Snowmass Village Inventory of Greenhouse Gas Emissions in 2009

By Richard Heede

Climate Mitigation Services

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Climate Mitigation Services

Principal Investigator: Richard Heede
heede@climatemitigation.com
1626 Gateway Road
Snowmass, CO 81654 USA
970-927-9511 office
970-343-0707 mobile

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Report commissioned by Town of Snowmass Village
Snowmass Village, Colorado
www.tosv.com
970-923-3777

Note on units: common US units are used throughout. The spreadsheets, however, estimate emissions in both US and metric units. Emissions of methane and nitrous oxide are also expressed in CO_2-equivalent terms (CO_2e).

Cover: Elevation map of Snowmass Village. Courtesy of maps.google.com. Image above from tosv.com

Summary

Snowmass Village Energy & Emissions Inventory

Rick Heede
Climate Mitigation Services

Climate Mitigation Services (CMS) was commissioned by the Town of Snowmass Village to conduct a comprehensive community-wide energy and greenhouse gas inventory for 2009. This report summarizes the results in tables and charts; additional information and the detailed emission worksheets are available in the Appendix. In discussions with TOSV Town Manager Russ Forrest and Lesley Compagnone it was decided to adopt the inventory protocol and boundary definition used in the Aspen inventories of 2004 & 2007 to foster comparison of emissions in both jurisdictions.

This comprehensive inventory includes emission sources from several sectors:

Boundary definition (Town of Snowmass Village; Scopes 1, 2, & 3; CO_2, CH_4, N_2O, & refrigerants)

Buildings sector

- Electricity
- Natural Gas (including TOSV snowmelt)
- Propane
- Fuel oil (if material)
- Special District buildings and facilities (e.g., Wastewater Treatment Facility, TOSV share of County Landfill)
- School district buildings and facilities.
- Discussion of residential, commercial, government, institutional, and other building types.

Transportation

- About town
- Commuting and local driving (personal & commercial vehicles)
- Tourist driving
- TOSV vehicles (e.g., police cruisers, snowplows, municipal)
- Local bus systems (RFTA & Snowmass shuttles)
- School buses (Snowmass routes only)

Air travel and aviation

- Commercial air travel via Aspen Pitkin County Airport, ASE (20 percent allocated to Snowmass)
- Commercial air travel via regional airports: EGE, GJT, DEN (20 percent allocated to Snowmass)
- Business and personal jets and turboprops operating out of ASE (20 percent allocated to Snowmass)
- Locally based personal aircraft

Other fuel and emissions

- Construction equipment
- Snowmass Ski area (on-mountain diesel and gasoline)
- Other (mowers, blowers, & misc. equipment)

Methane and nitrous oxide emissions

- Wastewater Treatment Facility (deemed not material)
- Snowmass share of County Landfill (energy and fugitive methane)
- Methane emissions from coal and natural gas supplying Xcel Energy & Holy Cross Energy power plants
- N_2O from fertilizer application (chiefly for Town Parks and golf course)

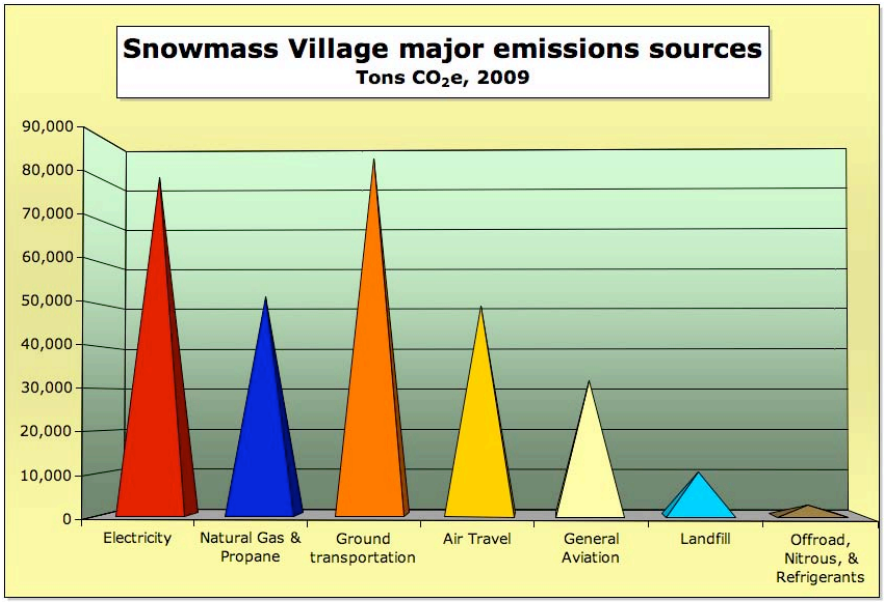
References, data sources, list of contacts, folio of worksheets

Table 1. Summary of Snowmass Village greenhouse gas emissions 2009

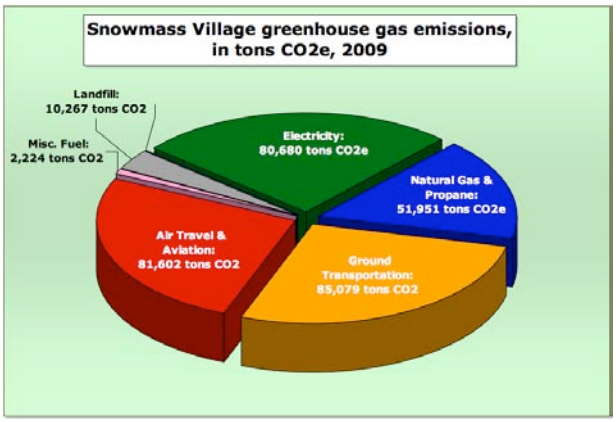
SOURCE	TONS CO_2e	PERCENT
Electricity (buildings & snowmelt)[1]	80,680	25.9
Natural Gas & Propane (buildings & snowmelt)	51,951	16.7
Ground Transportation	85,079	27.3
Air travel & Aviation	81,602	26.2
Miscellaneous fuel uses	2,224	0.7
Landfill	10,267	3.3
Nitrous oxide	56	0.0
HFCs and refrigerants	52	0.0
Total	310,856	100.0

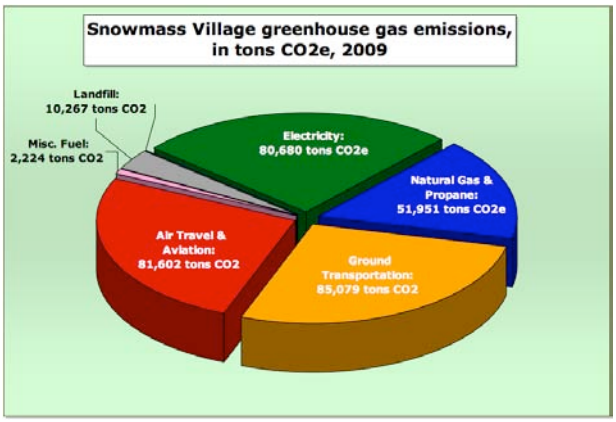
Table 2. Per capita emissions, selected jurisdictions

AREA	TONS CO_2e	TONS CO_2e/capita
Snowmass Village (2009: 1,911 res)	310,856	163
Snowmass Village (2009: 4,000 res + vis)	310,856	78
Aspen (2004, 8,200 res)	840,875	103
Aspen (2004, 16,693 res + vis)	840,875	50
Frisco (2007, 2,697 res)	128,698	48
Frisco (2007, 6,906 res + vis)	128,698	19
Boulder (2003, 96,700 res)	2,012,000	19
United States (2006, all sources)	7,800,000,000	26
Global average	31,950,000,000	5



[1] Town of Snowmass Village consumed 731,910 kWh of electricity and 431,806 therms of natural gas for Upper and Lower Snowmelt Road, Parcel C/snowmelt garage, and Lot 2 snowmelt, for gas-related emissions of 2,884 tons CO_2e, plus electricity emissions of 663 tons CO_2e; total 3,547 tCO_2e, or 1.1 percent of Snowmass Village total emissions.


Snowmass Village greenhouse gas emissions, in tons CO2e, 2009
Landfill: 10,267 tons CO2
Misc. Fuel: 2,224 tons CO2
Electricity: 80,680 tons CO2e
Natural Gas & Propane: 51,951 tons CO2e
Air Travel & Aviation: 81,602 tons CO2
Ground Transportation: 85,079 tons CO2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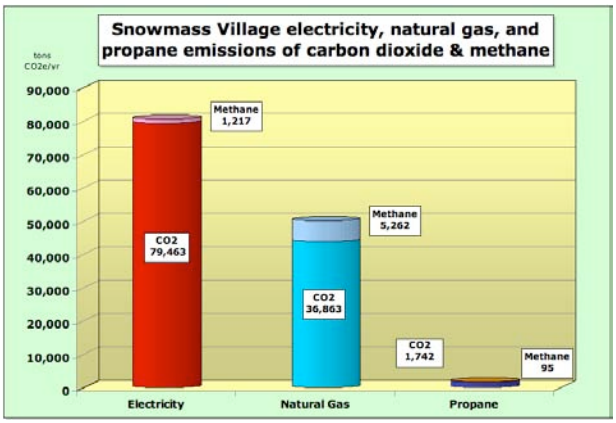
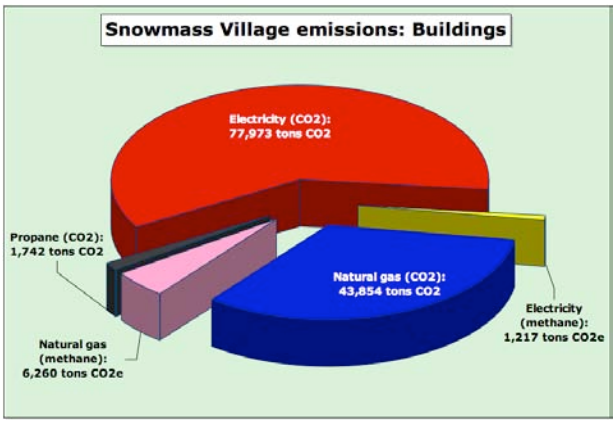
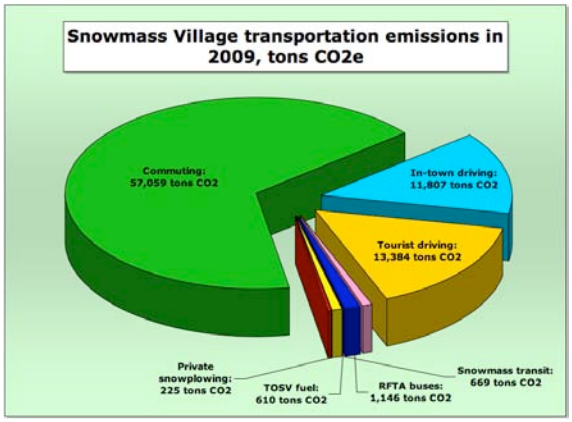
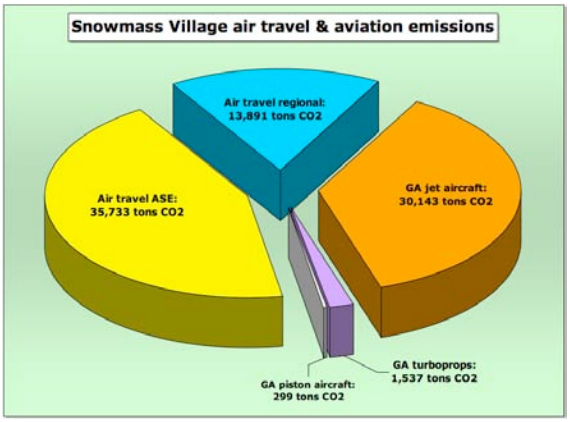
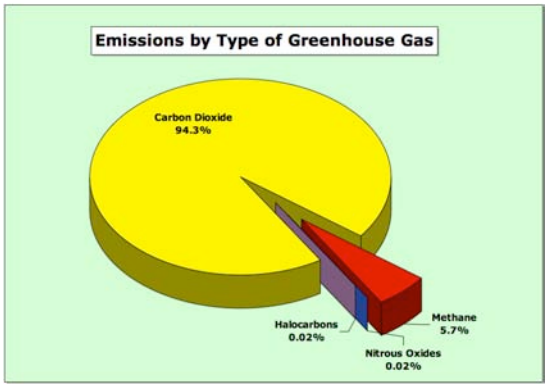
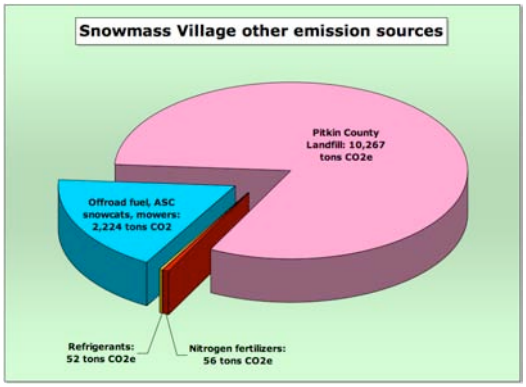

Snowmass Village electricity, natural gas, and propane emissions of carbon dioxide & methane
tons CO2e/yr
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Methane 1,217
CO2 79,463
Methane 5,262
CO2 36,863
CO2 1,742
Methane 95
Electricity
Natural Gas
Propane


Snowmass Village emissions: Buildings
Electricity (CO2): 77,973 tons CO2
Propane (CO2): 1,742 tons CO2
Natural gas (CO2): 43,854 tons CO2
Electricity (methane): 1,217 tons CO2e
Natural gas (methane): 6,260 tons CO2e


Snowmass Village transportation emissions in 2009, tons CO2e
Commuting: 57,059 tons CO2
In-town driving: 11,807 tons CO2
Tourist driving: 13,384 tons CO2
Private snowplowing: 225 tons CO2
TOSV fuel: 610 tons CO2
RFTA buses: 1,146 tons CO2
Snowmass transit: 669 tons CO2


Snowmass Village air travel & aviation emissions
Air travel regional: 13,891 tons CO2
Air travel ASE: 35,733 tons CO2
GA jet aircraft: 30,143 tons CO2
GA turboprops: 1,537 tons CO2
GA piston aircraft: 299 tons CO2


Emissions by Type of Greenhouse Gas
Carbon Dioxide 94.3%
Methane 5.7%
Halocarbons 0.02%
Nitrous Oxides 0.02%


Snowmass Village other emission sources
Pitkin County Landfill: 10,267 tons CO2e
Offroad fuel, ASC snowcats, mowers: 2,224 tons CO2
Refrigerants: 52 tons CO2e
Nitrogen fertilizers: 56 tons CO2e

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Contacts

Contact information is listed on each worksheet of the inventory emission sources.

Folio of worksheets

Worksheet 1:	**Summary**
Worksheet 2:	**Electricity**
Worksheet 3:	**Natural Gas**
Worksheet 4:	**Propane**
Worksheet 5:	**Transportation: commuting, driving around town, tourist driving**
Worksheet 6:	**Transportation: RFTA**
Worksheet 7:	**Transportation: School buses, Pitkin County, TOSV fleet, ASC, & misc.**
Worksheet 8:	**Aviation: Commercial via ASE and regional airports**
Worksheet 9:	**Aviation: General Aviation via ASE**
Worksheet 10:	**Fertilizers & nitrous oxide**
Worksheet 11:	**Pitkin County Solid Waste Facility (and recycling)**
Worksheet 12:	**Halocarbons & refrigerants**

Town of Snowmass Village

Summary

Community Greenhouse Gas Emissions Inventory, 2009

Last Modified: 21 July 2010

Rick Heede Climate Mitigation Services, 970-927-9511

	Physical Units		Energy Units		GHG Emissions		CO2e Equivalent (Full accounting)		Percent of Total	CO2e (TOSV + half of commuting, tourist diriving, air travel, and aviation (in dark red))	Percent of Total
Buildings: electricity											
Electricity: residential (Holy Cross Energy)	43,765,009	kWh	446,403	10^6 Btu	38,802	tons CO2	38,802	tons CO2	12.4%	38,802	16.5%
Electricity: commercial (Holy Cross Energy)	43,598,119	kWh	444,701	10^6 Btu	38,654	tons CO2	38,654	tons CO2	12.4%	38,654	16.4%
Electricity: ASC Snowmass Mtn (Holy Cross Energy)	2,263,631	kWh	23,089	10^6 Btu	2,007	tons CO2	2,007	tons CO2	0.6%	2,007	0.9%
Electricity (fugitive methane)	49	tons CH4		10^6 Btu	49	tons CH4	1,217	tons CO2e	0.4%	1,217	0.5%
Total electricity	89,626,759	kWh	914,193	10^6 Btu	79,463	tons CO2	80,680	tons CO2e	25.9%	80,680	34.3%
Buildings: natural gas and propane											
Natural Gas (SourceGas)	884,119	Mcf	750,353	10^6 Btu	43,854	tons CO2	43,854	tons CO2	14.1%	43,854	18.6%
Natural Gas (fugitive methane)	250	tons CH4	11,967	10^6 Btu	250	tons CH4	6,260	tons CO2e	2.0%	6,260	2.7%
Propane (AmeriGas, Ferrellgas, Cross Propane)	275,049	gallons	25,119	10^6 Btu	1,742	tons CO2	1,742	tons CO2	0.6%	1,742	0.7%
Propane (fugitive methane)	4	tons CH4		10^6 Btu	4	tons CH4	95	tons CO2e	0.0%	95	0.0%
Total natural gas & propane	275,053	gallons	787,438	10^6 Btu	na	tons CO2e	51,951	tons CO2e	16.7%	51,951	22.1%
Total buildings	na	gallons	1,701,631	10^6 Btu	na	tons CO2	132,632	tons CO2e	42.5%	132,632	56.4%
Transportation: highway, around town, buses, and waste hauling											
Commuting & driving to Snowmass Village	5,728,557	gallons	716,471	10^6 Btu	57,059	tons CO2	57,059	tons CO2	18.3%	28,530	12.1%
In-town driving	1,190,194	gallons	148,858	10^6 Btu	11,807	tons CO2	11,807	tons CO2	3.8%	11,807	5.0%
Tourist driving to Snowmass Village	1,366,100	gallons	170,858	10^6 Btu	13,384	tons CO2	13,384	tons CO2	4.3%	6,692	2.8%
Transit Buses (Snowmass shuttles: diesel)	36,194	gallons	5,020	10^6 Btu	405	tons CO2	405	tons CO2	0.1%	405	0.2%
Transit Buses (Snowmass shuttles: gasoline)	26,941	gallons	3,370	10^6 Btu	264	tons CO2	264	tons CO2	0.1%	264	0.1%
Transit Buses (RFTA Snowmass routes)	106,567	gallons	14,781	10^6 Btu	1,146	tons CO2	1,146	tons CO2	0.4%	573	0.2%
School Buses on SV bus routes	5,106	gallons	708	10^6 Btu	57	tons CO2	57	tons CO2	0.0%	57	0.0%
School buses on field trips & away games	2,676	gallons	371	10^6 Btu	26	tons CO2	26	tons CO2	0.0%	26	0.0%
Pitkin County fuel use (diesel) (10 percent to TOSV)	4,045	gallons	561	10^6 Btu	45	tons CO2	45	tons CO2	0.0%	45	0.0%
Pitkin County fuel use (gasoline) (10 percent to TOSV)	5,163	gallons	646	10^6 Btu	51	tons CO2	51	tons CO2	0.0%	51	0.0%
Town of Snowmass fuel use (diesel fuel)	63,483	gallons	7,940	10^6 Btu	305	tons CO2	305	tons CO2	0.1%	305	0.1%
Town of Snowmass fuel use (gasoline)	58,022	gallons	7,257	10^6 Btu	305	tons CO2	305	tons CO2	0.1%	305	0.1%
Private snowplowing	20,097	gallons	2,787	10^6 Btu	225	tons CO2	225	tons CO2	0.1%	225	0.1%
Total highway vehicles, around town, buses, & waste hauling	8,613,144	gallons	1,079,627	10^6 Btu	85,079	tons CO2	85,079	tons CO2	27.3%	49,285	20.9%
Transportation: commercial and private aviation (TOSV share)											
Air Travel - Commercial via Aspen Pitkin County Airport (20%)	3,483,158	gallons	470,226	10^6 Btu	35,733	tons CO2	35,733	tons CO2	11.5%	17,867	7.6%
Air Travel - Commercial using other regional airports (20%)	1,374,043	gallons	185,496	10^6 Btu	13,891	tons CO2	13,891	tons CO2	4.5%	6,946	3.0%
Air Travel - General Aviation (jets, 20%)	2,858,758	gallons	385,932	10^6 Btu	30,143	tons CO2	30,143	tons CO2	9.7%	15,071	6.4%
Air Travel - General Aviation (turboprops, 20%)	145,774	gallons	19,679	10^6 Btu	1,537	tons CO2	1,537	tons CO2	0.5%	769	0.3%
Air Travel - General Aviation (piston aircraft, incl Air Ambi, 20%)	32,360	gallons	3,889	10^6 Btu	299	tons CO2	299	tons CO2	0.1%	149	0.1%
Total commercial and private aviation	7,894,092	gallons	1,065,223	10^6 Btu	81,602	tons CO2	81,602	tons CO2	26.2%	40,801	17.3%
Off-road fuel use (construction, Snowmass Ski Area, misc.)											
Construction equipment fuel use	10,000	gallons	1,251	10^6 Btu	112	tons CO2	112	tons CO2	0.04%	112	0.0%
Snowmass Ski Area (diesel)	138,907	gallons	18,752	10^6 Btu	1,555	tons CO2	1,555	tons CO2	0.50%	1,555	0.7%
Snowmass Ski Area (gasoline)	38,996	gallons	4,877	10^6 Btu	382	tons CO2	382	tons CO2	0.12%	382	0.2%
Off-road (construction equip., gas widgets)	17,620	gallons	2,204	10^6 Btu	175	tons CO2	175	tons CO2	0.06%	175	0.1%
Total off-road fuel and emissions	205,523	gallons	27,084	10^6 Btu	2,224	tons CO2	2,224	tons CO2	0.7%	2,224	0.9%
Total transportation	16,712,760	gallons	2,171,934	10^6 Btu	168,905	tons CO2e	168,905	tons CO2e	54.2%	92,310	39.2%
Landfill (Snowmass Village's share of Pitkin County Landfill)											
Electricity	64,139	kWh	654	10^6 Btu	57	tons CO2	57	tons CO2	0.02%	57	0.0%
Fuel consumption (diesel & gasoline: onsite)	2,588	gallons	323	10^6 Btu	29	tons CO2	29	tons CO2	0.01%	29	0.0%
Landfill: fugitive methane	407	tons CH4		10^6 Btu	407	tons CH4	10,181	tons CO2e	3.26%	10,181	4.3%
Total landfill	various		978	10^6 Btu		na	10,267	tons CO2e	3.3%	10,267	4.4%
Nitrous Oxide sources											
Snowmass Club (golf course)	3,705	kg N	na		116	kg N2O	38	tons CO2e	0.0%	38	0.0%
Snowmass Village Parks	544	kg N	na		17	kg N2O	6	tons CO2e	0.0%	6	0.0%
Snowmass Village athletic fields	-	kg N	na		-	kg N2O	-	tons CO2e	0.0%	-	0.0%
Private greenspace within town limits	1,248	kg N	na		39	kg N2O	13	tons CO2e	0.0%	13	0.0%
Total nitrous oxide sources	5,497	kg N			172	kg N2O	56	tons CO2e	0.02%	56	0.02%
HFCs and refrigerants											
Refrigerant leakage from refrigerators, freezers, and AC units	4	kg HFC-134a	na	10^6 Btu		tons CO2e	6	tons CO2e	0.0%	6	0.0%
Improper venting of refrigerant at appliance disposal	na	kg R-12	na	10^6 Btu		tons CO2e		tons CO2e	0.0%	-	0.0%
Refrigerant leakage from vehicle air conditioners	32	kg HFC-134a	na	10^6 Btu		tons CO2e	46	tons CO2e	0.0%	46	0.0%
Total HFCs	36	kg HFC-134a			-	tons CO2e	52	tons CO2e	0.02%	52	0.02%
Total	various	units	3,874,543	10^6 Btu	various	units	311,912	tons CO2e	100%	235,316	100%
Credit for TOSV windpower purchases and local generation	1,172,575	kWh	11,960	10^6 Btu	1.800	lb CO2e/kWh	1,056	tons CO2e	0.3%	1,056	0.4%
Total net emissions after renewable energy credits	various	units	3,862,583	10^6 Btu	various	units	310,856	tons CO2e	99.7%	234,261	99.6%
Methane emissions					710	tons CH4	17,753	tons CO2e	5.69%	17,753	7.54%
Nitrous oxide emissions					172	kg N2O	56	tons CO2e	0.02%	56	0.02%
Refrigerant leakage					36	kg HFC-134a	52	tons CO2e	0.02%	52	0.02%
Carbon dioxide emissions							294,051	tons CO2	94.27%	217,456	92.41%

1 ton CH4 = 47.792 million Btu (EPA "Natural Gas Methane Units Converter")

Cell: P2
Comment: Rick Heede:
This worksheet summarizes all sources of greenhouse gas emissions attributable to the community of Snowmass Village in 2009. All relevant sums -- physical units, energy units, GHG emissions, and CO2e equivalent -- are linked to their respective worksheets and thus automatically updated whenever any changes are made.

Cell: F6
Comment: Rick Heede:
EPA (undated) "Natural Gas Methane Units Converter," 2 pp., www.epa.gov/gasstar; PDF in Climate / Emissions / Emissions Factors. 1 ton CH4 = 47.792 million Btu

Cell: B17
Comment: Rick Heede:
CMS estimates fugitive methane from the production, processing, pipelining, and distribution of natural gas. It is an estimate of system losses, and is not attributed to SourceGas. CMS assumes the U.S. average heating valeu of 1,027 Btu per cubic foot in converting tons of fugitive methane into cubic feet.

Cell: B78
Comment: Rick Heede:
Holy Cross Energy provided 2009 data on Wind Power Pioneer participation (1.15 million kWh) and Local Renewable Energy Pool generation (19,275 kWh), which is credited here and on the "Electricity" worksheet.

Cell: I78
Comment: Rick Heede:
Holy Cross Energy's emission factor per delivered kWh. See "Electricity" worksheet for details.