consumed by this vehicle to be 887.4 KWh and its emissions to be .331 metric tons of CO_2e. Greenhouse gas emissions per mile traveled for an electric vehicle is highly dependent on the local utilities power mix. To ensure the City of Spokane's use of the 2011 Nissan Leaf is the best alternative passenger car available for the power mix in Spokane, we compared the emission rates of the Nissan Leaf and a 2009 Honda Civic Hybrid, also driven in 2012. The Nissan Leaf returned a calculated emissions rate of 0.127 $kgCO_2e$/mile while the Honda Civic Hybrid gave 0.211 $kgCO_2e$/mile, a 60% increase in emission rates. This strongly suggests that the use of electric vehicles is beneficial to the attainment of the City of Spokane's greenhouse gas emission reduction goals.

b) Refrigerants

Vehicle fleet air conditioning systems use refrigerants. While air conditioning systems are designed to be closed, small amounts of refrigerants do leak into the environment over the lifetime of a vehicle. Air conditioning is now standard equipment in vehicles manufactured since 2006. The standard refrigerant used in 2010 and 2012 was HFC-134a (R-134a). This is an area of interest for this report because refrigerants have a much higher warming potential than most greenhouse gases. The figures reported for fugitive emissions due to vehicle refrigerants are most likely greatly underestimated because of data limitations described in Methods.

c) Department Breakdowns

Table III-75 City of Spokane 2010 GHG Vehicle Fleet Emissions by Department

GHG Source	CO_2	CH_4	N_2O	CO_2e
1) Solid Waste Management	4,631	0.02438	0.01978	4,637
2) Police Department	1,551	0.04246	0.03021	1,561
3) Street Department	1,487	0.02594	0.01761	1,493
4) Water Department	865	0.01985	0.02109	872
5) Wastewater Management	842	0.02201	0.01398	847
6) Parks Department	694	0.03816	0.03024	703
7) Fire Department	665	0.01712	0.00759	668
8) Engineering Services	47.4	0.00368	0.00322	48.5
9) Fleet Services	45.0	0.00796	0.00261	46.0
10) Business/Development Services	45.4	0.00123	0.00082	45.7
11) Community/Neighborhood Services	42.3	0.00158	0.00139	42.8
12) Libraries	19.8	0.00059	0.00132	20.2
13) MIS Department	4.3	0.00010	0.00008	4.36
2010 Totals*	10,938	0.20514	0.14993	10,988

Table III-76 City of Spokane 2012 GHG Vehicle Fleet Emissions by Department

GHG Source	CO_2	CH_4	N_2O	CO_2e
1) Solid Waste Department	4,799	0.02222	0.01566	4,805
2) Police Department	1,525	0.04056	0.02099	1,533
3) Street Department	1,467	0.02103	0.01446	1,472
4) Wastewater Management	861	0.01413	0.01185	865
5) Parks Department	746	0.02674	0.02307	754
6) Fire Department	741	0.01881	0.01316	745
7) Water Department	719	0.01247	0.01136	723
8) Fleet Services	41.1	0.00807	0.00168	41.8
9) Engineering Services	40.8	0.00161	0.00807	41.5
10) Community/Neighborhood Services	41.1	0.00084	0.00068	41.3
11) Business/Development Services	27.5	0.00101	0.00070	27.7
12) Libraries	20.5	0.00060	0.00013	20.9
13) MIS Department	4.4	0.00033	0.00048	4.5
2012 Totals*	11,033	0.16840	0.11756	11,073

*Department breakdowns do not include fugitive emissions due to refrigerants.

As seen in the preceding tables, the Solid Waste Management Department was the largest contributor of greenhouse gases for both years, emitting just over 40 % of the government vehicle emissions. This is mostly due to waste and recyclable collections, which each occurred once a week for residential customers and from once a day to once a month for commercial customers. In addition, about 21,000 customers had clean green picked up once a week for nine months of the year. The next two largest emitters for both years were the Police Department and the Street Department.

The department that experienced the largest absolute increase in emissions was the Solid Waste Management Department. Their emissions increased from 4,637 metric tons of CO2e in 2010 to 4,805 metric tons of CO_2e in 2012, an increase of 168 metric tons or 3.6 %. This increase is largely attributable to the increased usage of low fuel economy heavy duty vehicles. The department that experienced the largest relative increase in emissions was the Fire Department. Their emissions increased from 668 metric tons of CO2e in 2010 to 745 metric tons of CO_2e, an increase of 11.5 % or 77 metric tons. This was likely due to a 15.5% increase in incidents requiring a response from the fire department between the two years (28,150 incidents in 2010 to 32,521 incidents in 2012). The department which experienced the largest absolute decrease in CO_2e was the Water Department, decreasing from 872 metric tons of CO_2e to 723 metric tons, a decrease of 149 metric tons or 17.1%. The department which experienced the largest relative decrease in CO_2e was the Business/Development Services Department, decreasing from 45.7 to 27.7 metric tons, a decrease of 40.3% or 18 metric tons.

Figure III-16 Methods for Vehicle Fleet Section

Methods

Every attempt was made to follow the ICLEI May 2010 report: *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories*. CO_2 emissions were calculated by obtaining fuel use data for each department which were then multiplied by a conversion factor given in the protocol for each fuel type. It was assumed fuel use data for gasoline was 10 % ethanol, and 90 % petroleum gasoline. While CO_2 emissions for ethanol were calculated, they are considered biogenic emissions in this protocol, and were thus not included in emissions totals. For highway vehicles an emissions factor per mile provided by the protocol was multiplied by total mileage traveled to obtain nitrous oxide and methane emissions. Unfortunately, the estimates for Vehicle Miles Travelled (VMT) have limited accuracy because annual vehicle mileage is not routinely gathered for the City fleet. Recording the mileage of every vehicle in the city on the 31st of December would be a difficult task. Therefore, mileage data was obtained during regular vehicle maintenance, which may have occurred weeks or months away from a December 31st date. Environmental Programs made approximations based on similar vehicles and the partial mileage data available.

The Police Department had some of the best VMT data due to frequent vehicle use. While a large sample size likely partially compensates for VMT inconsistency, this inconsistency is a source of error for the inventory effort. To improve maintenance schedules, prevent theft of fuel, and improve fleet VMT data, the Fleet Department is currently installing vehicle mileage and fuel use monitoring systems in all new vehicle purchases made by the City of Spokane. Currently Police and Solid Waste Management vehicles have this new technology installed along with a minority of vehicles in other departments. As the City of Spokane's fleet of vehicles is gradually replaced, this technology will become more prevalent which will give future reports improved VMT data. Fortunately, emissions calculated from VMT data account for less than one percent of total CO_2e emissions, preserving the quality of our CO_2e calculations.

For non-highway vehicles, fuel use data was multiplied by a conversion factor specific to vehicle type and fuel used in order to obtain nitrous oxide and methane emissions. Nitrous oxide and methane emissions were then multiplied by their global warming potentials (310 and 21 respectively) to obtain a CO_2e equivalent emissions value. Total fleet vehicle numbers were obtained from a vehicle master list from the Fleet Department and a separate vehicle list from the Fire Department that is a more accurate representation of their vehicles.

Refrigerant emissions were calculated using the recommended approach from the protocol. The CO_2e conversion factor used for HFC 134a is 1300. The calculation for mass balance given by the protocol was used to determine metric tons of lost refrigerant, which was then multiplied by the CO_2e conversion factor to find CO_2e emission. Due to limited data on refrigerant usage in the vehicle fleet, only fugitive emissions from new and retired vehicles of each year were included in this calculation. 2010 had 90 new vehicles and 35 retired vehicles while 2012 had 78 new and 73 retired.

d) Methods Flow Chart

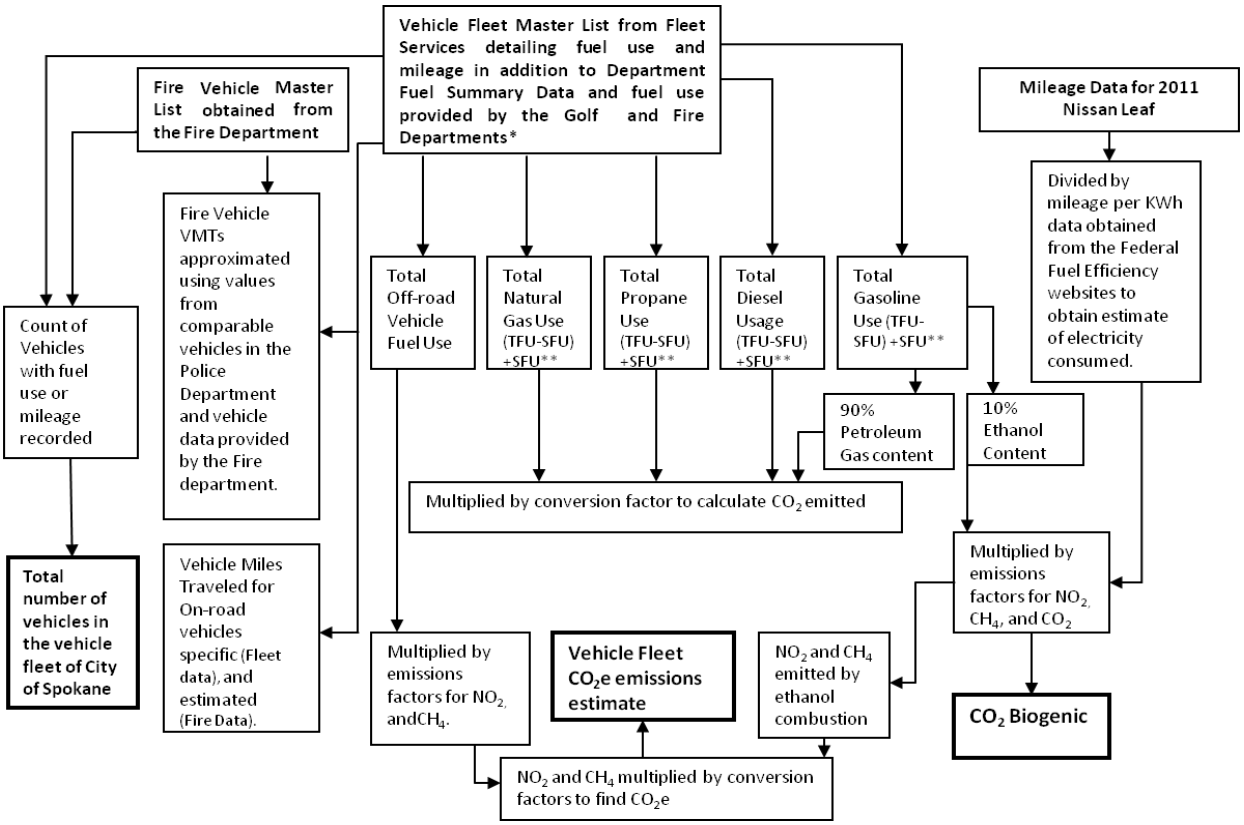


Table III-77 Summary of Vehicle Fleet Greenhouse Gas Emission Sources

GHG Source	Data Used	Approach Used
See Table D.1; Appendix D; Local Government Operations Protocol V1.1, May 2010		
1) Highway CO_2 emissions	Fuel usage data obtained from the Fleet and Fire Departments.	7.1.1.1 7.1.2 (Biofuels only)
2) Non-Highway CO_2 emissions	Fuel usage data obtained from the Fleet, Fire, and Golf Departments.	7.2
3) Alternative Fuel/Electric Vehicles CO_2 emissions	Electricity usage data for one Nissan Leaf was unavailable. Mileage data was used to approximate this.	N/A
4) Highway CH_4 and N_2O emissions	Vehicle miles traveled obtained from Fleet Department for all departments except Fire. Approximations for Fire Department Vehicles based on Police Department data.	7.1.3.1 7.1.3.2.3 (Fire only)
5) Non-highway CH_4 and N_2O emissions	Fuel usage data obtained from the Fleet, Fire, and Golf Departments.	7.2
6) Fugitive Emissions from Motor Vehicle Air Conditioning	Refrigerant data obtained from Fleet Services.	7.4.1

Figure III-17 List of Sources for Vehicle Fleet Section

List of Data Sources Used in This Section of the Report

1) Fuel usage data for the vehicle fleet, with the exception of the Parks and Recreation—Golf, Wastewater Management and Fire departments, was obtained from Fleet Service's FleetFocus M5 database, and compiled by Deborah Bisenius in Environmental Programs.
2) Fuel Usage data for the Fire Department were obtained from receipts sent by Karen Ripley in the Fire department detailing the purchase history of fuel from Cooperative Supply, Inc. and from the Centeron wireless tank monitering system, which detailed changes in the amount of fuel in Fire department fuel tanks, allowing us to combine the purchase data with changes in tank levels to accurately estimate annual fuel consumption.
3) Fuel usage data for the Parks and Recreation--Golf Department was received from LaVonne Martelle in the Golf Deparment for both 2010 and 2012.
4) Fuel usage data for Wastewater Management, Sewer Maintenance, was received from Sharon Bowers, Accountant 1. Fuel usage data for Wastewater Management, Riverside Park Water Reclamation Facility, was received from Edith Masingale, Warehouse Foreperson.
5) 2012 mileage data for one Nissan Leaf was obtained from Fleet Service's FleetFocus M5 database "Unit Cost History Display", by Deborah Bisenius in Environmental Programs. The vehicle was purchased in 2011 so no data was available for its mileage in 2010.
6) Vehicle Miles Traveled for all departments, with the exception of Fire, was obtained from the Fleet Service's M5 database by Temporary/Seasonal Environmental Clerk Eric Martin in Environmental Programs.
7) Vehicle Miles Traveled were unavailable for the Fire Department and were estimated using data from similar vehicles in the Police Department.
8) 2010 and 2012 Refrigerant data was obtained from Lorie Butz, an accountant at Fleet Services. This was also based on the assumption that "all" fleet vehicles purchased after "1996 model year" used cab air conditioning.

5. Travel- City Business & Employee Commute Emissions

"Can you reduce or mitigate some of these emissions? For example, emissions from employee business travel and commuting may represent a large source of emissions that the local government may be able to influence through travel policies and incentive programs." Page 122, Chapter 12 "Scope 3 Emission Sources," Local Government Operations Protocol, version 1, May 2010

Table III-78 Emissions from Employee Business Travel and Commuting

Year	Type	CO_2e
2010	City Business Travel	3,697
2012	City Business Travel	3,370
2010	Employee Commute	2,929
2012	Employee Commute	3,134

a) City Business Travel

"Significant" City employee business travel was determined to be five percent of department vehicle fleet emissions or greater. If each department employee business travel was found to be less than five percent of its total department vehicle fleet emissions, it was not included in the tables or discussion below. Employee business travel documents were reviewed for data, and the World Resources Institute protocol was followed. Travel within the United States assumed gasoline fuel contained ten percent ethanol by volume. Spreadsheet "Business Travel 2012_2010Summary.5.1.2015.xlsx"

Indicators of 2010 travel compiled from documents were: 927 employees took 487 business trips. Multiple modes of transportation could be used in this statistic, e.g., one business trip could include two car trips and an air trip.

Table III-79 2010 Indicators for City of Spokane Government Business Travel Trips

Car Trips	Car VMT	Air Trips	Air Miles	Bus Trips	Bus Miles	Train Trips	Train Miles	Ferry Trips	Ferry Miles
369	122,598	303	703,112	20	1,263	6	1,705	4	80

Table III-80 2010 City Business Travel Emissions by Department (includes air travel)

Department	Total Travel MTCO2e	Vehicle Fuel Usage (gallons)	Biogenic Fuel Usage (gallons) *Ethanol	Travel Fuel Cost
Spokane Police Department	1,413.8	369	36.9	$1,914.77
Spokane Fire Department	310	451;62.5 gals diesel	45.08	$1,364.71; $207.47
Spokane Area Workforce Development Council	259	23	2.30	$67.97
City Council	237	2.7	0.27	$7.95
Solid Waste Management	235	115.3	11.5	$675.02
City Attorney	183	11.8	1.2	$1,208.00
Community/Neighborhood Services	177	3.8	0.38	$11.89
MIS (IT) Department	141	7.7	0.77	$23.44
Parks and Recreation	104	62	6.2	$185.97
Water & Hydroelectric Svs	75	68.1	6.81	$200.46
Env Pgms & Utilities	63.3	106	10.6	$320.29
Police Ombudsman	52.4			
Public Defender	51.7	11.1	1.11	$32.60
Business/Developer Services	50.1	51.5	5.15	$373.55
Municipal Court	45.2	13.6	1.36	$41.12
Fleet Services	29.5	26.3	2.63	$78.80
Mayor's Office	17	14.3	1.43	$355.00
(Other Depts. or not identified)	176.2	234.6	23.5	$1,427.52
2010 City Business Travel Totals	**3,697**	**1,571 gasoline; 63 diesel**	**157**	**$8,836.53**

Table III-81 2012 Indicators for City of Spokane Employee Business Travel Trips

Car Trips	Car VMT	Air Trips	Air Miles	Bus Trips	Bus Miles	Train Trips	Train Miles	Ferry Trips	Ferry Miles
382	119,477	280	616,474	26	1,067	11	230	4	54

Indicators of 2012 travel compiled from documents: 929 employees took 396 business trips. This business travel information was not collected in 2005, so there is no way to compare with a "baseline" for this activity. There was an 8.9 % decrease in total emissions from employee business travel between 2010 and 2012. Attendance at local events is encouraged. Conferences and task forces are increasingly using electronic and telecommunications means to convey information. Also, some departments which used travel the most have moved to other public agencies. For example, Spokane Area Workforce Development Council has been adopted by Spokane Community Colleges.

Table III-82 2012 City Business Travel Emissions by Department (includes air travel)

Department	Total Travel $MTCO_2e$	Vehicle Fuel Usage (gallons)	Biogenic Fuel Usage (gallons)	Travel Fuel Cost
Spokane Police Department	1,163	3,694	369.4	$15,090.95
Spokane Area Workforce Development Council	348.2	152.2	15.2	$816.24
Spokane Fire Department	312.8	990; 89.5 diesel	99	$5,463.38; $394.20 diesel
City Attorney (Legal and Prosecutor)	228	11.5	1.15	$257.97
Mayor's Office	168.3	5.7	0.57	$19.95
Community/Neighborhood Services	148.4	22	2.17	$247.76
MIS(IT) Department	122.2	Not known	Not known	Not known
Parks and Recreation	114.2	161.6	16.2	$893.61
City Council	114	3.5	0.35	$27.92
Water & Hydroelectric Svs	109.6	55	5.47	$267.92
Business/Developer Svs	89.6	68	6.8	$1,795.14
Fleet Services	74.1	24	2.4	$100.00
Wastewater Management	64.9	79.6	7.96	$317.06
Human Resources	55.44	14.1	1.41	$578.77
Municipal Court	49.5	15.4	1.54	$58.26
Finance (Except MIS)	45.3	20.5	2.05	$281.81
Other Depts. or not identified	162.2	30.8	3.08	$1,060.07
2012 City Business Travel Totals	3,370	5,347 gas; 89.5 diesel	535	$27,671.01

b) Employee Commute Trips

City of Spokane employees have responded well to surveys that describe Employee Commute in detail for four worksites: City Hall, Public Safety Building, Water and Hydroelectric Services administration at East North Foothills, and Solid Waste Management at Marietta. These sites were identified by Spokane County Commute Trip Reduction program as housing "100 employees or more." Surveys are conducted in odd-numbered years. For 2010, the survey conducted in 2009 was used. For 2012, the commute surveys for 2011 were reviewed.

Table III-83-2010 and 2012 Employee STA and Private Vehicle Use

	Employees using STA	STA Passenger Miles	$MTCO_2e$	Employees Driving	VMT	$MTCO_2e$	Total $MTCO_2e$
2010	199	1,185,813	325.6	1,658	6,948,896	2,603	2,928.6
2012	224	1,022,806	280.9	1,635	7,616,804	2,853	3,133.9

In 2009, 888 employees out of 1,133 employees or 78 percent of those surveyed responded. There were 2,014 employees in 2010. In 2011, the commute surveys resulted in 879 responses out of 1,071 employees, an 82 percent response rate. There were 2,022 employees in 2012.

The statistical figures were extended to apply to the population of employees in 2010 and 2012. Diesel fuel was assumed used by Spokane Transit Authority buses for employee commute. City of Spokane negotiated an incentive for employees to use the public bus. Bus fare was paid when employees passed their City of Spokane identification badge through the fare collection device. The 2010 commute trip survey showed 199 employees used Spokane Transit Authority to travel 1,185,813 Passenger Miles. The result was 325.6 metric tons carbon dioxide equivalents. In 2012, this figure increased to 224 employees, traveling 1,022,806 Passenger Miles. The result was 280.9 metric tons carbon dioxide equivalents.

Bus pass data for 2010 showed 593 employees, just fewer than 30% of all employees, used the bus for at least one trip. In 2012 the percentage of employees using the bus at least once dropped to 26%. Of those in 2010 using the bus 21.8% used the bus every month (26% in 2012), while 11.1% used the bus less than two times (15% in 2012). Fourteen employees in 2010 (8 in 2012) used the bus for more than 550 trips per year, potentially indicating use of the bus for more than commute purposes. Some sections like Environmental Programs encourage employees to use the bus system for work related travel when feasible. That practice would raise bus pass use and lower City Fleet miles.

In 2010, there were 1,658 employees driving to work each day. They made 6,948,896 vehicle miles traveled. The result was 2,603 metric tons carbon dioxide equivalents. In 2012, 1,635 employees drove to work, making 7,616,804 vehicle miles traveled. This resulted in 2,853 metric tons carbon dioxide equivalents. The increase in 2012 was attributed to net increased distance. 585 out of 868 (67.4%) surveyed employees traveled to work from home each day.

Overall, 2,928 metric tons carbon dioxide equivalents were generated from Employee Commute in 2010. For 2012, 3,134 metric tons carbon dioxide equivalents were generated from Employee Commute trips. In 2005, employee commutes were responsible for 3,139 MT CO_2e.

Figure III-18 – 2010 and 2012 STA and Private Vehicle Commuting

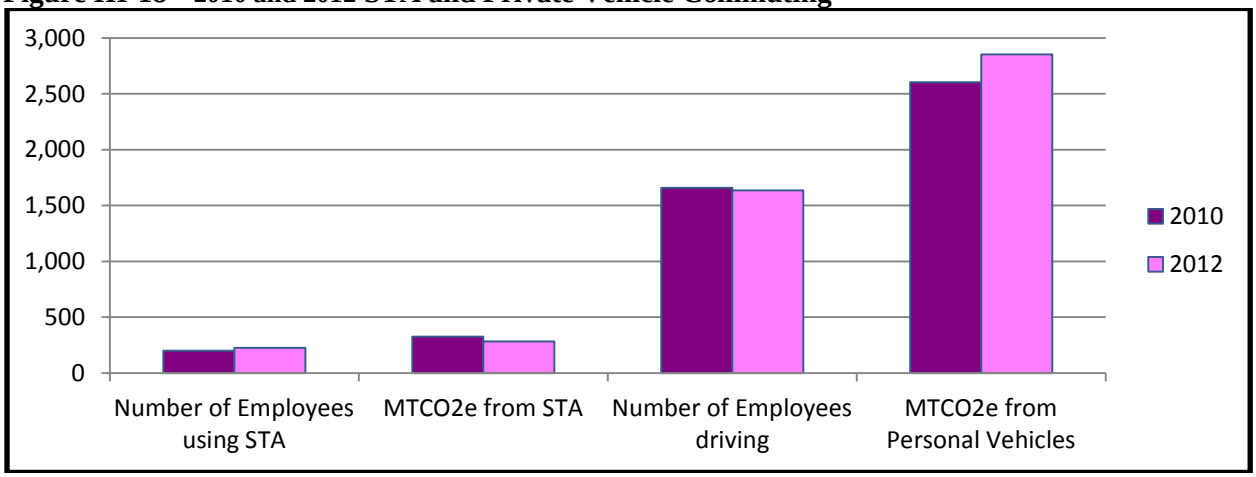
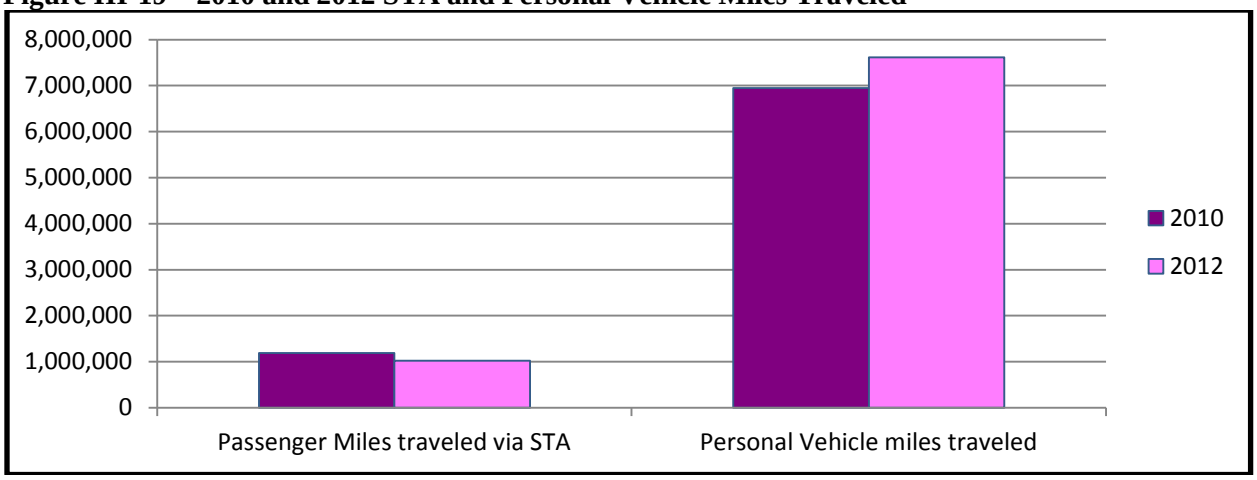


Figure III-19 – 2010 and 2012 STA and Personal Vehicle Miles Traveled



6. Power Generation

Table III-84 2010 and 2012 Emissions from City of Spokane Controlled Power Generation Facilities

Year	Source	CO_2	CH_4	N_2O	CO_2e
2010*	Stationary Combustion	96,318	86.9	11.4	101,683
	Purchased Electricity	501	0.01	0.01	503
	Biogenic Carbon**	150,949	0	0	150,949
	Informational Total	247,768	86.9	11.4	253,135
	Reported Total	0	0	0	0
2012	Stationary Combustion	97,470	85.7	11.2	102,755
	Purchased Electricity	24	0	0	24
	Biogenic Carbon**	146,284	0	0	146,284
	Informational Total	243,778	85.7	11.2	249,064
	Reported Total	97,494	85.7	11.2	102,780

*2010 WTE emissions are not officially included in the reported government inventory total. The facility was not in the city limits and not under direct City control at this time. Stationary combustion emissions are included here for information only.
**Biogenic Carbon is not included in reported totals.

For reasons mentioned below the data in this section is solely for the Waste to Energy Facility. Emissions from power generation are separated into stationary combustion and purchased electricity sections. CO_2 emissions from combusted biogenic waste are reported separately. The City of Spokane operates two electric power generation facilities: the Upriver Hydroelectric Dam and the Waste to Energy Facility.

The Upriver Hydroelectric Dam is a "flow of the river" concrete gravity dam that generated 70,788 MWh (Megawatt hours) of electricity in 2010 and 70,943 MWh of electricity in 2012. Purchased electricity and fuels for operation of the Upriver Hydroelectric Dam cannot be distinguished from the water department. This leads us to attribute all purchased electricity and petroleum fuel use for the dam to the drinking water system and treat the hydroelectric system as a zero emissions system.

The 70,877 MWh of electricity generated by the Upriver Hydroelectric dam in 2010 would have required 27,229 metric tons of CO_2e to generate by traditional generation methods. Similarly in 2012, the dam averted the release of 27,255 metric tons of CO_2e by generating 70,943 MWh of electricity. The city locally consumed 17,177 MWh of the total amount generated in 2012, avoiding the release of 6,599 metric tons of CO_2e that year. This facility is great for power generation and emissions reduction benefitting the city. However, current predictions tell us to expect the changing climate to reduce the flow of the Spokane River during summer months when electricity demand is at its highest. This may reduce the amount of electricity the Upriver Hydroelectric Dam will be able to harvest in the future.

The second power generation facility controlled by the City of Spokane is the Waste to Energy Facility (WTE). In 2010, the City owned WTE Facility, was operated by a private company located outside of the city limits. Under protocol, this disqualifies 2010 emissions from the WTE Facility to be included in government emissions totals. However, emissions data for this year is still provided and discussed in this sector for comparable purposes only. In 2012, the Facility, still operated under private contract, was located inside the city limits as a consequence of annexation. This qualifies 2012 emissions from the Facility to be included in government emissions totals. This Facility was constructed in 1991 as an alternative to landfills, which had caused significant groundwater contamination at some locations in Spokane and Spokane County. In an area dependent on the Spokane Valley-Rathdrum Prairie Aquifer as its main water source, landfill contamination is of continuing concern.

The WTE facility generated 178,017; 171,142; and 170,056 MWh in 2005, 2010, and 2012 respectively.

The WTE plant burns natural gas to begin the incineration of solid waste. Once at the operational temperature of 2500 degrees Fahrenheit, the process uses only solid waste as fuel. The system is able to reduce solid waste 90 % by volume and 80 % by weight. After incineration, ferrous metals are removed and the biologically inert treated ash is sent to Roosevelt Regional Landfill in Klickitat County for disposal. Exhaust gases are treated with carbon, lime, and other materials to help filter emissions of some harmful gases like mercury. The City of Spokane accounted for 46.5 % of the County of Spokane's total waste stream in 2010 and 44.7 % of the county's waste stream in 2012. It is assumed that the city accounted for similar proportions of the waste stream feeding into the WTE Facility's incinerators. Almost 100 % of the City of Spokane's solid waste is disposed of at this plant. The tables below show greenhouse gas emissions associated with solid waste incineration activities conducted by the WTE Facility.

a) Stationary Combustion

Table III-85 2010 and 2012 Waste to Energy Plant GHG Emissions

Year	Fuel used	Amount of fuel used	Percent of fuel Non-biogenic	CO_2	CH_4	N_2O	CO_2e
2010**	Municipal Solid Waste	281,813 short tons	38.75%	95,498	86.950	11.4121	100,862
	Natural Gas	154,691 therms	100%	820	0.015	0.0015	821
	Total			96,318	86.965	11.4136	101,683
2012	Municipal Solid Waste	273,958 short tons	39.75%	96,511	85.661	11.2430	101,795
	Natural Gas	180,871 therms	100%	959	0.018	0.0018	960
	Total			97,470	85.679	11.2448	102,755
Percent Change	Municipal Solid Waste	-2.8%	2.6%	1.2%	-1.5%	-1.5%	0.9%
	Natural Gas	16.9%	0%	16.9%	16.9%	16.9%	16.9%
	Combined			1.2%	-1.5%	-1.5%	1.1%

*CO_2 from biogenic material in municipal solid waste is not included in total CO_2e sum. CH_4 and N_2O from this source are still included per ICLEI protocol. ** 2010 WTE plant emissions provided here for informational purposes only. In 2010 the plant was located out of city limits and its emissions are not included in reported emissions for this year.

Slightly less waste was incinerated in 2012 compared to 2010. This may be due to the expansion of the single stream recycling program, implemented in October 2012. One percent more waste in 2012 was considered non-biogenic, allowing a larger portion of emitted carbon dioxide in 2012 to be included in the inventory. Included carbon dioxide emissions rose by 1.2 % between the two years while emissions of nitrous oxide and methane fell by 1.5 % each. Emissions from natural gas combustion rose by 16.9 % as natural gas usage rose by the same amount. However, emissions from natural gas comprise less than one percent of total WTE emissions, limiting the effect of rising natural gas usage.

b) Purchased Electricity

Table III-86 2010 and 2012 Indirect GHG Emissions from Electricity Purchased by the WTE Plant

Year	Power Purchased (MWh)	CO_2	CH_4	N_2O	CO_2e
2010	1,311	500.86	0.09541	0.0078	503.47
2012	63	24.23	0.00046	0.0004	24.35
Percent Change	-95.19%	-95.16%	-99.52%	-94.87%	-95.16%

The table above shows the indirect greenhouse gas emissions emitted due to the generation of electricity purchased by the Waste-to-Energy (WTE) Facility. Typically, the WTE Facility consumes power it has generated itself. In the event of incineration stoppages for maintenance or repair, it is forced to purchase power to continue secondary operations and to restart the incineration process. As overall power purchased fell by 95.19 % between 2010 and 2012, indirect greenhouse gas emissions fell by a comparable amount, reflecting less operational stoppages for the WTE Facility.

c) Overall Emissions

For combined stationary combustion and indirect emissions, decreases in electricity purchased and total waste incinerated led to an overall reduction in methane and nitrous oxide emissions. A slight increase in CO_2 and CO_2e was largely driven by an increase in the proportion of solid waste estimated to be non-biogenic in origin.

During the 2005 inventory, Wheelabrator-Spokane, a subsidiary of Waste Management Inc., was contracted to operate the Waste to Energy Facility for the City. The Facility was located at that time outside of the City of Spokane city limits. Only that portion of the combusted waste attributable to the community and the government of the City were included in the 2005 greenhouse gas inventory. The protocol for this previous community inventory assumed 35 percent non-biogenic fossil fuels. In 2005, the Waste to Energy Facility emitted 289,052 metric tons of carbon dioxide from both biogenic and non-biogenic sources. For comparison, in 2010, the WTE Facility emitted 247,768 metric tons of carbon dioxide from biogenic and non-biogenic sources, a decrease of 14 % percent from 2005. In 2012 the WTE Facility emitted 243,778 metric tons of carbon dioxide from biogenic and non-biogenic sources, a decrease of 2 % from 2010, and a decrease of 16 % percent from 2005.

Table III-87 2010 and 2012 Biogenic Emissions of CO_2 by the Waste to Energy Plant

Year	Biogenic CO_2 Emissions
2010	150,949
2012	146,284
Percent Change	-3.09%

Biogenic CO2 emissions, reported in the above table, fell by 3 %. However, as biogenic emissions are considered part of the natural carbon cycle instead of fossil carbon sequestered for millions of years before release, they are not counted towards the greenhouse gas inventory.

Figure III-20 Power Generation Methods and Sources

The amount of steam from both biogenic and non-biogenic sources was converted to heat required for that amount of steam with a factor of 0.0016 MMBtu/lb. Then heat produced converted to greenhouse gas emissions with factors from Tables G.1 and G.3 in ICLEI's *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.* The estimated portion of carbon dioxide to have originated from biogenic waste is reported separately from the rest of the CO_2e total. The biogenic CO_2 emissions are considered part of the natural carbon cycle and are not included in scope 1 or scope 2 in accordance with the local government operations protocol. However, biogenic nitrous oxide and methane emissions are caused by inefficient combustion, so somewhat controllable, and are therefore included in the CO_2e inventory totals.

A similar process of applying emissions coefficients to the total amount of natural gas purchased and combusted for facility heating was utilized to calculate greenhouse gas emissions from natural gas use. For both solid waste and natural gas combustion, methane and nitrous oxide emissions were multiplied by a coefficient of 21 and 310 respectively to account for their warming potential with respect to carbon dioxide. These equivalents are reflected in the unit of metric tons of CO_2e.

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For indirect emissions, total electricity purchased by the Waste to Energy Plant in both 2010 and 2012 was provided. Then total indirect emissions due to purchased electricity was determined by applying the EPA's eGRID 9th edition greenhouse gas coefficients for the Northwest Power Grid to the total amount of power purchased. Warming potentials of 21 for methane and 310 for nitrous oxide converted these values to CO_2e. Finally, direct and indirect emissions were summed in order to obtain a total number for greenhouse gas emissions from power generation for the City of Spokane in metric tons of CO_2e.

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Table III-88 Summary of Sources used for City controlled Power Generation related Emissions

GHG Source	Data Used	Approach Used
See Table D.1; Appendix D; Local Government Operations Protocol V1.1, May 2010		
1) Stationary Combustion	Wheelabrator-Spokane Data for EPA Mandatory GHG Reporting (Subpart C)	8.2 Utilizing Known Fuel Use Approach
2) Emissions from Purchased Electricity	Waste-to-Energy Key Performance Indicator (KPI) Data, Avista Utility Bills	8.3 (6.2.1) Utilizing the eGRID sub region emissions factor.

7. Solid Waste

a) Facilities

Table III-89 2010 Landfill Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Purchased Electricity				
Northside Landfill	304	0.006	0.005	306
Southside Landfill	5.69	0.000	0.000	5.71
Total	310	0.006	0.005	311
Fugitive Methane Emissions*				
Northside Landfill	-	396	-	8,312
Southside Landfill	-	172	-	3,616
Total	0	568	0	11,928
Biogenic Carbon Dioxide**	6,371	-	-	6,371
Informational Total	6,681	568	0.005	18,610
2010 Reported Total	310	568	0.005	12,239

Table III-90 2012 Landfill Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Purchased Electricity				
Northside Landfill	119	0.002	0.002	119
Southside Landfill	6.7	0.000	0.000	6.7
Total	126	0.002	0.002	126
Fugitive Methane Emissions*				
Northside Landfill	-	419	-	8,796
Southside Landfill	-	170	-	3,571
Total	0	589	0	12,367
Biogenic Carbon Dioxide**	5,576	-	-	5,576
Informational Total	5,702	589	0.002	18,069
2012 Reported Total	126	589	0.002	12,493

*Some uncertainty, deviation from protocol, & change from previous reported emissions - See Methods & Sources for further discussion.
**Emissions from biogenic carbon are not included in reported totals but are included for informational purposes only.

While the City over this reporting period has had a variety of solid waste facilities (Colbert and Valley Transfer Stations, Waste-to-Energy Facility, Northside and Southside Landfills, Offices on Marietta, Moderate Risk Waste turn-in centers), the reporting protocol being followed here only addresses landfills in this chapter. The other facilities and emission sources are addressed within other chapters (see Buildings, Fleet, and Power Generation).

Greenhouse gas emissions from Spokane's Northside and Southside landfills are comprised of emissions due to purchased electricity and fugitive methane emissions from landfill gas capture systems. Total CO_2e increased 254 metric tons or 2 % between 2010 and 2012. Emissions from purchased electricity make up only a small amount of the total landfill emissions, with most coming from methane gas escaping the landfill gas capture systems. Fugitive methane emissions in 2010 and 2012 are significantly lower for the Northside and Southside Landfills than the values estimated for 2005, 18,657 MTCO2e and 6,334 MTCO2e respectively. Overall CO2e emissions from fugitive methane at these two landfills went down by 52% between 2005 and 2012.

b) Purchased Electricity

Total emissions from purchased electricity fell 59.5 % or 185.26 metric tons of CO_2e from 2010 to 2012. The large majority of this portion came from the Northside Landfill, which saw electricity usage drop from 795,534 kWh in 2010 to 310,801 kWh in 2012. The main reason for this decrease in electricity usage lies in the groundwater pump failures suffered at the Northside landfill in 2012, cutting electricity usage dramatically. There is no groundwater pumping at the Southside Landfill.

c) Fugitive Methane Emissions

Landfill gas is generated during the anaerobic breakdown of organic material in landfills by bacteria. EPA provides guidance for calculating the disposed waste considered contributing to landfill gas generation. The EPA methodology counted waste put in place from 1960 forward. With this method, the Northside Landfill had a total of 3,817,922 metric tons of waste contributing to landfill gas in 2010 and 3,827,632 contributing metric tons in 2012. The Southside Landfill had a total of 831,545 contributing metric tons of waste in 2010 and 777,077 metric tons in 2012. To deal with generated landfill gas, the City installed comprehensive landfill gas capture systems in the Southside Landfill in 1988 and in the Northside Landfill in 1992. These systems utilize gas-extraction suction and a flare to burn off toxic substances and generated methane. Methane is a more potent greenhouse gas than the carbon dioxide and water vapor products that are produced from its combustion.

Landfill capture and flare systems are not perfect and their operation requires maintaining a balance. Too little suction can result in more fugitive methane emissions which risks increased levels of methane in neighboring basements and the potential of explosion. Too much suction risks pulling oxygen into the landfill which can result in a landfill fire. The Northside Landfill estimated collection efficiency of 81 % based on EPA GHG reporting methods compares to an efficiency of 75 % which was used in the 2005 calculations. The Southside Landfill has an estimated efficiency of 85 %, which compares with a 70% estimated efficiency used in 2005. These differences are discussed in more detail in the Sources and Methods section of this chapter. We know of no significant improvements or significant maintenance being done on the systems at the Northside or Southside Landfills in the interval between 2005 and late 2011. Significant maintenance at the Northside Landfill was initiated in 2012.

There are times when the flare and suction systems will turn off completely due to maintenance or critically low methane flow, potentially allowing methane to escape. Methane emissions escaping the capture systems are the main source of CO_2e calculated for landfills. In 2005, fugitive methane emissions were the single largest source of emissions in the City government inventory, making up 35 % of overall emissions.
Despite these fugitive emissions, and because methane is such a potent greenhouse gas, the placing of the cap and methane capture system on the Northside Landfill is believed to have reduced the City government overall emissions rate in 2005 to more than 7% below 1990 levels.

The Southside Landfill closed all waste cells in 1988 and the Northside Landfill operates with both a closed cell and an open waste cell. While the Northside Landfill still accepts waste, annual waste disposal quantities have shrunk after the main waste cell closed in 1992 to about a quarter of their previous values. EPA landfill models project the greatest emission year to be the final year of waste cell closure, with subsequent years decreasing emissions as in a parabola.

d) Northside Landfill

The Northside Landfill saw a 5.8 % increase in methane emission from 2010 to 2012. The Northside Landfill capture system was installed four years after the system in the Southside Landfill. In contrast to the Southside Landfill, the Northside Landfill flare was rarely shut down with a flare uptime of over 98 % both reporting years. This reduces the risk of escaping methane.

e) Southside Landfill

Methane emissions decreased 1.2 % at the Southside Landfill between 2010 and 2012. As less and less total methane is generated from the closed landfill with each subsequent year, it is more and more likely for collected methane levels to drop below the required amount to keep the flare lit. The South Landfill's flare was out 629 hours more in 2012 than in 2010. The City is currently working to change the methane treatment system at the Southside Landfill from a flare to biofilter.

f) Biogenic Carbon Dioxide

Carbon dioxide produced from organic landfill decomposition is considered natural biogenic emission and is not included in the primary greenhouse gas emissions inventory. These types of emissions are included in this section for informational purposes only. Biogenic emissions decreased 12.5 % between 2010 and 2012.

Table III-91 2010 and 2012 Landfill Biogenic Carbon Dioxide Emissions

	2010 CO_2	2012 CO_2
Northside Landfill	4,641	3,880
South Landfill	1,730	1,696
Total	6,371	5,576

Figure III-21 Solid Waste Methods and Sources

Purchased electricity data was obtained from the City's Utility Manager© database records. Emissions from purchased electricity were calculated using emissions factors obtained from "EPA eGRID 9th edition.V.1, 2010 data".

Methane emissions previously reported to EPA and Washington State for the Northside Landfill was used for this reporting per the protocol. The emissions currently (5/2/2016) displayed on EPA's website for the Northside Landfill: 9,895 $MTCO_2e$ for 2010, and 10,471 $MTCO_2e$ for 2012, are not used in this report. These reported values reflect the same metric tons of methane, but have a Global Warming Potential multiplier of "25." For both the Northside and Southside landfills for both years, 2010 and 2012, methane emissions were calculated using Subpart HH-Municipal Solid Waste Landfills in the 2009 EPA rule, *Mandatory Reporting of Greenhouse Gases; Final Rule.* The results obtained were compared to the reported emissions for the Northside Landfill. The results did not match perfectly, but they were close. Equation HH-8 was used to determine methane emissions because the output values were greater than results for Equation HH-6. Landfill gas volumetric flow data and methane concentration data were obtained from Solid Waste Disposal for both landfills and both years.

Yearly waste disposed information for the Northside landfill had previously been reported to the EPA by Solid Waste Disposal and was acquired for these calculations. Waste in Place data for the Southside Landfill was calculated from page 47 of the *1987 South Landfill Closure Plan.* The calculation details can be found in "2010_Gov_MasterCalc" and "2012_Gov_MasterCalc" under the Solid Waste Landfill Raw Data tabs.

The CO_2e calculations, as we have done them, assume that the measuring equipment at both landfills correct data to standard pressure of 1 atmosphere and standard temperature of 520° Rankine. The City's landfill engineer has provided information on two types of meters in use that indicate the readings are temperature and pressure compensated, while the methane and flow readings are done on a wet basis. Some landfill meters are twenty (20) years old.

There are two factors that can have a big influence on the fugitive methane emission rate calculation- the efficiency of the gas collection system, and the amount of time the collection system is operated. We have good data on the operational time, but the gas collection system efficiency has uncertainty associated with it. In 2008, Jay Dehner, P.E., a landfill engineer who was involved in the design and installation of the gas collection systems at both of the City's landfills wrote:

"Capture efficiency of these systems has varied over their current life cycle. Given that the Southside Landfill has been in operation longer, and gas generation is reduced to the point where flare operation is intermittent, it likely has a lower efficiency compared to the Northside Landfill. The following ranges would be our best guess at the range of operating efficiencies for these systems:
Northside Landfill: Historic Range 90% to 75 % ; Current Operation at least 75%
Southside Landfill: Historic Range 90% to 60%; Current Operation at least 60%"
Based on this assessment we used 75% and 70% capture efficiencies for the Northside and Southside Landfills respectively in the 2005 inventory calculations.

Then in April 2014, Jay Dehner, P.E., again responding to a request from the City seeking his judgment regarding extraction efficiency at the landfills, wrote:

"I am not familiar with EPAs protocol for estimating efficiencies directly; I'd need to consult with our

LFG experts to understand that approach a bit better. However, I would think that given the age of both of these collection systems that efficiencies would be on the decline due to the aging of the collection and treatment systems. As an example, during our Northside cover system upgrades project performed in 2012, and subsequent additional gas well inspections performed by the City in 2013, there were significant observations in several extraction wells (collapsed or pinched casings, etc.) that could adversely impact their collection performance and "zone of influence" within the LFG collection system. This could reduce the overall collection system efficiency, potentially significantly. The same may be true for collection wells at the Southside landfill, which also has a flare treatment system that's had difficulty maintaining combustion due to low gas supply. These issues may tend to reduce LFG extraction performance efficiencies, potentially below their overall historic ranges."

Continuing the discussion in November 2015, Rich Hanson, P.E., Senior Engineer with Solid Waste Management wrote:

"It is my professional opinion that based upon the ongoing operation, monitoring, maintenance and my personal field visits that a more appropriate range would be 80-90% with a value for calculations of 85% for the SSLF (South Side Landfill). If it is necessary to obtain a field calculated value for the collection efficiency a contractor would need to be hired to perform surface emissions testing while the system is operating. I believe that this project would cost the City between $25,000 and $40,000. The above discussion is solely regarding the issue of collection efficiency value used during GHG calculation. As I mentioned previously The Solid Waste Disposal Department is in communications with the USEPA regarding the effects of downtime on the GHG calculations with the hope of having a resolution shortly."

EPA reporting method defaults to 95% collection efficiency if the solid waste is entirely under a cover with an operating gas collection system. The landfill gas collection systems designer's statements are also on record. We do not have any specific testing or reports which would indicate what the collection efficiencies are beyond the EPA reports for the Northside Landfill. Both of the landfills are regularly monitored with collection system adjustments. There are some perimeter monitoring reports, but they do not show increasing levels of methane or any incidents of off-site migration of methane.

The collection system monitoring reports at both landfills do indicate collection system problems in the 2010 to 2012 timeframe. For this report we have provided the emissions as calculated using the EPA protocols, and "21" for the Global Warming Potential for methane gas. In the case of the Southside Landfill, the EPA protocol was revised to adjust for downtime resulting from decreased emissions in an aged, closed landfill. The original EPA methodology appears to assume that a measured amount of methane captured in a given period when the collection system is running will be lost in a like period when the collection system is off. - This assumption is made even when the landfill is near the end of its gas production with over-sized extraction equipment running intermittently.

The revised methodology makes accommodation for the landfill's age and low methane generation rate. The summary GHG spreadsheets show calculations both with reported data and the more recent calculations including the use of the revised method.

In 2009 and 2010 respectively, USEPA and Washington State passed GHG reporting requirements. Landfills were required to report if emissions exceeded 10,000 MTCO2e (WA State) or 25,000 MTCO2e (USEPA). The City began reporting to the State & EPA on the Northside Landfill's GHG emissions in 2010 and did so through 2012. The City has requested "non-reporting" status of both the State and USEPA for both landfills. Biogenic CO_2 emissions were calculated from flare data obtained

from each landfill. The measured monthly average CO_2 fraction was multiplied with the total measured monthly landfill gas captured. These monthly totals summed to make each yearly biogenic CO_2 from each landfill.

Sources:

Rich Hanson, P. E.	Spokane SWD	Landfill data, reports to EPA
Jay Dehner, P.E.	CH2M HILL	Landfill gas collection efficiencies
Spokane Env. Prog.	Utility Manager Database	Landfill electricity use
US EPA	GHGRP	Reported emissions
USEPA	eGRID 9th Edition	GHG factors for electrical use
WA Ecology	website	Mandatory GHG reporting data
South Landfill Closure Plan	(CH2M HILL 1987)	Southside Landfill history & design
Fluid Components Inc.	website	Gas flow meter information
Alan Vidal	LANDTEC	Gas flow meter information

8. Waste Disposed by City of Spokane Operations

Table III-92 2010 Waste Disposed From City of Spokane Operations

Method of Disposal	Short Tons	Disposal Cost	CO_2e
Incineration*	1,792.	$339,833.87	660.
Northside Landfill**	437.	$0.00	830.
Compost***	582.	$20,603.26	0.
Informational Total	2,811.	$360,437.13	1,490.
Reported Total	2,374.	$338,932.4	660.

Table III-93 2012 Waste Disposed From City of Spokane Operations

Method of Disposal	Short Tons	Disposal Cost	CO_2e
Incineration*	1,834.	$256,068.10	665.
Northside Landfill**	283.	$0.00	537.
Compost***	2,698.	$27,874.55	0.
Informational Total	4,815.	$283,942.65	1,201.
Reported Total	283.	$0.00	0

*2010 WTE incineration emissions for government waste only are included in this inventory. All 2012 WTE emissions including government waste are reported in the Power Generation sector of the inventory. 2012 incineration of government waste is therefore only included here in the informational total.

**All Northside Landfill emissions are counted in the Landfills sector. The values provided here is waste lifetime emissions for waste disposed in the landfill in the year and are provided for information only.

*** When composting is performed correctly, compost emissions are considered negligible. The composting was contracted and not done directly by, or in, the City.

a) Introduction

Listed above are the 2010 and 2012 calculated greenhouse gas emissions pertaining to the waste disposed by City of Spokane government operations, sorted by method of disposal. In 2010 and 2012, solid waste produced through government operations at City of Spokane facilities was disposed through incineration, composting, and land filling. Incineration at Spokane's Waste-To-Energy facility (WTE) was the predominant method of disposal in both 2010 and 2012. However, in 2010, the facility was located outside the city limits and outside of the City's direct control. Due to this qualification, only 2010 government waste incinerated are accounted for in the reported emissions total. All 2012 WTE emissions are accounted for under the Power Generation sector of this inventory.

Due to waste disposal, City of Spokane government operation was responsible for 660 metric tons of CO_2e in 2010 and 665 metric tons of CO_2e in 2012. These solid waste emission totals made up 1 % and 0 % of all government related emissions for the City of Spokane in 2010 and 2012 respectively. The disposal of solid waste results in various greenhouse gas emissions such as methane, nitrous oxide, carbon dioxide, etc. Emissions from these gases have been converted into metric tons of CO_2equivalent (MT CO_2e).

Figure III-22 – 2010 Emissions by Disposal Method

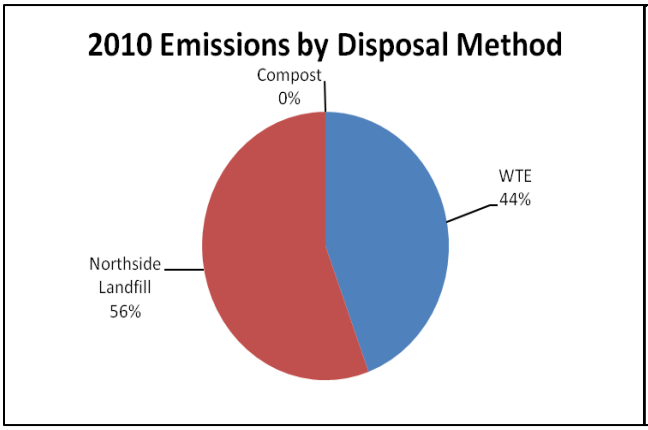
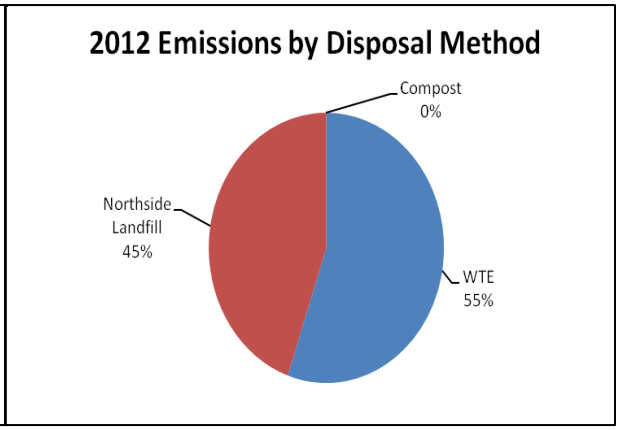


Figure III-23 – 2012 Emissions by Disposal Method



The City of Spokane government operations disposed a reported total of 2,811 tons of waste in 2010 and 4,815 tons of waste in 2012, compared to a 2005 baseline value of about 980 tons. In 2005, Spokane government sent 441 tons of waste to the Northside Landfill. From 2005 to 2010, wastewater grit, land fill disposed, decreased by 0.91%. From 2005 to 2012, it decreased by 35.8%. In 2005, 461 tons of City government yard waste was sent for composting. Between 2005 and 2010 tons composted increased by 26.3%, and between 2005 and 2012 tons composted increased by 485%. Between 2010 and 2012, the tons composted increased by 363.3%. In 2005 City employees recycled 79 tons of materials.

b) Incineration

Except for 2010 government waste incineration, the values discussed in this section should be used for information only. The City of Spokane's Waste-To-Energy facility is owned by the City of Spokane but was operated by Wheelabrator-Spokane Inc., a subsidiary of Wheelabrator Technologies USA, in 2010 and 2012. In 2012, a City annexation placed the plant inside the city limits. In this report we place all 2012 WTE emissions under the Power Generation sector while including 2012 incinerated government waste in this sector for informational purposes only. In 2010, only emissions specifically from government waste are included in the total emissions for this section.

Waste is sent to the WTE facility, and the steam produced through combustion is used to generate electricity. Then the resulting ash waste is sent to Roosevelt Regional Landfill. In 2010, 1,792 tons of waste (660 MT CO_2e) generated by City of Spokane government operations was estimated delivered to the WTE facility, while in 2012 it was 1,834 tons of waste (665 MT CO_2e). Between 2010 and 2012,

there was a 2.3% increase in City government waste tons incinerated, with less than a 1% increase of CO_2equivalent metric tons estimated emitted.

In 2010, the Spokane Waste-To-Energy facility processed a total of 281,813 tons of waste and emitted a total of 101,683 metric tons of CO_2e, not including biogenic CO_2. The City of Spokane government operations contributed 0.68 % of the total tonnage received by the WTE facility and 1.35 % of the total emissions in 2010. In 2012, the WTE facility processed 273,958 tons of total waste which resulted in 102,755 metric tons of CO_2e emissions, not including biogenic CO_2. Based on the values attributed to the City of Spokane government operations, 0.64% of the total tonnage received by the WTE facility and 1.36% of the total emissions generated can be attributed to government operations.

c) Landfill

Waste that is not sent to the City of Spokane's WTE facility can either be sent to the Northside Landfill (NSLF) in northwest Spokane, WA, or Roosevelt Regional Landfill in Roosevelt, WA. When waste other than wastewater grit is sent to the NSLF, it is typically due to an overflow at the WTE facility or waste that is unsafe or not suitable for incineration such as sheetrock and medical waste. In 2010, 437 tons of waste from government operations was sent to the NSLF, with 283 tons in 2012. In 2005, 441 tons of waste was sent to the NSLF, giving a decrease of 0.91 % between 2005 and 2010, and a decrease of 35.8 % between 2005 and 2012. Between 2010 and 2012, there was a decrease of 35.2 % in tons land filled, with a calculated corresponding decrease in MT CO_2e emitted. In 2010 and 2012 wastewater grit was the only City government waste identified as going to the landfill. The quantity of waste land filled is a bit nebulous in that there are some wastes, for example slightly contaminated soils or street sweepings, which might come in and be counted as waste or alternatively counted as cover material. Municipal solid waste is required to be covered on a daily basis.

Rather than to annual waste land filled, actual landfill emissions are related to all the waste previously put into the landfill and the methane emissions not captured by the collection system. The values for MTCO_2e given here are lifetime emissions of the waste stored in the landfill. That is the calculated total amount of CO_2e that this waste will generate over whatever period it is decaying. This quantity is based on an assumption that the wastewater grit organics are equivalent to a single sample tested in 2015 for total and volatile solids. This calculated quantity is at least three times lower than the average metric tons of CO_2e per ton of waste value for the annual NSLF as a whole. Total NSLF emissions are counted in the Landfills sector of this report with the discussion here provided for information about government waste only.

d) Compost

Compost is biogenic and considered a part of the natural carbon cycle. Per federal reporting regulations, local governments are not responsible for biogenic emissions. Biogenic emissions from compost have been listed for informational purposes but are not a part of the total reported emissions count. The two departments that contributed to composting materials in both 2010 and 2012 are the Fire Department and the Parks and Recreation Department. Materials that were sent for composting were disposed of through self-hauled yard waste or clean green. Composting material grows each reported year from 2005 to 2012 with a very large increase occurring between 2010 and 2012. Between 2005 and 2010 there was a 26.3% increase in tons sent for composting and between 2005 and 2012, a 485% increase. Comparatively, between 2010 and 2012, there was a 363% increase in tons composted. In 2010, a total of 19,632 tons of waste was sent for composting by the city with 582.2 tons or 3.0% attributed to City of Spokane government operations. Similarly, in 2012 a total of 8,953 tons of waste was sent for composting by the city, with 2,698 tons or 30.1% attributed to City of Spokane government operations.

e) Waste Type Breakdowns

Methods of disposal have been split into various waste types. Waste types 1 through 4 as well as wastewater screenings are disposed by incineration. Wastewater grit is landfilled and waste type 6 is composted. Wastewater "grit" includes wastewater-contaminated gravels disposed of at the Northside Landfill, while wastewater "screenings" includes lighter, bulky material, such as wood chunks, paper, and cloth. The waste type that experienced the largest change between 2010 and 2012 was Yard Waste Type 6, which was composted, with an increase of 363%.

Table III-94 2010 City of Spokane GHG Solid Waste Emissions by Waste Type

Type of Waste	**Short Tons**	**Method of Disposal**	**Disposal Cost**	CO_2e
Large Office Waste Type 1	145	Incineration	$60,517.68	36
Garage/Shop Waste Type 2	268	Incineration	$63,286.98	77
Parks Waste Type 3	615	Incineration	$197,778.41	241
Residential Un-compacted Waste Type 4	210	Incineration	$17,349.36	84
Wastewater Screenings	553	Incineration	$0.00	201
Total Incineration	1,792	Incineration	$338,932.43	660
Total Landfill - Wastewater Grit (waste lifetime)	437	Northside Landfill	$0.00	830
Total Compost - Yard Waste Type 6	582	Compost	$20,603.26	0
Informational Total (Not Reported)	2,920		$359,535.7	1,490

Table III-95 2012 City of Spokane GHG Solid Waste Emissions by Waste Type

Type of Waste	Short Tons	Method of Disposal	Disposal Cost	CO_2e
Large Office Waste Type 1	123	Incineration	$51,333.72	30
Garage/Shop Waste Type 2	323	Incineration	$69,567.36	92
Parks Waste Type 3	465	Incineration	$73,093.20	182
Residential Un-compacted Waste Type 4	532	Incineration	$62,074.00	214
Wastewater Screenings	390	Incineration	$0.00	146
Total Incineration	1,834	Incineration	$256,068.28	665
Total Landfill - Wastewater Grit (waste lifetime)	283	Northside Landfill	$0.00	537
Total Compost - Yard Waste Type 6	2,698	Compost	$27,874.40	0
Informational Total (Not Reported)	4,814		$283,942.5	1,202

Figure III-24 – 2010 Emissions by Waste Type

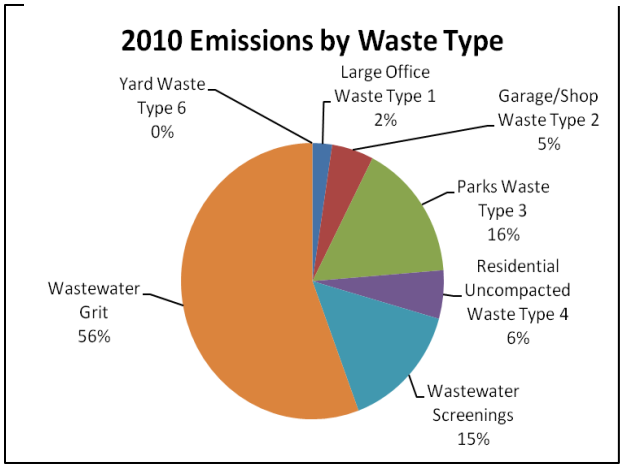
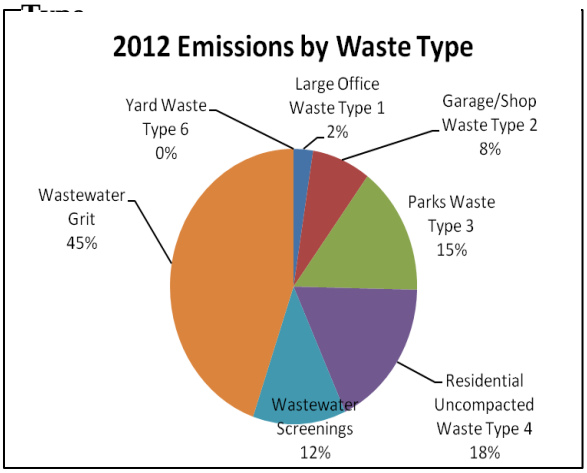


Figure III-25 – 2012 Emissions by Waste Type



f) Waste types by Department- largest contributors first:

Type 1: "Large Office Waste" includes solid waste from City Hall, Public Defender's office, Wastewater, Library, and part of Fire Department.

Type 2: "Garage/Shop" includes solid waste from Fleet Services(#1, 2010), Water Department(#1, 2012), Street Department, Fire Department (2010 only), Parks Department (2012 only).

Type 3: "Parks Waste" includes self-hauled refuse, Parks Department and East Central Community Center (2010 only).

Type 4: "Residential Un-compacted Waste" includes Fire Department, Police Department, Real Estate, Fleet Services, Asset Management, Parks (2012 only), Library (2012 only)

Type 5: Not used

Type 6: "Yard Waste" includes waste to be composted from Parks and Recreation Department (self-hauled) and from Fire Department.

Figure III-26 Waste Disposal Methods for Data Gathering and Calculations

Every effort was made to follow the ICLEI *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories*, however this protocol did not specifically describe or call for this information. Rather it is a section identified in the Data Collection workbook which accompanied the Protocol.

The initial task was to determine the tons of waste disposed by the various City departments and facilities. Some waste was self-hauled with weight ticket information available. Other waste was collected along with business and residential waste and so had to be estimated by can size and frequency of pick-up. The waste quantity from this latter category should be considered over estimated as we assumed the cans were full when picked up. The next significant step was to categorize the waste from specific locations based on the type and quantity of materials typically found with that type of waste. For example waste from shop and garage areas is significantly different in waste composition as compared to that found in office buildings like City Hall. Various waste survey data including some performed by Environmental Programs were used in making this determination.

One key piece of data has not traditionally been captured when waste surveys are done: the water content of the waste. We use the wet weight of garbage to try and estimate the amount of carbon in the garbage which can be converted to CO_2. Clearly there is a significant amount of variability introduced by the water content of the waste. The water content of the waste also impacts the amount of energy that can be extracted from it. Most everyone knows from experience how difficult it is to burn wet material.

CO_2e emissions were determined by multiplying the tons of waste disposed, by disposal method, for each department by percentages of waste kinds for each type. These figures were multiplied by an emissions factor for each kind of waste by disposal method. If the waste was incinerated, the tonnage value of the kind of waste was multiplied by the Waste-to-Energy emissions factor for each kind. The Northside Landfill (NSLF) emissions factor was derived in a manner not addressed in the protocol. This was done because the only waste attributed from the City government going to the NSLF was wastewater grit. The emissions factor derived by dividing the total reported emissions by tons of waste disposed at the landfill was not reasonable given the grit characteristics. Instead, grit emissions factor was based on a single grit sample analyzed in 2015 for total and volatile solids. We assumed the volatile solids portion was sugar and calculated the maximum theoretical methane that could be produced from this quantity of sugar. This factor gave a result about three (3) times lower than the former method. These results represent the maximum waste lifetime emissions, and are provided for information purposes only.

Once the MT CO_2e was determined for each department, the departments that contributed to each waste type were added together to determine the total values for each. These waste types were then split into methods of disposal, which included incineration, landfill, and compost. The total tons and MT CO_2e were each added up for each method of disposal. This was completed for both 2010 and 2012 data.

These data were then compared between 2010 and 2012, and 2005 baseline year. For the comparison between 2010 and 2012, percent change for both tons and MT CO_2e have been calculated for all disposal types. The only comparisons with 2005 include tons sent for composting and tons sent to landfill. The 2005 report did not include tons incinerated or MT CO_2e for tons sent to landfill.

The amount that the City of Spokane government operations contributed to community totals was calculated. Community waste disposed figure was used for total tonnage. The tonnage disposed by the City of Spokane government operations was then divided by the total tonnage to determine the percentage that government operations contributed to each disposal method considered. This was completed for incineration and compost.

Calculations (using the ICLEI Recycling & Composting Protocol, version 1, 2013) were also done on waste sent for composting to assess the GHG emissions avoided. The resulting data are included in the summary spreadsheet but not detailed in this report.
Generally the protocol methodology reports greater GHG emissions for composting as compared to incineration at the WTE facility.
These results are 100 $MTCO_2$eand 400 $MTCO_2$e for the composting amounts generated by City government facilities in 2010 and 2012 respectively. This protocol notes: "*Thus, while the methods in this protocol are unable to show the emissions benefits of composting over combustion at this time, the best available science indicates that composting (or anaerobic digestion) is the preferable policy option for reducing GHG emissions.*"

Sources:
Rhonda Albin, Solid Waste Disposal
Chuck Conklin, Solid Waste Disposal
Jeffery Donovan, Wastewater Management
Kathleen Keck, Parks and Recreation
Ron Nicodemus, Utility Billing
Tia Tauscher, Solid Waste Disposal
Jennifer Werner, Solid Waste Management

List of data sources used in this section of the report
"2010_Gov_MasterCalc_20150107"
"2012_Gov_MasterCalc_20150105"
WD-Solid Waste Final Input Data
Compiled into:
"Tables for Gov Solid Waste 6.2.2015jr"

Table III-96 – Summary of Waste Disposed Greenhouse Gas Emission Sources Used

GHG Source	Data Used	Approach Used
Incineration	Waste Types, kinds – EPA WARM model; CA State waste survey 2008; Spokane Cascadia 2009 waste survey; Spokane Env. Prog. waste surveys at City Hall, Normandie Yard, and Riverfront Park 2011-12	Waste density, waste types, and waste kinds were extracted from these sources
	Utility Billing data on containers, locations, frequency of collection, and billed amounts	Assumed containers were full at collection
	Hauled waste data from Solid Waste Disposal, Solid Waste Management, Parks & Rec, and Wastewater Management	Source, weight and cost information used
	EPA WARM 2014 Documentation on CO2e sources, see page 6-2	Waste kind specific factors
	CO2e emissions from the WTE plant, 2010, & 2012; Tons waste received, processed, and recycled	Reported emissions per ton
Landfill	Hauled waste data (as above) from Wastewater Management. Used factor for lifetime emissions of CO2e from non-covered landfill.	Developed special waste lifetime emissions factor for wastewater grit based on single grit sample test; Compared result to annual emissions/ton of waste disposed, not including cover material.
Compost	Utility Billing and Hauled waste data, as above from Fire and Parks & Rec; ICLEI Recycling & Composting Protocol, version 1, 2013	Assumed composting emission of CO2e is negligible; calculated emissions avoided

9. Wastewater and Water

a) Introduction

Table III-97 2010 Wastewater Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion (natural gas)	390	0.04	0.0007	391
Stationary Combustion (digester gas)	0	26.5	0	557
Purchased Electricity	9,234	0.18	0.14	9,282
Process Emissions	0	0	13.5	4,198
Biogenic Carbon*	10,861	0	0	10,861
Informational Total	20,485	27	14	25,289
Reported Total	9,624	27	14	14,428

*Emissions from biogenic sources are not included in the reported total

Table III-98 2010 Water Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion (natural gas)	299	0.03	0.0006	299
Purchased Electricity	4,510	0.09	0.07	4,533
Total	4,809	0.1	0.1	4,832

Table III-99 2012 Wastewater Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion (natural gas)	547	0.05	0.001	548
Stationary Combustion (digester gas)	0	25.15	0	528
Purchased Electricity	7,152	0.13	0.11	7,189
Process Emissions	0	0	11.34	3,515
Biogenic Carbon*	9,865	0	0	9,865
Informational Total	17,564	25.3	11.5	21,645
Reported Total	7,699	25.3	11.5	11,780

*Emissions from biogenic carbon are not included in the reported total.

Table III-100 2012 Water Emissions

GHG Source	CO_2	CH_4	N_2O	CO_2e
Stationary Combustion (natural gas)	337	0.03	0.0006	337.6
Purchased Electricity	8,609	0.16	0.13	8,653.5
Total	8,945	0.20	0.13	8,991.1

Table III-101 2010 & 2012 Emission Rates by Sector

Sector	CO_2e Emission Rate/Gallon	CO_2e Emission Rate/MMBTU
Water	grams (g)/ gallon pumped	Kilograms (kg)/ MMBTU
2010	0.234	34.3
2012	0.428	63.3
Wastewater	grams (g)/ gallon treated	Kilograms (kg)/ MMBTU
2010	1.04	78.9
2012	0.951	72

In 2010 the energy used in the distribution and treatment of both wastewater and water accounted for 19,260 metric tons of CO2e emissions, or 31.8 percent of the local government total. In 2012 the energy used to distribute and treat both water and wastewater accounted for 20,771 metric tons of CO2e emissions, or 12.6 percent of the government total. The energy use stated here includes electricity and natural gas used in administrative and maintenance buildings associated with wastewater and water operations as well as the pumping and distribution of water and the collection and treatment of wastewater. The majority of the emissions for this sector in both years were from wastewater operations, though total emissions from wastewater operation decreased by 18.4 %. Although wastewater operations serves a number of areas outside the City of Spokane city limits, all of the CO2e emissions from the City facility have been included in the inventory due to the location of the wastewater treatment facility within the city limits.

b) Water Department

The City of Spokane distributes water within the city limits, areas of service outside of the city limits, and is a wholesale provider of water to other water purveyors. For this section all of the emissions of the water department operations are included. The water department pumped 20,608,800,000 gallons of water in 2010 of which 89.7 % was within the City of Spokane. The city government used 1,093,249,179 gallons, or 5.4 % of the total pumped. 89.7 % of the 21,022,982,000 gallons of water pumped in 2012 were used within the City of Spokane. For 2012 the city government used 919,668,387 gallons or 4.4 % of the total amount pumped. Not all of the water pumped is used by consumers. In 2012 19.9 % of water pumped was lost to distribution system leakage.

In 2012, the Water Department saw an 86 % increase in total CO2e emissions from 2010. 2010 had a 22.1 % decrease in emissions compared to the 2005 value of 6,201 metric tons CO_2, while 2012 had a 45 % increase. The spike in emissions in 2012 is largely due to how Water Department electrical consumption was measured.

(1) Purchased Electricity

Table III-102 2010 Water Purchased Electricity by Sub-Sector

Sub-Sector	Purchased Electricity (kWh)	CO_2	CH_4	N_2O	CO_2e
Pumping and Distribution	11,091,775	4,239	0.08	0.07	4,261
Administrative and Maintenance	693,456	265	0.005	0.004	266
Sprinklers Irrigation Control	14,772	5	0.001	0.001	6
Total	11,800,003	4,510	0.086	.075	4,533

Table III-103 2012 Water Purchased Electricity by Sub-Sector

Sub-Sector	Purchased Electricity (kWh)	CO_2	CH_4	N_2O	CO_2e
Pumping and Distribution	21,790,376	8,328	0.16	0.13	8,371
Administrative and Maintenance	719,175	275	0.005	0.004	276
Sprinklers Irrigation Control	15,161	6	0.0001	0.00001	6
Total	22,524,712	8,609	0.16	0.13	8,654

Total electricity used by the Water Department equaled 39,609 MWh in 2010 and 39,743 MWh in 2012. However, electricity used to run the City's water operations in large part is sourced from the non-CO2e emitting hydroelectric Upriver Dam. In 2010 and 2012 electricity generated at the Upriver Dam was used at 2 well stations, the operation of the dam, and the Upriver administrative and maintenance facilities. The 2010 electrical contract had the additional electricity available for use at 40 other pumping and distribution sites. 27,809 MWh of Upriver Electricity were used in 2010 at these other sites. 11,800 MWh of electricity were purchased to meet the remaining demand. This purchased electricity was used to calculate greenhouse gas emissions. In 2012 however, the new electrical contract sold all excess power not used for operation of the Upriver Dam, requiring the Water Department to instead purchase that extra power for pumping and distribution. The Water Department needed to purchase 91 % more electricity in 2012 than 2010, though it only used less than 1 % more total power. In 2010 41,021,880 kilowatt hours of excess electricity from Upriver Dam were sold to Avista. 51,735,000 kWh of electricity were sold in 2012.

Table III-104 2010 & 2012 Water Electricity Used for Pumping and Distribution

	2010			2012		
	Water - Million Gallons per Year (MG/Y)	kWh	kWh/MG	Water MG/Y	kWh	kWh/MG
Extraction and Transmission*	20,608.8	30,676,400	1,488.5	21,022.9	29,767,100	1,415.9
Distribution**	9,926.6	8,623,864	868.8	10,509.5	9,083,929	864.4
Totals		39,300,264			38,851,029	

*This is actually the power used to pump the water from the ground into the appropriate lower pressure systems as the reservoir water levels varied with demand.

**This is the power used to move water into the upper pressure systems as their reservoir levels varied with demand.

The above table includes all power used in the pumping and distribution of water in the City of Spokane, regardless if it was generated at Upriver Dam or purchased power. The total water withdrawn from the Rathdrum Prairie-Spokane Valley aquifer and distributed using pumping stations changed by two percent (2%) between 2010 and 2012. Total power used associated with the distribution of water to locations of higher elevation increased by 5.3 percent, while power use due to pumping water from the aquifer decreased by 3 percent. Changes in power used per MG/Y are largely due to changes in the static head required to transport water to end use locations. The City also tracks the amount of water that is pumped from the ground but not accounted for in terms of use, which is termed Distribution System Leakage (DSL). In 2010 the DSL was found to be 18.1 percent while in 2012 it was 19.9 percent.

(2) Stationary Combustion

Water operations used 56,267 therms of natural gas in 2010 and 63,514 therms in 2012. This was an increase (12.8 %). Natural gas is used in water operations primarily to heat buildings.

c) Wastewater Operations

In 2010, the treatment plant received 13,910,150,000 gallons of waste from an estimated 303,035 people. Based on flow rates to the plant, approximately 76 percent were attributable to actual wastewater from 208,916 residents of the City of Spokane. The City of Spokane Valley portion was estimated at 16.6 percent, Spokane County 4.6 percent, Fairchild Air Force Base 1.5 percent, Airway Heights 1.4 percent, and Geiger Heights less than 1 percent. In December of 2011 Spokane County started operation of a new wastewater treatment facility treating the flow from Spokane Valley. In May of 2012, Airway Heights began operation of a facility treating their wastewater. The plant treated 12,318,750,000 gallons of waste water from an estimated 241,300 people in 2012. Based on flow to the plant 89 percent of the listed emissions were attributable to the 210,000 residents of the City of Spokane. Even with the new Spokane Valley plant there was an estimated 2.6 % flow from this area. Spokane County portion was estimated at 5.1 percent, Fairchild Air Force Base 2 percent, and Geiger Heights less than 1 percent.

In 2005, wastewater operations emitted 9,440 metric tons of CO_2e. Spokane increased its wastewater emissions by 53 % in 2010. There was a 25 % increase in CO2e emissions from 2005 to 2012. The increases are mostly from the 2010 and 2012 inclusion of wastewater nitrous oxide emissions which were not included in the 2005 emissions calculations. Nitrous oxide emissions were responsible for 4,340 metric tons CO_2e in 2010 and 3,565 metric tons CO_2e in 2012.

(1) Stationary Combustion

Table III-105 2010 & 2012 Wastewater Stationary Combustion

	Natural Gas (therms)	Natural Gas CO_2e	Digester gas to Boilers (therms)	Stationary Methane	CO_2e
RPWRF 2010	64,846	344.7	929,656	26.52	556.9
RPWRF 2012	96,282	511.8	895,135	25.15	528.3
Sewer Maintenance '10	8,748	46.5	-	-	-
Sewer Maintenance '12	6,864	36.5	-	-	-

The ICLEI protocol used for this inventory details calculations determining the methane and nitrous oxide emissions from the operation of a wastewater treatment facility. The incomplete combustion of anaerobic digester results in stationary methane emissions shown in the stationary combustion table above.

The use of methane, generated as a by-product in the pathogen reduction treatment of organic solids in the anaerobic digesters, as an energy source avoids the use of natural gas. In 2010, 57.7 % of methane generated was used for heating, resulting in the avoidance of 4,930 metric tons of CO_2e emissions. 61 % of the methane generated in 2012 was used for energy, resulting in the avoidance of 4,746 metric tons of CO_2e. The remaining methane was flared because methane is twenty-one times stronger of a greenhouse gas than the carbon dioxide generated from its combustion.

Carbon dioxide generated in the flaring of methane from the wastewater anaerobic digesters does not count as emitted CO_2e because no more than an equivalent amount of CO_2 was released compared to the emissions the organic matter would have released had it decomposed on its own in an aerobic environment. In addition, the source organic material is considered "old carbon" (non-fossil-fuel based carbon) and thus a part of the current carbon cycle. The formation of carbon dioxide (CO_2) from the combustion of the anaerobic digester gas is considered biogenic and is presented here for information, but is not part of the greenhouse gas totals. In 2010 there were 10,861 metric tons of biogenic CO_2 emitted. In 2012, 9,865 metric tons of biogenic CO_2 were emitted.

In the 1990 & 2005 Greenhouse Gas Inventory methane emissions from the anaerobic digesters were included in the Other Category of the Local Government Section. There were 382 metric tons of CO_2e from methane reported in 2005. Methane from anaerobic digesters in 2010 and 2012 are 46 % and 38 % higher than in 2005. In 2005 the calculation assumed that 1 % of digester biogas was lost and emitted as methane. The protocol equation used for this report assumes a collection efficiency of 0.99, equivalent to the previous inventory percentage.

(2) Process Emissions

Table III-106 2010 & 2012 Nitrous Oxide Process Emissions

Process	2010 N_2O	2010 CO_2e	2012 N_2O	2012 CO_2e
Treatment Plant Process N_2O	2.65	821.5	2.11	654.1
Effluent Process N_2O	10.89	3,375.9	9.23	2,861.3

The generation of N_2O results from the treatment of domestic wastewater during both nitrification and denitrification, originally in the form of urea, ammonia, and proteins. These compounds are converted to nitrate (NO_3) through the aerobic process of nitrification. Denitrification occurs under anoxic conditions (without free oxygen), and involves the biological conversion of nitrate into nitrogen gas (N_2). N_2O can be an intermediate product of both processes, but is more often associated with denitrification. The discharge of effluent to receiving aquatic environments may also generate N_2O. The table above has the nitrous oxide from nitrification/denitrification listed as Process N_2O. Nitrous oxide from the discharge to a water body is listed as effluent N_2O.

In addition, approximately 5,708 dry tons of wastewater biosolids were recycled onto farm land as fertilizer amendment in the Spokane region in 2010. In 2012 recycled biosolids equaled 5,408 dry tons, with 3,294 dry tons recycled in 2005. Emissions associated with the fuel used for transporting this material is accounted for in the Vehicle Fleet sector. While the biosolids are reported in dry tons, they are actually hauled and handled with considerable water content. In 2010 they averaged 17.7% solids, and in 2012, 18.7 %.

The production of chemical fertilizer is a significantly energy intensive endeavor. The use of 2012 biosolids to replace chemical fertilizer is calculated to have saved at least 815 $MTCO_2e$ and that does not include the savings from avoiding the transportation of the chemical fertilizer to Spokane.

(3) Purchased Electricity

Table III-107 2010 & 2012 Wastewater Purchased Electricity

Wastewater Management Section	Electricity (kWh)	CO_2e
RPWRF 2010	23,993,988	9,218
RPWRF 2012	18,549,228	7,126
Sewer Maintenance 2010	166,643	64
Sewer Maintenance 2012	162,647	63

Table III-108 2010 & 2012 Wastewater Electricity Use by Source

	2010			2012		
	Wastewater MG/Year	Electricity Use (kWh)	kWh / MG	Wastewater MG/Year	Electricity Use (kWh)	kWh/MG
Administration		2,334,406			1,800,075	
Treatment	13,910.15	19,985,091	1,436.7	12,318.75	15,069,557	1,223.3
Collection	13,910.15	1,897,060	135.1	12,318.75	1,838,418	149.2
Total		24,198,557			18,708,050	

The above table shows the electricity used to collect and treat the wastewater from the City of Spokane sewer service area. The collection system is primarily designed to utilize gravity flow. This helps minimize electrical requirements. This table only addresses electrical use and associated flows. Treatment occurs at the RPWRF where natural gas and methane from the anaerobic digesters are other sources of power used. It is estimated that 10 % of the electricity supplied to RPWRF is used for administrative functions. The table above uses this assumption for the energy use in treatment and administration. No electricity was used for wastewater operations directly from Spokane's power generation facilities. For wastewater operations, electricity used is the same as electricity purchased.

Figure III-27 Wastewater and Water Methods

The Local Government Operations Protocol version 1.1 May 2010 was used to determine the greenhouse gas emissions for the Local Government Wastewater and Water Sector. The City of Spokane has both financial and operational control of the wastewater system and water system.

Information for this section was gathered from the City of Spokane's Hydroelectric and Water Department and Environmental Programs Utility Manager database. The available data met the requirements for the preferred methods in the protocol. All of the facilities operated by the Hydroelectric and Water Department are included. Some of the electricity used by sprinkler and irrigation systems is included. There are 10 accounts from the Parks Department, Solid Waste Management and the Street Department where the electrical use was specifically identified so that it could be included in this sector. Equations 6.2, 6.3, 6.5, and 6.7 were used to calculate the emissions for the stationary combustion of natural gas at 4 locations. Equations 6.10 and 6.11 were used to determine the total annual emissions from purchased electricity.

The city government water use is from the 2012 City Government Water Use Report prepared by Environmental Programs. The distribution system loss is from the Report on City of Spokane Drinking Water for 2012 prepared by Environmental Programs. Both of these reports have a more in depth presentation of the data and are available from Environmental Programs. To calculate the purchased electricity used by the water department the method of accounting used by the 2010 electrical contract with Avista was used. For 2010 excess electricity generated by the Upriver dam was wheeled to 41 other locations. For 9 months this excess power met the demand of all these locations. For 2 months, September and October a portion of the electricity was purchased. In August all of the electricity used at the 41 locations was purchased.

For 2012 all of the excess power not used by Parkwater, Well Electric and Upriver facility was sold to Avista. The electricity used by the 41 locations in identified in the 2010 contract purchased their electricity from Avista.

The Wastewater Sector information came from the City of Spokane Wastewater Management Department, the 2010 and 2012 Riverside Park Water Reclamation Facility Annual Assessment's, and Environmental Programs Utility Manager Database. All of the purchased electricity and natural gas used in all of the wastewater facilities are included in this section. This includes the Riverside Park Water Reclamation Faculty (RPWRF), all pumping and lift stations, administrative buildings and maintenance facilities.

The emissions from purchased energy were calculated using the same equations as the water sector. The operation of the RPWRF creates a unique set of process and fugitive greenhouse gas emissions. Stationary methane emissions from the incomplete combustion of anaerobic digester gas were calculated using equation 10.1. Process nitrous oxide emissions from the nitrification and denitrification of the nitrogen present were calculated from equation 10.7. Equation 10.9 was used to calculate the nitrous oxide emissions created by discharging effluent to the Spokane River. The population used in equation 10.7 was determined from the average daily BOD flow in the given year to the RPWRF and assumed there was 0.2 pounds of BOD generated per person per day.

The avoided greenhouse gas emissions from using digester gas were calculated from the energy value of the digester gas. The greenhouse gas emissions were calculated as if natural gas was used instead of the digester gas to meet the energy requirement. The biogenic CO2 reported was calculated with equation 6.2 and emission factor for Wastewater Treatment Biogas from table G2.

Contacts
Jeff Donovan - City of Spokane Wastewater Angela Cline – City of Spokane Accounting Department

Table III-109 Summary of Wastewater and Water Sources Used for GHG Emissions

GHG Source	Data Used	Method Used
Water Energy	Data from Environmental Programs Utility Manager Database	6.2, 6.3, 6.5, 6.7, 6.10, 6.11
Wastewater Energy	Data from Environmental Programs Utility Manager Database	6.2, 6.3, 6.5, 6.7, 6.10, 6.11
Wastewater Stationary Methane	Data provided by City of Spokane Wastewater Department	10.1
Wastewater Process Nitrous Oxide	Data provided by City of Spokane Wastewater Department	10.7
Wastewater Effluent Nitrous Oxide	Data provided by City of Spokane Wastewater Department	10.9
Wastewater Biogenic Carbon Dioxide	Data provided by City of Spokane Wastewater Department	6.2

10. Contracted Services

The only City contracted service data collected was regarding the contract with Avista for street lighting. Please see the Lighting section for details.

IV. Existing Reduction Efforts

A. Spokane City Community Emissions

Besides Federal and State efforts as discussed in the introduction, the City has made some efforts to help reduce the community GHG emissions and private companies have also been taking steps to reduce/encourage emission reductions. The City has been encouraging in-fill development and centers and corridor development for some time. The City passed low impact development regulations in 2013 as regards storm water handling and is encouraging this type of development. In recent years the City has focused on multi-modal transportation. Bike lanes, trails, and pedestrian safety have risen in priority. These type of reduction efforts are primarily aimed at reducing future impacts from growth across sectors and do not lend themselves to easy quantification of resulting reductions. Other efforts, such as working with Avista Utilities through SNAP to help low income folks with energy conservation are more direct and should be more measureable.

Avista has a significant suite of consumer incentives to encourage energy efficiency. This includes some grants for solar panels on community buildings. Avista has also been increasing its wind energy component of its fuel mix portfolio. Inland Power & Light offers incentives for heat pumps, lighting upgrades and irrigation system upgrades.

On other fronts the City has been encouraging water conservation since 2005, and solid waste recycling from the 1980's. In late 2012 the City switched to single stream recycling to encourage more recycling in the community. In October of 2012 Waste Management Inc. completed its SMaRT (Spokane Materials and Recycling Technology) Center. Spokane Transit has been gradually upgrading their fleet to hybrid buses that are more fuel efficient and less polluting. All of the following buildings have solar panel arrays installed: North Central High School, Whitworth University, the Unitarian Universal Church, the Community Building, Saranac Building, Main Market Building and Avista Corporation Headquarters Building.

B. City of Spokane Government Emissions

The City has moved from less efficient buildings and has consolidated operations, particularly with the recent move of the Fleet Department to a new building at the City Central Services Center. Another significant move was the Fleet, Street, and Field Engineering departments out of the very old Normandie site. Lighting is slowly being transitioned to more efficient LED. Low impact development standards have been provided that will reduce the need for energy intensive wastewater and storm water treatment systems. The City is monitoring government energy and water use monthly. Exceedances and savings are noted and information is gathered from departments regarding the cause of the change.

The City continues to report on its emissions and annually generates Departmental Energy and Water Use reports. The City is replacing its Solid Waste diesel fleet with cleaner burning natural gas vehicles. This change was primarily made to take advantage of lower priced natural gas (at the time of the decision). Toxic emissions from the Solid Waste fleet are also reduced with this fuel change. What this change will mean for GHG emission reduction is still being evaluated. It is complicated because any loss of methane is at least 21 times worse than a loss of carbon dioxide of the same quantity. In addition the natural gas has to be compressed for injection into the vehicles and this energy needs to be factored into the analysis. Further complicating matters is the fact that the quantity of natural gas going into any one vehicle is not metered but the total quantity of natural gas used in all the vehicles is metered.

V. Proposed Reduction Efforts

The reduction efforts suggested below revolve around several key concepts:

1) To reduce Scope 1 emissions we need to use renewable alternative energy.
2) The most efficient way to make energy available and to reduce waste is to conserve.
3) Since public transit is necessary we should use it and help improve it.
4) Energy conversions and energy transport result in energy loss.
5) Fighting climate change requires cooperation, communication, and consideration.

A. Community Reduction Efforts

Built Environment (residential & commercial)

1) Strongly consider the incentives offered by utilities
   https://www.avistautilities.com/services/Pages/communitysolar.aspx
   https://www.inlandpower.com/
2) Purchase and use Energy Star products
   https://www.energystar.gov/
3) Encourage solar panel installations
4) Recognize & reward LEED Building

Transportation

1) Continue with multi-model streets & mixed use development
2) Encourage use of public transit
3) Get STA City Central line installed
4) Encourage use of biofuels
5) Encourage use of "SmartWay" certified vehicles

https://www3.epa.gov/otaq/greenvehicles/find/index.htm

6) Encourage use of plug-in hybrids
7) Are Avista, STA, & City reducing carbon footprint?

Solid Waste

1) Cut waste/Use less
2) Purchase less packaging
3) Encourage increase in plastics recycling
4) Discourage production of non-essential non-recyclable waste
5) Consider ways to further reduce moisture in waste stream
6) Encourage composting and use of compost

Wastewater & Water

1) Use "WaterSense" labeled products
   https://www3.epa.gov/watersense/product_search.html
2) Conserve water
3) Take advantage of utility incentives as available

B. City of Spokane Government Reduction Efforts

Buildings
1) Install Light Emitting Diode (LED) lighting
2) Achieve goal of no less than 90% Energy Star equipment
https://www.energystar.gov/
3) Generate electricity where feasible
4) Take advantage of utility programs
https://www.avistautilities.com/services/Pages/communitysolar.aspx

https://www.inlandpower.com/
5) Leadership in Energy and Environmental Design (LEED^{R}) by example

Lights
1) Install LED lighting

Water
1) Further increase emphasis on leak detection & conservation
2) Increase conservation goals (particularly indoor)
3) Conserve power/increase efficiency
4) Generate electricity wherever feasible
   - Increase generation at Upriver?
   - Put generators in water pipes?

Wastewater
1) Use as much of the generated biogas as possible, flare little
2) Generate as much biogas as reasonably possible
3) Conserve power/increase efficiency
4) Generate electricity where feasible
   - Generator at outfall?
   - Biogas/Steam generator?

Solid Waste
1) Purchase less packaging
2) Cut waste/use less
3) Use compost
4) Use chemical fertilizers sparingly

Power Generation
1) Conserve power/increase efficiency
2) Purchase less packaging
3) Encourage increase in plastics recycling
4) Discourage production of non-essential non-recyclable waste
5) Consider ways to further reduce moisture in waste stream

Fleet
1) Encourage more bus use for City business travel & commuting
2) Periodically revisit, and increase as feasible, bio-fuel use
3) Purchase plug-in hybrids
4) Install vehicle charging stations

Disposed Waste
1) Encourage recycling and composting

Travel
1) Increase Tele-work
2) Consider 4 day work week where feasible
3) Encourage more bus use for commute
4) Continue encouragement of bike to work
5) Encourage Video-Conferencing

VI. Conclusion

The proposed actions cause change and likely come at some increased cost. They are proposed as potential ways to cut greenhouse gas emissions and thereby cut some of the unwelcome environmental impacts that have been predicted to be forthcoming if little or no change is made.

In looking at the Scope 1 emissions, stationary combustion and vehicle fuel, for both the Community and City government it is clear that the trend is not in the downward direction (reductions).

The last couple of years have, in this writer's experience, provided, again, hints of what might become more normal: fire storms, drought, and wind storms, these at greater intensity than the previous "normal". In addition, but more removed from us, others losing everything to floods, tornados, drought, and hurricanes.

Let us not forget, while man is being impacted, most other living things which lack our adaptability suffer very significant environmental change as well.

The City of Spokane's goals set in 2010 appear to be in-line with the State and Federal goals. They are not recommended to be changed at this time.

Instead, taking action to meet the goals sooner rather than later is strongly encouraged. In part this is because at some point our ability to make positive change may be constrained by the cost of adapting to and recovering from the negative changes that come. There are sources of energy that do not result in GHG emissions. We just need to learn how to harness and use them.

Appendices

A. Detailed City of Spokane Emissions by Scope and Sector

Table A-0-1 2010 City of Spokane Government Scopes Summary

2010 City Government Grand Totals								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	5,166	3,939	27	0	0.0	0.0	0.0
	Mobile Combustion	10,988	10,938	0	0			
	Fugitive Emissions	12,312	0	568	0	0.1	0.0	0.0
	Process Emissions	4,198	0	0	14	0.0	0.0	0.0
	Total Direct Emissions	32,664	14,877	595	14	0.1	0.0	0.0
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Purchased Electricity	21,909	21,795	0.415	0.338			
	Transmission & Distribution	-	-	-	-			
	Purchased Steam	453	451	0.043	-			
	District Heating & Cooling	-	-	-	-			
	Total Indirect Emissions	22,362	22,246	0.458	0.338			
SCOPE 3		CO_2e						
	WTE Emissions	112,182						

2010 GHG Government SCOPES Summary

BUILDINGS & OTHERFACILITIES						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	
	Stationary Combustion	3,259	3,251	0.306	0.006	
	Fugitive Emissions					
	Total Direct Emissions	3,259	3,251	0.306	0.006	
SCOPE 2		CO_2e	CO_2	CH_4	N_2O	
	Purchased Electricity	6,402	6,369	0.12	0.10	
	Purchased Steam	453	451	0.043	0.001	
	District Heating & Cooling					
	Total Indirect Emissions	6,855	6,820	0.164	0.099	
INDICATORS	Annual Power Use	116,077	MMBTU			
	Buildings	103				
	Number of Employees	2,014				

STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	1,380	1,373	0.026	0.021
	Total Indirect Emissions	1,380	1,373	0.026	0.021
SCOPE 3		CO_2e			
	Avista Contracted Street Lighting	2,472			

WATER TRANSPORT FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 1		CO_2e	CO_2	CH_4	N_2O
	Stationary Combustion	299	298	0.028	0.001
	Total Direct Emissions	299	298	0.028	0.001
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	4533	4510	0.086	0.07
	Purchased Steam	-	-	-	-
	District Heating & Cooling	-	-	-	-
	Total Indirect Emissions	4533	4510	0.086	0.07
INDICATORS					
	Water Transported	20,609	Million Gallons		

WASTEWATER TREATMENT FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	948	390	26.6	0.0	-	-	-
	Fugitive Emissions							
	Process Emissions	4,198	-	0.0	13.5	-	-	-
	Total Direct Emissions	5,146	390	26.6	13.5	0	0	0
SCOPE 2		CO2e	CO2	CH_4	N_2O			
	Purchased Electricity	9,282	9,234	0.176	0.143			
	Purchased Steam	-	-	-	-			
	District Heating & Cooling	-	-	-	-			
	Total Indirect Emissions	9,282	9,234	0.176	0.143			
INDICATORS	Wastewater Treated	10,569	Million Gallons					
	Wastewater Transported	8	Million Gallons					

SOLID WASTE FACILITIES - LANDFILLS						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	
	Stationary Combustion	-	-	-	-	
	Fugitive Emissions	11,928	-	568	-	
	Total Direct Emissions	11,928	0.00	568	0.00	
SCOPE 2		CO_2e	CO_2	CH_4	N_2O	
	Purchased Electricity	311	310	0.006	0.005	
	Total Indirect Emissions	311	310	0.006	0.005	
INDICATORS	Employees					
	Last 50 Years of Waste in Place	1,793,022	Metric Tonnes			

POWER GENERATION FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Total Direct Emissions					-	-	-
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Total Indirect Emissions				-			
SCOPE 3		CO_2e						
	WTE Emissions	102,186						
INDICATORS	Electricity Generated	242,019	MWh WTE + Upriver Dam					
	MSW Burned	281,813	short tons wet					
	Biogenic Emissions	150,949	Metric Tonnes CO_2					

VEHICLE FLEET								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	
	Mobile Combustion	10,988	10,938	0.19	0.15	-	-	
	Fugitive Emissions	152	-	-	-	0.12	-	
	Total Direct Emissions	11,140	10,938	0.19	0.15			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Electricity for Elec. Vehicles	0	-	-	-			
	Total Indirect Emissions	0	-	-	-			
INDICATORS	Number of Vehicles	1,256						
	Vehicle Miles Traveled	6,777,722						
	Gasoline Use	364,558	gallons	does not include ethanol portion				
	Diesel Use	755,406	gallons					

WASTE DISPOSED FROM CITY OPERATIONS			
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**	
SCOPE 1		CO_2e	
	Stationary Combustion	660	
	Fugitive Emissions	0	
	Total Direct Emissions	660	
SCOPE 3		CO_2e	
	Landfilled Waste Lifetime Emissions	830	
INDICATORS			
	Incinerated Waste	1,792	Short Tons
	Landfilled Grit	437	Short Tons
	Yard Waste Composted	582	Short Tons

EMPLOYEE COMMUTE AND BUSINESS TRAVEL		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Business Travel	3,697
	Employee Commute	2,929

REFRIGERANTS AND FIRE SUPPRESSION EQUIPMENT							
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**					
SCOPE 1		CO_2e	HFC-134a	R-410a			
	Fugitive Emissions	232	0.170	0.006			
	Total Direct Emissions	232	0.170	0.006			
SCOPE 3		CO_2e	HFC-134a	CO_2e	R-22		
	Loss From Recycled Home Appliances	11	0.028	58	0.032	+ Gov Buildings	

Table A-0-2 2012 City of Spokane Government Scopes Summary

2012 City Government Grand Totals							
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**					
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	106,674	101,379	86	11	0.0	0.0	0.0
	Mobile Combustion	11,073	11,033	0	0	-	-	0
	Fugitive Emissions	13,327	0	614	0	0.2	0.0	0.0
	Process Emissions	3,515	0	0	11	0.0	0.0	0.0
	Total Direct Emissions	134,589	112,412	700	23	0.2	0.0	0.0
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Purchased Electricity	24,144	24,019	0.456	0.373			
	Transmission & Distribution	-	-	-	-			
	Purchased Steam	363	362	0.034	0.001			
	District Heating & Cooling	-	-	-	-			
	Total Indirect Emissions	24,507	24,381	0.490	0.374			
SCOPE 3		CO_2e						
		10,275						

2012 GHG Government SCOPES Summary

BUILDINGS & OTHER FACILITIES						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	
	Stationary Combustion	3,033	3,025	0.285	0.006	
	Fugitive Emissions					
	Total Direct Emissions	3,033	3,025	0.285	0.006	
SCOPE 2		CO_2e	CO_2	CH_4	N_2O	
	Purchased Electricity	6,868	6,832	0.130	0.106	
	Purchased Steam	363	362	0.034	0.001	
	District Heating & Cooling					
	Total Indirect Emissions	7,230	7,194	0.164	0.107	
SCOPE 3		CO_2e				
	[Insert as needed]					
INDICATORS	Annual Power Use	124,871	MMBTU			
	Buildings	106				
	Number of Employees	2,022				

STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	1,284	1,277	0.024	0.020
	Total Indirect Emissions	1,284	1,277	0.024	0.020
SCOPE 3		CO_2e			
	Avista Contracted Street Lighting	2,513			
INDICATORS					

WATER TRANSPORT FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 1		CO_2e	CO_2	CH_4	N_2O
	Stationary Combustion	337.61	336.75	0.032	0.001
	Total Direct Emissions	337.61	336.75	0.032	0.001
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	8,653.52	8,608.68	0.164	0.134
	Purchased Steam	-	-	-	-
	District Heating & Cooling	-	-	-	-
	Total Indirect Emissions	8,653.52	8,608.68	0.164	0.134
SCOPE 3		CO_2e			
	[Insert as needed]				
INDICATORS	Drinking Water Treated				
	Water Transported	21,023	Million Gallons		

WASTEWATER TREATMENT FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	548	547	0.1	0.0	-	-	-
	Fugitive Emissions	528	-	25.2	-			
	Process Emissions	3,515	-	-	11.4	-	-	-
	Total Direct Emissions	4,592	547	25.3	11.3	0	0	0
SCOPE 2		CO2e	CO2	CH_4	N_2O			
	Purchased Electricity	7,189	7,152	0.1	0.1			
	Total Indirect Emissions	7,189	7,152	0.1	0.1			
INDICATORS	Wastewater Treated	12,319	Million Gallons					
	Wastewater Transported	6	Million Gallons					

SOLID WASTE FACILITIES - LANDFILLS						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	
	Stationary Combustion	-	-	-	-	
	Fugitive Emissions	12,367	-	589	-	
	Total Direct Emissions	12,367	0.00	589	0.00	
SCOPE 2		CO_2e	CO_2	CH_4	N_2O	
	Purchased Electricity	126	126	0.002	0.002	
	Purchased Steam	-	-	-	-	
	District Heating & Cooling	-	-	-	-	
	Total Indirect Emissions	126	126	0.002	0.002	
INDICATORS						
	Employees					
	Last 50 Years of Waste in Place	1,727,232	Tonnes			

POWER GENERATION FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	102,755	97,470	85.7	11.2	-	-	-
	Fugitive Emissions	-	-	-	-	-	-	-
		-	-	-	-	-	-	-
	Total Direct Emissions	102,755	97,494	87.5	11.2	-	-	-
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Purchased Electricity	24	24	0	-			
	Transmission & Distribution	-	-	-	-			
	Purchased Steam	-	-	-	-			
	District Heating & Cooling	-	-	-	-			
	Total Indirect Emissions	24	24	0	-			
SCOPE 3		CO_2e						
INDICATORS	Electricity Generated	241,001	MWh WTE + Upriver Dam					
	MSW Burned	273,958	short tons wet					
	Biogenic Emissions	146,284	Metric Tonnes CO_2					

VEHICLE FLEET							
Scope		**Greenhouse Gas Emissions (metric tons)**					
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs
	Mobile Combustion	11,073	11,033	0.168	0.166	-	-
	Fugitive Emissions	200	-	-	-	0.154	-
	Total Direct Emissions	11,273	11,034	0.168	0.116		
SCOPE 2		CO_2e	CO_2	CH_4	N_2O		
	Electricity for Elec. Vehicles	0	-	-	-		
	Total Indirect Emissions	0	-	-	-		
INDICATORS	Number of Vehicles	1,249					
	Vehicle Miles Traveled	6,676,767					
	Gasoline Use	360,704	gallons	does not include ethanol portion			
	Diesel Use	768,314	gallons				

WASTE DISPOSED FROM CITY OPERATIONS					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 3		CO_2e			CO_2e
	Landfilled Waste Lifetime Emissions	537		Waste Incinerated	665
INDICATORS	Incinerated Waste	1,834	Short Tons		
	Landfilled Grit	283	Short Tons		
	Yard Waste Composted	2,698	Short Tons		

EMPLOYEE COMMUTE AND BUSINESS TRAVEL		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Business Travel	3,370
	Employee Commute	3,134

REFRIGERANTS AND FIRE SUPPRESSION EQUIPMENT						
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**				
SCOPE 1		CO_2e	HFC-134a	HFC-410a		
	Fugitive Emissions	232	0.170	0.006		
	Total Direct Emissions	232	0.170	0.006		
SCOPE 3		CO_2e	R-134a	CO_2e	R-22	
	Loss From Recycled Home Appliances	12	0.031	44	0.024	+ Gov Buildings

B. Spokane City Community GHG Emissions Report Summary Tables

These are required tables to satisfy requirments for U.S. COMMUNITY PROTOCOL FOR ACCOUNTING AND REPORTING OF GHG EMISSIONS, ICLEI-Local Governments for Sustainability USA, version 1.1, July 2013.
Abbreviations used in the Tables:
SI= Local Government Significant Influence
CA= Community-Wide Activities
HC= Household Consumption
IE= Included Elsewhere; Emissions for this activity are estimated and presented in another category of the inventory. The category where these emissions are included should be noted in explanation.
NA= Not Applicable; The activity occurs but does not cause emissions; explanation should be provided.
NO= Not Occurring; The source or activity does not occur or exist within the community.
NE= Not Estimated; Emissions occur but have not been estimated or reported (e.g., data unavailable, effort required not justifiable).

Table B-1 1 2010 Spokane City Community GHG Emissions Report Summary Table

Sector	**Carbon Dioxide CO_2**	**Methane CH_4**	**Nitrous Oxide N_2O**	**Sulfur Hexafluoride SF_6**	**Emissions Metric Tons Carbon Dioxide Equivalent**
Built Environment	1,246,376	311	14	0.049	**1,258,376**
Transportation	851,932	77	41		**865,840**
Solid Waste	44,573	444	5		**63,465**
Wastewater/Water	14,418	7	8		**17,003**

Table B-1 2 2010 Spokane City Community Four Sectors GHG Emissions Report Summary Table

Built Environment Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
Use of fuel in residential and commercial stationary combustion equipment	Source and Activity	X	CA, HC		Mainly Natural Gas; Wood, propane, kerosene and fuel oil also combusted	430,209
Industrial stationary combustion sources	Source					30,733
Power Generation in the Community	Source		SI	IE- Waste-To-Energy (not in City Limits in 2010)	SF_6 emissions described here. City of Spokane owns Upriver Dam	1,176

				101,893 $MTCO_2e$ information item in Solid Waste Incineration Table III-34.	Hydroelectric considered "zero emissions."	
Use of electricity in the community	Activity	X	CA, HC			791,662
District heating/cooling facilities in the community	Source			NE	Emissions from district heating and cooling were not separately identified.	
Use of district heating/cooling by the community	Activity			NE	District heating and cooling were not separately identified.	
Industrial Process emissions in the community	Source			NO-Beyond those with stationary combustion, none identified. All facilities reported to EPA were located outside City of Spokane city limits.	Avista Utilities Natural Gas (methane)leakage.	4,596
Refrigerant leakage in the community	Source			NE	Refrigerant leakage and fire suppressant emissions not quantified.	
Electric Power Transmission and Distribution Losses	Source			NA	Electricity T&D losses emissions quantified but not included in total	54,150
Upstream Emissions from Energy Use	Source			NA	Upstream emissions not included in total	257,657
TOTALS						**1,258,376**

Transportation and other Mobile Sources						
Transportation Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting	Excluded: IE, NA, NO, or	Explanatory Notes(Optional)	Emissions Metric Tons

			Frameworks: SI, CA, HC	NE		Carbon Dioxide Equivalent
On-road passenger vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	
On-road passenger vehicle travel associated with community land uses	Activity	X	SI, CA			430,664
On-road freight and service vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	
On-road freight and service vehicle travel associated with community land uses	Activity	X	CA			284,018
On-road transit vehicles operating within the community boundary	Source		SI	IE	Obtained data for preferred activity-based method instead	
On-road transit vehicle travel associated with community land uses	Activity	X	SI, CA			9,811
Transit Rail vehicles operating within the community boundary/Use	Source and Activity			NO	No transit rail in Spokane. Amtrak covered under Inter-city rail	
Inter-city passenger rail vehicles operating within the community boundary	Source		SI		Amtrak	226
Freight rail vehicles operating within the community boundary	Source		SI		BNSF and UP Railroads	21,064
Marine vessels operating within the community boundary/Use	Source and Activity			NE	Only occasional boat operation and use on Spokane River.	
Off-road surface vehicles and other mobile equipment operating within the community boundary	Source		SI		Includes Air Support vehicles.	100,383
Use of Air Travel by the community	Activity		CA			27,655

TOTALS						**865,840**
Solid Waste						
Solid Waste Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
Operation of solid waste disposal facilities in the community	Source		SI		City of Spokane operates Northside Landfill=8,312; 101,893 MTCO2e Waste-To-Energy facility outside City of Spokane boundary.	**8,312**
Generation and disposal of solid waste by the community	Activity	X	SI, CA		Combustion of City waste= 47,153 $MTCO_2e$ at Waste-To-Energy Facility operated by Spokane Regional Solid Waste System until 2014.	55,153
TOTALS						**63,465**
2010 Water and Wastewater						
Water and Wastewater Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
Potable Water: Operation of water delivery facilities in the community	Source			NE		
Potable water: Use of energy associated with use of potable water by the community	Activity	X	SI, CA			4,785
Use of energy associated with generation of	Activity	X	SI, CA			12,101

wastewater by the community						
Centralized Wastewater Systems-Process Emissions: Process emissions from operation of wastewater treatment facilities located in the community/generation of wastewater by the community	Source		SI	IE	Included in Use of energy calculation above.	
Use of septic systems in the community	Source and Activity		SI, CA			117
TOTALS						**17,003**

Table B-2 1 2012 Spokane City Community GHG Emissions Report Summary Table

2012 Sector	**Carbon Dioxide CO_2**	**Methane CH_4**	**Nitrous Oxide N_2O**	**Sulfur Hexafluoride SF_6**	**Emissions Metric Tons Carbon Dioxide Equivalent**
Built Environment	1,160,605	337	13	0.067	**1,173,336**
Transportation	900,100	80	41		**914,370**
Solid Waste	96,932	504	11		**120,120**
Wastewater/Water	22,812	6.01	9.53		**25,895**

Table B-2 2 2012 Spokane City Community Four Sectors GHG Emissions Report Summary Table

2012 Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
Use of fuel in residential and commercial stationary combustion	Source and Activity	X	CA, HC		Mainly Natural Gas; Wood, propane, kerosene and fuel oil also combusted	415,793

equipment						
Industrial stationary combustion sources	Source					29,975
Power Generation in the Community	Source		SI	IE- Waste-To-Energy 102,054 $MTCO_2e$ in Solid Waste Incineration Table III-35.	SF_6 emissions described here. NA-City of Spokane owns Upriver Dam Hydroelectric considered "zero emissions."	1,611
Use of electricity in the community	Activity	X	CA, HC			721,355
District heating/cooling facilities in the community	Source			NE	Emissions from district heating and cooling were not separately identified.	
Use of district heating/cooling by the community	Activity			NE	District heating and cooling were not separately identified.	
Industrial Process emissions in the community	Source			NO-Beyond those with stationary combustion, none identified.	All facilities reported to EPA were located outside City of Spokane city limits.	4,602
Refrigerant leakage in the community	Source			NE	Refrigerant leakage and fire suppressant emissions not quantified.	
Electric Power Transmission and Distribution Losses	Source			NA	Electricity T&D losses emissions quantified but not included in total	49,341
Upstream Emissions from Energy Use	Source			NA	Upstream emissions not included in total	202,691
2012 TOTAL						**1,173,336**

2012 Transportation and other Mobile Sources						
Transportation 2012 Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
On-road passenger	Source			IE	Obtained data for	

vehicles operating within the community boundary					preferred activity-based method instead	
On-road passenger vehicle travel associated with community land uses	Activity	X	SI, CA			422,683
On-road freight and service vehicles operating within the community boundary	Source			IE	Obtained data for preferred activity-based method instead	
On-road freight and service vehicle travel associated with community land uses	Activity	X	CA			291,907
On-road transit vehicles operating within the community boundary	Source		SI	IE	Obtained data for preferred activity-based method instead	
On-road transit vehicle travel associated with community land uses	Activity	X	SI, CA			9,617
Transit Rail vehicles operating within the community boundary/Use	Source and Activity			NO	No transit rail in Spokane. Amtrak covered under Inter-city rail	
Inter-city passenger rail vehicles operating within the community boundary	Source		SI		Amtrak	225
Freight rail vehicles operating within the community boundary	Source		SI		BNSF and UP Railroads	19,829
Marine vessels operating within the community boundary/Use	Source and Activity			NE	Only occasional boat operation and use on Spokane River.	
Off-road surface vehicles and other mobile equipment operating within the community boundary	Source		SI		Includes Air Support vehicles.	104,396
Use of Air Travel by the community	Activity		CA			57,732
2012 TOTALS						**914,370**
2012 Solid Waste						
Solid Waste Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons

			Frameworks: SI, CA, HC			Carbon Dioxide Equivalent
Operation of solid waste disposal facilities in the community	Source		SI		City of Spokane operates Northside Landfill=8,796; 102,054 MTCO2e Waste-To-Energy facility inside City of Spokane boundary.	**110,850**
Generation and disposal of solid waste by the community	Activity	X	SI, CA	IE- Landfill City waste =2,206; Combustion of City waste= 45,646;	Process emissions=6,651; Transportation=2,619	9,720
2012 TOTALS						**120,120**
2012 Water and Wastewater						
Water and Wastewater Emissions Type	Source or Activity?	Included, Required Activities	Included Under Reporting Frameworks: SI, CA, HC	Excluded: IE, NA, NO, or NE	Explanatory Notes(Optional)	Emissions Metric Tons Carbon Dioxide Equivalent
Potable Water: Operation of water delivery facilities in the community	Source			NE		
Potable water: Use of energy associated with use of potable water by the community	Activity	X	SI, CA			8,803
Use of energy associated with generation of wastewater by the community	Activity	X	SI, CA			16,977
Centralized Wastewater Systems-Process Emissions: Process emissions from operation of wastewater treatment facilities located in the community/generation of wastewater by the	Source		SI	IE	Included in Use of energy calculation above.	

community						
Use of septic systems in the community	Source and Activity		SI, CA			115
2012 TOTALS						**25,895**

C. References

Table C-0-3 References 10-001 to 10-009

Call #	Author(s)	Title	Publisher or Journal	Year
10-001	California Air Resource Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry	Local Government Operations Protocol	California Air Resource Board, California Climate Action Registry, ICLEI - Local Governments for Sustainability, The Climate Registry	2010
10-002	ICLEI - Local Governments for Sustainability USA	ICLEI U.S. Community Protocol - July2013-Version1.1	ICLEI - Local Governments for Sustainability USA	2013
10-003	ICLEI - Local Governments for Sustainability USA	Appendix C - Built Environment Emission Activities and Sources - U.S. Community Protocol	ICLEI - Local Governments for Sustainability USA	2013
10-004	ICLEI - Local Governments for Sustainability USA	Appendix D: Transportation and Other Mobile Emission Activities and Sources	ICLEI - Local Governments for Sustainability USA	2013
10-005	ICLEI - Local Governments for Sustainability USA	Appendix E - Solid Waste Emission Activities and Sources - U.S. Community Protocol	ICLEI - Local Governments for Sustainability USA	2013
10-006	ICLEI - Local Governments for Sustainability USA	Appendix F - Wastewater and Water Emission Activities and Sources - U.S. Community Protocol	ICLEI - Local Governments for Sustainability USA	2013
10-007	ICLEI - Local Governments for Sustainability USA	Appendix G - Agricultural Livestock Emission Activities and Sources - U.S. Community Protocol	ICLEI - Local Governments for Sustainability USA	2013
10-008	ICLEI - Local Governments for Sustainability USA	Appendix H - Emissions Associated with the Community's Use of Materials and Services - U.S Community Protocol	ICLEI - Local Governments for Sustainability USA	2013
10-009	ICLEI - Local Governments for Sustainability USA	Appendix I - Consumption-Based Emission Activities and Sources - U.S. Community Protocol	ICLEI - Local Governments for Sustainability USA	2013

Table C-0-4 References 10-010 to 10-024

Call #	Author(s)	Title	Publisher or Journal	Year
10-010	ICLEI - Local Governments for Sustainability USA	ICLEI_recycling_composting_protocol_v 1	ICLEI - Local Governments for Sustainability USA	2013
10-011	Washington State Department of Commerce	Washington State Electric Utility Fuel Mix Disclosure Reports for Calendar Year 2012	Washington State Department of Commerce	2013
10-012	California Energy Commission	Full Fuel Cycle Assessment: Well-To-Wheels Energy Inputs, Emissions, And Water Impacts	California Energy Commission	2007
10-013	Cascadia Consulting Group	City of Spokane - 2009 Waste Characterization Memo	Cascadia Consulting Group	2009
10-014	EPA	Standard Volume-to-Weight Conversion Factors	EPA	1996
10-015	Brian Bonlender	Washington State Electric Utility Fuel Mix Disclosure Reports for Calendar Year 2012	Washington State Department of Commerce	2013
10-016		SWMP_Approved 2011.4.15 Appendix B - Waste Flow Analysis FINAL		2007
10-017	Spokane Regional Solid Waste System	One Man's Trash Newsletter	Spokane Regional Solid Waste System	2014
10-018	SCS Engineers	Spokane County Solid Waste and Moderate Risk Waste Management Plan	Spokane County Washington	2014
10-019	Department of Ecology	Mica Landfill final periodic review_2008	Department of Ecology	2008
10-020	US Army Corps of Engineers	Fifth Five-Year Review Report For Colbert Landfill Superfund Site	EPA	2014
10-021	US Dept. of Transportation	National Transportation Statistics	US Dept. of Transportation	2013
10-022	WSDOT	2012 Summary of Public Transportation	WSDOT	2013
10-023	National Transit Database	Transit Profile: All Transit Agencies for the 2011 Report Year	National Transit Database	2011
10-024	WTDOT	Washington State Rail Plan Public Review Draft	WTDOT	2013

Table C-0-5 References 10-024 to 10-029

Call #	Author(s)	Title	Publisher or Journal	Year
10-024	WTDOT	Washington State Rail Plan Public Review Draft	WTDOT	2013
10-025	US Energy Information	Washington - U.S. Energy Information Administration (EIA) - U.S	US Energy Information	2015
10-026	WADOE	WADOE calc ghgemissions_electricity_MW_MMBTU	WADOE	2014
10-027	US Energy Information	Report Source EIC Carbon	US Energy Information	2013
10-028	EPA	eGRID 9th edition Version 1.0 Year 2010 GHG Annual Output Emission Rates	EPA	2010
10-029	Avista	2015 Electric IRP Final Electronic Version	Avista	2015

D. Community Data Sources

Table D-1 Community Data Sources 10-101 to 10-121

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-101	.pdf	<Waste Characterization 2009 - Cascadia>	Cascadia	7/7/2014
10-102	.xls	<WARM_2010_recycled materials_2>	Deborah Bisenius	8/27/2014
10-103	.xls	<WARM_2010_recycle_ferrous_metal>	Deborah Bisenius	8/27/2014
10-104	.xls	<WARM_2010_rabanco overflow>	Deborah Bisenius	8/27/2014
10-105	.xls	<WARM_2010_ns landfill overflow>	Deborah Bisenius	9/18/2014
10-106	.xls	<WARM_2010_ns landfill ash>	Deborah Bisenius	8/27/2014
10-107	.xls	<WARM_2010_bury ash rabanco>	Deborah Bisenius	8/27/2014
10-108	.xls	<WARM 2010_compost Royal City WA>	Deborah Bisenius	9/17/2014
10-109	.xls	<2010 YEARLY SITE SPREADSHEETS(all sites)>	WTE Plant	9/3/2015
10-110	.pdf	<2010 Solid Waste Handling Permit Report - WTE>	Steve Holderby	1/11/2013
10-111	.pdf	<2010 Solid Waste Handling Permit Report - VTS>	Scott Windsor	8/13/2014
10-112	.pdf	<2010 Solid Waste Handling Permit Report - NTS>	Damon Taam	8/14/2014
10-113	.txt	<JDehner on Landfill methane extraction efficiency20140410>	Jay Dehner	7/24/2015
10-114	.xls	<2010 Yrend>	Solid Waste	2/11/2013
10-115	.pdf	<COVERSHEET whole year 2010 draft>	WTE Plant	1/12/2015
10-116	.pdf	<2010 Solid Waste Handling Permit Report - WTE>	Solid Waste	1/11/2013
10-117	.pdf	<UPRR 2010 Est Fuel - City of Spokane Spokane County>	Michael Jon Germer	2/12/2014
10-118	.xls	<SRTCdata20131106>	Anna Ragaza-Bourassa	11/6/2013
10-119	.pdf	<SRTC 2010 Model Update Report 11-30-2012>	SRTC	9/27/2013
10-120	.txt	<SOttersonEcy2011ModelUpdate20140819>	Sally Otterson	8/19/2014
10-121	.xls	<EMartinCommunityVehicleEmissions 20141020modLBSR>	Sally Otterson	10/20/2014

Table D-2 Community Data Sources 10-122 to 10-143

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-122	.txt	<STA_MKenneyData>	Matthew Kenney	8/7/2014
10-123	.xls	<STA 2010Passenger Miles file>	STA	6/26/2013
10-124	.txt	<MKenneySTAEmissions Info>	Matthew Kenney	8/11/2014
10-125	.xls	<2012DB_Energy_Consumption>	Deborah Bisenius	12/5/2013
10-126	.pdf	<Annual Route Report>	STA	5/30/2013
10-127	.xls	<2012 Table 19 Transit Operating Stats>	STA	7/3/2014
10-128	.xls	<STA2005Energy_Consumption>	STA	6/26/2013
10-129	.xls	<STA2005 Possible passenger miles>	STA	6/26/2013
10-130	.xls	<STA 2010Passenger Miles file>	STA	6/26/2013
10-131	.xls	<STA 2010Energy consumption gallons Used>	STA	6/26/2013
10-132	.txt	<AmtrackResponses2008>	Amtrak	10/28/2014
10-133	.txt	<UPRR Locomotive Fuel Consumption Spokane County WA 2010 2012>	Michael Jon Germer	2/12/2014
10-134	.pdf	<UPRR 2010 Est Fuel - City of Spokane & Spokane County>	Union Pacific	2/12/2014
10-135	.zip	<SEP 2010 Bus Routes>	Matthew Kenney	9/1/2011
10-136	.pdf	<Census 2010 Spokane city>	census.gov	1/7/2014
10-137	.xls	<Percent of Washington state fuel use in occupied housing2013_11_21_xlsx>	Deborah Bisenius	11/21/2013
10-138	.xls	<2012 HHW Totals_Jan_2013>	Deborah Bisenius	11/26/2013
10-139	.htm	<RE Questions about Electric Service delivery in 2010 and 2012>	Ian Swan	2/10/2014
10-140	.xls	<SRCAA Registrations 2012_12-18-2013>	Deborah Bisenius	8/11/2014
10-141	.pdf	<NucEnergy6-01-2-15-45>	LAKA	6/1/2015
10-142	.xls	<2010-AdditionalIndustryTypes-8-18-2014>	EPA	8/11/2014
10-143	.xls	<2011 Subpart DD as supplemented 20150819>	Deborah Bisenius	8/19/2015

Table D-3 Community Data Sources 12-101 to 12-118

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-101	.xls	<ofm_april1_population_change_and_rankon2014.06.23>		6/23/2014
12-102	.xls	<CityGHG20141121>		2/16/2015
12-103	.htm	<Area of Spokane city boundaries 2014.1.29>	Steven Allenton	1/29/2014
12-104	.htm	<Self Supplied inside COS service area>	Doug Greenlund	5/9/2014
12-105	.htm	<Questions about Number of Permitted Septic Systems>	Steve Holderby	3/7/2014
12-106	.xls	<City water use from County Demand model_2014.5.9 Dgreenlund>	Doug Greenlund	5/9/2014
12-107	.xls	<City of Spokane 2010 and 2012 Connection Comparison>	Doug Greenlund	10/16/2013
12-108	.xls	<WasteToEnergyEmissions Factor 2014.09.04db>	Deborah Bisenius	9/4/2014
12-109	.xls	<YEARLY SITE SPREADSHEETS 2012>	Deborah Bisenius	9/3/2015
12-110	.xls	<Waste Stats 2010_2012Comparison with 2005f>	Deborah Bisenius	9/18/2014
12-111	.xls	<WARM_recycled materials 2012.2014.08.27>	Deborah Bisenius	8/27/2014
12-112	.xls	<WARM_2012_recycled materials_2>	Deborah Bisenius	8/27/2014
12-113	.xls	<WARM_2012_recycle_ferrous_metal>	Deborah Bisenius	8/27/2014
12-114	.xls	<WARM_2012_rabanco overflow>	Deborah Bisenius	8/27/2014
12-115	.xls	<WARM_2012_Rabanco instead_ns landfill overflow>	Deborah Bisenius	9/18/2014
12-116	.xls	<WARM_2012_ns landfill overflow>	Deborah Bisenius	8/27/2014
12-117	.xls	<WARM_2012_ns landfill ash>	Deborah Bisenius	8/27/2014
12-118	.xls	<WARM_2012_bury ash rabanco>	Deborah Bisenius	8/27/2014

Table D-4 Community Data Sources 12-119 to 12-142

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-119	.xls	<WARM_2012 recycled materials_3>	Deborah Bisenius	9/17/2014
12-120	.xls	<WARM 2012 recycled nonferrous metals>	Deborah Bisenius	9/17/2014
12-121	.xls	<WARM 2012 recycled mixed recyclables>	Deborah Bisenius	9/17/2014
12-122	.xls	<Solid Waste>	Deborah Bisenius	1/13/2015
12-123	.xls	<Route_info_JWerner_2012on 22 Jan 2013>	Jennifer Werner	12/10/2013
12-124	.pdf	<Recycling Rate 55 percent 2014.1>	Suzanne Tresko	1/17/2014
12-125	.htm	<RE Waste Characterization update to 2004 data in SWMP 2009>	Suzanne Tresko	7/3/2014
12-126	.pdf	<RE Question about Yard WasteGreen Waste in Spokane Regional Solid Waste System_txt - Notepad>	Suzanne Tresko	2/5/2014
12-127	.xls	<jreed Solid Waste Updated>	Jessica Reed	2/16/2015
12-128	.pdf	<2012-spokane-county-recycling-rate>	Department of Ecology	8/13/2014
12-129	.pdf	<2012 Annual Report Valley Transfer Station Facility ID 611>	Department of Ecology	2/13/2014
12-130	.pdf	<2012 Annual Report North Transfer Station Facility ID 504>	Department of Ecology	2/13/2014
12-131	.pdf	<2012 Annual Report Energy Recovery-Incineration Facility ID 574>	Department of Ecology	3/29/2013
12-132	.xls	<2012 Yrend>	Solid Waste	5/9/2013
12-133	.pdf	<2012 TOTALS>	WTE Plant	1/12/2015
12-134	.txt	<RE County MSW>	Kristine Major	1/12/2015
12-135	.xls	<Solid Waste 20151029MK>	Environmental Programs	10/30/2015
12-136	.pdf	<UPRR 2012 Est Fuel - City of Spokane Spokane County>	Michael Jon Germer	2/12/2014
12-137	.txt	<UPRR Locomotive Fuel Consumption Spokane County WA 2010 2012>	Michael Jon Germer	2/12/2014
12-138	.xls	<2012DB_Transit_Way_Mileage>	Deborah Bisenius	12/5/2013
12-139	.xls	<2012DB_Energy_Consumption>	Deborah Bisenius	12/5/2013
12-140	.doc	<Otterson communication, 2012 county emission data>	Sally Otterson	6/26/2014
12-141	.pdf	<Ratio of City of Spokane to Spokane County Rail Road Tracks>	Deborah Bisenius	9/15/2014
12-142	.txt	<LBrewer to KirdahyRE Union Pacific Railroad estimated fuel usage request - Spokane>	Lloyd Brewer	7/9/2014

Table D-5 Community Data Sources 12-143 to 12-159

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-143	.txt	<Kirdahy20140122FW Amtrak Information-City of Spokane>	Kathryn Kirdahy	1/22/2014
12-144	.xls	<BNSF2010_2012FuelUse20142703>	BNSF	7/7/2014
12-145	.pdf	<UPRR 2012 Est Fuel - City of Spokane & Spokane County>	Union Pacific	2/12/2014
12-146	.xls	<Final Rail data 2010_2012>	Environmental Prgms	7/29/2014
12-147	.xls	<Nonroad 2010_2012>	Environmental Prgms	7/30/2014
12-148	.zip	<SEP 2012 Bus Routes>	Matthew Kenney	8/7/2011
12-149	.lyr	<SEP_2012 REV>	Matthew Kenney	11/20/2012
12-150	.xls	<Yearly Data Non-Aviation>	Matt Breen	7/23/2014
12-151	.xls	<Yearly Data Aviation>	Matt Breen	7/23/2014
12-152	.pdf	<Hist_data>	Matt Breen	7/22/2014
12-153	.xls	<Air Travel>	Matt Breen	8/5/2014
12-154	.doc	<Washington 2010 and 2012 Population estimates>	US Dept of Commerce	11/7/2013
12-155	.xls	<Population projections 2015-2020-2030 Washington OFM 2014.06.23>	Deborah Bisenius	10/30/2014
12-156	.xls	<2012-AdditionalIndustryTypes-8-18-2014>	EPA	8/18/2014
12-157	.xls	<City of Spokane 2012NG>	Avista	10/31/2013
12-158	.txt	<AvistaBooth20110804_Data Request for 2010 GHG Inventory>	Avista	8/4/2011
12-159	.doc	<West Plains Annexation Information>	City of Spokane	8/8/2014

E. Government Data Sources

Table E-1 Government Data Sources 10-501 to 10-524

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-501	.xls	<SRTCdata20131106.xls>	Anna Ragaza-Bourassa	11/6/2013
10-502	.xls	<BNSF2010_2012FuelUse20142703.xls>		3/27/2013
10-503	.xls	<Roberts_Sam_Spokane_orm_2011_2012.xls>	Sally Otterson	6/26/2013
10-504	.xls	<Brewer_2011_EI_orm.xls>	Sally Otterson	10/4/2013
10-505	.xls	<Spokane_sourcetypeyear_2008_pop.xls>	Sally Otterson	9/27/2013
10-506	.xls	<Spokane_sourcetypeyear_2011_pop.xls>	Sally Otterson	10/4/2013
10-507	.xls	<Spokane_sourcetypeyear_2012_pop.xls>	Sally Otterson	8/28/2013
10-508	.pdf	<UPRR 2010 Est Fuel - City of Spokane Spokane County.pdf>	Michael Germer	2/12/2014
10-509	.pdf	<UPRR 2012 Est Fuel - City of Spokane Spokane County.pdf>	Michael Germer	2/12/2014
10-510	.xls	<2010_Gov_MasterCalc_20140812.xls>	Mollie Picha	8/13/2014
10-511	.xls	<CityGov2013EnergyReport20140714.xls>	Mollie Picha	8/13/2014
10-512	.xls	<2009-2011 Biogas Usage_a.xls>	Mollie Picha	8/13/2014
10-513	.pdf	<2010 Solid Waste Handling Permit Report - NTS>	Damon Taam	8/13/2014
10-514	.pdf	<2010 Solid Waste Handling Permit Report - VTS>	Scott Windsor	8/14/2014
10-515	.pdf	<2010 Solid Waste Handling Permit Report - WTE>	Damon Taam	1/11/2013
10-516	.pdf	<Water Dept 2010Energy Cost 1.24>	Water Dept.	1/24/2014
10-517	.pdf	<Sewer Maint Pump 2010 costs>	Sewer Dept.	1/27/2014
10-518	.pdf	<Sewer Maint Pump 2010 costs>	Sewer Dept.	1/28/2014
10-519	.pdf	<RPWRF Pump 2010 costs>	Wastewater Dept.	1/27/2014
10-520	.txt	<RE Questions About Grit>	Jeffery Donovan	2/3/2014
10-521	.txt	<RE Digester Gas Composition>	Jeffery Donovan	1/17/2014
10-522	.xls	<Calculation and Summary Water Delivery Pump Energy and Costs 2010_2012v1006ddg>	Deborah Bisenius	10/6/2014
10-523	.xls	<2010 Water Dept Ele and gas from UM>	Water Dept.	9/30/2013
10-524	.xls	<2010 only Water Dept Use by site>	Water Dept.	10/1/2014

Table E-2 Government Data Sources 10-525 to 10-547

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-525	.xls	<Vehicle Fleet GHG Emissions Report 2014.2.06>	Lloyd Brewer	2/6/2014
10-526	.xls	<Summary Depts Fuel 2012_20130222>	Deborah Bisenius	
10-527	.pdf	<natural gas payback>	truckinginfo.com	7/26/2013
10-528	.xls	<2010FuelUsageSummary.rev2014.8.01>	Utility Manager	8/4/2014
10-529	.xls	<2010 Vehicle Mileage Revisions2>	Environmental Programs	9/25/2013
10-530	.xls	<2010 Vehicle Mileage Revisions20130906b>	Water Dept.	9/6/2013
10-531	.xls	<2011 Fire Apparatus>	Fire Department	6/12/2012
10-532	.doc	<Summary of New Accounts 2010 to October 2013>	Avista	10/22/2013
10-533	.pdf	<StreetLightsLineItemUsage2010umprpt>	Utility Manager	10/2/2013
10-534	.xls	<All Utility Data 2010mp2_ed2014.11.25>	Utility Manager	11/25/2014
10-535	.xls	<Accounts by Department with Lights 2010>	Utility Manager	11/25/2014
10-536	.pdf	<2010 TRFC Signal Usage w partial 2014.3>	Utility Manager	3/3/2014
10-537	.pdf	<2010 traffic sig elec rpt after history 2013.12>	Utility Manager	12/19/2013
10-538	.pdf	<2010 St Lites elec rpt after history 2013.12>	Utility Manager	12/19/2013
10-539	.pdf	<2010 Pk Lites elec rpt 2013.12>	Utility Manager	12/20/2013
10-540	.pdf	<2010 Parks Energy Use rpt 12-20-13>	Utility Manager	12/20/2013
10-541	.xls	<WasteToEnergyEmissions Factor 2014.09.18>	Deborah Bisenius	9/18/2014
10-542	.xls	<Solid Waste sum Govt 10_12 Volume2014.02.06>	Utility Manager	2/6/2014
10-543	.xls	<Refrigeration totals 2010_ RKasierSWM>	Rodger Kaiser	5/13/2014
10-544	.xls	<South Landfill Perimeter Wells 2010>	Solid Waste	1/4/2011
10-545	.xls	<South Landfill Interior Wells 2010>	Solid Waste	1/14/2011
10-546	.xls	<South Landfill Gas Probes 2010>	Solid Waste	1/13/2011
10-547	.xls	<South Landfill Flare Station 2010>	Solid Waste	1/13/2011

Table E-3 Government Data Sources 10-548 to 10-580

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-548	.xls	<North Landfill Perimeter Wells 2010>	Solid Waste	1/13/2011
10-549	.xls	<North Landfill Interior Wells 2010>	Solid Waste	1/14/2011
10-550	.xls	<North Landfill Gas Probes 2010>	Solid Waste	1/13/2011
10-551	.xls	<North Landfill Flare Station 2010>	Solid Waste	8/17/2011
10-552	.xls	<Monthly Summary of Employee Bus Trips 2010>	Deborah Bisenius	12/20/2013
10-553	.pdf	<StreetMaintUse+Cost2010umprpt>	Utility Manager	9/26/2013
10-554	.pdf	<StreetMaintRanchUse+Cost2010umprpt>	Utility Manager	9/26/2013
10-555	.pdf	<SolWstBldgUsage2010umprpt>	Utility Manager	9/25/2013
10-556	.pdf	<PubDef gas 2010umprpt>	Utility Manager	9/13/2013
10-557	.pdf	<PubDef elect 2010umprpt>	Utility Manager	9/13/2013
10-558	.pdf	<PoliceBldgUsage2010umprpt>	Utility Manager	9/25/2013
10-559	.pdf	<PoliceAcadUsage2010umprpt>	Utility Manager	9/26/2013
10-560	.pdf	<ParksPoolUsage2010umprpt>	Utility Manager	9/26/2013
10-561	.pdf	<ParkRiverfrontUsage2010umprpt>	Utility Manager	9/26/2013
10-562	.pdf	<ParkRestroomUse2010umprpt>	Utility Manager	9/26/2013
10-563	.pdf	<ParkPoolCosts2010umprpt>	Utility Manager	9/26/2013
10-564	.pdf	<ParkManitoUse+Cost2010umprpt>	Utility Manager	9/26/2013
10-565	.pdf	<ParkLightsCost2010umprpt>	Utility Manager	9/30/2013
10-566	.pdf	<ParkDwightMerkelUse+Cost2010umprpt>	Utility Manager	9/26/2013
10-567	.pdf	<Nat Gas 2010_Avista.8.4>	Utility Manager	8/4/2015
10-568	.pdf	<LibrarybldgUsage2010umprpt>	Utility Manager	9/26/2013
10-569	.pdf	<Intermodal gas 2010umprpt>	Utility Manager	9/13/2013
10-570	.pdf	<Intermodal elec 2010umprpt>	Utility Manager	9/13/2013
10-571	.pdf	<GolfUsage2010umprpt>	Utility Manager	9/26/2013
10-572	.pdf	<FleetSvsShopUsage2010umprpt>	Utility Manager	9/25/2013
10-573	.pdf	<FleetSvsBroadwyUsage+Cost2010umprpt>	Utility Manager	9/26/2013
10-574	.pdf	<FireStnsUsage2010umprpt>	Utility Manager	9/26/2013
10-575	.pdf	<FireStn1gas2010umprpt>	Utility Manager	9/13/2013
10-576	.pdf	<FireStn1elect2010umprpt>	Utility Manager	9/13/2013
10-577	.pdf	<FireBldgSitesUsage2010umprpt>	Utility Manager	9/25/2013
10-578	.pdf	<eGRID2012V1_0_year09_GHGOutputrates>	Utility Manager	10/3/2013
10-579	.pdf	<ECCC gas 2010umprpt>	Utility Manager	9/13/2013
10-580	.pdf	<EastCentralCCElec2010umprpt>	Utility Manager	9/13/2013

Table E-4 Government Data Sources 10-581 to 10-591 and 12-501 to 12-512

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
10-581	.pdf	<CopsUsage2010umprpt>	Utility Manager	9/26/2013
10-582	.pdf	<City hall elec 2010umprpt>	Utility Manager	9/13/2013
10-583	.pdf	<BldgCosts2010rankumprpt>	Utility Manager	9/25/2013
10-584	.pdf	<Avista Utility-Fuel-Mix-Reports-Data-CY2012>	Utility Manager	10/4/2013
10-585	.pdf	<AllUtilityData2010mp2_ed2014.11.25_12_30>	Utility Manager	12/30/2014
10-586	.pdf	<AlbiStadiumUse+Cost2010umprpt>	Utility Manager	9/26/2013
10-587	.pdf	<2837630_MuniCourt_Probation _lease 2010>	Utility Manager	12/26/2014
10-588	.pdf	<2450527_MunicCourt_Probation_lease2010modified_2012>	Utility Manager	12/26/2014
10-589	.pdf	<81822_Police Lease Public Safety 2008_OPR11-46>	Utility Manager	12/26/2014
10-590	.xls	<2010ParkNatGas_Avista.8.4.2015>	Utility Manager	8/4/2015
10-591	.xls	<2010NatGasDataComparison>	Utility Manager	8/4/2015
12-501	.xls	<SRCAA Registrations 2012_12-18-2013.xls>	Mollie Picha	8/13/2014
12-502	.xls	<2012_Gov_MasterCalc_20140811.xls>	Mollie Picha	8/13/2014
12-503	.xls	<CityGov2013EnergyReport20140714.xls>	Mollie Picha	8/13/2014
12-504	Personal	VA Hospital Light Fuel Oil Usage 2012 data for VA Hospital. Personal phone call between Mollie Picha and Kevin in engineering at the VA Hospital.	Kevin at 509-434-7400	8/15/2014
12-505	.pdf	<2012 Annual Report Energy Recovery-Incineration Facility ID 574>	Russ Menke	3/29/2013
12-506	.pdf	<2012 Annual Report North Transfer Station Facility ID 504>	Russ Menke	2/13/2014
12-507	.pdf	<2012 Annual Report Valley Transfer Station Facility ID 611>	Russ Menke	2/13/2014
12-508	.pdf	<Water Dept 2012Energy Cost1.24>	Water Dept.	1/24/2014
12-509	.xls	<Water 01.29.2014>	Environmental Programs	1/29/2014
12-510	.xls	<Wastewater 10.08.2014>	Environmental Programs	11/11/2014
12-511	.pdf	<UpriverPower2010_12>	Water Dept.	1/24/2014
12-512	.pdf	<Sewer Maint Pump 2012 costs>	Sewer Dept.	1/27/2014

Table E-5 Government Data Sources 12-513 to 12-534

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-513	.xls	<2012 Water Dept Ele and gas from UM>	Water Dept.	9/30/2013
12-514	.xls	<2012 only Water Dept Use by site>	Water Dept.	1/23/2014
12-515	.xls	<2009-2013 Biogas Usage>	Water Dept.	8/24/2015
12-516	.xls	<Calculation and Summary Water Delivery Pump Energy and Costs 2010_2012v1006ddg>	Deborah Bisenius	10/6/2014
12-517	.xls	<Fire Department Vehicle List 12.09.2013>	Fire Department	12/9/2013
12-518	.xls	<2012 Vehicle Mileage Revisions2>	Environmental Programs	9/25/2013
12-519	.xls	<Summary Depts Fuel 2012_20130222>	Deborah Bisenius	7/24/2014
12-520	.xls	<FireDataSummary20140217LBa>	Lloyd Brewer	2/18/2014
12-521	.xls	<2013 Fire Apparatus inventoryLB>	Fire Department	12/10/2013
12-522	.xls	<GHG VehicleFleet 9.16.13 EM>	Utility Manager	2/20/2015
12-523	.xls	<Decommissioned Vehicles 2010-2012>	City Records	11/27/2013
12-524	.xls	<2012 Vehicle Mileage Revisions20130905b>	Water Dept.	9/5/2013
12-525	.xls	<Kevin Brooks - WWM, Fuel & Mileage 10.23.13>	Water Dept.	10/23/2013
12-526	.htm	<Lorie Butz - Fleet SVCS Refrigerant Inventory 12.5.13>	Lorie Butz	12/10/2013
12-527	.htm	<Kevin Brooks - WWM, Mileage Request 9.17.13>	Kevan Brooks	12/10/2013
12-528	.xls	<Kevin Brooks - WWM, Fuel & Mileage 10.23.13>	Kevan Brooks	9/23/2013
12-529	.htm	<Jane Nordling - Request for Master Vehicle List 10.15.13>	Jane Nordling	10/10/2013
12-530	.xls	<Jane Nordling - Fleet SVCS Master Vehicle List 10.15.13>	Jane Nordling	10/15/2013
12-531	.htm	<RE Fire Vehicle Fleet Greenhouse Gas Emissions Progress since 2005.2014.3.25>	Nichols, Art	3/25/2014
12-532	.xls	<Fleet Svs progress update 2014.3.24>	Fleet Services	3/24/2014
12-533	.xls	<sfd vehicles>	Fleet Services	12/9/2013
12-534	.xls	<Fire Department vehicles and Property 2009>	Fire Department	12/9/2013

Table E-6 Government Data Sources 12-535 to 12-556

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-535	.htm	<Art Nichols - Fire Dept. Vehicle Information Request 12.9.13>	Art Nichols	12/10/2013
12-536	.xls	<2013 Fire Apparatus inventory>	Art Nichols	4/15/2013
12-537	.xls	<Streetlights Summary 20151109>	Deborah Bisenius	11/9/2015
12-538	.txt	<Avista Streetlights SummaryDB20151016>	Deborah Bisenius	10/19/2015
12-539	.xls	<Avista Streetlights Summary2010_12DB_20151016>	Deborah Bisenius	10/16/2015
12-540	.htm	<RE Two questions Overall Decrease in Electricity Use for Street Lights Please reply>	Val Melvin	2/12/2015
12-541	.pdf	<TRFCSignalUsagewithpartial2012umprpt>	Utility Manager	10/8/2013
12-542	.pdf	<TRFCSignalUsage+Costpartial2012umprpt>	Utility Manager	10/2/2013
12-543	.xls	<TRFCSignalCost2012umprpt>	Utility Manager	10/1/213
12-544	.doc	<Summary of New Accounts 2010 to October 2013>	Avista	10/22/2013
12-545	.pdf	<StreetLitesUsage2012umprpt>	Utility Manager	10/8/2013
12-546	.xls	<ParkLightsUsage2012umprpt>	Utility Manager	10/1/2013
12-547	.xls	<Accounts by Department with Lights 2012>	Utility Manager	11/26/2014
12-548	.pdf	<2012Trfc Usage after update 2014.3>	Utility Manager	3/10/2014
12-549	.pdf	<2012 TRFC Signal Usage w partial 2014.3>	Utility Manager	3/3/2014
12-550	.pdf	<2012 St Lites elec rpt after history 2013.12>	Utility Manager	12/19/2013
12-551	.pdf	<2012 Pk lites elec rpt 2013.12>	Utility Manager	12/19/2013
12-552	.pdf	<REJDonovan08.12>	Jeffery Donovan	8/12/2014
12-553	.htm	<RE Waste Characterization update to 2004 data in SWMP 2009>	Suzanne Tresko	7/3/2014
12-554	.htm	<RE Two questions 2.06.2014 YW Conversion chart>	Suzanne Tresko	2/6/2014
12-555	.txt	<RE Question about Yard Waste Green Waste in Spokane Regional Solid Waste System>	Suzanne Tresko	2/5/2014
12-556	.doc	<LERiverfront20130710LBarev 2013.12.31>	Deborah Bisenius	12/31/2013

Table E-7 Government Data Sources 12-557 to 12-579

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-557	.htm	<FW Questions About Grit 2014.02.03>	Kathryn Kirdahy	2/3/2014
12-558	.msg	<FW Flow quantities and values for calculating NSLF GHG9.10.15 >	Rich Hanson	9/11/2015
12-559	.pdf	<Composting Contract Memo>	Russ Menke	2/27/2012
12-560	.xls	<Solid Waste summary 2014 1 16 kk>	Jennifer Werner	1/16/2014
12-561	.xls	<Summary Waste-To-Energy 2010_2012_b>	Deborah Bisenius	8/28/2014
12-562	.xls	<Employee Commute>	Deborah Bisenius	8/21/2014
12-563	.xls	<RefrigSummary20151005a>	Deborah Bisenius	10/7/2015
12-564	.xls	<Refrigeration totals 2012_RKaiserSWM>	Rodger Kaiser	5/13/2014
12-565	.xls	<Refrigerant Using Equipment - RPWRF_8_2011>		5/13/2014
12-566	.msg	<RE Refrigeration totalsRKaiser.July10.2012>	Rodger Kaiser	7/10/2012
12-567	.txt	<RE Refrigerants collectedKaiser20151007>	Rodger Kaiser	10/7/2015
12-568	.txt	<NoelStormUpriverEmail20130717a >	Noel Storm	10/6/2015
12-569	.txt	<FW Refrigerant Fleet>	Eric Martin	10/6/2015
12-570	.txt	<RE Nstorm>	Noel Storm	10/6/2015
12-571	.txt	<NoelStormUpriverEmail20130717>	Noel Storm	1/17/2014
12-572	.txt	<Freon use>	Lloyd Brewer	10/6/2015
12-573	.xls	<Air conditioner refrigerant type and amount>		7/11/2013
12-574	.htm	<RE Energy Use information for Public Safety and other County buildings>	Angela Golden	9/26/2013
12-575	.doc	<ST100 Series Mass Flow Meter Specifications>	FCI	9/28/2015
12-576	.xls	<South landfill_emissions_tool_v1_3_on20150724>	Deborah Bisenius	7/24/2015
12-577	.pdf	<South Landfill Methane>	Spokesman Review	9/30/2014
12-578	.txt	<RHanson Email - City of Spokane June 2015 North and South Landfill Gas Report>	Rich Hanson	7/28/2015
12-579	.xls	<Northside Landfill w EPA calculations 2014.03.14db_c>	Lloyd Brewer	3/14/2014

Table E-8 Government Data Sources 12-580 to 12-602

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-580	.pdf	<Mica Landfill final periodic review_2008>	Ecology Department	1/1/2008
12-581	.txt	<LF meter measurements FluidComponents20150910>	Rich Hanson	9/28/2015
12-582	.pdf	<2012 Northside Landfill Report_WA_GHG_Reporting_Data_ Summ_2012_2013>	Ecology Department	12/1/2014
12-583	.pdf	<2010NorthLandflElecUse.2014.09>	Solid Waste	9/29/2014
12-584	.xls	<South Landfill Interior Wells 2012>	Solid Waste	1/16/2013
12-585	.xls	<South Landfill Gas Probes 2012>	Solid Waste	1/8/2013
12-586	.xls	<South Landfill Flare Station 2012>	Solid Waste	7/24/2015
12-587	.xls	<North Landfill Perimeter Wells 2012>	Solid Waste	1/8/2013
12-588	.xls	<North Landfill Interior Wells 2012>	Solid Waste	1/16/2013
12-589	.xls	<North Landfill Gas Probes 2012>	Solid Waste	1/8/2013
12-590	.xls	<North Landfill Flare Station 2012>	Solid Waste	8/26/2015
12-591	.pdf	<Facility Directoryjgonzalez2013.09.19>		9/20/2013
12-592	.xls	<STA Bus Pass summary_3_25_2013db>	Deborah Bisenius	12/20/2013
12-593	.xls	<Scope 3 Travel Emission Factors. EPA CLimate Leaders. 03.10.14>	EPA	3/10/2014
12-594	.pdf	<Number of Employees 2010 email_NGoes_2010.10.15>	Nicole Peterson	3/4/2014
12-595	.pdf	<Email communication employee bus pass 2011,2,10>	Lynn Franke	2/10/2011
12-596	.xls	<Business Travel 2012_2010Summary.5.1.2015>	Deborah Bisenius	5/4/2015
12-597	.xls	<Steam Plant Energy Usage>	Ron Oscarson	12/29/2014
12-598	.txt	<Steam Heat Energy Correspondence>	Ron Oscarson	12/30/2014
12-599	.doc	<Synopsis of conversation with Ron Oscarson_SpoCty Facilities2015.1.12>	Ron Oscarson	1/12/2015
12-600	.pdf	<ROscarson_SpoCounty_Leased PSB.2014.12>	Ron Oscarson	1/9/2015
12-601	.msg	<RE Information for 2010 and 2012 Courthouse Campus leased electricity and steam heat>	Ron Oscarson	12/29/2014
12-602	.pdf	<3128032_Interlocal Probation_MuniCourt_lease>	Howard Delaney	12/26/2014

Table E-9 Government Data Sources 12-603 to 12-618

Call #	Extension	Document Title or <file name as received>	Source (person or URL)	Received
12-603	.pdf	<StreetRanchUse+Cost2012umprpt>	Utility Manager	10/8/2013
12-604	.pdf	<SPDAcademyUse2012umprpt>	Utility Manager	10/9/2013
12-605	.pdf	<RiverfrontPkUsage2012umprpt>	Utility Manager	10/7/2013
12-606	.pdf	<RankTopTenBldgEnergyUse2012umprpt>	Utility Manager	10/7/2013
12-607	.pdf	<Pools EnergyUse2012umprpt>	Utility Manager	10/7/2013
12-608	.pdf	<ParksCentersSplashpdsRestrmsUsage2012umprpt>	Utility Manager	10/7/2013
12-609	.pdf	<NatGas_Avista_2012.8.4.15>	Utility Manager	8/4/2015
12-610	.pdf	<ManitoEnergyUse2012umprpt>	Utility Manager	10/7/2013
12-611	.pdf	<LibBranchesEnergyUse2012umprpt>	Utility Manager	10/7/2013
12-612	.pdf	<Joe Albi StadiumUse+Cost2012umprpt>	Utility Manager	10/7/2013
12-613	.pdf	<Golf Usage2012umprpt>	Utility Manager	10/7/2013
12-614	.pdf	<FleetSvsNormandieUsage2012umprpt>	Utility Manager	10/7/2013
12-615	.pdf	<FleetSvsBroadwayFuel +WashUse+Cost2012umprpt>	Utility Manager	10/7/2013
12-616	.pdf	<FireStnEnergyUse2012umprpt>	Utility Manager	10/7/2013
12-617	.pdf	<City Hall 2012umprpt>	Utility Manager	10/7/2013
12-618	.pdf	<AllUtilityData2012Sbmp2014.11.25_12_30>	Utility Manager	12/30/2014

F. Workbooks

File	Call#	Document Title
2010_2012		CityGHG20141121.xls
		DATA SOURCES.xls
GHG		GHGSectorSum20160202c.xls
		2010_Gov_MasterCalc_20151211.xls
		2012_Gov_MasterCalc_20151208.xls
Built Env		CBuilt Environment20151014.xls
		RefrigSummary20160129.xls
		Streetlights Summary 20151109.xls
Transportation		CVehicleEmissionsEMartin 20161115.xls
SolidWaste		CSolid Waste 20151210.xls
		GSolid Waste 20151216jr4.xls
		CCompost and Recycling data 151021.xls
Water_WW		CWaterWW summary for 2010 and 2012.xls
		CountyWaterWW emissions for 2010 and 2012 with SRHD septic and Dec 14 pops.xls