APPENDIX F GREENHOUSE GAS EMISSIONS CALCULATIONS

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GREENHOUSE GAS EMISSIONS CALCULATIONS

INVENTORY AND FORECAST DATA, METHODS, AND ASSUMPTIONS

Current (2013) and future (2020, 2030, and 2050) operational emissions were estimated for the following sectors: transportation, building energy, agriculture, solid waste, wastewater, potable water, and off-road vehicles. The following presents the data sources, methods, and assumptions used to estimate both current and future emissions in the County.

General Approach

For all greenhouse gas (GHG) emissions calculations, the global warming potential (GWP) factors from IPCC's Second Assessment Report (SAR) were used where methane (CH_4) and nitrous oxide (N_2O) have GWP factors of 23 and 296, respectively. These factors were also used in the County's 2005 GHG inventory. GWP factors for gases not available in the SAR were taken from more recent IPCC reports or from published academic studies and were based on 100-year lifetime factors.

Additionally, the project was assumed to be built out by calendar year 2050. Most estimates for the emissions and activity factors between 2013 and 2050 were interpolated.

Transportation

General Approach

Annual transportation emissions were estimated by multiplying vehicle emission factors (emissions per mile) to annual vehicle miles travelled in the unincorporated county. The California Air Resources Board's (ARB) Emission Factor Model (EMFAC) 2014 provides on-road emissions and estimated annual vehicle miles traveled (VMT) by vehicle type, fuel type, county, and calendar year. Table 1 presents the emission factors used in calculating emissions from transportation.

Table 1 Transportation Assumptions and Emission Factors

Fuel Type	Percent VMT (EMFAC 2014)	Average kWh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)
2013					
Diesel	6%		1271.54	1.80E-01	4.18E-02
Electric	0.2%	29	0.81	3.75E-05	7.93E-06
Gasoline	94%		442.09	2.70E-02	1.29E-02
2020					
Diesel	6%		1185.03	1.15E-01	3.90E-02
Electric	1.7%	29	0.71	3.37E-05	7.14E-06
Gasoline	92%		364.78	1.47E-02	6.04E-03
2030					
Diesel	7%		1099.64	8.40E-02	3.62E-02
Electric	8.9%	29	0.71	3.37E-05	7.14E-06
Gasoline	84%		236.82	8.81E-03	2.74E-03
2050					
Diesel	7%		1116.20	7.57E-02	3.67E-02
Electric	9.5%	29	0.71	3.37E-05	7.14E-06
Gasoline	83%		221.17	8.14E-03	2.34E-03

Notes: CH_4 = methane; CO_2 = carbon dioxide; kWh = kilowatt-hours; N_2O = nitrous oxide; VMT = vehicle miles traveled

Source: Data compiled by Ascent Environmental, Inc. in 2015

EMFAC2014 takes into account the future impact of regulations and policies such as the Advanced Clean Cars program and the Low Carbon Fuel Standard. Emission factors for carbon dioxide (CO_2) and CH_4 were calculated by dividing total estimated emissions for San Diego County by the total VMT estimated by EMFAC for a given calendar year. For diesel vehicles, N_2O emission factors were calculated by dividing total fuel consumption (gallons) by total VMT and multiplying the result by 0.3316, as recommended by ARB (ARB 2011). For gasoline vehicles, N_2O emission factors were calculated by dividing total NOx emissions by total VMT and multiplying the result by 0.0416, as recommended by ARB (ARB 2011). EMFAC2014 also takes into account the electric vehicle mode share, in addition to diesel and gasoline vehicles. Based on the current average light duty electric vehicle efficiency, the average electric fuel economy is assumed to be 29 kilowatt-hours (kWh)/100 miles (EPA 2015). Emission factors for electric vehicles are assumed to be the same as those used for the building energy sector.

2013 County Emissions Inventory

A project-specific traffic analysis was not prepared for the proposed project. However, in Volume IV (Appendix E) of the General Plan Update (GPU) Program Environmental Impact Report (PEIR), Fehr & Peers prepared a technical memorandum evaluating the "Recommended Project 2011", which was the land use alternative ultimately adopted as the 2011 GPU land use map. This technical memorandum provided daily VMT for the unincorporated Plan area for the year 2007 and for the General Plan build-out year under the "Recommended Project 2011" condition. Fehr & Peers based their analyses on the San Diego Association of Governments (SANDAG) transportation model for the GPU PEIR. It is important to note that a subsequent memorandum from Fehr & Peers to AECOM in 2011 regarding VMT estimates for the County's climate action planning efforts removed VMT related to roads within Camp Pendleton, because the County does not have jurisdiction over roadway or land use planning in that area (Chen, pers. comm., 2011). Thus, any efforts to use this transportation inventory in a climate action plan should also exclude VMT within Camp Pendleton.

To be consistent with the GPU EIR, the County's 2013 unincorporated VMT was estimated by scaling the known 2007 unincorporated VMT from the Fehr & Peers memorandum using county-specific VMT growth between 2007 and 2013 as published in Caltrans' *California Public Road Data* report (Caltrans 2008:54, Caltrans 2014:96). The Public Road Data (PRD) report contains daily VMT data for each county in the state broken out by responsible agency. It was assumed that unincorporated VMT included VMT on County-owned roads as well as on rural roads owned by state, federal, and tribal agencies. The applicable daily VMT was multiplied by 365 days in a year to estimate the annual VMT for 2013. 2013 emission factors for CO_2, CH_4, and N_2O from EMFAC2014 were applied to the estimated 2013 unincorporated VMT to calculate 2013 transportation emissions from the County. Table 2 summarizes the calculations used to determine the 2013 unincorporated VMT.

Table 2 2007 and 2013 Daily and Annual Vehicle Miles Traveled in Unincorporated San Diego County

Scenario	Daily VMT	Annual VMT
2007 Unincorporated County VMT from SANDAG model [a]	15,922,149	5,811,584,385
2007 Unincorporated County VMT from Caltrans PRD	10,824,820	3,951,059,300
2013 Unincorporated County VMT from Caltrans PRD	8,154,150	2,976,264,750
Percent Change in Unincorporated VMT from 2007 to 2013 [b]	-24.7%	
Calculated 2013 Unincorporated VMT based on PRD Growth from 2007-2013	11,993,880	4,377,766,172

Notes: Caltrans = California Department of Transportation; PRD = Public Road Data; SANDAG = San Diego Association of Governments; VMT = vehicle miles traveled

Source: Chen, pers. comm., 2011, Caltrans 2008:54, Caltrans 2014:96

[a] From 2011 Fehr and Peers Memorandum for the 2011 General Plan Update

[b] Based on Caltrans Public Road Data (PRD)

2020, 2030, and 2050 County Emissions Forecasts

For annual vehicle travel within the unincorporated county, 2020 and 2030 VMT were interpolated between the VMT estimates for 2013 and the 2050 build-out scenario. 2050 VMT was estimated for the proposed project using land use estimates available from the County. Although a formal traffic analysis was not available for this project, County planners were able to provide acreages, dwelling units, and estimate average daily trips (ADT) for each land use type within the FCI-land boundaries (Citrano, pers. comm., 2015a). Average trip lengths (miles per trip) were determined for each land use type using the trip generation rates available from the San Diego Association of Governments (SANDAG) (SANDAG 2002). Finally, ADT was multiplied by trip lengths unique to each land use category and then summed across all categories to calculate the total daily VMT. Table 3 shows the applicable acres, ADT, and trip length assumptions for each land use category for the proposed project.

TABLE 3 SEIR Proposed Project: FCI Lands Build-Out Vehicle Miles Traveled Calculations

						Year	2050	2020	2030
Land Use Code	Land Use Category	FCI Acres	ADT	Miles/Trip (From SANDAG)	Land Use Match		Daily VMT		
OS(R)	Open Space (Recreation)	46	2,284	5.4	Parks		12,334	2,333	5,667
OS(C)	Open Space (Conservation)	337	0	10.8	Agriculture open space		-	-	-
P/SP	Public/ Semi-Public Facilities	99	26,423	6	Government		158,536	29,993	72,843
PAL	Public Agency Lands	1,571	3,142	5.4	Parks		16,967	3,210	7,796
RC	Rural Commercial 1 (Inside CWA)	187	41,644	5.2	Regional Shopping Center		216,551	40,969	99,499
RL-20	Rural Lands 20	4,325	4,500	7.9	Residential		35,550	12,277	20,035
RL-40	Rural Lands 40	25,162	11,196	7.9	Residential		88,448	30,545	49,847
RL-80	Rural Lands 80	31,057	7,236	7.9	Residential		57,164	19,742	32,216
SPA	Specific Plan Area	22	0	7.9	Residential		-	-	-
SR-1	Semi-Rural 1	555	6,192	7.9	Residential		48,917	16,893	27,568
SR-10	Semi-Rural 10	4,998	7,848	7.9	Residential		61,999	21,411	34,941
SR-2	Semi-Rural 2	1,386	6,624	7.9	Residential		52,330	18,072	29,491
SR-4	Semi-Rural 4	1,412	10,968	7.9	Residential		86,647	29,923	48,832
TL	Tribal Lands	98	0				-		-
VCMU	Village Core Mixed Use	152	59,450	6.55	Res/Comm		389,396	134,477	219,451
VR-2	Village Residential 2	301	7,116	7.9	Residential		56,216	19,414	31,682
VR-4.3	Village Residential 4.3	7	276	7.9	Residential		2,180	753	1,229
Total		**71,670**	**194,899**				**1,283,236**	**154,644**	**681,096**

Notes: ADT = Average Daily Trips; SANDAG = San Diego Association of Governments; VMT = vehicle miles traveled

The approach to estimate the entire unincorporated county's future VMT took into account the varying VMT that would occur on FCI lands, depending on the alternative. County-wide VMT for the project was not available from any previous traffic analysis. However, the GPU PEIR traffic analysis provided county-wide VMT for the "Recommended Project 2011", which had different land use assumptions for the FCI lands than the current project being considered. Therefore, the following approach in Equation 1 demonstrates how county-wide VMT for the project was calculated.

County-wide VMT for "Proposed Project"	=	*County-wide VMT for "Recommended Project 2011"*	--	*FCI-Land VMT for "Recommended Project 2011"*	+	*FCI-Land VMT for "Proposed Project"*

Equation 1

Table 4 shows the final outcome of the estimated build-out daily and annual VMT for the unincorporated area under the proposed project. 2020 and 2030 VMT are interpolated between these values and the estimated 2013 VMT for the unincorporated county.

Table 4 Estimated Build-out Vehicle Miles Traveled in FCI-lands and Unincorporated Area for Proposed Project

	Build-Out Daily VMT (2050)	Build-Out Annual VMT (2050)
Build Out VMT in FCI-Lands		
SEIR Proposed Project	1,283,236	468,381,110
Existing GP - No Project	1,418,578	517,781,064
Recommended Project 2011	615,327	224,594,364
Build Out VMT in non-FCI-Lands [a]		
Cumulative Projects	1,423.65	519,631
Build Out VMT in Entire Unincorporated Area		
Recommended Project 2011	24,544,826	8,958,861,490
With SEIR Proposed Project	25,212,735	9,202,648,236
With No Project	25,348,077	9,252,048,190
With No Project + Cumulative Projects	25,867,708	9,441,713,547

Source: Data compiled by Ascent Environmental, Inc. in 2015

[a] Included for informational purposes only.

Table 5 shows projected fuel consumption for each analysis year. The data is based on VMT forecasts shown above and fuel economy values from EMFAC2014.

Table 5 Annual Fuel Consumption Forecasts – SEIR Proposed Project

Fuel Type	Percent VMT (EMFAC 2014)	Annual VMT	Gallons per mile or kWh/100 miles	Miles per gallon	Annual Fuel Consumption (Gallons or kWh)
2020					
Diesel	6%	3,486,019	0.1176	9	409,956
Gasoline	92%	51,989,905	0.0431	23	2,240,765
Electric	2%	969,036	29	–	281,020
2030					
Diesel	7%	16,559,288	0.1091	9	1,806,618
Gasoline	84%	209,977,293	0.0280	36	5,879,364
Electric	9%	22,063,614	29	–	6,398,448
2050					
Diesel	7%	33,761,647	0.1107	9	3,737,414
Gasoline	83%	390,044,312	0.0261	38	10,180,157
Electric	10%	44,575,151	29	–	12,926,794

Notes: kWh = kilowatt-hours; VMT = vehicle miles traveled

Electric fuel consumption is in kWh

Source: EMFAC2014 and Data compiled by Ascent Environmental, Inc. in 2015

Energy

General Approach

Emissions from the energy sector were calculated by applying electricity and natural gas emission factors to the estimated total electricity and natural gas use for 2013 and future forecast years. 2013 San Diego Gas & Electric (SDG&E) electricity emission factors were not publicly available. Instead, 2013 SDG&E electricity emission factors were calculated based on the utility's known renewable energy mix for 2013 and a calculated non-renewable emission factor, discussed further below. Natural gas emission factors were assumed to be constant regardless of calendar year and were available from the Climate Registry (The Climate Registry: Table 12.9). Tables 6 and 7 summarize the energy emission factors for electricity and natural gas used in this analysis, respectively.

Table 6 Electricity Emission Factors for San Diego Gas & Electric

Application	Value	Unit	Source
2009			
SDG&E Renewable Mix	10.5%	Percent	CPUC 2010
Electricity	720	lb CO_2/MWh	ARB 2010: Table G.6
Electricity	802	lb CO_2/MWh	Calculated non-renewable emission factor
Electricity	0.364	MT CO_2/MWh	Calculated non-renewable emission factor
2013			
SDG&E Renewable Mix	23.6%	Percent	CPUC 2015
Electricity	613	lb CO_2/MWh	Calculated
Electricity	0.278	MT CO_2/MWh	Calculated
eGRID2010 Renewable Mix	25.6%	Percent	Calculated from EPA's eGrid 2010a (EPA 2014)
Electricity	28.49	lb CH_4/GWh	EPA's eGrid 2010 (EPA 2014)
Electricity	6.03	lb N_2O/GWh	EPA's eGrid 2010 (EPA 2014)
Electricity	1.29E-05	MT CH_4/MWh	Calculated
Electricity	2.74E-06	MT N_2O/MWh	Calculated
Electricity	1.74E-05	MT CH_4/MWh	Calculated non-renewable emission factor
Electricity	3.67E-06	MT N_2O/MWh	Calculated non-renewable emission factor
2020			
SDG&E Renewable Mix	33%	Percent	Assumes SDG&E will meet state RPS goals
Electricity	537	lb CO_2/MWh	Calculated
Electricity	0.244	MT CO_2/MWh	Calculated
Electricity	1.16E-05	MT CH_4/MWh	Calculated
Electricity	2.46E-06	MT N_2O/MWh	Calculated

Notes: ARB = California Air Resources Board; CH_4 = methane; CO_2 = carbon dioxide; CPUC = California Public Utilities Commission; EPA = United States Environmental Protection Agency; GWh = gigawatt-hours; lb = pounds; MT = metric tons; MWh = megawatt-hours; N_2O = nitrous oxide; RPS = Renewables Portfolio Standard; SDG&E = San Diego Gas & Electric;

[a] Includes Hydro, Wind, Solar, Geothermal, and Biomass. Nuclear was not included as is it not an eligible RPS source.

The most recent publicly available SDG&E CO_2 emission factor was for calendar year 2009 (720 pounds [lb] CO_2/MWh) as published in the Local Government Operations Protocol (ARB 2010: Table G.6). The California Public Utilities Commission (CPUC) indicates that, in 2009, SDG&E's electricity mix was 10.5% renewable according to their status in achieving the Renewable Portfolio Standard goals (CPUC 2010). The non-renewable energy emission factor for SDG&E was then estimated to be 802 lb CO_2/MWh. The CPUC reports that, in 2013, SDG&E achieved a 23.6% renewable mix, which would result in a calculated overall emission factor of 613 lb CO_2/MWh (CPUC 2015). A 33% renewable mix at this utility translates to an emission factor of 537 lb CO_2/MWh.

A similar approach was applied to the CH_4 and N_2O emission factors available for the CAMX region from EPA's eGrid 2010 summary tables. A 25.6% renewable mix[1] was calculated from the electricity generation resource mix for the CAMX region and was assumed to be applicable to the 2013 calendar year. For forecast years of 2020 and beyond, a 33% renewable mix was applied to the CH_4 and N_2O emission factors.

Table 7 Natural Gas Emission Factors for San Diego Gas & Electric

Application	Value	Unit	Source
Natural Gas Emission Factors			
Natural Gas – U.S. Weighted Average	53.02	kg CO_2/MMBtu	The Climate Registry 2014: Table 12.1
Natural Gas – U.S. Weighted Average	0.005302	MT CO_2/therm	Calculated
Natural Gas	5	g CH_4/MMBtu	The Climate Registry 2014: Table 12.9
Natural Gas	0.1	g N_2O/MMBtu	The Climate Registry 2014: Table 12.9
Natural Gas	0.00005	MT CH_4/therm	Calculated
Natural Gas	0.000001	MT N_2O/therm	Calculated

Notes: CH_4 = methane; CO_2 = carbon dioxide; g = grams; MT = metric tons; MMBtu = million British Thermal Unit; N_2O = nitrous oxide

2013 County Emissions Inventory

Total kWh of annual electricity use in the unincorporated county in 2013 was provided by SDG&E and presented for residential, commercial, and industrial customers.

2020, 2030, and 2050 County Emissions Forecasts

The change in residential energy use was assumed to be proportional to the change in the number of housing units under the proposed project. The number of existing housing units in 2013 was available from SANDAG's demographic & socioeconomic profile for the unincorporated county (SANDAG 2014). Per recommendations from County staff, the number of housing units in 2020 was assumed to be the same across all alternatives and was based on the number of housing building permits approved in between 2010 and 2014, available from Appendix 1 of the County's Annual Housing Element Progress Report (County of San Diego 2015:1-3). Assuming 2050 as the build-out year, the number of housing units for calendar year 2030 was interpolated between the calculated number units in 2020 and 2050. The County also provided the build-out number of housing units assumed for the FCI lands for each alternative. Because the General Plan Update ("Recommended Project 2011") had different housing assumptions for the FCI lands, the housing units previously assumed for the FCI lands were subtracted from the original unincorporated build-out estimates to find the original estimates for the number of housing units outside of the FCI lands. This figure was then added to the housing units on FCI lands estimated for each alternative to determine the total build-out number of housing units in the unincorporated county for each alternative.

Table 8 shows the County's assumption of the number of housing units and population for each alternative as well as for the General Plan Update, shown as "Recommended Project 2011". Population estimates were based on a density of 2.82 persons per household for the unincorporated county, as calculated from the population and housing unit estimates for the "Recommended Project 2011". Although not used to estimate future residential energy, these population estimates are used to forecast emissions from other sectors.

[1] Includes Hydro, Wind, Solar, Geothermal, and Biomass. Nuclear was not included as is it not an eligible Renewables Portfolio Standard source.

Table 8 Housing Units and Population Data

	General Plan Build-Out	
Scenario	**Housing Units**	**Population**
Unincorporated Area in 2005	162,381	460,247
Recommended Project (RP) 2011 between 2005 and Build-Out	72,683	202,761
Difference between RP2011 and FCI No Project	10,806	30,479
Difference between RP2011 and SEIR Proposed Project	1,957	5,520
Difference between Existing GP and other Cumulative Projects (Excluding FCI Updates)	6,213	17,524
GP Update - No Project	245,870	693,487
GP Update with Proposed Project	237,021	668,528
GP Update with No Project + Cumulative Projects	252,083	711,011

The change in commercial and industrial energy use was assumed to be proportional to the change in the commercial and industrial acres relative to each alternative. Build-out employment data for each alternative was not available from the County. The number of existing commercial and industrial acres was available from land use parcel data from the San Diego Geographic Information Source (SanGIS) online database (SanGIS 2014). Because 2013 land use data was not readily available, 2014 parcel data from SanGIS was used as a proxy for 2013 conditions. With respect to build-out conditions, the County provided commercial and industrial land use acres for each alternative. With respect to the land use categories present in the County's data, all "Office", "Commercial", and "Public/Semi-Public" plus half of "Village Core Mixed Use" land use types were categorized as commercial land use type. Only one land use type, "Industrial", was available to represent the overall industrial land use type. Refer to Attachment A for the build-out commercial and industrial land use assumptions used in this analysis.

Agriculture

General Approach

Agricultural sources of GHG emissions include off-road farm equipment, irrigation pumps, fertilizer volatilization, lime and urea application, pesticide application, residue burning, and manure management and enteric fermentation associated with livestock. Emissions from the agriculture sector do not include emissions from upstream conveyance and treatment of water used for irrigation; these emissions are included under the water sector. The process data for San Diego County's agricultural sector were obtained from a variety of sources, as discussed in detail below.

2013 County Emissions Inventory

GHG emissions associated with farming equipment were obtained from ARB's OFFROAD2007 model (ARB 2006a). ARB has a more recent off-road equipment model, the 2011 OFFROAD inventory model, but it is limited to construction, industrial, and oil drilling equipment types and does not include agricultural equipment. In cases where the 2011 inventory model does not cover a desired category, the ARB recommends using OFFROAD2007 as the current tool for estimating emissions.

The GHG emission factor and quantification method for agricultural irrigation pumps and number of pumps were obtained from ARB's GHG emissions inventory (ARB 2006b). Pump emissions were based on emissions from diesel powered pumps. Without additional published data, the number of diesel pumps in the unincorporated county in 2013 was assumed to be the same as the number of diesel pumps within the San Diego County APCD in 2003, postulating that all agricultural pumps are located within the unincorporated area and that little to no change has occurred since 2003 (ARB 2006b: Table D-2).

The acreage of each commercial crop type cultivated was based on the *2013 San Diego County Agricultural Crop Report* (County of San Diego [no date]). The amount of fertilizer application for each crop type grown in San Diego County was based on sample cost reports for each crop that are published by the University of California Cooperative Extension (University of California Cooperative Extension [various]). Emission factors and quantification methods for GHG emissions associated with fertilizer application were obtained from an IPCC's publication titled *N_2O: Direct Emissions from Agricultural Soil*s (IPCC [no date]). This same emission factor and quantification methods were used by ARB in its development of the state-wide GHG inventory (ARB 2007) and subsequent updates (ARB 2009, 2011, 2014).

Information about the mass amounts of urea and lime was provided in the Fertilizing Materials Tonnage Report for January to June of 2012 (California Department of Food and Agriculture [no date]). GHG emissions associated with urea and lime application were estimated using methodologies and emission factors provided in the IPCC's publication titled *N_2O: Direct Emissions from Agricultural Soil*s (IPCC [no date]).

Information about the mass amount of pesticides was obtained from the California Pesticide Information Portal, a web-based look-up table provided by the California Department of Pesticide Regulation (California Department of Pesticide Regulation [no date]). Two pesticides, specifically methyl bromide and sulfuryl fluoride, are also considered GHGs. Levels of CO_2e associated with application of methyl bromide and sulfuryl fluoride were calculated using a global warming potential value published by the IPCC (IPCC 2013: 733). Sulfuryl fluoride is most often used in structural pest control as a fumigant, and is not included as an agricultural emissions source, but is included later in a separate category. Based on the published factors from IPCC's fifth assessment report, methyl bromide is assumed to have a GWP factor of 2.

Residue burning refers to the burning of crop lands after they are harvested to clear the land of residual vegetation. The methodologies used to estimate GHG emissions from residue burning in San Diego County were based on the same methods used in ARB's statewide inventory. The inventory methodology takes into account the frequency in which residue burning occurs by applying a metric labeled "fraction of production areas burned" on an annual basis.

GHG emissions are also associated with various types of livestock. Methane is a GHG that is produced by the particular type of digestion process that some livestock have called enteric fermentation. Methane and nitrous oxide emissions are also associated with the manure produced by these animals. The quantity (i.e., number of head) of livestock in San Diego County was taken from the 2013 San Diego County Agricultural Crop Report (County of San Diego [no date]). All livestock-generated GHG emissions were estimated using emission factors and quantification methods identical to those by ARB in the statewide inventory.

2020, 2030, and 2050 County Emissions Forecasts

Future trends in agricultural emissions are assumed to be proportional to the anticipated change in irrigated and non-irrigated farmland. While the build-out agricultural land use under the General Plan scenarios can indicate some anticipated level of future agricultural use, current areas zoned for agriculture are not always farmed due to a variety of environmental and economic reasons. For this reason, the San Diego Farm Bureau was contacted to provide their best guess on anticipated future changes to agriculture in the County. The Farm Bureau estimated that non-irrigated rangeland would not change in future years, considering the relatively stable historical trends in rangeland acreages. However, the Farm Bureau estimated that irrigated farmland would experience a net loss of 500 to 750 acres per year, assuming no major environmental or economic effects on agriculture. (Larson, pers. comm., 2015)

Future soil management and farm equipment emissions were scaled by the change in irrigated farmland. Livestock emissions were assumed to remain unchanged in future years, consistent with the lack of change expected for rangelands (non-irrigated farmland). Because agricultural forecasts were based on input from the Farm Bureau, future agricultural emissions would not vary by alternative.

Solid Waste

General Approach

GHG emissions attributed to the solid waste sector include emissions from annual solid waste disposal. In addition, the inventory includes waste-in-place emissions associated with existing solid waste decomposition (i.e., anaerobic and aerobic decomposition that primarily produce CH_4 and CO_2 emissions, respectively).

2013 County Emissions Inventory

Annual GHG emissions associated with 2013 solid waste disposal were calculated using total disposal tonnage and emissions factors in the County's 2005 inventory based on ICLEI's CACP software. Solid waste disposal data for the unincorporated County in 2013 were obtained from CalRecycle's database.

Waste-in-place emissions associated with existing solid waste were extracted from the County's reported emissions inventory in the Climate Registry Information System (CRIS) for 2013. Reported emissions were apportioned by the unincorporated County population. For the community-wide inventory, only emissions for the Bonsall, Jamacha, and Valley Center landfills were included since these are the closed landfills located within unincorporated County boundaries. Used calculated emission factor using total tonnage and emissions found in 2005 inventory and applied that to the 2013 tonnage

2020, 2030, and 2050 County Emissions Forecasts

Forecasts for solid-waste-related GHG emissions were estimated using anticipated population served (community solid waste) and a natural decay rate of 1.98% per year from closed landfills (solid waste facilities).

Wastewater

General Approach

Wastewater emissions result from the release of methane gas through anaerobic digestion occurring in wastewater streams. Wastewater emissions were calculated using the same methodology used in the County's 2005 GHG Inventory which was based on Equation 6.3 in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006: 6.13). The inputs to this equation include population and country-specific biochemical oxygen demand (BOD) to calculate the total organic waste (TOW) per capita. A TOW methane emissions factor based on the average US treatment system is then applied to the calculated TOW to obtain total wastewater emissions.

2013 County Emissions Inventory

Based on the method describe above, 2013 unincorporated wastewater emissions were calculated using the IPCC Equation 6.3 and the total unincorporated county population, as shown in Table 8.

2020, 2030, and 2050 County Emissions Forecasts

Wastewater emissions for each alternative in 2050 were scaled from 2013 emissions based on the forecasted population as shown in Table 8. 2020 and 2030 emissions were scaled with the 2020 and 2030 unincorporated population data as interpolated between 2013 and 2050 build-out scenarios. This population-based method is mathematically equivalent to the method used to calculate the 2013 wastewater emissions.

Potable Water

General Approach

Potable water emissions result from electricity generation used to treat and convey potable water. Water-related energy use (kWh per million gallons) for agricultural and other uses was available from the California Energy Commission report, *California's Water-Energy Relationship* (CEC 2005: 11, 13). The CEC factors were assumed to be applicable to all years and alternatives. Electricity emission factors used in this sector are the same as those used to calculate building energy emissions.

2013 County Emissions Inventory

The San Diego County Water Authority's 2013 Annual Report provided the County's total agricultural and municipal/industrial water use in acre-feet. Because the 2013 report did not indicate how much of the county's water use was in the unincorporated area, the ratio of unincorporated population in each water district was applied to calculate the unincorporated portion of the County's water use (San Diego County Water Authority [no date]). CEC water-energy factors and 2013 electricity emission factors were applied to the total unincorporated water use in 2013 to calculate the existing potable water emissions.

2020, 2030, and 2050 County Emissions Forecasts

For potable water emissions in 2020, 2030, and 2050, agricultural and municipal/industrial water use in 2013 were scaled by the anticipated change in irrigated agricultural land and population, respectively. As with forecasted building energy emissions, the calculated SDG&E emissions factor based on a 33% renewable mix was applied to all electricity forecasts for 2020 through 2050.

Off-Road

General Approach

As mentioned under the Agricultural sector discussion above, GHG emissions associated with the operation of off-road equipment within the County were obtained from ARB's OFFROAD2007 model (ARB 2006a). ARB has a more recent off-road equipment model, the 2011 off-road inventory model, but it is limited to construction, industrial, and oil drilling equipment types and does not include other equipment such as landscaping equipment or recreational off-road vehicles. In cases where the 2011 inventory model does not cover a desired category, the ARB recommends using OFFROAD2007 as the current tool for estimating emissions. OFFROAD2007 reports CO_2, CH_4, and N_2O emissions.

This sector specifically excludes agricultural equipment emissions as they are already accounted for under the Agriculture sector.

2013 County Emissions Inventory

2013 off-road emissions for the county were taken from ARB's OFFROAD2007 model. To calculate the unincorporated portion of emissions, county-wide off-road emissions were scaled by the unincorporated population. 2013 off-road emissions were provided in the following categories: construction, transportation refrigerants, lawn and garden, light commercial, recreational and pleasure craft, and industrial.

2020, 2030, and 2050 County Emissions Forecasts

The method used to scale 2013 off-road emissions to future years and alternatives varied for each off-road emissions category. Construction, lawn and garden, and recreational and pleasure craft off-road emissions were scaled by population; light commercial off-road emissions were scaled by commercial acres; industrial off-road emissions were scaled by industrial acres; and transportation refrigerant off-road emissions were scaled by both commercial and industrial acres. For an explanation of how the commercial and industrial acres were developed, please refer the previous Energy sector discussion.

Other

General Approach

Sulfuryl fluoride (SO_2F_2) is a fully fluorinated greenhouse gas recognized by the IPCC a new species included in their 2013 Fifth Assessment Report (FAR) (IPCC 2013: 676). The FAR reported a 100-year lifetime GWP factor of 4,090 for sulfuryl fluoride emissions, which is significantly higher than the GWP factors of methane or nitrous oxide. It is mainly used as a fumigant pesticide in structural pest control, although it is sometimes used as a replacement for methyl bromide, an agricultural pesticide.

2013 County Emissions Inventory

The latest report from the California Department of Pesticide Regulation indicates that San Diego County used 383,643 pounds of SO_2F_2 in 2012 (California Department of Pesticide Regulation. [no date]). A 2009 article in the Journal of Geophysical Research estimated that approximately one third of SO_2F_2 used in fumigation would be destroyed in the fumigation process (Mühle et.al. 2009). Assuming that all sulfuryl fluoride used in the County was for fumigation and scaling the resulting emissions by the unincorporated population in 2013, total sulfuryl fluoride emissions from the unincorporated county in 2013 are estimated to be 74,149 $MTCO_2e$.

2020, 2030, and 2050 County Emissions Forecasts

Sulfuryl fluoride emissions in 2050 were scaled from 2013 emissions based on the forecasted population data as shown in Table 8. 2020 and 2030 emissions for each alternative were scaled with the 2020 and 2030 unincorporated populations as interpolated between 2013 and 2050 build-out scenarios.

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Personal Communications

Chen, Monique and Phuong Nguyen, Fehr and Peers, Roseville, CA. July 5, 2011—memorandum to Kim Howlett of ATKINS regarding the traffic analysis for the "Recommended Project 2011" as referenced in the San Diego County General Plan Update EIR Volume IV Appendix E.

Citrano, Robert. Land Use Planner. County of San Diego. San Diego, CA. January 15, 2015a—email to Erik de Kok of Ascent Environmental with spreadsheet of projected land use assumptions for each FCI alternative.

Citrano, Robert. Land Use Planner. County of San Diego. San Diego, CA. January 9, 2015b—email to Honey Walters of Ascent Environmental with attached list of active general plan amendments and their associated land uses.

Larson, Eric. Executive Director. San Diego County Farm Bureau. Escondido, CA. March 4, 2015—email to Brenda Hom of Ascent Environmental with regarding anticipated change in San Diego County agricultural land use.

Attachment A

Existing General Plan (2015)					
Community	**Office Prof.**	**Commercial**	**Industrial**	**VCMU**	**Pub/Semi Pub**
Alpine	5	131	256	41	716
Bonsall	10	88	0	0	1,208
Central Mnt.	3	43	2	0	1,887
Cuyamaca	*0*	*2*	*0*	*0*	*201*
Descanso	*0*	*14*	*0*	*0*	*512*
Pine Valley	*3*	*27*	*2*	*0*	*1,174*
Remainder	*0*	*0*	*0*	*0*	*0*
Crest/Dehesa	0	19	0	0	120
County Islands	0	0	0	0	259
Desert	27	863	171	0	1,503
Borrego Springs	*27*	*793*	*171*	*0*	*997*
Remainder	*0*	*70*	*0*	*0*	*506*
Fallbrook	54	253	283	118	1,890
Jamul/Dulzura	10	104	0	0	371
Julian	0	84	0	0	175
Lakeside	6	407	1,274	0	732
Mountain Empire	0	450	352	0	2,843
Boulevard	*0*	*177*	*0*	*0*	*933*
Campo/L. Morena	*0*	*52*	*6*	*0*	*913*
Jacumba	*0*	*76*	*0*	*0*	*734*
Potrero	*0*	*50*	*0*	*0*	*34*
Tecate	*0*	*95*	*346*	*0*	*59*
Remainder	*0*	*0*	*0*	*0*	*170*
North County Metro	66	289	97	0	992
Hidden Meadows	*7*	*144*	*0*	*0*	*391*
Twin Oaks	*51*	*59*	*45*	*0*	*162*
Remainder	*8*	*86*	*52*	*0*	*439*
North Mountain	0	122	0	0	208
Palomar Mnt.	*0*	*0*	*0*	*0*	*120*
Remainder	*0*	*122*	*0*	*0*	*88*
Otay	0	97	2,353	0	1,580
Pala/Pauma Valley	0	42	0	0	1,807
Pendleton/DeLuz	0	0	0	0	302
Rainbow	0	67	11	0	519
Ramona	18	409	185	0	1,447
San Dieguito	5	133	305	13	361
Spring Valley	74	234	284	0	579
Sweetwater	14	35	0	0	678
Valle de Oro	24	225	20	0	720
Valley Center	15	249	101	55	709

FCI GPA - Proposed Project					
Community	**Office Prof.**	**Commercial**	**Industrial**	**VCMU**	**Pub/Semi Pub**
Alpine	5	277	239	193	716
Bonsall	10	88	0	0	1,208
Central Mnt.	3	52	2	0	1,887
Cuyamaca	*0*	*2*	*0*	*0*	*201*
Descanso	*0*	*19*	*0*	*0*	*512*
Pine Valley	*3*	*31*	*2*	*0*	*1,174*
Remainder	*0*	*0*	*0*	*0*	*0*
Crest/Dehesa	0	19	0	0	120
County Islands	0	0	0	0	259
Desert	27	863	171	0	1,503
Borrego Springs	*27*	*793*	*171*	*0*	*997*
Remainder	*0*	*70*	*0*	*0*	*506*
Fallbrook	54	253	283	118	1,890
Jamul/Dulzura	10	104	0	0	371
Julian	0	84	0	0	170
Lakeside	6	407	1,274	0	732
Mountain Empire	0	450	352	0	2,843
Boulevard	*0*	*177*	*0*	*0*	*933*
Campo/L. Morena	*0*	*52*	*6*	*0*	*913*
Jacumba	*0*	*76*	*0*	*0*	*734*
Potrero	*0*	*50*	*0*	*0*	*34*
Tecate	*0*	*95*	*346*	*0*	*59*
Remainder	*0*	*0*	*0*	*0*	*170*
North County Metro	66	289	97	0	992
Hidden Meadows	*7*	*144*	*0*	*0*	*391*
Twin Oaks	*51*	*59*	*45*	*0*	*162*
Remainder	*8*	*86*	*52*	*0*	*439*
North Mountain	0	151	0	0	214
Palomar Mnt.	*0*	*29*	*0*	*0*	*126*
Remainder	*0*	*122*	*0*	*0*	*88*
Otay	0	97	2,353	0	1,580
Pala/Pauma Valley	0	42	0	0	1,807
Pendleton/DeLuz	0	0	0	0	302
Rainbow	0	67	11	0	519
Ramona	18	409	185	0	1,447
San Dieguito	5	133	305	13	361
Spring Valley	74	234	284	0	579
Sweetwater	14	35	0	0	678
Valle de Oro	24	225	20	0	720
Valley Center	15	249	101	55	709

FCI GPA - Mid-Density Alternative					
Community	**Office Prof.**	**Commercial**	**Industrial**	**VCMU**	**Pub/Semi Pub**
Alpine	5	276	239	193	716
Bonsall	10	88	0	0	1,208
Central Mnt.	3	52	2	0	1,887
Cuyamaca	*0*	*2*	*0*	*0*	*201*
Descanso	*0*	*19*	*0*	*0*	*512*
Pine Valley	*3*	*31*	*2*	*0*	*1,174*
Remainder	*0*	*0*	*0*	*0*	*0*
Crest/Dehesa	0	19	0	0	120
County Islands	0	0	0	0	259
Desert	27	863	171	0	1,503
Borrego Springs	*27*	*793*	*171*	*0*	*997*
Remainder	*0*	*70*	*0*	*0*	*506*
Fallbrook	54	253	283	118	1,890
Jamul/Dulzura	10	104	0	0	371
Julian	0	84	0	0	170
Lakeside	6	407	1,274	0	732
Mountain Empire	0	450	352	0	2,843
Boulevard	*0*	*177*	*0*	*0*	*933*
Campo/L. Morena	*0*	*52*	*6*	*0*	*913*
Jacumba	*0*	*76*	*0*	*0*	*734*
Potrero	*0*	*50*	*0*	*0*	*34*
Tecate	*0*	*95*	*346*	*0*	*59*
Remainder	*0*	*0*	*0*	*0*	*170*
North County Metro	66	289	97	0	992
Hidden Meadows	*7*	*144*	*0*	*0*	*391*
Twin Oaks	*51*	*59*	*45*	*0*	*162*
Remainder	*8*	*86*	*52*	*0*	*439*
North Mountain	0	151	0	0	214
Palomar Mnt.	*0*	*29*	*0*	*0*	*126*
Remainder	*0*	*122*	*0*	*0*	*88*
Otay	0	97	2,353	0	1,580
Pala/Pauma Valley	0	42	0	0	1,807
Pendleton/DeLuz	0	0	0	0	302
Rainbow	0	67	11	0	519
Ramona	18	409	185	0	1,447
San Dieguito	5	133	305	13	361
Spring Valley	74	234	284	0	579
Sweetwater	14	35	0	0	678
Valle de Oro	24	225	20	0	720
Valley Center	15	249	101	55	709

FCI GPA - Modified FCI Condition					
Community	**Office Prof.**	**Commercial**	**Industrial**	**VCMU**	**Pub/Semi Pub**
Alpine	5	174	239	41	716
Bonsall	10	88	0	0	1,208
Central Mnt.	3	52	2	0	1,887
Cuyamaca	*0*	*2*	*0*	*0*	*201*
Descanso	*0*	*19*	*0*	*0*	*512*
Pine Valley	*3*	*31*	*2*	*0*	*1,174*
Remainder	*0*	*0*	*0*	*0*	*0*
Crest/Dehesa	0	19	0	0	120
County Islands	0	0	0	0	259
Desert	27	863	171	0	1,503
Borrego Springs	*27*	*793*	*171*	*0*	*997*
Remainder	*0*	*70*	*0*	*0*	*506*
Fallbrook	54	253	283	118	1,890
Jamul/Dulzura	10	104	0	0	371
Julian	0	84	0	0	170
Lakeside	6	407	1,274	0	732
Mountain Empire	0	450	352	0	2,843
Boulevard	*0*	*177*	*0*	*0*	*933*
Campo/L. Morena	*0*	*52*	*6*	*0*	*913*
Jacumba	*0*	*76*	*0*	*0*	*734*
Potrero	*0*	*50*	*0*	*0*	*34*
Tecate	*0*	*95*	*346*	*0*	*59*
Remainder	*0*	*0*	*0*	*0*	*170*
North County Metro	66	289	97	0	992
Hidden Meadows	*7*	*144*	*0*	*0*	*391*
Twin Oaks	*51*	*59*	*45*	*0*	*162*
Remainder	*8*	*86*	*52*	*0*	*439*
North Mountain	0	151	0	0	214
Palomar Mnt.	*0*	*29*	*0*	*0*	*126*
Remainder	*0*	*122*	*0*	*0*	*88*
Otay	0	97	2,353	0	1,580
Pala/Pauma Valley	0	42	0	0	1,807
Pendleton/DeLuz	0	0	0	0	302
Rainbow	0	67	11	0	519
Ramona	18	409	185	0	1,447
San Dieguito	5	133	305	13	361
Spring Valley	74	234	284	0	579
Sweetwater	14	35	0	0	678
Valle de Oro	24	225	20	0	720
Valley Center	15	249	101	55	709

Total Unincorporated Acres

	Existing General Plan	Proposed Project	FCI June 2014 Staff Recommendation	Modified FCI Condition	FCI - No Project (=Existing)
Commercial (Office, Commercial, 50% VCMU, P-SP)	26,392.18	26,652.88	26,651.88	26,473.68	26,392.18
Industrial	5,693.38	5,676.93	5,676.93	5,676.93	5,693.38

2013 UNINCORPORATED COUNTY BASELINE GHG INVENTORY - COMMUNITY

SECTOR	SUBSECTOR	ACTIVITY DATA	UNITS/YEAR	MT CO_2	MT CH_4	MT N_2O	EMISSIONS (MT CO_2e / YEAR)
ENERGY							
	Residential Electricity	1,362,545,339	kWh	379,856	18	4	381,365
	Residential Direct Access Electricity	6,722,204	kWh	1,874	0	0	1,881
	Residential Natural Gas	37,097,579	Therms	196,691	1,855	37	250,334
	Residential Direct Access Natural Gas	8,201	Therms	43	0	0	55
	RESIDENTIAL SUBTOTAL	***1,406,373,323***		***578,465***	***1,873***	***41***	***633,636***
	Commercial Electricity	927,871,044	kWh	258,676	12	3	259,703
	Commercial Direct Access Electricity	112,201,898	kWh	31,280	1	0	31,404
	Commercial Natural Gas	20,132,967	Therms	106,745	1,007	20	135,857
	Commercial Direct Access Natural Gas	3,169,615	Therms	16,805	158	3	21,389
	COMMERCIAL SUBTOTAL	***1,063,375,524***		***413,506***	***1,179***	***26***	***448,353***
	Industrial Electricity	279,712,413	kWh	77,979	4	1	78,289
	Industrial Direct Access Electricity	128,244,582	kWh	35,753	2	0	35,895
	Industrial Natural Gas	4,714,542	Therms	24,997	236	5	31,814
	Industrial Direct Access Natural Gas	32,996,868	Therms	174,949	1,650	33	222,663
	INDUSTRIAL SUBTOTAL	***445,668,405***		***313,678***	***1,891***	***39***	***368,660***
	ENERGY SUBTOTAL						**1,450,649**
WATER							
	Water Demand	37,238	million gallons	128,589	2	0	128,771
	Wastewater	0	million gallons		2,295		52,787
	WATER SUBTOTAL						**181,558**
WASTE							
	Solid Waste	475,727	tons		4,435		101,996
	Waste-in-Place				217	0.0231	4,992
	WASTE SUBTOTAL						**106,987**
TRANSPORATION							
	Vehicle Miles Traveled	4,377,766,172	VMT				2,162,015
	TRANSPORTATION SUBTOTAL						**2,162,015**
OFF-ROAD/MOBILE							
	Construction			133,827	15	1	134,397
	Transportation Refrigerants			28,596	9	1	29,242
	Lawn and Garden			11,810	18	8	14,543
	Light Commercial			21,665	6	3	22,752
	Recreational and Pleasure Craft			62,317	60	19	69,477
	Industrial			13,951	2	0	14,024
	OFF-ROAD/MOBILE SUBTOTAL						**284,436**

2013 UNINCORPORATED COUNTY BASELINE GHG INVENTORY - COMMUNITY

SECTOR	SUBSECTOR	ACTIVITY DATA	UNITS/YEAR	MT CO_2	MT CH_4	MT N_2O	EMISSIONS (MT CO_2e / YEAR)
AGRICULTURE							
	Soil Management						28,005
	Livestock						48,597
	Farm Equipment						104,501
	AGRICULTURE SUBTOTAL						**181,103**
HIGH GWP GASES							
	Sulfuryl Fluoride	59,977	lb/year				74,179
	HIGH GWP GASES SUBTOTAL						**74,179**
TOTAL							**4,440,928**

Water Sector

County of San Diego Greenhouse Gas Emissions Inventory Potable Water									
						Emissions			Total Emissions
Year	Alternative	Application	MG	kWh/MG/year[c]	MWh	CO_2 (MT)	CH_4 (MT)	N_2O (MT)	MT CO_2e/yr
2013	Existing	Municipal and Industrial	24,400	12,700	309,877	86389	0.164	0.035	86,403
2013	Existing	Agriculture	12,838	11,791	151,373	42200	1.956	0.414	42,368
2013	Existing	Total	37,238		461,250	128,589	2	0	128,771
2020	All	Agriculture	11,973	11,791	141,175	34515	1.642	0.347	34,656
2030	All	Agriculture	10,014	11,791	118,078	28868	1.373	0.291	28,986
2050	All	Agriculture	6,448	11,791	76,033	18589	0.884	0.187	18,665
2020	Proposed Project	Municipal and Industrial	27,577	12,700	350,226	85625	0.148	0.031	85,637
2030	Proposed Project	Municipal and Industrial	29,319	12,700	372,351	91034	0.148	0.031	91,046
2050	Proposed Project	Municipal and Industrial	32,803	12,700	416,598	101851	0.148	0.031	101,864

Summary of Emissions ($MTCO_2e$)

	2020	2030	2050
Proposed Project	120,293	120,032	120,529

Sources

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California Energy - Water Relationship Staff Report CEC-700-2005-011-SF CEC 2005.
CCAR. 2009. General Reporting Protocol Version 3.1. Appendix E

ENERGY FORECAST

Activity Data			Existing	Proposed Project		
SECTOR	**SUBSECTOR**	**UNITS/YEAR**	**2013**	**2020**	**2030**	**2050**
ENERGY						
	Residential Electricity	kWh	1,362,545,339	1,539,960,261	1,652,065,167	1,876,274,977
	Residential Direct Access Electricity	kWh	6,722,204	7,597,492	8,150,569	9,256,722
	Residential Natural Gas	Therms	37,097,579	41,927,997	44,980,241	51,084,728
	Residential Direct Access Natural Gas	Therms	8,201	9,269	9,944	11,294
	Commercial Electricity	kWh	927,871,044	1,423,010,270	2,130,352,021	3,545,035,523
	Commercial Direct Access Electricity	kWh	112,201,898	172,076,125	257,610,734	428,679,952
	Commercial Natural Gas	Therms	20,132,967	30,876,510	46,224,427	76,920,262
	Commercial Direct Access Natural Gas	Therms	3,169,615	4,861,014	7,277,299	12,109,869
	Industrial Electricity	kWh	279,712,413	420,646,346	621,980,536	1,024,648,916
	Industrial Direct Access Electricity	kWh	128,244,582	192,860,997	285,170,161	469,788,489
	Industrial Natural Gas	Therms	4,714,542	7,089,978	10,483,458	17,270,418
	Industrial Direct Access Natural Gas	Therms	32,996,868	49,622,439	73,373,254	120,874,884

EMISSIONS (MT CO_2e / YEAR)			Existing	Proposed Project		
SECTOR	**SUBSECTOR**		**2013**	**2020**	**2030**	**2050**
ENERGY						
	Residential Electricity		381,365	378,029	405,549	460,588
	Residential Direct Access Electricity		1,881	1,865	2,001	2,272
	Residential Natural Gas		250,334	282,930	303,527	344,720
	Residential Direct Access Natural Gas		55	63	67	76
	RESIDENTIAL SUBTOTAL		***633,636***	***662,887***	***711,143***	***807,656***
	Commercial Electricity		259,703	349,320	522,958	870,235
	Commercial Direct Access Electricity		31,404	42,241	63,238	105,232
	Commercial Natural Gas		135,857	208,355	311,922	519,058
	Commercial Direct Access Natural Gas		21,389	32,802	49,107	81,717
	COMMERCIAL SUBTOTAL		***448,353***	***632,718***	***947,226***	***1,576,242***
	Industrial Electricity		78,289	103,260	152,684	251,531
	Industrial Direct Access Electricity		35,895	47,343	70,004	115,324
	Industrial Natural Gas		31,814	47,843	70,742	116,541
	Industrial Direct Access Natural Gas		222,663	334,852	495,123	815,664
	INDUSTRIAL SUBTOTAL		***368,660***	***533,299***	***788,552***	***1,299,059***

Proportionality Calculations for Proposed Project

	2013	2020	2030	2050
Housing units	172,124	194,536	208,698	237,021
Commercial acres	6,976	10,699	16,017	26,653
Industrial acres	1,550	2,331	3,446	5,677

Total number of units on FCI Lands at Buildout	6,245	Assumed to be built out by 2050
Commercial acres on FCI Lands	261	

Growth Proportionality for Proposed Project with respect to Overall Growth in County

	2013	2020	2030	2050
All Housing Units in Unincorporated County	172,124	194,536	208,698	237,021
Increase over 2013		22,412	36,574	64,897
Proportion of FCI units in 2050				10%
FCI units built by each horizon year		2,157	3,519	6,245

	2013	2020	2030	2050
Commercial Acres in Unincorporated County	6,976	10,699	16,017	26,653
Increase over 2013		3,723	9,041	19,677
Proportion of FCI units in 2050				1%
FCI units built by each horizon year		49	120	261

2020 Energy-related Emissions (Unmitigated and Mitigated)

	kWh/year	Title 24 kWh	Reduction T24 2008 to 2013 (kWh)	Mitigated kWh/year	MT CO_2e/yr (Unmitigated)	MT CO_2e/yr (Mitigated)
Residential Electricity	17,156,744	1,024,978	651,886	16,783,652.04	5,011	4,105
Commercial Electricity	7,361,893	2,039,727	1,595,066	6,917,232.24	2,150	1,692
					7,161	5,797

Electricity Emission Factors

	MT CO_2/MWh	MT CH_4/MWh	MT N_2O/MWh
20% RPS	2.91E-01	1.29E-05	2.74E-06
33% RPS	2.44E-01	1.08E-05	2.29E-06

	therms/year	Title 24 therms	Reduction T24 2008 to 2013 (therms)	Mitigated therms/year	MT CO_2e/yr (Unmitigated)	MT CO_2e/yr (Mitigated)
Residential Natural Gas	464,931	367,097	343,236	441,069.24	3,137	2,976
Commercial Natural Gas	164,941	86,432	71,912	150,420.81	1,113	1,015
					4,250	3,991

Natural Gas Emission Factors

MT CO_2/therm	MT CH_4/therm	MT N_2O/therm
0.005302	0.000050	0.000001

Notes:

kWh = kilowatt-hours

MWh = megawatt-hours

MTCO2e = metric tons of carbon dioxide equivalent

CO2 = carbon dioxide

CH4 = methane

N2O = nitrous oxide

RPS = Renewables Portfoilio Standard

Mitigated scenario includes reductions from T24 2008 to 2013 improvements and implementation of 33% RPS

2020 Transportation-related Emissions (Unmitigated and Mitigated)

Calendar Year 2020 County-Specific Weighted Average

Category	% VMT (from EMFAC 2014)	VMT	Average kWh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)	Emissions (MT CO_2)	Emissions (MT CH_4)	Emissions (MT N_2O)	Total Emissions (MT CO_2e)
Diesel	6%	3,486,025		1185.03	0.12	0.04	4,131.030	0.401	0.136	4,180
Electric	1.7%	969,037	29.00	0.84	0.00	0.00	0.818	0.000	0.000	1
Gasoline	92%	51,989,997		364.78	0.01	0.01	18,965.015	0.764	0.314	19,076
Totals		56,445,060								23,257

Calendar Year 2020 County-Specific Weighted Average

Category	% VMT (from EMFAC 2014)	VMT	Average kWh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)	Emissions (MT CO_2)	Emissions (MT CH_4)	Emissions (MT N_2O)	Total Emissions (MT CO_2e)
Diesel	6%	3,486,025		1316.70	0.13	0.04	4,590.033	0.446	0.136	4,641
Electric	1.7%	969,037	29.00	0.84	0.00	0.00	0.818	0.000	0.000	1
Gasoline	92%	51,989,997		410.01	0.01	0.01	21,316.677	0.764	0.314	21,427
Totals		56,445,060								26,069

LCFS Reduction	10%	36.48
Advanced Clean Cars Reduction	2.40%	8.75
		45.23

Conversion Factors

1	MT
1000000	g

Notes:

VMT = vehicle miles traveled; see Table 3 of Appendix
kWh = kilowatt-hours
g = grams
mi = miles
CO_2 = carbon dioxide
CH_4 = methane
N_2O = nitrous oxide
MT = metric tons
CO_2e = carbon dioxide equivalent
LCFS = Low Carbon Fuel Standard

2020 Water and Wastewater Emissions (Unmitigated and Mitigated)

MG/year	kWh/MG	MWh/year	$MTCO_2e/yr$
306	12,700	3,886	1,135
306	12,700	3,886	951

Wastewater	661	MTCO2e

Electricity Emission Factors

	MT CO_2/MWh	MT CH_4/MWh	MT N_2O/MWh
20% RPS	2.91E-01	1.29E-05	2.74E-06
33% RPS	2.44E-01	1.08E-05	2.29E-06

Notes:

kWh = kilowatt hours

MWh = megawatt hours

MG = million gallons

$MTCO_2e$ = metric tons of carbon dioxide equivalent

RPS = Renewables Portfolio Standard

CO_2 = carbon dioxide

CH_4 = methane

N_2O = nitrous oxide

Reductions applied for 33% RPS to water consumption

No reductions applied to wastewater emissions

Energy-related Emissions for Proposed Project

	2013	2020	2030	2050
Residential kWh	1,362,545,339	1,539,960,261	1,652,065,167	1,876,274,977
Residential DA kWh	6,722,204	7,597,492	8,150,569	9,256,722
Total residential kWh	**1,369,269,556**	**1,547,559,773**	**1,660,217,765**	**1,885,533,749**
Inrease over 2013 kWh		**178,290,217**	**290,948,209**	**516,264,193**
FCI Only kWh		**17,156,744**	**27,997,744**	**49,679,745**
FCI Only $MTCO_2e$		**5,011**	**6,848**	**12,151**

Residential therms	37,097,579	41,927,997	44,980,241	51,084,728
Residential DA therms	8,201	9,269	9,944	11,294
Total residential therms	**37,105,780**	**41,937,266**	**44,990,185**	**51,096,022**
Increase over 2013 therms		**4,831,486**	**7,884,405**	**13,990,242**
FCI only therms		**464,931**	**758,711**	**1,346,271**
FCI Only $MTCO_2e$		**3,137**	**5,120**	**9,085**

Commercial kWh	927,871,044	1,423,010,270	2,130,352,021	3,545,035,523
Commercial DA kWh	112,201,898	172,076,125	257,610,734	428,679,952
Total commercial kWh	**1,040,072,942**	**1,595,086,394**	**2,387,962,755**	**3,973,715,475**
Inrease over 2013 kWh		**555,013,452**	**1,347,889,813**	**2,933,642,533**
FCI Only kWh		**7,361,893**	**17,878,882**	**38,912,861**
FCI Only $MTCO_2e$		**2,150**	**4,373**	**9,518**

Commercial therms	20,132,967	30,876,510	46,224,427	76,920,262
Commercial DA therms	3,169,615	4,861,014	7,277,299	12,109,869
Total commercial therms	**23,302,582**	**35,737,524**	**53,501,726**	**89,030,131**
Increase over 2013 therms		**12,434,942**	**30,199,144**	**65,727,549**
FCI only therms		**164,941**	**400,572**	**871,833**
FCI Only $MTCO_2e$		**1,113**	**2,703**	**5,883**

Electricity Emission Factors

	MT CO_2/MWh	MT CH_4/MWh	MT N_2O/MWh
20% RPS	2.91E-01	1.29E-05	2.74E-06
33% RPS	2.44E-01	1.08E-05	2.29E-06

Natural Gas Emission Factors

MT CO_2/therm	MT CH_4/therm	MT N_2O/therm
0.005302	0.000050	0.000001

Notes:

kWh = kilowatt-hours

DA = Direct access

$MTCO_2e$ = metric tons of carbon dioxide equivalent

CO_2 = carbon dioxide

CH_4 = methane

N_2O = nitrous oxide

RPS = Renewables Portfoilio Standard

Energy use for the proposed project was estimated by applying the proportion of growth anticipated to occur on FCI lands

Transportation Emissions - Proposed Project

2020 ***County-Specific Weighted Average***

Category	% VMT (from EMFAC 2014)	VMT	Average kwh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)	Emissions (MT CO_2e)
Diesel	6%	3,486,019		1316.70	1.15E-01	3.90E-02	4,639.477
Electric	1.7%	969,036	29	0.84	3.37E-05	7.14E-06	0.820
Gasoline	92%	51,989,905		410.01	1.47E-02	6.04E-03	21,427.206
Totals		**56,444,960**					**26,068**

2030 ***County-Specific Weighted Average***

Category	% VMT (from EMFAC 2014)	VMT	Average kwh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)	Emissions (MT CO_2e)
Diesel	7%	16,559,288		1099.64	8.40E-02	3.62E-02	18,418.577
Electric	8.9%	22,063,614	29	0.71	3.37E-05	7.14E-06	15.707
Gasoline	84%	209,977,293		236.82	8.81E-03	2.74E-03	49,938.737
Totals		**248,600,196**					**68,373**

2050 ***County-Specific Weighted Average***

Category	% VMT (from EMFAC 2014)	VMT	Average kwh/100 miles	Emission Factors (g CO_2/mi)	Emission Factors (g CH_4/mi)	Emission Factors (g N_2O/mi)	Emissions (MT CO_2e)
Diesel	7%	33,761,647		1116.20	7.57E-02	3.67E-02	38,110.480
Electric	9.5%	44,575,151	29	0.71	3.37E-05	7.14E-06	31.733
Gasoline	83%	390,044,312		221.17	8.14E-03	2.34E-03	86,609.621
Totals		**468,381,110**					**124,752**

Notes:

VMT = vehicle miles traveled; see Table 3 of Appendix

kWh = kilowatt-hours

g = grams

mi = miles

CO_2 = carbon dioxide

CH_4 = methane

N_2O = nitrous oxide

MT = metric tons

CO_2e = carbon dioxide equivalent

Water Consumption-related Emissions for Proposed Project

Potable Water

	Million gallons/year	kWh/MG	MWh/year	$MTCO_2e$/yr	Increase $MTCO_2e$	$MTCO_2e$ Proposed Project
2013	24,400	12,700	309,880	90,501		
2013 33% RPS	24,400	12,700	309,880	75,795		
2020	27,577	12,700	350,226	102,284	11,783	1,134
2030	29,319	12,700	372,348	91,074	15,279	1,470
2050	32,803	12,700	416,593	101,896	26,101	2,512

Wastewater

	2013	2020	2030	2050
MTCO2e - unincorporated areas	52,787	59,660	64,516	74,228
Increase over baseline		6,873	11,729	21,441
MTCO2e - proposed project only		661	1,129	2,063

Electricity Emission Factors

	MT CO_2/MWh	MT CH_4/MWh	MT N_2O/MWh
20% RPS	2.91E-01	1.29E-05	2.74E-06
33% RPS	2.44E-01	1.08E-05	2.29E-06

Notes:

kWh = kilowatt hours

MWh = megawatt hours

MG = million gallons

MTCO2e = metric tons of carbon dioxide equivalent

RPS = Renewables Portfolio Standard

CO2 = carbon dioxide

CH4 = methane

N2O = nitrous oxide

Emissions for the proposed project was estimated by applying the proportion of growth anticipated to occur on FCI lands

Solid Waste and OffRoad Emissions for Proposed Project

Solid Waste

	2013	2020	2030	2050
$MTCO_2e$ - unincorporated areas	101,996	115,276	122,938	138,263
Increase over baseline		13,281	20,943	36,267
$MTCO_2e$ - proposed project only		1,278	2,015	3,490

OffRoad

	2013	2020	2030	2050
Construction	134,397	151,897	161,993	182,185
Lawn and Garden	14,543	16,437	17,530	19,715
Total $MTCO_2e$ - unincorporated areas	148,941	168,334	179,523	201,900
Increase over baseline		19,393	30,582	52,959
$MTCO_2e$ - proposed project only		1,866	2,943	5,096

	2013	2020	2030	2050
Light Commercial	22,752	34,894	52,239	86,928
Transportation Refrigerants	29,242	44,688	66,753	110,885
Total $MTCO_2e$ - unincorporated areas	51,994	79,582	118,992	197,813
Increase over baseline		27,587	66,998	145,819
$MTCO_2e$ - proposed project only		366	889	1,934

Total offroad emissions for project		2,232	3,832	7,030

Notes:

$MTCO_2e$ = metric tons of carbon dioxide equivalent

Emissions for the proposed project was estimated by applying the proportion of growth anticipated to occur on FCI lands

Global Warming Potentials

Carbon dioxide	1	1	
Methane	23	28	100 year lifespan. With inclusion of climate-carbon feedbacks as recommended by several studies (Gillett and Matthews 2010, Collins et al. 2013)
Nitrous Oxide	296	265	100 year lifespan. With inclusion of climate-carbon feedbacks as recommended by several studies (Gillett and Matthews 2010, Collins et al. 2013)
Source	*Used in 2005 Inventory*	*IPCC Fifth Assessment Report - Chapter 8. Table 8.7*	