

5B Greenhouse Gas Emissions Inventory: Sources and Methodology

5B.1 INTRODUCTION

Appendix 5B provides additional detail, sources of data, and methodology used to calculate San Joaquin County's greenhouse gas (GHG) emissions for 1990 and 2007 (i.e., unincorporated areas). The following sections of the San Joaquin County Background Report reference this appendix:

- Greenhouse Gas Emissions Inventory (Chapter 5, Climate Change)

5B.2 COUNTY-WIDE GREENHOUSE GAS EMISSIONS

Electricity and Natural Gas

The electricity and natural gas sectors include GHG emissions associated with electricity and natural gas consumption. Electricity consumption generates indirect GHG emissions associated with the production of electricity at a utility provider, while natural gas consumption generates direct GHG emissions associated with natural gas combustion at the end use (i.e., space and water heating). Both electricity and natural gas consumption are attributed to the following subsectors: residential, commercial, and industrial land uses.

2007 Greenhouse Gas Emissions

Electricity and natural gas consumption data for the year 2007 were obtained from three utility providers within the County, including: Pacific Gas & Electric (PG&E), Modesto Irrigation District (MID), and Lodi Electric Utility (LEU). Natural gas is provided solely by PG&E. Electricity and natural gas consumption data for unincorporated areas of the County, as well as County-operated buildings and facilities for the year 2007, were obtained from PG&E. The data provided by PG&E was provided for electricity and natural gas consumption for residential, commercial, and industrial uses. MID provided 2007 electricity consumption data separated by residential, commercial, and industrial uses for unincorporated portions of the County and the Mountain House community. LEU provided 2007 electricity consumption data for two County-operated buildings.

It should be noted that as a result of PG&E's 15/15 Confidentiality Rule, a part of the natural gas consumption associated with industrial land uses has been aggregated into those associated with commercial land uses. According to PG&E's 15/15 Rule, any aggregated information provided by the utilities must be made up of at least 15 customers and a single customer's load must be less than 15 percent of an assigned category. If the number of customers in the compiled data is below 15, or if a single customer's load is more than 15 percent of the total data, categories must be combined before the information is released (e.g., commercial and industrial energy consumption) for customer confidentiality purposes. The 15/15 Rule was triggered for natural gas consumption data received for the unincorporated portions of the County.

The GHG emissions associated with electricity and natural gas consumption were quantified using emission factors from the California Climate Action Registry's (CCAR) *General Reporting Protocol* Version 3.1 (CCAR 2009). The *General Reporting Protocol* contains California-specific emission factors for CO₂, CH₄, and N₂O associated with



electricity consumption. The California-specific emission factors reflect the energy portfolio mix (e.g., renewable energy, fossil fuel combustion) used for electricity production in California. The natural gas combustion emission factors are not geographically-specific because they depend on the type of fuel (i.e., natural gas) combusted or consumed rather than the production processes (which vary regionally for electricity).

1990 Greenhouse Gas Emissions

Electricity and natural gas consumption levels for 1990 are not available from PG&E, MID, and Lodi Electric Utility. Energy consumption levels for 1990 were generated for 2007 using population data from the California Department of Finance (DOF). Electricity and natural gas consumption within the County was assumed to be directly related to population in 1990. PG&E and MID were able to provide energy consumption data for 2003. This 2003 energy consumption data was used to validate the relationship between DOF population figures and electricity and natural gas consumption. Some unknown amount of natural gas consumption data associated with industrial land uses was aggregated into with commercial land uses for 1990 due to PG&E's 15/15 Confidentiality Rule.

The GHG emissions associated with 1990 energy consumption levels were quantified using the applicable emission factors from the CCAR's *General Reporting Protocol* Version 3.1 (CCAR 2009). The *General Reporting Protocol* contains a 1990-2006 California-specific emission factor for CO₂ associated with electricity consumption. This CO₂ emission factor differs from that used to quantify 2007 GHG emissions due to the different electricity generation portfolio mix (e.g., proportion of renewable energy and fossil fuel combustion) used for electricity production in California during this period. The electricity production emission factors for N₂O and CH₄ used to quantify GHG emissions were unchanged between 1990 and 2007. Natural gas consumption emission factors were also unchanged.

Transportation

The transportation sector includes the GHG emissions associated with VMT in the unincorporated areas of the County. The 1990 and 2007 VMT data for the County was provided by the traffic study performed for this General Plan Background Report.

2007 Greenhouse Gas Emissions

In order to calculate projected CO₂ emissions from the 2007 County VMT, a San Joaquin County-specific emission factor for gasoline and diesel fuel in units of grams per gallon was calculated using the Emission Factor (EMFAC) 2007 computer model. EMFAC2007 contains CARB-published mobile-source emission factors and location-specific vehicle fleet and activity data obtained from the California Department of Motor Vehicles. San Joaquin County-specific vehicle travel data (i.e., population, vehicle class, VMT, and fuel consumption) in 2007 were used to calculate weighted-average fuel efficiencies (i.e., miles per gallon) for gasoline and diesel vehicles. The 2007 VMT data was separated by gasoline and diesel VMT using San Joaquin County-specific VMT percentages for gasoline and diesel vehicles from EMFAC2007. The total 2007 VMT for gasoline and diesel were then divided by the weighted-average fuel efficiencies to calculate gallons of gasoline and diesel fuel consumed. The total gallons of gasoline and diesel fuel consumed were then multiplied by the EMFAC2007 emission factors to calculate CO₂ emissions.

Vehicle emission factors for N₂O and CH₄ in units of grams per mile were obtained from the CCAR *General Reporting Protocol* Version 3.1 (CCAR 2009). The *General Reporting Protocol* provides N₂O and CH₄ emission factors for gasoline- and diesel-fueled vehicles by vehicle class. The emission factors for gasoline and diesel vehicles were weighted using San Joaquin County-specific vehicle class counts and distribution. Weighted N₂O and CH₄

emission factors for gasoline and diesel vehicles were then multiplied by the 2007 gasoline and diesel VMT to calculate N₂O and CH₄ emissions.

1990 Greenhouse Gas Emissions

The 1990 CO₂ emissions associated with VMT within the unincorporated areas of the County was calculated using similar methods described above for the 2007 inventory. EMFAC2007 was used to determine the 1990 vehicle fleet and activity levels in order to calculate a CO₂ emission factor (i.e., grams CO₂ per gallon) and weighted fuel efficiencies for gasoline- and diesel-fueled vehicles. Emission factors for N₂O and CH₄ in units of grams per mile were obtained from the CCAR *General Reporting Protocol* Version 3.1 (CCAR 2009). The emission factors for gasoline and diesel vehicles were weighted using 1990 San Joaquin County-specific vehicle class population and distribution. Weighted N₂O and CH₄ emission factors for gasoline and diesel vehicles were then multiplied by the 1990 VMT to calculate N₂O and CH₄ emissions.

Waste

Solid Waste

The solid waste subsector includes GHG emissions associated with solid waste disposal within the County. Solid waste GHG emissions, primarily CH₄, are produced from the anaerobic decomposition of solid waste in landfills. Incineration of solid waste also generates CO₂ emissions.

2007 Greenhouse Gas Emissions

Solid waste disposal data for the County was provided by the San Joaquin County Solid Waste Division. The Solid Waste Division provided annual tons of solid waste disposed by waste categorization percentages (e.g., food waste, plant debris). The GHG emissions associated with solid waste disposal were quantified using ICLEI's CACP software. The CACP software uses nation-wide average GHG emission factors for various types of solid waste.

1990 Greenhouse Gas Emissions

Solid waste disposal data for the County in 1990 was provided by the County's Solid Waste Division. Similar to the 2007 inventory data, the Solid Waste Division provided annual tons of solid waste disposed and waste categorization percentages (e.g., food waste, plant debris). In addition, the Solid Waste Division performed controlled incineration in 1990. The GHG emissions associated with controlled incineration have also been included in the 1990 solid waste subsector. The GHG emissions associated with solid waste disposal and controlled incineration were quantified using ICLEI's CACP software.

Wastewater

The wastewater subsector includes the GHG emissions associated with wastewater treatment plant processes. The energy consumption associated with wastewater treatment plants is accounted for in the County-operated energy consumption.



2007 Greenhouse Gas Emissions

GHG emissions associated with wastewater treatment processes were quantified using methodologies and emission factors provided by IPCC (IPCC 2006). Process data (e.g., treatment capacity, biological oxygen demand) for the six wastewater treatment facilities that serve the unincorporated areas of the County were provided by the County's Public Works Department.

1990 Greenhouse Gas Emissions

The County's Public Work Department provided wastewater process data for 1990, which only included the operation of one wastewater treatment plant. The GHG emissions associated with wastewater treatment processes were quantified using methodologies and emission factors provided by IPCC (IPCC 2006).

Agriculture

The agriculture sector includes GHG emissions from farming equipment exhaust, agricultural irrigation pumps exhaust, fertilizer application, rice cultivation, residue burning, and livestock. These agricultural emission sources were quantified to be consistent with the agricultural emission sources quantified as part of CARB's GHG emissions inventory. The County's agriculture GHG emissions were quantified based on methodologies provided in CARB's GHG emissions inventory. Fuel combustion for farming equipment and agricultural irrigation pumps produce exhaust-related GHG emissions from diesel fuel combustion. Fertilizer application involves the addition of nitrogen to the soil, which can volatilize as N_2O . The anaerobic conditions (i.e., flooding) created for rice cultivation can lead to CH_4 emissions. In some cases, the residual crop material from a previous harvest would be burned prior to replanting the soil, which generates CO_2 emissions. Finally, enteric fermentation digestion and manure management associated with cattle and dairy cows generate CH_4 emissions.

2007 Greenhouse Gas Emissions

The GHG emission factors associated with farming equipment in 2007 were provided by OFFROAD2007; a CARB-approved emissions inventory model for off-road (i.e., heavy-duty) equipment (e.g., farming equipment). The GHG emission factor in units of tons of CO_2 per pump per day was calculated using CARB's GHG emissions inventory methodology (ARB 2006). The number of operating agricultural pumps in the County was provided by ARB's GHG emissions inventory (ARB 2003). Fertilizer application data for 2007 were provided by the California Department of Food and Agriculture (CDFA) Fertilizing Materials Tonnage Report for 2007 (CDFA 2007). Emission factors and methodologies to quantify GHG emissions associated with fertilizer application were provided by CARB's GHG emissions inventory (ARB 2007). Rice and other cultivated crops emissions were provided by San Joaquin County's 2007 Annual Crop Report (Agricultural Commissioner's Office 2007). Emission factors and crop parameters (e.g., moisture content, percent burned) were provided by CARB's GHG emissions inventory methodology (ARB 2007). Year 2007 cattle and dairy cow populations in the County were provided by the CDFA California Agricultural Resources Directory 2007 (CDFA 2007). The emission factors and quantification methodologies for enteric fermentation and manure management were provided by IPCC (IPCC 2006).

1990 Greenhouse Gas Emissions

The agriculture sector in 1990 is comprised of the same agricultural processes as described above for the 2007 inventory (i.e., farming equipment exhaust, agricultural irrigation pump exhaust, fertilizer application, rice cultivation, residue burn, and livestock). The emission factors and methodologies used to quantify GHG emissions from these

agricultural processes are similar to those described above for the 2007 inventory. The 1990 farming equipment activity levels and GHG emissions were provided by m OFFROAD2007. Agricultural pumps operating in the County in 1990 were assumed to be the same as those calculated in the 2007 inventory. Fertilizer application data for 1990 were provided by the CDFA Fertilizer Materials Tonnage Report for 1990 (CDFA 1990). The 1990 San Joaquin County Agricultural Report was used to gather data for acres of rice and other crops cultivated (Agricultural Commissioner's Office 1990). The County's 1990 dairy cow population was provided through personal communications with CDFA staff (Dapper, pers. com. 2008). Cattle counts in 1990 were estimated assuming the same ratio of cattle to dairy cows in 2007.

5B.3 COUNTY GOVERNMENT GREENHOUSE GAS EMISSIONS

Electricity and Natural Gas

The government-related GHG emissions include electricity and natural gas consumption in buildings and facilities operated by the County. Consumption data for government buildings and facilities were provided by electricity and natural gas providers.

2007 Greenhouse Gas Emissions

PG&E provided 2007 electricity and natural gas consumption data for residential, commercial, and industrial uses operated by the County. Lodi Electric Utility provided calendar year 2007 electricity consumption data for two County-operated buildings. MID does not serve electricity to any County-operated buildings or facilities. The GHG emissions associated with government-related electricity and natural gas consumption were quantified using the same methodology described above for County-wide energy consumption. Electricity for the government-related operations would be produced from the same portfolio as that for the County-wide GHG emissions inventory.

1990 Greenhouse Gas Emissions

The 1990 government-related energy consumption data used 2007 data and the same methodologies described above for the County-wide GHG emissions inventory. PG&E provided separate electricity and natural gas consumption data for County-operated buildings and facilities. MID does not provided electricity to any County-operated buildings. Electricity consumption data provided by Lodi Electric Utility for the two County-operated buildings in 2007 and 1990 DOF population figures were used to infer 1990 emissions.

Transportation

The government-related transportation sector includes GHG emissions associated with vehicle fleets owned or operated by the County. For example, sheriff and waste management vehicles would be considered part of the government transportation sector. At the time of this analysis, VMT data for government-related vehicles was not available for 2007 or 1990. No government-related transportation emissions were analyzed as part of this inventory.

Waste

The government-related waste sector is includes GHG emissions from solid waste and wastewater produced at County-operated buildings and facilities. The government-related wastewater subsector includes the GHG emissions



associated with treatment of government-related wastewater. The data collected for solid waste and wastewater were unable to separate government-related operations from Community-wide operations for 1990 and 2007. No government-related solid waste or wastewater emissions were analyzed as part of this inventory.

Agriculture

No agricultural-related emissions were assumed to be associated with government operations.

5B.4 GREENHOUSE GAS EMISSIONS INVENTORY

The following tables provide a detailed summary of the 1990 and 2007 GHG emissions for San Joaquin County.

**San Joaquin County GHG Emissions Inventory
Residential Energy Consumption**

Calendar Year 2007											
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP	
PG&E	Unincorporated SJC	Electricity	419,085,379	kWh	878.71	1	0.0037	296	0.0067	23	167,274.9
		NG	16,556,761	therms	53.06	1	0.0001	296	0.005	23	88,089.6
PG&E	County Operated	Electricity	1,422,366	kWh	878.71	1	0.0037	296	0.0067	23	567.7
		NG	20,210	therms	53.06	1	0.0001	296	0.005	23	107.5
MID	Unincorporated SJC	Electricity	740,535	kWh	878.71	1	0.0037	296	0.0067	23	295.6
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
MID	Mountain House	Electricity	15,666,794	kWh	878.71	1	0.0037	296	0.0067	23	6,253.3
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Lodi Electric	County Operated	Electricity	na	kWh	878.71	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Total		Electricity	436,915,074	kWh							174,391.5
		NG	16,576,971	therms							88,197.1
Total Residential											262,588.6

Calendar Year 1990											
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP	
PG&E	Unincorporated SJC	Electricity	372,167,964	kWh	804.54	1	0.0037	296	0.0067	23	136,027.3
		NG	14,828,209	therms	53.06	1	0.0001	296	0.005	23	78,892.9
PG&E	County Operated	Electricity	1,392,262	kWh	804.54	1	0.0037	296	0.0067	23	508.9
		NG	25,928	therms	53.06	1	0.0001	296	0.005	23	137.9
MID	Unincorporated SJC	Electricity	467,569	kWh	804.54	1	0.0037	296	0.0067	23	170.9
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
MID	Mountain House	Electricity	na	kWh	804.54	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Lodi Electric	County Operated	Electricity	na	kWh	804.54	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Total		Electricity	374,027,796								136,707.1
		NG	14,854,137								79,030.8
Total Residential											215,737.9

kWh = kilowatt hours
MWh = megawatts hours
lbs = pounds
kg = kilograms
MMBtu = million British thermal units

**San Joaquin County GHG Emissions Inventory
Commercial Energy Consumption**

Calendar Year 2007											
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP	
PG&E	Unincorporated SJC	Electricity	833,456,791	kWh	878.71	1	0.0037	296	0.0067	23	332,668.2
		NG	33,375,688	therms	53.06	1	0.0001	296	0.005	23	177,574.0
PG&E	County Operated	Electricity	41,496,389	kWh	878.71	1	0.0037	296	0.0067	23	16,563.0
		NG	821,479	therms	53.06	1	0.0001	296	0.005	23	4,370.6
MID	Unincorporated SJC	Electricity	10,252,997	kWh	878.71	1	0.0037	296	0.0067	23	4,092.4
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
MID	Mountain House	Electricity	7,688,884	kWh	878.71	1	0.0037	296	0.0067	23	3,069.0
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Lodi Electric	County Operated	Electricity	145,145	kWh	878.71	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Total		Electricity	893,040,206	kWh							356,392.6
		NG	34,197,167	therms							181,944.7
		Total Commercial									538,337.3

Calendar Year 1990												
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)	
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP		
PG&E	Unincorporated SJC	Electricity	715,774,100	kWh	804.54	1	0.0037	296	0.0067	23	261,615.3	
		NG	29,947,860	therms	53.06	1	0.0001	296	0.005	23	159,336.4	
PG&E	County Operated	Electricity	28,805,555	kWh	804.54	1	0.0037	296	0.0067	23	10,528.4	
		NG	693,567	therms	53.06	1	0.0001	296	0.005	23	3,690.1	
MID	Unincorporated SJC	Electricity	3,631,408	kWh	804.54	1	0.0037	296	0.0067	23	1,327.3	
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-	
MID	Mountain House	Electricity	na	kWh	804.54	1	0.0037	296	0.0067	23	-	
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-	
Lodi Electric	County Operated	Electricity	127,692	kWh	804.54	1	0.0037	296	0.0067	23	46.7	
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-	
Total		Electricity	748,338,753									273,517.7
		NG	30,641,427									163,026.5
		Total Commercial									436,544.2	

kWh = kilowatt hours

MWh = megawatts hours

lbs = pounds

kg = kilograms

MMBtu = million British thermal units

**San Joaquin County GHG Emissions Inventory
Industrial Energy Consumption**

Calendar Year 2007											
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP	
PG&E	Unincorporated SJC	Electricity	13,113,840	kWh	878.71	1	0.0037	296	0.0067	23	5,234.3
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
PG&E	County Operated	Electricity	24,692,393	kWh	878.71	1	0.0037	296	0.0067	23	9,855.8
		NG	1,630,008	therms	53.06	1	0.0001	296	0.005	23	8,672.4
MID	Unincorporated SJC	Electricity	17,145,049	kWh	878.71	1	0.0037	296	0.0067	23	6,843.3
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
MID	Mountain House	Electricity	na	kWh	878.71	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Lodi Electric	County Operated	Electricity	na	kWh	878.71	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Total		Electricity	54,951,282	kWh							21,933.4
		NG	1,630,008	therms							8,672.4
		Total Industrial									30,605.8

Calendar Year 1990											
Energy Provider	Location/User	Energy	Consumption	units	Emission Factors and GWP (lbs/MWh) and (kg/MMBtu)						Total GHG Emissions (tonnes CO ₂ e/yr)
					CO ₂	GWP	N ₂ O	GWP	CH ₄	GWP	
PG&E	Unincorporated SJC	Electricity	9,279,244	kWh	804.54	1	0.0037	296	0.0067	23	3,391.6
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
PG&E	County Operated	Electricity	23,780,389	kWh	804.54	1	0.0037	296	0.0067	23	8,691.7
		NG	1,441,443	therms	53.06	1	0.0001	296	0.005	23	7,669.1
MID	Unincorporated SJC	Electricity	16,918,844	kWh	804.54	1	0.0037	296	0.0067	23	6,183.8
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
MID	Mountain House	Electricity	na	kWh	804.54	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Lodi Electric	County Operated	Electricity	na	kWh	804.54	1	0.0037	296	0.0067	23	-
		NG	na	therms	53.06	1	0.0001	296	0.005	23	-
Total		Electricity	49,978,476								18,267.1
		NG	1,441,443								7,669.1
		Total Industrial									25,936.3

kWh = kilowatt hours
MWh = megawatts hours
lbs = pounds
kg = kilograms
MMBtu = million British thermal units

**San Joaquin County GHG Emissions Inventory
1990 and 2007 Transportation Emissions**

Calendar Year 2007

Category	Community Travel (miles/yr)	Weighted Average Fuel Efficiency (miles/gallon)	Fuel Consumption (gallons)	Emission Factors			Total GHG Emissions (tonnes CO ₂ e/yr)
				CO ₂ (grams/gallon)	N ₂ O (grams/mile)	CH ₄ (grams/mile)	
Gasoline VMT (miles)	5,832,822,129	21.0	278,039,715	8,628	0.052	0.048	2,495,379
Diesel VMT (miles)	703,375,221	13.9	50,530,283	10,080	0.004	0.004	510,234
Totals	6,536,197,350		328,569,997				3,005,613

Calendar Year 1990

Category	Community Travel (miles/yr)	Weighted Average Fuel Efficiency (miles/gallon)	Fuel Consumption (gallons)	Emission Factors			Total GHG Emissions (tonnes CO ₂ e/yr)
				CO ₂ (grams/gallon)	N ₂ O (grams/mile)	CH ₄ (grams/mile)	
Gasoline VMT (miles)	3,909,073,225	18.2	215,285,649	7,762	0.048	0.043	1,730,419
Diesel VMT(miles)	437,836,605	15.5	28,213,195	10,080	0.003	0.004	284,862
Totals	4,346,909,830		243,498,844				2,015,281

Source:

Calendar year 1990 and 2007 daily VMT was provided by Dowling Inc.. Annual VMT was calculated by multiplying daily VMT by 365.

Calendar year 1990 and 2007 fuel consumption and fuel efficiency were estimated using EMFAC2007 San Joaquin County.

California Climate Action Registry (CCAR). 2009 (January). California Climate Action Registry General Reporting Protocol Version 3.1. Table C.4

**San Joaquin County Greenhouse Gas Emissions Inventory
Domestic Waste Water Treatment - 2007**

Facility	First Year of Operation	Year of Data	Type of Treatment	Facility-Specific Data									Default Emission Factor (kg CH ₄ /kg BOD)	CH ₄ Correction Factor	Adjusted Emission Factor (kg CH ₄ /kg BOD)	
				Capacity (MGD)	Capacity (gal/yr)	Influent (MGD)	Influent (gal/yr)	Influent BOD (mg/L)	BOD (kg/gal)	BOD (kg/yr)	Adjusted Emission Factor (kg CH ₄ /kg BOD)	kg CH ₄ /yr				tonnes CO ₂ e/yr
														0.6	0.8	0.48
Lockeford		ND	anaerobic activated sludge	0.21	76,650,000	-						0.48	-	-		
Waterloo	1990	1990	Primary Activated Sludge	0.13	45,625,000	0.04	14,600,000	254	0.0010	14,029	0.48	6,734	141			
				0.13	45,625,000	0.04	14,600,000	440	0.0017	24,331	0.48	11,679	245			
Flag City (as of April 2008 no longer in operation)		2003	2007	Activated Sludge, Primary & Secondary Treatment	0.16	58,400,000	-		306	0.0012	67,536	0.48	32,417	681		
Linne Estates		2006	2007	Activated Sludge	0.06	20,075,000	-		280	0.0011	21,278	0.48	10,213	214		
Fair Oaks Ranch		2007	2007	S.B.R. Activated Sludge	0.03	12,045,000	-		8	0.0000	365	0.48	175	4		
Mountain House		2007	2007	Tertiary	5.68	2,073,200,000	0.471	171,915,000	250	0.0009	162,692	0.48	78,092	1,640		
Septic				activated sludge aerated lagoons												
																could not be determined

MGD = million gallons per day
gal = gallons
mg = milligrams
kg = kilograms
L = liters
BOD = biological oxygen demand

Total (1990)	141
Total (2007)	2,784

Source:
Intergovernmental Panel on Climate Change 2006. IPCC Guidelines for National Greenhouse Gas Inventories; Chapter 6: Wastewater Treatment and Discharge
Ron Rall. San Joaquin County Department of Public Works Utility District Superintendent

**San Joaquin County GHG Inventory
Solid Waste**

Amount of Waste (tons): Managed Landfill	1990		2007	
-Paper Produce	28,106	24.2%	39,806	24.2%
-Food Waste	6,355	5.5%	9,000	5.5%
-Plant Debris	19,095	16.4%	27,044	16.4%
-Wood/Textiles	25,437	21.9%	36,026	21.9%
-All other waste	37,248	32.0%	52,755	32.0%
-% of Methane capture (if any)	N/A	N/A	N/A	N/A
Total	116,241		164,631	

Amount of Waste (tons): Controlled Incineration	1990		2007
-Paper Produce	1,492	24.2%	No controlled incineration performed in 2007.
-Food Waste	337	5.5%	
-Plant Debris	1,014	16.4%	
-Wood/Textiles	1,351	21.9%	
-All other waste	1,978	32.0%	
-% of Methane capture (if any)	N/A	N/A	
Total	6,172		

Note: Values above were input into the ICLEI CACP Software to calculate solid waste and incineration GHG emissions.

**San Joaquin County Greenhouse Gas Emissions Inventory
1990 Agricultural Emissions - Farm Equipment Operations**

GHG	Emissions (tons/day)	Emissions (tonnes/yr)
Carbon Dioxide (CO ₂)	556.00	184,105.96
Methane (CH ₄)	0.18	57.95
Nitrous Oxide (N ₂ O)	0.01	2.08
CO ₂ E	561.62	186,053.28

Sources

OFFROAD 2007: Annual 1990 Agricultural Equipment in San Joaquin County

**San Joaquin County Greenhouse Gas Emissions Inventory
2007 Agricultural Emissions - Farm Equipment Operations**

GHG	Emissions (tons/day)	Emissions (tonnes/yr)
Carbon Dioxide (CO ₂)	518.00	171,523.18
Methane (CH ₄)	0.10	31.56
Nitrous Oxide (N ₂ O)	0.01	1.99
CO ₂ E	521.86	172,837.05

Sources

OFFROAD 2007: Annual 2007 Agricultural Equipment for San Joaquin County

**San Joaquin County Greenhouse Gas Emissions Inventory
1990 Agricultural Emissions - Agricultural Irrigation Engines**

# Pumps in SJC	Emission Factors (avg tons per day/pump) Diesel CO ₂	Total GHG Emissions (tonnes CO ₂ e/yr)
413	0.206	28,116.25
Total Emissions		28,116.25
Total SJVAPCD pumps (Portable and Nonportable) <p align="center">7,057</p>		
Total SJVAPCD CO₂ Emissions (tons per day) <p align="center">1,451.2</p>		

Sources:

California Air Resources Board 2003. Fuel Consumption Methodologies for Agricultural Irrigation Engines (category 052-042-1200-0000). Available at: <http://www.arb.ca.gov/ei/areasrc/FULLPDF/FULL1-1.pdf>

California Air Resources Board 2006. Rulemaking to Consider Proposed Amendments to the Stationary Diesel Engine Control Measure - Appendix D: Emission Inventory Methodology Agricultural Irrigation Pumps - Diesel. Available at: <http://www.arb.ca.gov/regact/agen06/append.pdf>

**San Joaquin County Greenhouse Gas Emissions Inventory
2007 Agricultural Emissions - Agricultural Irrigation Engines**

# Pumps in SJC	Emission Factors (avg tons per year/pump) Diesel CO2	Total CO2E Emissions (tonnes CO2E/yr)
413	0.206	28,116.25
Total Emissions		28,116.25
Total SJVAPCD pumps (Portable and Nonportable)		
7,057		
Total SJVAPCD CO2 Emissions (tpd)		
1,451.2		

Sources:

California Air Resources Board 2003. Fuel Consumption Methodologies for Agricultural Irrigation Engines (category 052-042-1200-0000). Available at: <http://www.arb.ca.gov/ei/areasrc/FULLPDF/FULL1-1.pdf>

California Air Resources Board 2006. Rulemaking to Consider Proposed Amendments to the Stationary Diesel Engine Control Measure - Appendix D: Emission Inventory Methodology Agricultural Irrigation Pumps - Diesel. Available at: <http://www.arb.ca.gov/regact/agen06/append.pdf>

**San Joaquin County Greenhouse Gas Emissions Inventory
1990 Agricultural Emissions - Fertilizer-Related Emissions**

Nitrogen Applied in Fertilizer (tons)	Nitrogen Applied (grams)	Nitrogen Volatization (gram/gram)	Nitrogen Emitted As N₂O (gram N₂O/gram N₂)	MW N₂O/MW N₂	Total GHG Emissions (tonnes CO₂e/year)
23,567.00	2.14E+10	2.14E+09	21,379,982.40	1.57	9,944.75

Nitrogen Volatization (grams/gram) 0.1

Nitrogen Emitted As N₂O (grams/gram) 0.01

MW = molecular weight

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory: Agriculture and Forestry. N₂O from Nitrogen Applied in Fertilizer. 2007

Department of Food and Agriculture. Fertilizer Tonnage Report. 1990

**San Joaquin County Greenhouse Gas Emissions Inventory
2007 Agricultural Emissions - Fertilizer-Related Emissions**

Nitrogen Applied in Fertilizer (tons)	Nitrogen Applied (grams)	Nitrogen Volatization (gram/gram)	Nitrogen Emitted As N₂O (gram N₂O/gram N₂)	MW N₂O/MW N₂	Total GHG Emissions (tonnes CO₂e/year)
141,881.00	1.29E+11	1.29E+10	128,714,443.20	1.57	59,870.60

Nitrogen Volatization (g/g) 0.1

Nitrogen Emitted As N₂O (g/g) 0.01

MW = molecular weight

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory: Agriculture and Forestry. N₂O from Nitrogen Applied in Fertilizer. 2007
Department of Food and Agriculture. Fertilizing Materials Tonnage Report. January-June 2007 and July-December 2007.

San Joaquin County Greenhouse Gas Emissions Inventory
1990 Agricultural Emissions - Rice Cultivation

Acres of Rice	Hectares of Rice	Rice Field Emission Factor (grams CH₄/hectare)	Total GHG Emission (tonnes CO₂e/yr)
4,950	2,003	122,000	5,620.97

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory:
Agriculture and Forestry. CH₄ from Harvested Rice Area. 2007

**San Joaquin County Greenhouse Gas Emissions Inventory
2007 Agricultural Emissions - Rice Cultivation**

Acres of Rice	Hectares of Rice	Rice Field Emission Factor (grams CH₄/hectare)	Total GHG Emission (tonnes CO₂e/yr)
5,280	2,137	122,000	5,995.70

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory:
Agriculture and Forestry. CH₄ from Harvested Rice Area. 2007

**San Joaquin County Greenhouse Gas Emissions Inventory
1990 Agricultural Emissions - Residue Burning**

Crop	Total Acres Harvested (acre/yr)	Residue Burned (tons/acre)	Moisture Content	Percent Acres Burned	Residue Burned (tons/yr)	Emission Factors (ton/ton burned)			Total GHG Emissions (tonnes CO ₂ e/yr)
						CO ₂	CH ₄	N ₂ O	
Corn	42,800	4.2	0.086	0.03	463.78	1.31	1.75E-03	1.00E-04	580.56
Rice	4,950	3	0.086	0.99	1,264.33	1.16	7.20E-04	2.00E-04	1,417.41
Almonds	36,600	1	0.183	0.84	5,626.15	1.83	1.17E-03	2.00E-04	9,779.85
Walnuts	27,400	1.2	0.331	0.95	10,339.12	1.64	1.64E-03	2.00E-04	16,291.59
Wheat	65,100	1.9	0.073	0.11	993.23	1.19	1.82E-03	1.00E-04	1,136.64
Barley	2,150	1.7	0.069	0.07	17.65	1.17	2.47E-03	2.00E-04	20.60
Total Emissions									29,226.64

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory: Agriculture and Forestry. Crop Acreage Burned. 2007

**San Joaquin County Greenhouse Gas Emissions Inventory
2007 Agricultural Emissions - Residue Burning**

Crop	Total Acres Harvested (acre/yr)	Residue Burned (tons/acre)	Moisture Content	Percent Acres Burned	Residue Burned (tons/yr)	Emission Factors (ton/ton burned)			Total GHG Emissions (tonnes CO ₂ e/yr)
						CO ₂	CH ₄	N ₂ O	
Corn	81,700	4.2	0.086	0.03	885.30	1.31	1.75E-03	1.00E-04	1,108.21
Rice	5,280	3	0.086	0.177	241.12	1.16	7.20E-04	2.00E-04	270.31
Almonds	46,000	1	0.183	0.84	7,071.12	1.83	1.17E-03	2.00E-04	12,291.61
Walnuts	44,000	1.2	0.331	0.95	16,602.96	1.64	1.64E-03	2.00E-04	26,161.67
Wheat	14,300	1.9	0.073	0.11	218.18	1.19	1.82E-03	1.00E-04	249.68
Barley	800	1.7	0.069	0.07	6.57	1.17	2.47E-03	2.00E-04	7.66
Total Emissions									40,089.15

Sources

California Air Resources Board. Greenhouse Gas Emissions Inventory: Agriculture and Forestry. Crop Acreage Burned. 2007

**San Joaquin County Greenhouse Gas Emissions Inventory
1990 and 2007 Agricultural Emissions - Cattle Management**

1990 Livestock Emissions

Livestock Type	Population	Enteric Fermentation			Manure Management			Total GHG Emissions
		Emission Factor (kg CH ₄ /head-yr)	kg CH ₄ /yr	tonnes CO ₂ E/yr	Emission Factor (kg CH ₄ /head-yr)	kg CH ₄ /yr	tonnes CO ₂ e/yr	tonnes CO ₂ e/yr
Cattle	84,857	53	4,497,428.57	103,440.86	2	169,714.29	3,903.43	107,344.29
Milk Cows	66,000	128	8,448,000.00	194,304.00	68	4,488,000.00	103,224.00	297,528.00
Total								404,872.29

2007 Livestock Emissions

Livestock Type	Population	Enteric Fermentation			Manure Management			Total GHG Emissions
		Emission Factor (kg CH ₄ /head-yr)	kg CH ₄ /yr	tonnes CO ₂ E/yr	Emission Factor (kg CH ₄ /head-yr)	kg CH ₄ /yr	tonnes CO ₂ e/yr	tonnes CO ₂ e/year
Cattle	135,000	53	7,155,000.00	164,565.00	2	270,000.00	6,210.00	170,775.00
Milk Cows	105,000	128	13,440,000.00	309,120.00	68	7,140,000.00	164,220.00	473,340.00
Total								644,115.00

Methane (CH₄) GWP 23
kg = kilograms

Sources

California Department of Food and Agriculture (CDFA). California Agricultural Resources Directory 1990
IPCC. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 10 Emissions from Livestock and Manure Management. 2006