Greenhouse Gas Inventory
Community and City Operations
Results, Analysis and Recommendations

Report prepared by Good Company, February 2016

Table of Contents

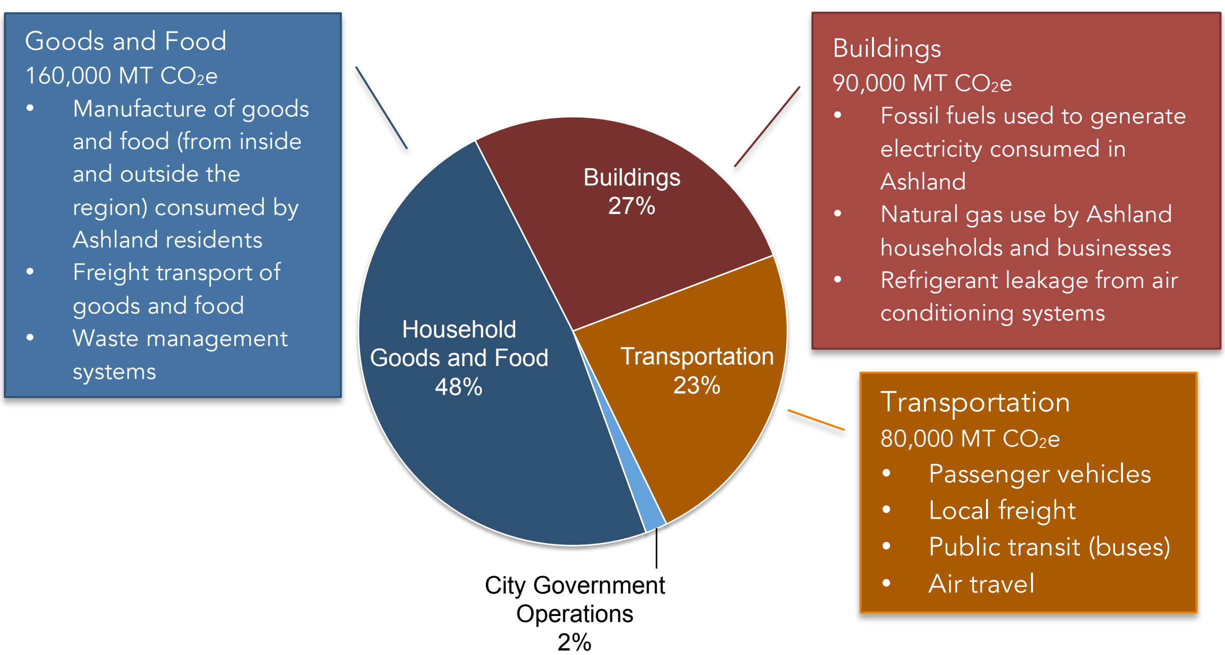
EXECUTIVE SUMMARY

The Intergovernmental Panel on Climate Change (IPCC), the United Nations body that regularly convenes climate scientists, has identified human activity as the primary cause of the climate change. The IPCC suggests that human-caused emissions must be reduced significantly – perhaps more than 50% globally, and by 90% in wealthier, developed nations – by mid-century in order to avoid the worst potential climate impacts on human economies.

The Community GHG Inventory presented in this report follows internationally recognized protocol and accounts for all significant sources of GHG emissions that are supported by locally available data or credible estimation methodologies. This report also includes detailed inventories for City Government Operations (a subset of Community Emissions) and the Municipal Electric Utility's Supply Portfolio (to provide context about the community's electricity supply). Additional detail may be found in the following sections of this report.

Figure 1 shows the scale of four categories of greenhouse gas emissions for the City of Ashland: Buildings, Transportation, Goods and Food, and City Government Operations. The total emissions associated with these activities comprise Ashland's 2015 community carbon footprint, which is estimated at about 300,000 metric tons of carbon dioxide equivalent (MT CO2e). This total represents 0.5% percent of Oregon's total GHG emissions (~60 million MT CO_2e per year[1]). An average household in the Ashland area has a footprint of approximately 32.5 MT CO_2e per year, less than the average Oregon household footprint of 42 MT CO_2e.

Figure 1: Ashland's 2015 Total GHG Emissions, by Category.



[1] Oregon Department of Environmental Quality (2012). For details visit http://www.oregon.gov/deq/AQ/Pages/Greenhouse-Gas-Inventory-Report.aspx#inventory.

Findings in Brief

Community GHG Inventory

- Ashland's largest sources of community emissions include residential and commercial energy use by buildings (24% of total); residential on-road transport (17%); and emissions from the production of residential goods (22%) and food (15%).
- **Ashland's Community GHG emissions have decreased by 6% between 2011 and 2015**. This is the result of decreases in electricity and natural gas use in the residential sector, decreases in natural gas use in the commercial sector, and increased hydro electricity generation on the regional electricity grid. These effects lower the average carbon intensity (CI) of grid electricity and the emissions from its use.
- Ashland Community GHG Emissions *intensities* also declined between 2011 and 2015. On a per capita basis, emissions have declined by almost 8%. In 2015, the average Ashland resident's carbon footprint is 16.6 MT CO2e / person. In 2015, average household emissions equal 36.8 MT CO_2e and have declined nearly 6% since 2011.

City Government GHG Operations

- City government operational emissions represent roughly 2% of community emissions.
- The largest emissions sources include production of goods and services purchased by the City (60%), electricity use in buildings (19%), fuel use in vehicles and equipment (8%), and landfill disposal of wastewater biosolids (7%).
- City Government's overall emissions have *increased* by 10% between 2011 and 2015 due to increases in purchasing. During the same time period building energy related emissions have *decreased* by -15% due to warmer winters and the lower carbon intensity of electricity.

Electric Utility Supply Portfolio

- Ashland's contracted and owned-electricity generation supply is very low-carbon compared to the regional electricity grid. This is overwhelmingly the result of Ashland's long-term power contract with Bonneville Power Administration (BPA), which is served by hydro and nuclear resources that do not produce GHG emissions during generation.
- From a community perspective, Ashland's electricity supply is from low-carbon resources, but the Utility and, by extension, the community *does not own the contracted resources or the associated environmental benefit*. Ownership of the environmental benefits associated with renewable electricity is conveyed contractually with Renewable Energy Certificates (REC), which are not produced or bundled with contracted BPA electricity. However, in 2015, the Utility, and to a lesser extent, the community voluntarily purchased RECs equal to 5.7% of community grid electricity use from BPA and Bonneville Environmental Foundation. Therefore the climate impacts of Ashland's grid electricity use are best represented by the carbon intensity of the region electricity grid, the Northwest Power Pool, adjusted by community REC purchases.
- From a Utility perspective, this inventory provides a public accounting of the greenhouse gas emissions associated with Ashland's owned electricity-generation (2% of total) and the upstream emissions from the community's contracted supply from BPA (remaining 98%). The Utility's electricity supply is generated almost entirely from low-carbon resources and therefore risk related to future GHG regulations is likely low.

1. INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC), the United Nations body that regularly convenes climate scientists, has identified human activity as the primary cause of the climate change that has occurred over the past few decades and quickened in recent years. Consensus statements from the IPCC suggest that human-caused greenhouse gas emissions (GHG) must be reduced significantly – perhaps more than 50% globally, and by 80% in wealthier nations that are the largest emitters – by mid-century in order to avoid the worst potential climate impacts on human economies and societies that have been projected. The common international goal often referenced, to mitigate the worst climate impacts, is to limit average global average temperature increases to no more than 2°C relative to temperatures at the start of the industrial revolution. As of 2015 – we've already passed the halfway point – average temperatures have increased by 1°C since the industrial revolution.

It's with this understanding and urgency that the City of Ashland has undertaken its first-ever suite of greenhouse gas (GHG) inventories. A GHG inventory quantifies the GHG emissions associated with a specific boundary – such as operational control within and organization or the geographic boundary of a community – for a specific period of time. By conducting inventories at regular intervals, GHG inventories can be used to understand trends and manage emissions from specific emissions sources and activities. The results of the GHG inventories will be used to support development of Ashland's Community Climate and Energy Action Plan and provides the foundation for a long-term GHG emissions tracking and management system.

Project Description

Good Company was contracted by the City of Ashland, Oregon to assist the City staff in completion of a suite of three (3) annual greenhouse gas (GHG) inventories for the period of 2011 through 2015. The boundaries of these inventories include the Ashland Community; City Government Operations; and Ashland's Municipal Electric Utility's owned and contracted electricity supply. This work began in September 2015 and concluded in February of 2016.

Structure of This Report

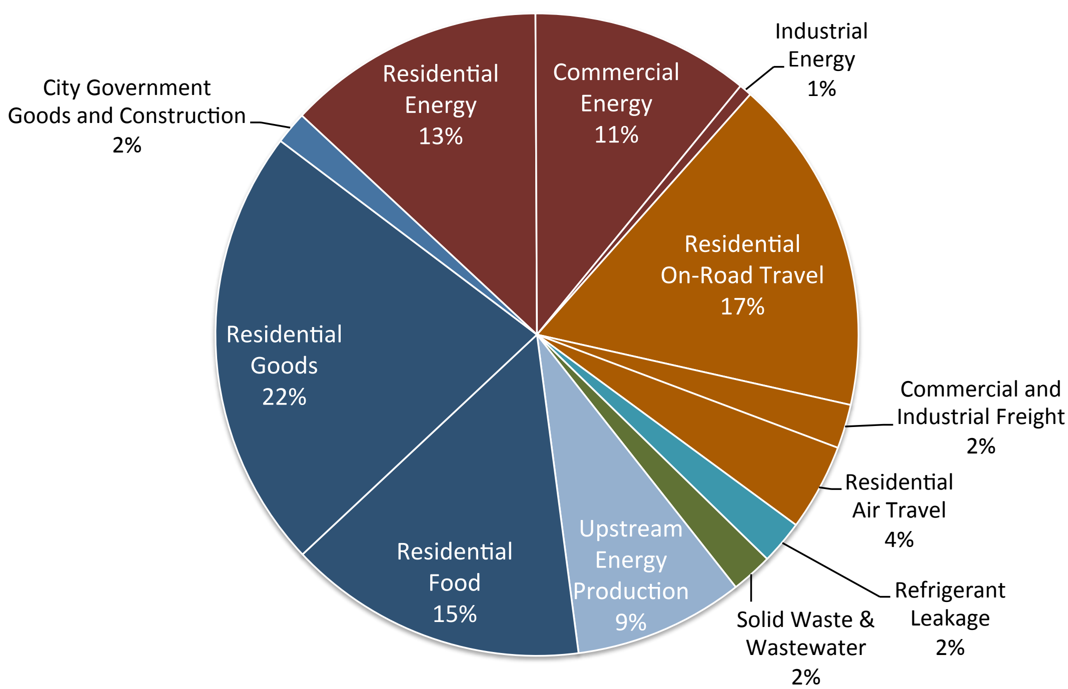
Following this Introduction, Section 2 details the results of Ashland's Community GHG Inventory; and Section 3 focused on the detailed results of the City's Government Operational Inventory. In addition to the primary Sections of the report, there are 3 Appendices. Appendix A discusses the detailed results of Ashland's Municipal Electric Utility's Supply Portfolio GHG Inventory. Appendix B and C provide additional details on data, emissions factors and methodology used in the Community, City Operations, and Electric Utility Portfolio GHG Inventories. In addition to these Appendix B and C, there is an Audit Trail for each type of inventory, for each year, which documents in detail the data, calculations, and methodology.

2. COMMUNITY INVENTORY

The City of Ashland, Oregon has a population of 22,700 and is located at the southern tip of the Rogue Valley, approximately 15 miles north of the Oregon-California border. Nestled in the foothills of the Siskiyou Mountains, Ashland has a nationally recognized and Tony Award-winning repertory theater company, the Oregon Shakespeare Festival (OSF), and the nearby Mount Ashland Ski Area provide abundant outdoor recreational opportunities in the region. Ashland is also home to Southern Oregon University (SOU), with close to 6,000 students.

Figure 2 provides a summary of Ashland's 2015 emissions, by source and sector. As can be seen the largest sources of emissions include Residential and Commercial Energy use by buildings and other facilities (24% of total); Residential On-Road Transport (17%); and emissions from the production of Residential Goods (22%) and Food (15%). Upstream Energy Production represents the "upstream" energy use and emissions associated with the extraction and production of final fuel products that used in Ashland's buildings and vehicles.

Figure 2: Summary of Ashland's 2015 Community GHG Emissions.



Ashland's community greenhouse gas (GHG) inventory includes both "sector-based" and "consumption-based" emissions. Sector-based emissions include local emissions from building energy use in residential, commercial and industrial sectors, transportation energy use, methane emissions from solid waste disposal, wastewater treatment, and fugitive leakage of refrigerants from cooling systems. Consumption-based emissions are generated outside the community in order to produce the goods and food consumed by Ashland residents. Together, they make up a community's total emissions. The community has greater control over the sector-based emissions sources, as well as better data, which is why these emissions are typically the primary accounting methodology used to set emissions mitigation goals. While the community does not control the means of production for the majority of goods and food it consumes, there is local control and choice in the quantity of demand; the types of products; and vendors who supply the products.

Ashland's sector-based emissions decreased -10% between 2011 and 2015. This decrease is the result of decreases in electricity and natural gas use in the residential sector, decreases in natural gas use in the commercial sector, and increased hydro electricity generation on the regional electricity grid which in turn lowers the average carbon intensity of northwest grid electricity and the emissions from its use.

Figure 3: Sector-based emissions by year.

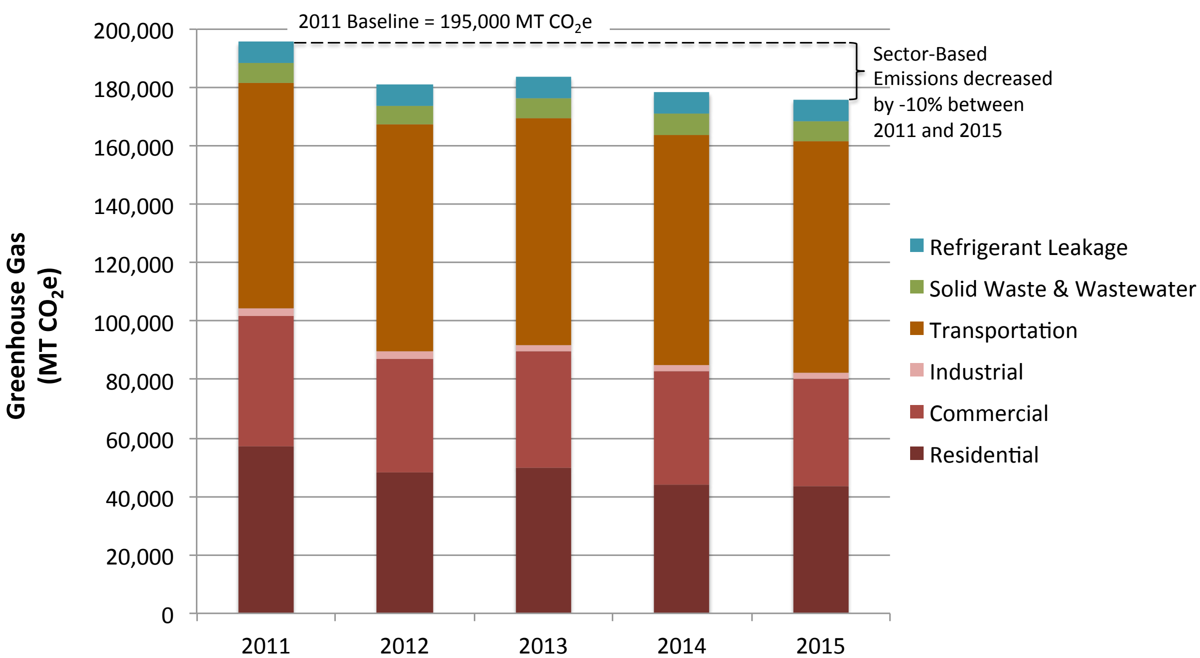


Figure 4 shows the change in total emissions (sector + consumption-based emissions) from 2011 through 2015. Consumption-based emissions double the community's total emissions, compared to a sector-based only view. Between 2011 and 2015 Ashland's total emissions decreased by -6%. See Figure 6 for tabular results and additional details about emissions change over time.

Figure 4: Sector-based plus consumption-based emissions, or Total Emissions, by year.

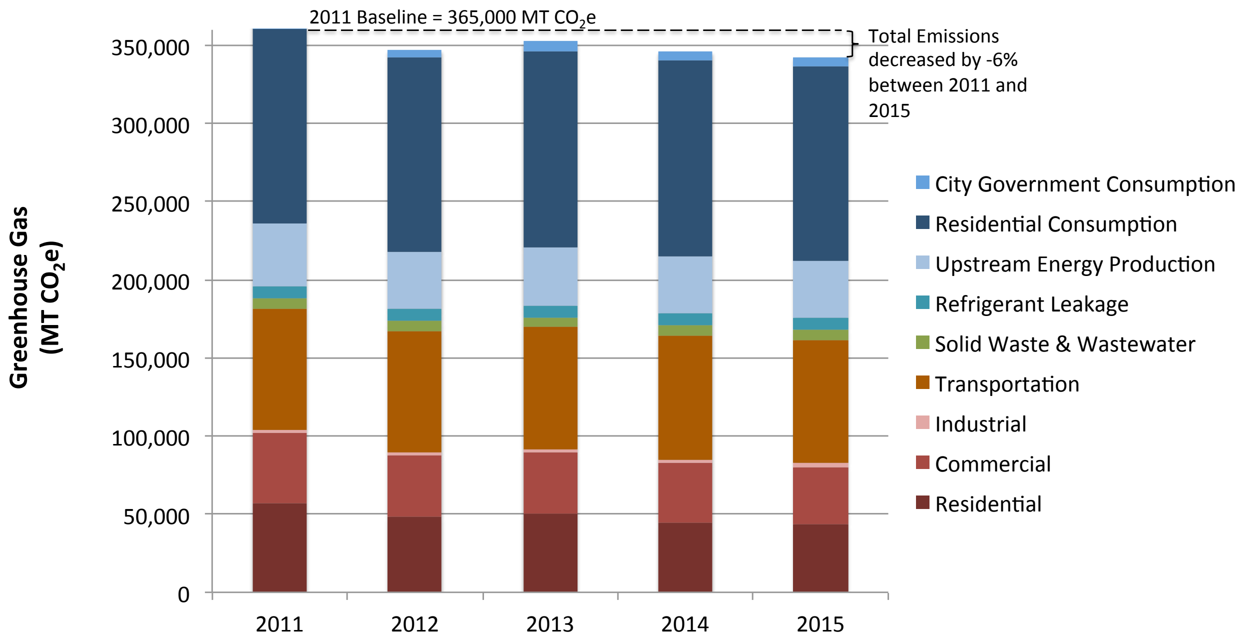


Figure 5 shows Sector-based and Total Emissions intensity per capita and per household. Sector-based emissions per Ashland resident decreased by almost 12% between 2011 and 2015; while total emissions per capita decreased by almost 8%. Sector-based emissions per Ashland household decreased by almost 10% between 2011 and 2015; while total emissions per household decreased by almost 6%.

Figure 5: Emissions intensity per capita and per household for sector-based and total emissions.

Emissions Intensity Metric	2011	2012	2013	2014	2015	% Change 2011 - 2015
Per Capita Emissions						
Ashland Population	20,314	20,465	20,510	20,684	20,684	1.8%
Sector-Based Per Capita (MT CO2e	***9.6***	***8.8***	***9.0***	***8.6***	***8.5***	***-11.6%***
Total Per Capita (MT CO2e / person)	***17.9***	***17.0***	***17.2***	***16.7***	***16.6***	***-7.7%***
Per Household Emissions						
Ashland Households	9,339	9,325	9,292	9,311	9,311	-0.3%
Sector-Based Per Household (MT C(	***20.9***	***19.4***	***19.8***	***19.1***	***18.9***	***-9.7%***
Total Per Household (MT CO2e / HH	***39.0***	***37.2***	***38.0***	***37.2***	***36.8***	***-5.7%***

Figure 6: Detailed summary of sector-based and consumption-based emissions, 2011 - 2015.

Emissions Category	2011	2012	2013	2014	2015	% Change 2011 - 2015	Factors in change between 2011 to 2015
Built Environment	104,337	89,636	91,871	84,879	82,426	-21%	Decrease is the result of three primary factors - increased renewable electricity on the regional electricity grid; decreased use of electricity in the residential sector; and decreased natural gas use due to warmer winters.
Residential	*57,333*	*48,459*	*49,869*	*44,230*	*43,490*	*-24%*	
Commercial	*44,614*	*38,835*	*39,680*	*38,410*	*36,808*	*-17%*	
Industrial	*2,390*	*2,342*	*2,322*	*2,239*	*2,128*	*-11%*	
Transportation	77,300	77,800	78,400	79,000	79,000	2%	No significant change over the time period.
Residential On-Road	*56,000*	*56,200*	*56,500*	*57,000*	*57,000*	*1.8%*	
Commercial Freight	*4,500*	*4,600*	*4,600*	*4,600*	*4,600*	*2.2%*	
Industrial Freight and Equipment	*2,600*	*2,600*	*2,700*	*2,800*	*2,800*	*7.7%*	
Residential Air Travel	*14,200*	*14,400*	*14,600*	*14,600*	*14,600*	*2.8%*	
Refrigerant Leakage	7,300	7,300	7,400	7,400	7,400	1%	No significant change.
Solid Waste & Wastewater	6,368	6,222	6,523	6,923	6,923	9%	Increase in the quantity of landfill solid waste disposal.
Sector-Based Total:	195,305	180,958	184,194	178,202	175,749	-10%	
Residential Consumption	124,200	124,600	125,200	125,200	125,200	0.8%	No significant change.
Goods	*73,500*	*74,200*	*74,700*	*74,700*	*74,700*	*1.6%*	
Food	*50,700*	*50,400*	*50,500*	*50,500*	*50,500*	*-0.4%*	
Upstream Energy Production	40,826	37,105	37,376	36,530	36,031	-12%	Increased renewable electricity on regional grid.
City Government Consumption	4,100	4,400	6,300	6,000	5,500	34%	Increase due to construction and vehicle purchases.
Consumption-Based Total:	169,126	166,105	168,876	167,730	166,731	-1%	
Total Emissions:	364,431	305,649	309,485	303,493	342,480	-6%	

Note: Values reported in metric tons of carbon dioxide equivalent (MT CO_2e).

Methodology and Approach

Protocols and Tools

This inventory follows ICLEI's U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions in conjunction with the more recent Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories by World Resource Institute and ICLEI. The most notable deviation between these two protocols is the guidance on use of electricity emissions factors. This inventory follows the guidance of the Global Protocol and uses the regional emissions factor (i.e. location-based emissions factor) to represent the emissions from community adjusted by voluntary, community purchases of Renewable Energy Certificates (RECs).

ICLEI'S web-based ClearPath Community-Scale Emissions Management Software was used to calculate or catalog all greenhouse gas (GHG) emissions for the Ashland's Community Inventory. All data and calculation files used in the inventory can be found in the Community Inventory Audit Trail 2011 – 2015. This audit trail is provided to clearly document data sources and methods for replication in future inventories.

All community GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). Quantities of individual GHGs are accounted for in the ICLEI's ClearPath carbon calculator and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), CFCs, PFCs, and sulfur hexafluoride (SF_6) per the Kyoto Protocol. All GHG calculations use the global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

Inventory Boundaries

There are a core group of emissions sources and activities required by ICLEI's Protocol (see *items on Figure 7). ICLEI's community protocol encourages communities to "report on all GHG emissions sources and activities over which they have significant influence, as well as community interest, and emissions associated with consumption activities of community households." Ashland's community inventory follows this guidance and goes beyond the basic requirements to include all emissions sources and activities that are under the community's influence and interest that can be calculated or estimated with publically available data, models, and tools.

Figure 7: Crosswalk of emission and Scope categories.

Emissions Type	Protocol Required Emissions	Scope 1	Scope 2	Scope 3
Residential Energy				
Electricity	•		✔	
Stationary Combustion	•	✔		
Comercial Energy				
Electricity	•		✔	
Stationary Combustion	•	✔		
Industrial Energy				
Electricity	•		✔	
Stationary Combustion		✔		
Refrigerant Leakage	•			
Transportation				
On-Road Passenger Vehicles	•	✔		✔
On-Road Freight Vehicles	•	✔		✔
On-Road Transit Vehicles		✔		
Off-Road Vehicles and Equipment		✔		
Air Travel		✔		✔
Solid Waste, Potable Water, and Wastewater				
Solid Waste	•			✔
Potable Water Use Energy	•		✔	
Wastewater Treadment	•		✔	
Consumption-Based Emissions				
Household Consumption				✔
City Government Consumption				✔
Upstream Energy				✔

Community Protocol asks the user to account for emissions from various emissions sources and activities and groups emissions into like categories such as built environment, transportation, etc. This is a departure from the Scope categories used in Operational GHG Protocol, described in Section 3 of this report. The reason for this inconsistency between protocols is that community emissions often cross politically defined geographic boundaries and therefore do not fit neatly into Scope classifications based on operational control. Examples of this include transportation, solid waste landfill disposal, and wastewater treatment emissions. Figure 7 provides a summary of the emissions sources and activities included in this inventory and a crosswalk to categorize emissions into Scope categories. Those emissions sources or activities that cross inventory boundaries are those that are applicable to multiple Scope categories in Figure 7. For example, emissions from on-road transportation are considered Scope 1 for emissions within the community boundary, while emissions that happen outside of the community boundary are considered Scope 3.

Exclusions from the Community Inventory

- Consumption-based emissions for local businesses. Like households, businesses consume materials and, in the case of restaurants, food in order to serve their customers. Those emissions are not accounted for in this inventory due to a lack of available data from which to estimate emissions.

Data Collection

Good Company worked with Adam Hanks, Project Manager for the City of Ashland to collect the data required to calculate emissions. Primary data collection for the 2011 - 2015 inventories was completed in September 2015 through January of 2016.

Primary, accurate data is available for the Ashland Community's use of electricity, natural gas, gasoline, and landfilled solid waste quantities. Primary data for all other emissions sources included in the community inventory required either scaling down state-level data or using Jackson County-level data within models to estimate primary data per protocol guidance. See Appendix B for more details.

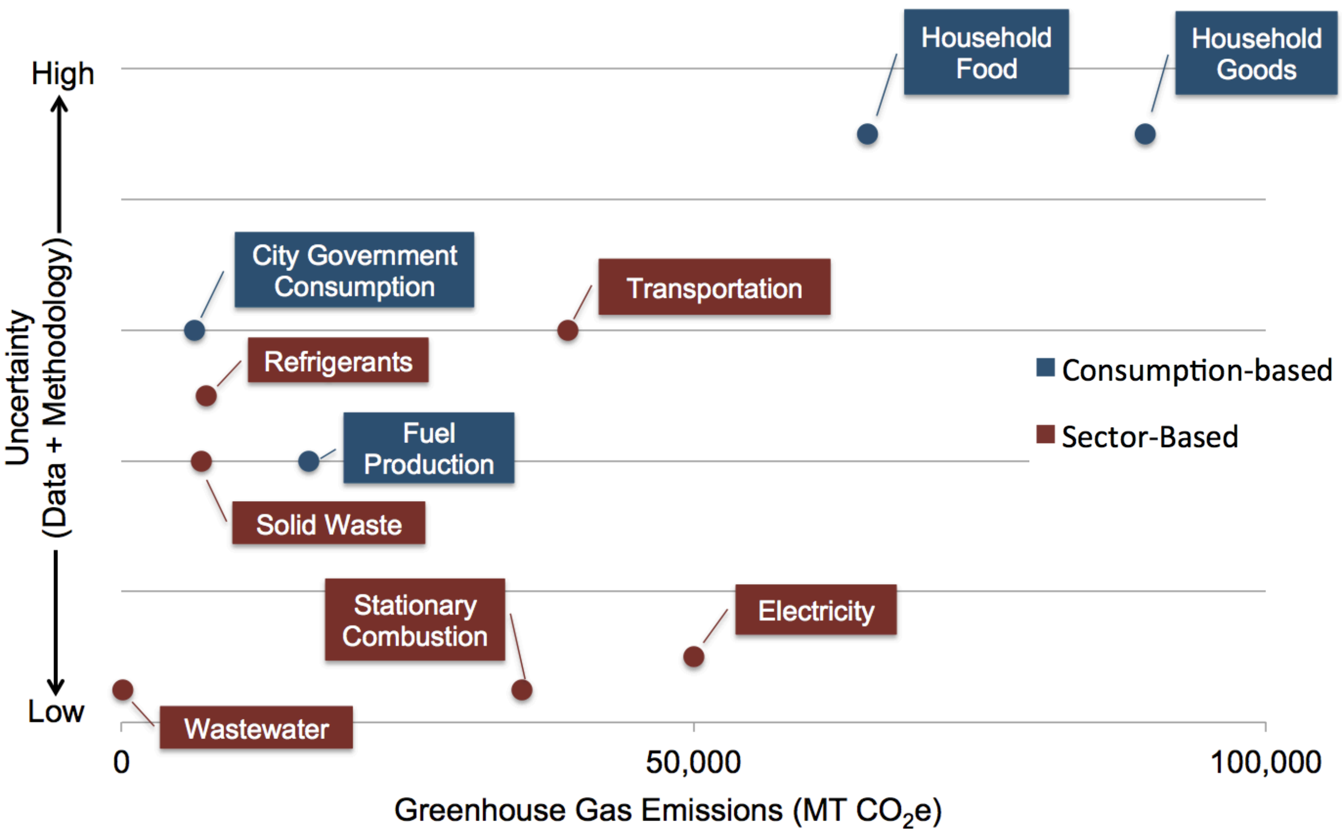
Two data models were used in the course of Ashland's community inventory to estimate primary data using methods and guidance provided in ICLEI's Community GHG Protocol. These include: Oregon Department of Transportation's (ODOT) Regional Strategic Planning Model and Oregon Department of Environmental Quality's (ODEQ) Oregon Household Carbon Calculator. The ODOT model is used to estimate on-road passenger and freight transport vehicle-miles traveled and associated GHG emissions. ODOT model results are compared to alternative data sources and emissions calculator methodology. ODEQ's Oregon Carbon Calculator was used to estimate household consumption-based emissions for the Ashland community.

Emissions Calculations and Uncertainty

As the previous discussion makes clear, there is some degree of uncertainty in Ashland's community inventory results. This uncertainty comes from a variety of sources including lack of publically available data sources or other data issues, but uncertainty can also stem from the calculation methodology or emissions factors used to calculate emissions from activity data. The relative scale of uncertainty can be used to inform the reading of the results. It can also helpful in planning the approach to future inventory and reporting efforts, including prioritization of additional data gathering. The relative scale of uncertainty may also be useful for goal setting and prioritization of climate actions.

Figure 8 provides a subjective assessment of this uncertainty by emissions source for sector-based (red) and consumption-based (blue) emissions. Sector-based emissions trend towards lower uncertainty and have mid-to-low scale while consumption-based emissions trend toward higher uncertainty and are larger scale. The emissions sources that have mid-to-high levels of uncertainty are rounded in the presentation of results to convey a higher degree of uncertainty. For example, note the rounded values in Figure 8.

Figure 8: Assessment of emissions calculation uncertainty for the Community Inventory.



SUGGESTIONS FOR FUTURE INVENTORIES

- **Household Consumption Data and Methodology:** Consumption in this inventory was calculated using the Oregon Carbon Calculator, but in the near future ODEQ will be able to support communities in completing community household consumption inventories, as they did for Eugene, by scaling down Oregon's State-Level Consumption Based Model. That approach was explored for this inventory, but ultimately not used due to project timing and resource limits. We recommend contacting David Allaway at Oregon Department of Environmental Quality about a potential collaboration for future updates to the community inventory.
- **Refrigerant Data:** Establish process to collect more accurate, local refrigerant data. Invite cooling equipment vendors and services to join the Climate Action Planning process with a primary goal of establishing voluntary, anonymous data collection methods.

Detailed Results for Significant Emissions

Built Environment

Electricity and natural gas use by the residential and commercial sectors are the leading sector-based emissions. Ashland's residents' homes have a slightly larger impact than their commercial business. Industrial energy is small in comparison.

By energy type, electricity had a larger impact (~60% of total building energy) in 2015 than natural gas (~40%). As can be seen in Figure 9, Ashland's residential electricity demand declined over 9% between 2011 and while commercial and governmental demand increased slightly.

Use of natural gas decreased 13% between 2011 and 2014 in all sectors[2]. Most of this decrease occurred between 2013 and 2014 driven by warmer than average winter temperatures leading to lower space heating. This can be seen in the declining number of heating degree-days (HDD)[3] over the same time period (dashed line in Figure 10).

Other stationary combustion fuels (fuel oil and propane) are included in the inventory, but represent a very small source of community emissions. The remaining significant emissions source related to buildings is escaping refrigerant gases from air conditioning and refrigeration units. This source represents 5% of Ashland's sector-based emissions. These refrigerants have global warming potentials that are hundreds to thousands of times that of carbon dioxide. In other words, losing a little can add up quickly.

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[2] 2015 natural gas data is not available. Available data spans from 2011 – 2014.

[3] Heating degree days reflect the energy required to heat a building when average outdoor temperatures drop below 65°F.

Figure 9: Ashland electricity use (in MWh), by sector. Percent (%) change, 2011 – 2015.

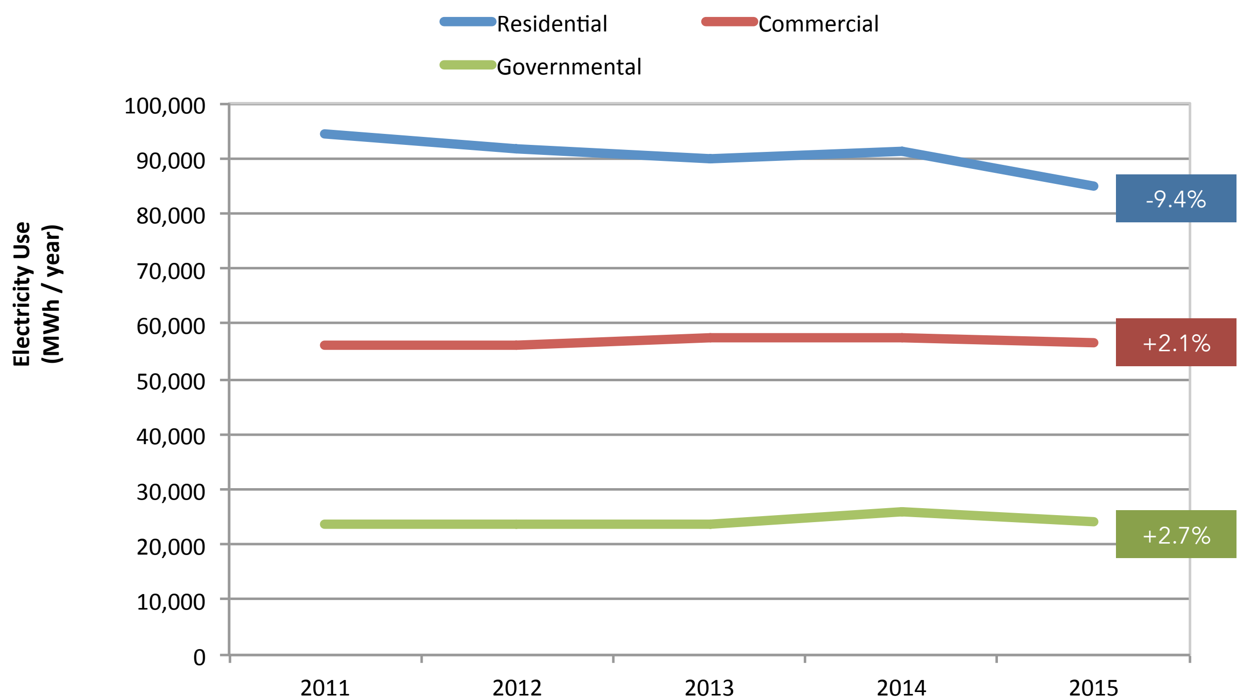
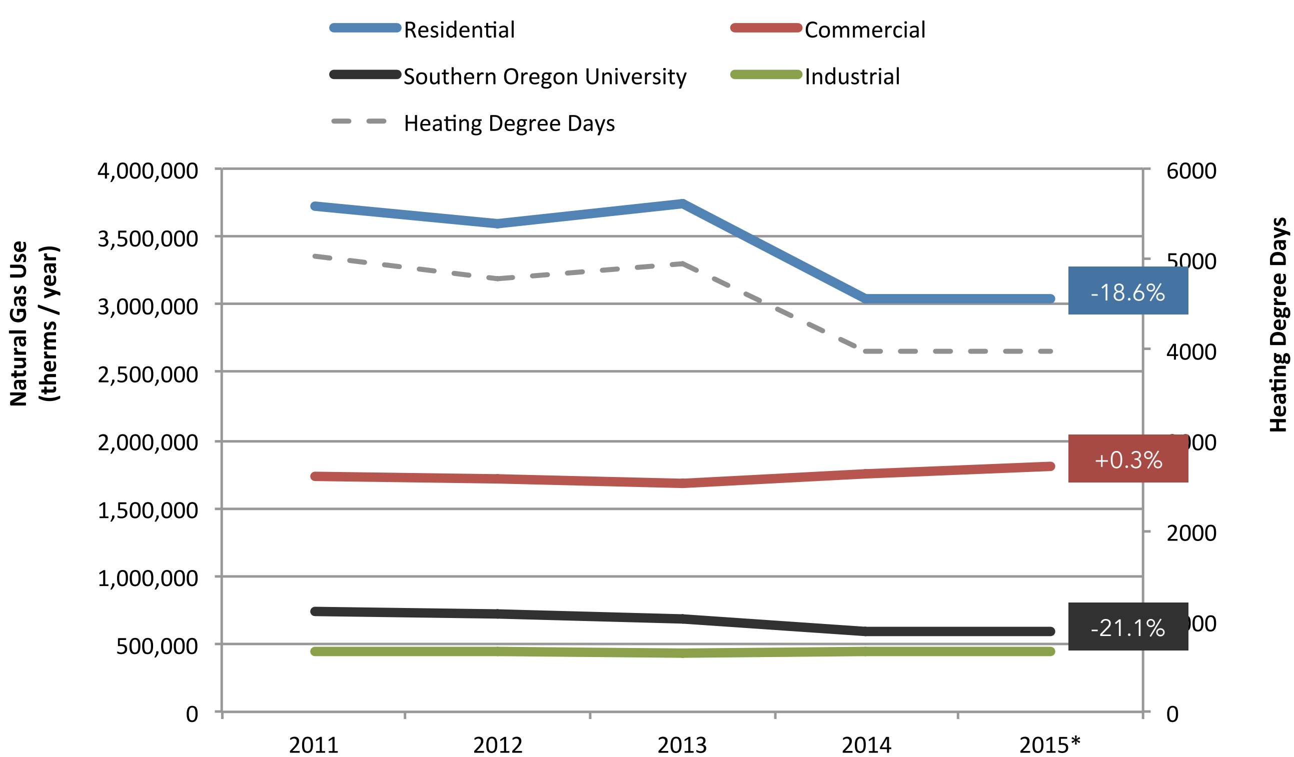


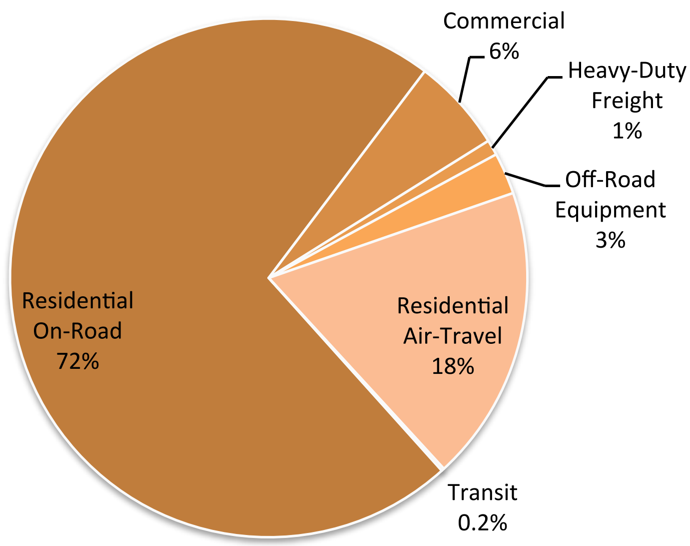
Figure 10: Ashland's natural gas use (in therms), by sector. Percent (%) change, 2011 – 2015.



Local, on-road transportation of passengers is Ashland's leading source of transportation-related emissions. These emissions originate from residential-owned passenger cars and trucks and which primarily use gasoline (E10) and relatively small quantities of diesel (B5). Roughly half of these emissions are the result of trips inside the City's boundaries, while the remaining half originate inside the City's boundaries, but have a destination outside the City.

The next largest source is air travel by Ashland households. While Ashland does have a small airport, the majority of these emissions are from plans departing from airports outside of the Ashland community.

Figure 11: Distribution of On-Road transport emissions, by vehicle category, as estimated by RSPM.



Commercial freight vehicles are the next largest source of emissions. These vehicles include local freight, restaurant delivery, and service providers such as electricians, plumbers, etc. Off-road vehicles and equipment represent about 3% of transportation emissions for local construction. Heavy-duty freight vehicles operating within the City limits represent only 1% of transportation-related emissions. The majority of long-distance freight emissions are accounted for within the consumption-based emissions for the Goods and Services consumed by Ashland households.

It is acknowledged that Ashland is one of Oregon's premier tourist destinations and that travel-related emissions may be significant relative to Ashland's other emissions sources. That said, data is not readily available to calculate or scale these emissions, and this emissions source falls outside the boundaries of Community GHG Inventory.

Consumption of Goods and Food

Consumption-based GHG emissions are produced outside of Ashland to manufacture and transport products and services to meet local consumption of goods. As was previously noted, Ashland's industrial energy use is small and there isn't any significant agriculture within the City limits. Therefor, it is reasonable to assume that the Ashland community (i.e. businesses within Ashland city limits) does not locally produce a significant portion of the goods and food it consumes. Instead it relies almost entirely on imported goods, food, and energy products to meet the community's needs.

As can be seen in Figure 12, the scale of consumption-based emissions as a category is large relative to Ashland's sector-based emissions. Consumption-based emissions are also large for City Operations (presented in the next section). While these emissions are large, they are "indirect" emissions and not under the same level of community control as the local, sector-based emissions. For example, the Ashland community could change local development codes to increase the energy efficiency of built space to address residential or commercial energy emissions. The Ashland community does not have a same ability to influence production efficiencies or fuel choices for imported goods and services.

The consumption-based emissions are split into four high-level categories in Oregon's Carbon Calculator, which include[4]:

- **Household Goods:** Emissions from extraction, manufacture, and transportation of raw materials into final products such as construction, automobile, furniture, clothing, and other goods.
- **Household Food:** Emissions from agricultural (energy for irrigation, production of fertilizers, methane emissions from livestock, etc.), transportation of raw materials and finished products emissions. Categories included are cereal, dairy, meat, produce, and other foods.
- **City Government Consumption:** Emissions from the production of goods (as described above) and some services purchased in the course of City operations.[5]
- **Energy (Fuel Production):** Process and energy emissions from the extraction and production into usable fuel products (e.g. electricity from household outlets, gasoline pumped into cars, natural gas combusted by furnaces, etc.). These upstream emissions are considered at the community-scale for electricity, natural gas, gasoline, diesel, propane, and fuel oil.

In 2011 – 2015, the largest source of consumption-based emissions for Ashland – household consumption of goods and services - remains relatively stable, increasing by only 1% over the period. Fuel production emissions for the energy consumed in Ashland decreased by -11% as a result of increased availability of hydropower on the regional electricity grid, The Northwest Power Pool, as well as decreased demand for residential electricity and natural gas and commercial natural gas. City Government consumption represents only a small fraction of Ashland's consumption-based emissions.

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[4] Please note, services are also included as a category in Oregon's Carbon Calculator. They are not included here because they are assumed to be equal to commercial energy use and therefore would represent double counting.

[5] Note: These supply chain emissions are presented in detail in the next Section of this report, specifically Figure 13. For the community purposes of including these emissions in the community inventory, energy and community services emissions are excluded to avoid double counting.

Figure 12: Upstream emissions from the production of the Goods, Foods and Services

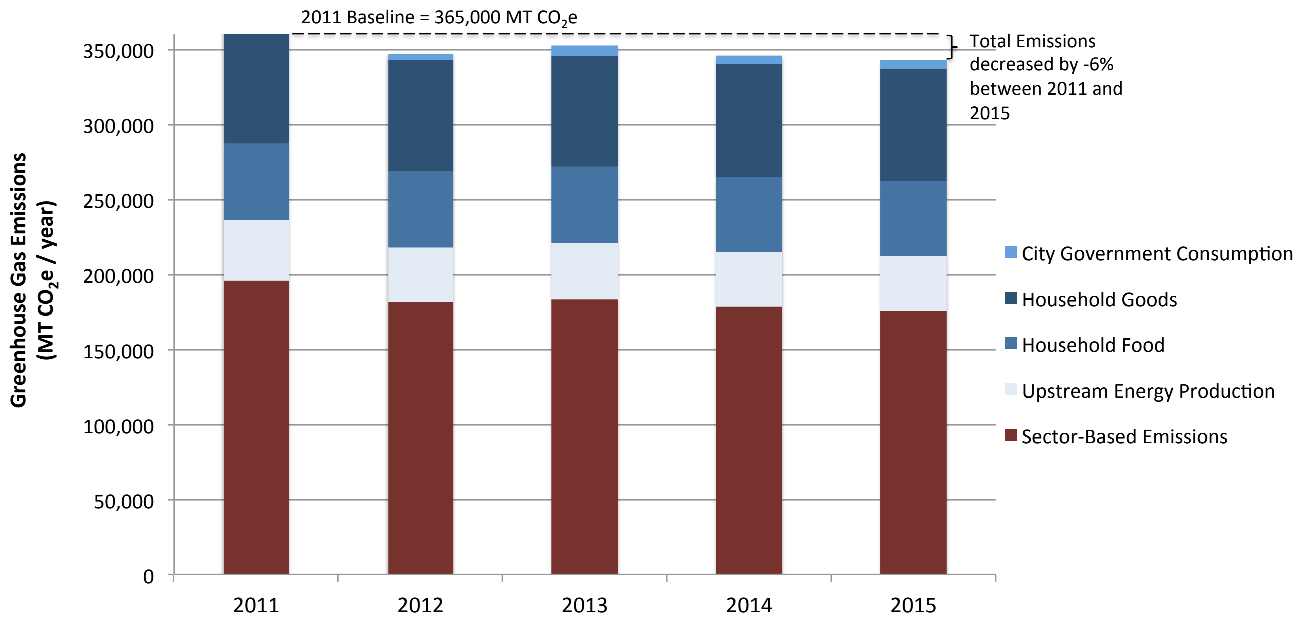
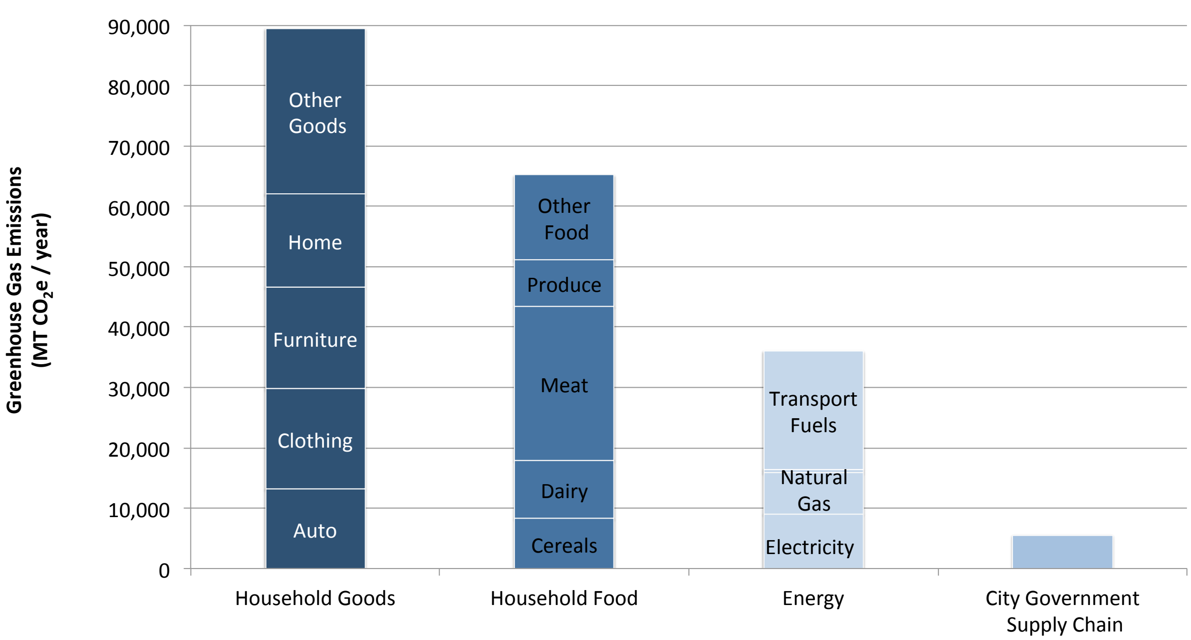


Figure 13 provides additional detail for each of the consumption categories. Emissions from household goods are dominated by home construction, furniture, clothing, and vehicle purchases. For the average Ashland resident, a large portion of food emissions are from the production of meat, with lesser contributions by dairy, produce, and cereals.[6] Upstream energy production emissions are dominated by the production of transportation fuels (gasoline and jet fuel), electricity, and natural gas. See Section 3 of this report for details about City Government Supply Chain emissions.

Figure 13: FY 2015 consumption-based emissions by category.



[6] Goods and food consumption-based emissions were adjusted to exclude in-state transportation emissions. It is assumed that 100% of the on-road diesel included in the Transportation sector-based emissions is going towards transportation of goods and foods consumed in the City of Ashland.

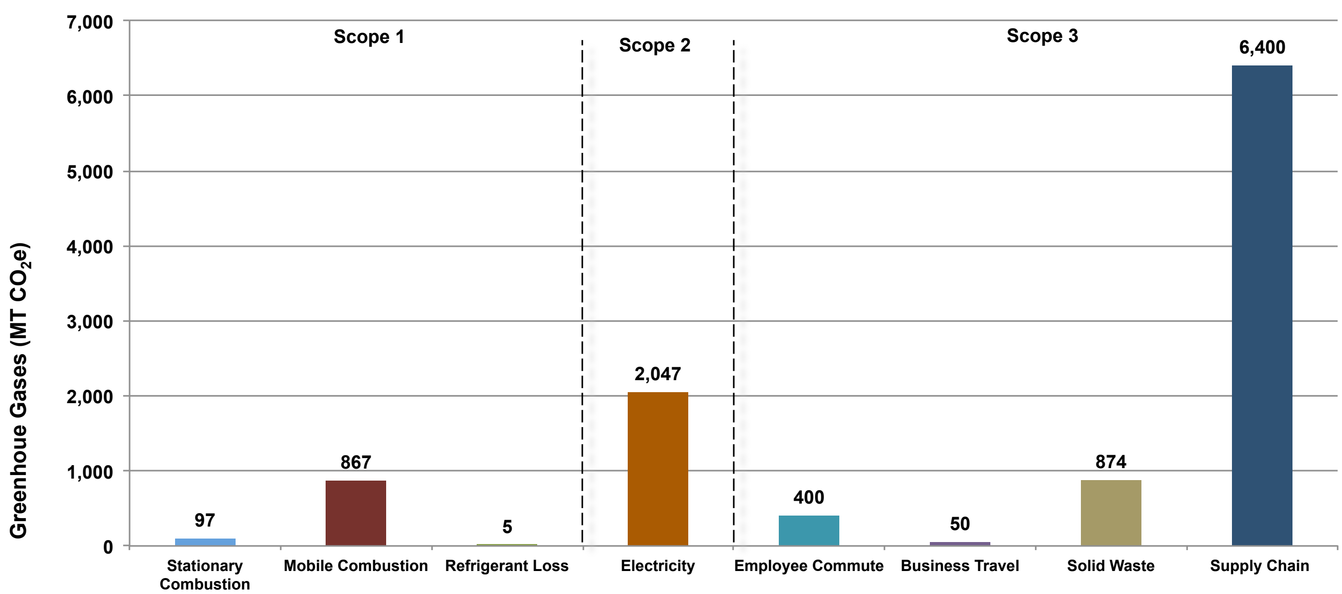
3. CITY GOVERNMENT OPERATIONS

The City of Ashland's government provides a full range of municipal services including police and fire protection, parks and recreation facilities and activities, streets, airport, planning, zoning, senior programs, and general administration services. The City also operates the water, wastewater, and electrical utility systems.

The City of Ashland's (City) operational emissions from buildings and fleet transportation total 3,016 MT CO_2e, categorized in Figure 14 as Scope 1 and Scope 2. These emissions sources are under the operational control of City staff and are somewhat comparable to sector-based emissions in a community inventory. Scope 1 and Scope 2 emissions are typically the basis for organizational goal setting and tracking over time. Scope 3 emissions are more difficult to track, but are large in scale and serve mission critical activities - and therefore should not be ignored. This inventory includes 7,700 MT CO_2e from Scope 3 emissions sources.

The largest emissions sources in 2015 are electricity use, fuels combustion in vehicles and equipment, landfill disposal of biosolids, and supply chain (i.e. upstream emissions from the production of mission-critical goods and services). Operational emissions are a subset of community commissions.

Figure 14: City of Ashland Greenhouse Gas Emissions, FY 2015.

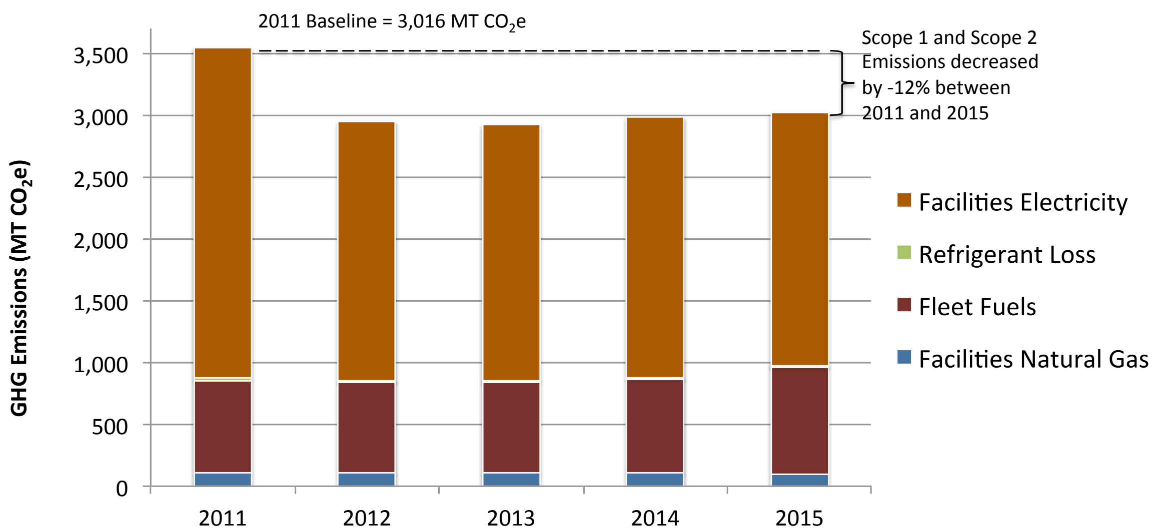


Scope 1 and Scope 2 emissions total 3,016 MT CO_2e. This is equivalent to any one of the following[1]:

- $30,160 for purchase of voluntary carbon offsets (at $10 / MT CO_2e)
- Annual emissions from the energy consumed by 275 average U.S. homes
- Annual emissions from 635 passenger vehicles
- 77,333 tree seedlings grown for 10 years

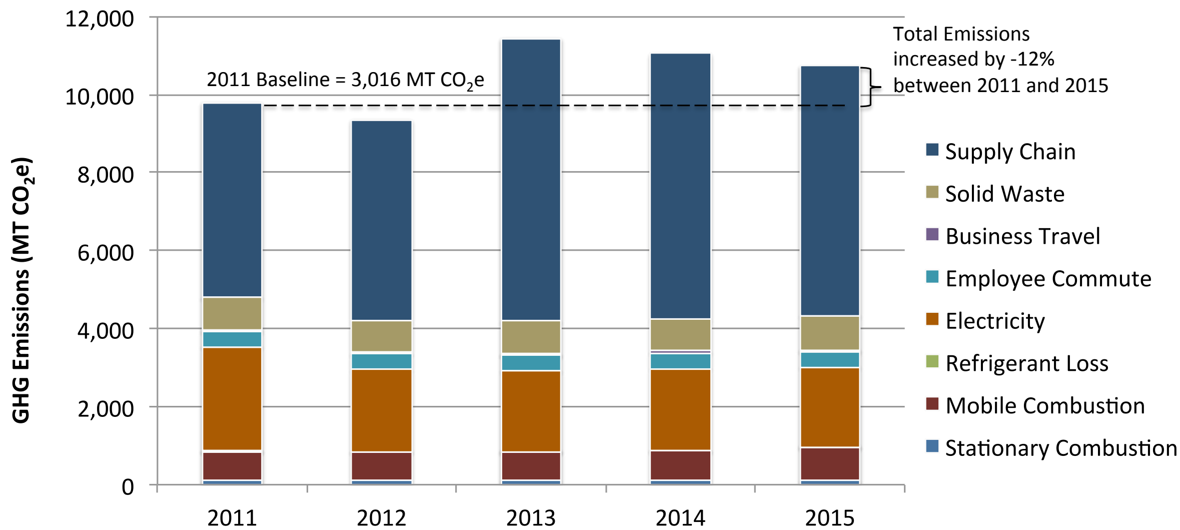
Figure 15 compares Scope 1 and Scope 2 emissions over time. Combustion (fleet) has increased 16% from 2011 and 2015. This increase can be attributed to increased fuel use by the Police and Parks departments. Electricity emissions declined by -23% in 2012 due to increased low-carbon electricity availability on the NWPP grid resulting from a particularly good "water year" for hydro power. The carbon intensity of NWPP grid electricity can fluctuate significantly from year-to-year and will correspondingly effect the City's operational emissions, positively or negatively.[7]

Figure 15: Comparison of Scope 1 and Scope 2 emissions, by source, over time.



As can be seen in Figure 16, Scope 3 emissions sources represent a large portion of the City's total operational emissions (~70% of total). Significant Scope 3 sources include supply chain, solid waste disposal, and employee commute. The largest of these, supply chain, increased significantly post-2012 due to increases in construction projects and vehicle purchases.

Figure 16: Comparison of total emissions, by source, over time.



[7] The most recent eGRID factors available are based on 2012 data and are used to calculate 2012 emissions, but are also used as a proxy to calculate 2013 – 2015 emissions, per inventory protocol.

Figure 17: Detailed Description of the City of Ashland's Operational GHG Emissions, 2011-2015

Emissions Category	2011	2012	2013	2014	2015	% Change 2011 to 2015	Factors in change between 2011 and 2015
Scope 1 Totals	**882**	**852**	**855**	**876**	**969**	**10%**	
Stationary Combustion	103	106	105	113	97	-6%	Stationary combustion has remained steady with a small drop over the 5 year period that can be attibuted a warmer average winter temperatures. Note that natural gas use in incomplete for Parks department.
Mobile Combustion	750	739	740	750	867	16%	Mobile combustion remained steady until a significant increase in 2015. This increase is due increased fuel use by the Police and Parks departments.
Fugitive Emissions	29	7	9	12	5	-83%	Refrigerant loss has decreased over the 5 year period. Note that data collection in known to be incomplete for this emissions source.
Scope 2 Totals	**2,658**	**2,096**	**2,066**	**2,105**	**2,047**	**-23%**	
Electricity	2,658	2,096	2,066	2,105	2,047	-23%	Electricity usage is unchanged over the 5 year period. Electricity emissions however have decreased by -23% as a result of more hydro and wind generated electricity available on the regional electricity grid.
Scope 1 + Scope 2 Subtotal:	**3,540**	**2,947**	**2,921**	**2,981**	**3,016**	**-15%**	
Scope 3 Totals	**6,246**	**6,348**	**8,462**	**8,043**	**7,741**	**24%**	
Employee Commute	400	400	400	400	400	0%	Employee commute emissions have been stable over the 5 year period. The City workforce has been consistent in number and geographic distribution over this period.
Business Travel	40	50	40	50	50	25%	City business travel (air and auto miles) has increased by 25% This is due to increased air travel.
Solid Waste	806	798	822	793	891	11%	Emissions from solid waste has increased during the 5 year period due to an increase in the quantity of biosolids waste volume between 2014 and 2015. Biosolids waste is represents 97% of the City's total landfill-related emissions.
Supply Chain	5,000	5,100	7,200	6,800	6,400	28%	Supply chain emissions have increased over the time period due to increased spending on construction and maintenance and vehicle purchases.
Total Emissions:	**9,786**	**9,295**	**11,384**	**11,023**	**10,757**	**10%**	

Note: Values reported in metric tons of carbon dioxide equivalent (MT CO_2e).

Figure 18 shows emissions intensities metrics – emissions per Ashland resident and emissions per 1,000 square feet of City-owned facilities. As can be seen, total emissions have increased per capita, but Scope 1 and Scope 2 emissions per capita and per 1,000 square feet of building space have both decreased.

Figure 18: Emissions per Ashland resident and per 1,000 sq.ft. of City-owned facilities.

Emissions Intensity Metric	2011	2012	2013	2014	2015	% Change 2011 to 2015
Per Population Served						
Ashland Population	20,078	20,314	20,465	20,510	20,684	3%
Scope 1&2 Per Capita (MT CO_2e / person)	***0.2***	***0.1***	***0.1***	***0.1***	***0.1***	***-17%***
Total Per Per Capita (MT CO_2e / person)	***0.5***	***0.5***	***0.6***	***0.5***	***0.5***	***7%***
Per 1,000 Square Feet						
City Government Square Footage	110,589	110,589	110,589	110,589	110,589	0%
Facility-Related Per 1,000 sq.ft. (MT CO_2e / 1000 sf)	***25.2***	***20.0***	***19.7***	***20.2***	***19.4***	***-23%***

Methodology and Approach

Protocols and Methodology

The City of Ashland's Operational Inventory follows The Local Government Operations Protocol v1.1 (LGOP) for Scope 1 and Scope 2 emissions sources as well as guidance, best practices, tools and models from a variety of other sources including World Resource Institute's (WRI) Scope 2 Guidance, EPA's Climate Leaders, EPA's Waste Reduction Model (WARM), Oregon Department of Environmental Quality's Purchaser Price Model, and others to estimate Scope 3 emissions sources.

Good Company's Carbon Calculator v3.8 (G3C) was used to calculate all greenhouse gas (GHG) emissions for the City's operations. G3C follows the standards set by the LGOP Protocol in its methodology and calculation of emissions. Calculations in G3C are fully transparent and include citations to all resources utilized.

All operational GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). Quantities of individual GHGs are accounted for in the G3C file used to calculate emissions for this GHG inventory. The GHG calculations use the global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

Inventory Boundaries

Operational inventory protocols classify emissions sources and activities as producing either direct or indirect GHG emissions. Direct emissions are those that stem from sources owned or controlled by a particular organization. Indirect emissions occur because of the organization's actions, but the direct source of emissions is controlled by a separate entity unless the organizations negotiates with its purchasing power or procures differently made goods. To distinguish direct from indirect emissions sources, three "Scopes" are defined for traditional GHG accounting and reporting.

Scope 1 – Direct sources of GHG emissions that originate from owned equipment and facilities such as combustion of fuels or loss of fugitive refrigerants.

Scope 2 – Indirect emissions from purchased electricity and how the power is generated.

Scope 3 – All other indirect sources of emissions that result from the institution's activities and choices, but are directly controlled by another party, such as employee commutes, air travel, solid waste disposal or supply chain.

Scope 1 (direct) and Scope 2 (indirect) emissions must be reported for most operational protocols and registries. Scope 3 emissions are indirect and usually considered optional when reporting emissions to a registry, but serve to clarify an organization's entire carbon footprint and illuminate the potential climate, regulatory and financial risks an institution may face due to its carbon footprint. Ashland's City Operational Inventory follows an Operational Control approach and covers emissions from fiscal year 2011 through FY 2015. The emissions sources included in this inventory are summarized and described on Figure B1. The data was collected for all owned and leased City facilities.

There are three known emissions exclusions in this inventory:

- Scope 1 natural gas emissions from a portion of the City's accounts. Natural gas consumption for several Parks department accounts due to accounting classification discrepancies between City master accounts and the Parks department separate accounts with Avista Utilities (the estimated volumes are not expected to substantially alter the initial analysis and ratio of carbon emissions by category).
- Scope 1 fugitive refrigerant from buildings. A portion of the data was available and included, but the data set is assumed to be incomplete.
- Scope 1 fugitive refrigerant from vehicles. These emissions sources are assumed to be relatively small for the City of Ashland's fleet and do not have readily available data streams to support emissions calculations.

This inventory includes six "Kyoto gases": carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). The City of Ashland does not use PFCs, NF_3 or SF_6; therefore those gases are not included. Overwhelmingly, direct and indirect CO_2-equivalent (CO_2e) emissions consist of CO_2 from the combustion of fossil fuels. Emissions are reported in units of metric tons of carbon dioxide equivalent (MT CO_2e). See the G3C calculator for details about specific gases.

Data Collection

Good Company worked primarily with Adam Hanks, Project Manager for the City of Ashland, to collect the data required to calculate operational emissions for FY2011-2015. Good Company provided the City with a data collection checklist that specified data types and units. The City's Project Manager used the checklist to either directly supply data or coordinate data collection efforts among the appropriate City staff.

After the receipt of an individual data file, Good Company reviewed it for completeness and asked follow-up questions if necessary. All data source files, answers to follow-up questions, resulting calculation files, and related resource files are documented and cataloged an Audit Trail for each inventory year. For more details see Appendix C.

In general, data was available and comprehensive. The two exceptions, a portion of the natural gas data and refrigerant emissions from buildings, were noted in the previous section. Of these the priority should be to collect the outstanding natural gas data. Refrigerant emissions are relatively small for most City governments and other organizations.

Emissions Calculations and Uncertainty

There is some degree of uncertainty in any GHG inventory. This uncertainty can come from incomplete data, but it can also result from uncertainty in the methodology or factors used in translating units of activity (e.g. gallon of gasoline, kilowatt-hour of electricity, short ton of solid waste) into CO_2-equivalent emissions. The sources of uncertainty should inform future inventory and reporting efforts, including prioritization of additional data gathering, framing inventory results, and in the development of mitigation goals and tracking systems.

Figure 19 provides a subjective assessment of this uncertainty, by emissions source. Later sections of the report provide additional detail, but the general points are straightforward:

- Stationary and mobile combustion have low uncertainty. Both sources are supported by good data and the methods for quantifying emissions from them are well-defined and accepted.
- Purchased electricity, the second-largest emissions source, has well-defined and well-known units of activity (kWh of electricity consumed) but significant year-over-year changes in emissions factors (from changes in available renewable electricity) combined with a 3-year lag in the availability of emissions factors creates "real-time" uncertainty. Emissions calculations will be more accurate as this data becomes available.
- Several emissions sources are low to moderate in magnitude and have some uncertainty with their data and methods. These include fugitive refrigerants, air travel, employee commute, and solid waste.
- Supply chain is the source of the largest emissions and uncertainty. The high degree of uncertainty related to supply chain emissions, and consumption-based emissions calculations in general, is that calculation of these emissions require models to

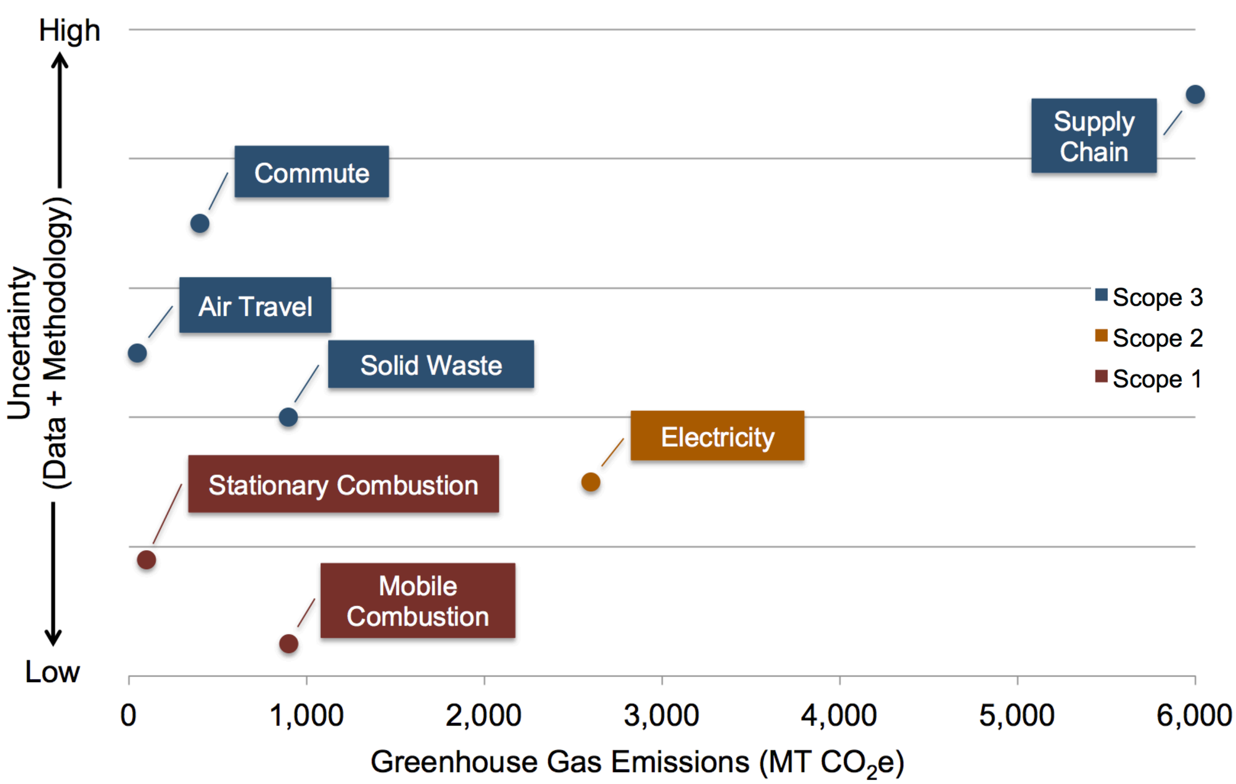
approximate complex economic interactions and effects for over 400 economic sectors as well as global trade.

Suggestions for Future Operational Inventories

In general, data availability for City of Ashland Operations is very good and uncertainty is based more on inherent methodological challenges as opposed to improvements to be made by the City. There are two exceptions (prioritized by scale of emissions):

- Stationary Combustion: Establish a data collection system that includes all City accounts, including the excluded Parks accounts previously mentioned.
- Solid waste: Establish a data collection systems that provides annual landfilled biosolids weights.
- Employee commute: Conduct surveys to coincide with future updates to the Operational Inventory. The survey should be designed in a way to track and monitor the effectiveness of any City programs that encourage alternative modes of commute.

Figure 19: Assessment of operational emissions calculation uncertainty.

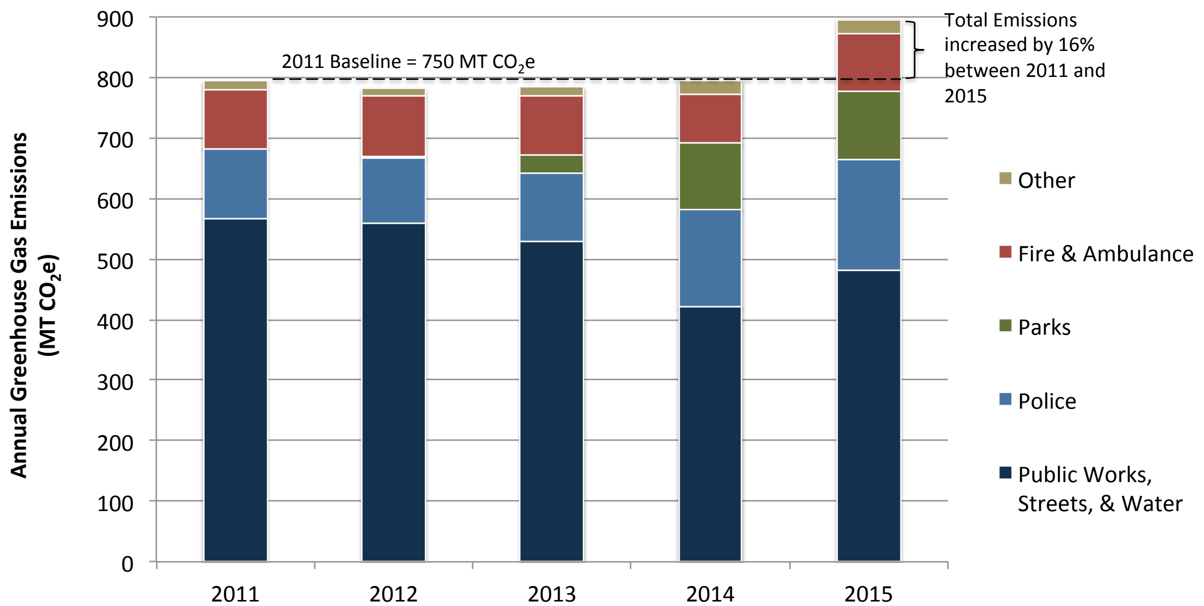


Detailed Results for Significant Emissions

Mobile Combustion

Mobile combustion represents emissions from city vehicles and equipment. The data represents E10 gasoline (10% Ethanol) and B5 Diesel (5% Biodiesel). Figure 20 shows these emissions by department. Public Works uses the greatest quantities of these fuels followed by, Police, Fire & Ambulance, and all others. While overall emissions remained steady between 2011-2014, an increase of 13% was experienced between 2014 and 2015. Over this time period, Public Works decreased fuel use and emissions compared to the 2011 baseline, while the largest increases are by Police and Parks[8].

Figure 20: Fleet emissions by department, FY2011 – 15.



Electricity

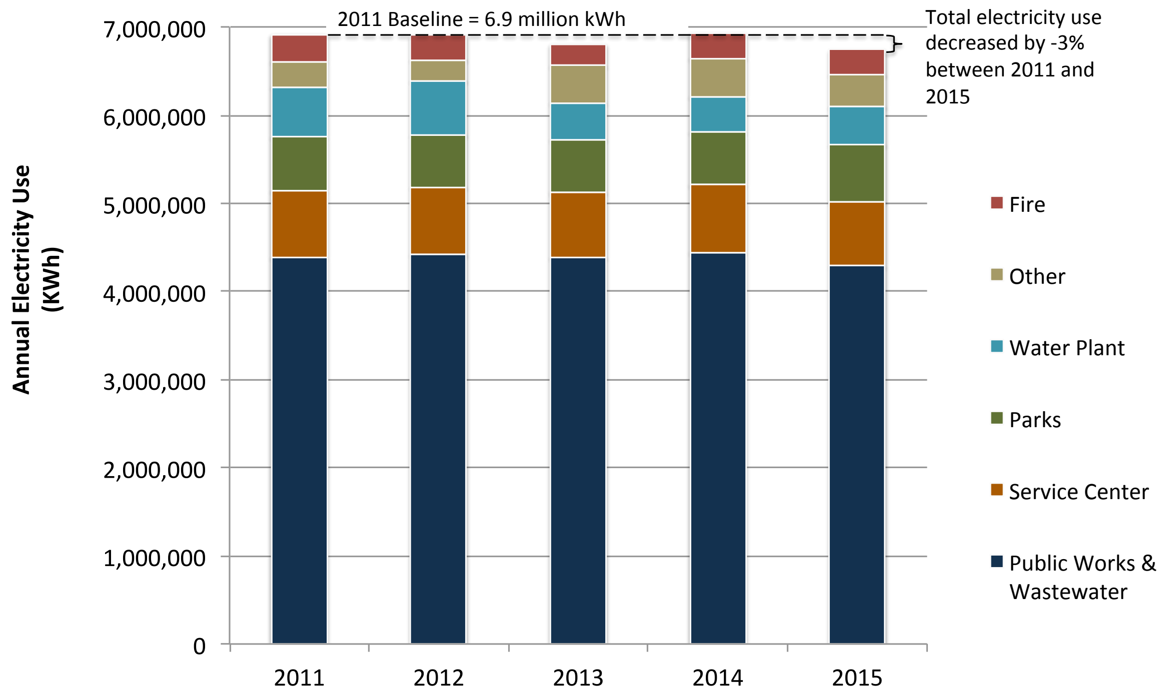
City electricity use remained relatively stable between 2011 and 2015, decreasing by 2.5%. The largest electricity use within City operations is the wastewater treatment plant (nearly 50%). Most City departments decreased electricity use (between -2% and -23% compared to 2011) except for Parks, which increased use by 5% and the Other category increased (22%).

Presenting the activity data in Figure 21 (in KWh) for operational electricity is important to clearly show that the operational electricity emissions reductions are primarily the result of a

[8] Potential Source of Uncertainty: The change in emissions for Parks may be the result of internal accounting methodology rather than actual increases in fuel usage.

significant reduction in the carbon intensity of grid supplied electricity as opposed to electricity conservation or efficiency efforts. City wide operational electricity use has been stable over the 2011 – 2015 time period.

Figure 21: Electricity use by departments or activities, FY2011 – 15.

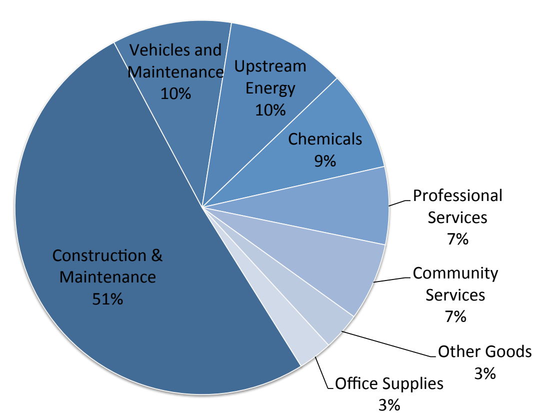


Consumption of Goods and Services

As is described in the Community Inventory, consumption-based emissions associated with the City's supply chain include the upstream emissions from production of goods and services consumed in the course of providing community services.

Over half of these emissions between 2011 and 2015 are the result of facility and infrastructure construction and maintenance. Production of vehicles and equipment, fuels and energy, chemicals, and professional and community services are all significant contributors as well. Description of Purchasing Categories:

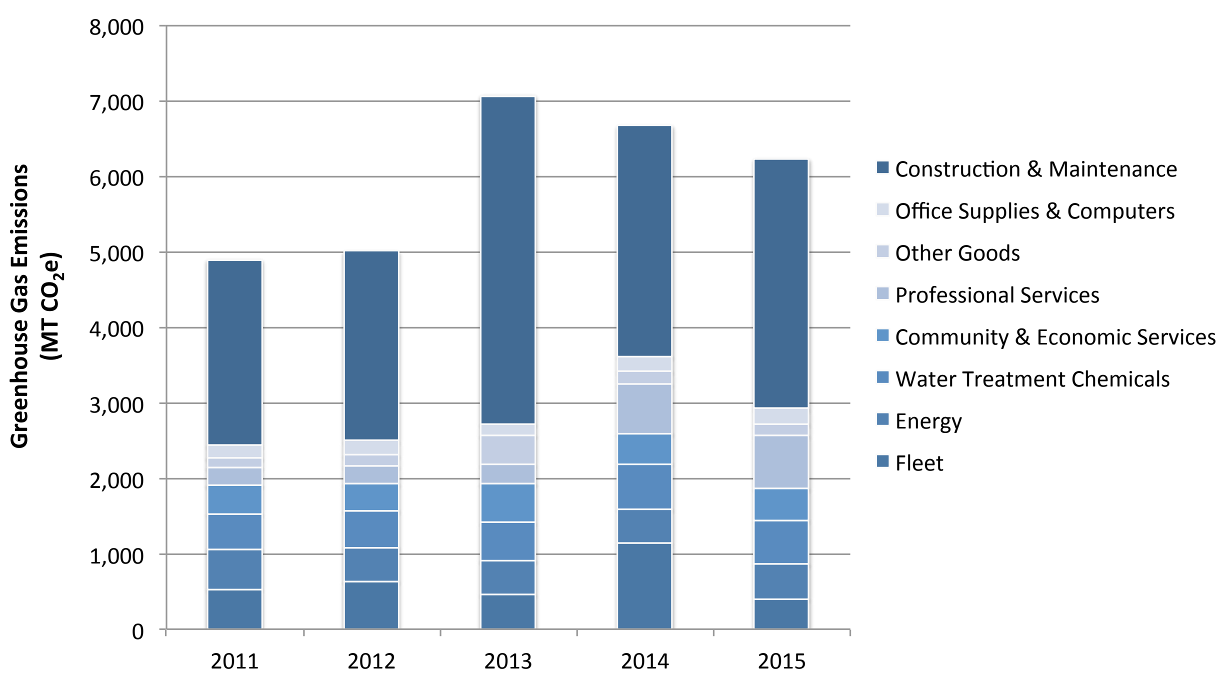
Figure 22: Average supply chain emissions, 2011 - 2015, by category.



- **Construction & Maintenance:** This category includes construction of infrastructure, facilities and improvements, and contractual services. Contractual services are services contracted by the City and performed by third parties and primarily include construction and professional services. This category also includes small tools, other maintenance equipment, and safety equipment.
- **Office Supplies and Computers:** This category includes the office, communications, audio/visual, computing supplies and software necessary to maintain the City's operations.
- **Chemicals:** This category includes chemicals, principally for water treatment.
- **Energy:** This category includes upstream emissions from the extraction and processing of fuels prior to combustion.
- **Fleet:** This category includes vehicle purchases and maintenance.
- Community & Economic Services: This category includes community programs and the administration of memorials and grants.
- **Professional Services:** This category includes contractual purchases of professional and technical services that support the City.
- **Other Goods:** This category includes goods not included in the above categories.

As can be seen in Figure 23, consumption-based, supply chain emissions from many of these categories remain consistent. Energy (fuel production), chemicals, services, and office supplies all have little change over the 2011 – 2015 period. The variability in Ashland's supply chain emissions is largely the result of significant purchases like construction projects and vehicle purchases. In addition to being more variable, these emissions are typically the most significant in terms of scale.

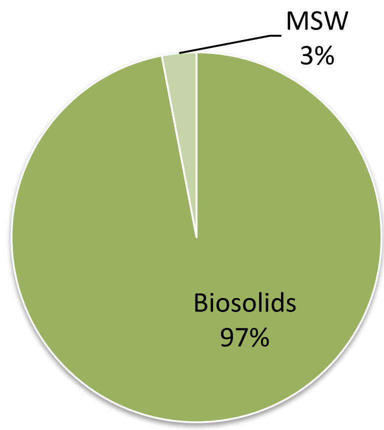
Figure 23: Composition of supply chain emissions over time, by category



Solid Waste

The City disposes of its mixed solid waste (MSW) and biosolids from wastewater treatment at Dry Creek Landfill. Once landfilled, solid waste in general, and specifically organic wastes,[9] decompose under anaerobic conditions (without oxygen) and begin to produce landfill gas (a mix of methane and carbon dioxide).

Figure 24: Share of 2015 solid waste emissions by waste category.



Dry Creek is a modern landfill with landfill gas capture and electricity generation.[10] It is very difficult to capture 100% of landfill biogas – a certain percentage is bound to escape. According to the EPA's Waste Reduction Model (WARM), approximately 85% of landfill gas is captured.

The City's operational solid waste tonnage and associated landfill emissions are dominated by wastewater biosolids, which represents 97% of solid waste emissions. Mixed solid waste from the City's other facilities represent the remaining 3%. Solid waste emissions have stayed relatively consistent between 2011 and 2015, averaging 830 MT CO_2e / year.

[9] Examples include paper, wood, food waste, biosolids, etc.
[10] Dry Creek has also been proactive in exploring use of landfill biogas as a low-carbon fuel for collection trucks.

APPENDIX A: ELECTRIC UTILITY – ELECTRICITY SUPPLY PORTFOLIO GHG INVENTORY

In addition to the Ashland's Community and City Government Operations GHG Inventories already presented, Good Company calculated another GHG inventory focused on emissions associated with Ashland Municipal Utility's Electricity Supply Portfolio. The purpose of the Portfolio inventory is to examine the direct GHG emissions associated with Ashland's Municipal Utility's-owned electricity generation resources as well as the indirect emissions from power contracts with regional suppliers.

Ashland has owned its Municipal Electric Utility since 1909. It is the second oldest Municipal Utility in Oregon. The majority (~98%) of the electricity resources that serve the City of Ashland are purchased from the Bonneville Power Administration, with the majority of the remaining (2%) generated by City-owned hydro facilities and a very small fraction of the City's owned community solar project, Solar Pioneer II (a 63.5kW PV solar installation). All electricity is distributed through city-owned distribution lines to the City Utility's customers.

The Portfolio GHG Inventory is focused on the carbon intensity of the BPA power contracts and local hydro generation used to serve the Ashland community's retail electric load. This inventory is not meant to consider operational emissions from the Utility's services (e.g. Utility-owned building or fleet vehicles). Those emissions are included in the City Government Operational Inventory presented in Section 3 of this report.

This inventory is meant to inform two primary audiences and perspectives.

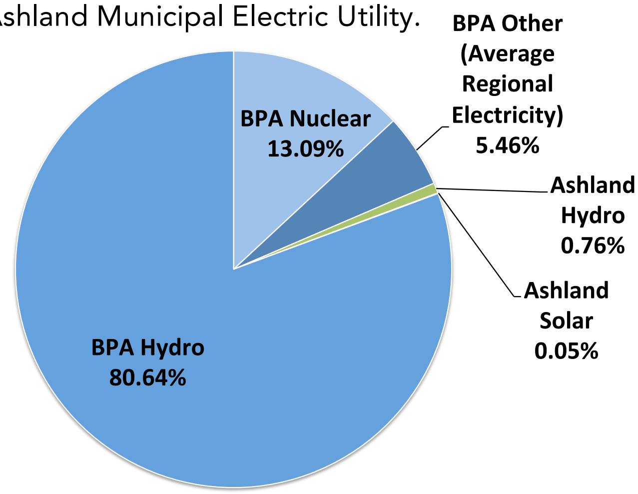
- **Ashland Municipal Utility:** The City's Electric Utility staff may use this inventory to understand and share the direct and indirect emissions associated with its owned-generation and contracted power supply. This understanding is meant to inform potential supply-side GHG mitigation opportunities from a Utility power purchasing perspective, as well as a cost-of-carbon risk perspective related to future regulations, such as the Clean Power Plan, to the Utility and its customers.
- **Community-at-Large:** The Community may use this inventory to better understand the GHG impacts of the resources currently used to supply community electricity demand and the interaction of those resources with larger regional electricity grid.

As of this writing, Ashland is about to embark on developing its first Community Climate and Energy Action Plan. This process is generating interest from the public for information on the "carbon footprint" of their electricity use. The City of Ashland's Electric Utility has both an opportunity and a responsibility to provide information on the impacts of electricity generation and use in order to enable its customers and the community-at-large to make informed decisions related to its use of electricity and the carbon consequences of using electricity.

INVENTRORY RESULTS

Because BPA electricity supplies the majority of the City's demand – the results of this inventory are fairly straightforward.

Figure A1: Sources of electricity supply for Ashland Municipal Electric Utility.



- The carbon intensity – as defined by The Climate Registry's Electric Power Sector Protocol - of Ashland's Municipal Utility's supply is very small (0.039 MT CO_2e / MWh) relative to the Northwest Power Pool (NWPP) regional grid (0.30 MT CO_2e / MWh), as a result of the following;
    - BPA's electricity generation, which supplies 98% of the community's demand, is dominated by low-carbon hydro and nuclear resources (90% of total), which do not emit GHGs.[11] See Figure A1 for details on BPA resource mix.
    - The remaining 10% of BPA generation is served by the average regional electricity supply, which includes coal and natural gas generation. It's these purchases -made by BPA to serve the requirements of its contracts with Ashland - that result in the only source of GHG emissions in Ashland's Utility's supply portfolio.
    - The City of Ashland's owned-generation hydro resources provide the remaining 2% of the City's demand, which do not emit GHGs.
- While Ashland is served by BPA power via long-term contracts for electricity, the environmental benefits of BPA power are shared and accounted for in the average carbon intensity of our regional electricity grid, the Northwest Power Pool.
- While BPA resources are low-carbon, they do not generate Renewable Energy Certificates (REC)[12], nor is any ownership of the low-carbon of benefits from BPA transferred to Ashland's Municipal Utility or the Ashland Community, except for the following exception:
    - On behalf of the community, The City of Ashland does purchase BPA's Environmentally Preferable Product for a premium at a quantity equal to 5% of the Ashland community's annual consumption. The Environmentally Preferable

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[11] Hydro and nuclear power generation do not produce any emissions at the point of generation. That said they do produce upstream emissions, in the gathering of the uranium for nuclear power; methane emissions from dam reservoirs. These upstream emissions are not included in TRC's Electric Sector Protocol.

[12] Renewable Energy Certificates or RECs are a contractual means of transferring ownership of the environmental benefit associated with qualifying renewable electricity generation.

Product is wind-generated electricity bundled with wind generated RECs that are retired on behalf of the Ashland community.

- Because the Ashland community does not own the environmental benefits of BPA power, the best representation of the GHG consequences of Ashland's electricity use is the carbon intensity (ie. emissions factors) of the regional NWPP electricity grid, adjusted downward for voluntary community purchases of RECs.
- From a Utility perspective, this inventory provides a public accounting of the greenhouse gas emissions associated with Ashland's owned electricity-generation (2% of total) and the upstream emissions from the community's contracted supply from BPA (remaining 98%). The Utility's electricity supply is generated almost entirely from low-carbon resources and therefore risk related to future GHG regulations is likely low.
- In addition, it's important to note that BPA contracted power is one of the lowest-cost power resources available in our region.

Figure A2 shows the results of the 2015 inventory by emissions source and Scope category. Scope 1, or direct emissions, for the Utility's owned hydro-electricity generation are 0 MT CO_2e. Scope 2 emissions from line loss total 126 MT CO_2e. These emissions account for the inherent loss of energy as you transmit electricity over distribution lines. Scope 3 indirect emissions are the largest sources within the Utility inventory equal 2,912 MT CO2e. These emissions are the result of BPA's "spot market" purchases of power or average grid electricity (roughly 10% of BPA's generation resources). Average grid electricity in our region does include emissions from combustion of coal and natural gas to generate electricity.

Figure A2: Ashland Utility emissions by source and Scope category.

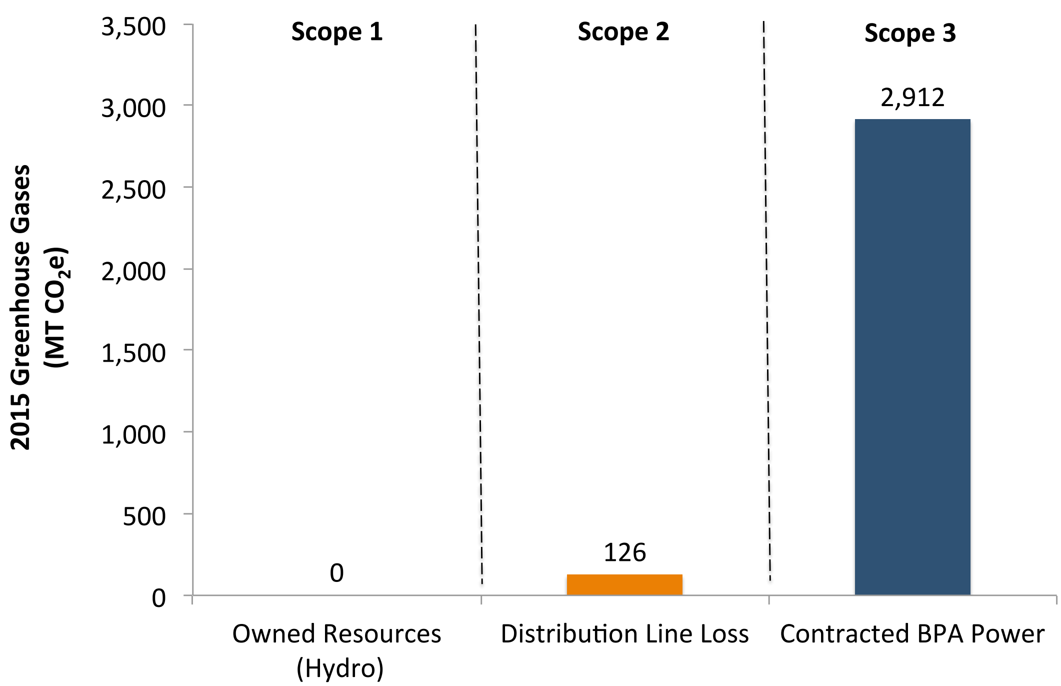

Figure A3 compares the carbon intensity (MT CO_2e / MWh) of Ashland Utility's supply portfolio to the regional electricity grid (Northwest Power Pool), and regional grid adjusted for Ashland's REC purchases. Notably, the electricity emissions factors can fluctuate significantly from year to year based on the amount of hydroelectric power generated by BPA, as is seen between 2011 and 2012.

The Ashland Utility emissions factors show that the Ashland's electricity supply contracts and owned-generation are low-carbon, even if the Utility or the Community does not own those environmental benefits. Because Ashland does not own the environmental benefits of BPA power, a better representation of the climate consequences of Ashland's electricity use is Regional Grid, NWPP. The best representation of is use of NWPP adjusted to account for the REC's purchased voluntarily by Ashland's Utility on behalf of the community from BPA and voluntary, community-at-large REC purchases from Bonneville Environmental Foundation. Ownership of the community-at-large RECs remains with the households and businesses making these purchases, but are included in this inventory so as not to overestimate emissions from grid electricity.[13] For more details and a description of issues with using the TCR protocol for BPA supplied public utilities, see the following Methodology section.

The NWPP Grid (REC adjusted) emissions factor is used to calculate emissions for the Ashland Community and City Government Operations GHG Inventory. It is recommended that a market-based calculation methodology using the regional grid factor (NWPP) adjusted by total community REC purchases is used to calculate emissions in Ashland operational and community inventories.

Figure A3: Comparison of Utility-Specific and Regional Grid emissions factors.

Type of Emissions Factors (MT CO2e / MWh)	2011	2012	2013	2014	2015
Ashland Utility	0.080	0.039	0.044	0.039	0.039*
Regional Grid (NWPP)	0.373	0.304	0.304*	0.304*	0.304*
NWWP Grid (REC adjusted)	0.355	0.288	0.288*	0.288*	0.288*

*Indicates previous year's factor used as proxy. Most recent EPA eGRID factor for NWPP is 2012.
Likewise 2015 data from BPA for Ashland's inventory is not available.

Methodology and Approach

Protocols and Methodology

This inventory follows The Climate Registry's Electric Power Sector Protocol. Calculations used the Bonneville Power Administration's (BPA) 12-month average firm energy resources as reported in BPA's Annual Facts Reports. BPA resources defined as "other" sources of energy

[13] Community-at-large purchases REC data was received late in the process. This data is included in the Audit Trail for the Community inventory, but was only included in the accounting for the 2015 inventory.

were assigned the average Northwest Power Pool (NWPP) energy generation GHG intensity. NWPP emissions factors are provided by the EPA eGRID data tables. All utility GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). The GHG calculations use the global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

There are inherent problems with TCR's Electric Power Sector Protocol accounting methodology when it's applied to publically-owned utilities in our region because of the scale of BPA power generation and the way in which BPA power is preferentially distributed to publically-owned utilities. This inventory for Ashland mostly represents an inventory of BPA power. Therefore it is not recommended that Ashland continue to conduct this inventory in the future. It is clear from this accounting that Ashland's owned and contracted-electricity supply resources are low-carbon. The results of this inventory for Ashland's Electric Utility will not change significantly over time, and will always be correlated with BPA's electricity generation resource mix.

The TCR protocol focuses on emissions from generation of electricity supply, which is appropriate for many electric utilities around the country and around the globe as they move towards renewable electricity generation and away from fossil fuels. Focusing on supply is not as appropriate or useful for small, publically owned utilities served by BPA. For these utilities, it could be argued that the focus should be on energy efficiency and conservation, and cost effective, local renewable generation. In other words - efforts to reduce peak and overall demand by Ashland for grid generated electricity. By reducing demand for grid power, low-carbon BPA electricity can be redirected back to the regional grid to reduce the need for generation from fossil fuels; thereby lowering emissions from the regional electricity grid.

It is anticipated that in the future, Oregon's Clean Power Plan will provide additional guidance on how to best account for climate impacts and help define the most effective means of mitigation for specific communities.

Inventory Boundaries

The boundary of the Utility Inventory is defined by a) sources of power generation owned by Ashland's Municipal Electric Utility and b) the electricity, from any source, distributed, transmitted and delivered by the Utility. Together these sources are comprised of electricity generated and delivered by the Utility's hydro plant and community solar installation and BPA electricity delivered to Utility customers. The Utility also distributes electricity directly to some Pacific Power customers under an agreement with Pacific Power and emissions associated with these deliveries are within this inventory's boundaries.

Data Collection

Good Company worked with Adam Hanks, Project Manager for the City of Ashland to collect the data required to calculate emissions. Primary data collection for the FY2011-2015 inventories was completed in September through December of 2015. Good Company provided the City with a data collection checklist that specified data types and units. The City's Project Manager used the checklist to either directly supply data or coordinate data collection efforts among the appropriate City staff and external parties. After the receipt of a data file, Good Company reviewed it for completeness and asked follow-up questions if necessary. All data source files, answers to follow-up questions, resulting calculation files and related resource files are documented and cataloged an Audit Trail for each inventory year.

Inconsistencies in reported line loss numbers, reported by the City, required Good Company to make assumptions related to line loss effects for several years. The percentage of electricity lost in distribution in 2012 and 2014 was the calculated average of the reported values from 2010, 2011 and 2013. This was necessary because the reported line losses for 2012 and 2014 were unrealistically low and high respectively, and the city could not provide further insight into the methodology used in calculating these values.

Suggestions for Improvements to Future Inventories

As previously mentioned, it is not recommended that Ashland update this inventory in the future, using the TCR protocol. If Ashland does decide to update the inventory, the following suggestions are provided to improve the accuracy:

- Pass through electricity delivery for Pacific Power is tracked separately but is accounted for in Line Loss in the Utility's power generation and consumption reporting. It is recommended that this value be fully split out into a pass-through or 3rd party delivery category.
- Reported Utility Line loss values fluctuate significantly over the FY 2010 – 2014 time period without any indication as to the cause. It is recommended that the values used to calculate line loss be separated and accounted for to better understand the cause of these fluctuations.
- Community owned solar generation is not included in the Utility's generation and delivery report. It is recommended that this be included, especially as this source may grow in the future.

APPENDIX B: COMMUNITY INVENTORY – SUMMARY OF DATA AND EMISIONS FACTORS

Emissions Category	Category Description	Descripion of Data and Emissions Factors
Built Environment		
Residential Energy Commercial Energy Industrial Energy	These categories include direct emissions from natural gas, fuel oil, propane combustion by the residentia, comercial, and industrial sectors within the City of Ashland's geographic boundaries. Also includes the indirect emissions from grid electricity use by the same sectors for the same geographic boundaries.	Electricity and natural gas data provided by utilities and considered highly accurate. Fuel oil and propane use estimated using state-level per capita fuel usage data and Ashland's annual population. Emissions factors for natural gas, fuel oil, and propane are taken from The Climate Registry's 2015 Default Emissions Factors and are considered highly accurate. The Electricity location-based emissions factors are taken from EPA eGRID data for the Northwest Power Pool (NWPP) subregion. The eGRID factors are considered accurate for 2011 and 2012. Emissions factors are not available for 2013 - 2015 and therefore 2012 data is used as a proxy. The 2013 - 2015 emissions factors should be updated and emissions recalculated as the EPA publishes the relevant emissions factors. Market-based factors are based on Ashland's Utility Inventory presented in Section 3 and are considered accurate.
Transportation		
On-Road Energy Off-Road Energy	Direct emissions from gasoline and diesel for passenger and freight transportation as well as off-road vehicles and equipment used for construction.	Emissions are calculated using 2 methods. 1) Emissions are modeled by Oregon's Department of Transportation using the Regional Strategic Planning Model. 2) State-level consumption is downscaled on a per capita basis. Emissions factors for gasoline and diesel and calculation methodology are considered highly accurate. Data source 1 is considered more accurate and therefore used to report results. Data source 2 may be used as a point of comparison.
Refrigerant Loss		
Refrigerant Loss (buildings and vehicles)	Fugitive loss of refrigerants from building and vehicle air conditioning systems.	Actual data on refrigerant loss is not available at the local level. State-level data from Oregon's 2013 GHG Inventory is down-scaled by population to estimate emissions. Emissions factors are taken from The Climate Registry's 2015 Default Emissions Factors.
Solid Waste and Wastewater		
Solid Waste	Fugitive methane emissions from mixed solid waste and wastewater biosolids generated in the Ashland community and disposed of at Dry Creek Landfill. Its important to note that Dry Creek Landfill is modern landfill that collects landfill gas (LFG) and generates electricity. Even using best practices, achieving 100% LFG collection is difficult and therefore solid waste landfill disposal produces GHG emissions.	Mixed Solid Waste: The City was able to provide total shorts tons of materila transfered to Dry Creek Landfill. Annual solid waste weights were multipled by 70% to exclude population outside of the inventory boundaries. An average mixed solids waste (MSW) emissions factor from EPA's Waste Reduction Model (WARM) was used to estimate emissions. In addition to MSW generation from operations, the City also landfills significant quantities of wastewater treatment biosolids. Biosolids: Annual spend data for landfill disposal was available, as were average, annual tip fees charged by Dry Creek Landfill for all inventory years (FY2011 – 15). These data were used to estimate annual wet biosolids disposal weights. Moistue content of biosolids is available from City staff. An emissions factor for biosolids is not included in EPA's WARM and therefore needed to be calculated using the Biosolids Emissions Assessment Model (BEAM).
Water & Wastewater	Fugitive nitrous oxygen emissions from nitrofication / denitrification process and from discharge of treated effluent.	Nitrogen quantities discharged in plant effluent are available for calendar year 2014. 2014 data was used as a proxy for all other inventory years. Ashland population data is readily available for all inventory years and is used to calculate nitrification/denitrification emissions. Emissions factors are taken from LGOP protocol.
Household Consumption-Based Emissions		
Goods	Upstream energy and process emissions raw material extraction, manufacturing, and out-of-state transportation of goods.	Accurate data on quantities consumed and suppliers for the goods and food consumed by Ashland community households is not readily available. Therefore Oregon's Carbon Calculator and US Cencus Bureau data on distribution of households by household income were used to estimate emissions.
Food	Upstream energy and process emissions from the growing, processing and transportation of foods.	
Energy (Fuel Production)	Upstream energy and process emission from the production and distribution of natual gas, gasoline, diesel and electricity consumed either directly or indirectly by the Ashland Community.	Data is readily available for electricity and natural gas, as previously described. Data for gasoline and diesel use is as previously described. Upstream emissions factors are provided in the ICLEI protocol. These factors are based on industry averages and are considered moderately accurate.
City Government Consumption	Upstream energy and process emissions for the production of goods purchased to support City Operations.	Purchasing data (in FY $) is readily available and considered accurate. Emissions factors are provided by the Oregon Department of Environmental Quality's Purchaser Price Model and are considered highly accurate. The City's supply chain emissions (i.e. consumption-based emissios), calculated for the City's Operational inventory are adjusted to remove local services and upstream fuel production emissions to avoid double counting with other emisisons categories.

APPENDIX C: OPERATIONS INVENTORY – SUMMARY OF DATA AND EMISSIONS FACTORS

Emissions Category and Source	Description of Emissions Source	Description of Data and Emissions Factors
Scope 1		
Stationary Combustion	Natural gas combustion by City-owned and leased facilities.	Natrual gas data is only partially available for all inventory years. Data that is available is considered highly accurate. Emissions factors and methodlogy per protocol for stationary combustion are well understood and considered highly accurate.
Mobile Combustion	Gasoline (E10) and diesel (B5) combustion by City-owned vehicles and equipment.	Gasoline and diesel data was readily available by fuel type and by department. Emissions factors and methodlogy per protocol for mobile combustion are well understood and considered highly accurate.
Fugitive Emissions	Fugitive loss of refrigerants from building heating, ventilation and air conditioning (HVAC) systems. Fugitive nitrous oxide (N2O) process emissions are generated during wastewater treatment process.	*Refrigerant Fugitive Loss:* Refrigerant recharge data is considered partially complete with reporting from 1 service vendor for all inventory years. It is possible that there are additional vendors that service the City's building air conditioning units, but they could not be identified for this inventory. A better tracking system could be developed to support future inventories. Fugitive refrigerant loss from vehicles is considered a diminimus emissions source and therefore was excluded from the inventory. Emissions factors and methodlogy per protocol are considered highly accurate. *Wastewater Treatment Process Emissions:* Nitrogen quantities discharged in plant effluent are available for calendar year 2014. 2014 data was used as a proxy for all other inventory years. Ashland population data is readily available for all inventory years and is used to calculate nitrification/denitrification emissions, per methods dictated by GHG inventory protocol. Emissions factors and methodology per protocol are based on industry averages and therefore are considered moderately accurate.
Scope 2		
Electricity	Indirect emissions from grid electricity generation for electricity consumed by City operations.	Data provided by City for purchased electricity is considered highly accurate for all inventory years. Emissions factors are readily available from EPA eGRID for 2011 and 2012. Note 2012 emissions factor is most recent avilable and used as a proxy for 2013 - 2015. Available emissions factors and methodlogy per protocol for electricity are well understood and considered highly accurate. The primary source of uncertainty is lack of emissions factors for 2013 - 2015.
Scope 3		
Employee Commute	Gasoline (E10) combustion by employee-owned	Emissions were estimated using survey data collected in 2015. The survey conducted by City of Ashland provided a modal split and average, one-way commute miles. The City only conducted the survey for a single year. The results of the 2015 survey are used as proxy data for all other inventory years, 2011-2014. The City provided the number of full-time equivalent City staff employed during each inventory year, which were used in conjunction with the survey results to estimate employee commute emissions for all inventory years. Commute methodolgy and emissions factors require some assumptions be made and is therefore considered moderately accurate.
Business Travel	This category includes emissions from: 95,539 miles of air travel; 27,361 miles driven in employee-owned vehicles used for business travel	*Air Travel:* Annual dollars ($) spent on air travel was available and used to estimate passenger-miles traveled using average cost per mile data from Air Travel Association. Air travel emissions factors and calculation methodology per protocol are considered accurate. *Employee-Owned Reimbursed Mileage:* Annual dollars ($) reimbursed to employees was available for all inventory years. This data was used to calculate vehicle miles traveled based on annual corporate per mile reimbursement rates. Fuel efficiency values from the commute survey were used to convert miles to gallons. This methdology is per protocol and considered to be moderately accurate. Once gallons have been calculated the emissions factors and methodlogy per protocol for mobile combustion are considered highly accurate.
Solid Waste	Types / quantity of waste and destination landfill with methane management technique. Include how much waste was generated.	*Mixed Solid Waste:* The City was able to provide a receptacle count; volume of each receptable; and frequency of pickup for all City facilities. Annual volume was converted to weight using solid waste density values. Based on available data, the operational inventory assumes that all inventory year's (FY2011 – 215) MSW generation is equal. Dry Creek Landfill is a modern landfill with a landfill gas collection system and electricity generation. An average mixed solids waste (MSW) emissions factors was taken from the EPA's Waste Reduction Model (WARM) that represents local landfill management practices. In addition to MSW generation from operations, the City also landfills significant quantities of wastewater treatment biosolids. *Biosolids:* Annual spend data for landfill disposal was available, as were average, annual tip fees charged by Dry Creek Landfill for all inventory years (FY2011 – 15). These data were used to estimate annual wet biosolids disposal weights. An emissions factor for biosolids is not readily available as part of EPA's WARM and therefore needed to be calculated using the Biosolids Emissions Assessment Model (BEAM). The biosolids were reported This calculation and the resulting values are documented in Operational Inventory Audit Trail and G3C.
Supply Chain	Upstream energy and process emissions for the production of goods purchased to support City Operations.	Annual spend data was readily available and was moderately compatible with Oregon Department of Environmental Quality's *2010 Purchaser Price Model*. The ODEQ model provides a database of emisions factors for roughly 400 economic sectors for Oregon. The methodology used follows best practice.Its important to note that there is significnat general uncertainty in estimating supply chain emissions (ie. consumption-based) due to the reliance on a large, complecated economic models to estimate emissions using industry averages. See Supply Chain detailed results for more information. Upstream energy and process emissions