Quick Tracker Community Greenhouse Gas Emissions Inventories: 2012 & 2013

CITY OF ASPEN, CANARY INITIATIVE

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Community Greenhouse Gas Emissions

Quick Tracker Inventory: 2012 & 2013

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ACRONYMS

AE	Aspen Electric
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
DMV	Department of Motor Vehicles
EIB	Emissions Inventory Boundary
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
HCE	Holy Cross Energy
ICLEI	International Council for Local Environmental Initiatives
MPG	Miles per gallon
mt	Metric tons
N_2O	Nitrous Oxide
RFTA	Roaring Fork Transportation Authority
VMT	Vehicle Miles Travelled

EXECUTIVE SUMMARY

2012 & 2013 Total Emissions

The importance of reporting electricity annually is illustrated in the differences between 2012 and 2013 emissions. These differences could be attributed to varying climate causing different consumption rates, higher occupancy in 2013, as well as other unknown factors. However, the emissions factors for Aspen Electric and Holy Cross Energy increase substantially from 2012 to 2013. One could assume this is a result of a change in fuel mix from 2012 to 2013; and fuel mix can be affected by elements of policy, economics, and climate. For example, 2011 was a dry and low snowpack year that reduced water available for hydropower generation and caused a more carbon intense fuel mix for 2013.

Below are the Total Emissions for each year:

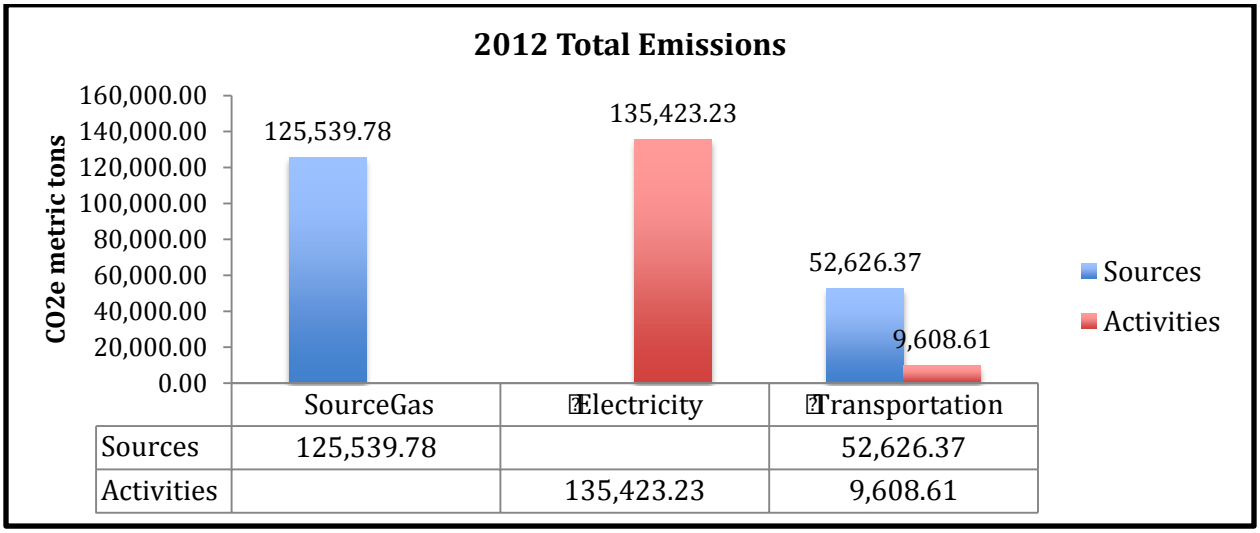


Figure 0.1. 2012 Total Emissions

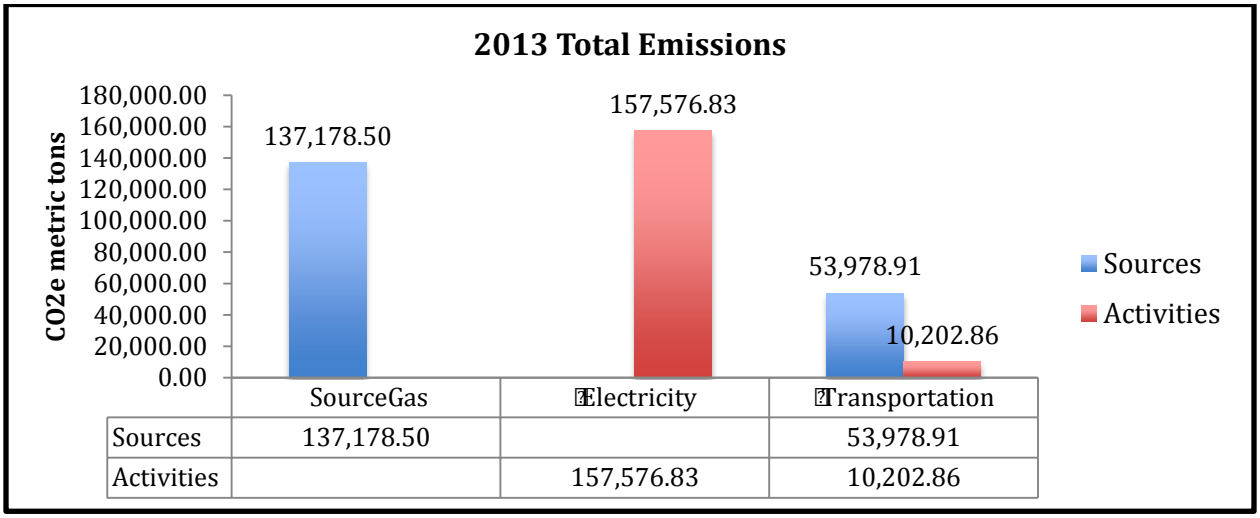


Figure 0.2. 2013 Total Emission

1 INTRODUCTION

The City of Aspen municipal government is a leader in greenhouse gas (GHG) emissions tracking, climate planning, and environmental sustainability initiatives among cities of its size and larger. In 2006, The Canary Initiative was created to oversee all goals, programs, and tracking associated with climate and energy related work. In 2005, the City adopted a policy to reduce emissions 30% by 2020 and 80% 2050 in their Climate Action Plan. To track progress, the City conducts an "internal" greenhouse gas inventory which accounts for the emissions associated with City operations. The City also conducts a "community" inventory every three years that quantifies emissions among all sectors within the Emissions Inventory Boundary (EIB).

In 2014, the City of Aspen commissioned the design and implementation of a Quick Tracker GHG emissions inventory accounting tool. The Quick Tracker identifies key sectors for Aspen's greenhouse gas emissions and, in essence, conducts a mini inventory of emissions from those sectors for years in between full inventories. The community Quick Tracker mechanism helps city staff better assess how various programs and projects are moving the needle on emissions reductions on an annual basis, without dedicating the time and resources to conducting a full, ICLEI-compliant inventory.

The report that follows contains the first ever inventories conducted using this Quick Tracker tool. It reports emissions from stationary combustion of natural gas, electricity use, and mobile combustion from passenger vehicles and transit for 2012 and 2013.

2 METHODOLOGY

2.1 WHAT'S INCLUDED IN THE QUICK TRACKER INVENTORY?

According to the Quick Tracker methodology, a Quick Tracker inventory includes emissions from:

1. Stationary combustion of natural gas, from residential and commercial sectors
2. Electricity use by residential and commercial sectors, as provided by Aspen Electric and Holy Cross Energy
3. Mobile combustion resulting from passenger vehicles driving within Aspen, passenger vehicles commuting to and from Aspen, and RFTA buses operating within Aspen and to and from Aspen from Glenwood Springs.

2.2 HOW IS THE QUICK TRACKER INVENTORY ORGANIZED?

As recommended by the ICLEI Community Greenhouse Gas Reporting Protocol and by Beckman and Goldberg 2014a, community inventories should be sorted by sources and activities to help city officials conceptualize, organize, and inform policy to meet reduction targets.

Table 2.1 Source and Activity Emissions of the City of Aspen.

"Source" Emissions of Aspen	"Activity" Emissions of Aspen
Built Environment	
SourceGas	Holy Cross Energy
	Aspen Electric
Transportation	
Driving Around Town	Passenger Commuter Traffic
RFTA City of Aspen Bus data	RFTA Valley-Wide Commuter data

2.3 DATA COLLECTION METHODOLOGY

Methods for this study were developed in conjunction with ICLEI guidance for community quick tracker methodologies. Despite the Quick Tracker not being a complete inventory, it can be expanded on to be a fully compliant inventory (refer to Report 1: "Recommendations for Future Inventories"). This section provides a brief over view of how the authors collected

necessary data for each calculation. For more detailed methods please refer to Report 2: Data Management Plan Methodology document, Section 4.

2.3.1 Electricity

The City of Aspen's past inventories indicated the utilities that were necessary to report in the Quick Tracker.

2.3.1.1 Aspen Electric and Holy Cross Energy

By using the total electricity consumed (kWh) of the residential and commercial subdivisions, we are able to calculate the total emissions of CO_2, CH_4, and N_2O. Each of these emissions are calculated by the utility-specific carbon factor and eGRID's subregion acronym RMPA-WECC Rockies. After the total consumption is multiplied by each emissions factor, the GHG emission totals were multiplied by their associated GWP (100-year); this provides the CO_2e of each GHG. Lastly, GHG emissions (CO_2e) were converted to metric tons. It is important all CO_2e metric tons are separated by residential, commercial, and total emissions. The combination of the subdivision will indicate the total emissions attributed to Aspen Electric and Holy Cross Energy, while the subdivisions illustrate the areas responsible for emissions and how they could be improved.

2.3.2 Stationary Combustion

2.3.2.1 Source Gas

Using the total therms consumed by the residential and commercial subdivisions, we were able calculate total emissions of CO_2, CH_4, and N_2O. CO_2 was calculated using the utility-specific emissions factor, and CH_4 and N_2O were calculated using ICLEI's The Built Environment Appendix-C "Table B.3 Default Methane and Nitrous Oxide Emissions Factor by Fuel Type and Sector." The total consumption of each subdivision was multiplied by the GHG emissions factors, then converted to CO_2e through the corresponding GWP. Lastly, these totals were converted to metric tons and summed; providing a total CO_2e metric by subdivision.

(Note: Refer to Report 1: "Recommendations for Future Inventories" for Stationary Combustion calculations for SourceGas Activities)

2.3.3 Transportation

The Driving Around Town data was provided by "Air Pollution Control Division Colorado Department of Public Health and Environment 2001" while the Pitkin County DMV provided Beckman and Goldberg with "Vehicle Registration Data" for 2012. This data provides the average vehicle type, make, and year within the urban growth boundary. For 2012, the data indicated that a 2001 Grand Jeep Cherokee, 4.0L automatic 2WD was the mid-technology

vehicle (please refer to Appendix A of the Data Management Plan for more information on Assumptions).

For both source and activities of the Transportation sector, Beckman and Goldberg used the mid-technology vehicle for 2012 and 2013 commuter data by utilizing the highway fuel economy (please see section "3.3 Commuter Traffic" in the "Data Management Plan"). Assumed vehicle miles traveled by passenger vehicles and RFTA commuters was 82.2 miles (please refer to Appendix A of the Data Management Plan for more information on Assumptions).

Table 2.2 Mid-Technology Vehicle Type for 2012 & 2013

Mid-Technology Vehicle	Fuel Economy (city/highway)	CO_2 emissions factor	CH_4 emissions factor	N_2O emissions factor
"2012" *2001* *Jeep Grand Cherokee*	(14/20)	8.78 kg/gallon	.0151 g/mi	.0164 g/mi
"2013" *2002* *Jeep Grand Cherokee*	(14/19)	8.78 kg/gallon	.0178 g/mi	.0228 g/mi

3 2012 EMISSIONS

3.1 REPORTED BY SOURCES & ACTIVITIES

ICLEI's Significant Influence framework divides emissions by sources and activities that help officials develop a deeper understanding of their community emissions. In other words, the City government can conceptualize, organize, and report emissions and identify areas where efficiency measures have been successful, could be improved, and inform policy. The distinction between sources" and activities" help city officials avoid double counting on a regional scale. An "Activity" refers to a community activity that results in the creation of GHG emissions either directly (e.g., use of household furnaces and vehicles with internal combustion engines) or indirectly (e.g., use of electricity created through combustion of fossil fuels at a power plant). On the other hand, a "Source" is a physical process or activity that releases GHG emissions into the atmosphere.

For each year, the Quick Tracker divides emissions by sources and activities in the Building and Transportation sectors. In terms of policy, this can help City officials understand where the density of community's emissions come from and how to improve that sector with sustainability initiatives, policy, and incentivizing other technologies.

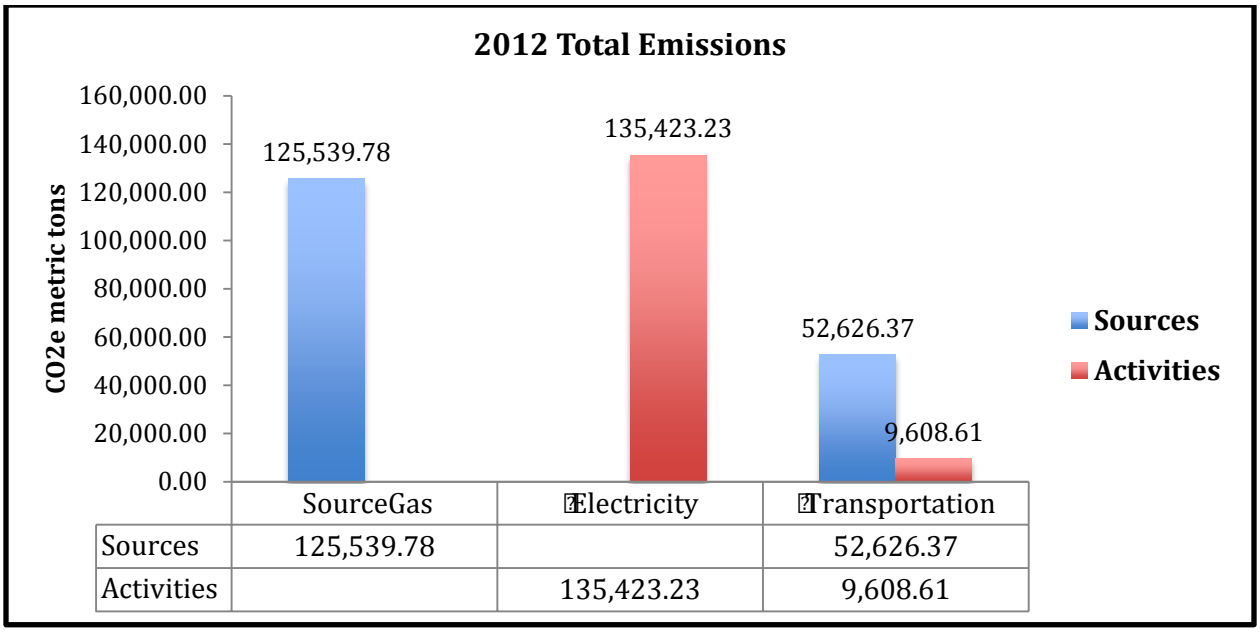


Figure 3.1 The Total Emissions by Sources and Activities within each sector (stationary combustions, electricity, and transportation)

3.1.1 2012 Building Sector Sources

Due to the Quick Tracker focusing on three primary sectors, the built environment is divided according to sources and activities of stationary combustion and electricity. According to ICLEI's framework, because SourceGas is combusted within the EIB in the residential and commercial sectors, it is a source. On the other hand, because Holy Cross and Aspen Municipal Electric are generated outside of the EIB they are considered an activity.Please refer to Table 2.1 for an explanation of the division of sources and activities within the Building Sector for the City of Aspen.

As illustrated in Figure 3.2 below, SourceGas is the main contributor to the source emissions of the Building Sector in 2012..

Table 3.1 2012 Sources of the Building Sector's emissions factors and consumption.

2012 "Source" of the Building Sector	SourceGas
Emissions Factor	0.1179 lbs CO_2 / kBtu
Residential Consumption	780166900 kBtu
Commercial Consumption	780678700 kBtu

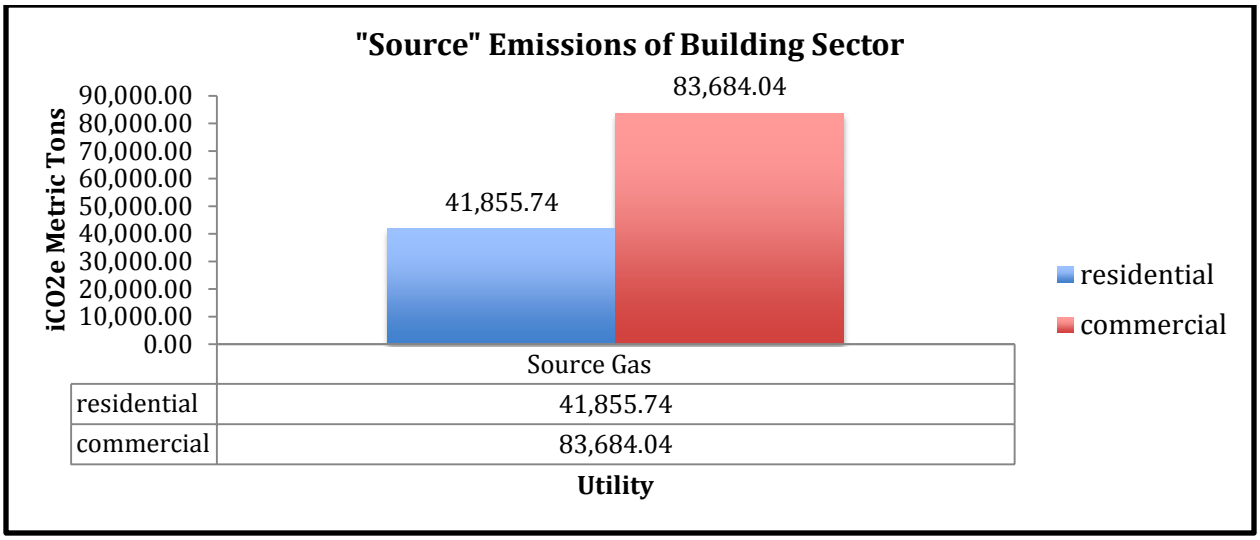


Figure 3.2 2012 Source Emissions of the Building Sector

3.1.2 2012 Activities of the Building Sector

According to ICLEI's framework, Holy Cross Energy and Aspen Electric are activities of the building sector. This can be seen in "Table 1: The division of Sources versus Activities within the Building Sector" in section 4.1.1. Below is a table depicting the emissions factors and subdivisions of consumption.

Table 3.2 2012 Activities of the Building Sector

2012 Activities of the Building Sector	Holy Cross Energy	Aspen Electric
Emissions Factor	1,810 lbs CO_2/MWH	485 lbs CO_2/MW
Residential	89,472.2 MWh	21337.645 MWh
Commercial	58,319.6 MWh	38608.827 MWh

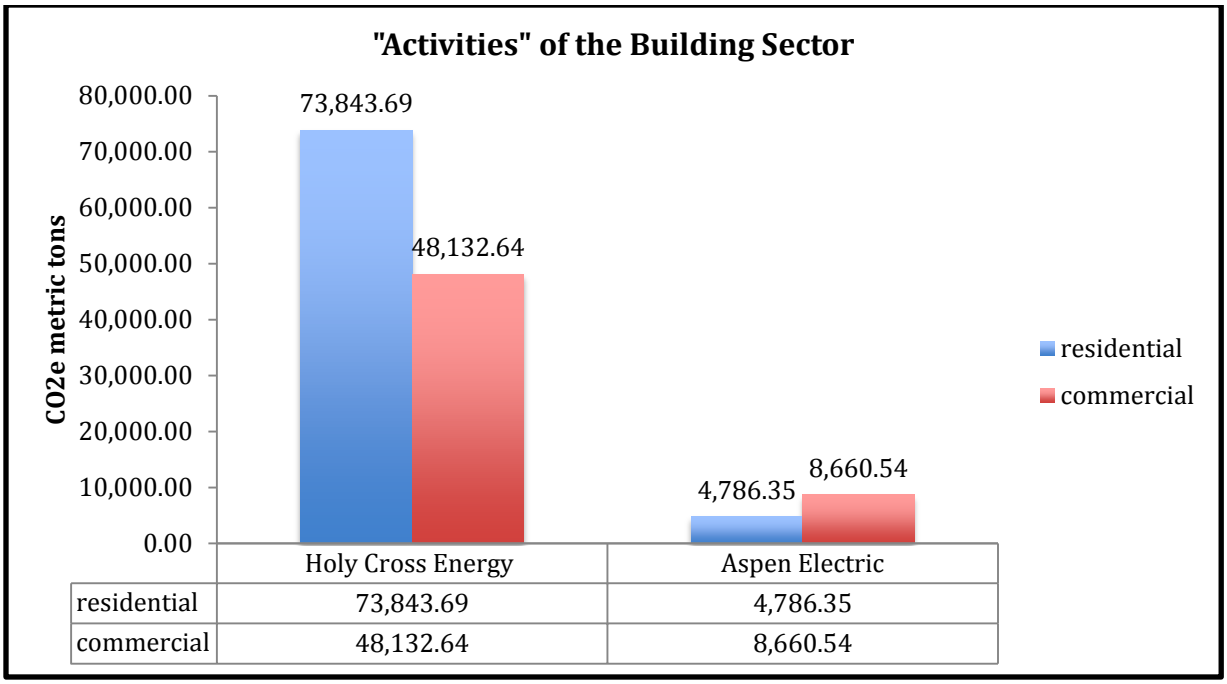


Figure 3.3 2012 Activity Emissions of the Building Sector

3.1.3 2012 Sources in the Transportation Sector

Sources of the Transportation sector are "Driving Around Town" and RFTA Aspen-only bus routes. These emissions are combusted only within the urban growth boundary, and are therefore sources. Beckman and Goldberg chose this data to capture the true emissions associated with the City of Aspen versus the emissions associated with the activities of Aspen, such as commuter data. Regretfully, RFTA data is not included in this inventory, please refer to Report 1: Recommendations for Future Inventories for more information.

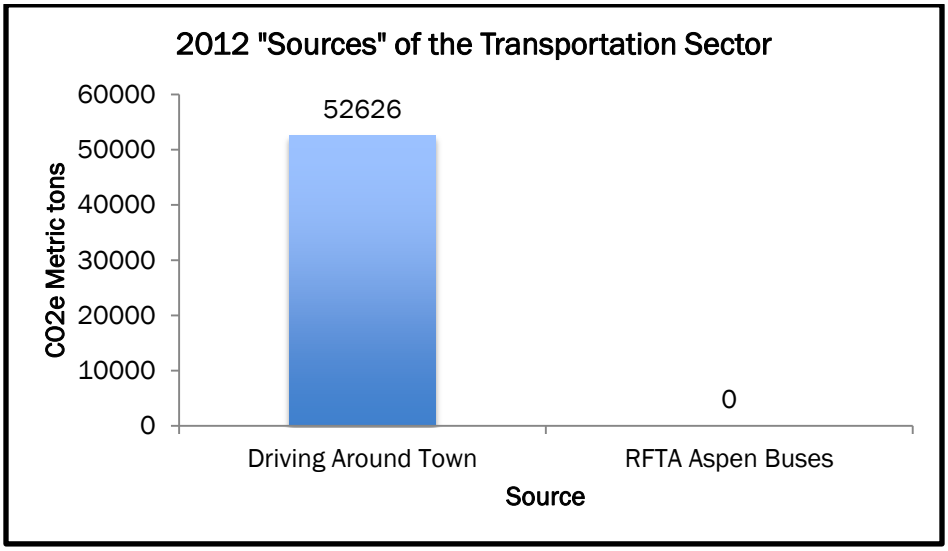


Figure 3.4 2012 Sources of the Transportation Sector

3.1.4 2012 Activities of the Transportation Sector

As mentioned in section "3.1.3 Sources of the Transportation Sector," activities associated with the city of Aspen are people commuting into Aspen's urban growth boundary. Beckman and Goldberg have captured these emissions by separating two types of commuter activities, commuters in passenger vehicles and commuters on RFTA valley-wide transit. The city of Aspen provided Traffic Counter data that tracked vehicles crossing into the urban growth boundary of Aspen. Please refer to "Table 4: Mid-Technology Vehicles used for 2012 and 2013 Inventories" for vehicle information.

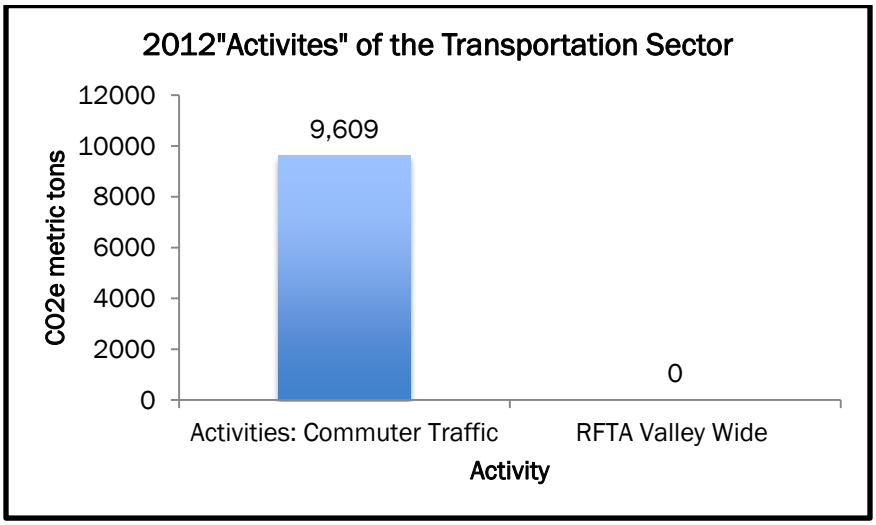


Figure 3.5 2012 Activities of the Building Sector

3.2 REPORTED BY SECTORS

This additional section of the inventories provides greater context to the emissions by illustrating the total emissions of the Building (stationary combustion and electricity) and Transportation sectors.

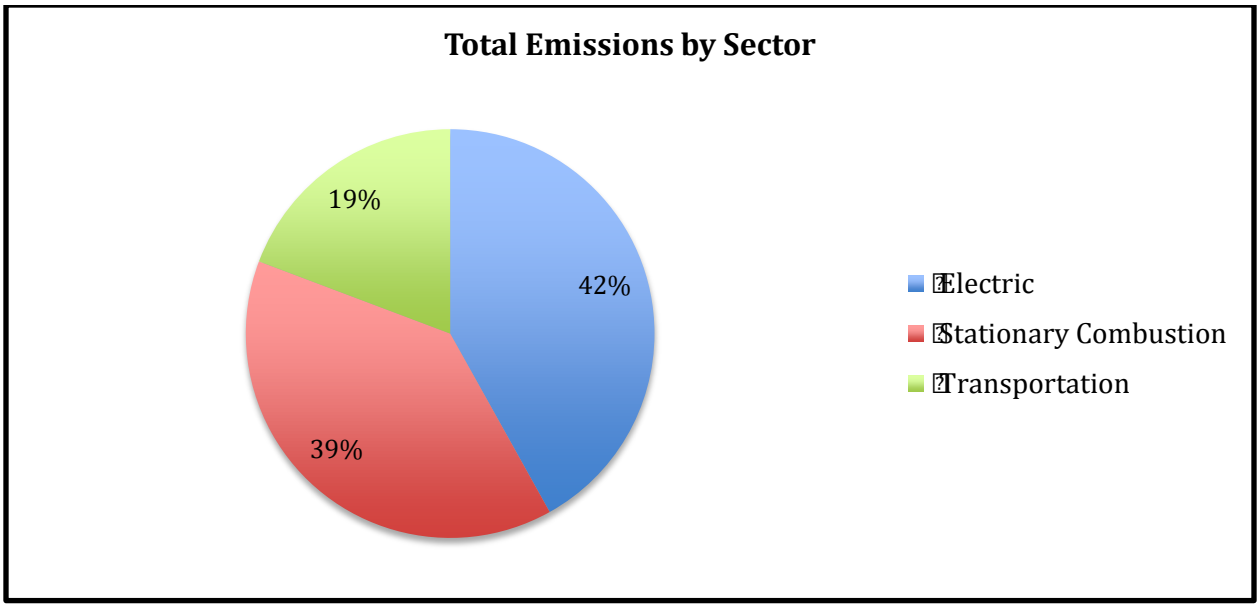
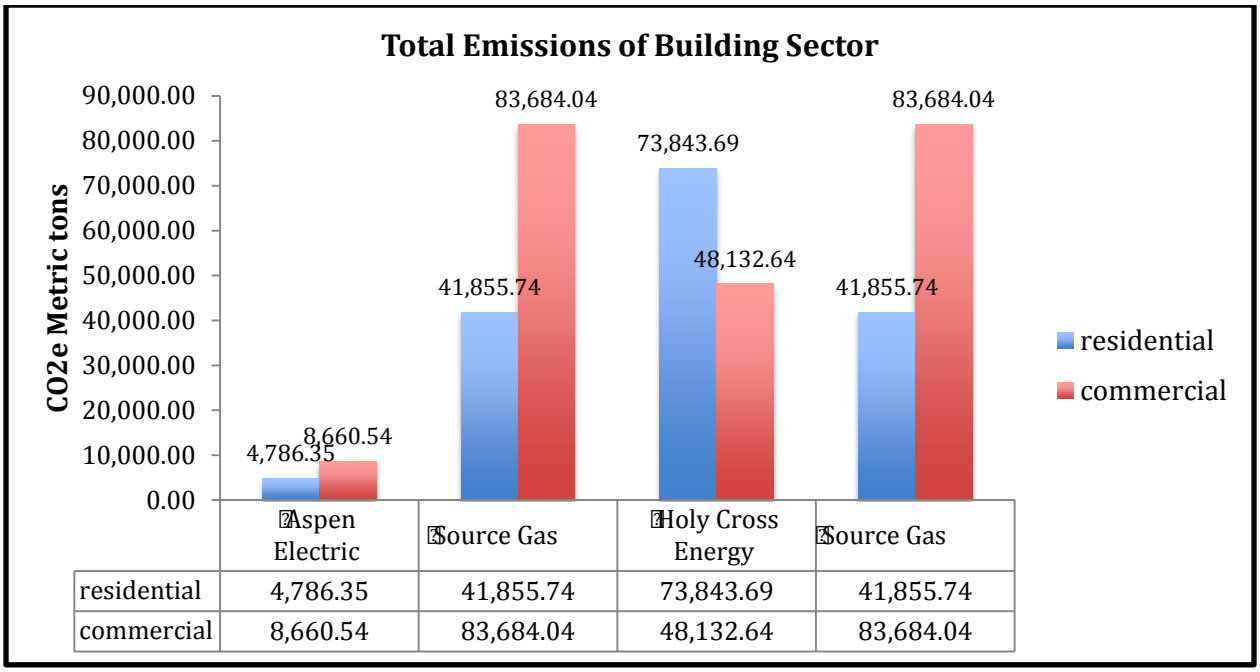


Figure 3.6 2012 Total Emissions of the Building Sector (stationary combustion and electricity) and Transportation illustrates the main contributors to the City of Aspen's total emissions by percentage of total emissions.

3.2.1 2012 Total Emission of the Building Sector

The total emissions of the Building Sector consist of Aspen Electric, SourceGas, Holy Cross Energy, and SourceGas (industrial). Additionally, the emissions associated with each category are divided by the subdivisions of residential and commercial CO_2e metric tons of emissions.



	Aspen Electric	Source Gas	Holy Cross Energy	Source Gas
residential	4,786.35	41,855.74	73,843.69	41,855.74
commercial	8,660.54	83,684.04	48,132.64	83,684.04

Figure 3.7 2012 Total Emissions of the Building Sector

3.2.2 2012 Total Emissions of the Transportation Sector

The total emissions of the Transportation sector illustrates both source and activity emissions affiliated with the city of Aspen.

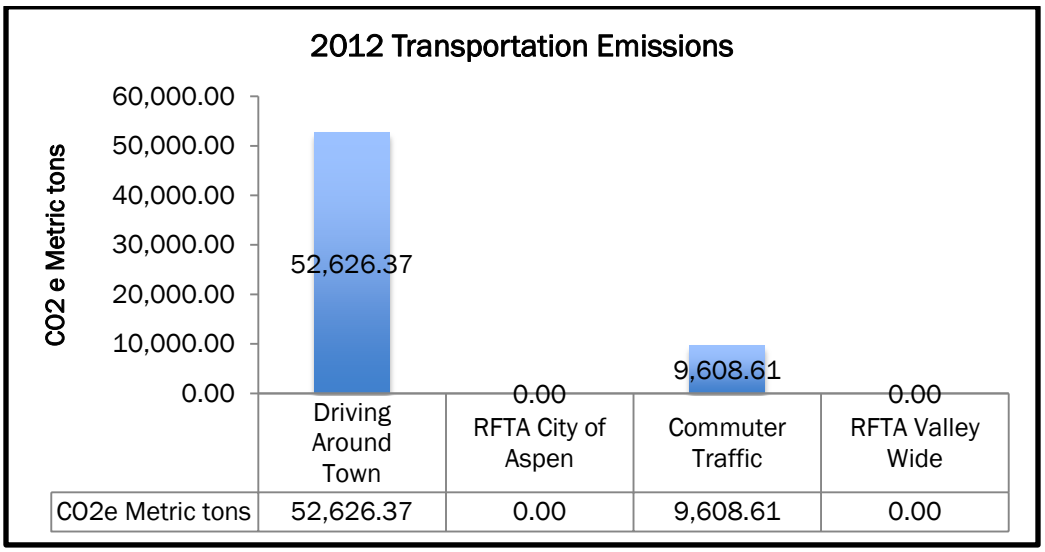


Figure 3.8 2012 Transportation Emissions

3.3 2012 TOTAL EMISSIONS OUTLOOK

The total emissions outlooks combines all the emissions associated with the city of Aspen for 2012.

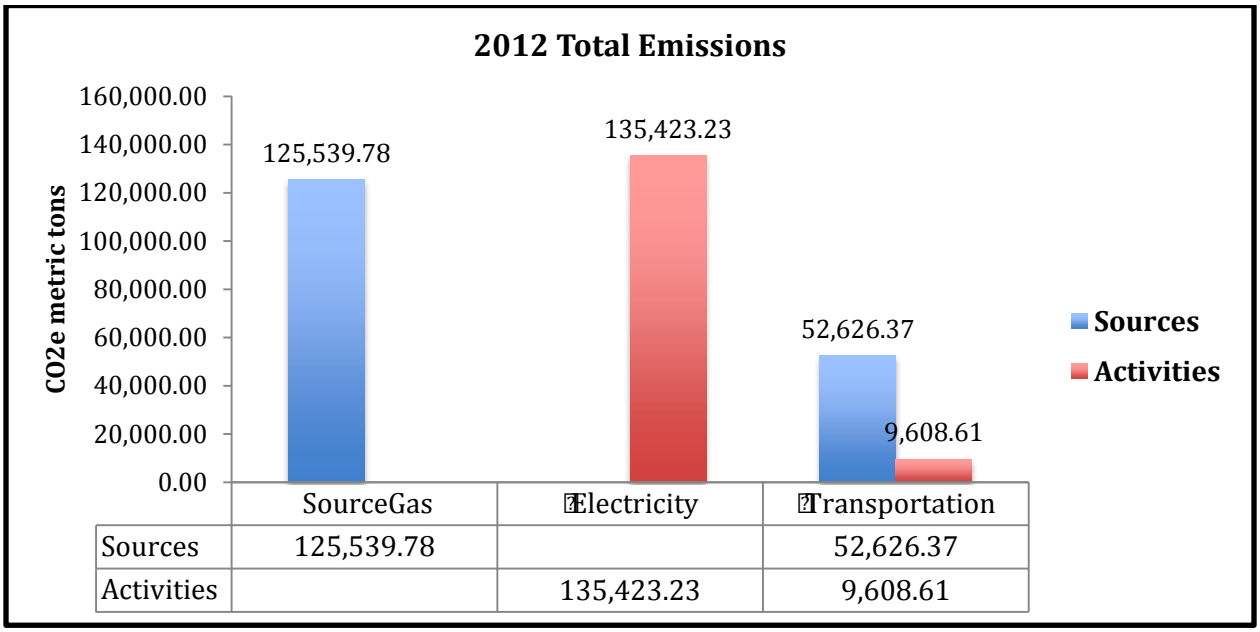


Figure 3.9 2012 Total Emissions

As demonstrated by the figure below, Holy Cross Electric is the main contributor to the City of Aspen's 2012 emissions. Holy Cross Energy supplies a large portion of electricity to consumers within the EIB and there the City of Aspen compared to Aspen Electric. Additionally, there is a dramatic difference between Holy Cross Energy and Aspen Electric's CO_2e emissions factors. Emissions factors are determined by quantifying the carbon intensity of the fuels used for electrical generation. The different fuel mixes of energy suppliers demonstrate an opportunity for the City of Aspen to implement incentives to reduce electricity demand within the building sector. This would directly decrease consumption of Holy Cross Energy's high GHG emitting electricity, as well as, distribution and transmission losses.

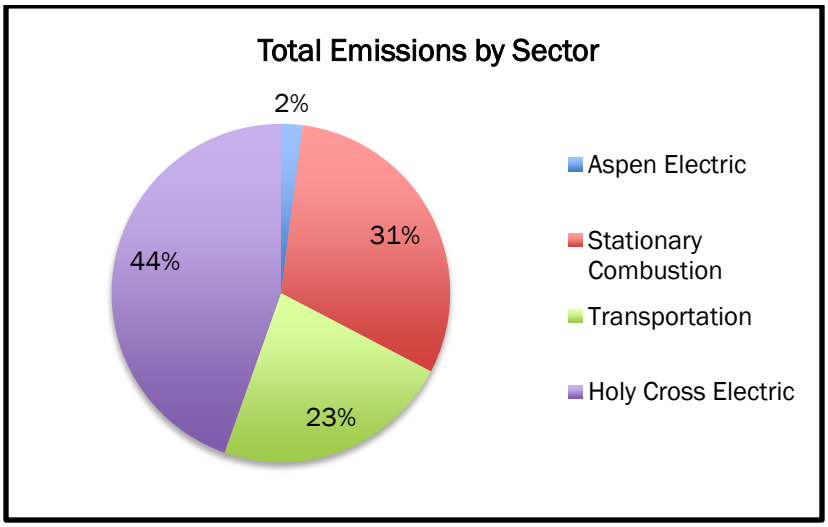


Figure 3.10 2012 Total Emissions by Sector percentage.

4 2013 EMISSIONS

4.1 REPORTED BY SOURCES & ACTIVITIES

4.1.1 2013 Sources of the Building Sector

Due to the Quick Tracker focusing on three primary sectors, the built environment is divided according to sources and activities of stationary combustion and electricity. According to our framework, because SourceGas is combusted within the urban growth boundary in the residential and commercial sectors it is a source. Additionally, Aspen Electric is generated within the urban growth boundary, which makes it a source. On the other hand, because Holy Cross is generated outside of the urban growth boundary it is considered an activity. Similarly, SourceGas is also considered an activity. The activity is the "mining" and extraction of the natural gas by the utility. The total volume provided to the City of Aspen would multiply the emissions factors associated with the extraction. By separating SourceGas as an activity and a source, the City can identify areas to improve stationary combustion technology within the urban growth boundary. Please refer to Table 2.1 Division of Sources and Activities for

the City of Aspen for an explanation of the division of sources and activities within the Building Sector for the City of Aspen.

As illustrated in Figure 2 below, SourceGas is a large contributor to the Source emissions of the Building Sector in 2013. It is important to note the impact of 2013 emissions factor for both Aspen Electric and SourceGas.

2013 "Source" of the Building Sector	SourceGas
Emissions Factor	0.1102 lbs CO_2 / kBtu
Residential Consumption	950,896,700 kBtu
Commercial Consumption	893,000,600 kBtu

Table 4.1 2013 Sources of the Building Sector's emissions and consumption.

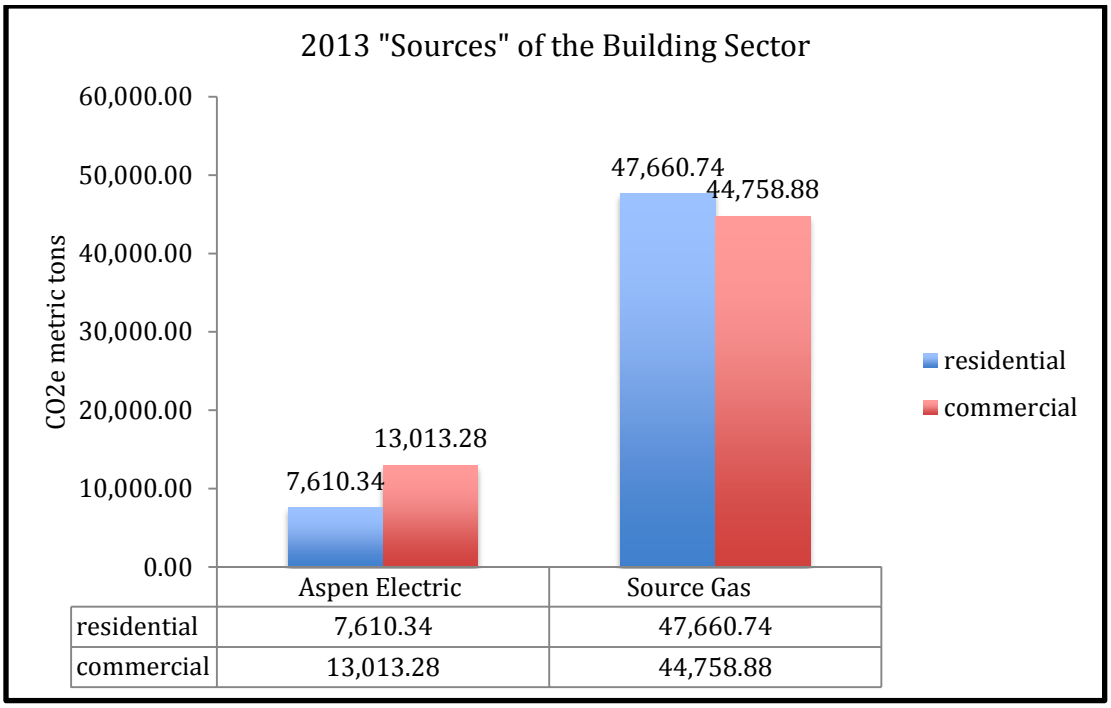


Figure 4.1 2013 Sources of the Building Sector Emissions

4.1.2 2013 Activities of the Building Sector

According to our framework, Holy Cross Energy and SourceGas (industrial) are activities of the building sector. This can be seen in "Table 1: The division of Sources versus Activities within the Building Sector" in section 4.1.1. Below is a table depicting the emissions factors and subdivisions of consumption.

Table 4.2 2013 Activities of the Building Sector's emissions factors and consumption.

2013 Activities of the Building Sector	Aspen Electric	Holy Cross Energy
Emissions Factor	710 lbs CO_2/MWh	1,930 lbs CO_2/MWH
Residential	23,156.9 MWh	96,005.4 MWh
Commercial	39,597.2 MWh	607,15.2 MWh

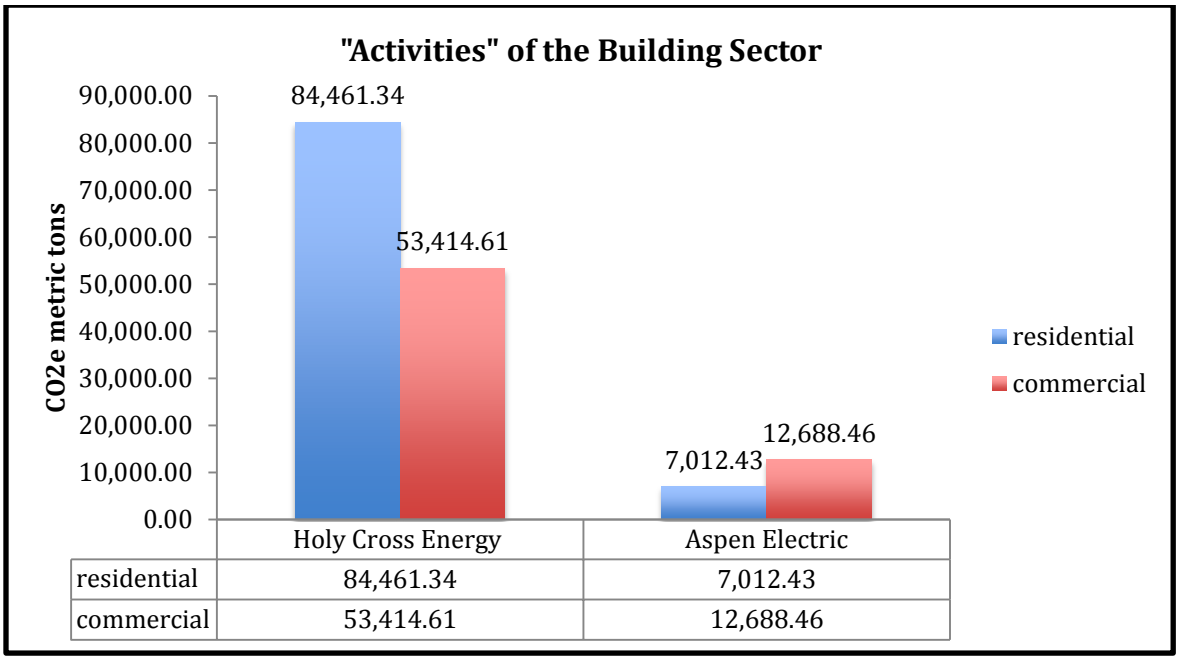


Figure 4.2 2013 Activities of the Building Sector

4.1.3 2013 Sources of the Transportation Sector

As mentioned in section "3.1.3 Sources of the Transportation Sector," activities associated with the city of Aspen are people commuting into Aspen's urban growth boundary. Beckman and Goldberg have captured these emissions by separating two types of commuter activities, commuters in passenger vehicles and commuters on RFTA valley-wide transit. Please refer to "Table 4: Mid-Technology Vehicles used for 2012 and 2013 Inventories."

Table 4.3 Mid-Technology Vehicle Type used for 2012 & 2013

Mid-Technology Vehicle	Fuel Economy (city/highway)	CO_2 emissions factor	CH_4 emissions factor	N_2O emissions factor
"2012" *2001 Grand Jeep Cherokee*	(14/20)	8.78 kg/gallon	.0151 g/mi	.0164 g/mi
"2013" *2002 Grand Jeep Cherokee*	(14/19)	8.78 kg/gallon	.0178 g/mi	.0228 g/mi

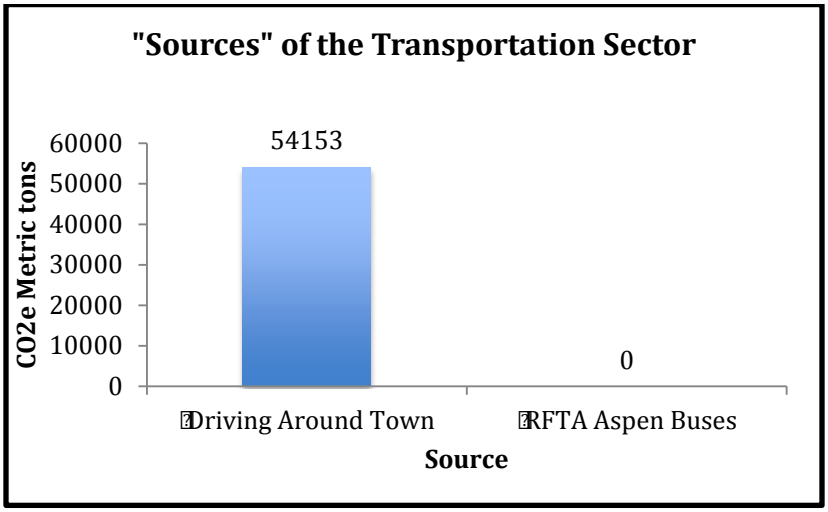


Figure 4.3 2013 Sources of the Transportation Sector Emissions.

4.1.4 2013 Activities of the Transportation Sector

Sources of the Transportation sector are "Driving Around Town" and RFTA Aspen only bus routes. These emissions are combusted only within the urban growth boundary, and are therefore sources. Beckman and Goldberg chose this data to capture the true emissions associated with the City of Aspen versus the emissions associated with the activities of Aspen, such as commuter data. The Driving Around Town data was provided by " Air

Pollution Control Division Colorado Department of Public Health and Environment 2001" while the Pitkin County DMV provided Beckman and Goldberg with "Vehicle Registration Data" for 2013. This data provides the average vehicle type, make, and year within the urban growth boundary. The mid-technology vehicle for 2013 Driving Around Town data, which indicated the mid-technology vehicle to be a 2002 Grand Jeep Cherokee, 4.0L, automatic 2WD (please refer to Appendix A of the Data Management Plan for more information on Assumptions).

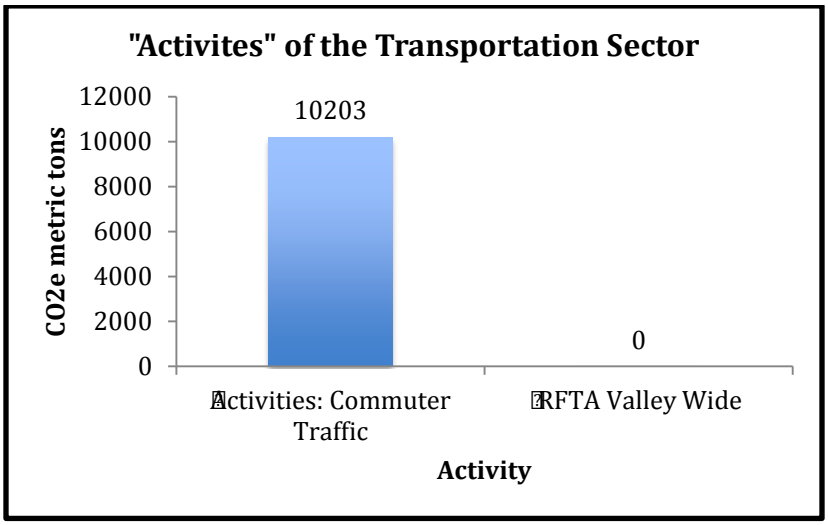


Figure 4.4 2013 Activities of the Transportation Sector

4.2 Report by Sector

This additional section of the inventories provides greater context to the emissions by illustrated the total emissions of the Building (stationary combustion and electricity) and Transportation sectors.

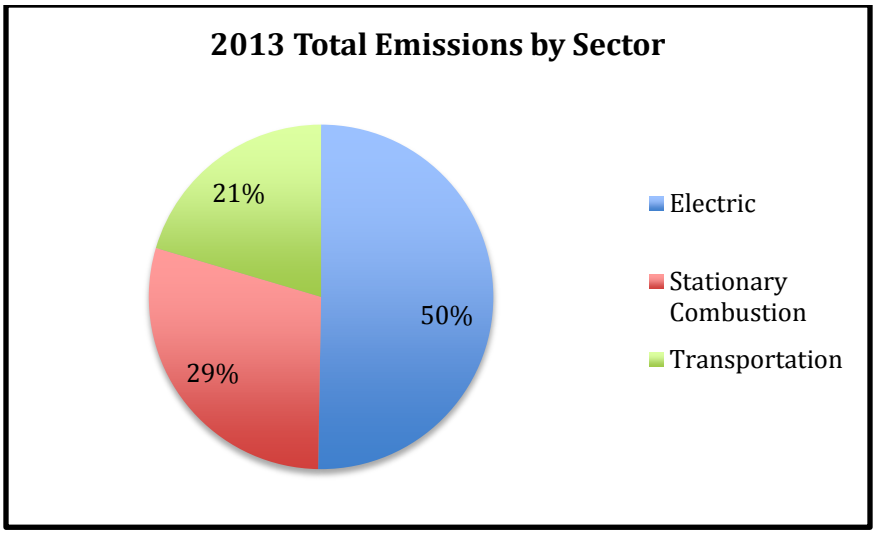


Figure 4.5 2013 Total Emissions by Sector Percentage Total.

4.2.1 2013 Building Sector

The total emissions of the Building Sector consist of Aspen Electric, SourceGas and Holy Cross Energy. Additionally, the emissions associated with each category are divided by the subdivisions of residential and commercial CO_2e metric tons of emissions.

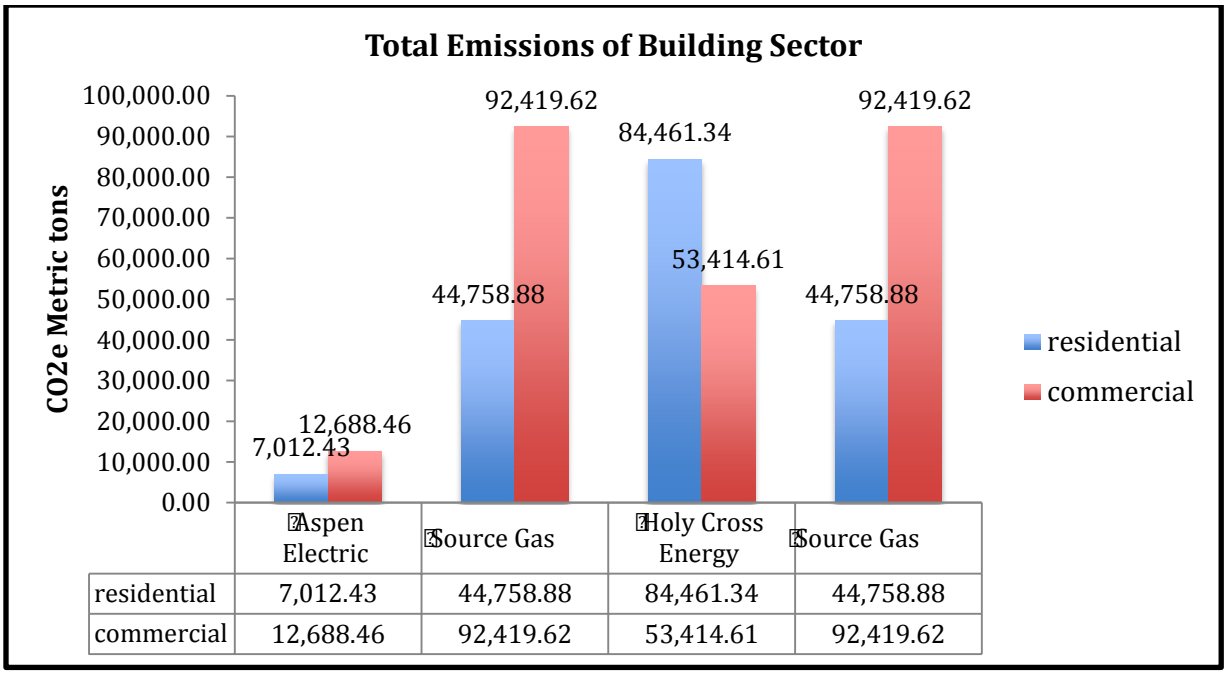


Figure 4.6 2013 Total Emissions of Building Sector

4.2.2 2013 Emissions of the Transportation Sector

The total emissions of the Transportation sector illustrates both source and activity emissions affiliated with the city of Aspen.

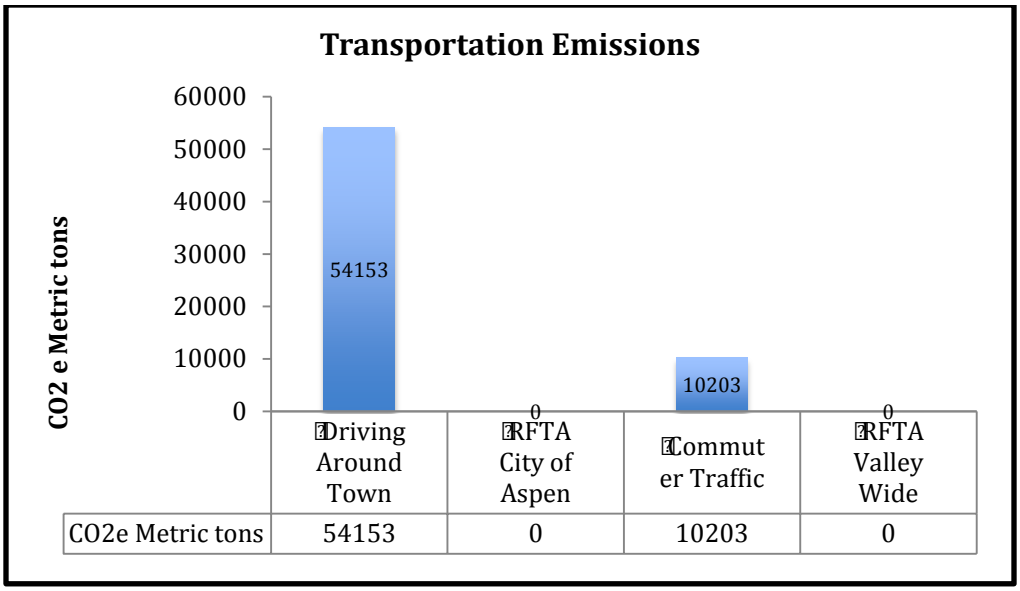


Figure 4.7 2013 Transportation Emissions

4.3 2013 Total Emissions Outlook

The total emissions outlooks combines all the emissions associated with the city of Aspen for 2013 by sources and activities. By providing the "Total Emissions Outlook" section, City officials can identify areas where efficiency measures can be implemented, policies incentivizing cleaner technologies, or policy.

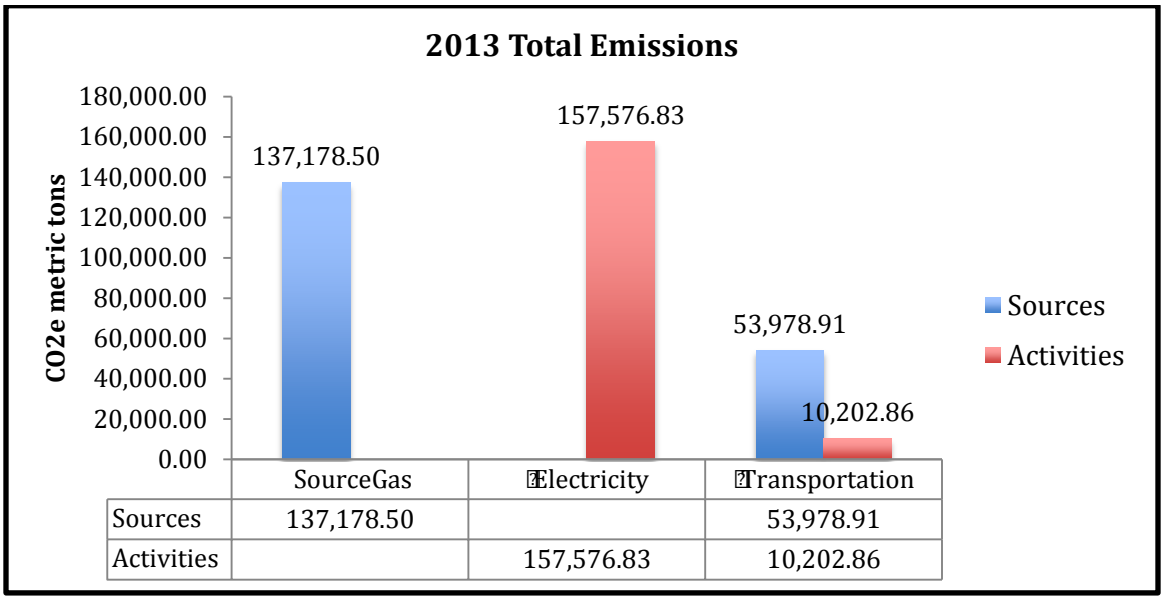


Figure 4.8 2013 Total Emissions

As demonstrated by the figure below, Holy Cross Electric is the main contributor to the City of Aspen's 2013 emissions. Yet, Holy Cross Energy supplies a large portion of electricity to the City of Aspen compared to Aspen Electric. Additionally, there is a dramatic difference

between Holy Cross Energy and Aspen Electric's CO_2 e emissions factors, which is due to the fuel mixes of each electricity producer. This is a perfect example of an area the City of Aspen can implement efficiency incentives to reduce overall electricity demand of the building sector, which would directly decrease the consumption of Holy Cross Energy's high emission electricity.

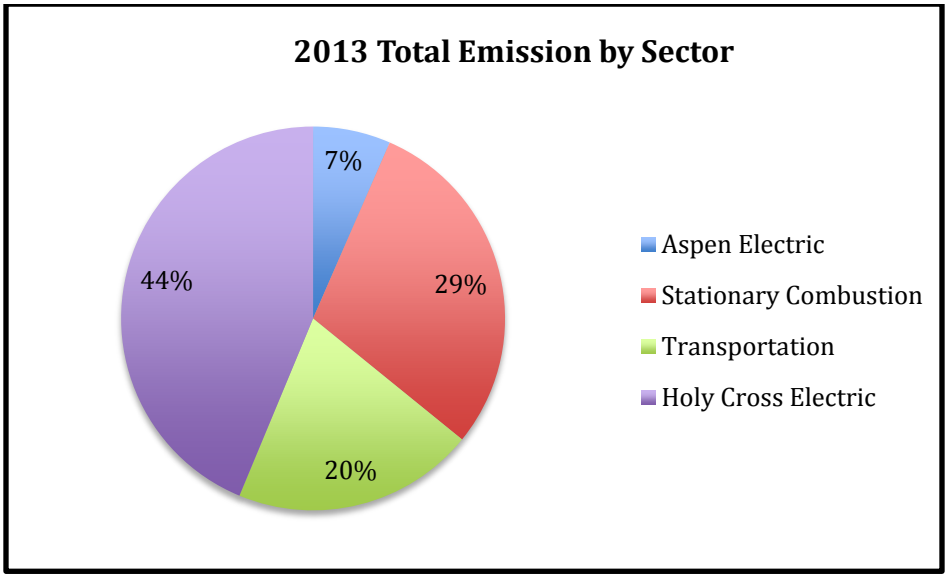


Figure 4.9 2013 Total Emissions by Sector Service percentage.

5 COMPARATIVE EMISSIONS

5.1 2012 & 2013 TOTAL EMISSIONS

5.1.1 Electricity

The total emissions by Sector are illustrated in the table below.

Table 5.5.1 2012 & 2013 Total Emissions by Sector

Total Emissions by Sector in $MtCO_2e$			
Year	Electric	Stationary Combustion	Transportation
2012	135,423	83,684	62,235
2013	158,500	92,420	64,356

The total emissions (135,423 CO_2e metric tons) can be compared to the annual emissions of:

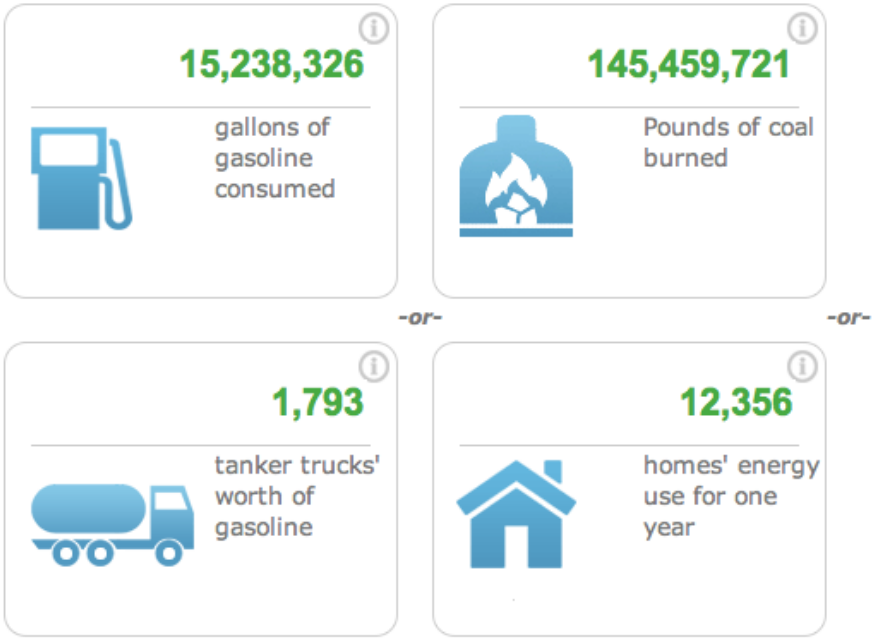


Figure 5.1 Comparative Emissions for 2012 Electricity.

Despite the City of Aspen having 5,802 homes (city-data.com), in 2012 the electricity sector emits the equivalent of 12,356 homes. Assuming a home in Aspen consumes the EPA's average home, the commercial subdivision is the dominant source of emissions in the electricity sector.

The total emissions of 2013 (158,500 CO_2e metric tons) can be compared to the annual emissions of:

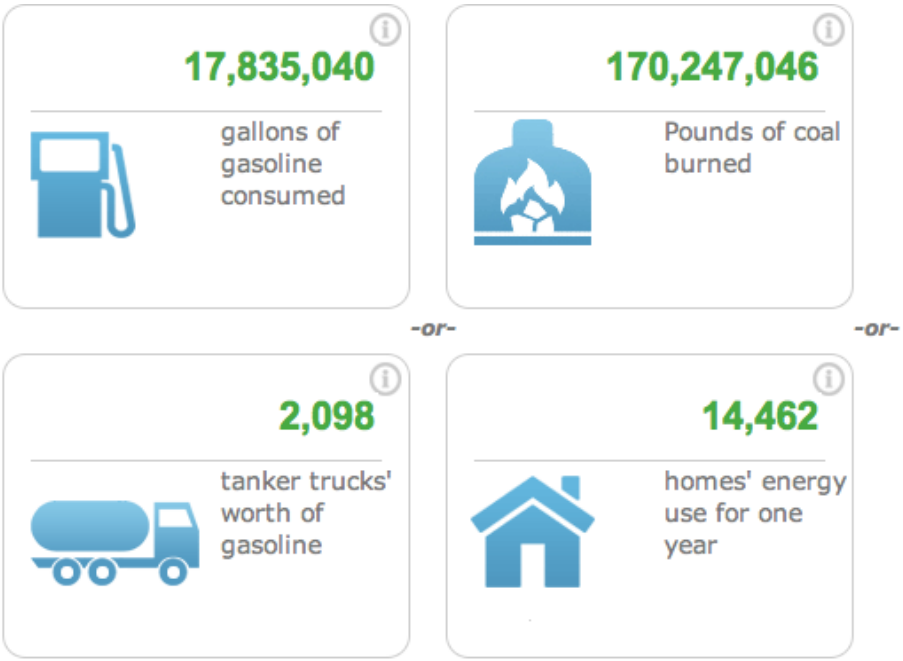


Figure 5.2 Comparative Emissions for 2013 Electricity.

Similarly, in 2013 the electricity sector emits the equivalent of 14,462 homes. Assuming a home in Aspen consumes the EPA's average home, the commercial subdivision is the dominant source of emissions in the electricity sector.

5.1.2 Stationary Combustion

The combustion of Natural Gas by the residential and commercial sectors is illustrated in the table below.

Table 5.5.2 2012 & 2013 Total Emissions by Sector- Stationary Combustion.

Total Emissions by Sector in $MtCO_2e$			
Year	Electric	Stationary Combustion	Transportation
2012	135,423	83,684	62,235
2013	158,500	92,420	64,356

The total emissions 2012 (83,684 CO_2e metric tons) can be compared to the annual emissions of:

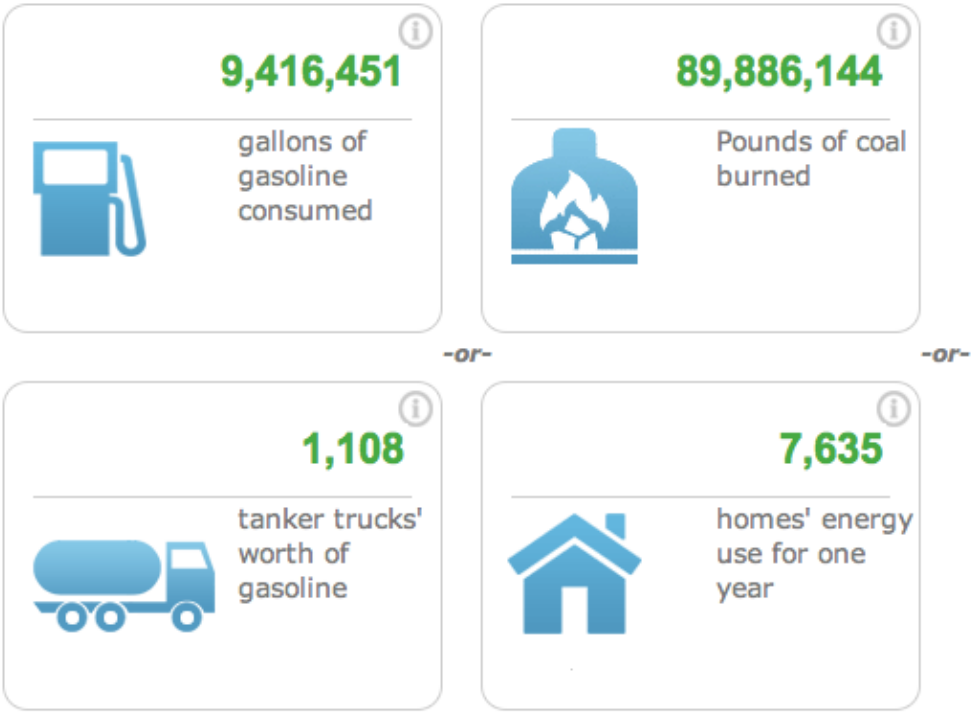


Figure 5.3 Comparative Emissions for 2012 Stationary Combustion.

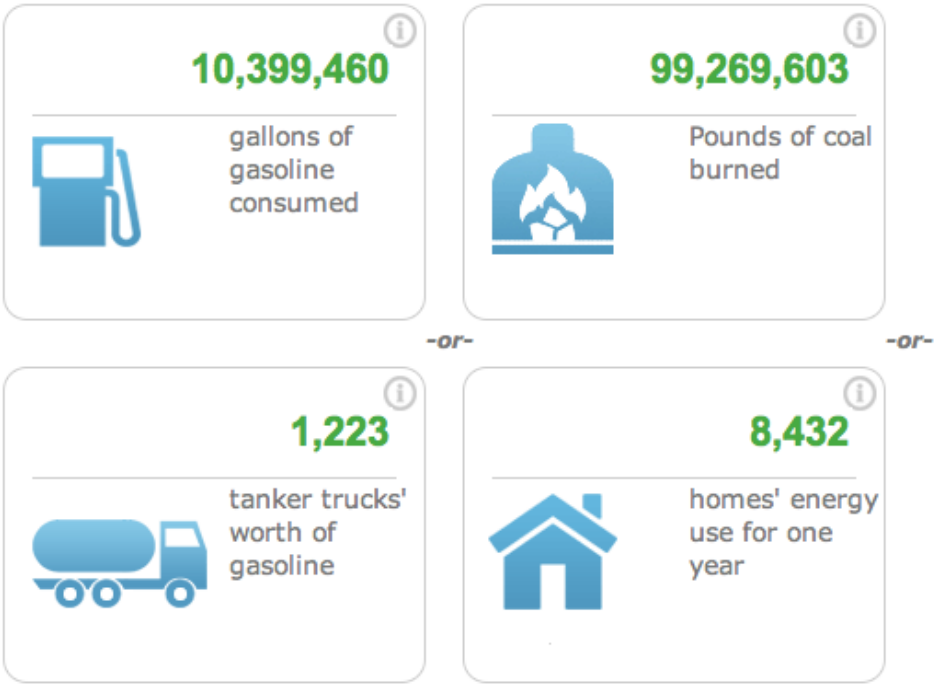


Figure 5.4 Comparative Emissions for 2013 Stationary Combustion.

Interestingly, stationary combustion contributes much less than the electricity sector. This could be attributed to the fuel mix of Holy Cross Energy and Aspen Electric.

5.1.3 Transportation

Table 5.5.3 2012 & 2013 Total Emissions by Sector-Transportation

Total Emissions by Sector in $MtCO_2e$			
Year	Electric	Stationary Combustion	**Transportation**
2012	135,423	83,684	62,235
2013	158,500	92,420	64,356

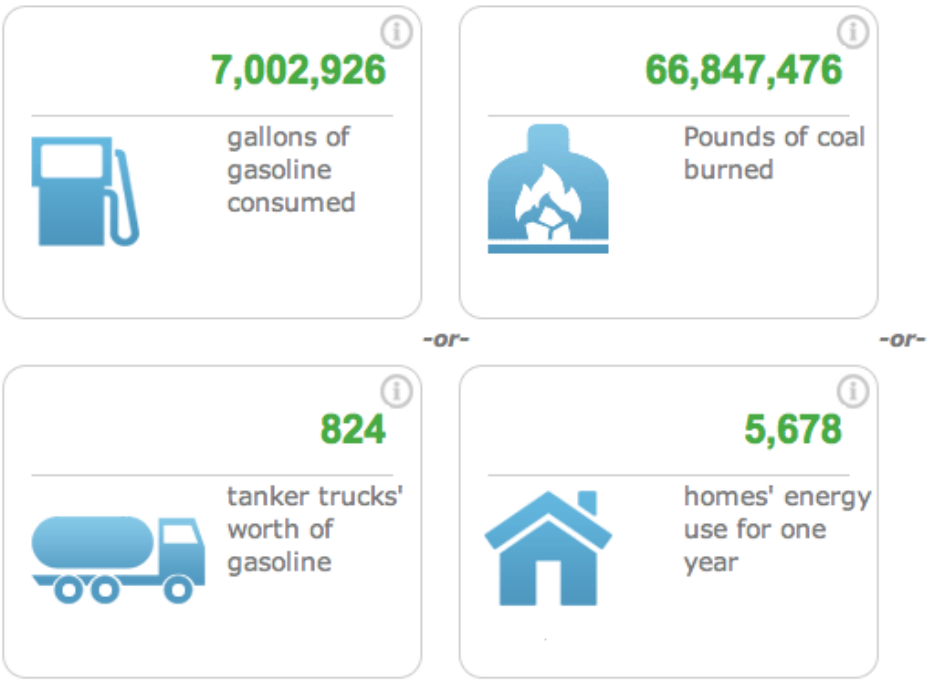


Figure 5.5 Comparative Emissions for 2012 Transportation.

The Transportation sector contributes significantly less; however, this is not taking into account all the RFTA emissions associated with the City of Aspen.

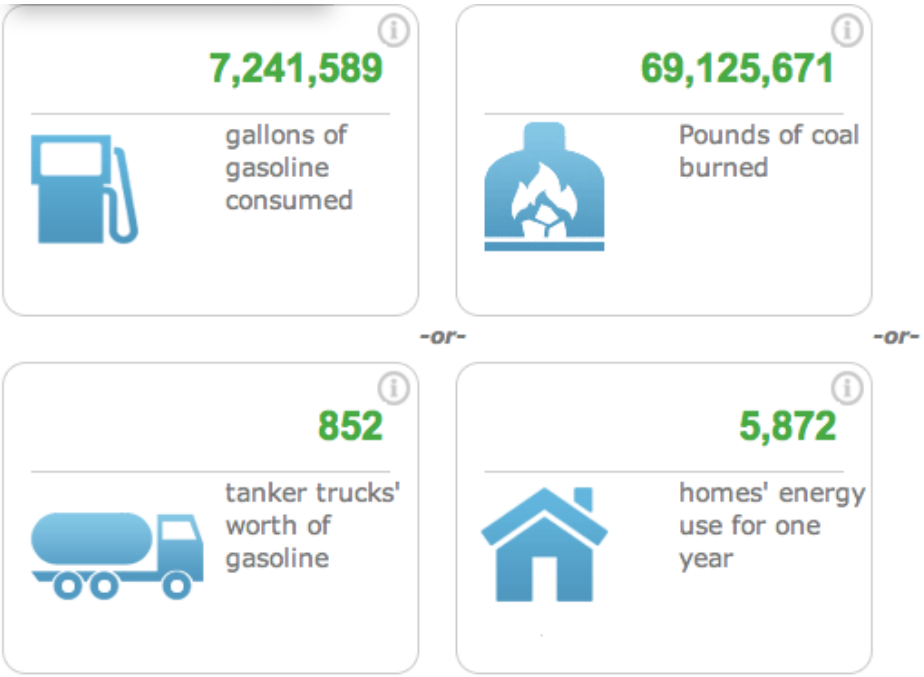


Figure 5.6 Comparative Emissions for 2013 Transportation.

The Transportation sector contributes significantly less; however, this is not taking into account all the RFTA emissions associated with the City of Aspen.

6 RECOMMENDATIONS

See Report 1: Recommendations for Future Inventories, Beckman and Goldberg.