



Greenhouse Gas Emissions Inventory Management Plan for Community-Wide Emissions

Town of Mountain Village, CO

Calendar Year 2019



2019 GHG Inventory Contact Information

Town of Mountain Village

Zoe Dohnal

Business Development and Sustainability Senior Manager

P: 970.369.8236

E: zdohnal@mtnvillage.org

Lotus Engineering and Sustainability, LLC

Julia Ferguson, Senior Associate

1627 Vine Street, Denver, Colorado 80206

P: 216.346.7478

E: julia@lotussustainability.com

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INTRODUCTION

Lotus Engineering and Sustainability, LLC (Lotus) was contracted by the Town of Mountain Village, Colorado (Mountain Village/Town) to create a 2019 greenhouse gas (GHG) emissions inventory. The purpose of the GHG emissions inventory was to create a clear picture of current GHG emission sources in the Mountain Village community and establish a baseline for future emission inventories that will guide climate action planning.

To support this work, Lotus completed the following tasks:

- Developed a 2019 community GHG inventory and incorporated GHG accounting best practices, including data collection and methodology that are consistent with accepted national and international standards. Lotus created a customized inventory management workbook to keep record of data, emission factors, contacts, and assumptions.
- Created this accompanying Inventory Management Plan (IMP) for the inventory tool providing guidance so that staff can continue to track emissions. The IMP is contained herein and provides community information, inventory boundary and scope, GHG emission factors, emission quantification methods, data management methods, and an overview of the inventory tool.

INVENTORY DETAILS

PROTOCOL

The GHG inventory uses the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC protocol) methodology.¹ The GPC provides a transparent and consistent GHG accounting methodology for reporting community GHG emissions. There are two reporting levels for the community framework:

- **BASIC:** The BASIC level includes stationary energy, in-boundary transportation, and community-generated waste.
- **BASIC+:** The BASIC+ level includes BASIC emission sources, as well as a more comprehensive coverage of emissions sources such as transboundary transportation; electricity transmission and distribution losses; industrial processes and product use; and agriculture, forestry and other land uses.

The Mountain Village 2019 community GHG inventory was developed in compliance with the GPC BASIC reporting level.

BOUNDARY

Per the GPC, communities shall establish a geographic boundary that identifies the spatial dimensions or physical perimeter of the inventory's boundary. The boundary for the Mountain Village inventory reflects the physical town limits.

¹ For more information regarding GPC see: http://c40-production-images.s3.amazonaws.com/other_uploads/images/143_GHGP_GPC_1.0.original.pdf?1426866613.

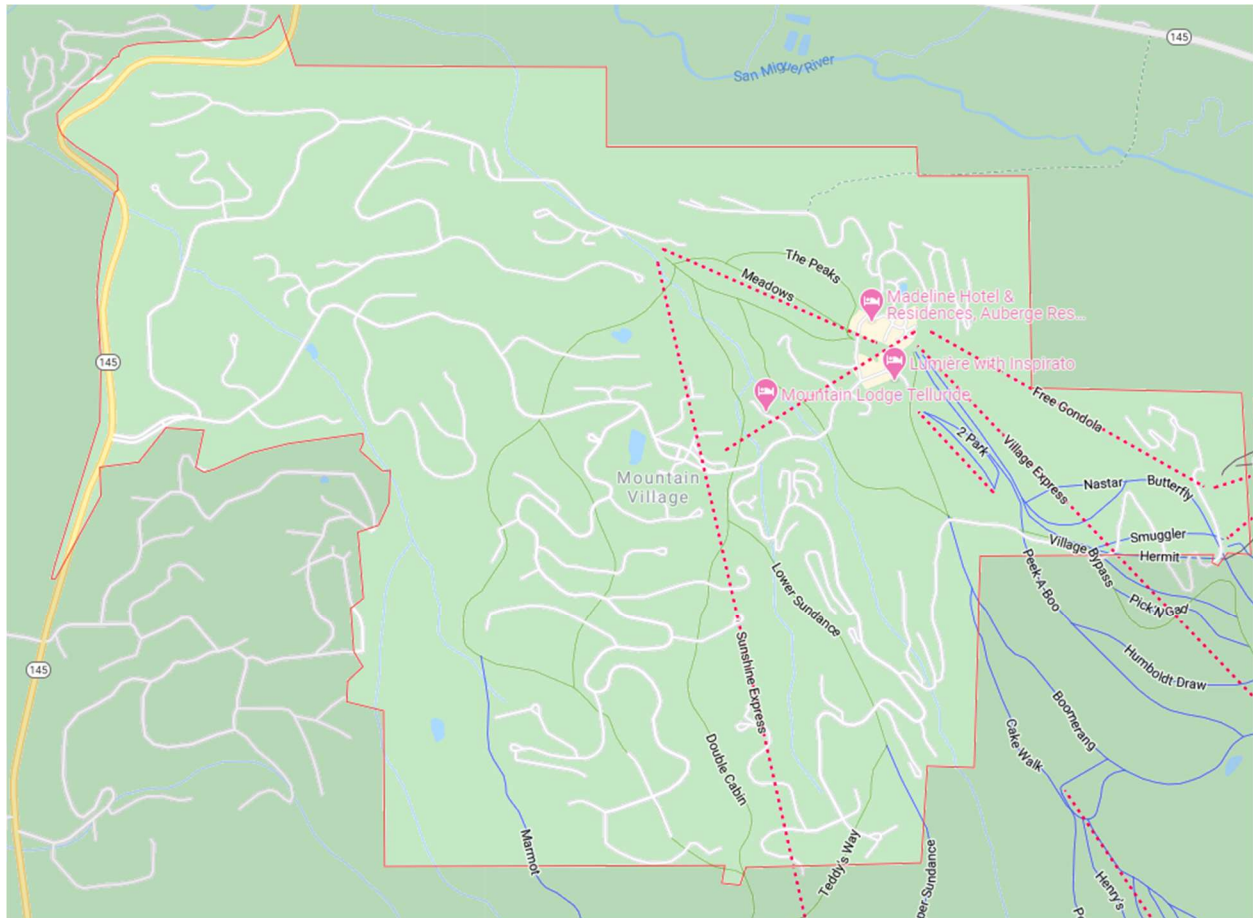


FIGURE 1. MOUNTAIN VILLAGE TOWN LIMITS

TIME PERIOD

The 2019 inventory is based on the calendar year of 2019 (January 1, 2019 through December 31, 2019). If data specific to 2019 was not available, the most recent year was included and noted in the workbook and this IMP.

EMISSION SCOPES

Per the GPC, BASIC emission scopes are defined as follows. The items listed in *italics and bold* are applicable to Mountain Village. The other items are not applicable to Mountain Village because they were confidential (C), not occurring (NO) or the emissions were included elsewhere (IE).²

- Scope 1: GHG emissions from sources located within the city boundary, including:
 - **Building energy fuel combustion.**
 - **Fugitive emissions (i.e. leakage from natural gas consumption).**
 - Energy industries energy consumption. (NO)
 - Non-specified sources energy consumption. (NO)
 - Energy consumption from agriculture, forestry, and other land use (AFOLU). (IE)
 - **On-road transportation (including transit) fuel combustion.**

² The GPC uses notation keys to note the reason why an emission source is not applicable to a community. The notation keys include: Not Occurring (NO), Included Elsewhere (IE), Confidential (C) and Not Estimated (NE).

- Railways fuel combustion. (NO)
- Waterborne navigation. (NO)
- Aviation fuel combustion. (NO)
- Off-road vehicles fuel combustion. (C)
- Municipal solid waste generated in the City and disposed of within the City. (NO)
- Composted waste generated in the City and disposed of within the City. (NO)
- Municipal wastewater generated inside the City and disposed of within the City. (NO)
- Municipal wastewater generated outside the City and disposed of within the City. (NO)
- Incinerated waste. (NO)
- AFOLU emissions. (NO)
- Scope 2: GHG emissions occurring as a result of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary.
 - **Building electricity consumption.**
 - **On-road transportation (including transit) electricity combustion.**
 - Other industry and transportation activities consuming electricity. (NO)
- Scope 3: GHG emissions that occur outside the city boundary as a result of activities taking place within the county boundary, including:
 - **Transboundary aviation fuel consumption. (BASIC+ category included for information only).**
 - **Municipal solid waste generated in the City and disposed of outside the City.**
 - Composted waste generated in the City and disposed of outside the City. (NO)
 - Incinerated waste. (NO)
 - **Municipal wastewater generated inside the City and disposed of outside the City.**

Note on Information-Only Items

The GPC does not recognize emissions avoided through the purchase of renewable energy credits (RECs), local installation of renewable energy systems (including solar and wind), or recycling. However, communities frequently want to understand the potential impact of these activities. For Mountain Village, these items are calculated as “information-only” and include avoided emissions from:

- Recycling.
- On-site solar.
- Green Block Sales from San Miguel Power Association (SMPA).

It should be noted that the RECs for on-site solar are owned by SMPA and are included in SMPA’s electricity emission factor. Since SMPA’s electricity emission factor applies to their entire service territory, on-site solar does help reduce emissions from Mountain Village’s electricity consumption. The unbundled RECs from the Green Block Sales program are owned by the Town. The Town could claim the benefits of these RECs separately from the GHG emissions inventory. It should be noted that as of March 2020, state policy on the accounting of unbundled RECs is currently under review. The final determination is expected summer of 2020. At that time, Mountain Village is advised to consider the best way to account for these RECs in the GHG emissions inventory.

REPORTED GREENHOUSE GASES

The following GHGs are included in the inventory:

- Carbon dioxide (CO₂).
- Methane (CH₄).

- Nitrous oxide (N₂O).

The following fluorinated GHGs are typically used in industrial processes.

- Perfluorocarbons (PFCs).
- Sulfur hexafluoride (SF₆).
- Nitrogen trifluoride (NF₃).

Industrial processes were not identified for Mountain Village, and therefore, these GHGs were not included in the inventory.

Total emissions were reported as metric tons of carbon dioxide equivalent (mt CO₂e).

GLOBAL WARMING POTENTIALS

All GHGs have different global warming potentials (GWP). This allows for easy comparison of the absolute effects of different gases. The GWP of a GHG defines its contribution to global warming (i.e., the ability of each gas to trap heat in the atmosphere), where a GWP of one is equal to the impacts of one unit of CO₂. The effect of a non-CO₂ GHG or the combination of different GHGs is expressed as CO₂e or carbon dioxide equivalent.

GWPs have been sourced from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report.³ Table 1 shows the GHGs included in the inventory and their GWPs. Methane and N₂O are converted to CO₂e by multiplying their value by the 100-year GWP coefficient.

TABLE 1. GLOBAL WARMING POTENTIALS

Common Name	Formula	GWP
Carbon Dioxide	CO ₂	1
Methane	CH ₄	28
Nitrous Oxide	N ₂ O	265

Lotus recommends that for each new inventory the most recent IPCC 100-year GWP values are used.

INVENTORY UPDATE TIME NEEDED

Lotus recommends updating the GHG inventory at regular intervals to track trends. The total time dedicated to data collection is estimated at between 20 and 40 hours. Data collection typically takes between two to four months, allowing time for consistent follow-up to each data contact.

For consistency purposes, it is good practice to request that data is provided in the same format it was provided for this inventory. In the zipped folder of data provided by Lotus, portable document format (pdf) copies of email communication with each data contact are included (where applicable). The text in the emails/pdfs can be used to save time when sending out new emails to collect data.

In addition, the inventory workbook is set up so that it is clear which cells need to be updated/reviewed each year. Blue cells require manual entry each year, green cells should be checked annually to verify that

³ For more information see: <https://www.ipcc.ch/report/ar5/index.shtml>.

they are still accurate, and white cells include equations or other information that will not change year-to-year. See example highlighted above in Table 1.

MOUNTAIN VILLAGE WORKBOOK OVERVIEW

The Mountain Village inventory workbook includes different color tabs, as described below:

- **Summary Tabs:** The **black** and **dark gray** tabs provide an overview of the spreadsheet including a 1) Workbook Intro; 2) Visual and Emissions Summaries; and 3) Inventory Data Checklist.
- **Conversion Factors and GWPs and Community Indicators Tabs:** These two **dark blue** tabs provide data used throughout the workbook. Community indicators are those that are unique to Mountain Village. The community indicators also allow for the ability to identify trends over time (e.g., population increase or decline).
- **Source Data Tabs:** The various blue tabs store the raw data for each source and calculate the resulting GHG emissions. All data in light blue cells within these tabs will need to be updated annually or as often as a new inventory is completed.
- **GHG Declaration Tabs:** The **teal** tabs provide summary data that can be used to demonstrate GPC compliance. These tabs include: 1) GPC Table 4.1; 2) GPC Table 4.2; 3) GPC Table 4.3; and 4) GPC Table 4.4. The data in these tabs are linked to the source data tabs and will automatically update when new data is entered within the source data tabs.

SUMMARY TABS

Workbook Introduction

The black tab is the workbook introduction and provides an overview of each tab within the workbook and is intended to guide the user. This does not need to be updated with each new inventory unless changes are made to the spreadsheet by adding or subtracting tabs.

Visual and Emission Summary

These two gray tabs provide visual and emission summaries from the workbook and aggregates the data in tables, charts, and graphs. No changes will need to be made annually.

Inventory Data Checklist

This gray tab provides the information on where the inventory team collected data. This data will need to be researched and updated with each new inventory that is completed. It also includes recommended contact information for each source. Moving forward, the Inventory Data Checklist will need to be updated if: 1) contact information changes; and/or 2) additional data needs to be collected.

CONVERSION FACTORS AND GWPs AND COMMUNITY INDICATORS TABS

Conversion Factors and GWPs

This dark blue tab provides conversion factors that will not change over time. The GWPs will need to be updated when the most recent IPCC 100-year values are made available. See the Global Warming Potentials subsection for more information.

Community Indicators Tabs

The Community Indicators tab (also dark blue) provides key information about Mountain Village that is useful for normalizing emissions and understanding trends and drivers behind changes in the community's total emissions over time. This tab will need to be updated with each new inventory.

SOURCE TABS

These tabs range in color from blue to light blue. Within each tab, there are four sections:

- Emissions Summary: The emission summary summarizes all emissions from the tab by scope.
- Data Sources and Assumptions: Explains each data source and assumptions.
- Emission Factors: Provides a list of all emission factors used in calculations. *Appendix A: Emission Factors* provides all the emissions factors.
- Data Calculations: Provides an overview of the data calculations.

At times, it was necessary to make assumptions regarding the data received in order to calculate emissions. The assumptions used in each tab are detailed within the section *Inventory Assumptions*.

Stationary Energy Data Tab

Mountain Village receives electricity from SMPA and natural gas from Black Hills Energy (BHE). Other energy sources such as propane, gasoline, and diesel are not used in significant amounts within the community. Each energy provider delivers data in a unique reporting format. As such, Lotus made assumptions when necessary to ensure the usability and consistency of data. Some assumptions used in this section are explained below, and a full explanation of assumptions can be found in the section *Inventory Assumptions*. Emissions from stationary energy use were calculated in the Stationary Energy tab of the data management workbook and are aggregated to show total emissions from stationary energy.

ELECTRICITY

SMPA provides electricity to the Town of Mountain Village.

It should be noted that electricity consumed by electric vehicles, the Gondola, and the Gondola cable were subtracted from residential and commercial totals for buildings. See section *Electric Vehicles and Transit Tab* for more information. It was assumed that these systems were metered with the building's consumption and were therefore removed from the building totals so that emissions can be calculated in the appropriate sector.

Wiley Freeman, Manager of Member Services with SMPA, provided 2019 electricity consumption and CO₂ emission factor data. Note that commercial includes commercial use, industrial use, unmetered security lighting, and streetlighting. Other emission factors (i.e., CH₄ and N₂O) were taken from eGRID.⁴

$$\text{GHG emissions from electricity} = \text{kWh} * \text{emission factor} * \text{GWP}$$

NATURAL GAS

Mountain Village receives natural gas services from BHE. Brien Gardner, BHE's Supervisor of Operations, provided 2019 natural gas consumption and CO₂ emission factor data. Other emission factors were

⁴ For more information see: <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>.

sourced from ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions – Appendix C.⁵

BHE was only able to provide total usage for the community and data were not broken out by the residential and commercial sectors. The historic 2018 data provided by Kim Wheels with EcoAction Partners shows that residential natural gas use accounts for approximately 48.6% of the community's total consumption. EcoAction Partners' historic data came from a dataset provided by BHE that did break out residential and commercial use. This same percentage was applied to 2019 data.

$$\text{GHG emissions from natural gas} = \text{th} * \text{emission factor} * \text{GWP}$$

RENEWABLE ENERGY

Terry Schuyler, Energy Services and Key Account Executive with SMPA, provided data on on-site solar and Green Block Sales.

$$\text{Avoided GHG emissions from renewable energy} = -\text{kWh} * \text{emission factor} * \text{GWP}$$

Fugitive Emissions Tab

Fugitive emissions account for leakage from natural gas distribution systems and are based on an assumed methane leakage rate of 0.3 percent. The leakage rate was based on a report from the Environmental Defense Fund. No additional fugitive emission sources were identified for the Town (e.g., oil and gas wells).

$$\text{GHG emissions from fugitive natural gas} = (\text{th}/(1 - \text{leakage rate})) * 100,000/\text{natural gas energy density} * 0.02832 \text{ cubic meters/cubic foot} * \text{density of natural gas} * \text{percent of CO}_2 \text{ (or CH}_4\text{)} * \text{leakage rate}$$

On-Road Vehicles Tab

Gasoline and Diesel Vehicles

A combination of data inputs are used to calculate emissions from on-road transportation including vehicle miles traveled (VMT), vehicle distribution, and fuel efficiency. Fuel emission factors were provided by The Climate Registry.⁶ Final emission calculations for fossil fuel-based vehicles exclude electric vehicles, see section *Electric Vehicles* for more information.

Mountain Village does not track community VMT data. One source selected for VMT transportation data was from Dale Evans at Colorado Department of Health and Environment (CDPHE). Dale Evans provided VMT by vehicle type defined by HPMS Code ID:

- Motorcycle (HPMS ID - 10).
- Passenger Car (HPMS ID - 20).
- Light Truck (HPMS ID - 30).
- Bus (HPMS ID - 40).
- Single Unit Truck (HPMS ID - 50).
- Combination Unit Truck (HPMS ID - 60).

Daily VMT was multiplied by 365 to get annual VMT for Mountain Village.

⁵ For more information see: <https://icleiusa.org/publications/us-community-protocol/>.

⁶ See Local Government Operations Protocol May 2019: <https://www.theclimateregistry.org/wp-content/uploads/2019/05/The-Climate-Registry-2019-Default-Emission-Factor-Document.pdf>.

Additionally, the Town of Mountain Village uses a traffic counter to record the number of vehicles that enter the Town on a daily basis. Per conversation with JD Wise, it is estimated that most trips recorded by the traffic counter travel to and from Village Center. That distance is 2.5 miles one way. The roundtrip distance to and from the Village Center (5 miles) was multiplied by the total annual traffic count to provide a second estimate of community VMT. This estimate and the estimate using CDPHE data were averaged to calculate overall community VMT for Mountain Village.

Once community VMT was calculated, Lotus used data from Kevin Kihn of the Colorado Department of Revenue (CDR) to determine a regional vehicle distribution of fuel type. The number of vehicles applicable to the Town were attributed based on the portion of the County's population that lives in the Town (21 percent) and vehicle distribution percentages from the CO DOR were modified slightly to better reflect the vehicle distribution of Mountain Village.

Vehicle efficiencies were taken from the U.S. Environmental Protection Agency's (EPA) state inventory tool.⁷ See Table 2.

TABLE 2. VEHICLE FUEL EFFICIENCIES BY VEHICLE TYPE

Vehicle Type	Fuel Efficiency (miles per gallon)
Gas cars	24.1
Gas light trucks	18.5
Diesel cars	32.4
Diesel trucks	22.1
Gas freight trucks	7.1
Diesel freight trucks	6.6
Gas motorcycles	50.0

It was assumed that all motorcycles run on gasoline and all combination trucks run on diesel.

It was assumed that standard gasoline used at the pump contains 10 percent ethanol and that standard diesel contains no biodiesel. These assumptions were used to estimate on-road vehicle emissions from gasoline, diesel, and ethanol.

Gallons of fuel consumed by fuel type was calculated using the following example formulas for gasoline cars:

$$\text{GHG emissions from on-road transportation} = (\text{VMT} * \text{emission factor}) + (\text{gallons consumed} * \text{emission factor}) * \text{GWP}$$

Example:

⁷ For more information visit EPA's State Greenhouse Gas Inventory and Projection Tools -- Mobile Combustion Module at: <https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool>. Fuel economy for buses is not included in EPA State Inventory tool and was pulled from spreadsheet 103101_fuel_economy_by_vehicle_type_Buses.

Gasoline Car VMT = Annual VMT for passenger cars * % passenger cars that are gasoline * (1 - 10% ethanol)

Where “% passenger cars that are gasoline” was determined from the fuel type distribution provided by CDR and “annual VMT for passenger cars” was calculated by the community VMT and the vehicle type distribution provided by CDPHE.

Gallons of gasoline consumed in cars = Gasoline car VMT / fuel efficiency per vehicle type

These calculations should be repeated for each fuel and vehicle type.

ELECTRIC VEHICLES

Data on the number of electric vehicles (EV) in Mountain Village was obtained from Kevin Kihn with the Colorado DOR, which indicated there are 55 electric vehicles in San Miguel County. Since data was only available on the county level, the number of electric vehicles in Mountain Village was assigned based on the Town’s population in proportion to the population of San Miguel County (21 percent). Thus, it is estimated that there are 12 electric vehicles in Mountain Village.

To estimate electric vehicle miles traveled, the proportion of EVs to total vehicles in Mountain Village was calculated (0.38 percent). This proportion was multiplied by the total annual community VMT for Mountain Village to estimate total EV VMT. Electricity consumed by EVs was estimated by converting EV VMT to electricity using the U.S. Department of Energy constant of 0.34 kWh/VMT.

To avoid double counting, EV VMT values were subtracted from VMT totals. Electricity consumed by electric vehicles was subtracted from residential and commercial building electricity consumption totals. The inventory team assumed that electricity used for electric vehicle charging stations is included in existing building meters. Based on data from Idaho National Laboratory’s *Plugged In: How Americans Charge Their Electric Vehicles*, we assumed that 85 percent of electric vehicle charging stations are metered as residential and 15 percent are metered as commercial.⁸ The Town of Mountain Village provided data on the electricity consumed by one charging station within Town limits; data on the additional five stations in Mountain Village were unavailable, so Lotus multiplied the known data by five in order to estimate commercial electricity consumption from EVs.

GHG emissions from electric vehicles = percent of community vehicles that are EVs * community VMT * vehicle efficiency * electric emission factor

Transit Tab

There are three primary transit services in the Town: Dial-a-Ride, hotel shuttles, and the Gondola. The Telluride Mountain Village Owners Association (TMVOA) owns Dial-a-Ride, which is operated by Telluride Ski and Golf Resort. The entire route takes place within Town limits. Several hotels operate shuttle services to transport guests around Town. The Gondola transports people from Mountain Village to Telluride and

⁸ For more information see: <https://avt.inl.gov/sites/default/files/pdf/arra/PluggedInSummaryReport.pdf>.

back again and is used as transit between the two towns. The Gondola is 3 miles long,⁹ of which approximately 50 percent is located within the Town limits.¹⁰

Fuel emission factors were provided by The Climate Registry.¹¹ The electricity emission factor was provided by SMPA.

Zoe Dohnal, Business Development and Sustainability Senior Manager with the Town of Mountain Village, provided data on Dial-a-Ride that includes miles driven per year. Miles driven were converted into fuel consumed using paratransit fuel efficiency data from the Federal Highway Administration.¹²

Gallons of gasoline equivalent from Dial-a-Ride = miles driven / fuel efficiency

Hotel shuttle data was received from hotel staff at the Mountain Lodge at Telluride and Bear Creek Lodge. Data received includes hours of shuttle operation, number and location of stops, average number of daily trips and proportion of stop requests.

Gallons of gasoline equivalent from Hotel Shuttles = [(# of annual stops for Mountain Lodge Telluride to Stop X * X trip miles + # of annual stops for Mountain Lodge Telluride to Stop Y * Y trip miles...) + (# of annual stops for Bear Creek Lodge to Stop X * X trip miles + # of annual stops for Bear Creek Lodge to Stop Y * Y trip miles...)] * fuel economy for paratransit vehicles

JD Wise, Assistant Public Works Director for the Town of Mountain Village, provided electricity consumption data for the Gondola and its cables. Fifty percent of this energy consumption was applied to the Town.

GHG emissions from transit = (gallons of fuel * emission factor) + (electricity consumed * emission factor)

⁹ For more information see <https://www.telluride.com/blog/14-things-you-didnt-know-about-gondola>.

¹⁰ See Google map image at <https://www.google.com/maps/place/Mountain+Village,+CO/@37.9286636,-107.8362561,14.75z/data=!4m5!3m4!1s0x873f2947cac98aa9:0x9f6679ec18213ace!8m2!3d37.9313827!4d-107.8564531>.

¹¹ See Local Government Operations Protocol May 2019: <https://www.theclimateregistry.org/wp-content/uploads/2019/05/The-Climate-Registry-2019-Default-Emission-Factor-Document.pdf>.

¹² For more information see: <https://afdc.energy.gov/data/10309>.

Aviation Tab

There are no airports located within Mountain Village. Transboundary aviation travel was determined from neighboring Telluride Regional Airport and Montrose Regional Airport. The number of flights from each airport were determined using data from the Colorado Flights Alliance.¹³ One-way flight distances were calculated using www.webflyer.com's Mileage Calculator.¹⁴ Round-trip flight distances were then estimated, and categorized as short-, medium- or long-haul flights, as described by the US EPA's Business Travel and Employee Commuting report.¹⁵ Total mileage per flight type was multiplied by its corresponding emission factor.

Previous inventories assumed that 50 percent of Telluride Regional Airport's emissions were to be attributed to Mountain Village and 65 percent of Montrose Regional Airport's emissions were to be attributed to San Miguel County; of these, 21 percent of emissions are attributable to Mountain Village. Discussions with Town staff determined that these assumptions were still reasonable.

GHG emissions from aviation = sum (total short-haul flight miles * emission factor + total medium-haul flight miles * emission factor + total long-haul flight miles * emission factor)

Waste Recycling Data Tab

Mountain Village has two municipal solid waste collectors: Waste Management (WM) and Bruin Waste Management (Bruin). WM delivers waste to the Montrose County Landfill and Bruin delivers waste to the Broad Canyon Landfill. Neither landfill is located within Town limits. Waste emissions are determined based on tonnage of waste generated, waste distribution, and landfill processes.

WM only serves commercial customers, while Bruin serves both residential and commercial customers. JD Wise, Assistant Public Works Director for the Town of Mountain Village, provided 2019 tonnage data on solid waste and recycling generation from Bruin Waste Management. A majority of community generated waste and all of community generated recycling is collected by Bruin Waste Management. WM data was provided by Zoe Dohnal, Business Development and Senior Sustainability Manager with the Town of Mountain Village. Data from Waste Management was divided into five categories: MSW, RECY, COMI, MXPA and OCC. All categories except for MSW were grouped as 'recycling', while MSW was included under 'waste'. Data from Waste Management and waste data from Bruin were provided in cubic yards. Recycling data from Bruin was provided in pounds. Mountain Village provided a conversion factor of 150 pounds per cubic yard (lbs/yd³).

There are no comprehensive composting efforts in Mountain Village.

A waste characterization study specific to San Miguel County was available, and data from the Franz Klammer site was used as the waste characterization for Mountain Village. Values shown in the report did not always align with waste emission factor categories. Every attempt was made to combine similar waste types. Recycling characterization was taken from the 2013 EPA Advanced Sustainable Materials Management Report, Table 2: Recovery of Municipal Solid Waste. Percentages of material type by recovery were not provided in the table, and thus, were calculated based on the total weight of each

¹³ For more information see: <https://coloradoflights.org/schedule/>.

¹⁴ For more information see: http://www.webflyer.com/travel/mileage_calculator/.

¹⁵ For more information see: Table 8 Business Travel and Employee Commuting: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf.

material recovered in 2013 divided by the Total Materials in Products value (i.e. the denominator only included recyclable materials, not food waste, yard waste, or 'other' waste).

According to data from the EPA's Landfill Methane Outreach Program (LMOP),¹⁶ neither landfill collects landfill gas. Therefore, landfill gas collection efficiency was noted as 0.

$$\text{GHG emissions from landfilled waste} = (\text{sum (tons of waste * percent of waste type * emission factor)}) * (1 - \text{oxidation factor}) * (1 - \text{landfill gas collection efficiency})$$

Wastewater Data Tab

Residents and businesses of Mountain Village are served by a municipal wastewater treatment plant (WWTP) that is located in Telluride, CO. Bill Goldsworthy with the Town of Telluride provided wastewater data. Wastewater emissions for the following sources were calculated using ICLEI's wastewater calculations:

- Process N₂O emissions for WWTPs without nitrification and denitrification.
- Fugitive N₂O emissions from effluent discharge.

$$\text{GHG emissions from process emissions} = \text{population served} * \text{industrial commercial discharge multiplier} * \text{emission factor}$$

$$\text{GHG emissions from fugitive emissions} = \text{total nitrogen discharged} * \text{days per year} * \text{molecular weight ratio of N}_2\text{O to N}_2 * \text{emission factor}$$

The wastewater treatment plant that services Mountain Village does not use anaerobic processes, and therefore, does not produce digester gas. Thus, the emissions from the wastewater treatment plant occur from processes without nitrification or denitrification, as well as effluent discharge.

INVENTORY ASSUMPTIONS

Lotus and Town staff collected data from various sources to complete the 2019 emissions inventory. Whenever possible, actual source data on emissions-generating activity were used to calculate emissions. In some cases, it was necessary to make assumptions about the data received. The assumptions made for each sector are listed below; these are also included in the notes section on each sector's data tabs.

COMMUNITY INDICATORS ASSUMPTIONS

The following assumptions were made in the Community Indicators tab:

- U.S. Census Bureau American Factfinder 2017 estimates were used to estimate population, number of households, and housing units. Estimates for 2019 were not yet available, and 2017 numbers were assumed to be a close approximation.
- Unoccupied housing units includes both vacant houses and second homes that are not populated 100% of the year.

STATIONARY ENERGY DATA ASSUMPTIONS

The following assumptions were made in the Stationary Energy tab:

¹⁶ For more information see: <https://www.epa.gov/lmop/project-and-landfill-data-state>.

- The 2018 data provided by Kim Wheels with EcoAction Partners shows that residential natural gas use accounts for approximately 48.6 percent of the total (2,128,510 therms/4,378,506 therms). This same percentage was applied to 2019 data.
- Diesel, gasoline, and propane use are considered minimal; and therefore, emissions were not calculated.

FUGITIVE EMISSIONS DATA ASSUMPTIONS

The following assumptions were made in the Fugitive Emissions Data tab:

- There are no active oil and gas wells within Town limits.

ON-ROAD TRANSPORTATION DATA ASSUMPTIONS

The following assumptions were made in the Transportation tab:

- Lotus assumed all gasoline used contains 10 percent ethanol. Ethanol fuel content is based on data at the fuel pump, which states that typical gasoline contains 10 percent ethanol. It is assumed that regular diesel contains no biodiesel.
- Vehicle miles traveled were provided by Dale Wells at CDPHE. It was assumed that average daily miles traveled could be converted to annual miles traveled using a factor of 365 days per year.
- All motorcycles were assumed to be gasoline. All combination trucks were assumed to be diesel. Light duty vehicles and passenger cars spread between diesel and gasoline vehicles was created using data on registered vehicles in San Miguel County. The amount of single axis vehicles that are diesel vs gasoline are unknown. Lotus assumed an even spread between gasoline and diesel.
- It should be noted that, per CDPHE, there are no traffic counts for Mountain Village except for Route 145, and VMT within the community was estimated as 10 percent of the counts on Route 145. Data was provided from 2018; it is assumed to represent 2019 values. Community traffic counts were also provided by the Town and multiplied by the average roundtrip distance to and from the Village Center. Final community VMT estimates were calculated using both sources of data and averaged to determine Mountain Village's total VMT.
- Per phone conversations with JD Wise with the Town of Mountain Village, vehicle distribution percentages from the CO DOR were modified to better reflect the vehicle distribution of Mountain Village. Thus, data was edited to reflect a 2% makeup of combination unit trucks instead of 7%, and the remaining 5% was added to passenger vehicles (from 47% to 52%).
- Based on a report by the Idaho National Laboratory titled *Plugged In: How Americans Charge Their Electric Vehicles*, it is assumed that 85 percent of charging occurs at charging stations in residential buildings and 15 percent of charging occurs at stations in commercial buildings.
- Data on electric vehicles was provided at the county level. Thus, the number of electric vehicles in Mountain Village was estimated based on population.
- Data from the Town-owned electric vehicle charging station was provided by Jim Loebe with the Town of Mountain Village. Data collection commenced in May 2019. Data was unavailable for the other 4 charging stations within Town limits, so Lotus assumed all charging stations used the same amount of kWh as the Town-owned charging station.

TRANSIT DATA ASSUMPTIONS

- According to Google maps, approximately 50 percent of the Gondola is located within Mountain Village's Town limits, with the remaining length located in Telluride.
- Distance from hotels to shuttle stops was calculated using Google Maps.

AVIATION DATA ASSUMPTIONS

The following assumptions were made in the Aviation tab:

- There are no airports in Mountain Village. Residents use Montrose and Telluride regional airports for flights.
- In previous inventories, EcoAction Partners assigned 50 percent of Telluride airport emissions to Mountain Village and 65 percent of Montrose airport emissions assigned to San Miguel County. Emissions assigned to Mountain Village were attributed based on population of the Town to San Miguel County. This was also used for flight data in the 2019 inventory.
- According to the EPA, short-haul flights are less than 300 miles, medium-haul flights are between 300 and 2,300 miles, and long-haul flights are longer than 2,300 miles. These categories were applied to flights from the Telluride and Montrose airports.

WASTE AND RECYCLING DATA ASSUMPTIONS

The following assumptions were made in the Waste Recycling Data tab:

- Mountain Village reports trash in cubic yards. The Town uses a conversion factor of 150 lbs/yd³, as confirmed by JD Wise.
- Characterization was based on the Franz Klammer Lodge study site. Values shown in the report did not always align with waste emission factor categories. Every attempt was made to combine similar waste types.
- Recycling characterization was from the 2013 EPA Advanced Sustainable Materials Management Report, Table 2: Recovery of Municipal Solid Waste. Percentages of material type by recovery were not provided in the table, and so were calculated based on the total weight of each material recovered in 2013 divided by the Total Materials in Products value (i.e. the denominator only included recyclable materials, not food waste, yard waste, or 'other' waste).
- According to data from the EPA's Landfill Methane Outreach Program (LMOP) (<https://www.epa.gov/lmop/project-and-landfill-data-state>), neither landfill collects methane gas.
- For the data in Quarter 4 from Waste Management, categories OCC, COMI, and MXPA were included in the total of recycled materials.

WASTEWATER DATA ASSUMPTIONS

The following assumptions were made in the Wastewater Data tab:

- Ranges were given for population served and average total nitrogen discharged per day. Lotus assumed the midpoint of the range for performing calculations.

PROCESS IMPROVEMENT PLAN

Every inventory sheds light on possible improvements for the next iteration. Mountain Village's team did an excellent job providing data, helping track down difficult datasets, and brainstorming data assumptions. Future inventories could benefit from the following three process improvements:

- Estimates for electric vehicles were assumed by Town staff. There was no available data available at the state or local level. It is recommended that Mountain Village track the number of registered electric vehicles in the City and include this number in future inventories.

- If possible, Mountain Village should work with BHE to get a better estimate of residential versus commercial natural gas consumption.
- Local VMT data was not available. Mountain Village could consider a travel survey of its residents and visitors to better estimate future VMT. This data could also shed light on transboundary transportation activity and the contribution from visitors.
- Limited availability of data on the wastewater treatment processes used at the Telluride Regional Wastewater Treatment Plant limit the ability to accurately estimate emissions. Efforts should be made to better track and collect information on the processes and digester gas produced at the facility.

CONCLUSION

The 2019 GHG emissions inventory provides Mountain Village a robust and defensible baseline of carbon emissions with which to base future policies and programs against. Mountain Village is now prepared to effectively monitor and track progress against carbon reduction goals and will be better informed when choosing specific sustainability efforts. Greenhouse gas emission inventories should be updated at regular intervals to capture changes over time, and the IMP contained herein, alongside the GHG emissions inventory workbook, will enable Town staff to update GHG emissions in the future.

APPENDIX A: EMISSION FACTORS

See Table 3 for an overview of the emission factors that were used for calculations throughout the inventory. The Notes column provides detail as to which emission factors need updated regularly.

TABLE 3. SUMMARY OF EMISSION FACTORS

Stationary Energy Emission Factors—Electricity & Natural Gas					
Emission Source	GHG	Value	Unit	Source	Notes
Electricity	CO ₂	0.774	mt CO ₂ /MWh	Provided by SMPA	Verify with each inventory. Likely that the CO ₂ emission factor will change annually.
	CH ₄	0.00006	mtCH ₄ /MWh	EPA's eGrid: eGRID 2018 summary tables, table 1, sub region RMPA. https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf .	Should remain constant but verify with each inventory.
	N ₂ O	0.00001	mtN ₂ O/MWh		Should remain constant but verify with each inventory.
Natural Gas	CO ₂	0.0051	mtCO ₂ /therm	Provided by Black Hills Energy	Should remain constant but verify with each inventory.
	CH ₄	0.0000005	mtCH ₄ /therm	2013 ICLEI US Community Protocol, Appendix C	
	N ₂ O	0.00000001	mtN ₂ O/therm		
Transportation Emission Factors—Ethanol, Gasoline, and Diesel					
Emission Source	GHG	Value	Unit	Source	Notes
Gasoline	CO ₂	0.009	mtCO ₂ /gal	The Climate Registry, May 2019	Should remain constant but verify with each inventory.
	CH ₄	Varies by vehicle	g/mile		
	N ₂ O		g/mile		
Diesel	CO ₂	0.01	mtCO ₂ /gal	The Climate Registry, May 2019	

	CH ₄	Varies by vehicle	g/mile		Should remain constant but verify with each inventory.
	N ₂ O		g/mile		
Ethanol	CO ₂	0.006	mt CO ₂ /gal	The Climate Registry, May 2019	Should remain constant but verify with each inventory.
	CH ₄	Varies by vehicle	g/mile		
	N ₂ O				
Transit Emission Factors					
Emission Source	GHG	Value	Unit	Source	Notes
Electricity	CO ₂	0.774	mt CO ₂ /MWh	Provided by SMPA	Verify with each inventory. Likely that the CO ₂ emission factor will change annually.
	CH ₄	0.00006	mtCH ₄ /MWh	EPA's eGrid: eGRID 2018 summary tables, table 1, sub region RMPA. https://www.epa.gov/sites/production/files/2020-01/documents/egrid2018_summary_tables.pdf .	Should remain constant but verify with each inventory.
	N ₂ O	0.00001	mtN ₂ O/MWh		Should remain constant but verify with each inventory.
Gasoline	CO ₂	0.0088	mt CO ₂ /gal	The Climate Registry, May 2019	Should remain constant but verify with each inventory.
	CH ₄	0.0085	g CH ₄ /mile		
	N ₂ O	0.0082	g N ₂ O/mile		
Aviation Emission Factors					
Emission Source	GHG	Value	Unit	Source	Notes
Short-Haul Travel	CO ₂	0.23	kg CO ₂ /passenger mile	Table 8 Business Travel and Employee Commuting: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf	Should remain constant but verify with each inventory.
	CH ₄	0.0039	g CH ₄ /passenger mile		
	N ₂ O	0.0072	g N ₂ O/passenger mile		
Medium-Haul travel	CO ₂	0.14	kg CO ₂ /passenger mile	Table 8 Business Travel and Employee Commuting:	Should remain constant but verify

	CH ₄	0.0006	g CH ₄ /passenger mile	https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf	with each inventory.
	N ₂ O	0.0043	g N ₂ O/passenger mile		
Long-Haul Travel	CO ₂	0.17	kg CO ₂ /passenger mile	Table 8 Business Travel and Employee Commuting: https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf	Should remain constant but verify with each inventory.
	CH ₄	0.0006	g CH ₄ /passenger mile		
	N ₂ O	0.0053	g N ₂ O/passenger mile		
Waste Emission Factors					
Emission Source	GHG	Value	Unit	Source	Notes
Municipal Solid Waste	CH ₄	Varies by waste type	mt CH ₄ / ton waste	2013 ICLEI US Community Protocol, Appendix E	Should remain constant but verify with each inventory.
Recycled Waste	CH ₄	Varies by waste type	mt CH ₄ / ton waste	ICLEI's U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol) – Recycling and Composting Emissions Protocol, Version 1.0, July 2013: Emission factors represent those for avoided emissions from a facility with no landfill gas capture.	Should remain constant but verify with each inventory.
	N ₂ O		mt N ₂ O/ wet short ton waste		
Wastewater	CH ₄	Varies by treatment	Varies	2013 ICLEI US Community Protocol, Appendix F	Should remain constant but verify with each inventory.
	N ₂ O				



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