

APPENDIX H

Greenhouse Gas Inventory Modeling

Municipal GHG Inventory

Municipality:	City of Escondido
Inventory Year:	2010

Departmental Breakdown of Emissions

Government Department	Electricity		Natural Gas		Vehicle Fleet		Employee Commute		TOTAL	
	MT CO2e	\$	MT CO2e	\$	MT CO2e	\$	MT CO2e	\$	MT CO2e	\$
CA Center for the Arts	700.58	\$ 459,654.35	827.19	\$ 113,387.08			-	\$ -	1,527.77	\$ 573,041.43
Police	178.06	\$ 98,148.82	43.14	\$ 7,245.54	-	\$ -	764.66	\$ 210,559.05	985.86	\$ 315,953.41
Public Works	93.39	\$ 64,742.52	10.54	\$ 2,116.56	-	\$ -	328.47	\$ 167,502.78	432.41	\$ 234,361.86
Community Center	72.68	\$ 56,660.33	-	\$ -	-	\$ -	-	\$ -	72.68	\$ 56,660.33
City Hall	289.72	\$ 177,970.66	19.67	\$ 3,604.75	-	\$ -	1,072.17	\$ 578,481.81	1,381.56	\$ 760,057.22
Pools	27.19	\$ 15,433.89	147.13	\$ 21,789.97	-	\$ -	323.83	\$ 167,502.78	498.14	\$ 204,726.64
Fire	713.93	\$ 429,487.49	387.81	\$ 56,560.66	-	\$ -	323.56	\$ 129,029.92	1,425.30	\$ 615,078.07
Communications	20.74	\$ 14,603.44	-	\$ -	-	\$ -	-	\$ -	20.74	\$ 14,603.44
Library	159.98	\$ 105,766.90	48.57	\$ 8,743.19	-	\$ -	89.29	\$ 46,667.44	297.83	\$ 161,177.53
Parks and Rec	43.07	\$ 24,821.74	139.40	\$ 21,197.44	-	\$ -	25.26	\$ 22,917.05	207.72	\$ 68,936.23
Water	1,268.42	\$ 881,682.87	1.62	\$ 390.67	-	\$ -	136.88	\$ 69,167.81	1,406.92	\$ 951,241.35
Wastewater	3,115.71	\$ 1,788,880.39	843.27	\$ 116,560.42	-	\$ -	77.45	\$ 37,361.73	4,036.43	\$ 1,942,802.54
Public Lighting	1,543.71	\$ 884,257.74	-	\$ -	-	\$ -	-	\$ -	1,543.71	\$ 884,257.74
Other Sources	95.38	\$ 88,388.64	33.27	\$ 6,244.66	-	\$ -	-	\$ -	128.65	\$ 94,633.30
Department 15	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -
Department 16	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -
Department 17	-	\$ -	-	\$ -	-	\$ -	-	\$ -	-	\$ -
TOTAL	8,323	\$ 5,090,499.78	2,502	\$ 357,840.94	2,739	\$ 740,180.34	3,142	\$ 1,429,190.36	16,705	\$ 6,877,531.08
Solid Waste and Wastewater									1,438	\$ -
									18,143	\$ 6,877,531.08

Other Sources

Solid Waste and Wastewater	N2O (metric tons)	CH4 (metric tons)	CO2e (metric tons)
Generated		56.16285714	1179.42
Owned Landfills		-	-
Wastewater	-	12.31	258.59
TOTAL			1,438.01

Electricity

Instructions: Insert electricity use data for all facilities, streetlights, buildings, and other electric accounts owned/operated by the local government for each department. Also enter the emissions factors for CO2, CH4, and N2O obtained from EPA eGrid or directly from the utility provider. Entering the rate code and associated cost per kWh of gas will allow the calculation of the total cost for each department's electricity use.

Utility Provider:

Emissions Coefficients	lbs/MWh	metric tons/kWh	CH4	GWP
	CO2	546.5		
CH4	0.029	1.31542E-08		310
N2O	0.011	4.98952E-09		

Department	Annual kWh	\$	Metric Tons				CO2e
			CO2	CH4	N2O		
CA Center for the Arts	2805554	\$ 459,654.35	695.46	0.04	0.01	700.58	
Police	713073	\$ 98,148.82	176.76	0.01	0.00	178.06	
Public Works	374006	\$ 64,742.52	92.71	0.00	0.00	93.39	
Community Center	291055	\$ 56,660.33	72.15	0.00	0.00	72.68	
City Hall	1160216	\$ 177,970.66	287.60	0.02	0.01	289.72	
Pools	108876	\$ 15,433.89	26.99	0.00	0.00	27.19	
Fire	2859017	\$ 429,487.49	708.72	0.04	0.01	713.93	
Communications	83075	\$ 14,603.44	20.59	0.00	0.00	20.74	
Library	640646	\$ 105,766.90	158.81	0.01	0.00	159.98	
Parks and Rec	172473	\$ 24,821.74	42.75	0.00	0.00	43.07	
Water	5079528	\$ 881,682.87	1,259.16	0.07	0.03	1,268.42	
Wastewater	12477264	\$ 1,788,880.39	3,092.97	0.16	0.06	3,115.71	
Public Lighting	6181982	\$ 884,257.74	1,532.44	0.08	0.03	1,543.71	
Other Sources	381944	\$ 88,388.64	94.68	0.01	0.00	95.38	
Department 15		\$ -	-	-	-	-	
Department 16		\$ -	-	-	-	-	
Department 17		\$ -	-	-	-	-	
TOTAL	33328709	\$ 5,090,499.78	8261.797019	0.438411919	0.166294	8322.554864	

Natural Gas

Instructions: Insert natural gas use data for all facilities, buildings, and other accounts owned/operated by the local government for each department. Entering the rate code and associated cost per therm of gas will allow the calculation of the total cost for each department's natural gas use.

Utility Provider:

Emissions Coefficients

CO2	52.91	kg/MMBTU	0.005291	metric tons/th	CH4	21
CH4	5	g/MMBTU	0.000005	metric tons/th	N2O	310
N2O	0.1	g/MMBTU	0.0000001	metric tons/therm		

Department	Annual therms	\$	Metric Tons				CO2e
			CO2	CH4	N2O		
CA Center for the Arts	152422	\$	113,387.08	806.46	0.76	0.02	827.19
Police	7950	\$	7,245.54	42.06	0.04	0.00	43.14
Public Works	1942	\$	2,116.56	10.28	0.01	0.00	10.54
Community Center	0	\$	-	-	-	-	-
City Hall	3625	\$	3,604.75	19.18	0.02	0.00	19.67
Pools	27110	\$	21,789.97	143.44	0.14	0.00	147.13
Fire	71460	\$	56,560.66	378.09	0.36	0.01	387.81
Communications	0	\$	-	-	-	-	-
Library	8950	\$	8,743.19	47.35	0.04	0.00	48.57
Parks and Rec	25686	\$	21,197.44	135.90	0.13	0.00	139.40
Water	299	\$	390.67	1.58	0.00	0.00	1.62
Wastewater	155384	\$	116,560.42	822.14	0.78	0.02	843.27
Public Lighting		\$	-	-	-	-	-
Other Sources	6131	\$	6,244.66	32.44	0.03	0.00	33.27
Department 15		\$	-	-	-	-	-
Department 16		\$	-	-	-	-	-
Department 17		\$	-	-	-	-	-
TOTAL	460959	\$	357,840.94	2438.93	2.30	0.05	2501.62

Vehicle Fleet

Instructions: Total fuel use includes off-road vehicles. Cost is based on average price per gallon of gasoline and diesel fuel in California in 2010 and total gallons of fuel used.

Emissions Coefficients

Gasoline	8.81	kg CO ₂ /gallon	0.00881	metric tons CO ₂ /gallon
Diesel	10.15	kg CO ₂ /gallon	0.01015	metric tons CO ₂ /gallon

Average \$/gallon Gasoline:	\$	3.14
Average \$/gallon Diesel:	\$	3.16

		CO ₂ (metric tons)	Total Cost
Total Gasoline (gal)	270279	2381.15799	\$ 848,676.06
Total Diesel (gal)	35289	358.18335	\$ 111,513.24
		2739.3413	\$ 960,189.30

Employee Commute

The values below are based on the Employee Commute Survey. The survey results were extrapolated to estimate emissions from the employee commutes of all City employees.

Emissions Coefficients

Gasoline	8.81	kg CO2/gallon	0.00881	metric tons CO2/gallon
Diesel	10.15	kg CO2/gallon	0.01015	metric tons CO2/gallon

GWP

CH4	21
N2O	310

Department	Survey Responses					All Employees	
	Metric Tons				\$	Extrapolated	
	CO2	CH4	N2O	CO2e	Cost	MT CO2e	Cost (\$)
CA Center for the Arts							
Police	283.54	0.01	0.01	286.28	78,832.00	764.6567375	\$ 210,559.05
Public Works	121.24	0.01	0.01	122.98	62,712.00	328.4749569	\$ 167,502.78
Community Center	-	-	-	-	-	0	\$ -
City Hall	401.41	0.02	0.02	401.41	216,580.00	1072.166001	\$ 578,481.81
Pools	121.24	0.01	0.01	121.24	62,712.00	323.8264202	\$ 167,502.78
Fire	121.14	0.01	0.01	121.14	48,308.00	323.5590211	\$ 129,029.92
Communications	-	-	-	-	-	0	\$ -
Library	33.43	0.00	0.00	33.43	17,472.00	89.28600322	\$ 46,667.44
Parks and Rec	9.46	0.00	0.00	9.46	8,580.00	25.25555563	\$ 22,917.05
Water	51.25	0.00	0.00	51.25	25,896.00	136.8833575	\$ 69,167.81
Wastewater	29.00	0.00	0.00	29.00	13,988.00	77.44957832	\$ 37,361.73
Public Lighting				-		0	\$ -
Other Sources				-		0	\$ -
Department 15				-		0	\$ -
Department 16				-		0	\$ -
Department 17				-		0	\$ -
TOTAL	1,171.70	0.05	0.05	1,176.18	535,080.00	3,141.56	1,429,190.36

Total Computer Respondants	386
Total Escondido Employees	1031
% Response rate	37.4%

Solid Waste

Instructions: Emissions from solid waste come from two sources: the waste generated by the government and the emissions from landfills owned/operated by the government. For generated solid waste, enter the landfill name where the waste is deposited, the total annual tons of waste, and select the landfill's methane recovery system. For the landfills, enter the name and the annual LFG gas collected, then override the default values related to the LFG system if specific values are known.

Generated Solid Waste

Landfill Name	Tons Waste/Year	Methane Recovery System	CH4 Emissions Coefficient (metric tons CH4/ton waste)	Total CH4 Emissions (metric tons)	Total CO2e (metric tons)
Sycamore Landfill	3931.4	Gas-to-Energy	0.3	56.16285714	1179.42
			0	0	0
			0	0	0
			0	0	0
			0	0	0
TOTAL	3931.4			56.16285714	1179.42

EPA

Methane Recovery Systems	metric tons CH4/ton waste
No Recovery	3.1
Flaring	0.64
Gas-to-Energy	0.3

Wastewater Emissions

Digester Gas	295,000
Fraction of methane in Gas	0.61

	CH4/N2O (metric tons)	CO2e (metric tons)
Stationary Methane Emissions	12.31	258.5864686

Stationary Methane Emissions

662	g/m3	Density CH4 at standard conditions
0.99		CH4 Destruction Efficiency
0.0283	m3/ft3	conversion
365.25	days/year	conversion
0.000001	metric ton/g	conversion

CITY OF ESCONDIDO
Greenhouse Gas Emission Inventory
Annual Usage and Generation

Inventory Year: 2010

	Growth Rates	
	2010 to 2020	2010 to 2035
Single Family	2.24%	5.68%
Multi Family	16.49%	46.46%
Average Residential	7.50%	19.80%
Commercial	20.10%	60.98%
Industrial	9.30%	24.84%
Average Non-Residential	16.30%	45.79%

Transportation

On-road Transportation	2005	2010	2020	2035
Annual Vehicle Miles Traveled:	745,048,457	735,247,975	903,409,558	1,219,016,356
Annual Trips:	234,731,758	231,644,061	338,626,654	456,926,126
Average \$/gallon Gasoline:	2.54	3.16		
Average \$/gallon Diesel:	2.61	3.16		

Electricity and Natural Gas

Electricity

SDG&E

Rate Code	Bundled Service		Direct Access
	Annual kWh	\$/kWh	Annual kWh
Residential	277,165,624	\$0.17400	331,233
Commercial	265,359,290	\$0.17400	42,478,455
Industrial	35,900,196	\$0.17400	25,683,447
Street Lighting	5,819,539	\$0.17400	
TOTAL	584,244,649	\$ 101,658,568.93	68,493,135

Electricity Emission Factors		
SDG&E 2005	WECC 2005	Units
546.5	724.1	lbs CO2/MWh
0.011	0.008	lbs CH4/MWh
0.029	0.03	lbs N2O/MWh

Note: SDG&E emission factors used for bundled service and WECC emission factors used for direct access.

Direct Electricity Emissions

	Generation (MWh)	CO2 (tons)	CH4(tons)	N2O (tons)	(eGRID2010 data, year 2007)
Escondido Power Plant	2,897	2473.90	96.98	9.70	
Palomar Energy	3,352,807	1403805.32	55038.75	5503.87	
Total	3,355,704	1,406,279	55,136	5,514	

Natural Gas

	Bundled Service		Direct Access
	therms	\$/therms	therms
Residential	14121490	\$0.94	32053
Commercial	5031767	\$0.78	962676
Industrial		\$0.66	20685344
TOTAL	19153257	\$17,216,184.50	21680073

Area Source Emissions: Landscaping and Woodburning Emissions

Landscaping Emissions

Land use:	2005	2010	
Single Family Residential Units:	29,637	29,163	units
Multi-family Residential Units:	15,853	15,810	units
Commercial Building Space:	17,092	17,092	1000 square feet
Industrial Building Space:	12,389	12,389	1000 square feet

Woodburning Emissions

Homes with wood stoves:	10%	% of residential homes
Amount of wood burned:	0.80	cords/unit
Homes with fireplaces:	10%	% of residential homes
Price of wood:	\$3.50	\$/cord of wood

Water and Waste Water

Metered Water Deliveries

	2005		2010	
	AF	kgal		Cost of Service
SFR	12,500		3,391,821	\$ 14,140,952
Residential/Agricultural			23,313	\$ 97,195
MFR	5,200		1,470,637	\$ 6,131,281
Commercial/Industrial/School	3,355		1,033,789	\$ 4,192,888
Irrigation/Institutional	1,260		650,183	\$ 2,859,805
Landscape District	2,090		23,891	\$ 105,084
Wild Animal Park			182,036	\$ 738,310
Special Unfiltered			188,432	\$ 470,614
Agricultural Use	6,190		218,253	\$ 874,057
SAWR Use			1,042,201	\$ 4,429,012
TOTAL	30,595		8,224,556	\$ 34,039,198

Source	AF
Local Water	3500
Purchased Water	23806

Wastewater Treatment Plant

Digester Gas	295,000
Fraction of methane in Gas	0.61

Solid Waste

Waste Disposal Sites	Name	Mileage (round trip)*	Annual Waste (tons)	Methane Recovery Type	Entity Owned/ Operated?
2010	Sycamore Landfill	26.6	147166	Gas-to-Energy	No
2005	Sycamore Landfill	26.6	161203.86	Gas-to-Energy	No

*Distance from center of area to facilities outside the city boundaries. For facilities within entity boundaries, use the average trip mileage for all trips.

46% Residential
49% Commercial
5.2% Industrial

Construction

CO ₂ (tons from URBEMIS)	
Demolition	260.48
Fine Grading	759.56
Trenching	22.71
Building	956.20
Paving	25.00
Architectural Coating	51.51
TOTAL	2075.46

CITY OF ESCONDIDO
Greenhouse Gas Emission Inventory
Comparison Summary

	2005	2010	2020	Reduced 2020
Transportation				
Mobile Source Emissions	374,454	367,332	418,477	288,916
HFC Emissions	1,315	1,290	1,265	21,746
Sub Total	375,769	368,622	419,741	310,662
Energy				
Electrical Consumption	174,732	170,061	193,232	112,294
Electricity Generation	0	8,286	8,286	8,286
Natural Gas	244,445	217,217	239,507	237,334
Sub Total	419,177	395,565	441,025	357,914
Area Sources				
Landscaping	38,399	37,841	39,192	38,667
Woodburning	14,887	14,718	15,785	15,785
Sub Total	53,287	52,559	54,977	54,451
Water and Wastewater				
Water consumption	28,125	25,102	27,000	21,705
Wastewater Generation	259	259	278	274
Sub Total	28,384	25,360	27,278	21,979
Solid Waste				
Landfill Offgasing	48,361	41,724	47,273	41,061
Sub Total	48,361	41,724	47,273	41,061
Construction				
Construction Emissions	2,288	2,288	2,288	2,059
Sub Total	2,288	2,288	2,288	2,059
TOTAL	927,266	886,118	992,583	788,127

Source	2005	2010	2020 BAU	2020 Reduced
Transportation	375,769	368,622	419,741	310,662
Energy	419,177	395,565	441,025	357,914
Area Sources	53,287	52,559	54,977	54,451
Water and Wastewater	28,384	25,360	27,278	21,979
Solid Waste	48,361	41,724	47,273	41,061
Construction	2,288	2,288	2,288	2,059
Total	927,266	886,118	992,583	788,127

CITY OF ESCONDIDO
Greenhouse Gas Emission Inventory
Comparison Summary

	2005	2010	2035	Reduced 2035
Transportation				
Mobile Source Emissions	374,454	367,332	554,869	271,436
HFC Emissions	1,315	1,290	1,949	20,431
Sub Total	375,769	368,622	556,818	271,436
Energy				
Electrical Consumption	174,732	170,061	236,230	88,181
Electricity Generation	0	8,286	8,286	8,286
Natural Gas	244,445	217,217	278,911	260,828
Sub Total	419,177	395,565	523,427	357,294
Area Sources				
Landscaping	38,399	37,841	41,487	40,068
Woodburning	14,887	14,718	17,665	17,665
Sub Total	53,287	52,559	59,151	57,733
Water and Wastewater				
Water consumption	28,125	25,102	30,664	23,475
Wastewater Generation	259	259	316	304
Sub Total	28,384	25,360	30,980	23,779
Solid Waste				
Landfill Offgasing	48,361	41,724	57,518	41,061
Sub Total	48,361	41,724	57,518	41,061
Construction				
Construction Emissions	2,288	2,288	2,288	2,059
Sub Total	2,288	2,288	2,288	2,059
TOTAL	927,266	886,118	1,230,182	753,363

Source	2005	2010	2035 BAU	2035 Reduced
Transportation	375,769	368,622	556,818	271,436
Energy	419,177	395,565	523,427	357,294
Area Sources	53,287	52,559	59,151	57,733
Water and Wastewater	28,384	25,360	30,980	23,779
Solid Waste	48,361	41,724	57,518	41,061
Construction	2,288	2,288	2,288	2,059
Total	927,266	886,118	1,230,182	753,363

CITY OF ESCONDIDO
Greenhouse Gas Emission Inventory
Modeling Coefficients and Data Assumptions

Standard

0.85 backcasting multiplier
 2204.6226 lbs / metric ton
 1000 kg/metric ton
 1000000 g/metric ton
 0.907 metric tons/short ton
 2000 lbs/ton
 2204.6226 lbs/metric ton
 0.0283 m3/ft3
 365.25 days/year
 0.000001 metric ton/g
 748 gal/ccf
 325,851 gal/acre-foot

GWP

21 CH4
 310 N2O

Transportation

On-Road Vehicles

8.81 kg/gallon CO₂ Gasoline
 10.15 kg/gallon CO₂ Diesel

Source: *California Climate Action Registry General Reporting Protocol, Version 3.1 January 2009 (Table C.3)*

Emfac Settings:

Version : Emfac2007 V2.3 Nov 1 2006
 Scen Years: 2005, 2010, 2020, 2035
 Season : Annual
 Area : San Diego County
 Temperature: 65; Humidity 60%; Sped 30 MPH

Electricity

Emission Factors

SDG&E (2005)	WECC (2005)
546.5	724.1 lbs CO ₂ /MWh
0.011	0.008 lbs CH ₄ /MWh
0.029	0.03 lbs N ₂ O/MWh

Source: *EPA Emissions and Generation Resource Integrated Database (eGRID2007), Version 1.1, December 2007.*

Natural Gas

53.06 kg CO₂/MMBTU
 5 g CH₄/MMBTU
 0.1 g N₂O/MMBTU
 1000 scf = 1Mcf
 0.9649 Mcf/MMBTU
 10 therms/mmbtu

Source: *California Climate Action Registry General Reporting Protocol, Version 3.1 January 2009 (Table C.7)*

Area Sources: Landscaping and Woodburning Emissions

Multifamily

24.55 Acres/property
 0.25 tons/property/day
 0.010183299 tons/acre/day
 24.44 units/acre
0.000416665 tons/unit/day

Single Family

0.0193 tons/acre/day
 3 units/acre
0.00643333 tons/unit/day

Non Residential

2*sqft=acreage
 43560 sqft=1 acre
 21780 sqft/acre
 0.010183299 tons/acre/day
4.67553E-07 tons/sqft/day

Source: *URBEMIS2007 Emissions Estimation for Land Use Development Projects, Version 9.2*

Wood Burning Coefficients and Conversions:

3400 lbs CO₂/ton wood
 2458 lbs in a cord of wood
 316 g CH₄/MMBTU
 4.2 g N₂O/MMBTU
 15.38 MMBTU/ton wood

Source: *EPA AP-42 Emission Coefficients, Fifth Edition, Volume I October 1996 (Section 1.10)*

Water and Waste Water

kWh/MG	Indoor Uses		Outdoor Uses	
	NorCal	SoCal	NorCal	SoCal
Water Supply and Conveyance	2117	9727	2117	9727
Water Treatment	111	111	111	111
Water Distribution	1272	1272	1272	1272
Wastewater Treatment	1911	1911	0	0
Regional Total	5,411	13,021	3,500	11,110

Source: *California Energy Commissions Refining Estimates of Water-Related Energy Use in California, December 2006 (Table ES-1)*

Wastewater Coefficients

Stationary Methane Emissions

662 g/m ³	Density CH ₄ at standard conditions
0.99	CH ₄ Destruction Efficiency

Source: *Local Government Operations Protocol, Version 1.0, September 2008 (Chapter 10: Wastewater Treatment Facilities)*

Process CH₄

0.00003785 l/MG	Conversion
0.6 kgCH ₄ /kgBOD removed	CH ₄ producing capacity (Bo)
0.8 (For anaerobic systems)	CH ₄ Correction Factor
365.25 days/year	Conversion
0.001 metric tons/kg	Conversion

Solid Waste

metric tons CH₄/ton waste

Landfill w/o recovery 3.1
 Landfill w/ Flaring 0.64
 Landfill w/ electric gen 0.3

Source: *EPA Solid Waste Management and Greenhouse Gases; A life-cycle assessment of emissions and Sinks, 3rd edition, September 2006.*