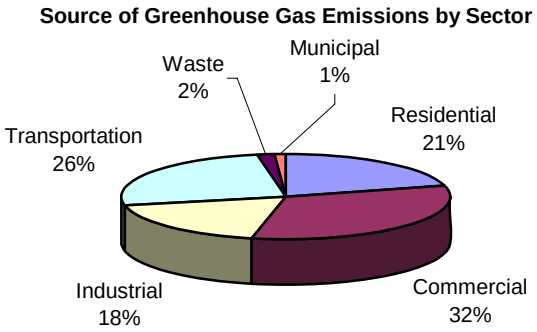
City of Arcata
Updated Greenhouse Gas Inventory
2006

Table of Contents

Summary of CO_2 Emissions

The City of Arcata has been taking active measures to monitor and reduce our community's contribution to climate change for almost a decade now. In 2001, the City joined the Cool Cities Campaign and committed to a 7% greenhouse gas reduction from 1990 emissions levels by 2007. In 2004, the City completed the first Greenhouse Gas Inventory for the community, setting 2000 as the baseline for emissions reductions. In 2006, the City passed the Greenhouse Gas Action Plan, which sets further emissions reductions targets of 20% below 2000 levels by 2010.

This Inventory is a 'progress check,' monitoring the City's progress towards emissions reductions goals. This Inventory can serve to show where the City and Community have made progress with emissions reductions, and where there still may be significant work or challenges to emissions reductions.



The 2006 Greenhouse Gas Inventory shows that there is much work to be done. Over all, energy usage has increased throughout the City. There has been a modest reduction in overall greenhouse gas emissions, but this is primarily due to PG&E efforts to provide a cleaner grid mix to their customers. In many cases, increases in energy usage were matched by decreases in emissions as a result of PG&E's efforts.

Transportation continues to be a troubling sector. A different methodology was used to quantify greenhouse gas emissions from transportation in this Inventory then in the 2000 GHG Inventory. The result was a significant drop in transportation emissions. For comparative purposes, the 2000 Inventory was updated as well. However, transportation, which was the single largest contributor to emissions in the 2000 Inventory, now contributes less than the commercial sector. It is not clear how accurate that is. For more on this, please see page 16.

Municipal emissions are another area of concern. In 2000, the City purchased electricity from the Association of Bay Area Governments (ABAG) via direct access agreements. This cooperative dissolved soon after, and since the City has purchased electricity from PG&E. ABAG guaranteed their power customers at least 20% green electricity, sometimes as much as 30% or more renewable energy in the power mix. Therefore, even though municipal energy usage has dropped considerably in some sectors due to energy retrofits and solar electric installations, the emissions have risen dramatically. This should reflect the importance of procurement decisions in supporting renewable energy and reducing greenhouse gas emissions. For more on this discussion, see page 23.

Summary of CO_2 Emissions, continued

2006-2006 Inventory Comparison at a Glance

Residential	**CO_2 (tons)**
2000	28,531
2006	28,137
Difference	-394
Percent Change	-1%
Commercial	**CO_2 (tons)**
2000	47,430
2006	43,814
Difference	-3,616
Percent Change	-8%
Industrial	**CO_2 (tons)**
2000	25,674
2006	24,462
Difference	-1,212
Percent Change	-5%
Transportation	**CO_2 (tons)**
2000	37,809
2006	34,465
Difference	-3,344
Percent Change	-9%
Municipal	**CO_2 (tons)**
2000	1,228
2006	1,539
Difference	311
Percent Change	25%
Waste	**CO_2 (tons)**
2000	2,108
2006	2,149
Difference	41
Percent Change	2%
Total	**CO_2 (tons)**
2000	142,690
2006	134,566
Difference	-8,124
Percent Change	-6%

Residential

2000 to 2006 Inventory Comparison at a Glance

Sector			2000	2000	2006	2006	% Change	% Change
	Source	Unit	Purchased	CO_2 (tons).	Purchased	CO_2 (tons).	Purchased	CO_2 (tons)
Residential	Natural Gas	Therms	2,752,945	17,009	2,938,710	18,156	7%	7%
Residential	Electricity	KWh	30,922,368	11,272	40,159,265	9,839	30%	-13%
Residential	Propane	Gallons	1,067	7	833	6	-22%	-14%
Water Pumping	Electricity	KWh	667,872	243	553,552	136	-17%	-44%
Totals				28,531		28,137		-1%

PG&E specific figures were used to calculate the kWh to carbon dioxide conversion. PG&E has significantly cleaned their grid mix since 2000. As a result, though there was a 10 million kWh increase in residential energy consumption (30%), actual emissions were reduced by 13%. The emissions could have been significantly lower if residential energy consumption had also reduced 13%. Natural gas consumption increased by 7% and resulting emissions were proportional. There was a significant reduction in water pumping energy. This is likely due to the installation of a freshwater pump at Heindon and Janes road, which supplies roughly 15% of the City water. The reduction in electricity usage here can also help explain the large increase in electricity usage in the municipal sector, further explained on page 23.

Residential

Non-HSU Water Pumping

Electricity from Water Pumping

Water and energy use obtained from HBMWD, Becky Moyle.

City of Arcata is responsible for 702 Million Gallons (MG) of the total from HBMWD, which is 19.37% of the total municipal water pumping demand. There are 4,297,414 kWh from municipal water usage.

City of Arcata water usage is .1937 * 4,297,414 = 832,409

HSU accounts for 5% of the water use, so that is subtracted from the total:

832,409 * .05 = 41,620 HSU water use kWh

832,409 – 41,620 = 790,789 kWh

Water printouts from the City of Arcata Finance Department show 30% of water consumption is by commercial accounts, so 30% of the kWh usage was subtracted and reported separately under commercial.

790,789 * .3 = 237,236

790,789 – 237,236 = 553,552

Non-HSU Water Pumping	KWh	CO_2 (tons)
2000	667,872[1]	243
2006	553,552	136
Change	-114,320	-107
Percent Difference	-17%	-44%

There was a large reduction in electricity usage in this sector. Right after the 2000 Inventory was completed, a freshwater pump went online near Heindon and Janes road. This pump supplies roughly 15% of the City water usage, helping to explain the 17% reduction from Humboldt Bay Municipal Water District. This is further supported by increases in the City electricity usage, especially in the water sector. Humboldt Bay Municipal Water District also gets electricity from PG&E, who cleaned their grid mix substantially over the past several years. This explains the 44% reduction in CO_2 while there is only a 17% reduction in electricity usage.

[1] In the 2000 Inventory, water-pumping kWh was not separated between commercial and residential. 30% of the pumping is for commercial uses, so I separated the kWh from 2000 by assuming a 30% mix was consistent for 2000 as well.

Residential

PG&E Accounts

Electricity and Natural Gas Use

In the 2000 Inventory, there was a 10% difference between the number of PG&E accounts and the US Census data for Arcata. I used the same 10% reduction with the 2006 numbers. In addition, I used PG&E specific kWh to CO_2 conversion factors in the software that applied to both the year 2000 and 2006. The PG&E emissions data for 2006 is actually the data from 2005, which is the most recent year available.

Propane Use

Propane numbers from Amerigas were 2500 gallons. I divided the amount of gallons by three to account for industrial, commercial, and residential sectors, as was done in the 2000 Inventory.

PG&E Accounts

Electricity	**KWh**	**CO_2 (tons)**
2000	30,922,368	11,272
2006	40,159,265	9,839
Change	9,236,897	-1,433
Percent Difference	30%	-13%
Natural Gas	**Therms**	**CO_2 (tons)**
2000	2,752,95	17,009
2006	2,938,710	18,156
Change	185,765	1,147
Percent Difference	7%	7%
Propane	**Gallons**	**CO_2 (tons)**
2000	1,067	7
2006	833	6
Change	-234	-1
Percent Difference	-22%	-14%

PG&E has made significant increases in the cleanliness of their grid mix, and this is reflected in the emissions. For example, though Residential energy consumption increased by 30%, the reported emissions actually decreased by roughly 13%. A significant portion of that is likely the increase in the percentage of PG&E electricity that comes from renewable sources. This should exemplify the support for cleaner energy forms that use less coal and carbon-intensive fuels, and promote a push for renewable energy. As the 2000 Inventory did not include data from Sequoia propane providers, it is difficult to tell where the reduction in residential propane usage comes from, and if it is truly accurate. It is likely that the significant reduction is really a result of reporting methods, as the propane consumption increased significantly in the commercial and industrial sectors.

Commercial

2000-2006 Inventory Comparison at a Glance

Sector			2000	2000	2006	2006	% Change	% Change
	Source	Unit	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)
Commercial	NG	Therms	2,067,624	12,774	2,805,732	17,334	36%	36%
Commercial	Electricity	KWh	64,391,506	23,472	58,176,605	14,253	-10%	-39%
Commercial	Propane	Gallons	1,067	7	36,833	249	3,374%	3,457%
HSU	NG	Therms	1,135,707	7,017	1,416,765	8,753	25%	25%
HSU	Electricity	KWh	10,621,040	3,872	8,171,079	3,138	-23%	-19%
HSU	Propane	Gallons	9,063	61	2,793	19	-69%	-69%
Water Pumping (HSU)	Electricity	KWh	89,910	33	41,620	10	-54%	-70%
Water Pumping (non-HSU)	Electricity	KWh	286,230	104	237,237	58	-17%	-44%
Total				47,340		43,814		-7%

The 2000 Inventory included the City of Arcata figures in the commercial sector. This is because in the year 2000, the City purchased electricity from an independent provider, and therefore wasn't included in PG&E accounts. The City now purchases their electricity from PG&E, and therefore it would be redundant to list the electricity twice. The impact of the City carbon footprint is accounted for separately under 'Municipal.' There has been a significant reduction of both electricity use and resulting emissions in the commercial sector. However, natural gas consumption has increased by 36%.

Data for propane consumption was from Amerigas and Sequoia. The 2000 Inventory did not include figures for Sequoia, who is the largest propane provider in the City. Figures from Sequoia were included in this Inventory, and the result is a seemingly large increase in propane consumption. It is hard to compare consumption to 2000, as figures from Sequoia are not available.

HSU has achieved broad savings across the board. In 2003, HSU conducted a campus wide energy audit and retrofits and as a result has decreased electricity consumption by almost 20%. However, natural gas consumption increased considerably at HSU. One reason for the rise in natural gas consumption at HSU could be increased usage of the co-generation system on campus, which burns natural gas to produce both electricity and heat. HSU also upgraded the irrigation system on campus, and water consumption has dropped considerably.

Commercial

HSU

Humboldt State University data was sent to me in 12 monthly reports from Tim Moxon, Senior Director of Facilities Management.

HSU electricity is delivered by PG&E, but purchased from APS (HSU is an unbundled customer.) Tim says APS guarantees 20% green electricity; meaning 20% of the electricity they provide comes from certified renewable sources. I applied a reduction of 20% to extract the green kWh, as a green kWh is considered carbon neutral. Tim mentioned that most of the propane goes towards fueling the Telonicher lab in Trinidad, but as some of the propane is for forklifts and some is for back-up generators, I included the propane figures as well.

HSU Electricity	KWh	CO_2 (tons)
2000	10,621,040	3,872
2006	8,171,079	3,138
Difference	-2,449,961	-734
Percent Change	-23%	-19%

HSU Natural Gas	Therms	CO_2 (tons)
2000	1,135,707	7,017
2006	1,416,765	8,753
Difference	281,058	1,736
Percent Change	25%	25%

HSU Propane	Propane (gal)	CO_2 (tons)
2000	9,063	61
2006	2,793	19
Difference	-6,270	-42
Percent Change	-69%	-69%

HSU Green Electricity	Green kWh
2000	2,665,260
2006	2,042,770
Difference	-622,490
Percent Change	-23%

HSU conducted a series of retrofits to campus buildings that have significantly reduced electricity consumption on campus. These retrofits vary from lighting to HVAC systems, and even include simple actions like putting idle computers on standby in computer labs. It is worth noting that HSU has reduced its kWh consumption by 3 million kWh while the other sectors have increased their consumption. Another factor could be the increased usage of co-generation systems on campus, which burns natural gas to create electricity and heat.

Commercial

HSU Water Pumping

Information obtained from Tim Moxon, Senior Director of Facilities Management at HSU. HSU uses about 33 MG of city water a year, which is 5% of the total Arcata usage. I subtracted 5% of the kWh demand associated with water pumping and reported it here.
832,409 kWh City of Arcata total * .05 = 41,620 kWh

HSU Water Pumping	KWh	CO_2 (tons)
2000	89,910	33
2006	41,620	10
Difference	-48,290	-23
Percent Change	-54%	-70%

HSU retrofitted the irrigation system on campus, resulting in a dramatic reduction in water consumption. The reduction in emissions is also a result of the increasing cleanliness of the PG&E grid mix.

Commercial

Non-HSU Commercial Water Use

Becky Moyle at the Humboldt Bay Municipal Water District provided the electricity use from water pumping. The percentage of City water used by commercial accounts was determined from account printouts provided by David Bradley. The total share of kWh (not including HSU) was split 30/70, with commercial accounts being responsible for 30% of the power use.

Total usage (not including HSU) 790,789 kWh * .30 = 237,237 kWh

Non-HSU Water Pumping	KWh	CO_2 (tons)
2000	286,230	104
2006	237,237	58
Difference	-48,993	-46
Percent Change	-17%	-44%

The Humboldt Bay Municipal Water District supplies water to many of the municipalities locally. The electricity usage shown here is proportional to the percentage of water that the City uses, and hence the percentage of electricity we are responsible for. In 2000 shortly after the Inventory was completed, the City installed a freshwater pump at Heindon and Janes road. This pump supplies roughly 15% of our water supply, and is consistent with the drop in usage from HBMWD. As the freshwater pump provides electricity for the entire City, these water pumping savings were shared across each sector. However, there is a proportionate increase in electricity in the municipal sector as well. The CO_2 reduction is again a result of the cleaner PG&E grid mix.

Commercial

PG&E Accounts, Commercial

The data I received in 2006 did not separate commercial and industrial customers. Using the figures from the 2000 Inventory, I was able to assume that industrial was responsible for 39% of the demand, and commercial was responsible for 61%. I also assumed there was the same 10% discrepancy between the data and the US Census reports as in the 2000 Inventory. I applied these figures to the data:
2314507.96 kWh * .61 = 64640672.0513 kWh *.10 = 6464067 kWh: 64640672.0513 kWh - 6464067 kWh = **58176604.8462 total kWh commercial**
5125911 therms * .61 =3117480.09344 *.10 = 311748.009344: 3117480.09344 - 311748.009344 = **2805732.0841 total therms commercial**
Electricity co-efficients are based on PG&E report to the California Energy Commission for year 2005. 2006 numbers are not yet available.
Propane numbers were received from Amerigas and Sequoia. Amerigas figures were divided by three to account for the three sectors, commercial, industrial, and residential. Sequoia figures were divided by two to account for commercial and industrial.
Amerigas= 2500/3 = 833.33
Sequoia= 72,000/2 = 36000
Commercial = 833.33 + 36000 = 36833.33

Electricity	**KWh**	**CO_2 (tons)**
2000	64,391,506	23,472
2006	58,176,605	14,253
Difference	-6,214,901	-9,219
Percent Change	-10%	-39%
Natural Gas	**Therms**	**CO_2 (tons)**
2000	2,067,624	12,774
2006	2,805,732	17,334
Difference	738,108	4,560
Percent Change	36%	36%
Propane	**Gallons**	**CO_2 (tons)**
2000	1,067	7
2006	36,833	249
Difference	33,632	242
Percent Change	3,352%	3457%

Reductions in CO_2 emissions are a result of the cleaner grid mix provided by PG&E. See page 4 for more discussion on this. The 2000 Inventory did not include propane data from Sequoia, though Sequoia is the largest propane dealer in the City of Arcata. The resulting propane emissions had a less than 1% impact on the total emissions, though they do have an impact on the individual sectors.

Industrial

2000-2006 Inventory Comparison at a Glance

Sector			2000	2000	2006	2006	% Change	% Change
	Source	Unit	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)
Industrial	NG	Therms	1,140,922	7,049	1,821,792	11,255	60%	60%
Industrial	Electricity	KWh	47,075,722	17,160	50,590,852	12,395	7%	-28%
Industrial	Propane	Gallons	1,067	7	36,833	249	3352%	3457%
Industrial	Fuelwood	Tons	14,059	1,458	6,500	563	-54%	-61%
Total				25,674		24,462		-5%

The large increase in propane consumption is a result of different data collection methods between the 2000 and 2006 Inventory, see page 8 for further discussion. There was a large increase in industrial natural gas consumption. Sun Valley Floral Farms had a large increase in their operations, which could likely be one of the explanations for the spike in natural gas usage. The reduction in CO_2 from electricity usage is due to a cleaner PG&E grid mix.

Industrial

Humboldt Flakeboard

The North Coast Unified Air Quality Management District (NCUAQMD) keeps burn permits on file for all industries that use wood burning for energy. Humboldt Flakeboard was the only facility in Arcata city limits that uses biomass for an energy source. NCUAQMD provided the information in tons of wood burned / year. Kerry Bartlett at the Humboldt Flakeboard plant informed me that the biomass they use in the boilers is leftover shavings from processed wood, so I classified the biomass as dry.

Fuel Wood	Tons	CO_2 (tons)
2000	14,059	1,458
2006	6,500	563
Difference	-7,559	-895
Percent Change	-54%	-61%

The 2000 Inventory data was for Louisiana Pacific. That mill is no longer operating, but in its place Humboldt Flakeboard has sprouted up. Therefore, this data is not a direct comparison. In addition, the 2000 Inventory included numbers for residential fuel wood consumption, and I was not able to find those numbers for this Inventory. However, the total emissions from residential fuel wood consumption constitute less than 1% of the total emissions, so I considered the fuel wood contribution de minimus.

Industrial

PG&E Accounts

The data I received in 2006 did not separate commercial and industrial customers. Using the figures from the 2000 Inventory, I assumed that industrial was responsible for 39% of the demand, and commercial was responsible for 61%. Agricultural data was included with industrial. I also assumed there was the same 10% discrepancy between the data and the US Census reports as in the 2000 Inventory. I applied these figures to the data:
106285308 * .39 = 41644636 * .10 = 4164463: 41644636 - 4164464 = 37480172 + (14567422 agricultural kWh- (14567422*.1)) = **50590852 kWh total industrial**
5125911 therms * .39 = 2008431 * .10 = 200843: 2008431 - 200843 = 1807588 + (15782 agricultural therms -(15782 * .10)) = **1821792 total therms industrial**
Propane numbers were received from Amerigas and Sequoia and split as in the commercial sector.
Amerigas= 2500/3 = 833.33
Sequoia= 72,000/2 = 36000
Commercial = 833.33 + 36000 = 36833

PG&E Accounts

Electricity	**KWh**	**CO_2 (tons)**
2000	47,075,722	17,160
2006	50,590,852	12,395
Difference	3,515,130	-4,765
Percent Change	7%	-28%
Natural Gas	**Therms**	**CO_2 (tons)**
2000	1,140,922	7,049
2006	1,821,792	11,255
Difference	680,870	4,206
Percent Change	60%	60%
Propane	**Gallons**	**CO_2 (tons)**
2000	1,067	7
2006	36,833	249
Difference	33,632	242
Percent Change	3,352%	3457%

The propane consumption did not increase as dramatically as this graph would indicate. The 2000 Inventory did not include figures from Sequoia, a major provider in Arcata. I did include these numbers for the 2006 Inventory, and so it appears as though the propane usage skyrocketed. The contribution of propane emissions is less than 1% of total community emissions, however, and was considered de minimus. The large increase in natural gas consumption could be due to the increase in size of Sun Valley Floral Farms, the largest industrial customer in the City of Arcata. The reduction in CO_2 emissions from electricity is a result of the increased cleanliness of the PG&E grid mix.

Transportation
2006-2006 Inventory Comparison at a Glance

Sector		2000	2000	2006	2006	% Change	% Change
	Unit	Recorded	CO_2 (tons)	Recorded	CO_2 (tons)	Recorded	CO_2 (tons)
Community Transportation	AVMT	55,005,500	37,809	52,768,050	34,465	-4%	-9%
Transportation of Waste	AVMT	207,255	464	180,600	349	-13%	-25%
Totals			38,273		34,814		-9%

The transportation data was the most difficult to calculate. There was no realistic data available for the 2006 Inventory. Through speaking with ICLEI, it was recommended that I use the CalTrans Highway Performance Monitoring System data. Because the data had VMT levels that were 2/3 less than the 2000 Inventory, I updated the original Inventory for comparative purposes using the same database. One result of the updated transportation data is that commercial energy usage now accounts for more of the greenhouse gas emissions in the City of Arcata then the transportation sector. Though this is an attractive concept, as it is much easier to address commercial energy consumption with technology retrofits and business practices then it is to get people out of cars, it is not clear how realistic this is. Transportation data is clearly very sensitive to assumptions. As the transportation sector is such a large part of the emissions, the City of Arcata is working to establish a permanent and repeatable method for quantifying transportation data. Also accounted for in the transportation sector is the transportation of solid waste from Arcata. All the solid waste created in Arcata is shipped to either southern Oregon or the Redding area. This shows the need for reducing waste in affecting greenhouse gas emissions in our community.

Transportation

Community Transportation

Conversations with ICLEI revealed that the preferred method for transportation data comes from the Highway Performance Monitoring System (HPMS). The numbers given by the HPMS data varied quite significantly from the numbers reported in the 2000 Inventory and the numbers that would have been reported in the 2006 inventory. After discussion with ICLEI and Doby Class, Director of Public Works at the City of Arcata, I decided to report the HPMS figures in place of the Fehr and Peers figures, as they seemed to accurately model traffic volumes. Hence, for the purposes of the updated Inventory, I have changed the historical 2000 data using HPMS year 2000 data obtained from the HPMS website, http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php. The original inventory will remain unchanged, but the numbers need to be updated for the current report so there can be a comparative analysis of transportation based GHG emissions.
I took the reported daily vehicle miles traveled (DVMT) miles and multiplied them by 365 to get annual vehicle miles traveled (AVMT). Contrary to ICLEI recommendations, I have not included highway mileage in these figures, as the City of Arcata does not have jurisdictional control over the highway, and cannot therefore impact emissions meaningfully.

		MAINTAINED MILES			DAILY VEHICLE MILES OF TRAVEL (DVMT) [1,000]		
COUNTY	JURISDICTION	RURAL	URBAN	TOTAL	RURAL	URBAN	TOTAL
HUMBOLDT							
CITIES	ARCATA	0.00	68.69	68.69	0.00	144.57	144.57
	BLUE LAKE	6.70	0.00	6.70	3.22	0.00	3.22
	EUREKA	0.00	126.26	126.26	0.00	353.60	353.60
	FERNDALE	8.66	0.00	8.66	4.32	0.00	4.32
	FORTUNA	0.72	46.28	47.00	0.68	86.50	87.18
	RIO DELL	10.09	2.91	13.00	8.77	2.23	10.99
	TRINIDAD	5.60	0.00	5.60	3.49	0.00	3.49
OTHER	BUREAU OF INDIAN AFFAIRS	202.10	0.00	202.10	13.53	0.00	13.53
	COUNTY (UNINCORPORATED)	1,095.53	109.53	1,205.06	482.74	222.27	705.01
	INDIAN TRIBAL NATION	0.20	0.00	0.20	0.07	0.00	0.07
	NATIONAL PARK SERVICE	12.95	0.00	12.95	4.39	0.00	4.39
	STATE HIGHWAY	289.80	47.26	337.06	1,220.49	1,017.55	2,238.04
	STATE PARK SERVICE	96.86	0.00	96.86	10.22	0.00	10.22
	US FISH & WILDLIFE SERVICE	1.41	0.00	1.41	0.49	0.00	0.49
	US FOREST SERVICE	321.47	0.00	321.47	9.64	0.00	9.64
HUMBOLDT Total		2,052.09	400.93	2,453.02	1,762.06	1,826.72	3,588.78

Table from CalTrans HPMS, found online at http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php, 10/30/2007

2000 MAINTAINED MILEAGE & DAILY VEHICLE MILES OF TRAVEL ESTIMATES BY JURISDICTION

COUNTY	MAINTAINED MILES			DVMT (1000)		
	JURISDICTION	RURAL	URBAN	TOTAL	RURAL	URBAN	TOTAL
HUMBOLDT							
	ARCATA	0.0	67.1	67.1	0.0	150.7	150.7
	BLUE LAKE	6.7	0.0	6.7	4.0	0.0	4.0
	EUREKA	0.0	126.0	126.0	0.0	349.2	349.2
	FERNDALE	8.7	0.0	8.7	5.4	0.0	5.4
	FORTUNA	0.0	47.0	47.0	0.0	91.8	91.8
	RIO DELL	13.0	0.0	13.0	12.2	0.0	12.2
	TRINIDAD	5.6	0.0	5.6	4.7	0.0	4.7
CITIES TOTAL		34.0	240.1	274.0	26.3	591.7	618.0
COUNTY		1,113.9	87.6	1,201.4	598.3	161.5	759.8
HIGHWAY		306.0	31.5	337.5	1,307.5	621.6	1,929.1
STATE PARKS&REC		96.9	0.0	96.9	12.7	0.0	12.7
USBIA		202.3	0.0	202.3	17.7	0.0	17.7
USFS		310.5	0.0	310.5	12.2	0.0	12.2
USNPS		33.5	0.0	33.5	6.9	0.0	6.9
HUMBOLDT COUNTY TOTAL		**2,096.9**	**359.1**	**2,456.0**	**1,981.6**	**1,374.8**	**3,356.4**

Table found from archived HPMS data at:
http://www.dot.ca.gov/hq/tsip/hpms/hpmsarchives.php

2000: 150.7 * 1000 * 365 = 55,005,500
2006: 144.75 * 1000* 365 = 52,833,750

Transportation	AVMT	CO_2 (tons)
2000	55,005,500	37,809
2006	52,768,050	34,465
Difference	-2,237,450	-3,344
Percent Change	-4%	-9%

Transportation

Solid Waste Transportation

The solid waste in Arcata is shipped to two different landfills, either Dry Creek in Southern Oregon or Anderson by Redding, CA. I calculated the associated transportation emissions based on the amount of garbage sent to each landfill. This information was obtained from Karen Sherman at Humboldt Waste Management Authority (HWMA).

Anderson:
With 2/3 of 12,417 tons going to Anderson, that means: 8,278 tons going to Anderson. 8,278 tons divided by truck capacity of 24.1 tons means 344 trips. 160 miles, multiplied by two for round trip, means 320 miles per trip. 344 trips times 320 miles means **110,080 total miles to Anderson a year.**

Dry Creek:
1/3 of waste goes to Dry Creek. 1/3 of 12, 417 is 4,139 tons going to Dry Creek. 4,139 divided by 24.1-ton capacity of truck means 172 trips to Dry Creek. Dry Creek is 205 miles away, so 410 miles round trip. 172 trips multiplied by 410 miles = **70,520 miles traveled**.

Transportation of solid waste	Miles	CO_2 (tons)
2000	207,255	464
2006	180,600	349
Difference	-26,655	-115
Percent Change	-13%	-25%

The difference in mileage between 2000 and 2006 is due to the fact that the original Inventory calculated mileage only to Dry Creek, which is further away then Anderson. The change in emissions is due to slightly improved gas mileage in the trucks compared to 2000. The 2000 Inventory recorded 5 MPG, while for this Inventory we calculated 5.5 MPG based on information from HWMA.

Solid Waste

2006-2006 Inventory Comparison at a Glance

Sector		2000	2000	2006	2006	% Change	% Change
	Unit	Produced	CO_2 (tons)	Produced	CO_2 (tons)	Produce	CO_2 (tons)
Waste	Tons	12,183	2,108	12,417	2,149	2%	2%

All of the solid waste created in the City of Arcata is shipped to either Dry Creek in Oregon or Anderson near Redding. Because the landfills are managed outside of the County, the City has little input as to the methane recovery practiced at these sites. The landfill in Dry Creek claims a very competitive recovery rate, but the landfill in Anderson has no methane recovery as of 2006. However, Anderson landfill is installing a very competitive methane recovery system for generating electricity from methane. This system went online in 2007, and the landfill managers expect to obtain very high methane recovery rates. In terms of limiting emissions associated with waste, the City can control the creation of waste. The new curbside recycling program implemented 2007 will likely have a positive impact on the volume of recycling, and hopefully there will be an associated reduction of waste tonnage. Less tonnage of waste also means less waste to be shipped out of the County, and a reduction in emissions associated with solid waste transportation.

Solid Waste

Community Solid Waste

Information obtained from Karen Sherman with the HWMA over the phone (268-8680).
Tons of garbage: from tipping station: **11,687** (extrapolated from total of 104,240 for County.) Including tonnage from Kernin, Arcata totals are **12,417 tons.** The solid waste in Arcata is sent to two separate locations, and each practice different methods of methane recovery.

Methane recovery factor:
Dry Creek obtains a competitive methane recovery rate of 87%. Currently methane is flared, but micro turbines will go on line soon. (Information obtained from phone conversation with Dry Creek landfill management.) 1/3 of waste goes to Dry Creek landfill. **4,139 tons of waste to Dry Creek.**

Anderson Valley installed a great landfill gas collection system in 2006-2007, which obtains around 75-85% of the landfill gas. Currently they flare. Unfortunately, prior to December 2006, the landfill released their landfill gas to the atmosphere. (Information obtained from phone conversation with Greg Johnson, 530-347-5236). Currently, 2/3 of waste goes to Anderson. This means that 2/3 of 12,417 tons of garbage have no methane treatment system. **8,278 tons of garbage to Anderson.**

To obtain methane recovery rate, I calculated a weighted average:
[(4,139/12,417)(.87)]+[(8,278/12,417)(0)]= .29 percent recovery rate

Waste Characterization
2000 Inventory used a waste characterization study from the State and from Arcata, and then assumed the figures for Arcata were still consistent, though outdated (1990.)

Waste	Tons	CO_2 (tons)
2000	12,183	2,108
2006	12,417	2,149
Difference	234	41
Percent Change	2%	2%

Other

Methane emissions from cows

I spoke with Alan Bauer from the UC Davis cooperative extension (445-7351.) He did not have any more recent data then was used in the 2000 Inventory, nor did he have any indicator data that could explain growth or decay in the agricultural industry within city limits. It was determined that methane emissions from cattle will contribute less than one percent of total GHG emissions. Therefore, this item was designated De Minimus, and the same numbers from the year 2000 were used.

60,310 kg of methane

Municipal

2000-2006 Inventory Comparison at a Glance

Sector			2000	2000	2006	2006	% Change	% Change
	Source	Unit	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)	Purchased	CO_2 (tons)
Municipal Energy	NG	Therms	37,584	232	33,533	207	-11%	-11%
Municipal Energy	Electricity	KWh	2,049,015	431	2,725,751	668	33%	55%
Municipal Fleet	Miles	AVMT	439,494	339	440,151	331	<1%	-2%
Public Transit	Miles	AVMT	101,538	197	120,000	232	18%	18%
Sewage Gas	Methane	Tons	2.15	50	2.22	51	3%	2%
Totals				1,228		1,539		25%

In 2000, the City purchased electricity through direct access agreements with the Association of Bay Area Governments. ABAG guaranteed minimum 20% of the electricity mix to come from renewable energy sources. ABAG dissolved the electricity portion of their energy services soon after 2000, and the City was forced to switch to PG&E, as at this time direct access laws had been repealed, and only those customers with existing contracts could continue the direct access arrangement. PG&E has made significant improvements in the cleanliness of the grid mix they provide, but they still guarantee only 13% renewable energy sources, as compared with ABAG's 20% guarantee. As a result, City emissions from electricity consumption have increased by 55%, where consumption has only increased by 30%. This conundrum exemplifies the importance of electricity procurement decisions in affecting greenhouse gas emissions. The increase in electricity consumption is largely due to the water sector; increased water consumption and increased pumping demands at the wastewater treatment plant. The City has been working for many years to upgrade existing facilities, and has achieved a 20% reduction in energy use in those buildings that have been upgraded. The City is also working hard to address energy consumption in the water sector, through improving motors to premium efficiency and selecting variable frequency drives where appropriate. A capital improvements plan has been put into effect to upgrade existing infrastructure, largely responsible for water infiltration into the system and increased pumping. In addition, the City is still researching feasible areas to improve their existing renewable energy generation capabilities. The increase of public transportation usage in the City is an excellent trend, which is worth noting. Additionally, the supervisor of the Arcata transit system is investigating fuel saving options.

Municipal

City of Arcata energy usage

Ivan Marruffo at PG&E contributed data from 1/2006-12/31/2006. Electric data was accumulated in three separate areas. Coefficients for electricity production were obtained from ICLEI and reflect the reports of PG&E.
Propane figures were received from Amerigas in Arcata, CA. Solar figures were drawn from the interactive data display at City Hall. I took the total number of kWh produced since the panels were installed, divided that by the number of months the system has been in place to get a monthly figure, and then multiplied that by 12 for an annual figure.

The emissions from electricity seem to have increased drastically between 2000 and 2006, even though this change is not well mirrored by actual consumption. This is due to the switch in service providers. In 2000, the City purchased electricity from an independent provider, the Association of Bay Area Governments (ABAG) who guaranteed 20% renewable energy. Now the City is with PG&E, which provides a clean mix of electricity, but does not guarantee 20% renewable energy. With natural gas consumption, it is clear that the City has reduced consumption overall. A series of energy retrofits conducted between 2003-2006 are likely the cause of reduced consumption in both kWh and therms. This disconnect between consumption and emissions exemplifies the importance of procurement decisions in promoting renewable energy and reducing greenhouse gas emissions.

City Electricity	Buildings	Streetlights	Water	CO_2 (tons)
2000	448,279	389,423	1,211,313	431
2006	416,948	474,025	1,834,778	668
Difference	-31,331	84,602	623,465	237
Percent Change	-7%	22%	51%	55%

City Natural Gas	Therms	CO_2 (tons)
2000	37,584	232
2006	33,533	207
Difference	-4,051	-25
Percent Change	-11%	-11%

The main reductions were achieved in the buildings sector, as the City implemented a broad capital improvements plan in the year 2005 to improve the efficiency of buildings. Meanwhile, increased street lighting in town has resulted in a large increase in this area. Additionally, there has been a very large increase in the electricity usage from the water sector. This is probably a combination of factors. For one, increased growth and therefore usage of the City water system would be reflected here, due to increased pumping. Also, the City installed a freshwater pump that now supplies 15% of the water for the City, but uses a lot of electricity.

Municipal

Transportation

Arcata Transit
Information from Larry Pardi, Transportation Superintendent at the City of Arcata. Mileage includes 'dead miles' from buses traveling to and from Eureka (where they are parked) each day.

Mad River Transit

	Miles	CO_2 (tons)
2000	101,538	176
2006	120,000	232
Difference	18,462	56
Percent Change	18%	32%

City of Arcata Fleet

Information obtained from Randy Flint and Lori at the City of Arcata Central Garage. Mileage is recorded for each vehicle, as well as gasoline consumption and cost of maintenance.

Municipal Fleet

2000	**Gallons**	**Miles**	**CO_2 (tons)**
Diesel	9,219	Diesel/ unleaded 437,409	
Unleaded	23,724		
CNG		2,085	
Total, 2000		**439,494**	**339**
2006			
Diesel	22,226	39,114	
Unleaded	75,441	366,262	
CNG	685	11,855	
Hybrid	469	22,043	
Propane		746	
Biodiesel		131	
Total, 2006		**440,151**	**331**
Difference		**657**	**-8**
Percent Change		**>1%%**	**-2%**

The City purchased several hybrids in 2003. These vehicles have supplemented much of the usage of non-hybrid cars. This is likely why there is only a 14% increase in CO_2 emissions, while there is a 22% increase in mileage.

Municipal

Water / Wastewater

EPA estimates that for 4.5 MGD flow, an estimated 45,000 scf of methane gas can be expected. These estimates hold when compared to the City of Eureka, which treats 4.5-5 MGD and produces around 45,000 scf/day of gas production. Using data obtained from Erik Lust at the City of Arcata WWTP, an average of the summertime flows was taken to estimate 1.3 MGD treated influent. Though flows can be as high as 3 MGD in the wintertime, much of this is assumed to be infiltration through old infrastructure of storm water, and not actually wastewater. This would indicate that high flows do not also mean higher gas production. Therefore, the summertime average flow was used in calculating the gas, and an average 13,000 scf/day is assumed. This number is within 3% of the number used for the 2000 Inventory. Both the US EPA and the IPCC consider methane from wastewater treatment to be of bio-genic origin, and do not count the CO_2 emissions resulting from combustion of biomethane as a contribution to greenhouse gasses. However, most flares that combust methane to convert it to CO_2 are assumed to have a 95% efficiency (US EPA), and the 5% of the biomethane that escapes combustion is reported as the global warming potential (GWP) is so high.
The 2000 Inventory counted the 50% of methane gas that was combusted in the flare as a contribution to GHG emissions. I have therefore updated the numbers of the 2000 Inventory to be consistent with the EPA and IPCC approach: see below.

13,000 f^3 / day * 365 days / year = 4,745,000 f^3 / methane a year
4,745,000 * .5 = 2,372,500 f^3 of methane combusted in the flare each year
2,372,500 f^3 methane*.05=118,625 f^3 methane escaped from combustion
118,625 f^3 methane* 1 m^3/ 35.315 f^3 * (662 g / m^3)[2] * 1 ton / 1,000,000 g = 2.22 tons methane
According to the Energy Information Administration of the US Government, the Global Warming Potential of methane is 23 times that of CO_2, so I multiplied the tonnage of methane by 23 to calculate the eCO_2.

2.22 tons methane * 23 (GWP of methane) = 51 tons eCO_2

2000 Inventory update:

4,594,425 f^3 methane * .5 = 2,297,212.5 f^3 of methane combusted in the flare annually
2,297,212.5 * .05 = 114,861 f^3 escaped from combustion
114,861 f^3 methane * 1 m^3/ 35.315 f^3 * (662 g / m^3) * 1 ton / 1,000,000 g = 2.15 tons methane

2.15 tons methane * 23 (GWP of methane) = 50 tons eCO_2

Sewage Gas

	Methane (tons)	eCO_2 (tons)
2000	2.15	51
2006	2.22	50
Difference	.07	1
Percent Change	3%	2%

[2] Density of sewage methane gas, from the US EPA.