# Greenhouse Gas Emissions Quick Tracker Methods and Data Management Plan

## CITY OF ASPEN, CANARY INITIATIVE

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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 |
| 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 |

# 1 INTRODUCTION: WHAT IS A QUICK TRACKER AND WHY IS IT NECESSARY?

Beginning in 2004, the City of Aspen began conducting community-wide greenhouse gas (GHG)inventories every three years, completing inventories in 2004, 2007, and 2011. Highlighting the need to understand changes in emissions annually as a result of City initiatives aimed at reducing emissions, but acknowledging the significant time and resource demands of conducting a full inventory, the City of Aspen decided to develop a Quick Tracker, which would annually take account of emissions from key sectors in the community.

In January of 2014, the City of Aspen's Canary Initiative asked Kaylee Beckman and Melissa Goldberg to develop a Community Greenhouse Gas Emissions Inventory Quick Tracker for the City of Aspen. Beckman and Goldberg found no existing protocols for Quick Trackers that have been successfully implemented. What follows is Beckman and Goldberg's suggested methodology and data management plan for the City of Aspen's Community Quick Tracker, based on research into best practices for community greenhouse gas inventories (see Beckman and Goldberg 2014a).

# 2 INVENTORY EMISSIONS BOUNDARY

In accordance with the City of Aspen's previously completed community-wide inventories, the Quick Tracker utilizes Aspen's Geographic Scope and Boundary to define the Emissions Inventory Boundary (EIB)

The Emissions Inventory Boundary (EIB) extends beyond Aspen's Urban Growth Boundary (UGB) to include emissions-generating sources and activities that are directly attributable to the City of Aspen's existence. While in the Quick Tracker spreadsheet and in Quick Tracker inventories, emissions quantifications are divided by sources and activities to help City managers consider the sectors they have the most influence over within the community, in this report, they are grouped by sector and not separated by sources and activities. For a more thorough discussion of sources and activities, see Beckman and Goldberg 2014 (Recommendations for Future Inventories).

The Emissions Inventory Boundary is depicted in Figure 1 below, but can qualitatively be described as including:

1. Emissions generating sources and activities within Aspen City limits and the UGB;

Within the EIB, but outside of City Limits:

2. All ski areas directly adjacent to the City of Aspen;
3. Whitehorse Springs and Starwood
4. Red Mountain, Mountain Valley, Highlands, Buttermilk West

5. Aspen Airport Business Center
6. North Forty
7. Excludes airport and air travel

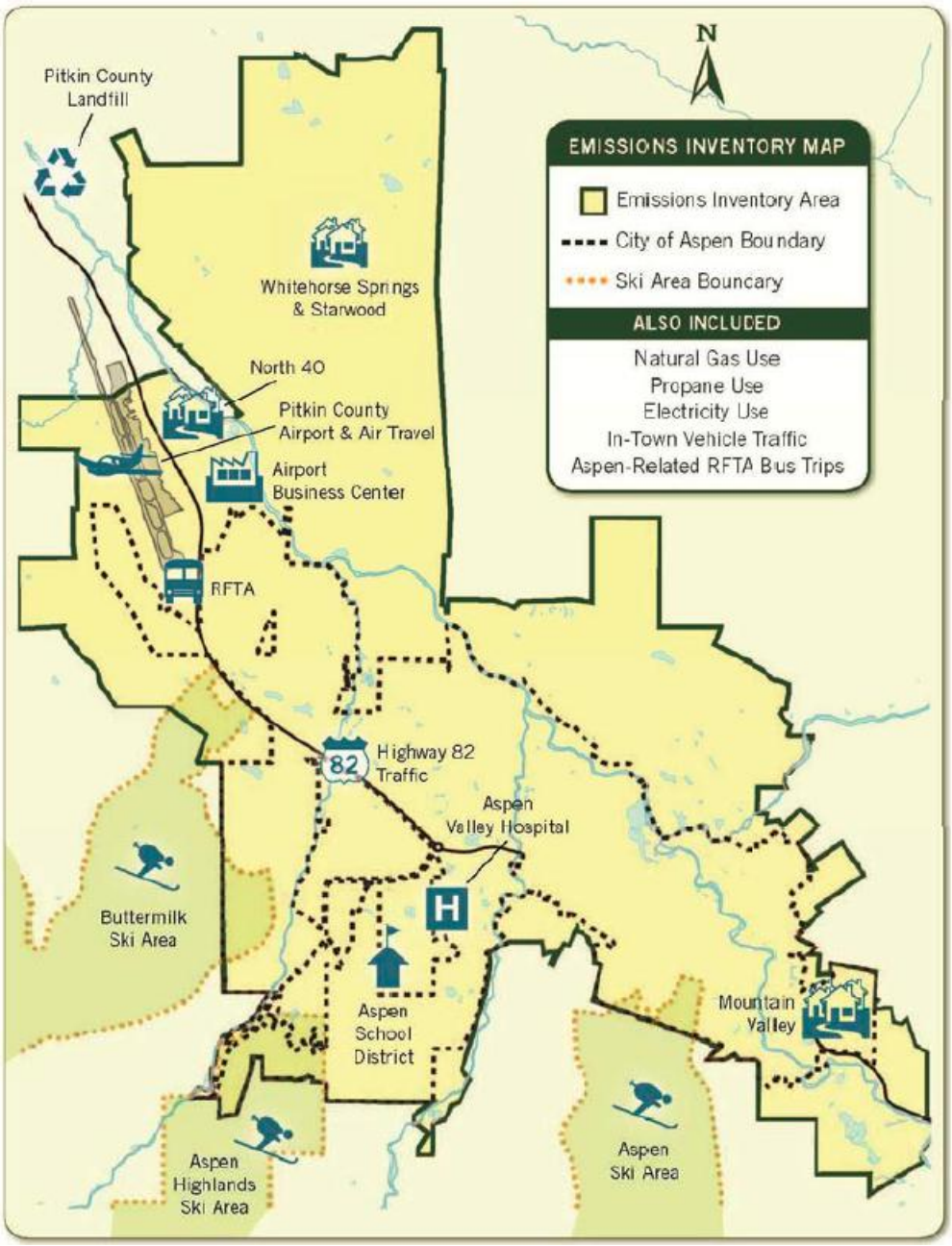


Figure 1. City of Aspen Emissions Boundary. Source: City of Aspen 2011 Greenhouse Gas Inventory.

## 2.1 WHAT EMISSIONS ARE INCLUDED?

As the goal of the Quick Tracker is to provide an easily attainable measure of emissions annually, Beckman and Goldberg identified three key sectors which made substantial contributions to the community's emissions to focus accounting efforts on. The three highest contributors to previous emissions were: stationary combustion of natural gas in the building sector, electricity use in the building sector, and passenger vehicles in the transportation sector. In 2007, these three sources alone contributed to 94.56% of the City of Aspen's emissions.[1] Individually, each sector contributed to Aspen's 2007 emissions as follows:

| Source of Emissions | % 2007 Aspen emissions |
|---|---|
| **Stationary Combustion (Natural gas):** (excluding fugitive methane emissions from natural gas extraction) | 20.22% |
| **Electricity** (excluding fugitive methane emissions from electricity production) | 34.17% |
| **Transportation** (passenger vehicles): | 40.16% |
| **Total percentage of 2007 Emissions** | 94.56% |

Table 1. Quick Tracker sectors as percentage of 2007 Aspen Emissions

Further explanation of what is included in each sector is provided in the following sections, which describe exactly how to quantify each metric for the Quick Tracker and how to gather and manage data to achieve replicable results.

# 3 EMISSIONS QUANTIFICATION

## 3.1 ELECTRICITY (ALL SOURCES)

While there are two different sources for electricity data (Aspen Electric and Holy Cross Energy) but the methods for calculating their emissions are the same. As such, the following methods can be followed for both and we will only utilize an example from one.

### 3.1.1 What's included?

Quantification of electricity emissions includes residential and commercial buildings in Aspen from Aspen Municipal Electric and Holy Cross Energy. This calculation excludes transmission and distribution losses and upstream emissions from electricity production.

[1] This figure (and all that follow for 2007) excludes aviation emissions from the total community emissions as aviation is no longer counted in City of Aspen GHG inventories.

### 3.1.2 How to Calculate

To calculate GHG emissions attributed to the consumption of electricity using Quick Tracker methods:

**Step 1.** Multiply annual total of electricity consumption for a given provider (by residential and commercial sectors separately) by the utility-specific emissions factor for $CO_2$.

Ex: In 2012, residential consumption from Aspen Electric was 21,337.65 MWh of electricity. Aspen Electric provided the 2012 utility-specific emissions factor of 485 lbs $CO_2$/MWh (see section **Error! Reference source not found.** for details on how to find electricity emissions factors). Multiplying these together results in the following:

$$21{,}337.6\ MWh \times \frac{485\ lbs\ CO_2}{MWh} \times \frac{1\ Metric\ ton}{2{,}204.6\ lbs} = 4{,}694.2\ mtCO_2$$

**Step 2.** Multiply annual total of electricity for a given provider (by residential and commercial sectors separately) by the specific emissions factors for that year for $CH_4$ and $N_2O$:

$$21{,}337.6\ MWh \times \frac{.023\ lbs\ CH_4}{1\ MWh} \times \frac{1\ Metric\ ton}{2204.6\ lbs} = .22\ mtCH_4$$

$$21{,}337.6\ MWh \times \frac{.03\ lbs\ N_2O}{1\ MWh} \times \frac{1\ Metric\ ton}{2204.6\ lbs} = .28\ mtN_2O$$

**Step 3.** Multiply $CH_4$ and $N_2O$ (now in Metric tons) by their 100-year Global Warming Potentials (21 and 310, respectively) to determine their $CO_2e$ in metric tons (see Table 2).

**Step 4.** Add the $CO_2e$ of each greenhouse gas together to determine the total emissions from Aspen Electric's residential sector (see Table 2).

| GHG | Metric tons | GWP | mt CO2e |
|---|---|---|---|
| $CO_2$ | 4,694.12 | 1 | 4,694.12 |
| $CH_4$ | 0.22 | 21 | 4.61 |
| $N_2O$ | 0.28 | 310 | 87.63 |
| **Total Metric tons CO2e Residential Sector of Aspen Electric** | | | **4,786.36** |

Table 2. Emissions from Aspen Electric Residential Sector

**Step 5.** Repeat these steps for the Aspen Electric commercial sector and sum residential and commercial for total emissions from Aspen Electric. Repeat again for Holy Cross Energy use data.

## 3.2 STATIONARY COMBUSTION (NATURAL GAS)

### 3.2.1 What's included?

Quantification of stationary combustion emissions includes natural gas provided to residences and commercial buildings in Aspen by SourceGas. This calculation excludes propane and fugitive methane from natural gas extraction, processing, and distribution processes. All of the above must be included in a full, ICLEI-compliant emissions inventory.

### 3.2.2 How to Calculate

To calculate greenhouse gas emissions attributed to the combustion of natural gas using Quick Tracker methods[2]:

**Step 1.** Multiply annual total of natural gas (we recommend separating the data by residential and commercial sectors for more information on demand for natural gas) by the emissions year's emissions factor for $CO_2$ (see section 4.2 for an explanation of finding emissions factors):

> Example: In 2012, the residential sector of Aspen combusted 780,166,900 kBtu of natural gas. SourceGas's $CO_2$ emissions factor for 2012 was 0.1179 lbs $CO_2$/kBtu. Multiplying these together reveals:

$$780{,}166{,}900 \text{ kBtu} \times \frac{0.1179 \text{ lbs } CO_2}{kBtu} \times \frac{1\ metric\ ton}{2{,}204.6\ lbs} = 41{,}722.6\ mt\ CO_2$$

**Step 2.** Multiply annual total of natural gas by the specific emissions factors for that year for $CH_4$ and $N_2O$:

> Example: Continuing with the 2012 residential sector for Aspen, we find that Source gas sold 780166.900 MMBtu of natural gas to residences. The 2012 default $CH_4$ emissions factor was .005 kg CH4/MMBtu of natural gas, and .0001 kg $N_2O$/MMBtu of natural gas. Multiplying these together we find:

$$780{,}166{,}900\ kBtu \times \frac{1\ MMBtu}{1000\ kBtu} \times \frac{0.005\ kg\ CH_4}{1\ MMBtu} \times \frac{1\ Metric\ ton}{1000\ kg} = 3.90\ mt\ CH_4$$

$$780{,}166{,}900\ kBtu \times \frac{1\ MMBtu}{1000\ kBtu} \times \frac{0.0001\ kg\ N_2O}{1\ MMBtu} \times \frac{1\ Metric\ ton}{1000\ kg} = .08\ mt\ N_2O$$

[2] In all cases, methods for the Quick Tracker were determined based on availability of data. In most cases, these methods do not represent an ideal calculation. Please refer to Beckman and Goldberg 2014a for recommended best practices in inventory calculations. In the future, if the City of Aspen is able to implement the recommended methods in full inventories, we recommend also implementing these methods in the Quick Tracker.

**Step 3.** The $CH_4$ and $N_2O$ totals should then be multiplied by the Global Warming Potential (100-year recommended) of each (see Table 3).

**Step 4.** Find the sum of $CO_2$ and $CO_2e$ emissions. See Table 3 for an overview of this calculation.

| GHG | Metric tons | GWP | $mtCO_2e$ |
|---|---|---|---|
| $CO_2$ | 41,722.60 | 1 | 41,722.6 |
| $CH_4$ | 3.9 | 21 | 81.9 |
| $N_2O$ | 0.08 | 310 | 24.8 |
| Total residential natural gas emissions in 2012 | | | 41,828.06 |

Table 3. Calculating CO2e for Residential Natural Gas Combustion in 2012

## 3.3 Commuter Traffic

### 3.3.1 What's included?

Emissions from commuter traffic, in theory, encompass emissions from vehicles driving to and from Aspen. Unlike in past inventories, our calculation of these emissions does not extend to air travel, nor does it explicitly include vehicles travelling from outside of the Aspen region. Instead, we have selected to calculate emissions using a standard roundtrip travel distance of 82.2 miles, the distance to and from Glenwood Springs, CO to Aspen, CO. We believe this number offers a metric that implicitly accounts for both shorter (and more frequent) trips to and from Aspen by commuters, and longer trips taken by visitors. It is not a calculated average, as we do not have data to support the average distance driven by commuters and visitors to Aspen. Please see Appendix A for further information about assumptions and Beckman and Goldberg 2014a (Recommendations for Future Inventories) for further discussion of data needs.

### 3.3.2 How to calculate

**Step 1.** Multiply the annual total of vehicles from the Castle Creek Bridge traffic counter by 82.2 (roundtrip distance from Glenwood Springs, CO to Aspen, CO) to determine a total for vehicle miles traveled (VMT) by commuters to Aspen in a given year.

> Ex: In 2012, 263,035 vehicles entered Aspen over Castle Creek Bridge. Multiplying by 82.2 reveals that a total 21,621,477 miles were driven by vehicles entering Aspen in 2012.

**Step 2.** To find an approximation of fuel use based on VMT, divide VMT by the highway-driving fuel economy of that year's average vehicle model and year.

E.g., in 2012, the most common mid-technology vehicle was a Jeep Grand Cherokee, and the average vehicle model year was 2001 (see section 4.3 for explanation of finding the average vehicle for an emissions year). The 2001 Jeep Grand Cherokee gets an average of 20 miles/gallon on the highway Therefore:

$$21{,}621{,}477 \text{ miles } \times \frac{1\ gallon}{20\ miles}$$
$$= \ 1{,}081{,}073.85 \text{ gal unleaded gasoline consummed commuting to Aspen}$$

**Step 3.** To determine $CO_2$ emissions, multiply the $CO_2$ emissions factor (see section 4.3 for finding emissions factors for transportation) by gallons of fuel used. Then convert this figure to metric tons. In 2012, this amounts to:

$$1{,}081{,}073.85 \text{ gal } \times \frac{8.78 \text{ kg } CO_2}{gal} \times \frac{1\ mt}{1{,}000\ kg} = 9{,}344.9\ mtCO_2$$

**Step 4.** To determine $CH_4$ and $N_2O$ emissions, multiple the VMT (note: $CH_4$ and $N_2O$ are calculated based on mileage, while $CO_2$ is calculated based on fuel use) by the $CH_4$ and $N_2O$ emissions factors. Then convert the total grams to metric tons:

E.g., in 2012 total VMT was 21,621,477 miles. Multiply this by the $CH_4$ emissions factor for a 2001 mid-sized vehicle (see section 4.3) to find that 326,484.3027 grams CH4 354,592.2229 g of $N_2O$ were emitted from commuter traffic in 2001. To convert to metric tons, divide these figures by .0000001 metric tons/gram.

$$21{,}621{,}477 \text{ mi.} \times \frac{.0151 \text{ g } CH_4}{mi.} \times \frac{1\ mt}{1{,}000{,}000\ g} = .32\ mtCH_4$$

$$21{,}621{,}477 \text{ mi.} \times \frac{.0164 \text{ g } N_2O}{mi.} \times \frac{1\ mt}{1{,}000{,}000\ g} = .35\ mtCH_4$$

**Step 5.** Multiply $CH_4$ and $N_2O$ figures by their GWP and sum the total emissions of all three GHGs (see Table 4).

| GHG | Emissions in metric tons | GWP | mt CO2e |
|---|---|---|---|
| $CO_2$ | 9,491.83 | 1 | 91,981,677.50 |
| $CH_4$ | 0.33 | 21 | 6.86 |
| $N_2O$ | 0.35 | 310 | 109.92 |
| **Total mt $CO_2$e from commuter vehicles, 2012** | | | **91,981,794.28** |

Table 4. Total GHG Emissions from 2012 Commuter Traffic

## 3.4 DRIVING AROUND TOWN TRAFFIC

### 3.4.1 What's included?

At the time of creating the Quick Tracker, minimal contextual data was available to explain the methods by which the Colorado Department of Public Health and Environment (CDPHE) calculated VMT data for the City of Aspen. The VMT number was calculated in 1997 (with a partial update in 2000) and given a projected compound growth rate of 2.57% per year or 58% by 2015.

The authors of this study have noted a significant discrepancy between the data in the 1997CDPHE study and annual traffic counter data from the Department of Transportation. While from 1999 to 2013 traffic counters on Castle Creek Bridge have counted a ***monthly*** average of between 21,000 and 23,000 vehicles crossing the bridge into the City, the Department of Public Health and Environment study (and previous inventories) cites average ***daily*** traffic ranging from 18,706 to 23,000 vehicles. The authors believe the DPHE study projects an unrealistically high VMT and daily vehicle counts, however in the absence of more recent and additional data, will use the DPHE study to illustrate the recommended Quick Tracker methods and in Quick Tracker inventories until new data become available.

### 3.4.2 How to calculate

**Step 1.** Determine the emission's year's projected VMT from the CDPHE study by summing the compound growth rate (you can use an interest calculator such as: www.investor.gov/tools/calculators/compound-interest-calculator):

> E.g., based on the compound growth rate for 2.57% annually, in 2012 the projected daily VMT would be 227,942.

**Step 2.** To calculate $CO_2$, first calculate gallons of fuel consumed. To find this divide VMT by the City fuel economy of the year's average vehicle (for 2012 this is a 2001 Jeep Grand Cherokee). Then multiple by the $CO_2$ emission factor, and convert to metric tons of $CO_2$:

$$227{,}942\frac{VMT}{day}\times\frac{365\ days}{year}\times\frac{1\ gallon}{14\ Mi.}\times\frac{8.78\ kg\ CO_2}{1\ gallon}\times\frac{1\ mt}{1{,}000kg}$$
$$= 52{,}177\ .55\ mt\ CO_2$$

**Step 3.** To calculate $CH_4$ and $N_2O$, multiple annual VMT (NOT fuel use) by the respective emissions factors and convert to metric tons:

$$227{,}942\frac{VMT}{day}\times\frac{365\ days}{year}\times\frac{.0151\ g\ CH_4}{mi.}\times\frac{1\ mt}{1{,}000{,}000\ g}=1.26\ mt\ CH_4$$

$$227{,}942\frac{VMT}{day}\times\frac{365\ days}{year}\times\frac{.0164\ g\ N_2O}{mi.}\times\frac{1\ mt}{1{,}000{,}000\ g}=1.36\ mt\ N_2O$$

**Step 4.** To sum total emissions from around town traffic, multiple each total by its GWP and add totals together, as demonstrated in Table 5.

| GHG | Metric tons | GWP | mt CO2e |
|---|---|---|---|
| CO2 | 52,177.00 | 1 | 52,177.00 |
| CH4 | 1.26 | 21 | 26.38 |
| N2O | 1.36 | 310 | 422.98 |
| Total mt CO2e emissions driving around town | | | 52,626.37 |

Table 5. Total Driving Around Town Emissions 2012

## 3.5 Public Transit

### 3.5.1 What's Included

Complete data was not available at the time of developing this methodology to calculate emissions generated by public transit. What follows is an overview of the preferred methods for when data becomes available in the future.

### 3.5.2 How to calculate regional transit

**Step 1.** Obtain annual vehicle miles travelled and fuel use data from RFTA for the desired emissions year on routes between Glenwood Springs, CO and Aspen, CO.

**Step 2.** Obtain fuel economy of different transit vehicles used by RFTA on Glenwood Springs to Aspen routes.

**Step 3.** Determine emissions factors for the specific fuel used by RFTA for vehicles in Step 2 (e.g. some RFTA buses use a 95% diesel, 5% biodiesel fuel mix, which would have a unique emissions factor) for $CO_2$, $CH_4$, and $N_2O$. There may be multiple emissions factors for different fuel types used for different vehicle types used on the Glenwood Springs to Aspen routes.

**Step 4.** Depending on the emissions factors, use VMT or fuel use data and multiply these by emissions factors for $CO_2$, $CH_4$, and $N_2O$. Convert totals into metric tons and multiple by GWP and sum to determine total CO2e.

### 3.5.3 How to calculate in-City transit

**Step 1.** Obtain annual vehicle miles travelled and fuel use data from RFTA for the desired emissions year on routes within Aspen's EIB .

**Step 2.** Obtain fuel economy of different vehicles used by RFTA on routes within Aspen's EIB .

**Step 3.** Determine emissions factors for the specific fuel used by the company (e.g. some RFTA buses use a 95% diesel, 5% biodiesel fuel mix, which would have a unique emissions factor) for $CO_2$, $CH_4$, and $N_2O$. There may be multiple emissions factors for different fuel types used for different vehicle types used on routes within Aspen's EIB .

**Step 4.** Depending on the emissions factors, use VMT or fuel use data and multiply these by emissions factors for $CO_2$, $CH_4$, and $N_2O$. Convert totals into metric tons and multiple by GWP and sum to determine total CO2e.

# 4 DATA MANAGEMENT

Data was obtained from multiple sources within the Aspen community and Pitkin County. The following describes who/what department we contacted, exactly what data we requested (and received), and how we recommend sorting and managing that data to replicate our results and consistently calculate emissions in the future.

## 4.1 ELECTRICITY

Electricity use data came from two sources: Aspen Electric and Holy Cross Energy.

### 4.1.1 Aspen Electric

*Use Data*

Aspen Electric data was obtained through Chris Menges of the Canary Initiative, who worked with Patrick Baird at Aspen Electric. The data came in the form of an Excel spreadsheet with over 70,000 entries, each containing a date, usage amount (in kWh), and a code designating the type of account (small commercial. large commercial, small government, large government, and residential).

We sorted the data by year and code, and summed the total usage by residential and commercial facilities for each calendar year. This total was then input into the Quick Tracker spreadsheet.

Ideally, electricity data from all sources would be obtained using a GIS shape file that encompasses the Emissions Inventory Boundary, and therefore allows the company to pull usage data for facilities and customers within that exact area.

*Emissions Factors*

As explained above, a $CO_2$ emissions factor for Aspen Electric came from Chris Menges of the Canary Initiative.

As utility-specific emissions factors for $CH_4$ and $N_2O$ were not available when designing and implementing the Quick Tracker, we consulted the EPA eGRID data

(last updated 2010). The City of Aspen falls within the WECC Rockies (RWPC) region, and so we used emissions factors based on the regional average provided. Note that EGRID provides $CH_4$ and $N_2O$ emissions factors in lbs/GWh, so further conversion was required across units (see Quick Tracker spreadsheet for conversions).

### 4.1.2 Holy Cross Energy

*Use Data*

To obtain data from Holy Cross Energy, we worked with Wayne Alderson, the Billing Support Services Supervisor for the company. Because the Emissions boundary for Aspen's inventories does not comply with jurisdictional boundaries that Holy Cross Energy uses, we provided Holy Cross with a GIS shape file that encompassed the EIB, and therefore allowed the company to pull usage data for facilities and customers within that exact area.

We received data that was aggregated by calendar year and by residential and commercial accounts. It was in units of KWh.

*Emissions Factors*

As explained above, a $CO_2$ emissions factor for Holy Cross Energy came from Chris Menges of the Canary Initiative. This data can also be found at www.holycross.com/pages/green-programs/co2-emissions, however currently there is no data for emissions factors after 2012.

As utility-specific emissions factors for $CH_4$ and $N_2O$ were not provided, we consulted the EPA EGRID data (last updated 2010). The City of Aspen falls within the WECC Rockies (RWPC) region, and so we used emissions factors based on the regional average provided. Note that EGRID provides $CH_4$ and $N_2O$ emissions factors in lbs/GWh, so further conversion was required across units (see Quick Tracker spreadsheet for conversions).

## 4.2 Stationary Combustion: Natural Gas

*Use Data*

We obtained data regarding the combustion of natural gas from SourceGas. As with past inventories, Source Gas provided data for Aspen (within City boundary), Snowmass and Snowmass Village, and Woody Creek. We excluded Snowmass and Snowmass Village from our emissions accounting, as these areas have never been included within Aspen's emissions boundaries. SourceGas's data was further divided by large commercial, small commercial, and residential. We summed all commercial together and all residential together by calendar year to determine fuel use within the Aspen boundary.

We recommend that in the future all stationary combustion data be obtained using a GIS shape file that encompasses the EIB , and therefore allows the company to pull usage data for facilities and customers within that exact area. Currently, it appears the data only reflects usage within Aspen City limits.

*Emissions Factors*

You will either use a utility-specific emissions factor or consult ICLEI's default emissions factors. For the first Quick Tracker, we received a utility-specific factor for $CO_2$ from Chris Menges. No utility-specific emissions factors were available for $CH_4$ or $N_2O$, so we obtained default $CH_4$ and $N_2O$ emissions factors from the ICLEI Protocol (2012) Appendix C, Table B.3.

For future inventories, we recommend obtaining emissions factors that are specific to Source Gas's product whenever possible. Residential and commercial sectors may have different emissions factors because of differing emissions types.

## 4.3 TRANSPORTATION

### 4.3.1 Vehicle Make and Model for passenger vehicle calculations

Find the most common vehicle makes

1. Obtain Pitkin County vehicle registration data for your emissions year.
2. With the spreadsheet they provide, select all data and from the toolbar select "Format as Table." This allows you to easily narrow down your data according to your specifications.
3. Note- we elected to include vehicles for the entire county, so there is no need to filter by City code.
4. In table options, organize the data according to "Make" (first) then "Body." This allows you to group all common vehicles together to find the best Mid-Technology Vehicle, meaning a mid-sized vehicle that represents a middle ground between sedans and full sized vehicles.
5. In the table "Filter," unclick all Electric vehicles. These will not be accounted for in the transportation sector, but the built environment.
6. Insert a "1" next to every data point. For example :

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | YEAR | MAKE | BODY | VIN | CITY CODE | FUEL | |
| 2 | 2012 | ACG | 2D | 1A9LREAR2CC596555 | 001U | E | 1 |
| 6 | 2009 | ACG | 2D | 1A9LOEAH69C596259 | 001U | E | 1 |
| 8 | 1983 | ALF | 2D | ZARBA541XD1016752 | 001U | G | 1 |
| 9 | 1979 | AMC | 2D | J9F93EC840966 | 001U | G | 1 |
| 12 | 2009 | AUD | 2D | WAURV78T29A006919 | 001U | G | 1 |
| 13 | 2008 | AUD | 2D | WUAYU48H58K800207 | 001U | G | 1 |
| 16 | 1961 | AUS | 2D | AN5L42085 | 001U | G | 1 |

7. Next filter the "Make" Types by excluding outlying abbreviations. For example, "ALF" and "AMC" seen above are the only vehicles of their type, so remove this. This way you are clearing your data so you can find the most common "Make."
8. Next, identify each vehicle Make. We recommend doing this in a separate document so you don't have to scroll through all the data points while typing.
9. Create a section of your excel sheet and create a table that identifies that top 10 Vehicle Makes.
10. For the top 10 Makes sum the 1s you added in column "G" that corresponds with each "make." For example, with "Jeep":
    a) Because the data is organized by "Make" SUM the first "Jeep" cell through the last "Jeep" cell.
    b) Do this for each of the top 10 Makes. This will show the most common brands of vehicle.
11. After this was completed, it was easy to identify the top 3 "Make" types (in 2012 and 2013: Jeep, Toyota, and Ford).

### Find the most common model

1. In the table, filter out all Makes besides the top 3.
2. Next, to find the most common "Body" type, look at the data and count the total of each Body type. In 2012 and 2013, this was "UP" utility passenger vehicles and "PK" pickup trucks.
3. In 2012 and 2013 the majority of the Ford and Toyota Body types were Pickups. As the goal is to identify the most common Mid-Technology vehicle that will capture the broad range of emissions of each Body type, the data revealed this would be a Jeep utility pickup.
4. Choose a common "Make" and "Body" type of the "mid-Technology" Vehicle. For Aspen, we selected a Jeep Grand Cherokee.

### Find the average model year

1. Next, to find the average year to finally find the emissions factors, go to the original, unfiltered data.
2. Select the column that shows vehicle model years and at the bottom, insert the function, =AVG(X:Y) that will average all the years within your data set.
3. This revealed "2001" to be the average for 2012, and "2002" for 2013.
4. With this information, you now can find the average fuel economy, emissions factors ($CO_2$, $CH_4$, and $N_2O$) based off your "Mid-Technology" vehicle.

### Find Fuel Economy

1. Visit www.fueleconomy.gov
2. Enter vehicle make, model, and year.
3. Select and note exactly which vehicle type you will be using. For the 2012 and 2013 inventories, we did not have sufficient data to determine the most common transmission, engine size, or drive-type. We selected a 2WD, 5-speed automatic Jeep Grand Cherokee.

### 4.3.2 Passenger Vehicles: Commuting

*Use Data*

To calculate data for commuter vehicles, we contacted the Department of Transportation and requested traffic counter data from the counters at Castle Creek Bridge. The data was compiled by month, so we calculated emissions by month and then summed the total before converting to mt $CO_2$e.

*Emissions Factors*

The Climate Registry General Reporting Protocol (2013) provides $CO_2$ emissions factors by fuel type. In that document, consult Table 13.1 to find the $CO_2$ emissions factor for gasoline.

The Climate Registry General Reporting Protocol (2013) provides $CH_4$ and $N_2O$ emissions factors by vehicle model year and vehicle class. Consult the most current Climate Registry Reporting Protocol Emissions Factors, Table 13.5 to find emissions for $CH_4$ and $N_2O$ by vehicle class (we have used Gasoline Light Trucks) and model year.

### 4.3.3 Passenger Vehicles: Around town

*Use Data*

Around town passenger vehicle data was obtained from the 2001 update to the Colorado Department of Public Health and Environment study that quantified vehicle miles travelled within the City of Aspen. We used the daily vehicle miles travelled established in that report, updated to reflect the compound growth rate of 2.57% per year since 1997 (counted as 15 years in 2012).

*Emissions Factor*

See section 4.3.2, as emissions factors for both commuter and around town vehicle traffic are the same.

# 5 RECOMMENDATIONS

There are many ways that the Quick Tracker and inventories using the Quick Tracker methodology can be improved. For the most part the team's recommendations for the Quick Tracker correspond with general recommendations provided to the City of Aspen for full ICLEI-compliant inventories. These recommendations can be found in Beckman and Goldberg 2014a.

The most significant recommendations would be:

1. Improving and updating data regarding transportation. As has been noted previously, the most recent data is from 1997 and may have miscalculated the number of vehicles traveling within and to Aspen annually.
2. Use a GIS shape file that includes the entire EIB to obtain electricity and stationary combustion data. This would be easily replicable in future studies and ensures the use of a consistent boundary in a given inventory and future inventories.
3. Use utility- and technology-specific emissions factors for each fuel source to obtain the most accurate emissions quantification of electricity and stationary combustion in Aspen.
4. Work with RFTA to obtain data indicated above in order to incorporate transit into Quick Tracker emissions calculations in the future.
5. Consider including additional emissions calculations in annual Quick Trackers, beyond the identified key sectors, to keep track of annually changing data that will be needed in the full inventories every three years.

# 6 REFERENCES CITED


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# APPENDIX A: ASSUMPTIONS

## 1. BUILDING SECTOR

The assumptions for both sources and activities are stated below.

### Electricity

- We omitted upstream emissions for electricity use because we assumed this is accounted for in the utility-specific emissions factor.
- Assumed transmission and distribution losses are accounted for in the utility-specific emission factors.
- Holy Cross Energy: Assumed government consumptions are a separate category of subdivisions and are not accounted for in total commercial consumption.
- Holy Cross Energy and Aspen Municipal Electric are Activities of the City of Aspen because it is not generated within the jurisdictional boundary.

### Natural Gas

- Natural Gas consumption both a Source and Activity; however, double counting was avoided by separating the lifecycle of natural gas by boundaries. In other words, the activity of natural gas is the "mining" of it and the volume transported to the City of Aspen's EIB . The total emissions would be found by multiplying the emissions factor provided by SourceGas and the volume of natural gas provided to Aspen. On the other hand, the source would be the volume of natural gas provided to the City of Aspen in the EIB and the emissions factor associated with the stationary combustion technology of the residential and commercial sector.
- Assumed the usage by City (City of Aspen) is within the EIB .
- Assumed residential consumption includes "Res. Trans. Ar. 1" and "Residential Ar 1"
- Assumed commercial consumption includes, "Sm Comm. Area 1," "Lg. Comm Trans Ar 1," and "Lg Comm. Area 1."
- Assumed average technology for residential and commercial natural gas combustion by utilizing "Table B.3 Default Methane and Nitrous Oxide Emissions Factors by Fuel Type and Sector" in ICLEI Community Wide Inventory, *Appendix C: Built Environment Activities and Sources.*
- Assumed "Natural Gas" is the all inclusive fuel type provided by SourceGas.
- Assumed government consumption is not included in any of the SourceGas data.
- Assumed the emissions factor accounts for lifecycle emission of the natural gas provided.

**Transportation (Could separate into sections of commuter and around town after we receive the data from RFTA)**

- The emissions factor provided in the report correspond with the data provided by Aspen Department of Motor Transportation for years 2012 and 2013. Assumed Jeep's most common (and mid-technology) SUV was the Jeep Cherokee.
- Assumed 2012 average vehicle was a 2001 Jeep Cherokee, 2WD, 6 cylinder, 4.0 L, Automatic 4 speed, Gasoline. (Please refer to section 3.3.1 Commuter Traffic Methodology)
- Assumed 2013 average vehicle was a 2002 Jeep Cherokee, 2WD, 6 cylinder, 4.0 L, Automatic 4 speed, Gasoline. (Please refer to section 3.3.1 Commuter Traffic Methodology)
- Commuter vehicles are driving primarily on highways so we should use the highway driving fuel economy to calculate commuter traffic emissions
- Vehicles driving around town are driving on local roads, so we used the city-driving fuel economy to calculate driving around town emissions.
- Assumed every single car that passes over the traffic counter at Castle Creek Bridge is traveling round-trip from Glenwood Springs to Aspen.
- Assumed that by traveling round-trip from Glenwood Springs to Aspen we are providing a conservative average of vehicle miles traveled for people commuting far beyond Glenwood Springs and shorter distances that may be traveled within the Roaring Fork Valley to Aspen.