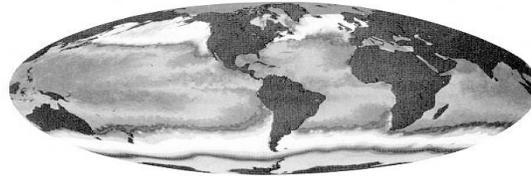


Aspen Greenhouse Gas Emissions 2004

For the City of Aspen's Canary Initiative



Richard Heede
Climate Mitigation Services
Old Snowmass, Colorado
18 January 2006



Climate Mitigation Services

Principal Investigator: Richard Heede
heede@climatemitigation.com
1626 Gateway Road
Snowmass, CO 81654 USA
970-927-9511 office
970-404-1144 mobile

Dedicated to my daughter Shana Breeze for her boundless enthusiasm, wisdom, and compassion.

Copyright ©2006 CMS

This work was done in July 2005 through January 2006 under contract with the City of Aspen.

Principal contacts:

Dan Richardson, Global Warming Project Manager, 970-920-5071, danr@ci.aspen.co.us,
Lee Cassin, Environmental Health Department Director, 970-920-5075, leec@ci.aspen.co.us.



CITY OF ASPEN
CANARY INITIATIVE

City of Aspen
130 S. Galena Street
Aspen Colorado 81611 USA

www.aspengov.com & www.aspenglobalwarming.com

Note on units: common US units are used throughout. The spreadsheets present emissions results in both US and metric units. Emissions of methane and nitrous oxide are expressed in CO₂-equivalent terms (CO_{2-e}). See Appendix A for conversions and emissions factors.



“Valley Beyond,” 102x126cm, Tania Dibbs, www.taniadibbs.com

Cover image: Aspen at Ute City Bank building, looking up at the Aspen Mountain gondola at dusk, with images on the left representing the sources of emissions, and the images on right representing some ways to reduce emissions.

Image at the banner of page 21 is courtesy of Aspen/Snowmass, photo by Paul Morrison.

Executive Summary

By Dan Richardson

In 1896 a Swedish chemist advanced the theory that increased levels of carbon dioxide would lead to global warming. In 1967 the first reliable computer simulation model showed that increased levels of carbon dioxide will increase global temperatures. In 1990, a local newspaper reported that a City of Aspen employee's research indicated that Aspen's winter seasons were getting increasingly shorter than 40 years earlier. In March of 2005, the City of Aspen adopted a plan to aggressively begin reducing global warming emissions (aka greenhouse gas emissions). These emissions are responsible for trapping additional heat in the atmosphere, causing global warming. And so, the Canary Initiative, so named because Aspen sees itself and other communities dependent on consistent water cycles as a canary in the coal mine, was born. This initiative serves as an action plan that identifies steps to reduce global warming pollution; inform the public about impacts from, and solutions for global warming; and to advocate for action on a regional, state, and national level. This *Greenhouse Gas Emissions Inventory* represents the completion of one of the initial steps in launching the Canary Initiative.

Purpose, scope, & boundary definition

For Aspen to take any meaningful action to reduce its global warming emissions, it needed to identify the sources and the quantity of greenhouse gas emissions. This inventory of emissions serves as the tool to better understand the sources of emissions. Although it is known that the primary source of emissions is the burning of fossil fuels, it is important for a community to understand the impact from each sector, such as 'Buildings,' 'Transportation,' or 'Other Sources.' The inventory goes into even greater detail by breaking out the various sources from each sector more specifically. For example 'Ground Transportation' is divided into different sub-categories, such as transit buses, in-town vehicles, commuting, etc. The Building sector is divided by type, such as commercial, residential, and municipal, and is then broken down further into electricity, natural gas, and propane use.

The scope of the inventory was designed to capture what Aspen's community is directly responsible for as well as the most important indirect sources attributable to the activities, buildings, and people of Aspen. In short, what is the carbon footprint reasonably attributable to Aspen's physical, cultural, and economic existence? As a resort-based economy, getting an accurate snapshot of the 'economic engine' required a comprehensive approach. For example it includes both legs of travel of both highway commuters and air travelers, since both are primary contributors to Aspen's economy and would not occur otherwise. Not included in this Inventory are emissions from the resource extraction, fabrication, and delivery of goods and services from outside the boundary.

This Inventory establishes a baseline for the entire community from which to begin tracking these reductions in global warming pollution. To establish a baseline for Aspen's greenhouse gas emissions, an 'Emissions Inventory Boundary' was created. Geographically, the boundary extends beyond the city limits to include adjacent areas such as Mountain Valley, Starwood, the Airport Business Center and others that are tied closely to Aspen. Conceptually, the boundary includes sources such as energy use (natural gas, propane and electricity) from both residential and

commercial buildings, including the indirect emissions from such sources as coal-burning power plants that generated electricity for Aspen; road travel of trucks, locals, tourists *and* commuters; the Pitkin County Landfill; the Aspen Skiing Company (excluding Snowmass); and air travel.

The Result

The amount of greenhouse gas emissions in or attributable to the City and community of Aspen in totaled 840,875 tons of carbon dioxide-equivalent (CO_{2e}) in the baseline year of 2004. Nearly all of the emissions are carbon dioxide emitted to the atmosphere from the combustion of fossil fuels, with a very small percentage coming from methane (landfill emissions) and nitrous oxide gases (fertilizers). This total reflects millions of small and routine acts of energy use such as turning on lights or driving to the post office. The total is broken down into six major sectors: Ground Transportation accounts for 25.1%, Commercial Air Travel accounts for 22.2%, Private Air Travel accounts for 18.8%, Electricity accounts for 19.8%, Natural Gas & Propane accounts for 12.7%, Landfill accounts for 1.4% and Fertilizer accounts for .04%.

Table ES-1. Summary of Aspen's greenhouse gas emissions in 2004

| SOURCE | TONS CO _{2e} | PERCENT |
|-----------------------------------|-----------------------|--------------|
| Electricity (buildings) | 166,557 | 19.8 |
| Natural Gas & Propane (buildings) | 106,754 | 12.7 |
| Ground Transportation | 211,175 | 25.1 |
| Air Travel: Commercial | 186,631 | 22.2 |
| Air Travel: Private | 157,856 | 18.8 |
| Landfill | 11,577 | 1.4 |
| Nitrous oxide: | 325 | 0.04 |
| Total | 840,875 | 100.0 |

In an effort to understand the impacts of steps Aspen has already taken to reduce greenhouse gas emissions, this Inventory also identifies the emissions reductions achieved by RFTA ridership and recycling efforts. For example, recycling efforts in the Aspen community alone reduced emissions by over 4,881 tons CO_{2e} in 2004. Ridership on RFTA attributable to Aspen reduced emissions by over 6,811 tons CO_{2e}.

Buildings: Electricity, natural gas, and propane

The source of global warming emissions from the 'Buildings' sector comes from the generation of electricity and the burning of natural gas and propane for heat. Buildings account for 273,311 tons, or 32.5% of Aspen's total. Of this, the residential sector is responsible for 46.7%, commercial buildings emit 50.8%, and municipal buildings account for 2.5%. When divided by energy source, electricity accounts for 60.9% and natural gas/propane account for 39.1%. The Inventory also includes the indirect emissions from these sources. Indirect emissions are those that occur outside of the geographic boundary, but are nonetheless attributable to Aspen. A good example is the emissions from coal & natural gas-fired power plants located elsewhere but from which Aspen acquires its electricity.

Although every person within the boundary shares responsibility for overall emissions stemming from the general economy, they are also responsible for their own household emissions, of which they have great control. To illustrate this point, several homeowners offered their 2004 utility bills

that are included as case studies in the report. A 2,100 sf house in the West End occupied full-time had a 'household footprint' of 12.2 tons of CO_{2e}, which translates into 11.7 CO_{2e}/sf. A 7,931 sf house in 5 Trees, occupied three weeks a year, had a 'household footprint' of 171.6 tons of CO_{2e}, which translates into 43 CO_{2e}/sf.

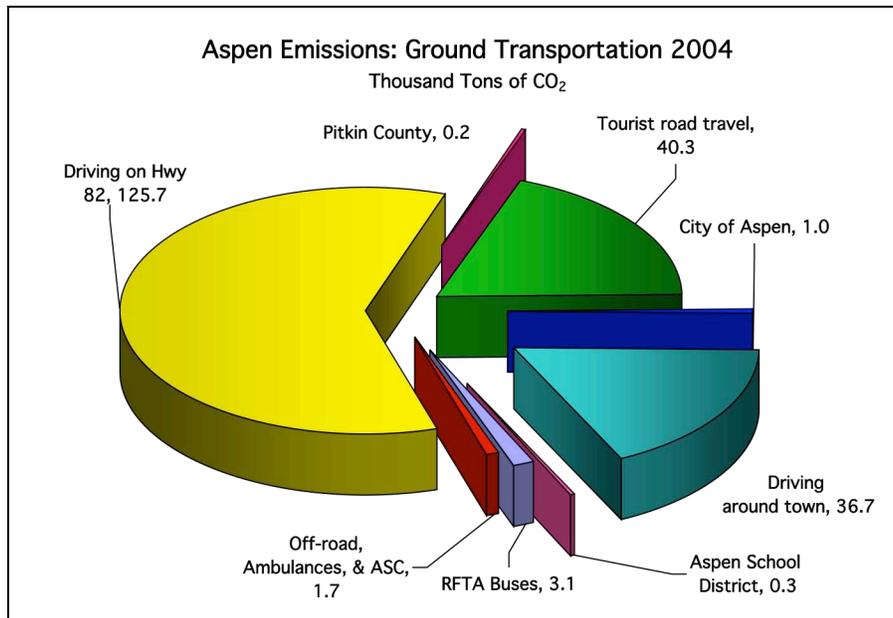
Some commercial building case studies are also included. The average emissions of eight offices at the Airport Business Center, totaling 55,790 sf, emitted 816 tons of CO_{2e}, giving them an average 'emissions intensity' of 29 lbs per sf. The Aspen Recreation Center is 82,000 sf, emitted 1,654 tons of CO_{2e}, and therefore has an 'emissions intensity' of 40 lbs per sf. The Wheeler Opera House is 22,065 sf, emitted 1,030 tons of CO_{2e}, and thus an 'emissions intensity' of 93 lbs CO_{2e}/sf. By simply comparing a few houses and businesses, it's difficult to assess how well they perform. What is evident is that house design and how a home is operated have a big impact on global warming emissions from the residential sector. Likewise, in the commercial sector, the decisions about design and operation, coupled with the type of business, greatly affect its global warming emissions. This information also allows individuals to compare their buildings to the case studies and identify reduction opportunities. The Community Office for Resource Efficiency (CORE) has been a resource for reducing greenhouse gas emissions by improving energy efficiency for over a decade and continues to assist homeowners and business owners.

Another opportunity to reduce greenhouse gas emissions from the building sector is to generate electricity from renewable resources, such as wind and hydroelectric power. The Inventory highlights Aspen's investment in renewable energy, because it indicates what total greenhouse gas emissions would be without this investment. In a year where the drought impeded a significant portion of Aspen's hydroelectric power generation, 23,516,474 kwh of electricity were generated by renewable sources, thus reducing the total emissions by 21,081 tons of CO_{2e}. Put another way, Aspen Electric's emissions would have been 35% higher if not for their investment in renewable energy. For comparison purposes, 2005 'savings' are at 55% due to better hydrological conditions. Holy Cross Energy, one of the other electric utilities in the area, has also made the purchase of wind power available to its customers. By taking advantage of this, its customers within the Emissions Boundary have been able to reduce their emissions by over 9,000 tons of CO_{2e}.

Transportation

The source of global warming pollution from the transportation sector comes from the burning of gasoline, diesel, and jet fuel, 54 million gallons of fuel to be precise. This translates into 555,662 tons of CO_{2e}. This sector is divided into 'Ground Transportation' and 'Air Travel.' 'Ground Transportation' is responsible for 211,175 and includes Highway 82 traffic, tourist traffic, around town traffic, RFTA buses, construction vehicles, school buses and every other source reasonably attributable to Aspen. Highway 82 traffic accounts for 59.5% of 'Ground Transportation', and includes both legs of commuter traffic, while around town & tourist traffic accounts for 36.5%. RFTA accounts for 1.5%. Air travel is responsible for 344,487 tons of CO_{2e}, 54.2% of which comes from commercial air travel and 45.8% comes from private jet travel. Because air travel is an integral part of Aspen's economy, both legs of air travel were included.

This inventory took a close look at the impact RFTA has had on Aspen's greenhouse gas emissions. RFTA's operations avoids the use of an estimated 696,329 gallons of gasoline if those bus riders were instead to use personal vehicles, which amounts to a *net* savings of 6,811 tons of CO_{2e}. This indicates that increased ridership in the future can lead to further greenhouse gas reductions.

Fig. ES-1: Sources of ground transportation emissions

Other sources

The two smallest sectors included in the inventory are 'Landfill' and 'Nitrous Oxide Sources.' The Landfill sector does not include the energy involved in producing the material that end up in the landfill, only the energy used onsite and the methane emissions from anaerobic digestion of the buried wastes. Landfill emissions total 11,577 tons of CO_{2e}. However, like RFTA's savings in transportation emissions, Aspen's recycling efforts play a significant role in reducing landfill emissions. Without these recycling efforts, total Landfill emissions would be 29% higher.

In this inventory, Nitrous Oxide emissions arise from the nitrogen in fertilizers applied to City- and privately-owned golf courses, athletic fields, parks, and backyards. It accounts for 325 tons of CO_{2e}. Although the amount of nitrous oxide applied is relatively small, its effect on global warming as a greenhouse gas is 296 times stronger than carbon dioxide, and is therefore important to track. Reduction strategies typically include applying fertilizers more efficiently and/or using fertilizers with lower nitrogen content.

Conclusion

While Aspen cannot control all of the factors that contribute to our emissions, only with an accurate understanding of the emissions attributable to Aspen can the community know what action is most effective in reducing global warming pollution. With this baseline Greenhouse Gas Emissions Inventory, the community can now set a goal and begin tracking its progress of reducing its emissions. The next step will be to develop specific reduction strategies based on the large greenhouse gas emissions sources identified in the report, which are: road travel, building energy use, and air travel. These reduction strategies should build on past successes highlighted in this report, such as the investments in renewable energy, transit and waste reduction programs. These, coupled with new creative ideas, are all partial solutions to global warming in which Aspen has, and can continue to lead the way. Any solution will require a commitment from the citizens and businesses. Solutions will also undoubtedly require several different options and participation from all sectors, but it is clear they're crucial to maintaining Aspen's economy and quality of life.