

AADT traffic counts at Castle Creek Bridge as an indicator of commuting CO2 emissions

Richard Heede
Climate Mitigation Services
Snowmass, Colorado
File Started 4 September 2008
Last Modified: 6 March 2009

The principal variables that need to be updated in future fuel and emissions inventories are: (a) AADT traffic count at Castle Creek Bridge, (b) vehicle type survey (if deemed necessary to update), and (c) fuel economy for each vehicle type (again, only if deemed necessary).

2004 estimate completed by Rick Heede, CMS, Nov05.

John Krueger, 920-5042, johnk@ci.aspen.co.us

2004											
Commuting and Hwy 82											
Vehicle by type	Average daily traffic, 2004	Annual traffic, 2004	Miles per trip	Miles driven (VMT)	Fuel economy	Fuel consumed	Carbon factor	Carbon dioxide	Carbon		
25-Aug-05	(both directions)	(both directions)		miles	mpg	gallons/yr	CO2/gallon	tons CO2/yr	tonnes carbon		
										short tons	metric tonnes
7 am - 1 pm											
Valley traffic across Castle Creek Bridge											
	8,003	23,524	8,586,260								
Passenger cars (sedans, cabriolets, etc)	25.8%	6,067	2,214,425	25.0	55,360,617	22.1	2,505,005	19.59	24,542	6,076	
Small SUVs and small pick-up trucks	13.3%	3,128	1,141,545	25.0	28,538,613	20.2	1,412,803	19.59	13,841	3,427	
Medium/Large SUVs and large "light" trucks	53.8%	12,648	4,616,603	25.0	115,415,084	17.0	6,789,123	19.59	66,513	16,468	
2-axle medium-duty trucks, RVs	2.6%	623	227,451	25.0	5,686,265	10.4	546,756	19.59	5,357	1,326	
3-axle trucks, dump trucks, etc	3.7%	864	315,427	25.0	7,885,669	7.4	1,065,631	22.38	11,927	2,953	
Semis, combination trucks	0.3%	79	28,968	60.0	1,738,066	5.6	310,369	22.38	3,474	860	
Motorcycles	0.5%	115	41,842	7.5	313,817	50.0	6,276	19.59	61	15	
Total	100%	23,524	8,586,260	25.0	214,938,131	17.0	12,635,963	19.90	125,714	31,125	

Composite fuel economy of passenger cars, small, medium, and large SUVs and pick-ups: 18.615

2007 estimate completed by Rick Heede, CMS, 10Nov08.

2007											
Commuting and Hwy 82											
Vehicle by type	Average daily traffic, 2007	Annual traffic, 2007	Miles per trip	Miles driven (VMT)	Fuel economy	Fuel consumed	Carbon factor	Carbon dioxide	Carbon		
28-Aug-08	(both directions)	(both directions)		miles	mpg	gallons/yr	CO2/gallon	tons CO2/yr	tonnes carbon		
										short tons	metric tonnes
7 am - 1 pm											
Valley traffic across Castle Creek Bridge											
	6,793	22,320	8,146,800	(22,180 and 8.096 million vehicles in Krueger's DailyCount.xls)							
Passenger cars (sedans, cabriolets, etc)	27.1%	6,059	2,211,660	25.0	55,291,495	22.1	2,501,878	19.59	24,511	6,068	
Small SUVs and small pick-up trucks	26.8%	5,980	2,182,875	25.0	54,571,866	20.2	2,701,578	19.59	26,467	6,553	
Medium/Large SUVs and large "light" trucks	39.6%	8,843	3,227,536	25.0	80,688,402	17.0	4,746,377	19.59	46,500	11,513	
2-axle medium-duty trucks, RVs	2.6%	578	211,091	25.0	5,277,279	10.4	507,431	19.59	4,971	1,231	
3-axle trucks, dump trucks, etc	2.5%	552	201,496	25.0	5,037,403	7.4	680,730	22.38	7,619	1,886	
Semis, combination trucks	0.7%	164	59,969	60.0	3,598,145	5.6	642,526	22.38	7,191	1,780	
Motorcycles	0.6%	143	52,173	7.5	391,298	50.0	7,826	19.59	77	19	
Total	100.00%	22,320	8,146,800	25.1	204,855,889	17.4	11,788,344	19.91	117,336	29,051	

Change to 20 miles??

Composite fuel economy of passenger cars, small, medium, and large SUVs and pick-ups: 19.151

Net change from 2004:	8,378	tons CO2
Percent change from 2004:	-6.7%	

2008 estimate completed by Rick Heede, CMS, 6Mar09.

2008											
Commuting & Hwy 82											
Vehicle by type	Average daily traffic, 2008	Annual traffic, 2008	Miles per trip	Miles driven (VMT)	Fuel economy	Fuel consumed	Carbon factor	Carbon dioxide	Carbon		
new survey?	(both directions)	(both directions)		miles	mpg	gallons/yr	CO2/gallon	tons CO2/yr	tonnes carbon		
										short tons	metric tonnes
Valley traffic across Castle Creek Bridge											
	21,542	7,862,830	<i>this uses the 2008 vehicle type results</i>								
Passenger cars (sedans, cabriolets, etc)	27.1%	5,848	2,134,569	25	53,364,220	22.1	2,414,671	19.59	23,657	5,857	
Small SUVs and small pick-up trucks	26.8%	5,772	2,106,787	25	52,669,675	20.2	2,607,410	19.59	25,545	6,324	
Medium/Large SUVs and large "light" trucks	39.6%	8,534	3,115,035	25	77,875,876	17.0	4,580,934	19.59	44,879	11,111	
2-axle medium-duty trucks, RVs	2.6%	558	203,733	25	5,093,331	10.4	489,743	19.59	4,798	1,188	
3-axle trucks, dump trucks, etc	2.5%	533	194,473	25	4,861,816	7.4	657,002	22.38	7,353	1,821	
Semis, combination trucks	0.7%	159	57,879	60	3,472,726	5.6	620,130	22.38	6,940	1,718	
Motorcycles	0.6%	138	50,355	7.5	377,659	50.0	7,553	19.59	74	18	
Total	100%	21,542	7,862,830	25.1	197,715,303	17.4	11,377,442	19.91	113,246	28,038	

Composite fuel economy of passenger cars, small, medium, and large SUVs and pick-ups: 19.151

Net change from 2007:	4,090	tons CO2
Percent change from 2007:	-3.5%	

AADT Commuting

	A	B	C	D	E	F	G	H	I	J	K	L	M
79													
80													
81			2009 estimate completed by										
82		2009											
83		Commuting & Hwy 82	Vehicle by type	Average daily traffic, 2009	Annual traffic, 2009	Miles per trip	Miles driven (VMT)	Fuel economy	Fuel consumed	Carbon factor	Carbon dioxide	Carbon	
84			(both directions)	(both directions)		miles	mpg	gallons/yr	CO2/gallon	tons CO2/yr	tonnes carbon		
85											short tons	metric tonnes	
86		Valley traffic across Castle Creek Bridge		-									
87													
88		Passenger cars (sedans, cabriolets, etc)	-	-	25	-	22.1	-	19.59	-	-	-	
89		Small SUVs and small pick-up trucks	-	-	25	-	20.2	-	19.59	-	-	-	
90		Medium/Large SUVs and large "light" trucks	-	-	25	-	17.0	-	19.59	-	-	-	
91		2-axle medium-duty trucks, RVs	-	-	25	-	10.4	-	19.59	-	-	-	
92		3-axle trucks, dump trucks, etc	-	-	25	-	7.4	-	22.38	-	-	-	
93		Semis, combination trucks	-	-	60	-	5.6	-	22.38	-	-	-	
94		Motorcycles	-	-	7.5	-	50.0	-	19.59	-	-	-	
95		Total	0%	-	-	#DIV/0!	-	#DIV/0!	-	#DIV/0!	-	-	
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98		Composite fuel economy of passenger cars, small, medium, and large SUVs and pick-ups: #DIV/0!											
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106		Commuting & Hwy 82	Vehicle by type	Average daily traffic, 2010	Annual traffic, 2010	Miles per trip	Miles driven (VMT)	Fuel economy	Fuel consumed	Carbon factor	Carbon dioxide	Carbon	
107			(both directions)	(both directions)		miles	mpg	gallons/yr	CO2/gallon	tons CO2/yr	tonnes carbon		
108											short tons	metric tonnes	
109		Valley traffic across Castle Creek Bridge		-									
110													
111		Passenger cars (sedans, cabriolets, etc)	-	-	25	-	22.1	-	19.59	-	-	-	
112		Small SUVs and small pick-up trucks	-	-	25	-	20.2	-	19.59	-	-	-	
113		Medium/Large SUVs and large "light" trucks	-	-	25	-	17.0	-	19.59	-	-	-	
114		2-axle medium-duty trucks, RVs	-	-	25	-	10.4	-	19.59	-	-	-	
115		3-axle trucks, dump trucks, etc	-	-	25	-	7.4	-	22.38	-	-	-	
116		Semis, combination trucks	-	-	60	-	5.6	-	22.38	-	-	-	
117		Motorcycles	-	-	7.5	-	50.0	-	19.59	-	-	-	
118		Total	0%	-	-	#DIV/0!	-	#DIV/0!	-	#DIV/0!	-	-	
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121		Composite fuel economy of passenger cars, small, medium, and large SUVs and pick-ups: #DIV/0!											
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Net change from 2008: - tons CO2
 Percent change from 2008: #DIV/0!

CMS note: This QuickTracker worksheet estimates annual Hwy 82 and commuting emissions based on annual AADT data supplied by John Krueger of the Aspen Transportation Dept.

Worksheet instructions:

- For each future year, get AADT data for the Castle Creek Bridge traffic counter from Aspen Transportation Dept (John Krueger prepares a memo for City Council in the 1st quarter).
- Enter average annual daily traffic (AADT) at "Valley traffic across Castle Creek Bridge" row.
- If deemed necessary, conduct a vehicle type survey at Castle Creek bridge or elsewhere near the entrance to Aspen (such as the round-about), and revise the vehicle type distribution in column B. If no survey is done, use the distribution from 2008.
- This worksheet calculates everything else and provides an estimate of total commuting fuel use and emissions.
- Each year's total CO2 is linked to the summary analysis worksheet for trend analysis.

Net change from 2009: - tons CO2
 Percent change from 2009: #DIV/0!

AADT Commuting

Cell: C15

Comment: Rick Heede:

The traffic counters do register vehicle classes at both the Castle Creek and Mill & Main Streets:
Class 1: Less than 18 feet,
Class 2: 18-25 feet in length,
Class 3: greater than 25 feet.

However, these sizes are not detailed enough for our fuel consumption purposes. We engaged Lee Cassin and the Env Health Dept staff, plus John Krueger of the City Transportation Dept, to survey vehicle types during several mornings during mid-August 2005. The main data set we use was taken on 25Aug05, from 7 am to 1 pm. (Thanks, everybody.) The survey counted 8,003 vehicles, for which the distribution by type is shown below. (We exclude 104 RFTA buses and 20 school buses from this survey; fuel consumption by RFTA and school buses is estimated elsewhere.)

Note: A high fraction of the semis serving Aspen's markets, hardware stores, lumber yards, etc arrive at night and depart before dawn. Our survey may, therefore, have underestimated the number of semis, since the principal vehicle type survey was done from 7am to 1 pm.

Cell: D15

Comment: Rick Heede:

Krueger, John D. (2005) Traffic Counts at The Castle Creek Bridge (memo to Mayor and City Council 7July2005).

Cell: E15

Comment: Rick Heede:

"Average Daily Traffic" times 365 days/yr.

Cell: F15

Comment: Rick Heede:

The typical commute to work is assumed to be 25 miles each direction. # We assume that 2-axle trucks (such as FedEx, UPS,* and other working vehicles) travel 20 miles per trip. Heavier 3-axle trucks are also assumed to travel 25 miles per trip (e.g., an average of originating in El Jebel, Carbondale, or on waste-collection trips between the City and the County Landfill).

Semis travel an average of 240 miles per day (ORNL 2005, TEDB, Table 5.4); we allocate half to other communities served by each semi entering town, thus 60 miles per trip into plus out of town.

We assume half a year of motorcycle driving, reducing the per trip miles from 15 to 7.5 miles per trip-day.

note: RFTA data show the average ridership ending in Aspen is 15 miles, 15.8 miles if Snowmass Village is included, and 28.7 miles if the I-70 corridor is included.

* UPS trucks originate in Glenwood Springs and drive approximately 140 miles per day (of course, route-miles vary). Interviews with several UPS drivers, Aug05. UPS trucks average 12-14 mpg.

Cell: H15

Comment: Rick Heede:

New vehicle fuel economy data are used in combination with average fleet fuel economy data. This leads to two conservatisms: 1. older vehicles may get poorer fuel economy, and 2. actual driving experience suggests that fuel economy is ~10 percent worse than EPA's fuel economy tests. Furthermore, snowy roads increase fuel consumption. Data from ORNL and Federal Highway Administration (see below).

Passenger cars in use average 22.1 mpg. TEDB Table 4.1 (average fuel economy of passenger automobiles in use, 2002 datum from US DOT/Federal Highway Administration (2002) Highway Statistics 2002, Table VM-1; www.fhwa.dot.gov). New passenger cars average 28.7 mpg (TEDB, Table 4.7).

New small SUVs (25.4 mpg) and small pick up trucks (21.7 mpg) averaged to 23.55 mpg. (Table 4.8); in order to reflect actual vehicle stock mpg and the average in-use fuel economy, the new vehicle average of 23.55 is factored by the average new truck mpg of 20.5 (table 4.8) divided by average in-use truck of 17.6 mpg: $17.6/20.5 = 0.8585$. Thus the Aspen vehicle population of small SUVs/light trucks is 23.55 mpg times 0.8585 = 20.22.

New large and medium SUVs (17.6 mpg and 21.3) and new large pick up trucks (18.3 mpg) and new small and large vans (23.5 and 18.3 mmpg) are averaged to 19.8 mpg. As above, this new SUV/truck fuel economy is adjusted to reflect the lower mpg of the average vehicle population in use: $19.8 \text{ mpg} * 0.8585 = 17.0 \text{ mpg}$. Note: probably conservative, considering the weight driven around by the typical SUV and pick-up truck and work van in Aspen. This category also contains Hummers (10-13 mpg, practical experience is closer to 8 mpg), Suburbans, Ford 350s, and similar brontomobiles.

2-axle medium-duty trucks (10-14,000 lb) average 10.4 mpg (Table 5.4).

3-axle trucks single-unit trucks (dump trucks, garbage trucks, etc) average 7.4 mpg (TEDB Table 5.1).

Semis or combination trucks (33,000 lb +) average 6.1 mpg (Table 5.4), 5.2 mpg in Table 5.2, and 5.5 mpg (Table 5.5); we use 5.6 mpg as the average.

Davis & Diegel (2004) Transportation Energy Data Book 2004, Tables 4.1, 4.8, and 5.4, Oak Ridge National Laboratory, USDOE.

Motorcycles: EIA uses 50 mpg (Energy Information Administration/2001 National Household Travel Survey, p. K-37).

Cell: I15

Comment: Rick Heede:

Miles driven / fuel economy. Conservative estimates.

Cell: H27

Comment: Rick Heede:

Average of all vehicle types: VMT / estimated fuel consumption.

Cell: K30

Comment: Rick Heede:

This is a composite average of fuel consumed and miles driven by pasenger cars plus small SUVs/pick-up trucks plus large SUVs/pick-up trucks. This number is also used to estimate saved fuel from RFTA bus services (a calculation that uses 1.63 persons per vehicle).

Note: this number is driven by data and does not have to be revised. Its revision depends on fuel economy by individual mpg data in the body of the worksheet.

Cell: C37

Comment: Rick Heede:

AADT Commuting

Kim Petersen and Marta Darba and John Eisler of the City of Aspen Canary Initiative plus several staffers of the Env Health Dept and John Krueger of the City Transportation Dept surveyed vehicle types on 28 August 2008 from 7 am to 1 pm. Vehicle numbers for the two locations -- at Truscott Place and Hwy 82, inbound lane, and Cemetery Lane and Powerplant Road -- were totaled and averaged for this commuting fuel and emissions computation for 2007.

The survey counted 6,793 vehicles, for which the distribution by type is shown below. (We exclude 88 RFTA and school buses from this survey, since fuel consumption by RFTA and school buses is estimated elsewhere.) Finally, CMS annualized the motorcycle percentage by halving the number of motorcycles since bike riding drops to near zero during the winter.

Cell: D37

Comment: Rick Heede (6Mar09):

CMS requested updated AADT traffic counts for 2008, and corrected the 2007 AADT from 22,302 to 22,320 per the Transportation Dept's revision. 2008 AADT totaled 21,542, down from the peak of 23,675 AADT in 1993.

Rick Heede:

Krueger, John D. (2008) Traffic Counts on SH 82 at the Castle Creek Bridge (memo to Mayor and City Council), dated 20 March 2008, 8 pages.

Rick called Krueger to confirm that AADT for 2007 remains 23,013 vehicles per day (JK: yes). Also asked Krueger to reconcile his other data from TrafficDailyCounts2007.xls, which shows AADT of 22,180 vehicles per day (and 8,095,716 vehicles crossing Castle Creek Bridge) in 2007. Krueger will review and respond.

Update 19Nov08: "Rick, It looks like 22,302 is the number. I have not been able to totally reconcile everything but, I am very close. John D. Krueger Director of Transportation." CMS updated AADT from 23,013 vehicles per day to JK's 22,302 vehicles per day. This change reduced fial commuting emissions from 120,979 tons CO2 to 117,242 tons CO2, or by 3,737 tons CO2. The 2004 emissions estimate was 125,714 tons CO2.

Cell: E37

Comment: Rick Heede:

"Average Daily Traffic" times 365 days/yr.

Cell: F37

Comment: Rick Heede:

The typical commute to work is assumed to be 25 miles each direction. # We assume that 2-axle trucks (such as FedEx, UPS,* and other working vehicles) travel 20 miles per trip. Heavier 3-axle trucks are also assumed to travel 25 miles per trip (e.g., an average of originating in El Jebel, Carbondale, or on waste-collection trips between the City and the County Landfill).

Nov08 update: CMS considered reducing the average typical commuting distance from 25 to 20 miles (to better agree with the average RFTA passenger trip length of 16 miles (Dan Blankenship)), but rejected the change in order to preserve comparability between 2004 and subsequent years.

Cell: H37

Comment: Rick Heede:

New vehicle fuel economy data are used in combination with average fleet fuel economy data. This leads to two conservatisms: 1. older vehicles may get poorer fuel economy, and 2. actual driving experience suggests that fuel economy is ~10 percent worse than EPA's fuel economy tests. Furthermore, snowy roads increase fuel consumption. Data from ORNL and Federal Highway Administration (see below).

Passenger cars in use average 22.1 mpg. TEDB Table 4.1 (average fuel economy of passenger automobiles in use, 2002 datum from US DOT/Federal Highway Administration (2002) Highway Statistics 2002, Table VM-1; www.fhwa.dot.gov). New passenger cars average 28.7 mpg (TEDB, Table 4.7).

New small SUVs (25.4 mpg) and small pick up trucks (21.7 mpg) averaged to 23.55 mpg. (Table 4.8); in order to reflect actual vehicle stock mpg and the average in-use fuel economy, the new vehicle average of 23.55 is factored by the average new truck mpg of 20.5 (table 4.8) divided by average in-use truck of 17.6 mpg: $23.55 / 17.6 = 1.338$. Thus the Aspen vehicle population of small SUVs/light trucks is 23.55 mpg times 0.8585 = 20.22.

New large and medium SUVs (17.6 mpg and 21.3) and new large pick up trucks (18.3 mpg) and new small and large vans (23.5 and 18.3 mmpg) are averaged to 19.8 mpg. As above, this new SUV/truck fuel economy is adjusted to reflect the lower mpg of the average vehicle population in use: $19.8 \text{ mpg} * 0.8585 = 17.0 \text{ mpg}$. Note: probably conservative, considering the weight driven around by the typical SUV and pick-up truck and work van in Aspen. This category also contains Hummers (10-13 mpg, practical experience is closer to 8 mpg), Suburbans, Ford 350s, and similar brontomobiles.

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Semis or combination trucks (33,000 lb +) average 6.1 mpg (Table 5.4), 5.2 mpg in Table 5.2, and 5.5 mpg (Table 5.5); we use 5.6 mpg as the average.

Davis & Diegel (2004) Transportation Energy Data Book 2004, Tables 4.1, 4.8, and 5.4, Oak Ridge National Laboratory, USDOE.

Motorcycles: EIA uses 50 mpg (Energy Information Administration/2001 National Household Travel Survey, p. K-37).

Cell: I37

Comment: Rick Heede:

Miles driven / fuel economy. Conservative estimates.

Cell: B40

Comment: Rick Heede:

CMS uses vehicle counts from this site since it counts nearly all traffic entering Aspen from downvalley, Highlands, and Cemetery Lane. Some traffic circumvents the congested Hwy 82 entrance to Aspen by taking McLain Flats Road/Cemetery Lane and Powerplant Road under Castle Creek Bridge. There is no traffic counter on this access road, which fairly heavily used during congested times on Hwy 82, and CMS is thus underestimating total average traffic flow in and out of Aspen by an unknown quantity (but probably less than 10 percent?).

Cell: H49

Comment: Rick Heede:

Average of all vehicle types: VMT / estimated fuel consumption.

Cell: F51

Comment: Rick Heede:

Nov08 update: CMS considered reducing the average typical commuting distance from 25 to 20 miles (to better agree with the average RFTA passenger trip length of 16 miles (Dan Blankenship)), but rejected the change in order to preserve comparability between 2004 and subsequent years.

Aspen Traffic Survey by City & Canary staff, August 2008

Taken at Aspen Hwy 82 & Cemetery Lane + Hwy 82 & Truscott, 7am-1pm

28-Aug-08

Last modified: 13Nov08
Climate Mitigation Services

Table 1

Cemetery Lane & Power Plant Road

New categories, undefined

Time	Passenger cars	Light trucks & SUVs	Med&Hvy trucks/SUVs	Large 2-axle trucks	Large 3-axle trucks	Semis	Buses (RFTA)	Small V (= EV?)	Large V (= ?)	Motor cycles	Total
Kim Peterson 7-9 AM	119	7	225	1	2		5		1	5	365
Kim Peterson 7-9 AM	81	5	171	1	1					4	263
John Eisler 8AM-1PM	241	128	424	14	6	1	7	1		24	846
Marta Darby 9AM-1PM	100	67	238	10	6		3			14	438
Total	541	207	1,058	26	15	1	15	1	1	47	1,912
Percentage of Total	28.3%	10.8%	55.3%	1.4%	0.8%	0.1%	0.8%	0.1%	0.1%	2.5%	100%

Table 2

Truscott Intersection Hwy 82

New categories, undefined

Time	Passenger cars	Light trucks & SUVs	Med&Hvy trucks/SUVs	Large 2-axle trucks	Large 3-axle trucks	Semis	Buses (RFTA)	Small V (= EV?)	Large V (= ?)	Motor cycles	Total
Aaron 7-9 AM		150	450	41	41			3	1	10	696
Jannette 7-9 AM	27	10	37		2	1	1				78
Jannette 7-9 AM	180		225			3	16				424
Jannette 7-9 AM	175		225			3	23				426
Jannette 7-9 AM	65	98					5				168
Ashley 9-11 AM	196			47	46	22	22			16	349
Krueger 9-10 AM	274	198	216	9	22	2	1		1		723
Krueger 10-11 AM		211	369		1						581
Ada & CJ 11-1 PM	240	295	336	39	21	8	3	1	2	10	955
Ada & CJ 11-1 PM	146	201	225	14	20	10	2			4	622
Total	1,303	1,613	1,633	150	153	49	73	4	4	40	5,022
Percentage of Total	25.9%	32.1%	32.5%	3.0%	3.0%	1.0%	1.5%	0.1%	0.1%	0.8%	100%

Table 3

Total & Average of Truscott/Hwy 82 & Cemetery Lane

Time	Passenger cars	Light trucks & SUVs	Med&Hvy trucks/SUVs	Large 2-axle trucks	Large 3-axle trucks	Semis	Buses (RFTA)	Small V (= EV?)	Large V (= ?)	Motor cycles	Total
Cemetery Lane + Truscott	1,844	1,820	2,691	176	168	50	88	5	5	87	6,934
Percentage	26.6%	26.2%	38.8%	2.5%	2.4%	0.7%	1.3%	0.1%	0.1%	1.3%	100%

Percent vehicle distribution in Table 4 is applied to commuting worksheet

Table 4

Total & Average of Truscott/Hwy 82 & Cemetery Lane: without RFTA buses

Time	Passenger cars	Light trucks & SUVs	Med&Hvy trucks/SUVs	Large 2-axle trucks	Large 3-axle trucks	Semis	Buses (RFTA)	Small V (= EV?)	Large V (= ?)	Motor cycles * 0.5	Total
Cemetery Lane + Truscott	1,844	1,820	2,691	176	168	50	deleted	deleted	deleted	44	6,793
Percentage	27.15%	26.79%	39.62%	2.59%	2.47%	0.74%				0.64%	100.00%

Traffic Survey 2008

Cell: D32

Comment: Rick Heede:

No data on passenger cars from Krueger in this time slot??

Cell: J51

Comment: Rick Heede:

CMS deletes the surveyed RFTA buses because RFTA fuel and emissions are accounted for in a separate worksheet.

Cell: K51

Comment: Rick Heede:

Discussed "Small V" and "Large V" with Kim Peterson 12Nov08: these are indeed electric vehicles and Prius hybrids, respectively, and are also counted in the "passenger car" columns, hence deleted as separate categories.

Cell: M51

Comment: Rick Heede:

CMS reduces the number of motorcycles in the survey (done in Aug08) by half to better reflect annual averages.

Aspen Bldg Permits

QuickTracker: City of Aspen annual floor area additions -- as a driver of building energy use

City Permit Histories and details are available
www.aspenpitkin.com/pdfs/depts/41/permit_hist_2001.pdf
 County Permit Details are available for 2004-2009, but no summary rpt with SF data are available (valuation and # permits but no SF)
www.aspenpitkin.com/depts/7/bldgdiv.cfm

Richard Heede
 Climate Mitigation Services
 4-Mar-09

Floor area added from 2005 to 2007

2004-2007 sf:		Baseline 2004		Floor area added from 2005 to 2007	
	sf	coml	resl	total	Percent
2004-2007 sf:	756,530		41,068		0.50%
half of 2004:	94,195		715,462		8.78%
Total	850,725	8,147,276		756,530	9.29%
Percent SF added	10.4%				

QuickTracker: City of Aspen (within City Limits) Building Permits Vs Properties by "year built" in Tax Assessor's database

Permit count	Actual valuation	Square footage	Property "Year Built"	Total Aspen floor area by type	Percent floor area added by type	Saved in CMS Aspen 2007 folder
	\$	gross floor area Aspen Comm Dev Dept "valuation reports"	(sf, by year) Tax Assessors	(sf, by year) AspenCityTaxAssessFeb09.xlsx	Percent computed	

Larry Fite, Tax Assessor's Office, 4Mar09: in parcel database downloaded and analyzed 20Feb09, "First Res SFLA" refers to residential square feet of heated floor area (living area); garages, porches, unfinished basements are valued at fractional SF for floor area purposes. "First Comm Total Area" refers to commercial buildings' total floor area within the exterior walls. "Year Built" refers to the year considered complete, even if a temporary CO (Certificate of Occupancy) has been issued.

The data below is derived from an analysis of the 5,360 parcels in the Tax Assessor's database as of 20Feb09, within Aspen City Limits (set database "Tax Area" to 001: 1-AFS). Various "parcels" of non-structural relevance -- vacant land, parking spaces, etc -- were deleted. Residential totaled ~7 million SF, and commercial buildings totaled ~2 million SF. See below for estimated additions by year, annual building stock SF. Also see worksheet "Feb09 Tax Assessor Properties" for a *summary* of the 5,360 buildings within the City of Aspen.

www.aspenpitkin.com/pdfs/depts/41/permit_hist_2001.pdf

2012	Jan-Dec	Com Res Total								
2011	Jan-Dec	Com Res Total								
2010	Jan-Dec	Com Res Total								
2009	Jan-Dec	Com Res Total								
2008	Jan-Dec	Com Res Total	218 429 647	\$ 79,093,897 90,853,914 169,947,811	no data no data	- 35,135 35,135	2,048,571 7,043,624 9,092,195	yr end	0.0% 0.5% 0.4%	SF added 2005-2008 791,665 8,147,276 9.72% baseline yr end 2003 percent added
2007	Jan-Dec	Com Res Total	266 597 863	\$ 67,515,865 187,754,848 255,270,713	327,313 158,690 486,003	- 70,418 70,418	2,048,571 6,973,206 9,021,777	yr end	0.0% 1.0% 0.8%	SF added 2005-2008 756,530 8,147,276 9.29% baseline yr end 2003 percent added
2006	Jan-Dec	Com Res Total	244 616 860	\$ 117,437,727 182,820,303 300,258,030	462,865 572,533 1,035,398	38,559 403,919 442,478	2,010,012 6,569,287 8,579,299	yr end	1.9% 6.1% 5.2%	
2005	Jan-Dec	Com Res Total	202 538 740	~\$35.58 ~\$208.84 \$ 244,420,986	140,731 907,451 1,048,182	2,509 241,125 243,634	2,007,503 6,328,162 8,335,665	yr end	0.1% 3.8% 2.9%	
2004	Jan-Dec	Com Res Total	222 422 644	~\$73.61 ~\$127.17 \$ 200,784,102	546,208 818,379 1,364,587	14,723 173,666 188,389	1,992,780 6,154,496 8,147,276	yr end	0.7% 2.8% 2.3%	PermitHist2004.pdf
2003	Jan-Dec	Com Res Total	355	\$ 105,532,854	567,003					Bldg type codes: undefined
2002	Jan-Dec	Com Res Total	295	\$ 561,391,283	353,072					
2001	Jan-Dec	Com Res Total	379	\$ 180,690,011	588,943					PermitHist2001.pdf
2000	Jan-Dec	Com Res Total	408	\$ 88,202,697	501,782					
1999	May-Dec	Com Res Total	262	\$ 78,115,639	278,580					

Aspen Bldg Permits

Cell: I15

Comment: Rick Heede:

Jennifer Phelan (Aspen CommDevDept, Sr Long Range Planner) points out that permits are generally in gross SF (includes garages, hallway connectors, storage areas, etc), as is the Assessor's database, although some datasets are net SF (excludes portions of garages, storage, etc).

Cell: K15

Comment: Rick Heede:

Data linked to worksheet "Feb09 Tax Assessor Properties", which summarizes the 5360 properties listed within the City of Aspen tax district and downloaded from www.pitkinassessor.org/assessor/ on 20Feb09. Instructions for updating the file for new properties built in future years are listed on worksheet.

Note: Confirm specific definition or data protocol for Tax Assessor's column titled "First Res SFLA" (heated Resl) and "First Comm Total Area" (Coml).

Cell: I53

Comment: Rick Heede:

Permit types were categorized: Commercial Permit Types: acbk04, acbu04 acgr04 Residential Permit Types: arbk04, arbu04, argr04.

The residential permit SF totaled ~818k of 1365k SF.

Residential and commercial properties within Aspen city limits as of year-end 2008, and template for 2004 to 2008 and beyond

Rick Heede
Climate Mitigation Services

Data from
Pitkin Tax Assessor's Ofc
via large Property database
larryf@co.pitkin.co.us
970-920-5160

18-Mar-09
5360 records

Update protocol

- Step 1: select "Assessor Subset query" at: www.pitkinassessor.org/assessor/
- Step 2: change only "Tax Area" to 001: 1-AFS www.pitkinassessor.org/assessor/subset.asp?
- Step 3: for QuickTracker update data only, enter range for "First Res Year Built" from 2007 to future year, and "First Comm Year Built" from 2007 - tk
- Step 4: select "Preview search"
- Step 5: select "Parcel Detail Data" & check "Output Field Names in First Row" (column headers) www.pitkinassessor.org/assessor/SubsetMultipleResults.asp
- Step 6: then select "Generate Text File" at www.pitkinassessor.org/assessor/SubsetMultipleResults.asp
- Step 7: the few dozen new properties added since 20Feb09 will be easy to sum
- Step 8: compute new Resl & Coml SF added since 20Feb09
- Step 9: If desired, compute SF for property type categories in Table 2; if not needed, simply enter total resl and coml SF built in year.

Table 1 Total residential and commercial floor area as of year-end 2008

Property Type (Column L)	start row	end row	net parcels	Resl Heated SF	Coml Total SF	Average SF
AG	11	25	15	2,334	-	156
COMM/HOUSING AU	26	26	1	-	2,656	2,656
COMM/RES	27	61	35	16,792	271,963	8,250
COMMERCIAL	62	629	568	1,691	1,058,232	1,866
COMMON AREA	630	1,021	392	-	175	0
CONDO	1,022	3,161	2,140	2,744,184	522	1,283
EXEMPT	3,162	3,324	163	287,094	20,500	1,887
FRACTIONAL	3,325	3,451	127	173,063	-	1,363
HOUSING AUTH	3,452	4,206	755	814,678	-	1,079
LODGE	4,207	4,275	69	7,319	605,935	8,888
LODGE/HOUSING	4,276	4,277	2	1,413	27,029	14,221
LODGE/RES	4,278	4,283	6	12,243	42,393	9,106
MINE	4,284	4,284	1	512	-	512
MULTI UNIT	4,285	4,330	46	146,091	-	3,176
MULTI UNIT/COMM	4,331	4,331	1	-	-	-
PARKING	4,332	4,453	122	-	17,341	142
POSSESSORY	4,454	4,458	5	-	1,825	365
RESIDENTIAL	4,459	5,298	840	2,836,210	-	3,376
SEVERED MINERAL	5,299	5,300	2	-	-	-
STATE ASSESSED	5,301	5,305	5	-	-	-
VACANT	5,306	5,370	65	-	-	-

Alternate

- Step 1: select "Assessor Subset query" at: www.pitkinassessor.org/assessor/
 - Step 2: change only "Tax Area" to 001: 1- www.pitkinassessor.org/assessor/subset.asp?
 - Step 3: for full file (5,360 properties as of 20Feb09), ignore all other fields
 - Step 4: select "Preview search"
 - Step 5: select "Parcel Detail Data" & check "Output Field Names in First Row" (column headers)
 - Step 6: sum "First Res SFLA" (heated Resl) and "First Comm Total Area" (Coml)
 - Step 7: compute new Resl & Coml SF added since 20Feb09
 - Step 8: If needed, compute SF for categories below
- If Comm Dev Dept could track CO s (Certificates of Occupancy) by Bldg Type and Year, that would help
If Comm Dev Dept could track demolished properties, that would help

Sum Resl & Coml SF 5,360 7,043,624 2,048,571 1,696

including vacant, parking

Sum Resl & Coml SF, year-end 2008 9,092,195 SF

Use Table 2 for new data on completed residential and commercial buildings by type in 2009 and beyond. Or summarize new residential and commercial properties in Table 2b; results in Table 2b are linked to the "QT trend analysis" worksheet.

Table 2 New Properties by "Year Built" in Tax Assessor's database for 2004 through 2008, with data entry for 2009-2015

Property Type	as of 20Feb09															2004-08 notes
	Built 2004	Built 2005	Built 2006	Built 2007	Built 2008	Total 2004-2008	Properties built	Average SF	Built 2009	Built 2010	Built 2011	Built 2012	Built 2013	Built 2014	Built 2015	
COMMERCIAL	-	2,509	38,559	-	-	41,068	53	775								all coml (some below
CONDO	24,020	13,070	140,949	42,561	-	220,600	70	3,151								all resl (exc 1 coml t
FRACTIONAL	-	136,062	-	-	-	136,062	78	1,744								all resl
HOUSING AUTH	36,602	5,580	148,709	2,856	-	193,747	183	1,059								all resl
LODGE/HOUSING (coml)	14,723	coml (2004)	-	-	-	14,723	1	14,723								1 coml: 14,723 SF (
LODGE/HOUSING (resl)	1,413	resl (2004)	-	-	-	1,413	1	1,413								1 resl: 1,413 SF (20
MULTI UNIT	-	13,914	3,945	8,556	-	26,415	4	6,604								all resl
RESIDENTIAL	111,631	72,499	110,316	16,445	35,135	346,026	65	5,323								all resl; 7 in 2008, 4
Total	188,389	243,634	442,478	70,418	35,135	980,054	455	2,154								

Table 2b Summary table for 2009 - 2015

Commercial	14,723	2,509	38,559	-	-	55,791	54	1,033								
Residential	173,666	241,125	403,919	70,418	35,135	924,263	401	2,305								
Total	188,389	243,634	442,478	70,418	35,135	980,054	455	2,154								

Tax Assessor Parcels

Cell: E7

Comment: Rick Heede:

See "AspenCityTaxAssessFeb09.xlsx" for full database of 5,360 properties by type, year built, parcel number, floor area, etc (all as of 20Feb09). The present worksheet only summarizes the extensive data.

Cell: H48

Comment: Rick Heede:

20Feb09: all coml (some below 100 SF, several below 500 SF).

Cell: H49

Comment: Rick Heede:

20Feb09: all resl (exc 1 coml built in 1888; & 9 resl no SF).

Cell: H50

Comment: Rick Heede:

20Feb09: all residential.

Cell: H51

Comment: Rick Heede:

20Feb09: all residential.

Cell: H52

Comment: Rick Heede:

20Feb09: 1 coml: 14,723 SF (2004); no other years.

Cell: H53

Comment: Rick Heede:

20Feb09: 1 resl: 1,413 SF (2004); no other years.

Cell: H54

Comment: Rick Heede:

20Feb09: all residential.

Cell: H55

Comment: Rick Heede:

20Feb09: all resl; 7 in 2008, 4 in 2007, 21 in 2006, 13 in 2005, 20 in 2004.

Aspen/Pitkin County Airport: Passenger Enplanement & Deplanement, 1998-2008, and template for Air Travel emissions

Methodology: download passenger enplanement and deplanement data from the Aspen Pitkin County Airport website (www.aspenairport.com/pdf/passenger_report.pdf); enter data in Table 1; Table 1 is linked to Tables 2 and 3, and automatically calculates estimated emissions in Table 3. These results are in turn linked to "QT trend analysis" summary worksheet. Analysts may assume that 2009 and later "tons CO2 per enplaned passenger" in row 59 is equal to 2008, or else re-calculate; e.g., lower if air carrier load factors continue to increase.

From David Ulane to Heede/CMS
7-Jan-09
 Last modified: 18Mar09

Table 1 Enplanement and deplanement data for Aspen Pitkin County Airport, commercial aviation, 2003 - 2009

	2003		2004		2005		2006		2007		2008		2009		2010		2011	
	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned	Enplaned	Deplaned
January	28,646	25,724	25,831	23,385	26,765	24,990	29,096	26,488	26,419	24,238	29,124	26,305						
February	27,898	29,246	25,051	24,505	26,224	24,321	27,294	27,412	25,494	25,132	28,732	28,941						
March	32,940	31,333	29,728	28,332	30,030	28,751	31,657	29,637	29,106	26,509	32,801	30,188						
April*	12,011	7,521	10,574	7,959	10,908	7,020	11,122	7,976	7,372	3,966	12,346	7,847						
May*	6,190	7,165	6,695	6,472	6,540	7,456	7,370	7,678	-	-	9,343	9,605						
June*	11,702	14,101	12,227	14,348	12,590	11,874	12,075	14,071	10,722	13,791	15,772	18,298						
July	16,590	17,728	16,067	16,257	16,259	16,963	18,548	18,467	19,401	18,776	22,726	22,576						
August	17,835	16,564	18,671	14,879	17,987	16,460	20,144	18,504	19,774	18,062	24,343	22,226						
September	10,306	8,537	8,590	7,747	12,824	12,295	13,473	11,672	12,286	10,490	14,416	12,405						
October	6,727	5,424	8,430	7,112	9,377	5,911	9,279	8,006	9,239	8,032	10,456	9,349						
November	5,549	6,017	6,857	7,555	7,170	7,399	7,521	7,871	7,899	8,746	7,637	8,531						
December	18,145	12,458	14,998	20,286	17,679	22,554	15,937	20,005	15,920	19,888	16,144	21,178						
Total Passengers:	194,539	181,818	183,719	178,837	194,353	185,994	203,516	197,787	183,632	177,630	223,840	217,449	-	-	-	-	-	-

*The Airport was closed from April 9, 2007 through June 7, 2007 for runway rehabilitation
 CMS note: 2008 enplanement and deplanement data updated from a file sent by Ulane, 16Jan09.

Table 2 Historic Passenger Enplanements & Deplanements, 1998 - 2008, and 2009 and beyond

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enplanement	248,510	213,903	214,816	187,622	183,704	194,539	183,719	194,353	203,516	183,632	223,840	-	-	-				
Deplanement	na	na	na	na	na	181,818	178,837	185,994	197,787	177,630	217,449	-	-	-				
Total Enp + Depl						376,357	362,556	380,347	401,303	361,262	441,289	-	-	-	-			

Table 3 Air travel emissions estimate

Projected total coml air travel, tons CO2e	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	-	-	-	-	-	-
Annual rate of change		-13.06%	1.44%	-11.78%	-1.10%	6.97%	-4.61%	-2.25%	-3.90%	-17.85%	16.86%						
ASE enplaned passengers 1998 - 2008	248,510	213,903	214,816	187,622	183,704	194,539	183,719	194,353	203,516	183,632	223,840	-	-	-	-	-	-
Tons CO2/enplaned passenger (computat	0.702	0.709	0.716	0.723	0.731	0.738	0.745	0.689	0.632	0.576	0.552						
Annual rate of change		1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	-7.60%	-8.22%	-8.96%	-4.13%						

re-calculate factor or assume equal to 2008

Air Travel Pax 1998-2008

Cell: F15

Comment: Rick Heede:

Data from Ulane, 15Aug05 Aspen Passenger report for 2003 & 2004. This data was used in the CMS inventory for Aspen, year 2004.

Cell: N15

Comment: Rick Heede:

Airport passenger data from Ulane's "AirportPassengerRpt2008" for 2006 to 2008, received 16Jan09.

Cell: H43

Comment: Rick Heede:

Airport Total, 2005 deplanements, Ulane Aug2005. His datum for enplanements differs slightly: 194,539 pax.

Cell: B58

Comment: Rick Heede:

This factor has computational value only (since actual emissions are calculated with far more detail than simply the number of enplaned passengers).

CMS has calculated the rate of change between 2004 and 2007, applied half the rate of decline to 2008, and has, furthermore, not assumed that aircraft fuel efficiency and load factors were not progressively worse prior to 2004. CMS has assumed the same factor for 1998 - 2003 as in 2004.

Cell: M58

Comment: Rick Heede (Mar09):

Although emissions per enplaned passenger declined sharply between 2004 and 2007 -- chiefly through higher load factors -- CMS anticipates that this rate of improvement to moderate in 2009 and beyond, as load factors are already high and may be pressured by declining air travel. This in spite of continually improving aircraft fuel efficiencies. CMS has therefore halved the average rate of decline from 2004 and 2007 (8.3 percent per year) to 4.1 percent in 2008. The inventory for 2010 may cause an adjustment to this rate of change.

Aspen emissions QuickTracker: major CO₂ emissions drivers -- commuting, air travel, and new construction -- and trend analysis template

The data entry templates in this folio of worksheets -- AADT Commuting, Tax Assessor Parcels, and Air Travel Pax -- are all linked to and will automatically update the tables below. Future trend analysts will need to review the veracity of our efficiency improvement factors (embedded in the "computational" rows 19, 37, and 49) and compare against the results of the 2010 full inventory.

Richard Heede
 Climate Mitigation Services
 Snowmass, Colorado
 File Started 4 September 2008
 Last Modified: 6 April 2009

numbers in **red** are "actual"
 numbers in **blue** are interpolated
 numbers in **green** are backcast or forecast

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Commuting emissions estimate																		
Commuting & driving to and from Aspen, tons CO ₂	120,397	121,002	120,280	118,305	122,450	121,342	125,714	124,479	116,525	117,336	113,246	-	-	-	-	-	-	-
Annual rate of change		0.50%	-0.60%	-1.64%	3.50%	-0.90%	3.60%	-0.98%	-6.39%	0.70%	-3.49%							
Average Annual Daily Traffic at Castle Creek bridge	23,217	23,217	22,963	22,473	23,144	22,820	23,524	23,420	22,044	22,320	21,542	-	-	-	-	-	-	-
tons CO ₂ per AADT (computational value only)	5.1857	5.2118	5.2380	5.2643	5.2908	5.3174	5.3441	5.3151	5.2860	5.2570	5.2570							
Annual rate of change		0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	-0.54%	-0.55%	-0.55%	0.00%							

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Building emissions estimate																		
Commercial buildings: floor area added	12,257	13,323	14,481	15,741	17,109	18,597	14,723	2,509	38,559	-	-	-	-	-	-	-	-	-
Residential buildings: floor area added	121,833	132,427	143,943	156,459	170,064	184,853	173,666	241,125	403,919	70,418	35,135	-	-	-	-	-	-	-
Total Comm & Resl floor area added	134,090	145,750	158,424	172,200	187,174	203,450	188,389	243,634	442,478	70,418	35,135	-	-	-	-	-	-	-
Total commercial building stock with Aspen City limits	1,913,529	1,926,852	1,941,333	1,957,074	1,974,183	1,992,780	2,007,503	2,010,012	2,048,571	2,048,571	2,048,571							
Total residential building stock with Aspen City limits	5,331,615	5,464,042	5,607,985	5,764,444	5,934,508	6,119,361	6,293,027	6,534,152	6,938,071	7,008,489	7,043,624							
Total building stock within Aspen city limits	7,245,144	7,390,894	7,549,318	7,721,518	7,908,691	8,112,141	8,300,530	8,544,164	8,986,642	9,057,060	9,092,195	-	-	-	-	-	-	-
Total building emissions, tons CO ₂ (actual 2004 & 2007)	268,671	268,702	269,080	269,821	270,943	272,463	273,324	270,102	272,262	262,475	258,002	-	-	-	-	-	-	-
Annual rate of change		0.01%	0.14%	0.28%	0.42%	0.56%	0.32%	-1.18%	0.80%	-3.59%	-1.70%							
Tons CO ₂ per SF of floor area (computational value only)	0.03708	0.03636	0.03564	0.03494	0.03426	0.03359	0.03293	0.03161	0.03030	0.02898	0.02838	0.02773	0.02710	0.02649	0.02589			
Annual rate of change		-1.96%	-1.96%	-1.96%	-1.96%	-1.96%	-1.96%	-4.00%	-4.16%	-4.34%	-2.08%							

The rate of decline in the computed CO₂ per SF rate from 2004 to 2007 at -4.16 percent per annum. CMS applies half of this rate to estimate 2008 emissions from electricity, natural gas, and propane.
 CMS note: Actual data from the anticipated year 2010 inventory will modify this projection.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Air travel emissions estimate																		
Projected total commercial air travel, tons CO ₂ e	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	-	-	-	-	-	-	-
Annual rate of change		-13.06%	1.44%	-11.78%	-1.10%	6.97%	-4.61%	-2.25%	-3.90%	-17.85%	16.86%							
ASE enplaned passengers 1998 - 2008	248,510	213,903	214,816	187,622	183,704	194,539	183,719	194,353	203,516	183,632	223,840	-	-	-	-	-	-	-
Tons CO ₂ per enplaned passenger (computational value only)	0.702	0.709	0.716	0.723	0.731	0.738	0.745	0.689	0.632	0.576	0.552	-	-	-	re-calculate	-	-	-
Annual rate of change		1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	-7.60%	-8.22%	-8.96%	-4.13%							

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Overall trend analysis and projections																		
Commuting & driving to and from Aspen, tons CO ₂	120,397	121,002	120,280	118,305	122,450	121,342	125,714	124,479	116,525	117,336	113,246	-	-	-	-	-	-	-
Total building emissions, tons CO ₂ (actual 2004 & 2007)	268,671	268,702	269,080	269,821	270,943	272,463	273,324	270,102	272,262	262,475	258,002	-	-	-	-	-	-	-
Projected total commercial air travel, tons CO ₂ e	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	-	-	-	-	-	-	-
Subtotal of buildings, traffic, and air travel	563,470	541,335	543,176	523,827	527,602	537,366	535,984	528,445	517,437	485,492	494,749	-	-	-	-	-	-	-
Annual rate of change		-3.93%	0.34%	-3.56%	0.72%	1.85%	-0.26%	-1.41%	-2.08%	-6.17%	1.91%							
Non-QT sources							292,664	277,409	265,624	274,775	280,014							
Interpolated, projected, and actual total Aspen GHG emissions							828,648	805,855	783,061	760,268	774,763							
Commuting, Buildings, & Air Travel: Percent of total							64.7%	65.6%	66.1%	63.9%	63.9%							
Annual rate of change							-2.75%	-2.83%	-2.91%	1.91%								
tons change from previous year							(22,794)	(22,794)	(22,794)	14,495								
average rate of change, 2004-2008:											-1.65%							
average rate of change, 2004-2007:											-2.83%							

Summary of 2004 and 2007 QuickTracker sources			
	2004	2007	% change
Commuting	125,714	117,336	-6.66%
Buildings	273,324	262,475	-3.97%
Air travel	136,946	105,681	-22.83%
Other sources	292,664	274,775	-6.11%
Total emissions	828,648	760,268	-8.25%
Subtotal QT	535,984	485,492	-9.42%

	2004 percent	2005 percent	2006 percent	2007 percent	2008 percent
Commuting	15.2%	15.4%	14.9%	15.4%	14.6%
Buildings	33.0%	33.5%	34.8%	34.5%	33.3%
Air travel	16.5%	16.6%	16.4%	13.9%	15.9%
QT of total e	64.7%	65.6%	66.1%	63.9%	63.9%

Summary of 2007 and 2007 QuickTracker sources			
	2007	2008	% change
Commuting	117,336	113,246	-3.49%
Buildings	262,475	258,002	-1.70%
Air travel	105,681	123,501	16.86%
Other sources	274,775	280,014	1.91%
Total emissions	760,268	774,763	1.91%
Subtotal QT	485,492	494,749	1.91%

QT trend analysis

Cell: B17

Comment: Rick Heede:

Yearly data from John Krueger, Aspen Transportation Dept, 1993, 1999-2008, 9Mar09. Omitted from this worksheet: 1993 AADT at Castle Creek: 23,675; 1999: 23,217. CMS assumes 1998 equal to actual AADT count for 1999.

Cell: B34

Comment: Rick Heede:

Building energy emissions include non-building energy use (streetlighting, wastewater treatment plant, ski lift motors, water pumps, heated driveways, etc), and encompass energy and emissions within the modified Urban Growth Boundary for 2004 and 2007. The other years are backcasts to 2003 and forecasts to 2008 based on the total heated floor area in the Tax Assessor's database (for City of Aspen parcels only) and is a factor of total building stock (city limits) times tons CO2 per SF-yr.

Cell: B37

Comment: Rick Heede:

Since the actual building emissions include non-building energy use as noted above, the factor of tons per SF-year is for computational use only, and has no inherent value. Indeed, the factor in 2007 of ~0.029 tons CO2/sf-yr or 58 lb CO2/sf-yr is far higher than our estimate of average emissions per residential SF, which was estimated by CMS in the ASHES report (2008) for Sopris Foundation as 23.2 lb CO2/sf-yr.

Cell: H37

Comment: Rick Heede:

Based on 2004 and 2007 actual emissions, and computed "tons per SF of heated floor area" (city limits only, not the full UGB boundary), emissions declined by 4.34 percent per annum. CMS applies half of this rate to estimate building emissions from 1998 to 2003, and to project emissions for 2008 and beyond.

Cell: M37

Comment: Rick Heede:

CMS has applied half of the average annual rate of decrease between 2004 and 2007 in estimating 2008 emissions.

Cell: H39

Comment: Rick Heede:

In order to account for variables in net SF of heated floor area added, the proportion of energy use in "buildings" actually being for streetlighting, water pumps, heated driveways, ski lifts, and other non-building uses, the computational use of tons of CO2 per SF of floor area in the city limits must not be taken as definitive. The forecasting usefulness of the factor will be assessed against the future 2010 inventory and updated rates of construction activity.

Cell: B49

Comment: Rick Heede:

This factor has computational value only (since actual emissions are calculated with far more detail than simply the number of enplaned passengers).

CMS has calculated the rate of change between 2004 and 2007, applied half the rate of decline to 2008, and has, furthermore, not assumed that aircraft fuel efficiency and load factors were not progressively worse prior to 2004. CMS has assumed the same factor for 1998 - 2003 as in 2004.

Aspen emissions QuickTracker: 2004 and 2007 QT data, interpolation & backcasting, and scenarios to 2020 and 2050

Canary Initiative staff do not have to update these scenarios. CMS performed these calculations only to forecast emissions to 2020 and 2050 in the context of gauging progress toward emissions reduction goals for 2020 vis-à-vis estimated emissions in 2008.

Richard Heede
Climate Mitigation Services
Snowmass, Colorado
File Started 4 September 2008
Last Modified: 24 April 2009

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
Commuting emissions estimate																									
Commuting & driving to and from Aspen, tons CO2	120,397	121,002	120,280	118,305	122,450	121,342	125,714	124,479	116,525	117,336	113,246	110,369	107,566	104,833	102,170	99,574	97,045	94,579	92,177	89,835	87,553	85,329	83,161	81,048	
Annual rate of change		0.50%	-0.60%	-1.64%	3.50%	-0.90%	3.60%	-0.98%	-6.39%	0.70%	-3.49%														
							average rate of change, 2004-2008:																		
							average rate of change, 2004-2007:																		
Average Annual Daily Traffic at Castle Creek bridge	23,217	23,217	22,963	22,473	23,144	22,820	23,524	23,420	22,044	22,320	21,542														
Building emissions estimate																									
Total building emissions, tons CO2 (actual 2004 & 2007)	268,671	268,702	269,080	269,821	270,943	272,463	273,324	270,102	272,262	262,475	258,002	254,339	250,729	247,170	243,661	240,202	236,792	233,431	230,117	226,851	223,630	220,456	217,326	214,241	
Annual rate of change	0.0%	0.0%	0.1%	0.3%	0.4%	0.6%	0.3%	-1.2%	0.8%	-3.6%	-1.7%														
							average rate of change, 2004-2008:																		
							average rate of change, 2004-2007:																		
Total building stock, City limits, Com+Resl (million SF)	7.25	7.39	7.55	7.72	7.91	8.11	8.30	8.54	8.99	9.06	9.09														
Air travel emissions estimate																									
Projected total commercial air travel, tons CO2e	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	121,297	119,132	117,007	114,919	112,868	110,854	108,876	106,933	105,025	103,151	101,311	99,503	97,727	
Annual rate of change	0.0%	-13.1%	1.4%	-11.8%	-1.1%	7.0%	-4.6%	-2.2%	-3.9%	-17.9%	16.9%														
							average rate of change, 2004-2008:																		
							average rate of change, 2004-2007:																		
ASE enplaned passengers 1998 - 2008	248,510	213,903	214,816	187,622	183,704	194,539	183,719	194,353	203,516	183,632	223,840														
Overall trend analysis and projections																									
Commuting & driving to and from Aspen, tons CO2	120,397	121,002	120,280	118,305	122,450	121,342	125,714	124,479	116,525	117,336	113,246	110,369	107,566	104,833	102,170	99,574	97,045	94,579	92,177	89,835	87,553	85,329	83,161	81,048	
Total building emissions, tons CO2 (actual 2004 & 2007)	268,671	268,702	269,080	269,821	270,943	272,463	273,324	270,102	272,262	262,475	258,002	254,339	250,729	247,170	243,661	240,202	236,792	233,431	230,117	226,851	223,630	220,456	217,326	214,241	
Projected total commercial air travel, tons CO2e	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	121,297	119,132	117,007	114,919	112,868	110,854	108,876	106,933	105,025	103,151	101,311	99,503	97,727	
Subtotal of buildings, traffic, and air travel	563,470	541,335	543,176	523,827	527,602	537,366	535,984	528,445	517,437	485,492	494,749	486,006	477,427	469,009	460,750	452,645	444,691	436,886	429,227	421,711	414,334	407,095	399,990	393,017	
Annual rate of change	0.0%	-3.9%	0.3%	-3.6%	0.7%	1.9%	-0.3%	-1.4%	-2.1%	-6.2%	1.9%	0.0%													
Interpolated, projected, and actual total Aspen GHG emissions							828,648	805,855	783,061	760,268	774,763														
							actual 2004	change calculation	actual 2007	projected															
Commuting, Buildings, & Air Travel: Percent of total							64.7%	65.6%	66.1%	63.9%	63.9%														
Annual rate of change							0.0%	-2.751%	-2.828%	-2.911%	1.907%														
Change, in tons							tons change from previous year	(22,794)	(22,794)	(22,794)	14,495														
							average rate of change, 2004-2008:																		
							average rate of change, 2004-2007:																		
QT, Non-QT, and total Aspen emissions																									
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
New CMS scenario for Aspen 1990-2050, rev. GA 2004	756,811	768,336	780,037	791,916	803,975	816,219	828,648	843,233	858,073	873,176	888,543	872,905	841,067	810,391	780,833	752,354	724,913	698,473	672,997	648,451	624,800	602,011	580,054	558,012	
Commuting	120,397	121,002	120,280	118,305	122,450	121,342	125,714	124,479	116,525	117,336	113,246	110,369	107,566	104,833	102,170	99,574	97,045	94,579	92,177	89,835	87,553	85,329	83,161	81,048	
Buildings	268,671	268,702	269,080	269,821	270,943	272,463	273,324	270,102	272,262	262,475	258,002	254,339	250,729	247,170	243,661	240,202	236,792	233,431	230,117	226,851	223,630	220,456	217,326	214,241	
Air travel	174,401	151,631	153,816	135,701	134,210	143,561	136,946	133,865	128,650	105,681	123,501	121,297	119,132	117,007	114,919	112,868	110,854	108,876	106,933	105,025	103,151	101,311	99,503	97,727	
Other sources	289,254	277,891	278,836	268,904	270,842	275,854	292,664	277,409	265,624	274,775	280,014	270,294	260,849	251,673	242,758	234,097	225,685	217,514	209,578	201,871	194,387	187,120	180,064	164,995	
New non-QT emissions, Apr09 scenario																									
Total Aspen emissions (actual 2004 & 2007, backcast & 2020 is 0.7 of 2004 baseline; 2009 to 2019 reduced by 2.3831 percent per annum for smooth curve between 2008 and 2020. -2.3831% required smooth rate of decrease 2009 to 2020 to reach objective of 2020 equal to 0.7 of 2004 (30 percent reduction))	852,724	819,226	822,012	792,731	798,444	813,221	828,648	805,855	783,061	760,268	774,763	756,300	738,276	720,682	703,507	686,742	670,376	654,400	638,805	623,582	608,721	594,215	580,054	558,012	
New scenario, Apr09: notes on scenario:							1998-2003 is backcast from sum of Commuting, Buildings, & Air Travel	Actual 2004 & 2007, interpolated 05-06, forecast 2008																	
							remaining constant proportion of Aspen total emissio	cell K53 (66.1 percent)																	
Annual rate of change, 1998 to 2050		-3.928%	0.340%	-3.562%	0.721%	1.851%	1.897%	-2.751%	-2.828%	-2.911%	1.907%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-2.383%	-3.800%	
Change from previous year, total emissions, tons CO2e		33,497	(2,786)	29,281	(5,712)	(14,777)	(15,428)	22,794	22,794	22,794	(14,495)	18,463	18,023	17,594	17,175	16,765	16,366	15,976	15,595	15,223	14,861	14,507	14,161	22,042	

	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD
1	Aspen emissions QuickTracker: 2004 and 2007 QT data, interpolation & backcasting, and scenarios to 2020 and 2050																													
2																														
3																														
4																														
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6																														
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8																														
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10																														
11	78,989	76,983	75,027	73,121	71,263	69,453	67,689	65,969	64,293	62,660	61,068	59,517	58,005	56,531	55,095	53,695	52,331	51,002	49,706	48,443	47,213	46,013	44,844	43,705	42,595	41,513	40,458	39,430	38,429	
12																														
13	211,200	208,202	205,246	202,333	199,460	196,629	193,838	191,086	188,374	185,700	183,063	180,465	177,903	175,378	172,888	170,434	168,014	165,629	163,278	160,960	158,675	156,423	154,202	152,013	149,855	147,728	145,631	143,564	141,526	
14																														
15																														
16																														
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21																														
22	95,984	94,271	92,589	90,937	89,314	87,720	86,155	84,618	83,108	81,625	80,168	78,738	77,333	75,953	74,598	73,267	71,959	70,675	69,414	68,176	66,959	65,764	64,591	63,438	62,306	61,195	60,103	59,030	57,977	
23																														
24																														
25																														
26																														
27																														
28																														
29																														
30																														
31	78,989	76,983	75,027	73,121	71,263	69,453	67,689	65,969	64,293	62,660	61,068	59,517	58,005	56,531	55,095	53,695	52,331	51,002	49,706	48,443	47,213	46,013	44,844	43,705	42,595	41,513	40,458	39,430	38,429	
32	211,200	208,202	205,246	202,333	199,460	196,629	193,838	191,086	188,374	185,700	183,063	180,465	177,903	175,378	172,888	170,434	168,014	165,629	163,278	160,960	158,675	156,423	154,202	152,013	149,855	147,728	145,631	143,564	141,526	
33	95,984	94,271	92,589	90,937	89,314	87,720	86,155	84,618	83,108	81,625	80,168	78,738	77,333	75,953	74,598	73,267	71,959	70,675	69,414	68,176	66,959	65,764	64,591	63,438	62,306	61,195	60,103	59,030	57,977	
34	386,173	379,455	372,862	366,390	360,038	353,802	347,681	341,673	335,775	329,984	324,300	318,719	313,241	307,862	302,581	297,396	292,305	287,306	282,398	277,579	272,847	268,200	263,638	259,157	254,757	250,435	246,192	242,024	237,931	
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55	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	
56	536,807	516,409	496,785	477,907	459,747	442,276	425,470	409,302	393,749	378,786	364,392	350,545	337,225	322,580	308,571	295,170	282,351	270,089	258,360	247,140	236,407	226,140	216,319	206,925	197,938	189,342	181,119	173,254	165,730	
57	78,989	76,983	75,027	73,121	71,263	69,453	67,689	65,969	64,293	62,660	61,068	59,517	58,005	56,531	55,095	53,695	52,331	51,002	49,706	48,443	47,213	46,013	44,844	43,705	42,595	41,513	40,458	39,430	38,429	
58	211,200	208,202	205,246	202,333	199,460	196,629	193,838	191,086	188,374	185,700	183,063	180,465	177,903	175,378	172,888	170,434	168,014	165,629	163,278	160,960	158,675	156,423	154,202	152,013	149,855	147,728	145,631	143,564	141,526	
59	95,984	94,271	92,589	90,937	89,314	87,720	86,155	84,618	83,108	81,625	80,168	78,738	77,333	75,953	74,598	73,267	71,959	70,675	69,414	68,176	66,959	65,764	64,591	63,438	62,306	61,195	60,103	59,030	57,977	
60	150,634	136,953	123,923	111,517	99,709	88,474	77,788	67,629	57,974	48,802	40,092	31,826	23,984	14,718	5,990	(2,226)	(9,954)	(17,217)	(24,039)	(30,440)	(36,440)	(42,060)	(47,318)	(52,232)	(56,818)	(61,093)	(65,072)	(68,771)	(72,202)	
61																														
62																														
63																														
64	536,807	516,409	496,785	477,907	459,747	442,276	425,470	409,302	393,749	378,786	364,392	350,545	337,225	322,580	308,571	295,170	282,351	270,089	258,360	247,140	236,407	226,140	216,319	206,925	197,938	189,342	181,119	173,254	165,730	
65	021 to 2050 based on smooth reduction to 0.2 of 2004 baseline (80 percent reduction by 2050, per City Council commitment made in ~2006).																													
66	total																													
67																														
68	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%	-3.800%
69	average rate of change, 2021-2035: -3.800%												average rate of change, 2036-2050: -4.343%																	
70																														
71	21,204	20,399	19,624	18,878	18,160	17,470	16,807	16,168	15,553	14,962	14,394	13,847	13,321	14,645	14,009	13,401	12,819	12,262	11,729	11,220	10,733	10,267	9,821	9,394	8,986	8,596	8,223	7,866	7,524	
72																														
73																														

QT scenarios

Cell: B17

Comment: Rick Heede:

Yearly data from John Krueger, Aspen Transportation Dept, 1993, 1999-2008, 9Mar09. Omitted from this worksheet: 1993 AADT at Castle Creek: 23,675; 1999: 23,217. CMS assumes 1998 equal to actual AADT count for 1999.

Cell: B22

Comment: Rick Heede:

Building energy emissions include non-building energy use (streetlighting, wastewater treatment plant, ski lift motors, water pumps, heated driveways, etc), and encompass energy and emissions within the modified Urban Growth Boundary for 2004 and 2007. The other years are backcasts to 2003 and forecasts to 2008 based on the total heated floor area in the Tax Assessor's database (for City of Aspen parcels only) and is a factor of total building stock (city limits) times tons CO2 per SF-yr.

Cell: B57

Comment: Rick Heede:

Since CMS revised the General Aviation emissions for 2004 (in the 2007 inventory, March09), CMS multiplies each year of the original scenario by the factor 0.98456 (828,648/840,875 tons COe2).

Cell: B58

Comment: Rick Heede:

Commuting emissions are driven by actual traffic counts (Castle Creek Bridge, city data). Emission intensity is also assumed to improve through increased fuel efficiency and decreased travel distances: 0.5 percent per year improvement.

Cell: B59

Comment: Rick Heede:

Building emissions are driven chiefly by estimated heated SF within City limits (Tax Assessors database, new buildings added each year 2004-2008, and additions assumed average of 2004-2008 in years 1998-2003). Emissions intensity is also estimated to be decreasing over time.

Cell: B60

Comment: Rick Heede:

CMS has not estimated emissions per passenger mile from 1998 through 2003, and assume gradual reduction in intensity over time. Scenario is driven by passenger enplanements each year. General aviation totaled 31,724 LTO in 1999 vs 24,693 in 2006 (ASE data), which supports the CMS estimate of higher emissions in 1998 and 1999 compared to 2007 and 2008.

Cell: B61

Comment: Rick Heede:

This row is the final (Apr09) CMS estimate of total Aspen emissions 1998-2050. It includes estimated emissions for each QT source (commuting, buildings, and air travel), plus non-QT sources, and meets the Aspen emissions reduction goal of reducing emissions to 70 percent of 2004 by 2020 and to 20 percent of 2004 by 2050.