Appendix D

Revised Draft EIR Appendix D
GHG Calculations

The following discussion is a supplement to the Master Response MR-1 to public comments made on the draft EIR.

Discussion of Revisions to the GHG Emission Calculations in the Draft EIR

This appendix has been revised pursuant to comments made on the draft EIR. These comments expressed concern over the methodology used to quantify and forecast stationary source emissions and solid waste emissions, indicating that estimates were not consistent with relative trends in oil production and landfill operations (Comments O6-27, O6-29, O6-30, O20-4, O20-7, O37-16, O37-17). Commenters also expressed a desire to see more explicit explanations of the calculation methodologies (Comments O37-15, O20-4). These comments are summarized in Table 1.

Table 1 Summary of Comments Made Concerning the GHG Emissions Calculations in the Draft EIR

Comment Number	Comment Summary Warranting Changes to the Draft EIR
O6-27	Noted that oil and gas emissions, associated with the stationary source sector, are inconsistent with California Air Resources Board's Mandatory Reporting Rule reports
O6-29	Noted inconsistent forecasts in solid waste emissions from Simi Valley Landfill and Toland Road Landfill relative to their anticipated landfill closure dates.
O6-30, O37-16, O37-17, O20-7	Expressed concern regarding the methodology used to forecast stationary source emissions. Noted inconsistency of oil and gas forecasts through the draft EIR's use of historical oil production back through 2008 compared with historical oil production back through 1980. Expressed concern over using top-down method to estimate county's share of emissions from state level data.
O20-4	Requested methodology discussion for all sectors
O37-15	Requested clarification of emission inventory and forecast methodology.

In response to these comments, two major changes were made to the emissions inventory and forecast estimates. Solid waste emissions forecasts were adjusted to account for corrections to scaling factors used for two major landfills. The stationary source emissions inventory and forecast were also revised following concerns over the original methodology used in the draft EIR that was based on a top-down method that scaled state-level emissions to the county level using the county's proportion of oil production in the state. In this final EIR, stationary source emissions have been revised to account for county-specific emissions from the California Air Resources Board (CARB) and oil production data from the California Department of Conservation.

These changes resulted in an overall reduction in emissions estimates compared to the total GHG emissions calculated in the draft EIR and in the emissions gap needed to be closed to meet the county's mass GHG emissions targets. Table 2 summarizes the differences between the draft EIR and final EIR versions of the GHG inventory and forecasts. A more detailed version of Table 2 showing emissions broken down by sector is provided in the modeling data that follows.

Table 2 Comparison of Total Greenhouse Gas Emissions Estimates between the Draft EIR and Final EIR (MT CO_2e).

	2015	2020	2030	2040
Business As Usual Forecast				
Draft EIR	1,897,112	1,902,823	1,934,846	1,980,736
Final EIR	1,939,238	1,881,423	1,857,220	1,815,904
Difference from Draft EIR	42,126	-21,400	-77,627	-164,832
Percent Change from Draft EIR	2%	-1%	-4%	-8%
Legislatively-Adjusted Business As Usual Forecast				
Draft EIR	1,897,112	1,793,971	1,627,124	1,540,630
Final EIR	1,939,238	1,772,537	1,549,522	1,375,898
Difference from Draft EIR	42,126	-21,434	-77,603	-164,732
Percent Change from Draft EIR	2%	-1%	-5%	-11%

Source: Ascent Environmental 2020

Most of the changes shown in Table 2 were due to changes in the methodology and data used to calculate emissions from the stationary source sector, namely from oil and gas production. Corrections made to the solid waste forecasts accounted for these changes to a lesser extent. Minor corrections were made to the off-road and water and wastewater emissions forecasts to adjust forecasts by the correct scaling factors. In the draft EIR, off-road and water and wastewater emissions were incorrectly calculated to be constant into the future. These factors have been corrected in the final EIR to account for the anticipated growth in the county. The changes made to the off-road and water and wastewater emissions were made following a review of the calculations of the draft EIR and were not related to comments on the draft EIR.

The overall reduction in emissions forecasts, shown in Table 3, decreases the emissions gap needed to close for the county to reach its GHG targets. Table 3 presents the comparison between the gap analyses in the draft EIR and this final EIR.

Table 3 Comparison of GHG Reductions Needed to meet Targets between Draft EIR and Final EIR

	2020	2030	2040
Target Percent Reduction from 2015 Values1	2.1%	41.3%	60.9%
Draft EIR BAU Emissions with Legislative Reductions ($MTCO_2e$)	1,793,971	1,627,124	1,540,630
Draft EIR Mass Emission Targets ($MTCO_2e$)	1,856,620	1,113,972	742,648
Draft EIR Reductions Needed to Meet Targets ($MTCO_2e$)	-62,649	513,153	797,982
Final EIR BAU Emissions with Legislative Reductions ($MTCO_2e$)	1,772,537	1,549,522	1,375,898
Final EIR Mass Emission Targets ($MTCO_2e$)	1,897,847	1,138,708	759,139
Final EIR Reductions Needed to Meet Targets ($MTCO_2e$)	-125,310	410,813	616,760
Change in Reductions Needed ($MTCO_2e$)	-62,661	-102,339	-181,223

Note: Negative reductions needed indicate that anticipated. BAU = business-as-usual

1 Calculated from the statewide reduction targets to achieve 1990 levels by 2020, 40 percent below 1990 levels by 2030, and 60 percent below 1990 levels by 2040 and adjusting these targets relative to 2015 based on the state's emissions in 1990 and 2015.

Although the revised inventory would reduce the amount of emissions needed to meet the County's GHG targets, which would result in minor modifications to the draft EIR analysis (as provided in Chapter 3, "Revisions to the Draft EIR"). These revisions clarify and support the analysis and conclusions in the draft EIR, they would not result in new or more severe significant impacts. The GHG reduction policies and programs of the 2040 General Plan identified in the draft EIR analysis would not be affected and forecasted GHG emissions would still result in significant and unavoidable impacts.

Summary of Changes Made to the Draft EIR

Table 4 lists the changes made to the Ventura County 2015 GHG Inventory and Forecast that follows. The tab titles are shown at the top of each page starting on Page 15. A detailed explanation of the changes made to the solid waste and stationary source emissions calculations are included after Table 4.

Note that no changes were made to the proposed GHG reduction measure calculations, because those measures did not overlap with the sectors revised in the final EIR.

Table 4 Summary of Changes Made to the Ventura County 2015 GHG Inventory and Forecast in Appendix D of the Draft EIR

Tab Title	Changes Made to Appendix D of the Draft EIR
All Tabs	Made formatting more consistent and easier to read. Added notes describing scaling factors and calculation methods for each of the calculation tabs
Summary	No change
Targets	This tab was removed because its contents are already included in the gap
Forecast-Leg Adjusted	Revised all stationary source emissions, solid waste forecasts, water and wastewater forecasts, off-road forecasts, and emissions totals.
Forecast-BAU	Revised all stationary source emissions, solid waste forecasts, water and wastewater forecasts, off-road forecasts, and emissions totals.
Demographics	Added 2050 estimates that were not included in this tab in the draft EIR. 2050 estimates are shown in other tabs. Some 2050 calculations are used to interpolate 2040 estimates.
Building Energy	Formatted table headers and descriptions to clarify contents
Transportation	Formatted table headers and descriptions to clarify contents
Off-Road Equipment	Corrected forecast calculations to account for population and employment scaling factors. Previously, calculations were incorrectly scaled, resulting in no change from 2015 emissions.
Solid Waste	Added another table set for legislatively adjusted business as usual results Edited headers and descriptions Revised calculation of Waste-in-Place emissions for Toland Road Landfill and Simi Valley Landfill, such that each landfill's waste-in-place emissions were individually modeled in CARB's Landfill Emissions Tool and the resulting forecasts were adjusted by the 2015 waste-in-place emissions reported by EPA's FLIGHT database. Previous estimates for Toland Landfill and Simi Valley Landfill were using incorrect tonnage data and landfill history data. See added footnotes. Removed diversion rate table that was not used for calculation.
Imported Water	Corrected calculations to link to the demographics table to scale forecasts by population. Previous calculations were incorrectly linked, resulting in no forecasted growth.
Wastewater	Corrected forecast calculations to account for population scaling factors. Previously, calculations were incorrectly scaled.
Agriculture	Added scaling factor notes.
Stationary Source	Moved forecast table to the top of the sheet to be consistent with the formatting of the other sectors.

Tab Title	Changes Made to Appendix D of the Draft EIR
	Removed irrelevant oil and production numbers from non-Ventura counties. Removed top-down scaled county emissions from statewide oil and gas emissions. Revised 2015 oil and gas emissions to be consistent with Ventura County-specific reports in a 2013 CARB oil and gas industry survey report for 2007 data. 2015 values were scaled from 2007 based on the relative change in oil production in the county. Revised forecasts for oil and gas emissions based on oil production. Based the forecast on historical data from 1980 to 2018. Trends seemed to indicate the declining end of the Hubbert curve, which is used in predicting resource extraction trends. The set of data could be represented by an exponential curve. Added the anticipated production numbers.
Assumptions Tab	Removed extraneous rows under GWP that were not being used for calculation.
EMFAC	No changes

GHG Inventory and Forecasting Methodology for Solid Waste and Stationary Source Emissions

Solid Waste

Multiple comments received during the public review of the draft EIR addressed the transparency of the methodology used to quantify emissions from the solid waste sector. Solid waste emissions consist of methane (CH_4) emissions generated by the anaerobic decay of organic material within a landfill. This sector consists of two types of emissions sources: waste generation and waste-in-place. The comments on the solid waste emissions methodology for the GHG inventory and GHG forecast are discussed further below.

Waste generation emissions refer to CH_4 related to the waste disposed in open landfills during the baseline year of emissions inventory. Using Equation SW.4.1 from the ICLEI U.S. Communities Protocol, an emissions factor of 0.041 metric tons of CH_4 per ton is used to quantify emissions from the disposal tonnage rates for each landfill in the county, which were available from CalRecycle. This formula also accounts landfills that have systems to capture fugitive methane emissions in place. Information on which landfills have landfill gas capture systems were available from the Landfill Gas Energy Project Data from U.S. Environmental Protection Agency's (EPA) Landfill Methane Outreach Program (LMOP) database (EPA 2016a). Forecasted waste generation emissions were scaled from 2015 based on the anticipated change in the county's population.

Waste-in-place emissions refer to CH_4 emissions from waste stored in place at a landfill since the landfill first accepted waste, excluding waste deposited in its first year. Emissions generated by a landfill rise over time as more waste is deposited into the landfill. Once that landfill reaches its maximum capacity and closes to additional disposal, the rate of methane emissions from the waste-in-place at landfills reaches its peak then declines over time as the organic material left to decay is exhausted. Emissions from "waste-in-place" can occur from both open and closed landfills, depending on how recently the landfills were closed.

In the draft EIR, the 2015 waste-in-place emissions for two of the largest landfills in Ventura County (Simi Valley Landfill and Toland Road Landfill) were available from the U.S. Environmental Protection Agency's (EPA) Facility Level Information on Greenhouse Gases Tool (FLIGHT) database (EPA 2016b). The 2015 waste-in-place emissions inventory for other smaller landfills and forecasts of all waste-in-place emissions were based on landfill total tonnages and landfill open and past or anticipated closure dates. This information was input into CARB's Landfill Emissions Tool (LET) (November 2011 Version), assuming a constant rate of annual disposal, in order to estimate 2015 and post-2015 emissions. For Simi Valley Landfill and Toland Road Landfill, waste-in-place emission forecasts were scaled from their

FLIGHT 2015 emissions by the relative decay anticipated in CARB's LET based on the disposal rates and open and closure dates for those landfills. This was done to ensure consistency with landfill-specific emissions calculations from FLIGHT, which accounts for any landfill gas capture systems, and the anticipated decay rates in the LET model.

Comments correctly pointed out inconsistencies for the GHG emission forecasts for Simi Valley Landfill and Toland Road Landfill in the solid waste emission calculations in Appendix D of the draft EIR. This inconsistency was due to the following errors. For Toland Road Landfill, the draft EIR incorrectly forecasted methane emissions by scaling the landfill's 2015 emissions by waste-in-place emissions for a landfill outside the county. For Simi Valley Landfill, forecasts were based on an annual decay rate of 0.059 percent per year which was incorrectly calculated from the LET. This low decay rate resulted in a much slower decay forecast for Simi Valley Landfill than Toland Road Landfill.

The methodology intended for forecasting waste-in-place emissions in the draft EIR and recalculated in the final EIR is as follows. For Simi Valley Landfill and Toland Road Landfill, waste-in-place emission forecasts were scaled from their FLIGHT 2015 emissions by the relative decay anticipated in CARB's LET based on the disposal rates and open and closure dates for those landfills. This method was used for consistency with landfill-specific emissions calculations from FLIGHT, which accounts for any landfill gas capture systems, and the anticipated decay rates in the LET model.

Table 5 compares the results for these two landfills between the draft EIR and final EIR. The revised forecast shows much lower emissions, consistent with the anticipated decay in organic waste at each landfill.

Table 5 Draft EIR and Final EIR GHG Emissions Forecasts for Toland Road Landfill and Simi Valley Landfill (Business-as-Usual Scenario) (Metric Tons of Carbon Dioxide Equivalent [MTCO2e])

	2020	2030	2035	2040	2050
Toland Road Landfill					
Draft EIR	2,366	1,937	1,777	1,618	1,244
Final EIR	2,794	2,842	2,572	2,327	1,905
Difference	428	905	795	709	661
% Difference	18%	47%	45%	44%	53%
Simi Valley Landfill					
Draft EIR	6,127	6,091	6,073	6,055	6,019
Final EIR	6,437	6,548	5,925	5,361	4,389
Difference	310	457	-148	-694	-1,630
% Difference	5%	8%	-2%	-11%	-27%

Source: Ascent Environmental 2020

Stationary Sources

The stationary sources sector is represented by emissions generated from fixed applications that are not related to electricity generation or consumer natural gas combustion, which are already accounted for in the building energy sector of the inventory. In the county, the major stationary sources are related to oil and gas production and processing. Emissions from oil and gas, accounted for in this inventory, include emissions from on-site combustion (e.g.,

flaring) of oil and associated gas (natural gas produced as a by-product from the processing of oil) as well as fugitive emissions from the processing and extraction of oil and gas. According to CARB, combustion sources are equipment burning fuel for energy, vented emissions are intentional releases of vapors to the atmosphere, and fugitive emissions are unintentional releases of vapors to the atmosphere (CARB 2013). Further description of the types of emissions generated by oil and gas production can be found in CARB's oil and gas survey report, which is cited in CARB's California GHG inventory documentation (CARB 2013).

This inventory does not include emissions related to the combustion of products sold by the oil and gas producers, such as vehicular fuels or other petroleum products, nor does the inventory include supply chain-related emissions, such as the transport of oil via rail or maritime tankers. Emissions from combustion of vehicular fuels and rail and maritime activity are already captured in the transportation and off-road sectors, as they pertain to activity within the jurisdictional boundary of the County. The process of organizing emissions this way is recommended by the ICLEI U.S. Communities Protocol (ICLEI 2013:12). Emissions occurring outside of the county's jurisdictional boundary are subject to inclusion the emissions inventory of the respective jurisdiction(s).

Previous estimates of GHG emissions from oil and gas production were based on scaling state-level emissions to Ventura County based on the county's respective production of oil and gas. However, commenters have raised on concerns about using this method in terms how the county's emissions could be reflective of statewide emission rates.

Emissions Inventory

The estimates of the County's 2015 GHG emissions from stationary sources included in the draft EIR were based on scaling State-level emissions to the county based on the county's respective production of oil and gas. However, comments on the draft EIR raised concerns about the appropriateness of using this method to estimate GHG emissions associated with oil and gas production in the county. In response to these comments, both the 2015 inventory and forecasted oil and gas emissions have been recalculated in the final EIR to reflect county-specific emissions. The methods used to recalculate GHG emissions from oil and gas production in the GHG inventory and forecast are described below.

In 2013, CARB published a report that measured the GHG emissions from "upstream crude oil and natural gas production, processing, and storage operations" based on survey results that captured 97 percent of the crude oil and natural gas production in the state (CARB 2013). According to this report, in 2007, 276,793 $MTCO_2e$ (adjusted for the Intergovernmental Panel on Climate Change's Fifth Assessment Report's global warming potential factors) were emitted within the jurisdiction of the Ventura County Air Pollution Control District (VCAPCD), which has the same geographic boundaries as Ventura County. For the purposes of this calculation the County has assumed that all oil and gas extraction within VCAPCD jurisdiction occurs in the unincorporated county. These emissions resulted from on-site combustion of fuels and fugitive (including vented) emissions generated during crude oil and gas production and processing. These 2007 emissions were scaled to 2015 levels based on the change in oil and gas production in the county between 2007 and 2015 according to the California Department of Conservation (California Department of Conservation 2020). From 2007 to 2015, oil production in the county increased slightly from 7.3 to 8.4 to million barrels, a 14.6 percent increase. Based on this change, the emissions were estimated to increase from 276,793 $MTCO_2e$ in 2007 to 317,222 $MTCO_2e$ in 2015. This scaling method is supported by CARB's documentation of California's GHG Inventory, where the emission factors for the oil and gas sector remained constant between 2007 and 2015, suggesting that emissions would change in

proportion to oil production. See the Revised Appendix D, Attachment to the final EIR for additional calculation details.

Note that gas production is excluded from scaling of emissions because there is no reported natural gas production in the county. Additionally, associated gas production is gas produced as a byproduct of oil production.

Forecasts

Commenters also raised concerns that the historical oil and gas production data in the county used in the draft EIR to forecast GHG emissions did not reflect the overall trends in production in the county and cited the county's historical production data dating back to 1980. In the draft EIR, the county's historical production data starting from 2008 were originally intended to determine production trends for GHG forecasting. However, the formulas in the calculation spreadsheet were not tied to the calculated average annual growth rate from 2008 and, instead, forecasts for years after 2020 were incorrectly linked to other growth rates.

Notwithstanding the errors associated with the incorrectly linked growth rates, the County has reviewed the county's historical oil and gas production data from the California Department of Conservation starting from 1980, and noted an anomalous spike in oil and gas production occurred between 2008 and 2018, likely due to the effects of the global recession at the start of that period. This spike occurred in contrast to the overall decline in oil and gas production in the county. Since 1980, oil and gas production in the county has decreased by approximately 60 percent, following an inverted growth curve pattern characteristic of oil production decline similar to that of the Hubbert Curve. The Hubbert Curve, which is similar to a bell curve, approximates the rate of production over time of finite resources, like fossil fuels. To forecast how this trend in production would continue through 2050, these historical production values were plotted and fitted based on an exponential function for the period between 1980 and 2018. The "Oil Production in Ventura County (1980-2050)" graph in the attached shows this trend through 2018 and the anticipated production through 2050, based an exponential regression calculator (CASIO Computer 2020). The forecasted oil production values were then used as scaling factors to scale the county's 2007 oil and gas emission from CARB's 2013 oil and gas survey report to future years.

Table 6 shows the difference in the 2015 inventory and forecasts for emissions from stationary sources between the draft EIR and final EIR. The revised emissions show higher estimates for 2015, but substantially lower forecasts through 2050 compared to the draft EIR estimates.

Table 6 Draft EIR and Final EIR GHG Emissions Inventory and Forecast for Stationary Source Emissions (Business-as-Usual Scenario) ($MTCO_2e$)

	2015	2020	2030	2040	2050
Draft EIR	275,096	287,845	314,526	343,679	375,535
Final EIR	317,222	245,340	198,432	160,660	130,212
Difference	42,126	-42,505	-116,094	-183,019	-245,323
%Difference	15%	-15%	-37%	-53%	-65%

References

California Air Resources Board. 2013 (October). *2007 Oil and Gas Industry Survey Results.* Final Report (Revised). Available: https://ww2.arb.ca.gov/sites/default/files/2020-04/FinalReportRevised_4.pdf. Accessed June 15, 2020.

CARB. *See* California Air Resources Board.

EPA. *See* U.S. Environmental Protection Agency.

ICLEI. See ICLEI – Local Governments for Sustainability USA.

ICLEI – Local Governments for Sustainability USA. 2013 (July). *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.* Version 1.1.

U.S. Environmental Protection Agency. 2016a. Landfill Gas Energy Project Data. Available: https://www.epa.gov/lmop/landfill-gas-energy-project-data. Accessed December 13, 2016.

--------. 2016b. Facility Level Information on GreenHouse gases Tool (FLIGHT). Available: https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal. Accessed December 2016.

The following summarizes the changes made to the GHG forecasts and calculations shown in Appendix D. Additions and changes to the draft EIR version of Appendix D are shown in green font (or yellow font where the background is green).

GHG Gap Analysis (MT CO2e / YEAR)		
SECTOR	**2030**	**2040**
Building Energy Total	285,079	225,567
Transportation Total	487,058	446,355
Solid Waste Total	316,441	288,020
Water and Wastewater Total	13,576	13,699
Off Road Equipment Total	54	56
Agriculture Total	248,882	241,541
Stationary Source Total	198,432	160,660
Legislatively Adjusted GHG Emissions Total	1,549,522	1,375,898
Target for Consistency with State Climate Policies	1,138,708	759,139
Reductions Needed to meet GPU Targets	410,813	616,760
CTM-B	-3,454	-5,111
CTM-C	-47,231	-78,405
COS-S	-2,019	-3,367
COS-8.4	-59,972	-20,445
COS-W	-5,042	-6,677
COS-H	-354	-708
AG-H	-33,830	-39,236
Quantified Reductions	**-151,903**	**-153,950**
Gap Remaining	258,911	462,810

CTM-B

	2030	2040
New VMT from 2015 baseline	90,240,682	150,401,136
Light Duty	84,189,124	140,315,481
Heavy Duty	6,045,830	10,076,404
Buses	5,727	9,252
Percent reduction target for VMT in new growth (relative to business as usual in 2030 and 2040)	15%	15%
Post program VMT	76,704,579	127,840,966
Light Duty	71,560,756	119,268,158
Heavy Duty	5,138,956	8,564,943
Buses	4,868	7,864

Pre-Program GHG Emissions (CO2e)	23,029.31	34,072.49
Post-Program GHG Emissions (CO2e)	19,574.92	28,961.61
GHG Savings	-3,454	-5,111

gCO2e/mi	2030	2040
Light Duty	235.9523762	209.2510967
Heavy Duty	522.1202114	466.3473808
Buses	1403.489593	1320.060821

CTM-C		
	2030	**2040**
Forecast VMT from heavy duty vehicles	1,770,625,968	1,826,755,613
Forecast VMT from light duty vehicles	127,153,053	131,183,863
% attributed to new growth	4.8%	7.7%
Percent VMT Reduction Goal from program implementation	5%	10%
Adjusted VMT light duty	1,597,900,202	1,503,755,939
Adjusted VMT heavy duty	114,749,187	107,988,453
Pre Program GHG Emissions	484,173	443,428
Post Program GHG Emissions	436,941	365,023
GHG reductions from Countywide VMT Reduction Program	-47,231	-78,405

gCO2e/mi	2030	2040
Light Duty	235.9523762	209.2510967
Heavy Duty	522.1202114	466.3473808
Source: Ascent Environmental GHG Forecasting using 2017 EMFAC emissions factors		

COS-S

Residential Green Building Ordinance		
Mixed-Fuel, Code Compliant Single Family Home	2030	2040
Annual kWh consumption DU - 2019 Title 24	5,007	5,007
Annual therms demand/DU - 2019 Title 24	381.7	381.7
Annual PV/storage kWh/DU - 2019 Title 24	5,007	5,007
Net kWh demand/DU - 2019 Title 24	0	0
All-Electric Residential		
Annual kWh demand/DU	7,745	7,745
Annual therms demand/DU	0	0
Annual PV/storage kWh/DU	7,745	7,745
Net kWh demand/DU	0	0
Difference in kWh demand/DU	0	0
Difference in therms demand/DU	-381.7	-381.7
Forecasted Housing Units in Ventura County	32,959	33,472
New Dwelling Units in Ventura County	768	1281
Total kWh reduction	0	0
Total therms reduced	-293,146	-488,958
MT CO2e Reduced	-2,019	-3,367

COS-8.4

CCA Enrollment

Clean Power Alliance City or County	Default Tier
Ventura County	100% Green Power

	Residential		Non-Residential	
Total Eligible Accounts	100%	31,214	100%	7,110
	%	**Number**	**%**	**Number**
Opt Up (Ineligible due to default tier)	0.00%	0	0.00%	0
Opt Mid (Green --> Clean)	0.84%	262	1.34%	95
Opt Down (Green --> Lean)	4.31%	1,345	3.05%	217
Opt Out (CPA --> SCE)	10.73%	3,349	17.05%	1,212
Enrollments	Residential		Non-Residential	
Total Remaining Enrollments	100.00%	27,865	100.00%	5,898
100% Green Power	94.23%	26,257	94.71%	5,586
Clean Power	0.94%	262	1.62%	95
Lean Power	4.83%	1,345	3.68%	217

	2015	2020	2030	2040
Residential electricity consumption (kWh)	262,750,031	264,831,397	269,018,616	273,205,835
Commercial electricity consumption (kWh)	118,867,785	119,225,592	124,892,675	129,659,819
Number of DU	32,191	32,446	32,959	33,472
kWh/DU	8,162.22	8,162.22	8,162.22	8,162.22

Business Accounts	7,110	7,466	7,839
Residential Units on CPA	28,965	29,422	29,880
Res 100 % Green Power (Current)	27,293	27,725	28,156
Res 100 % Green Power (97 percent target)	32,446	31,311	31,798
*Target Rate for 100% Green enrollment 95% by 2030			
Commercial on CPA	5,898	6,193	6,502
Com 100 % Green Power (Target)	5,586	5,865	6,158
Com 100 % Green Power (Current)		7,092	7,447
kWh from CPA 100% Green Power (Residential)	222,773,843	255,567,685	259,545,543
kWh from CPA 100% Green Power (Commercial)	93,665,944	118,648,041	123,176,828
Total kWh switched	316,439,787	374,215,726	382,722,371
CO2e Reduced under BAU	-67,955	-59,972	-20,445
Target			

COS-W		
	2030	2040
Residential electricity consumption (kWh) - existing buildings	269,018,616	273,205,835
Residential natural gas consumption (therms)	14,392,361	14,616,375
Commercial electricity consumption (kWh) - existing buildings	124,892,675	129,659,819
Commercial natural gas consumption	10,452,853	10,851,838
Number of Res DU	32,959	33,472
kWh/DU	8,162.22	8,162.22
therms/DU	436.67	436.67
Commercial Accounts	7,466	7,839
Target DU participation in outreach program	20%	25%
Target DU participation in monitoring program	20%	25%
Percent savings per DU from aggressive outreach	1%	1%
Percent savings per DU from in-home monitoring	4%	4%
Energy Savings		
Outreach - Electricity (kWh)	81.62	81.62
Outreach - Natural Gas (therms)	4.37	4.37
Monitoring - Electricity (kWh)	326.49	326.49
Monitoring - Natural Gas (therms)	17.47	17.47
Outreach - Total electricity savings (kWh)	538,037	683,015
Outreach - Total natural gas savings (therms)	28,785	36,541
Monitoring - Total electricity savings (kWh)	107,607	109,282
Monitoring - Total natural gas savings (therms)	23,028	23,028
Total electricity savings (kWh)	645,645	792,297
Total natural gas savings (therms)	51,813	59,569

GHG Reductions from electricity savings (MTCO2e)		-103	-85
GHG Reductions from natural gas savings (MTCO2e)		-357	-410
Total Residential GHG Reductions (MTCO2e)		-460	-495
		2030	2040
Commercial electricity consumption (kWh)		124,892,675	129,659,819
Commercial natural gas consumption (therms)		10,452,853	10,851,838
Target Reductions		5%	7%
Reduction in energy consumption from behavior mod programs			
	kWh	-6,244,634	-9,076,187
	Therms	-522,643	-759,629
Total Commercial GHG Reductions (MTCO2e)		-4,582	-6,182

COS-H

Urban Forest

	2030	2040
Total trees planted	10000	20000
Default Annual CO2 accumulation per tree for Miscellaneous Trees (MT CO2e/tree/year) (From Appendix A of CalEEMod v2016.3.1)	0.0354	-0.0354
GHG Reduction from Measure (MTCO2e/year)	-354	-708

AG-H

Reduced Inorganic Nitrogen Fertilizer

	2015	2030	2040
Existing N2O Emissions from Nitrogen Fertilizer Use (MTCO2e)	146,983	144,068	142,124
Tons Applied	43,631	42,766	42,189
Percent subsitution w/organic fertilizer from locally sourced organic waste from 2015 levels		25%	30%
Forecasted N2O tons of inorganic nitrogen fertilizer applied after reduction (MTCO2e)		32,723	30,542
N2O Emissions from Inorganic Nitrogen Fertilizer Use (MTCO2e)		110,237	102,888
Net GHG Reduction from AG-4 (MTCO2e)		-33,830	-39,236

Developed by:

Ventura County 2015 GHG Inventory Update and 2040 Forecast

Updated 6/11/2020

Workbook Description

This workbook contains the calculations for Ventura County's 2015 Greenhouse Gas (GHG) inventory and forecast through 2040.

Tab Descriptions and Update Instructions

Tab Name	Description	Category
Inventory and Forecast	This tab consolidates and summarizes the results from all emissions sectors for the business-as-usual (BAU) and Adjusted BAU (ABAU), or legislative adjusted, scenarios. Charts and inventory summaries are located further down on the sheet. This tab also calculates emissions forecasts for some sources (e.g., septic systems).	Summary
Demographics	This tab houses the population, housing, and employment data and forecasts from 2015 through 2040. This tab also calculates the unincorporated County's portion of this data by subtracting out Vandenberg Air Force Base and UC Ventura values.	Demographics
Transportation	This tab calculates on-road transportation based on Vehicle Travelled.	Calculations
Building Energy	This tab calculates the emissions from residential, commercial, industrial, and agricultural energy use.	Calculations
Offroad	This tab calculates the emissions from off-road equipment.	Calculations
Solid Waste	This tab calculates the emissions from waste generation and waste-in-place.	Calculations
Imported Water	This tab calculates emissions from water imported to the unincorporated County.	Calculations
Wastewater	This tab calculates the emissions from wastewater treatment processes from centralized wastewater treatment facilities and septic systems.	Calculations
Agriculture	This tab summarizes the emissions from agricultural sources.	Calculations
Stationary Source	This tab calculates provides the data for major stationary sources in the County.	Calculations
Assumptions	Includes reference material necessary for GHG calculations, including: Conversion factors, mode split, global warming potential (GWP) factors, electricity emission factors (provided by EPA eGRID), electricity emission factors as-calculated for each utility, natural gas emission factors, and more.	Background Data and Calculations
EMFAC	Includes emission factor outputs and calculations for on-road vehicles from CARB's Emissions FACtors model.	Background Data and Calculations

GHG Reduction Targets				
Milestone Year	Statewide Existing and Target Emissions (MMTCO2e)	Statewide Target Percent Reduction below 1990 levels by Target Years	Adjusted Target Percent Reduction below 2015 levels by Target Years	
1990 (Historical)	431	NA	NA	Source: https://www.arb.ca.gov/cc/inventory/pubs/reports/appendix_a1_inventory_ipcc_sum_1990.pdf
2015 (Historical)	440	NA	NA	Source: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf
2020 (Target)	431	0%	2.1%	AB 32
2030 (Target)*	258.60	40.0%	41.3%	SB 32
2040 (Target)	172.40	60.0%	60.9%	

** State emissions calculated from ARB's scoping plan*
Source: California GHG Inventory. ARB 2014 and 2016

Ventura County

Community Inventory	2015	2020	2030	2040	2050
Population	97,733	99,755	100,918	101,832	102,490
BAU Emissions (MTCO2e)	1,939,238	1,881,423	1,857,220	1,815,904	1,787,089
BAU with Legislative Reductions (MTCO2e)	1,939,238	1,772,537	1,549,522	1,375,898	1,288,892

Community Targets	2020	2030	2040	2050
Mass Emissions	1,897,847	1,138,708	759,139	379,569
Needed Reductions	125,310	(410,813)	(616,760)	(909,323)

FEIR

DETAIL (MT CO2e / YEAR)	Inventory	Legislative Adjustment Scenario			
SECTOR	2015	2020	2030	2040	2050
Building Energy	322,048	308,629	285,079	225,567	197,996
Transportation	692,753	625,263	487,058	446,355	450,232
Solid Waste	333,167	323,611	316,441	288,020	262,405
Water and Wastewater	13,148	13,420	13,576	13,699	13,788
Off Road Equipment	52	52	54	56	59
Agriculture	260,849	256,223	248,882	241,541	234,200
Stationary Source	317,222	245,340	198,432	160,660	130,212
TOTAL	1,939,238	1,772,537	1,549,522	1,375,898	1,288,892

DEIR

TOTAL UNINCORPORATED EMISSIONS	Inventory	Legislative Adjustment Scenario			
SECTOR	2015	2020	2030	2040	2050
Building Energy	322,048	308,629	285,079	225,567	197,996
Transportation	692,753	625,263	487,058	446,355	450,232
Solid Waste	333,167	302,811	278,381	270,289	262,560
Water and Wastewater	13,148	13,148	13,148	13,148	13,148
Off Road Equipment	52	52	52	52	52
Agriculture	260,849	256,223	248,882	241,541	234,200
Stationary Source	275,096	287,845	314,526	343,679	375,535
TOTAL	1,897,112	1,793,971	1,627,124	1,540,630	1,533,723

Difference

TOTAL UNINCORPORATED EMISSIONS	Inventory	Legislative Adjustment Scenario			
SECTOR	2015	2020	2030	2040	2050
Building Energy	0	0	0	0	0
Transportation	0	0	0	0	0
Solid Waste	0	20,800	38,060	17,731	-155
Water and Wastewater	0	272	428	551	640
Off Road Equipment	0	0	3	5	8
Agriculture	0	0	0	0	0
Stationary Source	42,126	-42,505	-116,094	-183,019	-245,323
TOTAL	42,126	-21,434	-77,603	-164,732	-244,831

Percent Difference from DEIR	2%	-1%	-5%	-11%	-16%

FEIR

DETAIL (MT CO2e / YEAR)	Inventory	Business As Usual Scenario			
SECTOR	2015	2020	2030	2040	2040
Building Energy	322,048	323,803	334,079	343,129	354,565
Transportation	692,753	704,364	727,433	750,452	773,467
Solid Waste	333,167	338,221	334,763	306,366	280,798
Water and Wastewater	13,148	13,420	13,576	13,699	13,788
Off Road Equipment	52	52	54	56	59
Agriculture	260,849	256,223	248,882	241,541	234,200
Stationary Source	317,222	245,340	198,432	160,660	130,212
TOTAL	1,939,238	1,881,423	1,857,220	1,815,904	1,787,089

DEIR

TOTAL UNINCORPORATED EMISSIONS DETAIL	Inventory	Business As Usual Scenario			
SECTOR	2015	2020	2030	2040	2050
Building Energy	322,048	323,803	334,079	343,129	354,565
Transportation	692,753	704,364	727,433	750,452	773,467
Solid Waste	333,167	317,388	296,727	288,735	281,106
Water and Wastewater	13,148	13,148	13,148	13,148	13,148
Off Road Equipment	52	52	52	52	52
Agriculture	260,849	256,223	248,882	241,541	234,200
Stationary Source	275,096	287,845	314,526	343,679	375,535
TOTAL	1,897,112	1,902,823	1,934,846	1,980,736	2,032,072

Difference

TOTAL UNINCORPORATED EMISSIONS	Inventory	Business As Usual Scenario			
SECTOR	2015	2020	2030	2040	2050
Building Energy	0	0	0	0	0
Transportation	0	0	0	0	0
Solid Waste	0	20,833	38,036	17,631	-308
Water and Wastewater	0	272	428	551	640
Off Road Equipment	0	0	3	5	8
Agriculture	0	0	0	0	0
Stationary Source	42,126	-42,505	-116,094	-183,019	-245,323
TOTAL	42,126	-21,400	-77,627	-164,832	-244,983

Percent Difference from DEIR	2%	-1%	-4%	-8%	-12%

Demographics

Ventura County Greenhouse Gas Emissions Inventory - Unincorporated County Population, Empoyment, Housing Forecast

	Inventory	Forecast					
	2015	**2020**	**2030**	**2035**	**2040**	**2050**	Sources:
Population							
County	850,491	894,000	928,339	946,000	961,867	994,133	Inventory: Department of Finance
Incorporated	752,758	794,245	827,421	844,496	860,035	891,643	Forecast: See Growth Forecast Spreadsheet
Population	97,733	99,755	100,918	101,504	101,832	102,490	
Percent Unincorporated	0	0	0	0	0	0	
Employment							
County	319,588	371,841	394,040	406,068	416,239	436,580	Inventory: Ventura County Background Report (p. 2-37)
Incorporated	286,699	338,853	359,484	371,226	380,364	398,639	Forecast: See Growth Forecast Spreadsheet
Persons employed	32,889	32,988	34,556	34,842	35,875	37,941	
Percent Unincorporated	0	0	0	0	0	0	
Housing Units							
County	273,286	283,000	300,250	311,000	317,500	330,500	Inventory: Ventura County Background Report (p. 2-37)
Incorporated	241,095	250,554	267,291	277,655	284,028	296,776	Forecast: See Growth Forecast Spreadsheet
Housing Units	32,191	32,446	32,959	33,345	33,472	33,725	
Percent Unincorporated	11.78%	11.47%	10.98%	10.72%	10.54%	10.20%	

Building Energy

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Emissions Summary (MTCO2e)

Legislatively Adjusted

	2015	2020	2030	2035	2040	2050	Scaling Factor
Residential	159,973	154,449	142,233	129,360	115,258	101,422	Annual Energy Usage and Legislatively-Adjusted Emission Factors
Commercial	97,091	94,326	92,004	86,039	81,663	79,041	Annual Energy Usage and Legislatively-Adjusted Emission Factors
Industrial	15,198	15,244	15,969	16,101	16,578	17,533	Annual Energy Usage and Legislatively-Adjusted Emission Factors
Agricultural	49,786	44,610	34,873	23,441	12,068	-	Annual Energy Usage and Legislatively-Adjusted Emission Factors
Total	322,048	308,629	285,079	254,940	225,567	197,996	

BAU

	2015	2020	2030	2035	2040	2050	Scaling Factor
Residential	159,973	161,240	163,789	165,708	166,339	167,594	Annual Energy Usage and 2015 Emission Factors
Commercial	97,091	97,383	102,012	102,856	105,905	112,004	Annual Energy Usage and 2015 Emission Factors
Industrial	15,198	15,244	15,969	16,101	16,578	17,533	Annual Energy Usage and 2015 Emission Factors
Agricultural	49,786	49,936	52,310	52,743	54,306	57,434	Annual Energy Usage and 2015 Emission Factors
Total	322,048	323,803	334,079	337,407	343,129	354,565	

Building Energy Emissions in 2015

			2015	2020	2030	2035	2040	2050
Energy Type (and Utility)	Energy Unit	Emission Factor per Energy Unit	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e
Electricity - SCE	kWh	MT CO2e/MWh	0.240	0.215	0.160	0.107	0.053	0.000
Natural Gas - So Cal Gas	Therm	MT CO2e/Therm	0.006887	0.006887	0.006887	0.006887	0.006887	0.006887
		County Average Electricity EF (g/kWh)	240.39	214.75	160.26	106.84	53.42	0.00

Annual Energy Usage					2015	2020	2030	2035	2040	2050	
Sector	Customer Type	Energy Type	Utility/Source	Energy Unit	Annual Usage	Annual Usage	Annual Usage	Annual Usage	Annual Usage	Annual Usage	Scaling Factor
Residential Energy	Residential	Electricity	SCE	kWh	262,750,031	264,831,397	269,018,616	272,169,233	273,205,835	275,266,796	Housing Units
Commercial Energy	Commercial	Electricity	SCE	kWh	118,867,785	119,225,592	124,892,675	125,926,339	129,659,819	137,126,779	Employment
Industrial Energy*	Industrial	Electricity	SCE	kWh	-						None
Agricultural Energy	Agricultural	Electricity	SCE	kWh	207,106,250	207,729,666	217,603,563	219,404,541	225,909,475	238,919,342	Employment
Residential Energy	Residential	Natural Gas	SoCal Gas	Therms	14,056,995	14,168,347	14,392,361	14,560,918	14,616,375	14,726,636	Housing Units
Commercial Energy	Commercial	Natural Gas	SoCal Gas	Therms	9,948,602	9,978,549	10,452,853	10,539,365	10,851,838	11,476,783	Employment
Industrial Energy	Industrial	Natural Gas	SoCal Gas	Therms	2,206,808	2,213,451	2,318,661	2,337,852	2,407,165	2,545,790	None
Total Electricity				kWh	588,724,066	591,786,655	611,514,854	617,500,114	628,775,129	651,312,916	
Total Natural Gas				Therms	26,212,405	26,360,346	27,163,876	27,438,135	27,875,378	28,749,209	

Annual Emissions					2015	2020	2030	2035	2040	2050	
Sector	Customer Type	Energy Type	Utility/Source	Scenario	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e	Scaling Factor
Residential Energy	Residential	Electricity	SCE	Legislative Adjusted	63,162	56,872	43,113	29,078	14,595	-	Housing Units
Commercial Energy	Commercial	Electricity	SCE	Legislative Adjusted	28,575	25,603	20,015	13,454	6,926	-	Employment
Industrial Energy*	Industrial	Electricity	SCE	Legislative Adjusted	-	-	-	-	-	-	None
Agricultural Energy	Agricultural	Electricity	SCE	Legislative Adjusted	49,786	44,610	34,873	23,441	12,068	-	Employment
Residential Energy	Residential	Natural Gas	SoCal Gas	Legislative Adjusted/BAU	96,811	97,577	99,120	100,281	100,663	101,422	Housing Units
Commercial Energy	Commercial	Natural Gas	SoCal Gas	Legislative Adjusted/BAU	68,516	68,722	71,989	72,585	74,737	79,041	Employment
Industrial Energy	Industrial	Natural Gas	SoCal Gas	Legislative Adjusted/BAU	15,198	15,244	15,969	16,101	16,578	17,533	None
Total Electricity Emissions					141,523	127,085	98,001	65,974	33,589	0	
Total Natural Gas Emissions					180,525	181,544	187,078	188,966	191,978	197,996	
				TOTAL	322,048	308,629	285,079	254,940	225,567	197,996	

Annual Emissions					2015	2020	2030	2035	2040	2050	
Sector	Customer Type	Energy Type	Utility/Source	Scenario	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e	MT CO2e	Scaling Factor
Residential Energy	Residential	Electricity	SCE	BAU	63,162	63,663	64,669	65,427	65,676	66,171	Housing Units
Commercial Energy	Commercial	Electricity	SCE	BAU	28,575	28,661	30,023	30,271	31,169	32,964	Employment
Industrial Energy*	Industrial	Electricity	SCE	BAU	-	-	-	-	-	-	None
Agricultural Energy	Agricultural	Electricity	SCE	BAU	49,786	49,936	52,310	52,743	54,306	57,434	Employment
Total Electricity Emissions					141,523	142,259	147,002	148,441	151,151	156,569	

Note: No propane usage is assumed because the number of Socal Gas residential customers in 2015 (32,717) is more than the number of households in the unincorporated are according to the County's background report (32,191). This means there could be more than one natural gas bill sent to a household considered by the County (See the Demographics tab).

Source: Data requests from SoCal Gas and Southern California Edison for customers in the unincorporated County.

* Industrial electricity use was not available due to CPUC 15/15 rule that states that any data provided by a utility must have more than 15 customers an no single customer's data accounts for more than 15 percent of total aggregated data.

Transportation

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Emissions Summary (MTCO2e)

BAU Forecast	2015	2020	2030	2040	2050	Scaling Factor
On-Road Transportation	690,265	701,749	724,717	747,685	770,653	Forecasted VMT and EMFAC Emission Factors
Rail	2,488	2,616	2,716	2,768	2,814	Countywide population
Total	692,753	704,364	727,433	750,452	773,467	

Adjusted Forecast	2015	2020	2030	2040	2050	Scaling Factor
On-Road Transportation (Leg Adjusted)	690,265	622,647	484,342	443,587	447,418	Forecasted VMT
Rail	2,488	2,616	2,716	2,768	2,814	Countywide population
Total	692,753	625,263	487,058	446,355	450,232	

On-Road Transportation Activity in 2015

Unincorporated County VMT

VMT Calculations	Source	2015 Annual VMT	2020 Annual VMT	2030 Annual VMT	2035 Annual VMT	2040 Annual VMT	2050 Annual VMT	
100% Internal, 50% I-E *	Adjusted from County-wide based on unincorporated VMT percentage	1,807,538,340	1,837,618,567	1,897,779,022	1,927,859,249	1,957,939,476	2,018,099,931	
Urban Bus VMT**		120,450	120,450	120,450	120,450	120,450	120,450	Scaling Factor: Unincorporated County Population Growth
Total Annual VMT		1,807,658,790	1,837,739,017	1,897,899,472	1,927,979,699	1,958,059,926	2,018,220,381	

County-wide VMT

VMT Calculations	Source	2012 Average Daily VMT	2012 Annual VMT	2040 Average Daily VMT	2040 Annual VMT	2015 Annual VMT (Interpolated)	2020 Annual VMT (Interpolated)	2030 Annual VMT (Interpolate	2035 VMT (Interpolated)	2050 VMT
Internal-Internal	VCTC Model	10,746,259	3,922,384,526	11,731,596	4,282,032,422	3,960,918,229	4,025,141,068	4,153,586,745	4,217,809,584	4,410,478,099
Internal-External (unincorporated Ventura to areas south and east of Ventura County)	VCTC Model *	15,537,451	5,671,169,732	17,026,660	6,214,730,729	5,729,408,411	5,826,472,874	6,020,601,802	6,117,666,265	6,408,859,656
Internal-External (unincorporated Ventura to north areas of Ventura County)	Calculated				35,472,890	25,050,315	27,134,830	31,303,860	33,388,375	39,641,920
50% Internal-External	Calculation (RTAC Method)				3,125,101,810	2,877,229,363	2,926,803,852	3,025,952,831	3,075,527,320	3,224,250,788
100% Internal, 50% I-E *	Calculation (RTAC Method)				7,407,134,232	6,838,147,592	6,951,944,920	7,179,539,576	7,293,336,904	7,634,728,888

*Source: Jim Damkowitch 11/7/2018 - Email to Ascent Environmental. Note: This VMT only includes light duty and heavy duty vehicle trips. It is assumed that this VMT does not include bus trips. Bus VMT is added separately.

** There is only one bus route in Ventura County that stops in the unincorporated area: Line 16 of Gold Coast Transit. The distance travelled by that route within the unincorporated area is about 10 miles. It travels along Ventura Ave between Ventura and Ojai, with stops in between. There are 17 northbound trips and 16 southbound trips daily, according to Gold Coast Transit route schedules. This results in an annual VMT of 120,450 VMT per year. This excludes bus VMT not associated with this route.
Note: The Regional Transportation Advisory Committee's recommended approach to calculating VMT is based on CARB's guidance for MPOS (https://www.arb.ca.gov/cc/sb375/staff_report_sb375_targets_update.pdf)

Adjustment for I-X trips north of Ventura*

	Source	2010	2012	2020	2040	2015 (Interpolated)	2030	2035	2050
Daily VMT I-X/X-I Santa Barbara County - Entire Ventura County (SB/VC)**	SBCAG	62,920		74,342	97,186	68,631	85,764	91,475	108,608
Daily VMT I-X/X-I South and East Areas - Entire Ventura County (SE/VC)**	VCTC Model		15,537,451	15,962,939	17,026,660	15,697,009	16,494,799	16,760,729	17,558,519.61
Ratio of SB/VC to SE/VC ***	Calculated			0.00466	0.00571	0.00437	0.00520	0.00546	0.00619

*According to Jim Damkowitch, the VCTC model excludes trips north of Ventura County because the VCTC model is based on SCAG's model which does not include Santa Barbara County

** Includes unincorporated areas AND cities

*** This ratio is applied to SB/VC VMT to estimate the VMT between SB County and Unincorporated Ventura County

Unincorporated VMT Adjustment

VMT Split by Boundary Method According to HPMS data

Unincorporated County Local Road VMT (Boundary)	1,394,030	HPMS
Unincorporated County VMT SHS VMT Boundary	3,519,851	GHD via Caltrans Volume Report
Other Unincorporated VMT Boundary	22,950	HPMS
Total Unincorporated VMT (Boundary)	**4,936,831**	
Total Incorporated Local Road VMT (Boundary)	6,689,160	HPMS
Total Incorporated SHS VMT (Boundary)	7,037,589	GHD via Caltrans Volume Report
Other Incorporated VMT	13,080	HPMS
Total Incorporated VMT (Boundary)	**13,739,829**	
Percent Nonincorporated	**26.4%**	

VMT Distribution in Unincorporated County by vehicle class

Light Duty	93%
Heavy Duty	7%
Buses	0.054%

Source: SCAG 2016 RTP model. Provided by Annabel Drayton VCREA - Email to Ascent Environmental 11/15/2018

On-Road Transportation Emissions Calculations

Annual VMT						
	2015	2020	2030	2035	2040	2050
Light Duty and Heavy Duty VMT	1,807,538,340	1,837,618,567	1,897,779,022	1,927,859,249	1,957,939,476	2,018,099,931
Bus VMT	120,450	120,450	120,450	120,450	120,450	120,450

VMT Distribution	2015	2020	2030	2035	2040	2050
Light Duty	1,686,431,501	1,714,496,323	1,770,625,968	1,798,690,791	1,826,755,613	1,882,885,258
Heavy Duty	121,106,839	123,122,244	127,153,053	129,168,458	131,183,863	135,214,672
Buses	120,450	120,450	120,450	120,450	120,450	120,450

EMFAC 2017 Weighted Vehicle Emission Factors for Ventura County						
gCO2/mi	2015	2020	2030	2035	2040	2050
Light Duty	360	317.047	235.859	217.894	209.180	204.4384
Heavy Duty	677	637.628	521.578	486.947	465.748	459.3973089
Buses	1,502	1461.054	1358.058	1305.580	1273.023	1242.449754

gCH4/mi	2015	2020	2030	2035	2040	2050
Light Duty	0.011	0.006	0.003	0.002	0.002	0.002025088
Heavy Duty	0.019	0.015	0.016	0.017	0.017	0.018022341
Buses	1.622	1.584	1.563	1.580	1.602	1.620750263

gN2O/mi	2015	2020	2030	2035	2040	2050
Light Duty	0.0001	0.00008	0.000	0.000	0.00004	3.88601E-05
Heavy Duty	0.0003	0.00029	0.000	0.000	0.00044	0.000474812
Buses	0.0039	0.00388	0.006	0.007	0.00828	0.010049969

gCO2e/mi	2015	2020	2030	2035	2040	2050
Light Duty	361	317	236	218	209	205
Heavy Duty	677	638	522	488	466	460
Buses	1,549	1,506	1,403	1,352	1,320	1,290

TOTAL On-Road Vehicle Emissions (Legislatively Adjusted)

MTCO2e	2015	2020	2030	2035	2040	2050
Light Duty	608,051	543,897	417,783	392,066	382,251	385,060
Heavy Duty	82,027	78,569	66,389	62,973	61,177	62,203
Buses	187	181	169	163	159	155
TOTAL	690,265	622,647	484,342	455,201	443,587	447,418

TOTAL On-Road Vehicle Emissions (BAU)

MTCO2e	2015	2020	2030	2035	2040	2050
Light Duty	608,051	618,170	638,408	648,527	658,646	678,884
Heavy Duty	82,027	83,392	86,122	87,487	88,852	91,582
Buses	187	187	187	187	187	187
TOTAL	690,265	701,749	724,717	736,201	747,685	770,653

Vehicle Category assignments based on EMFAC 2007 Vehicle Categories used in EMFAC 2017

SCAG Vehicle Category	EMFAC 2007 Vehicle Category
Light Duty	LDA
Light Duty	LDT1
Light Duty	LDT2
Light Duty	LHDT1
Light Duty	LHDT2
Light Duty	MCY
Heavy Duty	HHDT
Heavy Duty	MDV
Heavy Duty	MH
Heavy Duty	MHDT
Buses	OBUS
Buses	SBUS
Buses	UBUS

Locomotive Emissions in 2015

				Emissions per BTU of Diesel				Locomotive Emissions			
	Track length through the unincorporated Count (mi)	Number of One Way Trips per year	Annual Locomotive Miles Travelled	2015 BTU per train-mile	g CO2/BTU	g CH4/BTU	g N2O/BTU	MT CO2/BTU	MT CH4/BTU	MT N2O/BTU	MT CO2e
Amtrak Passenger Rail	27.1	3640	98,644	288,375	0.073453237	5.7554E-06	1.8705E-06	2,089	0.164	0.053	2,108
Metrolink Passenger Rail	11.4	1560	17,784	288,375	0.073453237	5.7554E-06	1.8705E-06	377	0.030	0.010	380
Total								2,466	0.193	0.063	2,488
Source	GIS	Amtrak schedule, Metrolink schedule		Transportation Energy Data Book 2017 (Table 9.10 - passenger rail, Table 9.8 - freight rail)							

Method: U.S. Community Protocol - Equation TR.5.1.

Off-Road Vehicles and Equipment

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Emissions Summary (MTCO2e) (Legistlatively Adjusted BAU and BAU)

	2015	2020	2030	2035	2040	2050	Scaling Factor
ConstMin	15	15	16	16	16	17	Employment
Industrial	8	8	9	9	9	10	Employment
Light Commercial	4	4	4	4	4	4	Employment
Portable Equipment	4	4	4	4	4	4	Population (to represent residential landscaping activity)
Oil Drilling	20	21	21	22	22	24	Employment
TRU	1	1	1	1	1	1	Employment
Offroad Emissions	**52**	**52**	**54**	**55**	**56**	**59**	

Offroad Emissions in 2015 for Unincorporated Ventura County

	MT CO2	MT CH4	MT N2O	MT CO2e	Scaled to unincorporated area by	% total GHG
AirGrSupp*	-	0.000	0.000	0	Excluded	0.0%
Commercial Harborcraft	0.000	0.000	0.000	0	Excluded	0.0%
Cargo Handling Equipment	0.000	0.000	0.000	0	Excluded	0.0%
ConstMin	14.626	0.003	0.001	15	Jobs	28.7%
Industrial	7.929	0.001	0.001	8	Jobs	16.0%
Light Commercial	3.298	0.004	0.001	4	Jobs	6.9%
Locomotive	0.000	0	-	0	Population	0.0%
Military	0.000	0.000	0.000	0	Excluded	0.0%
Ocean Going Vessels	0.000	0.000	0.000	0	Excluded	0.0%
Oil Drilling	20.212	0.002	0.001	20	All in unincorporated	39.4%
Portable Equipment	3.834	0.001	0.000	4	Population	7.5%
TRU	0.728	0.001	0.000	1	Jobs	1.4%
Total	50.626	0.013	0.003	52		100.0%

Note: Off-road Agricultural equipment included under the Agriculture Sector

*Camarillo, Oxnard, and Santa Paula Airports are located in incorporated areas. Other airports are military. Thus, no airport ground support emissions are attributed to unincorporated County

OFFROAD 2017 outputs for 2015 for Entire Ventura County

	Fuel Type	Fuel Use (gal/year)	Tons CO2/day	Tons CH4/day	Tons N2O/day	MT CO2e	Tons NOx/day (to calculate N2O)
AirGrSupp	Diesel	1,874	0.06	0.00	0.00	0	0.001
AirGrSupp	Gasoline	11,067	0.27	0.00	0.00	0	0.001
AirGrSupp	Nat Gas	1,241	0.02	0.00	0.00	0	0.000
Commercial Harborcraft	Diesel	4,874,984	21.18	0.03	0.00	26	1.951
Cargo Handling Equipment	Diesel	69,035	2.13	0.00	0.00	2	0.008
ConstMin	Diesel	4,022,763	123.93	0.02	0.00	138	1.235
ConstMin	Gasoline	309,600	5.00	0.01	0.00	6	0.042
Industrial	Diesel	463,136	14.27	0.00	0.00	16	0.148
Industrial	Gasoline	1,020,595	22.82	0.01	0.00	27	0.104
Industrial	Nat Gas	1,815,674	32.81	0.00	0.01	38	0.155
Light Commercial	Diesel	249,415	7.42	0.00	0.00	8	0.066
Light Commercial	Gasoline	1,082,860	17.29	0.03	0.01	22	0.137
Light Commercial	Nat Gas	239,429	4.36	0.00	0.00	5	0.014
Locomotive	Diesel	-	0.00	0.00	0.00	0	0.071
Military	Diesel	66,324	2.00	0.00	0.00	2	0.015
Ocean Going Vessels	Diesel	14,249,266	451.29	0.15	0.01	506	13.513
Oil Drilling	Diesel	594,860	18.34	0.00	0.00	20	0.133
Portable Equipment	Diesel	981,997	30.27	0.00	0.00	34	0.259
TRU	Diesel	4,074	6.42	0.01	0.00	7	0.361
Total		**30,058,194**	**759.87**	**0.27**	**0.04**	**859**	**18.216**
Diesel Only Totals		25,577,728	677.30	0.22	0.03	761	18

Source: OFFROAD2017 (https://www.arb.ca.gov/orion/)

OFFROAD 2017 outputs for 2015 for Entire Ventura County

Demographics Category	Percent in Unincorporated Area	Source
Population	11%	Department of Finance
New Housing Units	34%	DOF 2017/2018 (http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-5/)
Households	12%	Background Report
Jobs	10%	Background Report

Solid Waste GHG Emissions

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

BAU Emissions Summary (MTCO2e)

	2015	2020	2030	2040	2050	Calculation Method
Waste Generation	34,568	34,971	35,174	35,287	35,515	Population
Waste in Place	298,599	303,251	299,589	271,079	245,283	Landfill Tonnages, Landfill open and closure dates, and Decay Rate
Total	333,167	338,221	334,763	306,366	280,798	

Legislatively Adjusted BAU Emissions Summary (MTCO2e)

	2015	2020	2030	2040	2050	Calculation Method
Waste Generation	34,568	20,360	16,851	16,941	17,122	Population, AB 341, SB 1383
Waste in Place	298,599	303,251	299,589	271,079	245,283	Landfill Tonnages, Landfill open and closure dates, Decay Rate
Total	333,167	323,611	316,441	288,020	262,405	

Solid Waste Emissions in 2015

Source	MT CO2	MT CH4	MT N2O	MT CO2e
Waste Generation	0	1,235	0	34,568
Waste-in-Place	0	10,663	0	298,599
Total	0	11,897	0	333,167

Waste Generation Scaling & Legislative Adjustment

	2014	2015	2020	2030	2040	2050	Scaling Factor/Calculation Method
Delivered Tonnage from Unincorporated Ventura Co	124,057	116,403	117,760	118,444	118,827	119,594	Population
BAU Waste Generation Emissions MTCO2e		34,568	34,971	35,174	35,287	35,515	Delivered Tonnage from Unincorporated Ventura County
AB 341 Commercial Recycling - 75% Diversion for Commercial Solid Waste			-24,482	-24,624	-24,704	-24,863	Delivered Tonnage, Percent of commercial waste (w/o organics) out of all waste disposed, and 75% diversion rate
SB 1383 Organic Waste Diversion Regs			-24,716	-37,075	-37,075	-37,075	2015 Tonnage, Percent of organics out of all waste disposed, 50% diversion in 2020, and 75% diversion rate post-2020
Tonnage w/legislative adjustments			68,562	56,745	57,048	57,657	Calculated from values above
GHG Emissions w/Legislative Adjustments			20,360	16,851	16,941	17,122	2015 waste emission rate and anticipated tonnage with legislations

Source: CalRecycle Annual Solid Waste Disposal Reports https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Statewide/Disposal

Waste Generation Emissions in 2015

Receiving Landfill	Tonnage Delivered from Unincorporated Ventura County Only	Total ADC	Percent of Total Tonnage	Percent of year under LFG collection or control in 2016 (%)	Generated Methane Emissions with LFG Capture (MT CH4)	MT CO2	MT CH4	MT N2O	MT CO2e	% total
Antelope Valley Public Landfill	47	3	0%	0%	2		2		52	0.1%
Azusa Land Reclamation Co. Landfill	84		0%	0%	3		3		87	0.3%
Bakersfield Metropolitan (Bena) SLF	353		0%	0%	13		13		364	1.1%
Calabasas Landfill	3,160	2,597	3%	100%	53		53		1,483	4.3%
Chiquita Canyon Sanitary Landfill	5,954		5%	100%	55		55		1,534	4.4%
Commerce Refuse-To-Energy Facility			0%	100%	-		-		-	0.0%
El Sobrante Landfill	32		0%	100%	0		0		8	0.0%
Frank R. Bowerman Sanitary LF	23		0%	100%	0		0		6	0.0%
H.M. Holloway Inc.	27		0%	0%	1		1		28	0.1%
Lancaster Landfill and Recycling Center	1	2	0%	0%	0		0		3	0.0%
Olinda Alpha Sanitary Landfill	90		0%	100%	1		1		23	0.1%
Simi Valley Landfill & Recycling Center	27,984	4,463	24%	100%	298		298		8,357	24.2%
Southeast Resource Recovery Facility			0%	0%	-		-		-	0.0%
Tajiguas Sanitary Landfill	94	34	0%	100%	1		1		33	0.1%
Toland Road Landfill	78,554	9,153	67%	100%	807		807		22,591	65.4%
Total Ventura Unincorporated	116,403	16,252			1,235		1,235		34,568	100.0%

Source: CalRecycle, EPA LMOP Database, US Community Protocol Equation SW.4.1

Landfill Gas Collection Start Dates

Landfill	LFG Project Start date	
Antelope Valley Public Landfill	1/1/2020	<-indicates planned but no current project. No start date indicated
Azusa Land Reclamation Co. Landfill	1/1/2020	<-indicates planned but no current project. No start date indicated
Bakersfield Metropolitan (Bena) SLF	6/30/2016	
Calabasas Landfill	10/1/2002	
Chiquita Canyon Sanitary Landfill	11/23/2010	
Commerce Refuse-To-Energy Facility	1/1/1981	Started in 1981. No date provided.
El Sobrante Landfill	4/1/2004	
Frank R. Bowerman Sanitary LF	12/8/2007	
H.M. Holloway Inc.	1/1/2020	<-supplier of ag gypsum
Lancaster Landfill and Recycling Center	1/1/2020	<-indicates no current project
Olinda Alpha Sanitary Landfill	6/28/2012	
Simi Valley Landfill & Recycling Center	4/1/2004	
Southeast Resource Recovery Facility	1/1/2020	project shut down in 1993
Tajiguas Sanitary Landfill	3/31/2000	
Toland Road Landfill	8/1/2004	

Source: EPA's LMOP database

Waste-in-Place Emissions at Landfills Located in the Unincorporated County in 2015

							Fugitive Emissions			
Landfill/Disposal Site	Waste-in-Place (Tons) *	Status	Has LFG Capture?	Date Open	Date Closed	Average Tons Disposed Annually	MT CO2	MT CH4	MT N2O	MT CO2e
Alden V Johnson	?	Closed	No	?	1967					
Arnaz Road	?	Closed	No	?	?					
Bailard Landfill**	3,150,000	Closed	**Yes**	1961	1996	90,000		1,848		51,751
Balcom Canyon II	?	Closed/unpermitte	No	?	1986					
Balcom Canyon III	?	Closed/unpermitte	No	?	1997					
BMB Norcom 355	inert debris/engineered fill	Inactive	No	?	?					
Burns Property DS	400 CY construction/demolition, inert	Closed	No	?	2008					
Elkins Ranch 1980	?	Closed/unpermitte	No	?	?					
Fishback Illegal Disposal Site (IDS)	?	Closing	No	?	?					
Lagoon Landfill	?	Closed/Naval with	No	1952	1975					
Ojai County 1964	?	Closed	No	?	1964					
Otto Hopkins	?	Closed	No	?	1996					
Ozena 1967 Converted	?	Closed/unpermitte	No	?	?					
Ozena Modified Sanitary Landfill**	3,120	Closed	No	1975	1986	283.64		2		55
Phillip and Alice Lee Property	?	To Be Determined/	No	?	?					
Piru Dump	?	Closed/violation	No	?	1971					
Rockwell International - Old Area I LF	?	Closed (artillery fiel	No	1955	2005					
Rockwell International - Old Area II LF	?	Closed (artillery fiel	No	?	?					
Runway Landfill/Pt Mugu	?	Closed (electroplati	No	?	?					
Saticoy County 1962	?	Closed	Facility currently studying LFG potential	1946	1963					
Somis Dump	?	Closed/unpermitte	No	?	?					
Simi Valley Landfill***	19,966,988	Open	**Yes**	1970	2024	489,107		6,145	0.126	172,093
Toland Road Landfill***	7,046,887	Active	**Yes**	1970	2027	123,630		2,668	0.028	74,701
TOTAL							0	10,663	0	298,599
Total from Closed Landfills	**23,120,108**						**0**	**10,663**	**0**	**298,599**
			Average year of closed LFs	**1969**	**2022**					

* Tonnage data for landfills with "?" were not available. Based on the sparse documentation available for these individual landfills, many of these landfills without tonnage data are small unpermitted sites or military disposal sites. It is assumed that waste-in-place emissions from these landfills are minimal. Thus, calculations exclude landfills without tonnage data.

** GHG emissions calculated from CARB's LET Model based on landfill's open and closure dates and average annual tons disposed. The LET reports emissions in MTCO2e assuming a GWP factor of 21 for CH4. Annual tons disposed were input for each year that the landfill was open. The model calculated the decay after the closure of the landfill. Results were taken for the 2015 output year.

*** GHG emissions from EPA reports in the Facility Level Information on GreenHouse gases Tool (FLIGHT) database (https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal)

Source: CalRecycle, EPA LMOP Database, EPA Greenhouse Gas Emissions from Large Facilities, CARB Landfill Emissions Tool model (https://www.arb.ca.gov/cc/landfills/tool.htm)

Note: Excludes composting facilities, transfer stations, inert debris disposal sites, and planned landfills not yet in operation.

Waste In Place Forecast

	2020		2030		2035		2040		2050	
Landfill/Disposal Site	MT CH4	MT CO2e	MT CH4	MT CO2e	MT CH4	MT CO2e	MT CH4	MT CO2e	MT CH4	MT CO2e
Bailard Landfill*	1,598	44,731	1,308	36,623	1,183	33,137	1,071	29,984	808	22,611
Ozena Modified Sanitary Landfill*	2	49	1	40	1	36	1	33	1	25
Toland Road Landfill**	2,794	78,240	2,842	79,589	2,572	72,015	2,327	65,162	1,905	53,350
Simi Valley Landfill**	6,437	180,230	6,548	183,337	5,925	165,890	5,361	150,104	4,389	122,895
Total	10,830	303,251	10,700	299,589	9,681	271,079	8,760	245,283	7,103	198,881

*Emission forecasts for these landfills were taken directly from results from CARB's Landfill Emissions Tool (LET) model, given the current disposal tonnage at each landfill and the open and closure dates.

**Emissions forecasts for these landfills are scaled from 2015 levels using results from the LET model. Note that the LET model is used for decay forecast rates only and not used to estimate 2015 emissions. 2015 emissions for Toland and Simi Valley were based on reported fugitive emissions from the EPA. The LET model does not account for any fugitive methane capture or other landfill management methods and, thus, has very different 2015 emissions estimates. Bailar and Ozena results for 2015 and forecasts were taken directly from the LET model due to lack of reported data. This approach assumes that fugitive methane and other landfill management methods will continue in proportion to the on-site waste volume.

Waste in Place Estimates Using CARB's Landfill Emissions Tool

	2015	2020	2030	2035	2040	2050
Landfill/Disposal Site	MT CH4	MT CH4	MT CH4	MT CH4	MT CH4	MT CH4
Toland Road Landfill	5,332	5,585	5,682	5,141	4,652	3,808
Simi Valley Landfill	14,780	15,481	15,748	14,250	12,894	10,556

Additional Background Data and Assumptions

Method for Calculating Solid Waste Generation Emissions

Equation SW.4.1 Methane Emissions

$$CH_4\ Emissions = GWP_{CH4} * (1- CE) * (1- OX) * M * \sum_i P_i * EF_i$$

Where:

Term	Description	Value
CH_4 emissions	= Community generated waste emissions from waste M ($mtCO_2e$)	Result
GWP_{CH4}	= CH_4 global warming potential	
M	= Total mass of waste entering landfill (wet short ton)	User Input
P_i	= Mass fraction of waste component i	User Input
EF_i	= Emission factor for material i ($mtCH_4$/wet short ton)	Table SW.5
CE	= Default LFG Collection Efficiency	No Collection, 0 Collection, 0.75
OX	= Oxidation rate	0.10

Source: As developed by ICLEI staff and Solid Waste Technical Advisory Committee. Emissions factors from U.S. EPA Municipal Solid Waste Publication (2008) available at http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw2008data.pdf

Mixed MSW for Unincorporated Ventura County	0.041	CalRecycle Waste Characterization for Unincorporated Ventura County and WARM emission factors.

Imported Water

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Emissions Summary (MTCO2e)

	2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Imported Water (BAU)	5,002	5,105	5,165	5,195	5,211	5,245	See below
Imported Water (Leg Adjusted)	5,002	4,560	3,443	2,306	1,160	0	See below

Imported Water Emissions in 2015

Source	MG Supplied/year	Electricity Use (kWh/MG)	Electricity Use (kWh)	EF Source	Percent of MG
Groundwater	73,043	240	17,558,763	SCE	83%
SWP	3,598	236	848,885	CA Avg	4%
Surface Water	7,387	240	1,775,646	SCE	8%
Recycled Water	3,635	240	873,888	SCE	4%
TOTAL	87,663		21,057,182		
TOTAL Local	84,065		20,208,297		96%
TOTAL Imported	3,598		848,885		4%

Note: Private groundwater was not available from the Ventura County Water Agencies

Electricity Emissions Factors (g/kWh)

EF Source		2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
SCE		240.39	214.75	160.26	106.84	53.42	0.00	See Assumptions Tab
CA Avg		235.94	210.77	157.29	104.76	52.54	0.00	See Assumptions Tab

Electricity Use (kWh)

Source	2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Groundwater	118,064,545	120,507,185	121,912,125	122,620,032	123,016,266	123,811,151	Population
SWP	21,198,226	21,636,797	21,889,051	22,016,154	22,087,297	22,230,017	Population
Surface Water	8,877,349	9,061,013	9,166,651	9,219,879	9,249,672	9,309,440	Population
Recycled Water	331,407	338,264	342,207	344,195	345,307	347,538	Population
Total	148,471,528	151,543,258	153,310,035	154,200,259	154,698,542	155,698,146	

GHG Emissions (MTCO2e) (BAU)

Source	EF Source	2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Groundwater	SCE	28,381	28,969	29,306	29,477	29,572	29,763	Change in electricity use. 2015 emission factors.
SWP	CA Avg	5,002	5,105	5,165	5,195	5,211	5,245	Change in electricity use. 2015 emission factors.
Surface Water	SCE	2,134	2,178	2,204	2,216	2,224	2,238	Change in electricity use. 2015 emission factors.
Recycled Water	SCE	80	81	82	83	83	84	Change in electricity use. 2015 emission factors.
	TOTAL	35,597	36,333	36,757	36,970	37,090	37,329	
	TOTAL Local	30,595	31,228	31,592	31,776	31,878	32,084	
	TOTAL Imported	5,002	5,105	5,165	5,195	5,211	5,245	

GHG Emissions (MTCO2e) (Legislatively Adjusted)

Source	EF Source	2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Groundwater	SCE	28,381	25,879	19,538	13,101	6,572	0	Change in electricity use. Emission factors associated by year.
SWP	CA Avg	5,002	4,560	3,443	2,306	1,160	0	Change in electricity use. Emission factors associated by year.
Surface Water	SCE	2,134	1,946	1,469	985	494	0	Change in electricity use. Emission factors associated by year.
Recycled Water	SCE	80	73	55	37	18	0	Change in electricity use. Emission factors associated by year.
	TOTAL	35,597	32,458	24,505	16,429	8,244	0	
	TOTAL Local	30,595	27,897	21,061	14,123	7,084	0	
	TOTAL Imported	5,002	4,560	3,443	2,306	1,160	0	

Note: Emissions associated with electricity used to power pumps within the unincorporated County are assumed to be captured in the Building Energy sector

2015 Water Use

	Water User/Agency	2013 Ventura County Water Supply and Demand (Acre-Feet)			2015 Unincorporated County Water Supply and Demand (Acre Feet) (Calculated)			2015 Water-Related Electricity Use and Emissions					
								Electricity Use (MWh)					Emissions (MTCO2e)
		Agriculture	Municipal & Industrial	Total	Agriculture	Municipal & Industrial	Total	Supply	Conveyance	Treatment	Distribution	Total Electricity Use	
Surface Water	Casitas MWD	*8,305*	*9,990*	*18,295*	*8,023*	*997*	*9,020*	*0*	*0*	*32*	*3,527*	*3,559*	*856*
	City of Ventura	*0*	*4,200*	*4,200*	*0*	*582*	*582*	*0*	*0*	*19*	*228*	*247*	*59*
	UWCD	*6,257*	*0*	*6,257*	*6,257*	*0*	*6,257*	*0*	*0*	*0*	*2,447*	*2,447*	*588*
	Private	*7,974*	*0*	*7,974*	*7,974*	*0*	*7,974*	*0*	*0*	*0*	*3,118*	*3,118*	*750*
	Surface Water Total	**22,536**	**14,190**	**36,726**	**22,254**	**414**	**22,668**	**0**	**0**	**14**	**8,864**	**8,877**	**2,134**
Imported Water	UWCD	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Calleguas MWD	*5,537*	*105,747*	*111,283*	*4,349*	*6,693*	*11,041*	*0*	*21542*	*308*	*-651.44*	*21,198*	*5,002*
	Imported SWP Total	**5,537**	**105,747**	**111,283**	**4,349**	**6,693**	**11,041**	**0**	**21,542**	**308**	**-651**	**21,198**	**4,899**
Groundwater	Casitas MWD				*25*	3	*28*	*1*	*0*	*0*	*11*	*12*	*3*
	Ojai GMA	*3401*	*2,037*	*5,438*	*3,401*	*237*	*3,638*	*1,067*	*0*	*8*	*1,422*	*2,497*	*600*
	FCGMA	*105,346*	*44,949*	*150,295*	*105,346*	*5,224*	*110,570*	*13,147*	*0*	*170*	*43,235*	*56,553*	*13,595*
	UWCD	*83,243*	*13,115*	*96,358*	*83,243*	*1,524*	*84,767*	*12,304*	*0*	*50*	*33,146*	*45,499*	*10,938*
	Private (unreported)	*24,591*	*4,868*	*29,459*	*24,591*	*566*	*25,157*	*3,648*	*0*	*18*	*9,837*	*13,503*	*3,246*
	Groundwater Total	**216,581**	**64,969**	**281,550**	**216,606**	**7,554**	**224,160**	**30,167**	**0**	**246**	**87,652**	**118,065**	**28,382**
Recycled Water	Oak Park Water Service	*0*	*790*	*790*	*0*	*92*	*92*	*0*	*0*	*63*		*63*	*15*
	Lake Sherwood CSD	*0*	*484*	*484*	*0*	*56*	*56*	*0*	*0*	*38*		*38*	*9*
	California Water Service Co.	0	*644*	*644*	*0*	*75*	*75*	*0*	*0*	*51*		*51*	*12*
	City of Simi Valley/ County Waterworks No. 8	0	*56*	*56*	*0*	*7*	*7*	*0*	*0*	*4*		*4*	*1*
	Camarillo San. District	*1,840*	*46*	*1,886*	*1,840*	*5*	*1,845*	*0*	*0*	*4*		*4*	*1*
	Camrosa Water District Non-Potable	*4,687*	*1,372*	*6,059*	*4,687*	*159*	*4,846*	*0*	*0*	*109*		*109*	*26*
	Camrosa Water District Non-Potable to PVCWD	*3,241*	*0*	*3,241*	*3,241*	*0*	*3,241*	*0*	*0*	*0*		*0*	*0*
	Camrosa Water District CWRF Recycled (Title 22)	*901*	*268*	*1,170*	*901*	*31*	*932*	*0*	*0*	*21*		*21*	*5*
	Moorpark WWTP/County Waterworks No. 1	*3*	*718*	*721*	*3*	*83*	*86*	*0*	*0*	*57*		*57*	*14*
	City of Ventura/Ventura Water Reclamation Facility	0	*700*	*700*	*0*	*25*	*25*	*0*	*0*	*17*		*17*	*4*
	Recycled Water Total	**10,672**	**5,078**	**15,751**	**10,672**	**484**	**11,156**	**0**	**0**	***331***		**331**	**80**
TOTAL		**255,325**	**189,984**	**445,310**	**255,325**	**22,082**	**277,407**	**30,167**	**21,542**	**96,763**		**148,472**	**35,495**

Source: Table 8 of the County of Ventura. 2013 Water Supply and Demand. Prepared for: Ventura County Watershed Protection District. January 2015. No updates as of July 2018

Source: Ventura County 2013 Water Supply and Demand Report

Note: Assumes municipal and industrial water use is proportional to population. Assumes all agricultural water use takes place in the unincorporated County. Agricultural water deliveries are assumed to use non-potable, untreated, water.

Note: Calleguas purchases water from the Metropolitan Water District of Southern California, which gets its water from surface water, SWP, CRA, and the LA Aqueduct.

Imported Water

Urban Water Energy Intensity Matrix

in kWh/MG

Supply		Conveyance		Treatment		Distribution	
Surface Water	0	SWP-L.A. Basin	8325	EPRI (Avg)	100	EPRI Avg.	1200
Groundwater	4.45/MG/Foot	SWP-Bay Area	3150			Flat Topography	proposed
Ocean Desalination	13800	SWP-Central Coast	3150			Moderate Topograph	proposed
Brackish Water Desal	1,240- 5,220	SWP-San Joaquin Valley	1510			Hilly Topography	proposed
Recycled Water	0	CRA-L.A. Basin	6140			Recycled Water	1,200-3,000
		Hetch Hetchy- Bay Area	0				
		Mokelumne Aqueduct	160				
		Local/Intrabasin	120				

in kWh/AF

Supply		Conveyance		Treatment		Distribution	
Surface Water	-	SWP-L.A. Basin	2,713	EPRI (Avg)	33	EPRI Avg.	391
Groundwater (AF/MG/Foot)	1.45	SWP-Bay Area	1,026			Flat Topography	proposed
Ocean Desalination	4,497	SWP-Central Coast	1,026			Moderate Topograph	proposed
Brackish Water Desal	1,053	SWP-San Joaquin Valley	492			Hilly Topography	proposed
Recycled Water	-	CRA-L.A. Basin	2,001			Recycled Water	684
		Hetch Hetchy- Bay Area	-				
		Mokelumne Aqueduct	52				
		Local/Intrabasin	39				

Source: CEC-500-2006-118

Additional Background Data and Assumptions

Metropolitan Water District of Southern California Energy Intensity for 2014 (used as a proxy for Calleguas water)

	kWh/AF
Conveyance	1,951
Treatment	46
Distribution	-59
Source: Metropolitan 2015 UWMP	

Average Groundwater Depth in Ventura County

	Well Depth (ft)	Source
Mira Monte Well	20	Well located in Upper Ventura River Groundwater Basin. This is the average depth of groundwater in that area. CMWD UWMP AND AWMP - 2016 UPDATE
Ojai GMA	202.3	Appendix B of Ventura's 2013 Groundwater Section
FCGMA	82	Appendix B of Ventura's 2013 Groundwater SectionAnnual Report
UWCD	100.1	Appendix B of Ventura's 2013 Groundwater SectionAnnual Report
Private (unreported)	100	Assumed

Wastewater

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

The unincorporated area uses a combination of centralized WWTP treatment at fringe communities near cities and on-site septic tank systems.

BAU and Legislative Adjusted Emissions Summary (MTCO2e)

Source	2015	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Septic Methane Emissions	5,648	5,765	5,832	5,866	5,885	5,923	Population
WWTP Process Emissions	2,498	2,550	2,580	2,595	2,603	2,620	Population
Total	8,146	8,315	8,412	8,461	8,488	8,543	

Wastewater Emissions in 2015

Source	MT CO2	MTCH4	MTN2O	MT CO2e
Septic Methane Emissions	0	202	0	5,648
WWTP Process Emissions	0	75	1	2,498
Total	0	277	1	8,146

Wastewater Emission Calculations

Wastewater Treatment Emissions

Type of Treatment	WWTP Service by Percent of Unincorporated Population	Served Population	MT CH4*	MT N2O	Total CO_2e Emissions (MT CO_2e/yr)
Septic Tank Treatment	53%	51,613	202	0.00	5,648
Centralized Sewer Treatment	47%	46,120	75.08	1.50	2,498
Centralized Aerobic Treatment	*41%*	*40,500*			
Process N2O Emissions from Effluent Discharge (default N load data)				*0.94*	
Centralized Anaerobic Treatment with Cogeneration	*6%*	*5,620*			
Process emissions			*74.83*		
Stationary CH4 from Incomplete Combustion of Digester Gas			*0.25*		
Process N2O Emissions from Effluent Discharge (default N load data)				*0.15*	
Process N2O Emissions from WWTP with Nitrification/Denitrification	*assume this applies to all WWTPs*			0.40	
		Total Septic	202	0	5,648
		Total Centralized	75	1	2,498
		Total	277	1	8,146

** See methods below from EPA Inventory of US GHG Emissions and Sinks*

Note: Aerobic treatment does not result in CH4 emissions

Background Data and Assumptions

Demographics Summary	2015	Source
Unincorporated Population	97,733	Background Report
Unincorporated Households	32,191	Background Report
Approximate Number of Private Septic Systems in County	17,000	Email from Ventura County (Shelley Sussman) to Ascent Environmental (Brenda Hom/Erik de Kok) (10/17/2018)
Number of Unincorporated HH's on Septic	17,000	Assumption
Number of Unincorporated HH's on Sewer	15,191	Calculation
Percent of Unincorporated Population on Septic	53%	Calculation

Wastewater Treatment Capacity and Service Ventura County						
Agency	**WWTP Name**	**Rated Capacity (MGD)**	**Percent of WW treated from Unincorporated County***	**Unincorporated WW treated in WWTPs (MGD)**	**Anaerobic Treatment?**	**Total Number of Connections****
County Service Area No. 29	treated by City of Ventura	N/A				317
County Service Area No. 30	treated by City of Oxnard	N/A				510
County Service Area No. 32	countywide individual sewage disposal	N/A				N/A
County Service Area No. 34	treated by City of Oxnard	N/A				N/A
Camarillo Utility Enterprise	treated by Camarillo Sanitary District	N/A	0%			57
Todd Road Jail	On site WWTP	0.085	100%	0.09	No	N/A
Ventura County Waterworks District No. 1	Moorpark Wastewater Treatment Plant	5	15%	0.75	No	10,000 (population)
Ventura County Waterworks District No. 16	On site WWTP	0.5	100%	0.50	No	400 (population)
Camarillo Sanitary District	Camarillo WRP	7.25	40%	2.90	No	70,000 (population, city and unincorporated)
Ojai Valley Sanitary District	Ojai Valley WWTP	3	63%	1.88	No	20,000 (customers)
Saticoy Sanitary District	Jose Flores WWTP	0.25	100%	0.25	No	271
Triunfo Sanitation District	Tapia Water Reclamation Facility	16	21%	3.38	No	12,300
Camrosa Water District	Camrosa Water Reclamation Facility	1.5	100%	1.50	No	6,900
City of Oxnard	City of Oxnard WWTP	32.7	1%	0.48	Yes, with cogeneration	40,000
City of Simi Valley	Water Quality Control Plant	12.5	1%	0.16	No	40,000 (527 unincorporated)
City of Thousand Oaks	Hill Canyon Wastewater Treatment Plant	14	9%	1.22	Yes, with cogeneration	130,000 (population)
City of Ventura	Ventura Water reclamation facility	9	9%	0.80	No	N/A

* Estimates based on population served.

**From Table 7-3 of the background report

Source: Agency websites.

Percent of Unincorporated Centralised WW treated aerobically	88%
Percent of Unincorporated Centralised WW treated anaerobically	12%

Residential Wastewater Methods

Data Source: Total unincorporated population. Percentage breakdown of population served by Septic and Sewer systems. Percent breakdown of aerobic and anaerobic

Domestic Wastewater CH4 Emission Estimates from EPA Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2014

$$\textit{Emissions from Septic Systems} = A = US_{POP} \times (\%\ \text{onsite}) \times (EF_{SEPTIC}) \times 1/10^9 \times \text{Days}$$

$$\textit{Emissions from Centrally Treated Aerobic Systems} = B = [(\%\ \text{collected}) \times (\text{total } BOD_5 \text{ produced}) \times (\%\ \text{aerobic}) \times (\%\ \text{aerobic w/out primary}) + (\%\ \text{collected}) \times (\text{total } BOD_5 \text{ produced}) \times (\%\ \text{aerobic}) \times (\%\ \text{aerobic w/primary}) \times (1\text{-}\%\ \text{BOD removed in prim. treat.})] \times (\%\ \text{operations not well managed}) \times (B_o) \times (\text{MCF-aerobic\_not\_well\_man})$$

$$\textit{Emissions from Centrally Treated Anaerobic Systems} = C = [(\%\ \text{collected}) \times (\text{total } BOD_5 \text{ produced}) \times (\%\ \text{anaerobic}) \times (\%\ \text{anaerobic w/out primary}) + (\%\ \text{collected}) \times (\text{total } BOD_5 \text{ produced}) \times (\%\ \text{anaerobic}) \times (\%\ \text{anaerobic w/primary}) \times (1\text{-}\%\ \text{BOD removed in prim. treat.})] \times (B_o) \times (\text{MCF-anaerobic})$$

$$\textit{Emissions from Anaerobic Digesters} = D = [(\text{POTW\_flow\_AD}) \times (\text{digester gas})/(\text{per capita flow})] \times \text{conversion to } m^3 \times (FRAC\_CH_4) \times (365.25) \times (\text{density of } CH_4) \times (1\text{-DE}) \times 1/10^9$$

$$\text{Total } CH_4 \text{ Emissions (kt)} = A + B + C + D$$

where,

US_{POP} = U.S. population

% onsite	= Flow to septic systems / total flow
% collected	= Flow to POTWs / total flow
% aerobic	= Flow to aerobic systems / total flow to POTWs
% anaerobic	= Flow to anaerobic systems / total flow to POTWs
% aerobic w/out primary	= Percent of aerobic systems that do not employ primary treatment
% aerobic w/primary	= Percent of aerobic systems that employ primary treatment
% BOD removed in prim. treat.	= 32.5%
% operations not well managed	= Percent of aerobic systems that are not well managed and in which some anaerobic degradation occurs
% anaerobic w/out primary	= Percent of anaerobic systems that do not employ primary treatment
% anaerobic w/primary	= Percent of anaerobic systems that employ primary treatment
EF_{SEPTIC}	= Methane emission factor (10.7 g CH_4/capita/day) – septic systems
Days	= days per year (365.25)
Total BOD_5 produced	= kg BOD/capita/day × U.S. population × 365.25 days/yr
B_o	= Maximum CH_4-producing capacity for domestic wastewater (0.60 kg CH_4/kg BOD)
$1/10^6$	= Conversion factor, kg to kt
MCF-aerobic_not_well_man.	= CH_4 correction factor for aerobic systems that are not well managed (0.3)
MCF-anaerobic	= CH_4 correction factor for anaerobic systems (0.8)
DE	= CH_4 destruction efficiency from flaring or burning in engine (0.99 for enclosed flares)
POTW_flow_AD	= Wastewater influent flow to POTWs that have anaerobic digesters (MGD)
digester gas	= Cubic feet of digester gas produced per person per day (1.0 ft^3/person/day)
per capita flow	= Wastewater flow to POTW per person per day (100 gal/person/day)
conversion to m^3	= Conversion factor, ft^3 to m^3 (0.0283)
$FRAC\_CH_4$	= Proportion CH_4 in biogas (0.65)
density of CH_4	= 662 (g CH_4/m^3 CH_4)
$1/10^9$	= Conversion factor, g to kt

Source: EPA Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2014. Waste. Chapter 7. 7-18

Process CH4 Emissions from Anaerobic and facultative treatment lagoons

Equation 10.4 from the LGOP

Equation 10.4	Process CH_4 from Wastewater Treatment Lagoons (default values)

Annual CH_4 emissions (metric tons CO_2e) =

$((P \times F_{ind\text{-}com}) \times BOD_5 \text{ load} \times (1\text{-}F_P) \times Bo \times MCF_{anaerobic} \times 365.25 \times 10^{-3}) \times GWP$

Where:

Term		Description	Value
P	=	population served by lagoons adjusted for industrial discharge, if applicable [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
BOD_5 load	=	amount of BOD_5 produced per person per day [kg BOD_5/person/day]	0.090
F_P	=	fraction of BOD_5 removed in primary treatment, if present	0.325*
Bo	=	maximum CH_4-producing capacity for domestic wastewater [kg CH_4/kg BOD_5 removed]	0.6
$MCF_{anaerobic}$	=	CH_4 correction factor for anaerobic systems	0.8
365.25	=	conversion factor [day/year]	365.25
10^{-3}	=	conversion from kg to metric ton [metric ton/kg]	10^{-3}
GWP	=	Global Warming Potential	21

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-9 (2009) except: *F_P: Tchobanoglous, G., F.L. Burton, and H.D. Stensel, *Wastewater Engineering: Treatment and Reuse*, p. 396, 4th Edition (2003).

Stationary CH4 from Incomplete Combustion of Digester Gas (default)

Equation 10.2 from the LGOP

Equation 10.2	Stationary CH_4 from Incomplete Combustion of Digester Gas (default)

Annual CH_4 emissions (metric tons CO_2e) =

$(P \times \text{Digester Gas} \times F_{CH4} \times \rho(CH_4) \times (1\text{-}DE) \times 0.0283 \times 365.25 \times 10^{-6}) \times GWP$

Where:

Term		Description	Value
P	=	population served by the WWTP with anaerobic digesters	user input
Digester Gas	=	cubic feet of digester gas produced per person per day [ft^3/person/day]	1.0
F_{CH4}	=	fraction of CH_4 in biogas	0.65
$\rho(CH_4)$	=	density of methane [g/m^3]	662.00
DE	=	CH_4 Destruction Efficiency	.99
0.0283	=	conversion from ft^3 to m^3 [m^3/ft^3]	0.0283
365.25	=	conversion factor [day/year]	365.25
10^{-6}	=	conversion from g to metric ton [metric ton/g]	10^{-6}
GWP	=	Global Warming Potential	21

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-7 (2009).

Process N2O Emissions from WWTP with Nitrification/Denitrification

Equation 10.7 from the LGOP

Equation 10.7	Process N_2O Emissions from WWTP with Nitrification/Denitrification
Annual N_2O emissions (metric tons CO_2e) = $((P_{total} \times F_{ind\text{-}com}) \times EF\ nit/denit \times 10^{-6}) \times GWP$	

Where:

Term		Description	Value
P_{total}	=	total population that is served by the centralized WWTP adjusted for industrial discharge, if applicable [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
EF nit/denit	=	emission factor for a WWTP with nitrification/denitrification [g N_2O/person/year]	7
10^{-6}	=	conversion from g to metric ton [metric ton/g]	10^{-6}
GWP	=	N_2O Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009).

Process N2O Emissions from Effluent Discharge (default N load data)

Equation 10.10 from the LGOP

Equation 10.10	Process N_2O Emissions from Effluent Discharge (default N load data)
Annual N_2O emissions (metric tons CO_2e) = $((P_{total} \times F_{ind\text{-}com}) \times (Total\ N\ Load - N\ uptake \times BOD_5\ load) \times EF\ effluent \times 44/28 \times (1 - F\ plant\ nit/denit) \times 365.25 \times 10^{-3}) \times GWP$	

Where:

Term		Description	Value
P_{total}	=	population served [person]	user input
$F_{ind\text{-}com}$	=	factor for industrial and commercial co-discharge waste into the sewer system	1.25
Total N Load[27]	=	total nitrogen load [kg N/person/day]	0.026
N uptake[28]	=	nitrogen uptake for cell growth in aerobic system (kg N/kg BOD_5)	0.05[1]
	=	nitrogen uptake for cell growth in anaerobic system (e.g., lagoon) (kg N/kg BOD_5)	0.005[1]
BOD_5 load	=	amount of BOD_5 produced per person per day [kg BOD_5/person/day]	0.090
EF effluent	=	emission factor [kg N_2O-N/kg sewage-N produced]	0.005
44/28	=	molecular weight ratio of N_2O to N_2	1.57
F plant nit/denit	=	fraction of nitrogen removed for the centralized WWTP with nitrification/denitrification	0.7[1]
	=	fraction of nitrogen removed for the centralized WWTP w/o nitrification/denitrification	0.0[1]
365.25	=	conversion factor [day/year]	365.25
10^{-3}	=	conversion from kg to metric ton [metric ton/kg]	10^{-3}
GWP	=	Global Warming Potential	310

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007*, Chapter 8, 8-13 (2009), except:
[1] Grady, C. P. L., Jr., G. T. Daigger, and H. C. Lim, *Biological Wastewater Treatment*, p. 108-109, 644 2nd Edition (1999).

Agriculture

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Agricultural Emissions in 2015							
	MT CO2	MT CH4	MT N2O	MT CO2e	Scaled MTCO2e	% of total Ag	Year
Residue Burn	7,928	8	1	8,494	8,514	3%	2015
Enteric Fermentation	0	329	0	9,212	8,225	4%	2015
Manure Management	0	16	2	864	869	0%	2015
Farm Equipment	67,410	7	1	67,829	67,834	28%	2015
Agricultural Irrigation Pumps	22,257	0	0	22,257	21,625	9%	2015
Pesticide	0	0	0	0	658	0%	2015
Fertilizer	0	0	495	131,113	146,983	54%	2015
Lime Application	294	0	0	294	291	0%	2015
Urea Fertilization	4,941	0	0	4,941	4,894	2%	2015
Total	**102,830**	**360**	**499**	**245,004**	**259,894**	**54%**	

Source: See separate Agricultural calculation spreadsheet

Agricultural Emissions Forecasting 2020-2040						
	2020	2030	2035	2040	2050	Calculation Method/Scaling Factor
Residue Burn	8,298	7,864	7,647	7,430	6,996	Change in important farmland. See Assumptions.
Enteric Fermentation	8,171	8,062	8,007	7,953	7,844	Change in grazing land. See Assumptions.
Manure Management	864	852	846	841	829	Change in grazing land. See Assumptions.
Farm Equipment	66,107	62,651	60,923	59,196	55,740	Change in important farmland. See Assumptions.
Agricultural Irrigation Pumps	21,074	19,972	19,422	18,871	17,769	Change in important farmland. See Assumptions.
Pesticide	641	608	591	574	541	Change in important farmland. See Assumptions.
Fertilizer	146,011	144,068	143,096	142,124	140,181	Change in grazing land. See Assumptions.
Lime Application	289	285	283	282	278	Change in grazing land. See Assumptions.
Urea Fertilization	4,769	4,520	4,395	4,270	4,021	Change in important farmland. See Assumptions.
Total	**256,223**	**248,882**	**245,211**	**241,541**	**234,200**	

Stationary Sources

Ventura County Greenhouse Gas Emissions Inventory and Forecast - 2015 - 2050

Stationary Source Emissions (Oil and Gas Emissions) Forecasts (BAU and Legislatively Adjusted BAU)						
	2015	2020	2030	2040	2050	Calculation Method/Scaling Factor
Combustion Emissions	231,487	179,032	144,802	117,239	95,020	Forecasted growth rate in oil production
Vented Emissions	32,523	25,153	20,344	16,472	13,350	Forecasted growth rate in oil production
Fugitive Emissions	53,212	41,154	33,285	26,950	21,842	Forecasted growth rate in oil production
Total	**317,222**	**245,340**	**198,432**	**160,660**	**130,212**	

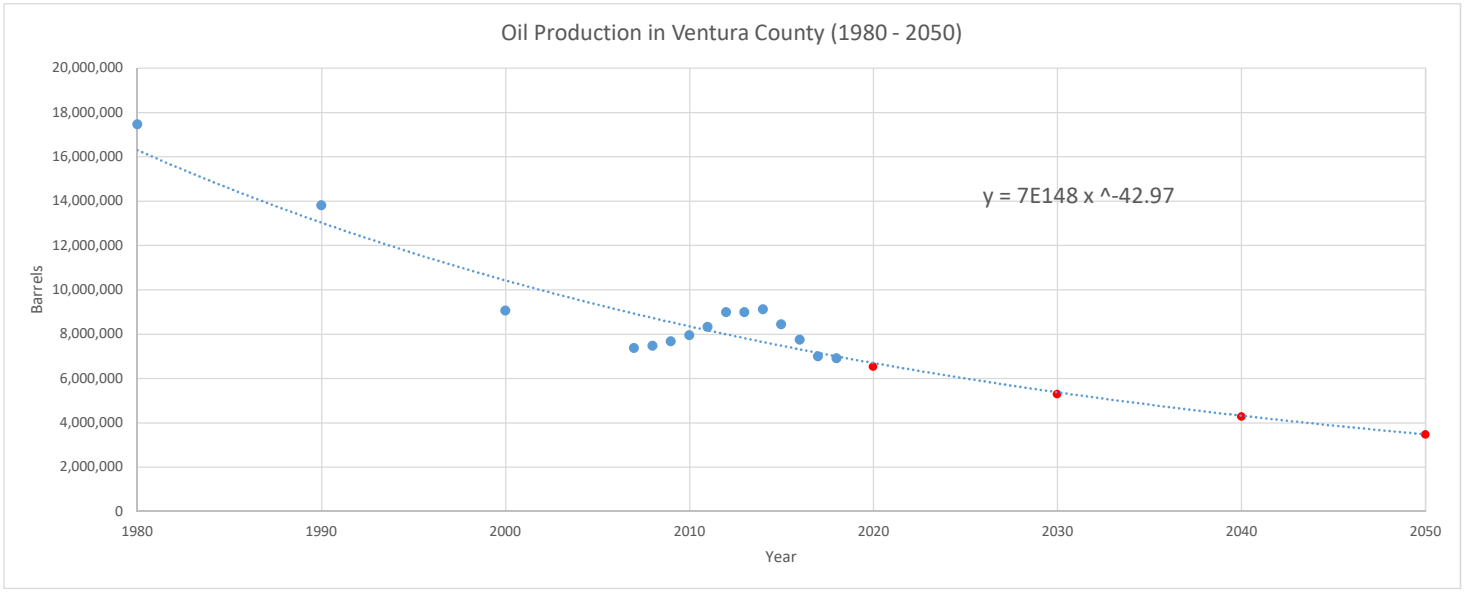
Estimating Ventura County Stationary Source Emissions from Oil and Gas Production and Processing in 2015				
	2007			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	189,880	385	5	201,985
Vented Emissions	25,074	118	-	28,378
Fugitive Emissions	11,234	1,257	-	46,430
Total	**226,188**	**1,760**	**5**	**276,793**
Source: CARB's 2007 Oil and Gas Industry Survey Results [Final (Revised)] (https://ww2.arb.ca.gov/sites/default/files/2020-04/FinalReportRevised_4.pdf)				
	2015			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	217,614	441	6	231,487
Vented Emissions	28,736	135	-	32,523
Fugitive Emissions	12,875	1,441	-	53,212
Total	**259,225**	**2,017**	**6**	**317,222**
Source: Scaled from 2007 levels based on total oil production in the county. Note: Associated Gas production is natural gas production that is associated with crude oil production. Thus, any emissions related to associated gas production are assumed to be proportional to oil production.				
Estimating Ventura County Stationary Source Emissions from Oil and Gas Production and Processing in 2020-2050				
	2020			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	168,303	341	4	179,032
Vented Emissions	22,225	105	-	25,153
Fugitive Emissions	9,957	1,114	-	41,154
Total	**200,485**	**1,560**	**4**	**245,340**
	2030			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	136,124	276	4	144,802
Vented Emissions	17,975	85	-	20,344
Fugitive Emissions	8,054	901	-	33,285
Total	**162,153**	**1,262**	**4**	**198,432**
	2040			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	110,213	223	3	117,239
Vented Emissions	14,554	68	-	16,472
Fugitive Emissions	6,521	730	-	26,950
Total	**131,287**	**1,022**	**3**	**160,660**
	2040			
	MT CO2	MT CH4	MT N2O	MT CO2e
Combustion Emissions	89,326	181	2	95,020
Vented Emissions	11,796	56	-	13,350
Fugitive Emissions	5,285	591	-	21,842
Total	**106,406**	**828**	**2**	**130,212**
Source: Scaled from 2007 levels based on forecasted oil production in the county. Note: Associated Gas production is natural gas production that is associated with crude oil production. Thus, any emissions related to associated gas production are assumed to be proportional to oil production.				

Oil and Gas Production Trends and Forecasts			
Year	Oil Production - Ventura (bbl)	Associated Gas - Ventura (Mcf)	Source
1980	17,458,241	25,275,891	California Department of Conservation
1990	13,794,524	14,583,052	California Department of Conservation
2000	9,050,774	9,593,691	California Department of Conservation
2007	7,354,231	7,611,026	California Department of Conservation
2008	7,466,152	7,626,361	California Department of Conservation
2009	7,665,283	7,799,236	California Department of Conservation
2010	7,944,456	7,951,650	California Department of Conservation
2011	8,308,059	7,676,656	California Department of Conservation
2012	8,977,459	8,411,316	California Department of Conservation
2013	8,973,076	8,275,223	California Department of Conservation
2014	9,101,060	8,558,641	California Department of Conservation
2015	8,428,402	8,231,282	California Department of Conservation
2016	7,729,845	4,049,625	California Department of Conservation
2017	6,988,161	6,503,659	California Department of Conservation
2018	6,894,516	6,239,856	California Department of Conservation
2020	6,518,530	5,792,850	Forecast based on non-linear trends from 1980-2018
2030	5,272,217	4,123,990	Forecast based on non-linear trends from 1980-2018
2040	4,268,642	2,940,818	Forecast based on non-linear trends from 1980-2018
2050	3,459,670	2,100,568	Forecast based on non-linear trends from 1980-2018

Source: https://www.conservation.ca.gov/calgem/pubs_stats/annual_reports/Pages/annual_reports.aspx

Note: Trends between 1980 and 2020 are indicative of the declining segment of the Hubbert Curve (similar to a bell curve), which approximates the rate of finite resource production over time. This prediction assumes that production follows the Hubbert Curve post-peak. A linear curve would predict zero barrels of oil produced between 2030 and 2040. Curve fitting for the segment of data analyzed is based on an expontential trend.

Ventura County is not a major producer of non-associated gas.



Blue Dots: Data from California Department of Conservation
Red Dots: Forecasted data

Note: The shown forecast equation is based on results from this exponential regression calculator from CASIO: (https://keisan.casio.com/exec/system/14059931777261) using data from 1980 through 2018).

Stationary Sources

Category	
Conversions	
g/MT	1000000
g/lb	453.592
lb/MT	2204.622622
kg/MT	1000
MT/ton	1.10231
g/ton	907185
lb/kg	2.20462
kWh/MWh	1000
MWh/GWh	1000
Btu/therm	100000
BTU/gal diesel	139000
MMBtu/therm	0.1
MMBtu/MWh	3.41214148
MMBtu/barrel of oil	5.8
MMBtu/Mcf of associated gas	1
LPG Gallons/GGE	1.344086022
LNG Gallons/GGE	1.572327044
gal/cubic foot	7.480519481
gal/Liter	3.785411784
gallon/acrefoot	325851.429
million gal/acre-feet	0.325851429
GWP	
Source (Select)	*IPCC Fifth Assessment Report GWP Values 100-year horizon*
CO2	1
CH4	28
N2O	265

Electricity Emission Factors

SCE	**2015**	**2020**	**2030**	**2035**	**2040**	**2045**	**Source/Notes**
RPS Status	25%	33%	50%	67%	83%	100%	
SCE Power Mix 2015							SCE 2015 Power Content Label
Natural Gas	26%						(https://www.energy.ca.gov/pcl/labels/2015_index.html)
Unspecified Sources	41%						. Forecasts based on SB350 targets for 2030 and SB100
GHG Free Sources	33%						targes for 2045.
SCE 2015 Calculated EFs							
lb CO2/MWh	**529**	**472.67**	**352.74**	**235.16**	**117.58**	**0.00**	2016 SCE Corporate Responsibility Report
lb CH4/GWh	**14.95**	**13.35**	**9.97**	**6.64**	**3.32**	**0.00**	Calculated from eGrid 2016 NG and Other Efs
lb N2O/GWh	**1.66**	**1.48**	**1.11**	**0.74**	**0.37**	**0.00**	Calculated from eGrid 2016 NG and Other Efs
MT CO2e/MWh	**0.240**	**0.215**	**0.160**	**0.107**	**0.053**	**0.000**	Calculated

California Average	**2015**	**2020**	**2030**	**2035**	**2040**	**2045**	**Source/Notes**
RPS Status	25%	33%	50%	67%	83%	100%	SCE 2015 Power Content Label
CA Average Power Mix 2015							(https://www.energy.ca.gov/pcl/labels/2015_index.html)
Natural Gas	44%						. Forecasts based on SB350 targets for 2030 and SB100
Unspecified Sources	15%						targes for 2045.
Coal	6%						
GHG Free Sources	41%						
CA Average 2015 Calculated EFs							
lb CO2/MWh	**519.21**	**463.8**	**346.1**	**230.5**	**115.6**	**0.0**	Calculated from eGrid 2016 NG and Other Efs
lb CH4/GWh	**11.96**	**10.7**	**8.0**	**5.3**	**2.7**	**0.0**	Calculated from eGrid 2016 NG and Other Efs
lb N2O/GWh	**2.32**	**2.1**	**1.5**	**1.0**	**0.5**	**0.0**	Calculated from eGrid 2016 NG and Other Efs
MT CO2e/MWh	**0.236**	**0.211**	**0.157**	**0.105**	**0.053**	**0.000**	Calculated

eGrid 2016 Emission Factors (For Calculation of California Average EFs)		Updated February 2017
Natural Gas EFs: eGRID2016 Average of California Natural Gas Electricity Plant EFs		https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
lb CO2/MWh	867.88	Weighted average based on annual plant net generation
lb CH4/GWh	16.50	Weighted average based on annual plant net generation
lb N2O/GWh	1.66	Weighted average based on annual plant net generation
MT CO2e/MWh	**0.3941**	Calculated
Coal EFs: eGRID2016 Average of California Coal Electricity Plant EFs		https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
lb CO2/MWh	1157.82	Weighted average based on annual plant net generation
lb CH4/GWh	13.41	Weighted average based on annual plant net generation
lb N2O/GWh	18.98	Weighted average based on annual plant net generation
MT CO2e/MWh	**0.5276**	Calculated
Unspecified EFs: eGRID2016 CAMX Emission Factors		Assumed to represent unspecified power sources
lb CO2/MWh	452.50	CAMX avg
lb CH4/GWh	26.00	CAMX avg
lb N2O/GWh	3.00	CAMX avg
kg/MWh	205.25	Calculated
kg/GWh	11.79	Calculated
kg/GWh	1.36	Calculated

Utility Natural Gas Emission Factors		**Source/Notes**	
kg CO_2/MMBtu	53.06	Natural Gas - US Weighted Average	2017 Climate Registry Emission Factors. Table 12.1.
g CH4/MMBtu	4.7	Natural Gas - Residential/Commercial	2017 Climate Registry Emission Factors. Table 12.9.
g N2O/MMBtu	0.1	Natural Gas - Residential/Commercial	2017 Climate Registry Emission Factors. Table 12.9.
MT CO2/therm	0.005306	Calculated	
MT CH4/therm	0.000047	Calculated	
MT N2O/therm	0.000001	Calculated	
MT CO2e/therm	**0.0069**	Calculated	

The Climate Registry 2017 Default Emission Factors		
Fuel Type	**Carbon Content (Per Unit Energy)**	**CO2 Emission Factor** (Per Unit Volume)
Fuels Measured in Gallons	**kg C / MMBtu**	**kg CO2 / gallon**
Gasoline	19.2	8.78
Diesel Fuel	20.2	10.21
Aviation Gasoline	18.9	8.31
Jet Fuel (Jet A or A-1)	19.7	9.75
Kerosene	20.5	10.15
Residual Fuel Oil No. 5	19.9	10.21
Residual Fuel Oil No. 6	20.5	11.27
Crude Oil	20.3	10.29
Biodiesel (B100)	20.1	9.45
Ethanol (E100)	18.7	5.75
Methanol	n/a	4.10
Liquefied Natural Gas (LNG)*	n/a	4.46
Liquefied Petroleum Gas (LPG)	17.2	5.68
Propane (Liquid)	16.8	5.72
Ethane	17.1	4.11
Isobutane	17.7	6.30
Butane	17.8	6.54
Fuels Measured in Standard Cubic Feet	**kg C / MMBtu**	**kg CO2 / Standard cubic foot**
Compressed Natural Gas (CNG)*	14.47	0.054
Propane (Gas)	16.76	0.1546
Source: Heat content and default emission factors are from EPA Final Mandatory Reporting of Greenhouse Gases Rule Table C-1. Carbon content derived using the heat content and default emission factor. Except those marked * are from EPA Climate Leaders, Mobile Combustion Guidance, Tables B-4, B-5, (2008). A fraction oxidized value of 1.00 is from the IPCC, *Guidelines for National Greenhouse Gas Inventories* (2006). Methanol emission factor is calculated from the properties of the pure compounds. Note: Carbon contents are calculated using the following equation: (Emission Factor / (44/12)) / Heat Content × Conversion Factor. Heat content factors are based on higher heating values (HHV). NA = data not available.		

Vehicle Type / Fuel Type	**CH4 (g / gallon)**	**N2O (g / gallon)**
Ships and Boats		
Residual Fuel Oil	0.11	0.60
Diesel Fuel	0.74	0.45
Gasoline	0.06	0.22
Locomotives		
Diesel Fuel	0.80	0.26
Agricultural Equipment		
Gasoline	1.26	0.22
Diesel Fuel	1.44	0.26
Construction/Mining Equipment		
Gasoline	0.50	0.22
Diesel Fuel	0.58	0.26
Other Non-Highway		
Snowmobiles (Gasoline)	0.50	0.22
Other Recreational (Gasoline)	0.50	0.22
Other Small Utility (Gasoline)	0.50	0.22
Other Large Utility (Gasoline)	0.50	0.22
Other Large Utility (Diesel)	0.58	0.26
Aircraft		
Jet Fuel	0.00	0.31
Aviation Gasoline	7.05	0.11
Source: US Inventory of Greenhouse Gas Emissions and Sinks 1990-2011 (April 2013) Annex 3, Table A-106. Original factors converted to g/gallon fuel using fuel density defaults from U.S. EPA Climate Leaders, Mobile Combustion Guidance (2008) Table A-6.		
Vehicle Type / Fuel Type	**CH4 (g / L)**	**N2O (g / L)**
Diesel Passenger Cars		
Advanced	0.0005	0.0010
Moderate	0.0005	0.0010
Uncontrolled	0.0006	0.0012
Diesel Light Trucks		
Advanced	0.0010	0.0015
Moderate	0.0009	0.0014
Uncontrolled	0.0011	0.0017
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses)		
Aftertreatment	0.0051	0.0048
Advanced	0.0051	0.0048
Moderate	0.0051	0.0048
Uncontrolled	0.0051	0.0048
CNG Medium and Heavy-Duty Vehicles (Trucks and Busses)		
CNG	1.9660	0.1750

Fuel Type	Heat Content	CO2 Emission Factor (Per Unit Energy)	CO2 Emission Factor (Per Unit Mass or Volume)
Natural Gas	**Btu / scf**	**kg CO2 / MMBtu**	**kg CO2 / scf**
US Weighted Average	1026.00	53.06	0.05
Greater than 1,000 Btu*	>1000	53.06	varies
975 to 1,000 Btu*	975 – 1,000	54.01	varies

Fuel Type / End-Use Sector	CH4 (g / MMBtu)	N2O (g / MMBtu)
Coal		
Residential	300.7	1.5
Commercial	10.0	1.5
Petroleum Products		
Residential	10.0	0.6
Commercial	10.0	0.6
Natural Gas		
Residential	4.7	0.1
Commercial	4.7	0.1
Wood		
Residential	253.2	3.4
Commercial	253.2	3.4

Population growth				
Population	**2013**	**2015**	**Growth from 2013**	Source
Ventura County	836,154	NA	NA	County of Ventura. 2013 Water Supply and Demand.
Ventura County	840,867	850,491	1%	Department of Finance
Unincorporated County		97,733		Department of Finance
City of Ventura Population		108,037		Department of Finance
Population supplied by City of Ventura		112,412		City of Ventura 2015 UWMP

Note: Factors used in Imported Water calculations.

Land Use Trends							
	2015	**2020**	**2030**	**2035**	**2040**	**2015 - 2040 Trend**	**Annual**
Important Farmland	120923	114410	109967	107745	105524	-12.7%	-0.5%
Grazing Land	192742	195394	190882	188626	186370	-3.3%	-0.1%

Source: 2020 - 2040 Projections based on 1984-2016 Land Use Data from California Department of Conservation's Farmland Mapping and Monitoring Program. See Land Use Growth Trends Spreadsheet.

Note: Factors used in Agriculture Forecasts.

Solid Waste Characterization			
	Tons	**Percent of total**	**Source**
Commercial Waste (w/o) organics	12,296	28%	2014 Commercial Waste Stream by Material Type in Ventura County
Residential Waste (w/o) organics	14,387	32%	2014 Residential Waste Stream by Material Type in Ventura County
Organics - Commercial	7,936	18%	
Organics - Residential	9,739	22%	
Organics - Combined	17,675	40%	
Solid Waste **Total**	44,358		

Source: CalRecycle Solid Waste Characterization for Unincoroporated Ventura County (https://www2.calrecycle.ca.gov/WasteCharacterization)

EMFAC 2017 Emission Factor Summary by SCAG Vehicle Category

SCAG Vehicle Category	CO2 g/mi	CH4 g/mi	N2O g/mi
Light Duty	360.2	0.0113	0.0001
Heavy Duty	676.7	0.0190	0.0003
Buses	1502.3	1.6224	0.0039

VMT Test	
15,367,891	81%
3,498,707	18%
51,641	0.27%

g per ton 907185

Output from EMFAC 2017

EMFAC2017 (v1.0.2) Emissions Inventory
Region Type: County
Region: VENTURA
Calendar Year: 2015
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

													Weighted by VMT and SCAG Vehicle Category		
Region	Calendar Year	Vehicle Category	SCAG VEH CAT	Model Year	Speed	Fuel	Population	VMT	Trips	CO2 g/mi	CH4 g/mi	N2O g/mi	CO2 g/mi	CH4 g/mi	N2O g/mi
VENTURA	2015	HHDT	Heavy Duty	Aggregated	Aggregated	GAS	10.45531516	201.3981635	209.1899457	2785.411232	0.88132186	0	0.160338293	5.07321E-05	0
VENTURA	2015	HHDT	Heavy Duty	Aggregated	Aggregated	DSL	2856.269122	284092.6478	26805.6492	1751.784312	0.017332984	0.002129387	142.243705	0.001407427	0.000172905
VENTURA	2015	HHDT	Heavy Duty	Aggregated	Aggregated	NG	56.59271026	2269.639992	220.71157	3747.758307	8.386015072	0.05167104	2.431201635	0.005440077	3.35194E-05
VENTURA	2015	LDA	Light Duty	Aggregated	Aggregated	GAS	257764.5357	9735876.625	1202803.446	316.1007037	0.00767939	0	200.256331	0.004865052	0
VENTURA	2015	LDA	Light Duty	Aggregated	Aggregated	DSL	2796.394678	112916.6356	13162.62327	235.6607335	0.001432697	0	1.731533448	1.05268E-05	0
VENTURA	2015	LDA	Light Duty	Aggregated	Aggregated	ELEC	1140.433608	40720.83903	5813.705517	0	0	0	0	0	0
VENTURA	2015	LDT1	Light Duty	Aggregated	Aggregated	GAS	29792.01842	997682.5711	132083.258	373.7735268	0.019870218	0	24.26535528	0.001289973	0
VENTURA	2015	LDT1	Light Duty	Aggregated	Aggregated	DSL	54.68934084	1029.5922	191.409685	436.7623092	0.013292069	0	0.029261469	8.9052E-07	0
VENTURA	2015	LDT1	Light Duty	Aggregated	Aggregated	ELEC	32.97445551	940.8671739	155.8402686	0	0	0	0	0	0
VENTURA	2015	LDT2	Light Duty	Aggregated	Aggregated	GAS	97569.80534	3640831.271	453078.5457	416.0681671	0.010527776	0	98.57136549	0.002494152	0
VENTURA	2015	LDT2	Light Duty	Aggregated	Aggregated	DSL	322.50626	14907.63867	1592.299453	330.0100127	0.001342905	0	0.320126558	1.30269E-06	0
VENTURA	2015	LDT2	Light Duty	Aggregated	Aggregated	ELEC	11.25957017	370.4753568	55.94907764	0	0	0	0	0	0
VENTURA	2015	LHDT1	Light Duty	Aggregated	Aggregated	GAS	9667.949504	322240.2109	144038.0424	850.1204178	0.019494039	0.003761232	17.82567198	0.000408759	7.8867E-05
VENTURA	2015	LHDT1	Light Duty	Aggregated	Aggregated	DSL	7012.299453	267489.0214	88205.90565	518.1401102	0.006360813	0.000133649	9.018595437	0.000110714	2.32625E-06
VENTURA	2015	LHDT2	Light Duty	Aggregated	Aggregated	GAS	1520.846228	55364.75561	22658.34274	967.5943347	0.010590956	0.003614496	3.485880016	3.81552E-05	1.30217E-05
VENTURA	2015	LHDT2	Light Duty	Aggregated	Aggregated	DSL	2290.518275	91034.81066	28811.83843	569.386227	0.005417874	0.000128274	3.372874496	3.20939E-05	7.59854E-07
VENTURA	2015	MCY	Light Duty	Aggregated	Aggregated	GAS	16078.66621	86485.61503	32157.33242	237.4705893	0.364527719	0	1.336409144	0.002051446	0
VENTURA	2015	MDV	Heavy Duty	Aggregated	Aggregated	GAS	80904.03297	2792548.29	373672.3129	495.8915598	0.011940621	0	395.8036882	0.009530595	0
VENTURA	2015	MDV	Heavy Duty	Aggregated	Aggregated	DSL	929.7187943	41024.03536	4600.713317	428.7902925	0.000915923	0	5.027774037	1.07396E-05	0
VENTURA	2015	MDV	Heavy Duty	Aggregated	Aggregated	ELEC	3.21702005	65.62526123	13.79356057	0	0	0	0	0	0
VENTURA	2015	MH	Heavy Duty	Aggregated	Aggregated	GAS	4449.138728	39906.79323	445.0918384	1749.410586	0.037777401	0	19.95404785	0.000430895	0
VENTURA	2015	MH	Heavy Duty	Aggregated	Aggregated	DSL	1116.305957	11871.49199	111.6305957	991.4394094	0.003868894	0	3.364061373	1.31276E-05	0
VENTURA	2015	MHDT	Heavy Duty	Aggregated	Aggregated	GAS	827.5784077	33933.12756	16558.18878	1791.461793	0.054889273	0.005401097	17.3749622	0.000532358	5.2384E-05
VENTURA	2015	MHDT	Heavy Duty	Aggregated	Aggregated	DSL	5433.837983	292793.9321	55084.74084	1079.564459	0.018521845	0.000259366	90.34478296	0.001550025	2.17054E-05
VENTURA	2015	OBUS	Buses	Aggregated	Aggregated	GAS	258.970114	10905.03035	5181.474041	1775.903658	0.028466077	0.004440815	375.0178876	0.006011187	0.000937768
VENTURA	2015	OBUS	Buses	Aggregated	Aggregated	DSL	159.1361575	8932.726012	1405.7879	1176.572926	0.02153926	0.000867219	203.5206902	0.003725808	0.000150009
VENTURA	2015	SBUS	Buses	Aggregated	Aggregated	GAS	63.61691184	2522.652147	254.4676474	1018.277131	0.13073451	0.052420003	49.7426665	0.006386359	0.002560708
VENTURA	2015	SBUS	Buses	Aggregated	Aggregated	DSL	331.64	10257.16316	3827.07962	1448.39885	0.013531626	0.00103012	287.6875965	0.002687713	0.000204607
VENTURA	2015	UBUS	Buses	Aggregated	Aggregated	GAS	56.68692214	4226.760619	226.7476886	1688.446763	0.004710732	0	138.197672	0.000385569	0
VENTURA	2015	UBUS	Buses	Aggregated	Aggregated	DSL	43.93929665	3327.785566	175.7571866	1690.819298	0.091867579	0	108.9577766	0.005920022	0
VENTURA	2015	UBUS	Buses	Aggregated	Aggregated	ELEC	0.114167013	2.640406279	0.456668051	0	0	0	0	0	0
VENTURA	2015	UBUS	Buses	Aggregated	Aggregated	NG	107.2596142	11466.20056	429.0384568	1527.62131	7.193904851	0	339.1883636	1.597312631	0