APPENDIX K

GLOBAL CLIMATE CHANGE

APPENDIX K: GLOBAL CLIMATE CHANGE

The focus of the inventory of community greenhouse gas emissions is on activities that directly produce greenhouse gas emissions, or on the direct consumption of energy (which indirectly produced greenhouse gases). It is these types of local activities that can most effectively be addressed by community-level emission reduction strategies, and advance progress toward the most measurable reduction targets. Specifically, this inventory addresses:

- Transportation GHG emissions
  - Automobile and truck petroleum combustion within the City and by commuters
  - Aircraft fuel (Jet A and aviation gasoline) combustion by aircraft flying into and out of Santa Barbara Airport
- Residential, Commercial and Industrial energy consumption
  - Electricity consumption (indirect GHG emissions)
  - Natural gas consumption (direct GHG emissions)
  - Construction vehicle petroleum combustion
- Water, waste and wastewater GHG emissions
  - Wastewater treatment (direct GHG emissions [primarily methane])
  - Solid waste decomposition (direct GHG emissions [primarily methane])
  - Energy consumption for State Water Project water pumping (indirect GHG emissions from electricity consumption])

The methodology used for this inventory does not currently include energy embedded in consumer goods imported from outside the community (e.g., automobiles, most consumer products, most of the City's food, etc.), nor does it include the potential for capture and storage of carbon by living plants (called biomass sequestration). Wood burning, while a significant contributor to particulate emissions, is considered to be essentially carbon neutral and is not considered here[1]. As is the case for the rest of southern California, wood burned for heating fuel in Santa Barbara is typically sourced from industrial softwood reforestation projects and orchards in northern California and Oregon. The CO_2 coefficient for burning such "fuelwood" is generally considered to be zero. Carbon released from burning wood cycles in and out of the atmosphere very quickly when viewed on the geologic time-scale of the carbon contained in fossil fuel. It is generally thought that the equivalent amount of carbon released by burning is re-sequestered in growing plant material, assuming that the ability of vegetation to perform this task is remaining stable (City of Eugene 2008)[2].

The year 2007 was selected as the existing environmental setting as this is the most recent year for which comprehensive data were available, and provides a snapshot of the current emissions setting. Emissions from the year 2004 were calculated and compared to 2007 to ensure that baseline data was not anomalous; the comparison revealed no anomaly in 2007 data and the 2004 analysis was not carried forward.

[1] Worldwide, wildfires release an amount of carbon dioxide into the atmosphere equal to 50 percent of that from combustion of fossil fuels (Bowman et al 2009).

[2] Though there is ongoing debate about the sequestration ability given the changing nature of forest and vegetation, for this inventory we have accepted the assumption. in the CACP software model of a net zero GHG impact of wood burning.

Greenhouse Gas Analysis Data Sources and Assumptions

Modeling Software

This analysis utilized the program CACP 2009 version 2.1, which is available to member Cities from ICLEI-Local Governments for Sustainability. This software package applies standard coefficients derived from Federal and State agencies to estimate CO_2 equivalents (CO_2e) from all major greenhouse gases, with the exception of water vapor.

Population

City populations for 2004 and 2007 were taken from estimates prepared by the California Department of Finance. The 1990 population was obtained from U.S. Census. Populations for the year 2030 were based on projected residential development under *Plan Santa Barbara* and alternatives and the existing number of persons per residence.

Electricity Consumption and GHG Emissions

Table K-1. Conversion of SCE Rate Classes into Sectors for Plan Santa Barbara Analysis

SCE Rate Class	SCE Description of Rate Class	Assigned *Plan Santa Barbara* Sector
AG TOU	Where 70% or more of demand is for agricultural purposes	*Agriculture*
Domestic	All residential service	*Residential*
GS-1, GS-2	General service whose monthly maximum demand is expected to exceed 20 kW (GS-1) or between 200 kW and 500 kW (GS-2)	*Small Commercial (GS-1) and Moderate to Large Commercial (GS-2)*
TOU-8	General service whose monthly maximum demand exceeds 500 kW	*Industrial*
Street Lighting, TC-1	Lighting of streets, highways and publicly-owned and publicly-operated parking lots where SCE owns and maintains the equipment (Street Lighting); Traffic signal systems and some thoroughfare lighting (TC-1)	*Street Lighting and Traffic Control*

Source: SCE 2009

Although the emissions from electricity generation do not occur within the City, the City's electricity consumption results in GHG emissions at the generation site which would not have otherwise occurred. Existing and future energy consumption within the City was calculated in several different ways, depending on the availability of data. For electricity and natural gas consumption, total consumption was available for the years 1990 and 2007, and consumption by sector was available for 2007. This data was sourced from Southern California Edison. Electrical consumption was broken down in a way which required conversion into residential, commercial and industrial sectors. This conversion is displayed in Table K-1. The additional electricity and that would occur in the City as a result of development under *Plan Santa Barbara* policies or alternatives was based on the projected development and existing per unit (residential) or per square foot (commercial and industrial) consumption rates. Because the energy efficiency of future construction is expected to be greater than current construction, use of these rates produces a conservative estimate of future energy consumption.

1990 electricity consumption was only available as a total for the City and was broken into sectors based on historic change in usage for each sector as identified by the City in the Development Trends Report. Industrial sector electricity consumption includes consumption for agriculture and agricultural water pumping.

2007 GHG emission coefficients were based on SCE-specific factors which are included in the CACP 2009 software, and which were reported by SCE. SCE-specific factors were not available for 1990; therefore, California Grid Average coefficients were used for this year. California Grid Average coefficients are currently higher than SCE-specific coefficients, so it is possible that the use of these coefficients may inflate the 1990 values for GHG emission from electrical consumption. However, in 1990 it is assumed that most renewable sources had not yet come online and that SCE's coal-fired Mohave Generation Station in Nevada was contributing a significant amount of power to SCE's grid. Therefore, it is expected that SCE's coefficients from 1990 would be much closer to the California Grid Average than they are currently.

Natural Gas Consumption and GHG Emissions

Natural gas consumption data were obtained from Southern California Gas for Years 2000-2007, (broken down into residential, commercial and industrial sectors). Values for 1990 were "backcasted" from the available data, assuming constant rates of change. Future consumption rates under *Plan Santa Barbara* and alternatives were based on the projected number and types of development (i.e., number of single family units, number of multiple family units). These calculations assumed that the per unit consumption rates for these different types of units would remain the same as existing; since efficiency is likely to improve by the year 2030 this results in a conservative estimate.

Transportation Fuels Consumption and GHG Emissions

Automobile oil and gasoline consumption rates were based on the baseline traffic model produced for *Plan Santa Barbara*. This model was for 2008 traffic, but was assumed to be similar enough to 2007 traffic to be interchangeable. This model generated Vehicle Miles Traveled (VMT) for trips inside the City, commute trips to and from the City, and trips to and from the City for non-commute reasons. This traffic model accounts for the effects of proposed *Plan Santa Barbara* policies to reduce trip generation and VMT, but does not take into account the potential effect on commute trips from potential changes in provision of affordable housing or the overall jobs/housing balance in the City. The model includes trips generated by projected development in the City's sphere of influence, which slightly inflates the GHG emissions.

This VMT data was combined with the statewide fleet-wide fuel economy and vehicle mix described in the Caltrans MVSTAFF report (Caltrans 2008) and fuel consumption was calculated for diesel and gasoline. Future consumption under *Plan Santa Barbara* or alternatives was based on the *Plan Santa Barbara* traffic model's projected VMT and the Caltrans MVSTAFF report's predicted fleetwide fuel economy and vehicle mix for the year 2030.

Aircraft fuel consumption for 2007 was taken from the Board of Supervisors packet for August 26, 2008, which obtained 2005 data from the UC Santa Barbara Economic Forecast Project's Annual Economic Outlook for Santa Barbara County. 2007 consumption rates were assumed to be substantially the same as 2007 and were used without alteration. Because the original data was county-wide, consumption by or for City residents and those visiting the City were estimated to be 50% of county-wide aircraft fuel consumption. Because this fuel consumption represents all fuel taken on at Santa Barbara Airport, it includes fuel that is burned outside Santa Barbara airspace. This generates a conservative estimate of City energy consumption. Future aircraft oil and gasoline consumption rates were projected based on the current per capita consumption rate and the projected population increase under *Plan Santa Barbara* and alternatives.

Based on California Air Resources Board Guidance, 1990 values for transportation GHG emissions were considered to be 15% lower than 2007 values. A lack of reliable data prevented the 1990 analysis from being as detailed as that performed for 2007.

Landfill Gas Emissions

Total landfill deposits at Tajiguas Landfill and those exported to other regional landfills were obtained from California Integrated Waste Management Board's (CIWMB's) Disposal Reporting System (http://www.ciwmb.ca.gov/LGCentral/DRS/). Waste stream characterization for 1990 was unavailable so data were used from FY 1997/1998 (County of Santa Barbara 2001). This most likely overestimates the amount of waste diversion that was occurring in 1990, but provides a conservative estimate of GHG emissions as compared to 2007.

Projection of GHG emissions from landfill decomposition assumes that waste diversion in 2030 would remain the same as currently exists (approximately 70 percent diversion, per City staff), and that per capita solid waste generation rates would also remain the same as at present. Future solid waste disposal quantities are based off projected population growth and the existing per capita solid waste generation rate, which accounts for both residential and non-residential growth. Calculations of decomposition emissions utilize the factors in the CACP 2009 software package.

The calculated emissions are only for the waste generated that year; decomposition emissions from waste that was disposed of in prior years (including those from the former Las Positas landfill) are not included. This GHG analysis does not account for combustion of landfill gases associated with the methane fuel cell at Tajiguas Landfill, thus providing a conservative estimate of GHG emissions. The waste stream and total waste disposed was input into the CACP software, which uses standard emission factors for different waste types to generate a total GHG emission value. Emissions for the year 2030 under *Plan Santa Barbara* and alternatives assumed that per capita waste generation and the waste stream characterization would be the same as existing; any increase in GHG emissions is related to increased population.

Emissions from Energy Used in Water Pumping

Because the energy used to pump water within the City and treat wastewater at El Estero Wastewater Treatment Plant are included in the City electricity and natural gas figures, only energy used to transport water to the City boundaries are included in this calculation. Specifically, the GHG emissions from the energy used to transport the City's share of State Water Project water were calculated. Emissions of GHG related to pumping of SWP water to Lake Cachuma were calculated by determining the amount of electricity required to deliver the water from its source in the Delta, approximately 3,000 kWh per acre-foot. The per capita usage of SWP water is assumed to remain the same as existing, which in 2007 was 0.00699 AFY per person. The electricity mix used is that for SCE, although other electricity providers provide the majority of the electricity for pumping.

GHG emissions from water pumping in future years was calculated based on a consistent per capita usage rate and the population projections developed for *Plan Santa Barbara*.

Wastewater Treatment GHG Emissions

The methane produced from sewage biosolids during treatment was calculated for the year 1990. In 2005 the City installed a fuel cell that uses methane from wastewater treatment to generate electricity rather than flaring the methane. Therefore, 2007 emissions assume total capture of methane from wastewater treatment at El Estero Wastewater Treatment Plant; thus, no GHG emissions are reported from wastewater treatment for that year. The amount of methane produced in 1990 was taken from a City press release that was produced for the dedication of the methane fuel cell.

Construction GHG Emissions

Construction emissions calculated using URBEMIS 2007 Version 9.2.4 based on the annual rate of development from 1990-2007 as identified in the Development Trends Report (City of Santa Barbara 2008). Refer to the Air Quality Appendix for a description of how Construction GHG emissions were calculated.

Community Greenhouse Gas Emissions in 2030
Plan Santa Barbara
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector						
Electricity	58,388	2,003	5,281	58,754	18.5	621,473
Natural Gas	85,779	323	16,166	85,999	27.1	1,466,586
Subtotal	144,166	2,326	21,447	144,752	45.6	2,088,059
Commercial Sector						
Electricity	86,678	2,974	7,839	87,222	27.5	922,596
Natural Gas	52,334	197	9,863	52,468	16.5	894,767
Subtotal	139,012	3,171	17,702	139,689	44.0	1,817,363
Industrial Sector						
Electricity	31,857	1,093	2,881	32,057	10.1	339,087
Natural Gas	732	3	28	733	0.2	12,513
Subtotal	32,589	1,096	2,909	32,790	10.3	351,599
Total	315,767	6,593	42,058	317,231	100.0	4,257,021

Community Greenhouse Gas Emissions in 2007
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector						
Electricity	54,213	1,860	4,903	54,553	6.2	577,036
Natural Gas	80,500	303	15,172	80,707	9.2	1,376,344
Subtotal	134,713	2,163	20,075	135,259	15.4	1,953,380
Commercial Sector						
Electricity	76,982	2,641	6,962	77,464	8.8	819,388
Natural Gas	46,459	175	8,756	46,578	5.3	794,325
Subtotal	123,441	2,816	15,718	124,042	14.1	1,613,713
Industrial Sector						
Electricity	29,436	1,010	2,662	29,620	3.4	313,314
Natural Gas	639	2	24	640	0.1	10,924
Subtotal	30,075	1,012	2,686	30,260	3.4	324,238
Transportation Sector						
Diesel	86,724	512	527	86,809	9.9	1,075,530
Gasoline	443,127	57,948	49,198	452,626	51.4	5,671,533
OFF ROAD Aviation Gasoline	3,127	83	5,292	3,195	0.4	42,354
OFF ROAD Jet Fuel	47,654	3,087	2,689	48,160	5.5	561,162
Subtotal	580,632	61,630	57,706	590,791	67.1	7,350,579
Total	868,861	67,622	96,185	880,353	100.0	11,241,910

This report has been generated for Santa Barbara, California using ICLEI's Clean Air and Climate Protection 2009 Software.

Community Greenhouse Gas Emissions in 2030
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation Sector						
Diesel	197,105	1,164	1,198	197,298	17.1	2,444,443
Gasoline	936,507	131,703	111,816	958,095	82.9	11,986,246
Subtotal	1,133,613	132,867	113,015	1,155,394	100.0	14,430,689
Total	1,133,613	132,867	113,015	1,155,394	100.0	14,430,689

Community Greenhouse Gas Emissions in 2030
No Project Alternative
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector						
Electricity	58,388	2,003	5,281	58,754	18.4	621,473
Natural Gas	85,779	323	16,166	85,999	26.9	1,466,586
Subtotal	144,166	2,326	21,447	144,752	45.3	2,088,059
Commercial Sector						
Electricity	88,250	3,027	7,981	88,803	27.8	939,321
Natural Gas	53,293	201	10,044	53,429	16.7	911,164
Subtotal	141,542	3,228	18,025	142,232	44.5	1,850,485
Industrial Sector						
Electricity	31,857	1,093	2,881	32,057	10.0	339,087
Natural Gas	732	3	28	733	0.2	12,513
Subtotal	32,589	1,096	2,909	32,790	10.3	351,599
Total	318,298	6,650	42,381	319,774	100.0	4,290,144

Community Greenhouse Gas Emissions in 2030
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation Sector						
Diesel	199,652	1,179	1,214	199,848	17.1	2,476,025
Gasoline	948,607	133,404	113,261	970,474	82.9	12,141,107
Subtotal	1,148,259	134,584	114,475	1,170,321	100.0	14,617,132
Total	1,148,259	134,584	114,475	1,170,321	100.0	14,617,132

Community Greenhouse Gas Emissions in 2030
Lower Growth Alternative
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector						
Electricity	57,181	1,962	5,172	57,539	18.9	608,630
Natural Gas	84,253	318	15,879	84,469	27.7	1,440,506
Subtotal	141,434	2,279	21,050	142,009	46.6	2,049,136
Commercial Sector						
Electricity	81,830	2,807	7,401	82,343	27.0	870,992
Natural Gas	49,399	186	9,310	49,526	16.3	844,598
Subtotal	131,229	2,993	16,711	131,869	43.3	1,715,590
Industrial Sector						
Electricity	29,837	1,024	2,699	30,024	9.9	317,585
Natural Gas	685	3	26	686	0.2	11,718
Subtotal	30,523	1,026	2,724	30,710	10.1	329,303
Total	303,186	6,299	40,486	304,588	100.0	4,094,029

Community Greenhouse Gas Emissions in 2030
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation Sector						
Diesel	185,752	1,097	1,129	185,934	17.1	2,303,643
Gasoline	882,564	124,117	105,376	902,909	82.9	11,295,838
Subtotal	1,068,317	125,214	106,505	1,088,843	100.0	13,599,481
Total	1,068,317	125,214	106,505	1,088,843	100.0	13,599,481

Community Greenhouse Gas Emissions in 2030

Additional Housing Alternative

Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector						
Electricity	60,579	2,078	5,479	60,959	19.5	644,802
Natural Gas	88,550	334	16,689	88,777	28.4	1,513,976
Subtotal	149,130	2,412	22,168	149,736	47.9	2,158,778
Commercial Sector						
Electricity	81,830	2,807	7,401	82,343	26.4	870,992
Natural Gas	49,399	186	9,310	49,526	15.9	844,598
Subtotal	131,229	2,993	16,711	131,869	42.2	1,715,590
Industrial Sector						
Electricity	29,837	1,024	2,699	30,024	9.6	317,585
Natural Gas	685	3	26	686	0.2	11,718
Subtotal	30,523	1,026	2,724	30,710	9.8	329,303
Total	310,882	6,432	41,603	312,316	100.0	4,203,671

Community Greenhouse Gas Emissions in 2030
Additional Housing
Report by Source

	CO_2 (tons)	N_2O (lbs)	CH_4 (lbs)	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation Sector						
Diesel	161,540	954	982	161,699	17.1	2,003,376
Gasoline	767,527	107,939	91,641	785,220	82.9	9,823,487
Subtotal	929,067	108,893	92,623	946,918	100.0	11,826,863
Total	929,067	108,893	92,623	946,918	100.0	11,826,863