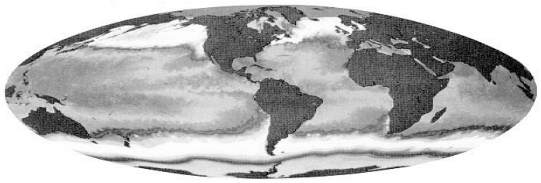
Anybody Home?

Energy Consumption and Carbon Emissions from Second Homes in Aspen

Aspen Second Homes Energy Study (ASHES)

Preliminary Report

Richard Heede
Climate Mitigation Services
19 September 2007



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Dedicated to John McBride for his wisdom and humor

Report commissioned by the Sopris Foundation
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Contents

Cover image: interior of an Aspen second home near Aspen with a view of Highlands. Photo by Rick Heede.

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Introduction

Aspen is home to the rich and famous as well as regular folks, and known to be progressive, eclectic, and beautiful beyond measure. Locals and visitors alike treasure the natural splendor and the best humanity has to offer, anywhere. Increasingly, however, the homes built by locals for locals have been purchased as second (or third or fourth) homes as a respite from busy lives in the big city. Speculative building and buying is on the rise, as noted by the press and local appraisers. The average house size in Aspen and its immediate surrounding area has expanded fast, mirroring the national trend. According to the National Association of Homebuilders, 42 percent of newly built houses now have more than 2,400 square feet of floor area, up from only 10 percent in 1970. New homes in the Aspen area now often exceed 8,000 square feet. While construction of new and renovated homes fuels local design and construction jobs, it also increases Aspen's and Pitkin County's tax base (helping to fund schools and services), and yet puts homes out of financial reach of most locals.

The flight "downvalley" has displaced countless individuals and families over the years, who can no longer afford the median home price in Aspen. The Aspen/Pitkin affordable housing program, has a portfolio of 2,740 properties (53% are deed-restricted, the rest are rental units), mostly in the City. The program aims to locally house 60 percent of the Aspen workforce, but has failed to keep up with the demand for housing. As a result, an average of 23,000 cars and trucks commute into and out of Aspen daily.

Annual property sales in the Aspen area now tops $2 billion per year, and new construction costs can exceed $1,000 per square foot. This flood of money and value creates a service sector dedicated to increasing the pie by building and servicing homes. Progressive local energy building codes have moderated the energy-intensity of new or re-built homes, and transferable development rights (TDRs) have focused development out of the backcountry into and near the city, with the unintended consequence of allowing larger and far more consumptive homes. As a consequence, some new homes use as much electricity as whole blocks of average American homes built elsewhere.

Most of the new homes are second homes and consume energy while sitting empty. The average second homeowner spends 88 days in Aspen, leaving 277 days for running the empty household. Many households are set to run warm in winter and cool in summer; the hot water heater is often on year-round, multiple refrigerators keep things (or nothing at all) cool, the wine collection cool, the security and ventilation and snowmelt systems on, and exterior and interior lighting to simulate occupancy.

Many of these uses are important for security and the safe keeping of paintings, plants, and pipes, but many energy demands may be worth re-consideration: snowmelt systems in the driveway and on the roof (some are left on in the summer), multiple hot tubs, towel bar heaters,

24/7 exterior lighting, and so on. High energy consumption, often with no comfort or security benefits, represents a problem for a community that aims to reduce its energy intensity and emissions of greenhouse gases. Fortunately, numerous opportunities exist to reduce emissions with no reduction in homeowner comfort or energy services. The issues of energy waste — and the many opportunities to easily cut energy waste — is the subject of this report.

The pollution is often generated elsewhere — at the coal mines or steel mills or oil refineries — yet climate change is global. Indeed, atmospheric warming will hit resort communities first, and hit towns like Aspen the hardest. As the Aspen Global Change Institute's 2006 report, *Climate Change and Aspen*, concludes in stark terms, our ski seasons will become shorter and warmer, with snowfall arriving later and deposited higher on the mountains. Runoff from snowmelt will come earlier, compromising rafting and kayaking and gold medal fishing. A drier local climate will of course affect our biological resources, too, with predicted bark-beetle losses and species migrations or local extinctions. The question is whether Aspen can help reduce the severity of the very climate changes that will alter life in Aspen by seizing opportunities to reduce energy waste and greenhouse gas emissions. One such opportunity is with second (as well as locally-owned) homes, as the present study will discuss.

Part of the 56,000 SF home of Prince Bandar bin Sultan bin Abdul Aziz in Aspen. Photo Christie's Great Estates.

In addition to the climate impacts of unnecessary energy use in unoccupied homes, other impacts are perhaps even more important. Owners of second homes may have staff employed year-round, which in turn results in energy and emissions from services rendered. Maintenance and upkeep such as house-cleaning, landscaping, flower delivery, snow removal, and car shuttling — with attendant lighting, heating, hot water, and gasoline requirements. Many of these services are essential to a well-run home in constant readiness for owner or guest visits. Service employees, like other locals, typically live down-valley, and thus have long commutes to get to their Aspen workplaces. Worker displacement, coupled to the growth of second homes, has another unintended consequence: employees don't live in town, and, more often than not, owners don't either, except for "high-season" for holidays, skiing, and summer vacations. Many of Aspen's quaint neighborhoods are now dark, leaving the community increasingly bereft of the very community that attracted people to Aspen in the first place.

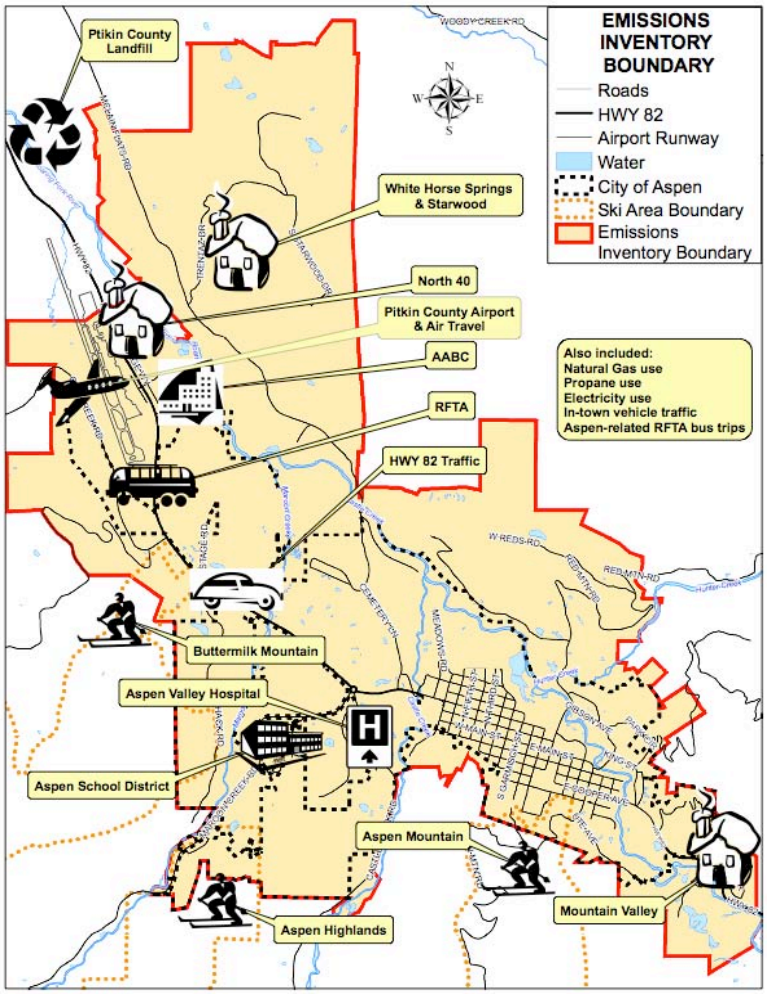
Objectives

It is this latter concern that caused the Sopris Foundation to start asking a few fundamental questions: how many of Aspen's 5,858 housing units are second homes? How long are those owners in town? How much energy do they use while unoccupied? And how can the community start to address both the loss of community and to reduce energy use and emissions?

Climate Mitigation Services (CMS) was commissioned by the Sopris Foundation to investigate several factors about ownership, home type, residence, and energy consumption in Aspen homes:

- The total number of housing units in the Aspen area,
- The number and proportion of non-resident (second) homes and locally-owned residences,
- Residential units by type of housing: condos, single family, town homes, duplexes, or multifamily,
- Total residential sector energy consumption and emissions of greenhouse gases (chiefly CO_2),
- Occupancy patterns and averages for Aspen's stock of second homes,
- Energy consumption & emissions of second homes when *un*occupied,
- Sample mitigation measures for saving energy, money, & emissions in unoccupied homes.

Figure 1: The Geographic Boundary for the Aspen Residential Survey



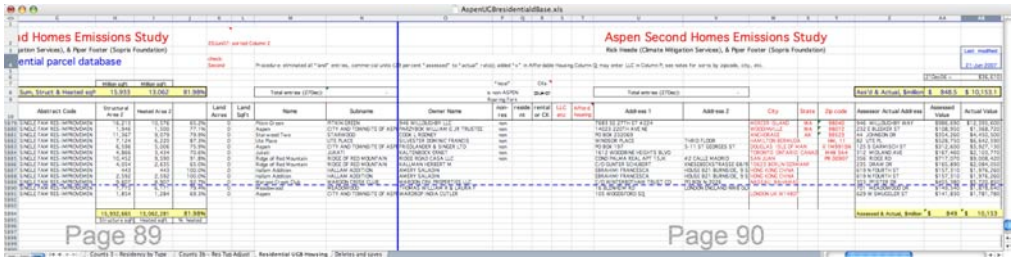
Modified Urban Growth Boundary (UGB) is used in both the ASHES study and the Aspen emissions inventory. Heede (2006). Red line = Modified UGB; black dotted line = Aspen City Limits.

Research approach

CMS and Sopris Foundation Director Piper Foster first defined the geographic boundary under study. Since the community of Aspen includes built-up areas beyond City Limits, we decided to adopt the same Modified Urban Growth Boundary (UGB) used in the *Aspen Emissions Inventory* (also done by CMS). Shown in the boundary map above, the UGB includes contiguous residential areas of Red Mountain, Mountain Valley neighborhoods east of town, Highlands Village and surrounding neighborhoods, residential areas at the bases of Highlands, Buttermilk, and Aspen Mountain, enclaves near the airport and the airport business center (including North Forty), and close-to-town sections of McLain Flats Road and Starwood. Many areas outside of the boundary are thus excluded in our statistical coverage and energy analysis but nonetheless face the same issues of lavish and seldom-occupied mansions of unusual proportions. Unincorporated areas of Pitkin County, such as Old Snowmass, Woody Creek, Brush Creek, Northstar Preserve, the bulk of Starwood, and Wildcat, as well the Town of Snowmass Village, all share the same characteristics we study here but are not within the defined boundary.

Next, we retrieved housing data from the Aspen/Pitkin Tax Assessors Office in early Dec06 on nearly 9,600 units within our geographic boundary. We parsed this database, which included commercial properties (identified by a tax rate of 29 percent), vacant land (2,332 parcels), church residences (3), "commercial special purpose/warehouse/storage" (10), "commercial merchandising" (19), and "commercial lodging" (8) that had unclear residential components, various "exempt private schools, homeowners associations, and lodging" (66), "commercial condos" (768), and similar units deemed non-residential. The final tally is **5,858** residential units totaling 15.76 million square feet (of which 12.90 million SF is "heated space") worth $10.2 billion ("actual value" estimated by Assessor's Office), giving an average value of $1.74 million per unit and average heated floor area of 2,202 SF worth $788 per heated SF.

Figure 2: Sample page of Tax Assessor's database of Aspen residential properties.



Sample page from the final database of Aspen's 5,858 residential units.

We then counted residential units by type: condos, single-family residences, duplex/triplexes, multifamily, and so forth, on which data is presented below. Sorting the database by owner's name and address to which tax notices are sent gave us a first estimate of owners living in Aspen versus elsewhere (49.5 percent and 50.5 percent, respectively). This approach was then modified through analysis of ownership and addressees. We reviewed all residential units and assigned ownership type by inclusion of such terms as LLC (205 units), Corporation (13 units), trust or trustee (159 units), family LP, Inc. (31 units), LLLP (10 units), Ltd (51 units), "interest" (67 units), "association" (96 units), and based on their address designated each as either "non-Aspen" or "Aspen." Tax assessment addresses out of Aspen but within the Roaring Fork Valley were deemed Aspen residents. The final count estimates that 3,381 (57.7 percent) of Aspen's total residential units are second homes and 2,477 homes (42.3 percent) are owned by residents.

Included in these numbers is a large proportion of Aspen/Pitkin County's Affordable Housing units: deed-restricted units total 842 in the city plus 602 in the County (most are within the UGB boundary used in this study, and 1,171 rental units in the city plus 126 in the County (again mostly within the UGB). Both of the deed-restricted and rental units are included in our data; however, since most of the rental units and many of the deed-restricted units are included in our "multi-units" category, CMS cannot estimate the proportion of Affordable Housing of total residential units in Aspen or within the Urban Growth Boundary. But it's probably true that a high percentage of locally-owned housing is preserved as such through the auspices of the Pitkin County Housing Authority's workforce housing.

Figure 3: Aspen's Ownership by Residency

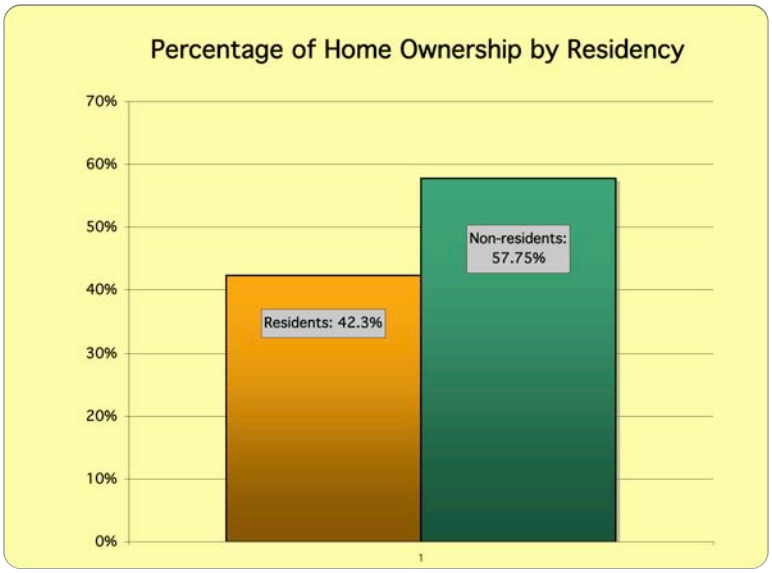
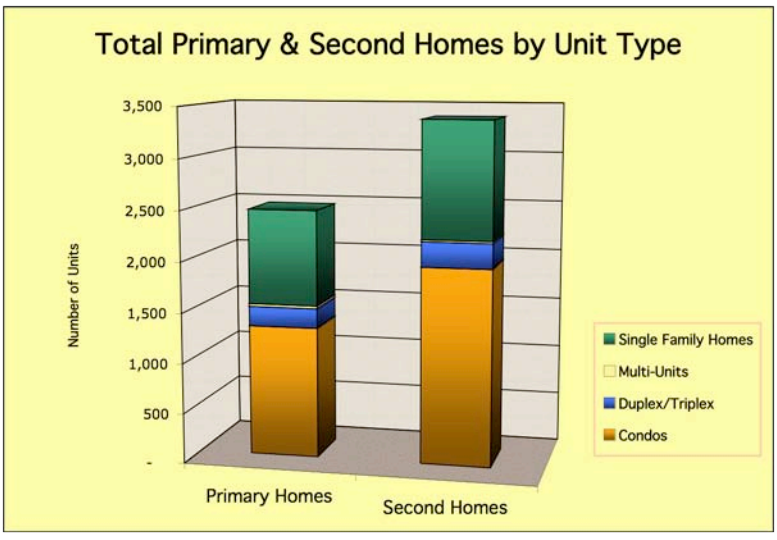


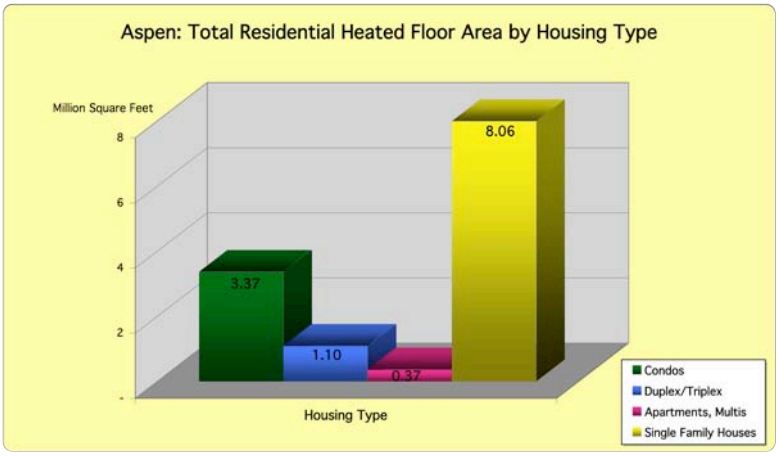
Figure 4: Aspen Homes by Residency & Type



Finally, the heated square feet of floor area for each housing type and residency was summed in order to estimate energy consumption and emissions — and eventually emissions reductions —

for each residential category and occupancy status. Heated floor area in locally-owned homes totals an estimated 5.03 million SF and 7.87 million SF in non-resident homes.[1]

Figure 5: Total Heated Floor Area of Aspen's Residences.



Total Aspen UGB residential heated square feet = 12.9 million SF.

A few notes and caveats are in order: The number of households involved precludes detailed review of each property; indeed, homes with guest houses and caretaker units are typically listed with a parcel number for each unit, which will inflate the number of Aspen "households" as used in this study but do not comprise separate households in many cases. CMS has not surveyed homeowners to ask if such units are typically occupied, only occupied when the owners are in town, or seldom occupied. In any case, total energy consumption and emissions — for which we have reliable data — are distributed equally to every housing parcel on the basis of heated SF of floor area. Also, our determination of local or non-local home ownership is on a best-guess approach. We interviewed local property managers, real estate attorneys, rental agencies, and realtors. Nonetheless, we cannot ascertain, given the large number of properties, the legal residency of the owners of any of Aspen's households. Nor have we delved into short- or long-term rentals of apartments, condos, town homes, or single-family homes. Our methodology would be improved through further in-depth analysis, homeowner surveys, home energy audits, and the results of implementation of home energy saving measures and solar energy systems.

Aspen's residential sector data

CMS analyzed Aspen's total residential units and total heated square feet of floor area by housing type (see Table 1). Average heated floor area by type of unit is computed from the Tax Assessor's database. Fifty-eight percent of Aspen homes are second homes, according to our analysis of tax assessments. This differs from results of a recent survey by Linda Venturoni for Northwest Colorado Council of Governments that found 51 percent of homes in Pitkin County are second homes (down from 55 percent in a 2003 survey). Venturoni also found that the average Pitkin second homeowner spends 63 days in residence per year, of which 24 days are in

[1] There are 142 single-family homes within the Aspen UGB that exceed 10,000 sq ft of total floor area ("structural area," which often include unheated decks, garages, unfinished basements, barns, sheds, and other outbuildings); of these, 55 single-family homes exceed 10,000 sq ft of "heated area." An additional 129 single-family homes encompass between 8,000 and 10,000 sq ft of structural area, of which 74 homes encompass between 8,000 and 10,000 sq ft of heated floor area. Unheated areas often use electricity for lighting and tools and pumps. Also heated pools, pumped waterfalls, well pumps, heated driveways, etc.

ski season.[2] CMS uses average occupancy of 88 days per year for second homes (vs 330 days/yr for primary homes), a result from our survey of second homeowners in Aspen.[3] Note: CMS has *not* accounted for occupancy by renters. Many homes, condos in particular, are partially or fully rented to visitors and residents. Venturoni (2007) notes that 58 percent of second homeowners in Pitkin County use their homes only for themselves and friends and family, while 34 percent let their homes for short-term rental and 9 percent for full-time rental.[4]

Table 1. Overview of Aspen Residences

Type	# of Units	Percent of total	Heated SF (million)	Percent of SF
Condos	3,265	55.74%	3.39	26.28%
Duplex/Triplex	447	7.62%	0.97	7.50%
Multi-family	48	0.81%	0.35	2.70%
Single-family	2,099	35.82%	8.20	63.54%
Total	5,858	100.00%	12.90	100.00%

Table 2. Aspen Residences, by Ownership and Floor Area[5]

Type	Aspen total # of Units	Primary # of Units	Primary average SF	Second # of Units	Second average SF
Condos	3,265	1,311	985	1,954	1,074
Duplex/Triplex	447	197	2,205	250	2,134
Multi-family	48	28	8,060	20	6,133
Single-family	2,099	941	3,272	1,158	4,421
Total or average	5,858	2,477	2,031	3,381	2,328

Energy consumption and emissions of Aspen residences

Based on estimated total emissions for all housing units within the UGB and average consumption by housing type, CMS estimated average emissions of greenhouse gases per unit. (Note: both electricity consumption and GHG emissions vary greatly within each housing category; many condos, for example, are all-electric; in addition, the carbon-intensity of areas served by Aspen's municipal utility and those served by Holy Cross Energy differs substantially due to each utility's different mix of power plants.)

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[2] Venturoni, Linda (2007), p. 4. Also see sq ft table at page 124 (median household floor area is higher for second homes); page 127: 2nd homeowners: 23 percent investment property vs 77 percent vacation home; page 129: second homes: 9.1% full term rental, 34.3% short term rental, 30.3% owner use only, 57.6% owner + friends + family use. Table 70 Total Use by number of days per year. The NWCOG study is based on 250 surveys returned by mail or on the web (out of 1,481 mailed and delivered surveys).

[3] Preliminary; this is based on a small sample, and the average will likely change as additional utility and occupancy data are evaluated. Many of our requests to (anonymously) analyze utility bill data to inform this study were met with reticence or non-compliance on the part of homeowners and property management firms. Further research will likely change our results and conclusions, perhaps by increasing (or decreasing) the energy use and emissions of second homes. Any submissions of utility data to the author will be treated with confidentiality.

[4] Venturoni (2007) *Transitions in Mountain Communities*, survey question #67: Current Use.

[5] Venturoni, Linda (2007) *Transitions in Mountain Communities, Resort Economies and their Secondary Effects*, Northwest Colorado Council of Governments, survey question #48 in the Pitkin County section shows 50 percent of second homeowners own condos and 40 percent own single-family homes (vs 20 percent and 56 percent for local residents, respectively; no question addresses the number of Pitkin residents renting their domiciles). The result of the CMS analysis of the Tax Assessor's database differs substantially, as shown in this table.

Table 3 summarizes average heated square feet per residential unit, average electricity use, and tons of CO_2-e both per unit and the estimated contribution to total residential sector emissions. Average consumption of electricity is *estimated* by housing type.[6] Aspen residential emissions totaled 149,440 tons CO_2-e in 2004 and account for ~18 percent of Aspen's total emissions.[7]

Table 3. Average Heated SF, Energy, and Emissions of Aspen/UGB Residences

Type	Heated sf (average/unit)	Electricity use (kWh/unit/yr)	Emissions per unit tons $CO_{2\text{-}e}$/unit/yr	Total emissions tons $CO_{2\text{-}e}$/yr
Condos	1,038	8,728	15.04	49,092
Duplex/Triplex	2,165	18,201	30.10	13,443
Multi-family	7,276	61,155	117.99	5,621
Single-family	3,906	32,831	38.73	81,284
Average	**2,202**	**18,512**	**25.51**	**total: 149,440**

Total residential-sector electricity consumption of 108 million kWh averaged over 12.9 million heated square feet equals 8.41 kWh per sf-yr. Emissions average 23.17 lb CO_2-e per sf-yr, and total energy consumption averages 151,600 Btu per sf-yr (electricity at primary heat value of 10,400 Btu/kWh). Data from Appendix Table 2.

Table 4. Emissions of Aspen's Primary and Second Homes

Type	Primary homes		Second homes	
	tons $CO_{2\text{-}e}$/unit/yr	tons $CO_{2\text{-}e}$/yr	tons $CO_{2\text{-}e}$/unit/yr	tons $CO_{2\text{-}e}$/yr
Condos	14.26	18,701	15.55	30,391
Duplex/Triplex	30.65	6,038	29.66	7,406
Multi-family	130.70	3,694	99.45	1,927
Single-family	32.44	30,511	43.84	50,774
Total	**average: 23.80**	**58,943**	**average: 26.77**	**90,497**

Data from Appendix "Summary of GHG Emissions of Aspen's Primary & Second Homes," Tables 5 and 6.

Estimates of energy and emissions in Aspen's primary and second homes

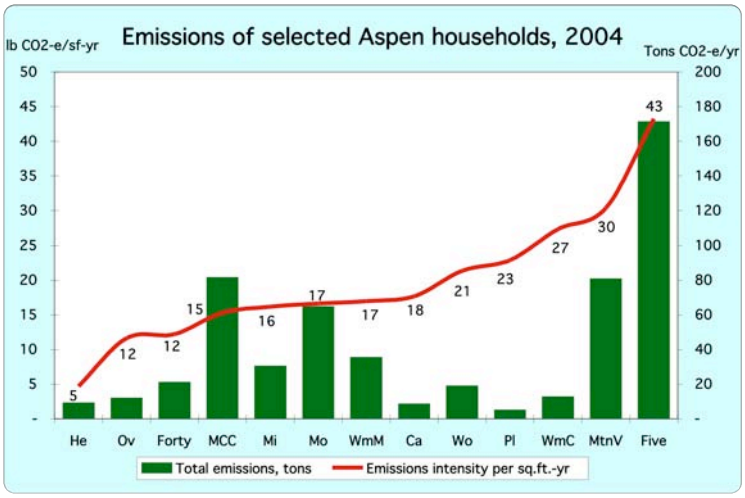
Sixty-one percent of Aspen's residential emissions are attributable to second homes in the region, even though these homes are *un*occupied an average of ~280 days per year. This suggests that an *unoccupied home uses as much energy and emits as much carbon dioxide, on average, as a fully occupied home.* What accounts for this counter-intuitive result? Second homes are somewhat larger, often newer, and while energy codes have improved, appliances and extra-ordinary uses have proliferated. Many larger residences have roof and/or driveway snowmelt systems. Anecdotally, driveway heating is typically on all winter regardless of occupancy to avoid difficult snow and ice clearing should the owner arrive suddenly. Roof-melt systems being left on all summer is sometimes the reason an electric utility auditor is summoned to explain the high electric bills. Absentee owners leave refrigerators plugged in, and often more than one. The water heater, sized for the peak loads of a fully-occupied home, is typically left on rather than put in "vacation" mode, in part because housekeepers often maintain homes year-round.

[6] Individual homes of any type vary greatly in terms of size, solar income, age, insulation, windows, shared interior walls, infiltration, heating type, and appliances. Equally important are factors such as occupancy patterns, number of residents, seasons, all-electric vs dual-fuel homes, occupant behavior, and, in terms of emissions, whether a home buys electricity from Aspen's municipal electric department or from Holy Cross Energy; of 108 million kWh sold to residential customers, 85 million kWh is sold to customers of Holy Cross.

[7] Heede (2006) *Aspen Greenhouse Gas Emissions 2004,* www.canaryinitiative.com. This inventory accounted for direct and indirect emissions totaling 840,875 tons CO_2-e (including air travel and commuting and emissions from natural gas, propane, and electricity in all buildings); Aspen's residences account for 17.8 percent of total emissions.

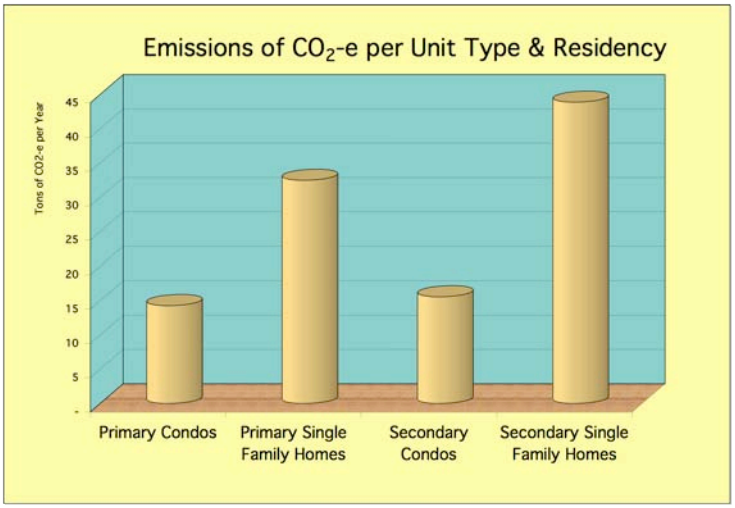
The average second home is 15 percent larger than locally-owned homes, and single-family second homes are 35 percent larger than primary single-family homes (4,421 and 3,272 heated SF, respectively).[8] Total emissions attributed to second homes represents 61 percent of the residential sector total — in line with the number of units estimated to be second homes (58 percent of 5,858 units) and total heated SF of floor area (61 percent of 12.9 million heated SF). The interesting result is that the low occupancy of second homes — 88 days per year — does *not* appear to reduce average energy intensity and total emissions.

Figure 6. Emissions of selected Aspen households



From *Aspen Greenhouse Gas Emissions 2004,* Heede (2006).

Figure 7. Emissions of Aspen's Primary and Second Homes, per Unit-Year



What this suggests is that empty homes use, when empty, as much energy as occupied homes; *or*, that high energy use during times of occupancy makes up for lower energy use when unoccupied. This is based on our (limited) survey and analysis of second homes' utility bills. Indeed, in our survey of 21 homes, the emissions rate per SF of heated space — ~21 lb CO_2-e —

[8] See Table 12, 12b, and 12c in the appended worksheet "Summary of GHG Emissions of Aspen's Primary & Second Homes" and supporting worksheets for details.

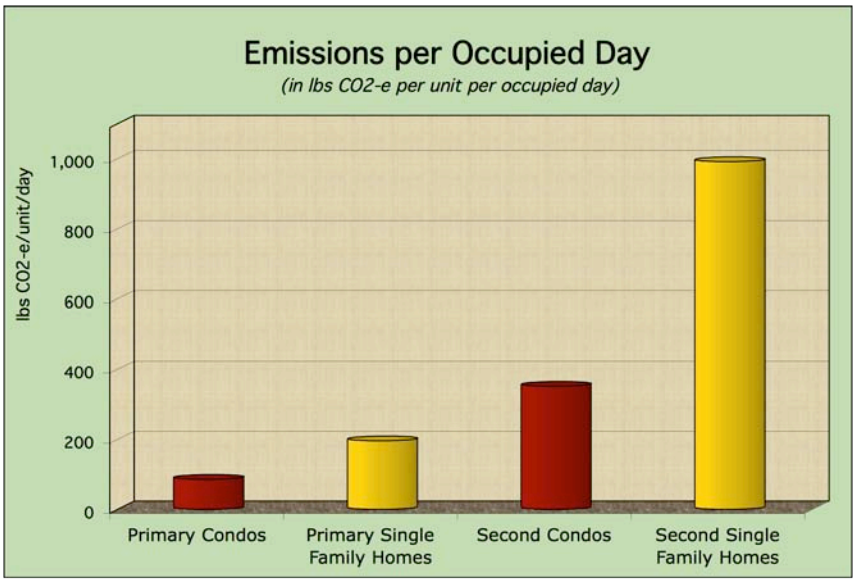
in second homes is virtually identical to that of our small sample of occupied homes. Further analysis of additional utility bills will cause these preliminary results to be revised.

CMS also estimated CO_2-e emissions **per day of occupancy**. While this varies tremendously, we estimate an average for Aspen households of 144 lb CO_2-e per occupied day (for which we assume 330 days per year) for resident-owned homes vs 606 lb CO_2-e per occupied day for second homeowners. For single-family homes these averages are even more distinct: 197 vs 993 lb CO_2-e per occupied day for primary and second homes, respectively.

Table 5. Emissions per day of owner occupancy: Primary and Second homes

Type	Primary homes lb $CO_{2\text{-}e}$/unit/occupied day	Second homes lb $CO_{2\text{-}e}$/unit/occupied day
Condos	86	352
Duplex/Triplex	186	672
Single-family	197	993
Average	**144**	**606**

Figure 8. Emissions per day of occupancy by type of residence



Community impacts (traffic, emissions, jobs)

CMS has not developed quantitative data on the fuel consumption and emissions generated by services provided to second homeowners. Most second homes are maintained by a phalanx of employees: half employ landscapers and gardeners, two-thirds have housekeepers, one-sixth have cooks or regular caterers, and one-eighth have personal trainers. While CMS has not quantified the energy consumed in providing such services to second homeowners, it's a fair guess that tens of thousands of vehicle trips are generated on their behalf. This primes local jobs and incomes and tax revenues. Second homeowners enrich the community, donate to local non-profits and community organizations, and help create Aspen as one of the most splendid places in the world to nourish everyone's — everyone who is lucky enough to be here at all — body, mind, and spirit.

Yet, this community must both grapple with and reduce the unintended consequences of our wealth and renown. We must seek ways to facilitate improved energy efficiency, and not in second homes alone but in *all* homes.

Ways to reduce energy consumption and emissions in second homes

Most homes of any type, regardless of having met local energy building codes, can reduce its energy consumption, energy costs, and emissions. While it's beyond the scope of the present study to detail energy efficiency measures applicable to Aspen homes, home energy audits offered by both electric utilities and local professionals can reveal numerous ways to save energy, and many measures have short payback periods; indeed, many measures cost nothing. Reducing infiltration of cold air, improving the efficiency of water heating, and replacing high-flow showerheads with more efficient models will often top the list of energy measures. Even showers with four or more heads can profitably be retrofitted. Furnace and boiler maintenance, sealing and insulating heating ducts, and installing programmable thermostats are good ways to save money, too. New and far more efficient washing machines, refrigerators, freezers, water heaters, and heating systems are good options for new construction or equipment replacement. Exceeding local energy building codes is legal and profitable, and passive solar heating and cooling designs work exceedingly well in our sunny mountain climate. Exceptional homes built in the Roaring Fork Valley demonstrate that "what exists is possible," in Amory Lovins' words.

But what can second homeowners, specifically, do to improve energy efficiency in existing homes? Replacing inefficient appliances and other energy-intensive widgets are good options, but let's focus on energy management systems, training, raising awareness and engaging in positive action. For example:

- Review your energy bills for the last year or two (your billing history is available on the websites of all local utilities). Compare your energy consumption with your neighbors, or consult with an energy professional.
- Temperature management: while most empty homes are kept cooler in winter than when occupied, many are kept warmer than necessary. Common reasons include protecting indoor plants, paintings, and plumbing. Vulnerable plumbing is an artifact of poor building design, and even in those cases less expensive options — such as insulation and heat tape — will serve the same objective.
- Cigar humidores, wine collections, pools, pumps, satellite, entertainment, and assorted equipment are whirring along in our absence; some of this energy use is necessary, although many such uses and systems can be placed on stand-by or turned off altogether.
- Have an energy audit done on both the technical and the behavioral side of your home's management. Train your staff or property manager on any new systems and on your revised expectations for you home's management.
- Put water heaters on vacation mode.
- Unplug fridges and freezers, or shift things left behind into one fridge and unplug the second one (if applicable).
- Install an energy management system, and instruct the property manager or caretaker how to effectively use it. Some systems can be managed remotely, from your own computer or iPHONE.
- Add pipe insulation in the boiler room and wherever exposed pipe is accessible.
- Some homes are kept in a constant state of readiness, both thermally and otherwise, for the owner's scheduling convenience and sudden change of plans. Revise these agreements.

- Lighting management while not in residence: review exterior lighting systems and schedules, in particular, and re-set each season. Use high-efficiency lighting wherever applicable. Install solar lighting systems for exteriors and yards. Scale back on holiday lighting.
- Select professionals and service providers who understand energy issues and your desire to manage energy efficiently.
- Jetting into Aspen? Consider donating to a city-run fund to offset a trip's emissions. $200 per 1,000-miles flown is a good start. If the fund isn't up and running yet, tell City Hall to get a move-on.
- Train and educate property managers, housekeepers, and other service personnel and contract labor about energy-saving opportunities. Communicating your new expectations of home energy management to your staff or property manager can yield good dividends. Consider sharing the bill-savings with your property manager.
- Your in-town vehicles add to the climate burden in proportion to the gallons of fuel you burn. Even a Hummer H2 or Escalade (12 and 13 mpg in city driving, respectively) can be driven with fuel economy in mind, eliminating idling, and, best of all, driving less. Of course, far more efficient vehicles are available, many with 4WD capability, but it still comes down to fuel consumption: a Prius driven 16,000 miles/yr is no better than a Suburban driven 5,000 miles/yr.
- Food and beverages: our food chain is the source of ~18 percent of total emissions of carbon dioxide and methane. The Aspen food supply chain is far more extensive in terms of far-flung sources of food and libation. Buy locally-grown greens, vegetables, fruits, and meats, waste less, and consider eating lower on the food chain once in a while. California wines, many of whose vintners are reducing carbon emissions in growing and making wines, require less transportation energy and thus lower emissions as well.
- Water: Aspen's tap water is excellent. Refill bottles rather than buying ennui-filled and carbon-intensive water transported from Fiji or glacier-melted water from Greenland or wherever. Saving domestic water is significant, too, since treating and providing Aspen water emits carbon dioxide at the plant. Obviously, reducing irrigation water is also important.
- If you wish to investigate your impact on energy and climate more broadly, consider estimating your full carbon footprint, or hire an expert to assist you. Measurement is the key to carbon management, as in everything else, and coupled with a commitment to set and achieve a personal objective, emissions and bills can both be reduced substantially and profitably. Climate stewardship starts at home, in the community, on the road, and in your investment priorities.
- Consider other opportunities to participate. *Think*. Incorporate the connections between your life and the climate into your decisions. Your attention will bear fruit.

Summary

Second homes comprise fifty-eight percent of Aspen's total residential units (3,381 of 5,858 total residential units within the modified Aspen Urban Growth Boundary),[9] encompass 61 percent of total sq ft of heated floor area (7.9 million of Aspen total 12.9 million sq ft of residential heated sq ft), and emit nearly 61 percent (90,497 tons) of Aspen's total residential emissions of 149,440 tons of CO_2-e per year.

The average Aspen home emits 26 tons CO_2-e per year. The typical primary home is slightly lower at 24 tons CO_2-e, whereas the average second home emits 27 tons CO_2-e. The disparity becomes larger with single-family homes: local resident homes emit on average 32 tons vs 44 tons CO_2-e per year for second homes.

[9] As noted in table 2 and related text, our use of the Tax Assessor's database of residential parcels

Behind the obscurity of the numbers is this startling conclusion: Aspen's second homes emit, on average, 12 percent *more* CO_2-e per year than resident-occupied homes. Single-family second homes emit 35 percent more annually than do primary homes. Second homes are larger, and therefore emit a higher percentage of the total, but while empty 277 days per year (on average) consume as much energy per sq ft of floor area as occupied homes do.

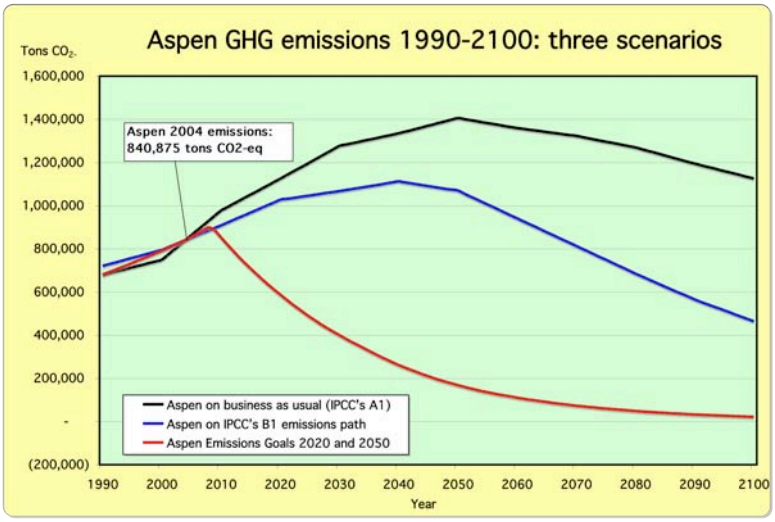
CMS also calculated emissions on an occupancy basis. For every day that a second home is occupied it emits 606 lb of CO_2-e, whereas the resident-owned home emits 144 lb of CO_2-e per occupied day. This is expected, of course, given the relative *un*occupancy of second homes, but the startling result is just that: second homes, even though largely unoccupied, still emit as much or more CO_2-e per year as its occupied cousins.[10]

Thirty percent of second homeowners have incomes of $1 million or more per year, whereas 3 percent of local residents earn more than a million.[11] Many second homeowners have the wherewithal to invest in energy efficiency, as of course do many local residents, once the opportunities to do so are learned. Many measures, in any case, are *free*, and most homes can reduce their energy consumption and bills and emissions at low cost and rapid paybacks.

Next Steps

The Aspen City Council recently adopted the *Canary Action Plan* that elaborates on a number of City and community opportunities to save energy and reduce Aspen's emissions of greenhouse gases. Inasmuch as the residential sector comprises ~18 percent of Aspen's total emissions (149,440 of 840,875 tons of CO_2-e in 2004), it is inevitable that homeowners, whether local or not, will be asked to address opportunities to reduce their own home's carbon footprint. Indeed, the *Canary Action Plan* calls for community-wide emissions to decline by 30 percent by 2020 (which means that emissions have to peak soon) — and by 80 percent by 2050.

Figure 9. Aspen emissions scenarios



The Canary Action Plan calls for Aspen to roughly follow the emissions path shown above (red line). It incorporates City Council's commitment to reduce community-wide emissions by 30 percent below 2004 by 2020 and by 80 percent below 2004 by 2050.

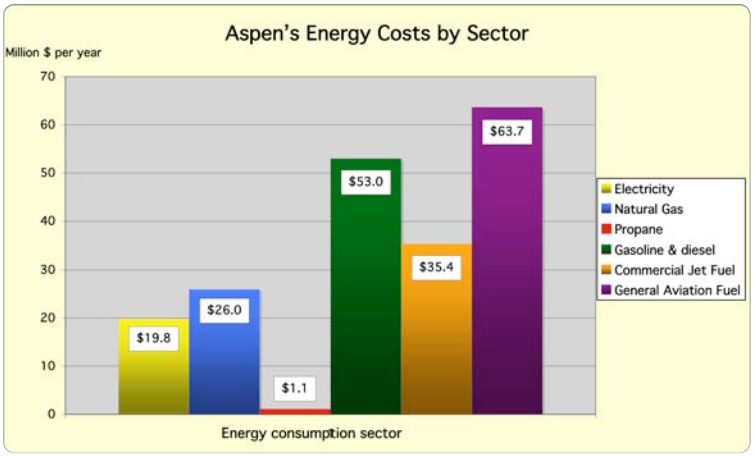
[10] This is based on a limited set of utility bills examined for 21 homes, seven of which are second homes occupied an average of 88 days per year. These are preliminary results and will certainly change as more data are analyzed.

[11] Venturoni (2007), survey question #46 in the Pitkin County section.

Assuming that Aspen's construction boom will not collapse, it is therefore likely that more homes will be built and many more homes will be replaced, renovated, or enlarged. While these new homes may be more efficient per square foot, and many use solar systems,[12] these efficiency gains are likely to be overwhelmed by more square footage. No one knows at this point how many new homes or new net square feet of residential floor area are added each year, and thus we don't know the residential sector's rate of growth. Nor does the City or County have much control over future building, although the TDR system tends to scale up the size of homes built in or near town.

Some homeowners will take up the challenge to reduce their home's energy use and emissions. The City will likely debate incentives, technical assistance, new building performance standards, compulsory energy audits attached to real estate transactions, appliance standards, and other proposals to increase local energy efficiency in an attempt to stem rising energy consumption and, of course, emissions. The City may even debate setting caps on net emissions in new residences. Or revisit the TDR system and/or the allowable size of new homes in the area. We can't prognosticate such matters. But one thing is clear: the City has embraced a plan that calls for dramatic efficiency improvements and/or substitutions in energy use.

Figure 10. Aspen's energy costs



Energy costs in Aspen buildings total $47 million, plus $53 million in ground transportation, and $99 million in aviation fuel, for a total of $199 million per year. Estimates and chart by Climate Mitigation Services.

This community has proven itself progressive and innovative. Local and second homeowners have the resources to make effective performance improvements in both technology and behavior. It appears from the results found in this study that second homeowners have more opportunities than hitherto known. Let's lead from the front.

Aspen possesses the virtue of having the financial resources to back up its goals. Not to mention the global goodwill for our future success, the inestimable value of being a progressive and green resort with a serious commitment to climate stewardship, and the substantial cost savings flowing from its numerous carbon reduction opportunities. As many have said before: "If not us, whom? If not now, when?" Are you ready?

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[12] Or pay into CORE's Renewable Energy Mitigation Program fund that invests in solar and efficiency in other local buildings and facilities.

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Notes



Anybody Home?

Energy Consumption and Carbon Emissions from Second Homes in Aspen

Aspen Second Homes Energy Study (ASHES)

Richard Heede

Climate Mitigation Services

19 September 2007

Folio of worksheets

Notes

Summary statistics

Total housing units within modified UGB:	**5,858**	units
Total condos	**3,265**	condos (55.7 percent)
Total single-family	**2,099**	homes (35.8 percent)
Total Duplex, Triplex, & Multi-units[13]	**495**	units (8.4 percent)
Aspen's total residential heated floor area:	**12.90**	million sqft
Condos	**3.39**	million sqft
Single-family	**8.20**	million sqft
Total Duplex, Triplex, & Multi-units	**1.31**	million sqft
Average heated floor area:	**2,202**	sqft
Condos:	**1,038**	sqft
Duplex, Triplex	**2,165**	sqft
Single-family	**3,906**	sqft
Total Aspen GHG emissions, all sources (2004):	**840,875**	tons CO_2-e
Total GHG emissions, residential sector:	**149,440**	tons CO_2-e
Average GHG emissions:	**25.5**	tons CO_2-e
Condos	**15.0**	tons CO_2-e
Single-family	**38.7**	tons CO_2-e
Average US single-family household[14]	**13.0**	tons CO_2-e
Average emissions, residential sector:	**25.5**	tons CO_2-e
Average primary condo emissions:	**14.3**	tons CO_2-e
Average primary single-family emissions	**32.4**	tons CO_2-e
Average second condo emissions	**15.6**	tons CO_2-e
Average second single-family emissions	**43.8**	tons CO_2-e
Ownership, 2006:		
Residents	**42**	percent
Nonresidents	**58**	percent (9-33% rented)
West End (anecdotally)	**67**	percent
Red Mountain (anecdotally)	**75**	percent

***IF* second homes halve emissions, then Aspen saves ~45,200 tons CO_2-e/yr**
(5.4 % of Aspen total, 30.3 % of residential sector).

Saving 10 % reduces Aspen's emissions by ~9,000 tons CO_2-e/yr.

[13] CMS counts only 50 multi-units, but these include large complexes such as Centennial and Hunter Creek.
[14] Heede (2002) *Cool Citizens: Everyday Solutions to Climate Change: Household Solutions Brief.*