2016 Greenhouse Gas Emissions Inventory Update and Forecast

PREPARED FOR

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INTRODUCTION

The County of Santa Barbara (County) Board of Supervisors adopted the Energy and Climate Action Plan (ECAP) in May 2015. The ECAP set a goal of reducing greenhouse gas (GHG) emissions in the unincorporated County by 15 percent below 2007 levels by 2020 and outlined strategies ("emission reduction measures" or "ERMs") to achieve this goal. The "unincorporated county" consists of the unincorporated areas within Santa Barbara County, excluding areas under the jurisdiction of incorporated cities, Vandenburg Air Force Base (VAFB), and the University of California – Santa Barbara (UCSB) because of the County's lack of jurisdictional control over those areas. The 2015 ECAP established the unincorporated county's 2007 GHG emissions baseline from which to reduce emissions and forecasted 2020 emissions. County staff subsequently released a report in September 2017 detailing the implementation progress of the ERMs set in the 2015 ECAP. This progress report showed that as of 2016 the County was 16 percent of the way toward reaching its 2020 emissions reduction target, as measured by the implementation of the individual emissions reductions activities in the ECAP (County of Santa Barbara 2017). This report provides a snapshot of the County's progress toward the ECAP's 2020 goal by assessing the unincorporated county's emissions in 2016, analyzing how emissions have changed since 2007, and updating the emissions forecast to 2050 based on updated demographics and policies.

ORGANIZATION OF THIS REPORT

This report consists of three main parts:

- Section 1 provides the executive summary of the 2016 GHG Inventory Update and Forecast.
- Section 2 summarizes the updated 2016 GHG emissions inventory for each sector, including any new sectors not previously included in the 2007 baseline inventory. In addition to presenting the 2016 emissions inventory results, this section also discusses the data sources and methods used to develop the updated inventory. This section also presents an adjusted version of the updated inventory using sectors and methods consistent with the 2007 baseline, to the degree possible, to provide an equal comparison.
- Section 3 summarizes the forecasted GHG emissions under "business-as-usual" (BAU) and legislative-adjusted BAU (ABAU) scenarios. A BAU scenario is one in which no action is taken by local, state, or federal agencies to reduce GHG emissions. An ABAU is one in which BAU conditions are adjusted to reflect policy or regulatory actions enacted by state or federal agencies, without considering any local actions to reduce GHG emissions. This section also compares emissions forecasts to reduction targets set in the 2015 ECAP and by the State. Consistent with these targets, emissions are forecasted for the years 2020, 2030, 2035, and 2050.

1 EXECUTIVE SUMMARY

In 2016, the unincorporated county emitted 1,542,541 metric tons of carbon dioxide equivalents (MT CO_2e). This is an approximate increase of 14 percent when compared to the 2007 inventory, after adjusting for the different methods and assumptions. This increase outpaced population growth, which increased by nine percent during the same period. Excluding differences in methods and assumptions, the increase is largely because of major increases in commercial and industrial energy use, on-road transportation activity, and agricultural activity. Without further action from the County, the County's emissions in 2020 are anticipated to be three percent higher than in 2007, accounting for known State and federal actions.

The 2016 emissions inventory also reflects updated data, methods, and assumptions based on guidance, protocols, and factors revised since 2007. Some of the main methodological differences from the 2007 inventory include:

- Updates to the global warming potential (GWP) factors associated with methane (CH_4) and nitrous oxide (N_2O) emissions;
- The addition of new emissions sources not previously included, such as process emissions from wastewater treatment plants (WWTP), waste already in place (waste-in-place) at landfills, and select off-road equipment sources; and
- Updated emission factors associated with on-road transportation, livestock, fertilizers, and wastewater emissions sources.

Table ES-1 and Figure ES-1 summarize the unincorporated county's 2016 emissions based on the updated data, methods, and assumptions. Table ES-2 shows a normalized comparison between the 2007 and 2016 inventories.

Table ES-1 2016 Unincorporated County of Santa Barbara Greenhouse Gas Inventory

Sectors	2016[1] (MT CO_2e/yr)	Percent of Total
Transportation	587,941	38%
Building Energy	425,741	28%
Agriculture	216,103	14%
Off Road Equipment	171,974	11%
Solid Waste	136,857	9%
Water and Wastewater	3,924	0.3%
Total	1,542,541	100%

Notes: For a comparison of the 2007 and 2016 inventories, see Table ES-2. Note that columns may not add to totals due to rounding.

MT CO_2e = metric tons of carbon dioxide equivalent; GWP = Global Warming Potential; IPCC = Intergovernmental Panel on Climate Change

1. Uses GWP Factors from IPCC's Fourth Assessment Report

Source: Data compiled by Ascent Environmental 2018.

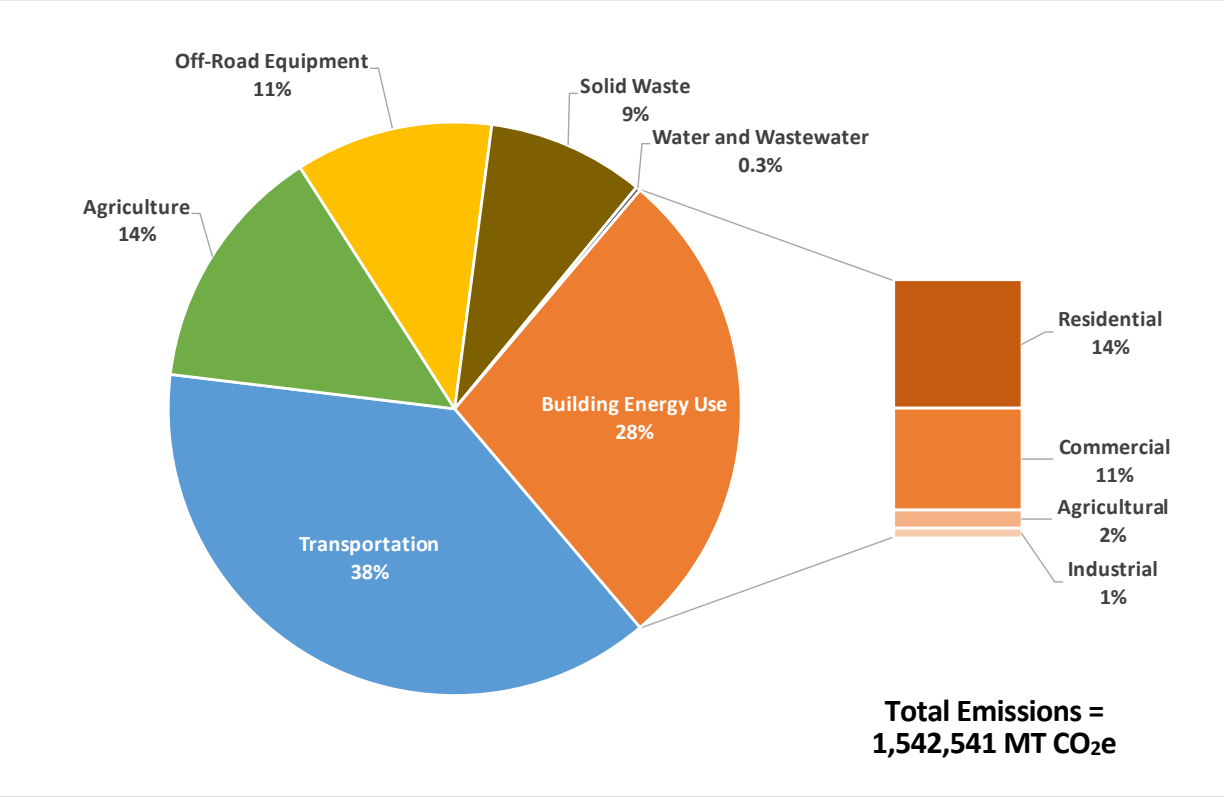


Figure ES-1 **2016 Unincorporated County of Santa Barbara Greenhouse Gas Inventory**

Table ES-2 **Normalized Comparison of Unincorporated County of Santa Barbara Greenhouse Gas Inventories (2007 and 2016) (for comparison only) (MT CO_2e/yr)**

Sectors	2007[1]	2016[2]	Difference	% change from 2007	Primary Reason for Change
Transportation	523,430	588,246	64,816	12%	Increase in VMT and decrease in vehicle emissions factors
Building Energy	330,370	374,164	43,794	13%	Increased non-residential natural gas use
Off-Road Equipment	102,140	138,950	36,810	36%	Increased construction activity
Solid Waste	91,920	82,750	-9,170	-10%	Reduction in waste tonnage
Agriculture	90,348	119,360	29,012	32%	Increase in fertilizer tonnage and decrease in livestock population
Water and Wastewater	4,699	3,364	-1,335	-28%	2007 inventory double counted electricity use for WWTPs and water pumping in unincorporated county
Total	1,142,907	1,306,833	163,926	14%	

Notes: This table contains adjusted 2007 and 2016 inventory numbers and is only to be used for comparison purposes only. MT CO_2e = metric tons of carbon dioxide equivalent; GWP = Global Warming Potential; IPCC = Intergovernmental Panel on Climate Change; VMT = vehicle miles traveled; WWTP = wastewater treatment plant

[1] Does not reflect published 2007 inventory due to exclusion of industrial electricity use and normalization adjustments to wastewater emissions.

[2] Adjusted to use the GWP factors from IPCC's Second Assessment Report and exclude sectors not included in the 2007 inventory.

[3] Livestock emissions adjusted from published 2007 inventory to match cattle populations published in the County's 2007 Crop Report and cattle emission factors used in the 2016 inventory. The 2007 inventory livestock population numbers did not match the 2007 Crop Report.

Source: Santa Barbara County 2017, Modeling by Ascent Environmental 2018.

According to forecasts from the Santa Barbara County Association of Governments (SBCAG), population in the unincorporated county would decline by less than one percent from 2015 to 2020 and increase by 10 percent 2015 to 2035. SBCAG also provided housing, employment, and transportation forecasts. Agricultural emissions were scaled by the historical trend in agricultural acres in the County. Combining these activity forecasts with known federal and State GHG reduction actions assumed to continue, the County's GHG emissions would decrease by 10 percent by 2020 and 34 percent by 2050 from 2016 levels. This projection is referred to as the adjusted business-as-usual (ABAU) scenario, which accounts for the implementation of known legislation; whereas the business-as-usual (BAU) scenario projects emissions solely based on growth trends. The known GHG reduction legislations would account for such improvements as a less carbon-intensive electricity grid and more efficient vehicles and buildings. Despite the ABAU reductions relative to 2016 levels, emissions would still be three percent higher by 2020 relative to 2007 levels. **Thus, without further action under the ABAU scenario, the County would not be able to meet its target to reduce emissions by 15 percent below 2007 levels by 2020.**

While the ECAP included a framework for reducing emissions in the unincorporated county by 2035, it did not set specific GHG reduction targets beyond 2020. To determine the GHG reduction targets beyond 2020, this analysis relies on consistency with the State's GHG reduction targets for 2030 and 2050. Lead by the California Air Resources Board (CARB), California aims to reduce statewide emissions to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050, per Assembly Bill (AB) 32, Senate Bill (SB) 32, and Executive Order (EO) B-30-15. Without a 1990 baseline for the County, these targets are translated relative to the County's updated 2016 inventory based on the State's per-capita targets set in *California's 2017 Climate Change Scoping Plan* (Scoping Plan) (CARB 2017b). This methodology is similar to the way the County's target was normalized to the 2007 inventory in the ECAP. The Scoping Plan set a plan-level target for local jurisdictions of 6 MT CO_2e per capita by 2030 and 2 MT CO_2e per capita by 2050. According to CARB, these per-capita targets are consistent with the State's GHG reduction goals. Applying these per-capita targets to population forecasts to translate to local levels results in an adjusted target to reduce the County's emissions by 40 percent below 2016 levels by 2030 and 77 percent below 2016 levels by 2050. Additionally, the County's ECAP target for 2020 (15 percent below 2007 levels) is equivalent to a 30 percent reduction from 2016 levels by 2020. The development of these adjusted targets is discussed in Section 3 of this report. These targets are reported here to provide a comparison of the County's emissions with the State's long-term GHG reduction goals. The County may choose to develop modified targets when an ECAP update is undertaken. The County's emissions forecasts and targets are shown in Table ES-3 and Figure ES-2.

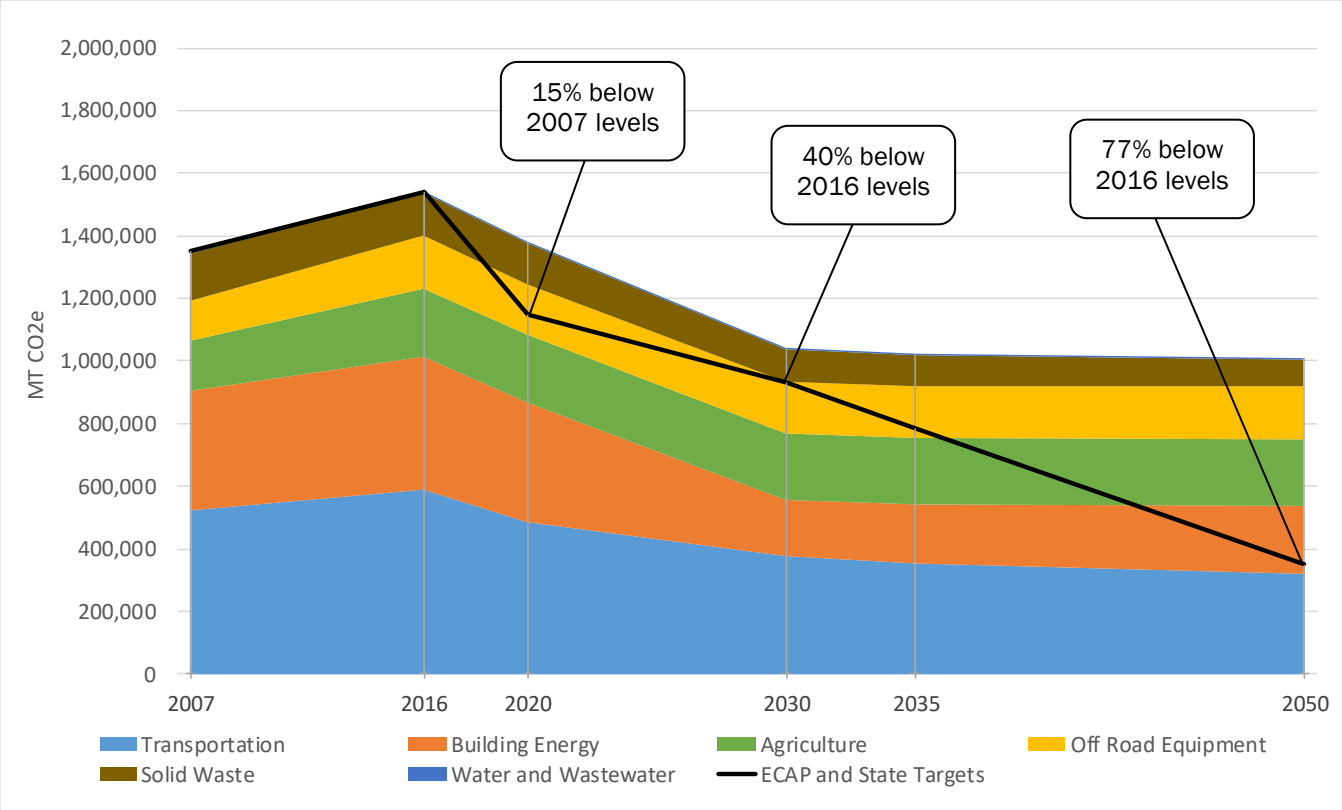


Figure ES-2 **Adjusted Business-as-Usual Unincorporated County of Santa Barbara Greenhouse Gas Trends, Forecasts, and Targets (2007-2050)**

Table ES-3 Adjusted Business-as-Usual Unincorporated County of Santa Barbara Greenhouse Gas Trends, Forecasts, and Targets (2007-2050) (MT CO_2e)

Sector	2007[1]	2016	2020	2030	2035	2050
Transportation	523,159	587,941	485,146	377,192	351,522	320,894
Building Energy	381,074	425,741	381,627	176,892	188,136	216,062
Off Road Equipment	126,416	171,974	162,038	164,893	166,397	171,237
Agriculture	163,577	216,103	217,250	215,045	213,951	210,704
Solid Waste	152,024	136,857	131,449	103,663	98,382	86,186
Water and Wastewater	5,482	3,924	3,981	3,953	4,076	4,469
ABAU Total	1,351,731	1,542,541	1,381,498	1,041,637	1,022,465	1,009,552
ABAU Percent Reduction from 2016			10%	32%	34%	35%
Comparison with Targets						
ECAP Targets (percent reduction from 2007)			15%	NA	NA	NA
State Target (percent reduction from 2016)			2%[2]	40%	NA	77%
Combined Targets (percent reduction from 2016)[3]			26%	40%	NA	77%
Target Emissions[3]			1,148,971	931,329	786,131[4]	350,537
Reductions from 2016 emissions needed to meet targets			393,570	611,212	756,410	1,192,004

Notes: ABAU = adjusted business-as-usual, ECAP = Energy and Climate Action Plan; CO_2e = carbon dioxide equivalents, NA = Not Available, GWP = Global Warming Potential, MT = metric tons

[1] Values adjusted from 2016 inventory based on percent changes by sector shown in Table ES-2.

[2] Based on the State's GHG inventory in 1990 and 2016. State's 2016 inventory extrapolated from historical trends between 2000 and 2015. (CARB 2017a).

[3] The most stringent of the targets between ECAP and state targets are used. ECAP is the most stringent of the two for the 2020 target year.

[4] Interpolated between 2030 and 2050.

Source: Santa Barbara County 2017. Data compiled by Ascent Environmental 2018.

As shown in Table ES-3, the County would need to reduce emissions from 2016 levels by 393,570 MT CO_2e by 2020 to meet the ECAP 15 percent reduction target and by 611,212 MT CO_2e by 2030 and 1,192,004 MT CO_2e by 2050 to be consistent with the State's GHG reduction goals. **This means that the County would need to reduce its current emissions by 26 percent within two years by 2020 to meet its ECAP target of 15 percent below 2007 levels by 2020.**

2 2016 GREENHOUSE GAS EMISSIONS INVENTORY UPDATE

2.1 SUMMARY OF RESULTS

Based on the modeling conducted, activities within the unincorporated county generated approximately 1,542,541 MT CO_2e in 2016, approximately 14 percent higher than in 2007 despite a nine percent increase in population. Major emissions sectors, in descending order, include transportation, building energy use, off-road vehicles and equipment, agriculture, solid waste, and water and wastewater management. Transportation and building energy use accounted for 66 percent of emissions in 2016. The 2016 inventory update also included several new emissions sources within these sectors that were not included in the 2007 baseline inventory. These new sectors include emissions from CH_4 generated at landfills (e.g., waste-in-place), a variety of new off-road sources, process emissions from wastewater treatment, and additional agricultural sources. These new sectors and revised methods increased the total reported emissions by about 40 percent. Additionally, for certain sectors, the methods used in the 2016 inventory differed somewhat from the 2007 inventory because data sources used in the 2007 inventory that were updated or no longer available. Some calculation approaches were also corrected to more accurately reflect emissions in the unincorporated county. Although reported in the 2007 inventory, the 2007 inventory excluded stationary source emissions due to the County's limited influence on these sources. For the same reasons, the 2016 inventory also excludes stationary source emissions. Additionally, the emissions inventory and associated demographics exclude VAFB and UCSB because of the County's lack of jurisdiction over those communities.

Table 1 and Figure 1 summarize the County's 2016 GHG emissions inventory by sector. A description of each emissions sector, including key sources of emissions, is provided in further detail.

Table 1 2016 Unincorporated County of Santa Barbara Greenhouse Gas Inventory

Sectors	2016[1] (MT CO_2e/yr)	Percent of Total
Transportation	587,941	38%
Building Energy Use	425,741	28%
Residential Energy	*212,256*	*14%*
Commercial Energy	*168,145*	*11%*
Agricultural Energy	*28,947*	*2%*
Industrial Energy	*16,393*	*1%*
Agriculture	216,103	14%
Off-Road Vehicles and Equipment	171,974	11%
Solid Waste	136,857	9%
Water	991	0.1%
Wastewater	2,871	0.2%
Total	1,542,541	100%

Notes: For a comparison of the 2007 and 2016 inventories, see Table 2. Note that columns may not add to totals due to rounding.

MT CO_2e = metric tons of carbon dioxide equivalent; GWP = Global Warming Potential; IPCC = Intergovernmental Panel on Climate Change

1. Uses GWP Factors from IPCC's Fourth Assessment Report

Source: Data compiled by Ascent Environmental 2018.

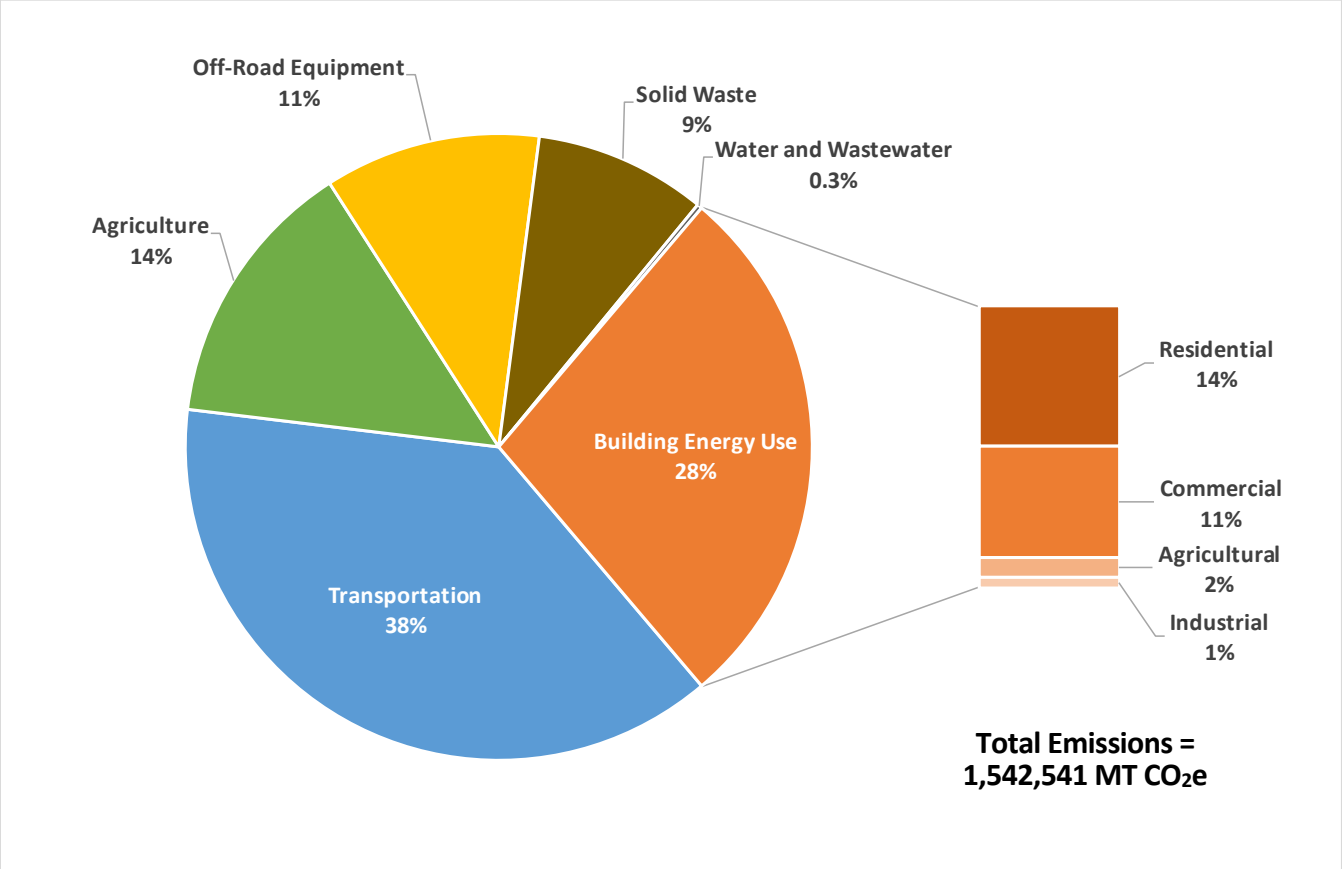


Figure 1 **2016 Unincorporated County of Santa Barbara Greenhouse Gas Inventory**

2.1.1 2007-2016 Emissions Trends

After normalizing methods and calculation assumptions to the extent possible, the emissions increased by 14 percent from 2007 to 2016, due mostly to increases in transportation activity, fertilizer application, and non-residential natural gas use. The increase in emissions outpaced population growth of nine percent in the unincorporated county within the same timeframe (DOF 2017, 2018). Emissions from the transportation sector, which accounted for over 45 percent of the 2007 and 2016 inventories, increased by 12 percent. Emissions from building energy, which accounted for about 30 percent of the total emissions in both years, also increased by about 13 percent. Although residential building energy constitutes approximately 50 percent of the building energy sector, residential energy use decreased by one percent, while commercial and industrial energy use increased by 35 and 20 percent, respectively. The agricultural sector increased by 32 percent from 2007 levels primarily because of a 127 percent increase in nitrogen fertilizer application, despite a 26 percent reduction in the County's livestock population between 2007 and 2016. The 2016 GHG inventory was also updated to use GWP factors from the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4) to be consistent with the State's current GHG inventory (IPCC 2007; CARB 2017a).

To normalize the two inventories for equal comparison, several adjustments were made to the 2007 and 2016 inventories; some methods or assumptions could not be normalized because of unavailability of certain data. The 2016 inventory was adjusted to use GWP factors from IPCC's Second Assessment Report (SAR), consistent with the methodology used in the 2007 inventory (IPCC 1996). In addition, only emissions sections that are present in both inventories were included. For example, although the 2007 inventory reported emissions from industrial electricity use, Pacific Gas and Electric (PG&E) could not provide the same data for 2016 due to the 15/15 rule adopted by the California Public Utilities Commission (CPUC) in

2009 (CPUC 2010). Citing confidentiality concerns, the 15/15 rule prevents investor-owned utilities from releasing aggregated energy use data where an aggregated category consists of less than 15 customers and if any single customer accounts for 15 percent of the category's total energy use. Also, the 2016 inventory adds new sectors not included in the 2007 inventory.

The normalized differences between the 2007 and 2016 inventories are detailed in Table 2. For reasons discussed above, the 2007 inventory shown in Table 2 differs from published version of the 2007 inventory. The values presented in Table 2 are for informational and comparison purposes only, because the actual 2016 inventory has been updated with revised methods and assumptions.

Table 2 Normalized Comparison of Unincorporated County of Santa Barbara Greenhouse Gas Inventories (2007 and 2016) (for comparison only) (MT CO_2e/yr)

Sectors	2007[1]	2016[2]	Difference	% change from 2007	Primary Reason for Change
Transportation	523,430	588,246	64,816	12%	
On-Road Transportation	*521,160*	*586,708*	*65,548*	*13%*	Increase in VMT and decrease in vehicle emission factors
Aircraft	*2,270*	*1,537*	*-733*	*-32%*	Difference in methodology and, potentially, activity
Building Energy	330,370	374,164	43,794	13%	
Residential Energy	*195,500*	193,764	-1,736	-1%	Lower electricity emission factors
Commercial Energy	*121,580*	164,433	42,853	35%	Increased natural gas use
Industrial Energy[3]	*13,290*	15,967	2,677	20%	Increased natural gas use
Off-Road Vehicles and Equipment	102,140	138,950[8]	36,810	36%	Increased construction activity
Agriculture	90,348	119,360[9]	29,012	32%	
Livestock	*56,268[4]*	*41,962*	*-14,307*	*-25*	Decrease in livestock population
Fertilizers	*34,080*	*77,398*	*43,318*	*127%*	Increase in fertilizer tonnage
Solid Waste	91,920	82,750[10]	-9,170	-10%	
Solid Waste Generation	*90,440*	*78,089*	*-12,351*	*-14%*	Reduced waste tonnage
Alternative Daily Cover[5]	*1,480*	*4,661*	*3,181*	*215%*	Increased ADC application
Water and Wastewater	4,669	3,364	-1,335	-28%	
Septic Tank	*2,199[6]*	*2,310*	*111*	*5%*	Increase in population
Water Electricity	*950[7]*	*991*	*41*	*4%*	Increase in water consumption from SWP
Wastewater Electricity	*1,550*	*62[11]*	*-1,488*	*-96%*	2007 inventory double counted electricity use in WWTPs and water pumping in the unincorporated county.
Total (for comparison only)	1,142,907	1,306,833	163,926	14%	

Notes: This table contains adjusted 2007 and 2016 inventory numbers and is only to be used for comparison purposes only. See Table 1 for the official 2016 inventory results. ADC = alternative daily cover; MT CO_2e = metric tons of carbon dioxide equivalent; GWP = Global Warming Potential; IPCC = Intergovernmental Panel on Climate Change; NA = Not applicable; CDFA = California Department of Food and Agriculture; CPUC = California Public Utilities Commission; WWTP = wastewater treatment plant; SWP = State Water Project; VMT = vehicle miles traveled

[1] Does not reflect published 2007 inventory due to exclusion of industrial electricity use and normalization adjustments to wastewater emissions.

[2] Emissions have been adjusted to use the global warming potentials in IPCC's Second Assessment Report to be consistent with the 2007 baseline GHG inventory assumptions.

[3] Excludes industrial electricity use due to the CPUC's 15/15 rule which prevents utilities from reporting aggregated industrial energy usage for sectors where more than 15 percent of energy use is associated with one customer and if there are 15 or less customers that make up that sectors. The industrial electricity sector in Santa Barbara County meets these criteria.

[4] 2007 livestock emissions also corrected to use livestock population from cattle population only from the County's 2007 Crop Report. Non-cattle livestock population numbers were not reported in the 2007 Crop Report. The livestock population assumptions used in the County's 2007 GHG Inventory did not match the 2007 Crop Report.

[5] Alternative daily cover is non-earthen material used to cover an active surface of a landfill at the end of each operating day to control for vectors, fires, odors, blowing litter, and scavenging. This material can include compost, construction and demolition waste, sludge, green material, shredded tires, spray-on cement, and fabric.

[6] Wastewater emissions have been adjusted to reflect a methane correction factor of 0.22, consistent with the 2016 methodology.

[7] 2007 inventory adjusted to only include electricity emissions from SWP.

[8] Excludes emissions from oil drilling, airport ground support equipment, entertainment equipment, other portable equipment, pleasure craft, railyard operations, recreational equipment, and transportation refrigeration units.

[9] Livestock emissions normalized to use livestock emission factors from the 2007 inventory. Fertilizer use was scaled up by change in fertilizer tonnage reports from CDFA between 2006 and 2016.

[10] Excludes emissions from waste-in-place.

[11] Excludes wastewater electricity from WWTPs located inside unincorporated county. 2007 emissions could not be disaggregated this way.

Source: County of Santa Barbara 2017, Modeling by Ascent Environmental 2018.

COMPARISON OF 2007 AND 2016 METHODOLOGIES

In addition to including new GHG emissions sectors and sources, the 2016 inventory update includes several changes to the data sources and emission factors used, along with changes in methods. These differences were necessary in cases where the original data sources used in the 2007 inventory were no longer available or have been updated. New methods that provide more accurate emissions estimates are available for sectors such as the on-road vehicles and solid waste sectors. The general approach used to estimate the County's 2016 GHG inventory is consistent with the latest guidance from the *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (Community Protocol) (Version 1.0) produced by the International Council for Local Environmental Initiatives (ICLEI) (ICLEI 2012).

As mentioned, to be consistent with the overall approach of the 2007 inventory, the 2016 inventory also excludes emissions from VAFB and UCSB. These entities are excluded because they are not under the County's jurisdiction. However, for the solid waste, off-road vehicles, and equipment sectors, metrics associated with VAFB and UCSB activity could be not be disaggregated from the data available. For most other sectors, assumptions were made to apportion emissions from these sectors to the unincorporated county areas only, and these assumptions are discussed in Section 2.2 "Transportation," 2.3 "Building Energy," 2.4 "Agriculture," 2.7 "Imported Water Conveyance," 2.8 "Wastewater Generation."

The following summarizes data sources and methods used in estimating the unincorporated county's 2016 GHG emissions inventory (see Table 3 for further detail):

- **Transportation:** For the on-road vehicle sector, SBCAG provided vehicle miles traveled (VMT) for the unincorporated area, excluding VAFB and UCSB, for calendar year 2010. This was the latest data from SBCAG that was based on the Regional Technical Advisory Committee's (RTAC's) origin-destination method. The 2010 RTAC-based VMT was scaled to 2016 levels based on the historical growth in the County's boundary-level VMT from 2010 to 2016 available from the California Department of Transportation (Caltrans). Vehicle emission factors were available from CARB's 2017 EMissions FACtor (EMFAC) model. SBCAG is in the process of updating their model to a base year of 2015, but does not anticipate completion of the model update until late 2018 or early 2019 (Perucho, pers. comm., 2017a).

  For aircraft landings and take-offs from Santa Ynez Airport, the only airport located in the unincorporated county, emissions were based on fuel dispensing data obtained from the Santa Barbara County Air Pollution Control District (SBCAPCD) and fuel-based emission factors from The Climate Registry's (TCR) 2017 Default Emission Factors, published in March 2017 (Iorio, pers. comm., 2017a; TCR 2017).

- **Building Energy:** Annual electricity and natural gas usage data from residential, commercial, industrial, and agricultural customers for the unincorporated areas were obtained from PG&E, Southern California Edison (SCE), and Southern California Gas (SoCal Gas). The utilities provided the data for residential, commercial, and industrial customer categories. Energy use from VAFB and UCSB were excluded. Industrial electricity use in 2016 was purposely excluded by PG&E because of the CPUC's 15/15 rule.

- **Solid Waste:** The solid waste inventory was updated using disposal and landfill data from the California Department of Resources Recycling and Recovery (CalRecycle) and landfill gas data from the U.S. Environmental Protection Agency (EPA), respectively.

- **Water and Wastewater:** The volume of imported water was available from each of the specific water suppliers that service the unincorporated county. It is assumed that indirect emissions from the electricity used for water pumping within the unincorporated county is already included in the building energy data provided by the utilities. Domestic wastewater emissions were calculated using population-based equations from the Community Protocol (ICLEI 2012). Populations from VAFB and UCSB were excluded.

- **Off-Road Vehicles:** Off-road vehicle emissions were estimated from CARB's OFFROAD 2017 model and scaled by population, jobs, new housing development, or location of activity. Agricultural diesel irrigation pump information was obtained from SBCAPCD and CARB.

- **Agriculture:** Agricultural emissions were based on livestock data from the County's 2016 Crop Report; fertilizer application rates from the annual Fertilizer Tonnage Reports from the California Department of Food and Agriculture (CDFA); and emission factors from CARB's 2015 GHG inventory. It was assumed that agricultural emissions did not occur within VAFB and UCSB jurisdiction. Agricultural equipment emissions are capture in the off-road sector, consistent with the 2007 inventory.

- Demographic data related to 2016 population, jobs, and housing were obtained from the California Department of Finance (DOF) and the California Employment Development Department (EDD) (DOF 2018; EDD 2017). This data were adjusted to deduct VAFB and UCSB. VAFB and UCSB data were obtained from the U.S. Census Bureau and UCSB's campus profile (U.S. Census Bureau 2017; UCSB 2017). See Section 3 for further details on demographics.

Table 3 compares the differences in data sources, calculation methods, and emission factors by sector and between the 2007 and 2016 GHG inventories.

Global Warming Potentials

GHG emissions other than carbon dioxide (CO_2) generally have a stronger insulating effect (e.g., ability to warm the earth's atmosphere or greenhouse effect) than CO_2. This effect is measured in terms of a pollutant's global warming potential (GWP). CO_2 has a GWP factor of one while all other GHGs have GWPs measured in multiples of one. CARB currently uses IPCC's AR4 GWP factors, where CH_4 and N_2O have GWPs of 25 and 298, respectively (IPCC 2007). This means that CH_4 and N_2O would be 25 and 298 times stronger than CO_2, respectively, in their potential to insulate solar radiation within the atmosphere. This inventory uses the same AR4 GWP values as used in CARB's 2015 GHG inventory (CARB 2017a). In comparison, IPCC's SAR, used in the development of the 2007 inventory, reported GWPs of 21 and 310 for CH_4 and N_2O, respectively (IPCC 1996).

EXCLUDED SECTORS

Because Santa Barbara County is not a major center for semiconductor manufacturing and these other high-GWP gases make minimal contributions to the State's inventory, other high-GWP emissions are not included in the County's GHG inventory. The 2016 Inventory also excludes emissions from stationary sources because of the County's limited influence over those sources.

In addition, emissions from changes in the carbon stock in vegetation due to land use development are not included. This emissions source is referred to by the State as "natural and working lands" sector. Although included in the Scoping Plan to reduce statewide emissions, the State has not yet quantified emissions from this sector nor quantified reduction targets for this sector (CARB 2017b). Also, the ICLEI Community Protocol does not provide guidance for carbon stocks or carbon sequestration projects because of the current inconsistencies in quantification methods for this sector (ICLEI 2012:10).

Table 3 Unincorporated County of Santa Barbara GHG Inventory: Data Sources and Methods by Year and Sector

Sector	2007 Inventory	2016 Inventory
All Sectors	◢ Used IPCC's SAR GWP, where GWP factors for CH_4 and N_2O are 21 and 310, respectively. ◢ Population and emissions exclude activity at incorporated cities, VAFB, and UCSB	◢ Used IPCC's AR4 GWP factors, where GWP factors for CH_4 and N_2O are 25 and 298, respectively. ◢ Population and emissions exclude activity at incorporated cities, VAFB, and UCSB.
Transportation: On-Road Vehicles	**Data:** RTAC-based daily VMT estimates for 2007 using SBCAG's travel demand model. **Method**: EMFAC2007 emissions factors applied to total RTAC-based VMT. Scaled to annual VMT assuming 347 days per year to account for decreased activity on weekends.	**Data:** RTAC-based daily VMT estimates using SBCAG's travel demand model for 2010 and scaling to 2016 based on the difference in VMT on roadways as reported in Caltrans' HPMS 2010 and 2016 reports. **Method**: EMFAC2017 emissions factors applied to total RTAC-based VMT. Scaled to annual VMT assuming 347 days per year consistent with the 2007 inventory.
Transportation: Aircraft Landings and Take-Offs	**Data:** Number of daily operations at Santa Ynez Airport from a 2010 FAA airport data report. **Method**: Unknown	**Data:** Annual gallons of fuel dispensed by fuel type at Santa Ynez Airport from SBCAPCD for 2016. **Method**: Fuel-based emission factors from TCR's 2017 Default Emission Factors.
Building Energy: Residential and Commercial	**Data:** Electricity and natural gas consumption provided by sector from PG&E, SCE, and SoCal Gas. Propane consumption not analyzed. **Method:** CO_2 electricity emissions factors from PG&E and SCE. CH_4 and N_2O emissions factors and Natural Gas emissions factors from 2010 LGOP.	**Data:** Electricity and natural gas consumption provided by sector from PG&E, SCE, and SoCal Gas. Propane estimates based on average natural gas use per household and difference between unincorporated county households and SoCal Gas residential customers. **Method:** CO_2 electricity emissions factors from PG&E and SCE. CH_4 and N_2O emissions factors from EPA's eGRID2016 CAMX factors. Natural Gas and propane emissions factors from TCR's 2017 Default Emission Factors.
Building Energy: Industrial	**Data:** Electricity and natural gas consumption provided from PG&E, SCE, and SoCal Gas. Propane consumption not analyzed. **Method:** CO_2 electricity emissions factors from PG&E and SCE. CH_4 and N_2O emissions factors and Natural Gas emissions factors from 2010 LGOP.	**Data:** Natural gas consumption provided by SoCal Gas. Electricity consumption not available from other utilities due to 15/15 rule. **Method:** Natural Gas emissions factors from TCR's 2017 Default Emission Factors.
Building Energy: Agricultural	Emissions not quantified. May be included in industrial or commercial sectors.	**Data:** Electricity consumption provided by sector from PG&E and SCE. No natural gas consumption reported for this sector from SoCal Gas. Agricultural natural gas use may be included in commercial or industrial sectors. **Method:** CO_2 electricity emissions factors from PG&E and SCE. CH_4 and N_2O emissions factors from EPA's eGRID2016 CAMX factors. Natural Gas emissions factors from TCR's 2017 Default Emission Factors.
Off-Road Vehicles	**Data source:** CARB OFFROAD2007 model used for agricultural, construction and mining, industrial, lawn/garden, light commercial, and oil drilling equipment only. **Method**: Emissions scaled to unincorporated area based on agricultural acres, jobs, construction permits, and location of drilling facilities.	**Data source:** CARB's OFFROAD 2017 model used for all available off-road sources. In addition to the ones reported in the 2007 inventory, sources include airport ground support, entertainment, other portable equipment, pleasure craft, railyard operations, recreational equipment, and transportation refrigeration units. Agricultural diesel pump information from SBAPCD via public data requests. **Method:** Emissions scaled to unincorporated area based on agricultural acres, jobs, number of new housing units, and location of drilling facilities. For agricultural diesel pumps, emission factors from CARB (CARB 2006: Table D-2).

Table 3 Unincorporated County of Santa Barbara GHG Inventory: Data Sources and Methods by Year and Sector

Sector	2007 Inventory	2016 Inventory
Solid Waste: Waste Generation	**Data:** Waste generation data provided by waste provider. **Method:** 2010 LGOP	**Data:** Tons of ADC and solid waste generated and landfilled at each receiving landfill, available from CalRecycle. Only receiving landfills with LFG capture include Santa Maria Regional Landfill, Simi Valley Landfill, and Tajiguas Sanitary Landfill, per EPA's LMOP data. **Method**: Equation SW.4.1 from ICLEI Community Protocol using CH_4 emission factors based on CalRecycle's waste characterization for the unincorporated county and EPA WARM emission factors by waste type.
Solid Waste: Waste-in-Place	Emissions not quantified.	**Data:** Tonnage of waste in place at most landfills from CalRecycle and County staff. Assumed tonnages for landfills where tonnage data were not available. Landfill open and closure years from CalRecycle, County, or assumed based on average 30-year lifespan. **Method:** CARB's LET model assuming tonnages are applied evenly across years in which landfill was open. Estimated emissions in 2016 based on historical disposal rates and schedule. LET model accounts for natural decay rates.
Agriculture: Livestock	**Data:** Vehicle and equipment data from CARB Off-Road model. Enteric fermentation and manure management data from livestock populations from Santa Barbara County agriculture report. **Method:** IPCC Livestock emissions factors	**Data:** Enteric fermentation and manure management from livestock populations from Santa Barbara County agriculture report. **Method**: CARB agricultural emissions inventory methods.
Agriculture: Fertilizer	**Data:** Fertilizer data from crop acres from County Crop Report and nitrogen application rates per acre from UCCE cost reports. **Method:** CARB methods	**Data:** Nitrogen fertilizer used in County from 2016 CDFA Fertilizer Tonnage Report. **Method**: CARB agricultural emissions inventory methods.
Water	**Data:** Annual volume of water delivered by water district. Volumes broken down by water source (e.g., SWP, groundwater). Data from SBCWA. **Method**: Water scaled to the unincorporated area based on percent of unincorporated population served for each water district. Electricity factors for each water source from 2006 CEC water-energy study. Straight average PG&E and SCE electricity emissions factors applied. CH_4 and N_2O emissions factors from LGOP.	**Data:** Annual volume of water delivered by water district. Volumes broken down by water source (e.g., SWP, groundwater). Data from SBCWA. **Method**: Water scaled to the unincorporated area based on percent of unincorporated population served for each water district. Water volumes from non-local sources (e.g., SWP) excluded because electricity use from local sources assumed to be captured in the building energy sector. Electricity factors for each water source from 2006 CEC water-energy study. Weighted average PG&E and SCE electricity emissions factors applied based on results from the building energy sector. CH_4 and N_2O emissions factors from eGRID2016.
Wastewater: Septic	**Data:** Septic tank numbers from a 2010 survey done by the County and average household size (2.9 persons per household). **Method:** Septic tank emissions based on Equation 10.9 from LGOP, assuming MCF of 0.5.	**Data:** Population served by septic tanks scaled from 2007 inventory based on change in population. **Method**: Equations WW.11 (Alt) the ICLEI Community Protocol, assuming MCF of 0.22.

Table 3 Unincorporated County of Santa Barbara GHG Inventory: Data Sources and Methods by Year and Sector

Sector	2007 Inventory	2016 Inventory
Wastewater: WWTP Process Emissions	Emissions not quantified.	**Data:** WWTP treatment profiles and population served by each WWTP serving the unincorporated county from WWTP websites, data requests, and 2007 inventory assumptions. **Method**: Equations WW.1.a, WW.2.a, WW.7, WW.8, and WW.12.a from the ICLEI Community Protocol to calculate domestic wastewater CH_4 emissions, depending on the treatment type.
Wastewater: WWTP Electricity Use	**Data:** WWTP wastewater volumes based on permitted capacity of WWTPs and percent of customers in unincorporated county. WWTP treatment profiles from unknown source. **Method:** WWTP electricity factors by treatment type each water source from 2006 CEC water-energy study. Straight average PG&E and SCE electricity emissions factors applied. CH_4 and N_2O emissions factors from LGOP.	**Data:** Treatment profiles and population served by each WWTP from WWTP websites, data requests, and 2007 inventory assumptions. WWTPs located outside of the unincorporated county are excluded to avoid double counting with the building energy sector. **Method**: WWTP electricity factors by treatment type each water source from 2006 CEC water-energy study. Weighted average PG&E and SCE electricity emissions factors applied based on results from the building energy sector. CH_4 and N_2O emissions factors from eGRID2016.

Notes: ADC = alternative daily cover; AR4 = Fourth Assessment Report; CalRecycle = California Department of Resources Recycling and Recovery; CAMX = California region in EPA's eGRID; CARB = California Air Resources Board; CDFA = California Department of Food and Agriculture; CEC = California Energy Commission; CH_4 = methane; CO_2 = carbon dioxide; DOF=California Department of Finance; eGRID = Emissions & Generation Resource Integrated Database; EMFAC = CARB's Emission Factor model; EPA = U.S. Environmental Protection Agency; FAA = Federal Aviation Administration; GHG = greenhouse gases; GWP = global warming potential; ICLEI = International Council for Local Environmental Initiatives; IPCC = Intergovernmental Panel on Climate Change; LET = Landfill Emissions Tool; LFG = landfill gas; LMOP = Landfill Methane Outreach Program; MCF = methane correction factor; N_2O = nitrous oxide; SAR = Second Assessment Report; SBCAPCD = Santa Barbara County Air Pollution Control District; SBCWA = Santa Barbara County Water Agency; SCE = Southern California Edison; SoCal Gas = Southern California Gas; SWP = State Water Project; RTAC = Regional Technical Advisory Committee; PG&E = Pacific Gas & Electric; TCR= The Climate Registry; UCCE = University of California Cooperative Extension; UCSB = University of California – Santa Barbara; VAFB = Vandenburg Air Force Base; VMT = vehicles miles traveled; WARM = Waste Reduction Model; WWTP = wastewater treatment plant

Source: Santa Barbara County 2017; 2016 inventory prepared by Ascent Environmental 2018.

2.2 TRANSPORTATION

The transportation sector consists of emissions from on-road vehicles and aircraft operations. Together, these sources accounted for 587,941 MT CO_2e in 2016, or 38 percent of the County's 2016 inventory, representing the largest emissions sector. Transportation emissions in 2016 were 12 percent higher than in 2007. Transportation emissions from watercraft are accounted for in the off-road sector, Section 2.6.

2.2.1 On-Road Vehicles

Based on modeling conducted, on-road vehicle use resulted in 586,402 MT CO_2e in 2016, or 99.7 percent of the County's transportation emissions. On-road vehicle emissions are primarily the result of exhaust from the combustion of gasoline and diesel fuels. To a smaller degree, emissions from on-road vehicles also result from upstream electricity generation for electric vehicles (EVs) and operation of heavy duty natural gas vehicles. On-road vehicle emissions in 2016 are 13 percent higher than they were in 2007. This is mostly because of the increased amount of vehicle activity since 2007.

On-road vehicle emissions were calculated by estimating the annual vehicle miles traveled (VMT) associated with trips that begin or end in the unincorporated county and multiplying the estimated VMT by region-specific vehicle emission factors. The estimated vehicle trips included 100 percent of vehicle trips that originate from

and end in the unincorporated area (i.e., fully internal trips), 50 percent of trips that either end in or depart from the unincorporated area (i.e., internal-external or external-internal trips), and zero percent of vehicle trips that are simply passing through the area (i.e., external-external, or "pass-through," trips). This vehicle trip accounting method is consistent with CARB recommendations in 2010 by RTAC (established through the Sustainable Communities and Climate Protection Act of 2008 [Senate Bill 375]). However, SBCAG could only provide daily RTAC-based VMT data for calendar year 2010 (Perucho, pers. comm., 2017b). To adjust this VMT to 2016 levels, the VMT was scaled in proportion to the historical growth associated with boundary-based VMT available from Caltrans' Highway Performance Monitoring System (HPMS). HPMS provides annual reports on daily VMT levels within the physical boundaries of a given region. Between 2010 and 2016, the boundary-based VMT increased by 5.7 percent (Caltrans 2018). To estimate annual VMT, daily VMT values for 2016 were then multiplied by 347 days per year to estimate annual VMT. This is less than the actual number of days per year to account for decreased trips during weekends and holidays. This assumption is consistent with the daily-to-annual conversion rate used in the County's 2007 inventory and CARB's assumptions used in a variety of emissions modeling (CARB 2008; CARB 2009; CARB 2010).

Vehicle emission factors for gasoline, diesel, and – to a lesser extent – natural gas vehicles were obtained from CARB's recently updated EMissions FACtor model, EMFAC2017. EMFAC reports a variety of emission factors and can disaggregate VMT by jurisdiction, calendar year, vehicle speed in five mile-per-hour increments, model years, fuel types, and vehicles classes. EMFAC's VMT outputs were used as a reference because it uses a vehicle-registration based accounting method, which differs from the RTAC method used in this inventory. EMFAC emission factors were run for the 2016 calendar year for the County disaggregated by fuel type (e.g., gasoline, diesel, EVs). An average emissions factor was calculated for each fuel type weighted by the associated VMT, as estimated by EMFAC. Although EMFAC acknowledges that a small percent of total VMT is associated with EVs, it does not report emission factors for EVs. To estimate emission factors from EVs, the average fuel economy of EVs, measured in kilowatt-hours (kWh) per 100 miles (kWh/100 mi), from model years through 2017 was taken from EPA's fuel economy database (DOE 2018). Then, the emissions per kWh quantified from the building energy emissions calculations in Section 2.3 were applied to the emission factors to obtain GHG emissions per mile.

Table 4 shows the calculation of annual VMT in 2016 which is scaled using the VMT growth rate between 2010 and 2016 as reported in Caltrans' HPMS reports and the 2010 RTAC-based VMT reported by SBCAG.

Table 4 Unincorporated County of Santa Barbara On-Road Vehicle Fleet Activity (2010-2016)

Trip Type	2010 VMT based on RTAC Method	2010 VMT based on Boundary Method from HPMS	2016 VMT based on Boundary Method from HPMS	2016 VMT based on RTAC Method (Scaled from 2010)
Internal to Internal	1,127,382	NA	NA	1,191,737
Internal to External/External to Internal	4,882,656	NA	NA	2,580,686
100% Internal to Internal + 50% Internal to External/External to Internal	3,568,710	NA	NA	3,772,422
Average Daily VMT	3,568,710	1,137,750	1,202,696	3,772,422
Total Annual VMT	1,238,342,457	394,799,250	417,335,512	1,309,030,560

Notes: VMT = vehicle miles traveled; NA = not available; RTAC = Regional Technical Advisory Committee; HPMS = Highway Performance Monitoring System. Totals may not sum due to rounding.

Source: Caltrans 2018; Perucho, pers. comm., 2017b; Data compiled by Ascent Environmental 2018.

Table 5 shows the 2016 annual VMT, average emissions factors, and calculated emissions for 2016 by fuel type.

Table 5 2016 Unincorporated County of Santa Barbara GHG Inventory: On-Road Vehicle Emissions

Fuel Type	Percent of Annual VMT[1]	Annual VMT[2]	Average Emission Factor (g CO_2e/mi)	Annual Emissions (MT CO_2e)
Diesel	7.18%	93,989,843	1,074	100,963
Gasoline	92.50%	1,210,848,522	399	483,697
Electric Vehicles[3]	0.28%	3,642,965	12.5	46
Natural Gas	0.04%	549,229	3,088	1,696
Total (Average for Emission Factors)	100%	1,309,030,560	448	586,402

Notes: VMT = vehicle miles traveled; NA = not available; RTAC = Regional Technical Advisory Committee; HPMS = Highway Performance Monitoring System. Totals may not sum due to rounding.

[1] From EMFAC2017 for Santa Barbara County in 2016. EMFAC does not separate out unincorporated and incorporated areas in a given County. Thus, the VMT distribution reflects countywide characteristics.

[2] Calculated from Table 4 and percent VMT breakdown from EMFAC2017.

[3] Based on average passenger vehicle emission factors from EPA. EMFAC2017 assumes a small percentage of electric buses, medium duty vehicles, and light duty trucks operate, but it is assumed that the emissions from those vehicles would be minimal.

Source: Data compiled by Ascent Environmental 2018.

2.2.2 Aircraft Emissions

Aircraft emissions in the unincorporated county accounted for 1,539 MT CO_2e in 2016, or 0.26 percent of transportation emissions. These emissions are 32 percent less than in 2007, mostly due to decreased activity. These emissions are based on the annual jet fuel and aviation gasoline dispensed at Santa Ynez Airport, the only airport located in the unincorporated county. SBCAPCD provided monthly fuel dispensing volumes for the Santa Ynez Airport (Iorio, pers. comm., 2017a). Fuel emissions factors for Jet Fuel A and aviation gasoline were available from TCR's 2017 Default Emission Factors. Table 6 shows the emission factors used to calculate emissions from aircraft operations and Table 7 shows the fuel data provided by SBCAPCD and calculated emissions by month.

Table 6 Aircraft Fuel Emissions Factors

Fuel Type	g CO_2/gal	g CH_4/gal	g N_2O/gal	g CO_2e/gal
Jet Fuel A	9,750	0.000	0.3100	9,842
Aviation Gasoline	8,310	7.050	0.1100	8,519

Notes: g = grams; CO_2 = carbon dioxide, CH_4 = methane, N_2O = nitrous oxide; CO_2e = carbon dioxide equivalents; gal = gallon; IPCC = Intergovernmental Panel on Climate Change.

[1] Using global warming potential factors from IPCC's Fourth Assessment Report

Source: TCR 2017

Table 7 2016 Aircraft Monthly Fuel Use and Emissions

Month	Fuel Use Jet Fuel A (gal)	Fuel Use Aviation Gasoline (gal)	Emissions Jet Fuel A (MT CO_2e)[1]	Emissions Aviation Gasoline (MT CO_2e)[1]	Total Emissions (MT CO_2e)
January	801	4,347	8	37	45
February	1,378	6,002	14	51	65
March	480	6,031	5	51	56
April	2,626	6,551	26	56	82
May	2,364	6,406	23	55	78
June	8,429	6,812	83	58	141
July	3,728	7,954	37	68	104
August	60,043[2]	6,055	591	52	643
September	2,125	6,411	21	55	76
October	5,009	5,966	49	51	100
November	2,228	5,629	22	48	70
December	2,600	6,435	26	55	80
Total	91,811	74,599	904	636	1,539

Notes: g = grams; CO_2 = carbon dioxide, CH_4 = methane, N_2O = nitrous oxide; CO_2e = carbon dioxide equivalents; gal = gallon

[1] Using global warming potential factors from IPCC's Fourth Assessment Report

[2] Increased fuel usage this month due to fueling firefighting aircraft during regional wildfire this month, according to SBCAPCD.

Source: Iorio, pers. comm., 2017a. Data compiled by Ascent Environmental 2018.

As shown in Table 7, an anomalous amount of Jet Fuel A was dispensed in August 2016. SBCAPCD explained that this was because of increased fuel used for firefighting during regional wildfires occurring that month.

2.3 BUILDING ENERGY SECTOR

Based on modeling conducted, residential, commercial, industrial, and agricultural building energy use resulted in approximately 425,741 MT CO_2e in 2016. This sector comprised 28 percent of total emissions in 2016. These emissions were a result of electricity, natural gas, and propane energy use at buildings and facilities. The building energy sector consumed 605 gigawatt-hours (GWh) of electricity, 44 million therms of natural gas, and 2.7 million gallons of propane. This estimate includes a small negative credit for electricity consumption from electric vehicle charging to avoid double-counting with the on-road vehicle sector. PG&E and SCE both provide electricity in the county, and SoCal Gas was the natural gas utility in the County in 2016. In terms of the renewable energy sources recognized under the Renewable Portfolio Standard (RPS), PG&E and SCE provided electricity with a renewable mix of 33 and 28 percent, respectively, in 2016. RPS excludes some GHG-free sources, such as large hydroelectric dams and nuclear sources, from counting toward a qualified renewable mix because of their environmental impacts apart from gaseous emissions, as defined in section 2805 of the Public Resources Code. Thus, in terms of GHG-free sources, including large hydroelectric dams and nuclear sources, PG&E and SCE provided electricity with a GHG-free mix of 69 and 40 percent, respectively, in 2016. (CEC 2017a, 2017b).

Natural gas and electricity use accounted for 65 and 31 percent of total emissions from the building energy sector, respectively. Approximately four percent of emissions were associated with propane usage. Fifty percent of building energy emissions were from non-residential sources (i.e., commercial, industrial, and agricultural facilities), contributing a total of 213,484 MT CO_2e in 2016. Thirty-eight percent of all building energy emissions were generated by commercial buildings alone. Residential buildings accounted for 212,256 MT CO_2e, the other 50 percent of building energy emissions.

Electricity and natural gas usage data from 2016 was provided by PG&E, SCE, and SoCal gas, excluding usage from VAFB and UCSB. Propane usage estimates assumed that households without utility connections to SoCal Gas would use propane instead of natural gas. SoCal Gas provided the number of customers associated with commercial, industrial, and residential natural gas usage (Fox, pers. comm., 2017). The total number of households, excluding VAFB and UCSB, was calculated from data available from the Department of Finance, U.S. Census Bureau, and UCSB (DOF 2018; U.S. Census Bureau 2017; UCSB 2017). The difference in the number of households (4,909) was then multiplied by the average annual natural gas energy usage rate of 500 therms per household per year, according to SoCal Gas's data. The therms-per-household rate was then converted to gallons of propane based on the energy content of propane (91,333 British Thermal Units [BTU] per gallon, or 1.1 gallons per them).

Table 8 presents factors used to quantify emissions from electricity, natural gas, and propane use. Table 9 presents building energy use and associated emissions by fuel and source.

Table 8 2016 Unincorporated County of Santa Barbara GHG Inventory Building Energy Emission Factors

Emission Factor	Unit	Source
Electricity – PG&E		
294	lb CO_2/MWh	PG&E News Release (Schmitz 2018)
6.44	lb CH_4/GWh	PG&E Power Content Label and EPA's eGRID 2016 natural gas power plant emission factors[1]
0.70	lb N_2O/GWh	
Electricity - SCE		
529	lb CO_2/MWh	2016 SCE Corporate Responsibility Report
13.79	lb CH_4/GWh	SCE Power Content Label and EPA's eGRID 2016 natural gas power plant emission factors
1.54	lb N_2O/GWh	
Natural Gas		
53.06	kg CO_2/MMBtu	TCR 2017 Default Emission Factors. Table 12.1
4.7	g CH_4/MMBtu	TCR 2017 Default Emission Factors. Table 12.9
0.1	g N_2O/MMBtu	
Propane		
5.72	kg CO_2/gal	TCR 2017 Default Emission Factors. Table 13.1
0.17	g CH_4/gal	TCR 2017 Default Emission Factors. Table 13.3
0.01	g N_2O/gal	

Notes: PG&E = Pacific Gas and Electric; SCE = Southern California Edison; eGRID = Emissions & Generation Resource Integrated Database; g = grams; kg = kilograms; MMBTU = million British Thermal Units; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; gal = gallon; TCR = The Climate Registry

Source: Schmitz 2018; SCE 2017; CEC 2017a; CEC 2017b; TCR 2017.

Table 9 2016 Unincorporated County of Santa Barbara GHG Inventory: Building Energy Use and GHG Emissions by Source

Source		MT CO_2e/yr
Electricity		
PG&E	**kWh/yr**	
Agricultural	145,126,993	19,378
Commercial	40,769,762	5,444
Industrial[1]	-	-
Residential	131,557,429	17,566
PG&E Electricity Total	317,454,184	42,387
SCE	**kWh/yr**	
Agricultural	39,809,150	9,569
Commercial	82,293,114	19,780
Industrial[1]	-	-
Residential	166,622,597	40,050
SCE Electricity Total	288,724,861	69,399
Combined	**kWh/yr**	
Agricultural	184,936,143	28,947
Commercial	123,062,704	25,224
Industrial[1]	-	-
Residential	298,176,449	57,616
Electric Vehicles[2]	-1,197,517	-221
Electricity Total	604,977,779	111,566
Natural Gas		
PG&E[3]	**Therms/yr**	
Commercial	172	1
Industrial[1]	-	-
Residential	3,577	24
PG&E Natural Gas Total	3,749	25
SoCal Gas	**Therms/yr**	
Commercial	21,082,698	142,920
Industrial	2,418,183	16,393
Residential	20,616,122	139,757
SoCal Gas Total	44,117,003	299,069
Combined	**Therms/yr**	
Commercial	21,082,870	142,921
Industrial[1]	2,418,183	16,393
Residential	20,619,699	139,781
Natural Gas Total	44,120,752	299,095

Table 9 2016 Unincorporated County of Santa Barbara GHG Inventory: Building Energy Use and GHG Emissions by Source

Source		MT CO_2e/yr
Propane		
Miscellaneous Vendors	**Therms/yr**	
Residential	2,633,483	15,080
Propane Total	2,633,483	15,080
Total		
Customer Type		
Agricultural		28,947
Commercial		168,145
Industrial		16,393
Residential		212,256
Total		425,741

Notes: Totals in columns may not add due to rounding. MWh = megawatt-hours; kWh = kilowatt-hours; MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent, PG&E=Pacific Gas and Electric, SCE = Southern California Edison, SoCal Gas = Southern California Gas Company

[1] Industrial electricity usage not available from utilities because this sector meets the criteria of CPUC's 15/15 rule. This rule's criteria were not met for the natural gas data.

[2] Electric vehicle charging is subtracted from total building electricity, based on the total kWh of charging already estimated under the on-road vehicle fleet sector.

[3] A small number of PG&E gas customers are located in the unincorporated County, according to data provided by PG&E (Newvine, pers. comm., 2018)

Source: Data compiled by Ascent Environmental 2018.

2.4 AGRICULTURE

Based on modeling conducted, emissions from the agriculture sector accounted for approximately 216,103 MT CO_2e in 2016, or 14 percent of the County's annual emissions. This sector includes emissions resulting from agricultural activity such as direct emissions from livestock and fertilizer use. Other agricultural activity such as building energy use, agricultural equipment and pumps, and water use are included in other sectors (e.g., building energy, off-road, and water). CH_4 emissions from livestock and N_2O emissions from fertilizer use made up 37 percent and 63 percent of total emissions from the sector, respectively. These emissions are summarized in Table 10.

Table 10 2016 Unincorporated County of Santa Barbara Agriculture Emissions by Source

Source	MT CH_4/yr	MT N_2O/yr	MT CO_2e/yr
Enteric Fermentation	2,300	0	57,509
Manure Management	810	9	22,928
Nitrogen Fertilizer Application	0	455	135,666
Total	3,110	464	216,103

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = CH_4; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas

Source: Data compiled by Ascent Environmental, 2018.

With respect to livestock emissions, CH_4 and N_2O are released through enteric fermentation (a type of digestion process) and exposure of manure produced by these animals. These emission rates vary by

livestock type. The 2016 Santa Barbara County Crop Report (Crop Report) provides estimates of total population of cattle in the County for calendar year 2016. Although included in the County's 2007 GHG inventory, sheep, swine, and other non-cattle livestock types were not reported in the 2016 Crop Report (County of Santa Barbara 2016a). The Crop Report also did not provide the population distribution by cattle type (e.g., beef, dairy). Relying on the Crop Report data, it was assumed that only cattle populations were present in the County in 2016 and representations of other livestock types were minimal and excluded. To estimate the distribution of cattle types, it was assumed that the cattle distribution in the County was equivalent to the State's cattle population distribution by cattle type, per the 2015-16 California Agricultural Statistics Review (CASR) (CDFA 2017a).

The livestock population assumptions in the 2007 inventory incorrectly used the number of livestock produced rather than the population of living livestock in 2007. As reported by County Crop Reports, the number of cattle decreased by 26 percent from 40,864 in 2007 to 30,112 in 2016 (County of Santa Barbara 2007, 2016a). The 2007 inventory had assumed a population of 15,541 cattle and 3,129 dairy cows, for a total of 18,670 heads of cattle. For the normalized comparison between the 2007 and 2016 inventories, the 2007 cattle population was corrected to reflect the values published in the 2007 Crop Report. Because the CASR is not available for 2007, it was assumed that the revised 2007 cattle population would have had the same cattle type distribution as used in the 2007 GHG inventory. The cattle population correction was made in the normalized comparison between the 2007 and 2016 inventories shown in Table ES-2 and Table 2.

GHG emissions from enteric fermentation and manure management from cattle were estimated using population-based emission factors and quantification methods used by CARB in the 2015 statewide inventory, the most recent available (CARB 2017a). Livestock population and emissions factors are shown in Table 11.

Table 11 2007 and 2016 Unincorporated County of Santa Barbara Livestock Population and Emission Factors

Factor	Livestock Type			
	Beef Cattle	Dairy Cattle	Other Cattle	Total Cattle
2007				
Revised 2007 Livestock Population[1]	34,015	6,849	NA	40,864
Livestock Emissions Factor (kg CH_4/head-yr)[2]	53	128	NA	65.6
2016				
2016 Livestock Population[3]	19,601	5,363	5,148	30,112
Enteric Fermentation Emissions Factor (kg CH_4/head-yr) [4]	76.43	95.38	56.46	76.4
Manure Management Emissions Factor (kg CH_4/head-yr) [4]	2.37	139.67	2.73	26.9
Manure Management Emissions Factor (kg N_2O/head-yr) [4]	NA	1.56	0.13	0.30

Notes: kg= kilograms; CH_4 = methane; N_2O = nitrous oxide; NA = not available; IPCC = Intergovernmental Panel on Climate Change.

1 Revised to reflect values published in the 2007 Crop Report and cattle type distribution used in the 2007 inventory (County of Santa Barbara 2007).

2 The 2007 inventory used a general livestock emissions factor from IPCC's Livestock Estimate equations based on kg CH_4 per dead per year by type of animal. (County of Santa Barbara 2013:23). N_2O emission factors were not used.

3 2016 Crop Report (County of Santa Barbara 2016a)

4 Calculated from assumptions used in California's 2015 GHG Inventory (CARB 2017)

Source: Data compiled by Ascent Environmental, 2018.

The use of nitrogen-based fertilizers in agricultural lands results in N_2O emissions through microbial processes in the soil (CARB 2017c). N_2O has the highest GWP of the three main GHGs (CO_2, CH_4, and N_2O). Annual tonnage of nitrogen application by county were available from the California Department of Food and Agriculture's *Fertilizing Materials Tonnage Report* (CDFA) (CDFA 2017b:11,26). This report stated that Santa

Barbara County applied 30,228 tons of nitrogen in calendar year 2016. Adjusted for the unincorporated area, this results in 28,576 tons of nitrogen. To convert this tonnage to N_2O, a volatilization factor of 0.0175 g N_2O per g nitrogen was used based on the calculated emissions and assumed tonnages from nitrogen applied in fertilizer in the State's 2015 GHG Inventory (CARB 2017a). This method differs from the 2007 inventory in that nitrogen application rates were calculated based on the crop types, associated acreages, and average nitrogen application rates by crop type. This method improves upon the 2007 inventory approach by using the reported nitrogen application rates for Santa Barbara County, which is likely to be more accurate than using assumed average nitrogen application rates and applying them to crop acreages.

2.5 SOLID WASTE

Based on modeling conducted, the solid waste sector was responsible for approximately 136,857 MT CO_2e, or nine percent of the County's 2016 GHG inventory. The ICLEI Community Protocol recommends that community GHG inventories include emissions from waste generated by the community and solid waste facilities located in the community (i.e., "waste-in-place"). CH_4 emissions from the solid waste generation accounted for 61,532 MT CO_2e, or 45 percent of solid waste emissions. This reflects a two percent reduction in the tons of waste disposed between 2007 and 2016. Waste-in-place CH_4 emissions generated at solid waste facilities located within the unincorporated area accounted for 75,505 MT CO_2e, or 55 percent of emissions from the solid waste sector. The 2007 inventory did not include emissions from waste-in-place. Table 12 summarizes emissions from the solid waste sector. Sections 2.5.1 and 2.5.2 describe the methods used to calculate emissions from waste generation and waste-in-place sources, respectively.

Table 12 2016 Unincorporated County of Santa Barbara GHG Inventory: Solid Waste Emissions by Source

Source	2007			2016				
	ADC Tons	Disposal Tons	Total Waste Tons	ADC Tons	Disposal Tons	Total Waste Tons	MT CH_4	MT CO_2e
Solid Waste Generation	2,380	115,390	117,770	10,754	104,716	115,470	2,454	61,352
Waste-in-Place	NA	NA	NA	NA	12,285,493	12,285,493	3,020	75,505
Total	2,380	115,390	117,770	10,754	12,390,209	12,400,963	5,474	136,857

Notes: ADC = alternative daily cover; NA = not available; MT = metric tons; CH_4 = methane; CO_2e = carbon dioxide equivalents

Source: County of Santa Barbara 2013:21. Data provided by Ascent Environmental 2018.

CH_4 emissions generated by waste disposed in landfills occur from the decomposition of organic material that occurs anaerobically under the surface of covered disposal sites, like landfills. Landfills are covered by soil or other earthen material or by alternative daily cover (ADC). ADC is non-earthen material used to cover an active surface of a landfill at the end of each operating day to control for vectors, fires, odors, blowing litter, and scavenging. This material can include compost, construction and demolition waste, sludge, green material, shredded tires, spray-on cement, and fabric. Given that ADC can also include organic material, CH_4 emissions from landfills result from organic decomposition in both waste disposal and ADC.

CH_4 from waste-in-place is primarily emitted in the form of landfill gas (LFG). LFG is a mix of gases, primarily composed of CH_4, generated from decomposing organic waste and waste chemical reactions and evaporation in landfills. If a landfill has an impermeable membrane that covers a portion or all the landfill (i.e., cover-and-capture), it can harvest the LFG and prevent CH_4 emissions from being released into the atmosphere. Once captured, a landfill can either convert the CH_4 to CO_2 through flaring or use it as a fuel for other energy-related applications. CO_2 emissions from flaring were not counted toward the County's inventory because the IPCC considers any CO_2 emissions from flaring or fugitive emissions to be of biogenic origin and not significant to

overall solid waste emissions (IPCC 2006). Once a landfill is closed, landfill-generated CH_4 emissions gradually decrease overtime because of organic decomposition.

According to EPA's Landfill Methane Outreach Program (LMOP) and the California Department of Resources Recycling and Recovery (CalRecycle), three of the 11 open landfills that accepted waste from the unincorporated county in 2016 and one closed landfill located within the unincorporated county operate LFG collection systems. These include the Santa Maria Regional Landfill, the Simi Valley Landfill and Recycling Center, the Tajiguas Sanitary Landfill, and the closed Foxen Canyon Sanitary Landfill. (EPA 2018A; CalRecycle 2018a).

2.5.1 Waste Generation

To quantify emissions related to annual solid-waste generation, disposal tonnages to landfills accepting waste from the unincorporated county, including alternative daily cover (ADC), were applied to Equation S.W.4.1 of the ICLEI Community Protocol shown below.

$$CH_4\ Emissions\ from\ Waste\ Generation = (1 - CE) * (1 - OX) * M * EF_{waste}$$

Where,

CH_4 = Community generated waste emissions from waste mass (MT CH_4)

CE = Default LFG collection efficiency (no collection = 0, collection = 0.75)

OX = Default oxidation rate (0.10)

M = Total mass of waste entering landfill (wet short tons)

EF_{waste} = Average emission factor for all waste disposed at landfill (0.063 MT CH_4/wet short ton)

EF_{waste} was calculated by applying the CalRecycle's waste characterization of the unincorporated county to the EPA's emissions factors specific to each waste component as shown in Table SW.5 of the ICLEI Community Protocol and shown below in Table 13. ICLEI recommends EPA's Waste Reduction Model (WARM), which provides decay emissions factors for several types of waste, such as food or paper waste. The resulting emission factor is slightly higher, but consistent, with ICLEI's default emission factors for mixed municipal solid waste (0.060 MT CH_4/wet short ton).

Table 13 Solid Waste Emission Factors by Waste Component[1]

Organic Waste Component	Emission Factor (MT CH_4/wet short ton)	Percent of Unincorporated Waste Stream[2]
Newspaper	0.043	2%
Office Paper	0.203	13%
Corrugated Containers	0.120	7%
Magazines/Third-Class Mail	0.049	5%
Food Scraps	0.078	24%
Grass	0.038	3%
Leaves	0.013	3%
Branches	0.062	3%
Unincorporated County of Santa Barbara Waste Mix Emission Factor	0.063	NA
Average U.S. Municipal Solid Waste Emission Factor	0.060	NA

Notes: MT CH_4 = metric tons of methane; NA = Not applicable

[1] Only organic waste components are included. Non-organic waste does not decompose and, therefore, does not emit methane emissions from decomposition.

[2] From CalRecycle's Solid Waste Characterization reports

Source: ICLEI 2012; CalRecycle 2016. Data provided by Ascent Environmental 2018.

Using Equation S.W.4.1, Table 14 shows the emissions from the waste and ADC tonnage delivered to the 11 landfills that accepted waste from the unincorporated county in 2016. As shown in Table 14, solid waste generation accounted for 61,352 MT CO_2e in 2016.

Table 14 Emissions from Solid Waste Generation by the Unincorporated County in 2016

Receiving Landfill	Waste Delivered from Unincorporated County of Santa Barbara Only (tons/year)	Total ADC (tons/year)	Has LFG Capture in 2016	Generated Methane Emissions (MT CH_4)	MT CO_2e
Azusa Land Reclamation Co. Landfill	3	0	No	0	5
Chemical Waste Management, Inc. Unit B-17	10,259	0	No	584	14,611
Chicago Grade Landfill	1,140	133	No	73	1,813
Chiquita Canyon Sanitary Landfill	709	0	No	40	1,010
City of Lompoc Sanitary Landfill	5,186	227	No	308	7,709
Cold Canyon Landfill, Inc.	674	0	No	38	960
McKittrick Waste Treatment Site	354	0	No	20	504
Santa Maria Regional Landfill	16,315	1,008	Yes	247	6,168
Simi Valley Landfill & Recycling Center	60	1	Yes	1	22
Tajiguas Sanitary Landfill	69,754	9,385	Yes	1,127	28,178
Vandenberg Air Force Base Landfill	261	0	No	15	372
Total Santa Barbara Unincorporated	104,716	10,754	NA	2,454	61,352

Notes: ADC = alternative daily cover; MT CH_4 = metric tons of methane; MT CO2e = carbon dioxide equivalents; NA = not applicable

[1] Only organic waste components are included. Non-organic waste does not decompose and, therefore, does not emit methane emissions from decomposition.

[2] From CalRecycle's Solid Waste Characterization reports

Source: ICLEI 2012, CalRecycle 2016, EPA 2018a, Data provided by Ascent Environmental 2018.

2.5.2 Waste-in-Place

In 2016, waste-in-place accounted for 75,505 MT CO_2e, or five percent of the County's emissions. CH_4 emissions from waste-in-place at 12 closed landfills and one open landfill in the unincorporated county were quantified using separate methods for closed and open landfills. To quantify emissions from waste-in-place at closed landfills, the tonnages of waste already disposed at landfills in the unincorporated county and the open and closure dates were input into CARB's Landfill Emissions Tool (LET) for each landfill (CARB 2011). For a given landfill, the LET estimates annual CH_4 emissions associated with the cumulative waste deposited in previous years. LET accounts for how much and how frequently waste was deposited in previous years, when the landfill was open, how long the landfill was open for, and the time passed since that waste was last deposited. Because annual disposal rates for the closed landfills were not available, it was assumed that the total tonnage for a given landfill was deposited evenly for each year that the landfill was open. Landfill tonnages and open and closure dates were either available from data requests, CalRecycle solid waste facility profiles, government documents, or estimated based on the approximate size of the landfill.

Adjustments were made to emissions from two of the closed landfills. The Casmalia Resources Landfill is a designated superfund site by EPA due to its collection of nearly three million tons of commercial hazardous waste. According to EPA's November 2017 Proposed Plan for the site, LFG emissions from the site are "relatively insignificant because organic rich municipal solid waste was not disposed in the landfill" (EPA 2017a). Thus, despite the large amount of waste disposed at this landfill, CH_4 emissions from Casmalia Resources Landfill were assumed to be zero in 2016. For Foxen Canyon Sanitary Landfill, the only closed landfill with LFG capture in the unincorporated county, LET results were scaled down using the same 75 percent LFG collection efficiency rate assumed in Equation S.W.4.1.

For Tajiguas Landfill, the only open landfill in the unincorporated county, the waste-in-place emissions were obtained from EPA's Facility-Level Information on Greenhouse Gases (FLIGHT) database. FLIGHT reports annual GHG emissions from large facilities nationwide. According to CalRecycle and the County, Tajiguas Landfill was open in 1967 and currently contains nearly 9 million tons of municipal waste. In 2016, the Tajiguas Landfill emitted 2,870 MT CH_4 in 2016, which is equivalent to 71,743 MT CO_2e, or 52 percent of all solid waste emissions (EPA 2017b). Note that waste-in-place emissions from Tajiguas Landfill differ from the emissions generated by solid waste disposed at the landfill in 2016 because these account for waste disposed at the landfill from the landfill's opening in 1967 through 2015. Solid waste generation emissions account for only the emissions generated by the waste deposited in 2016.

Table 15 summarizes the emissions results from LET and FLIGHT based on the profiles of 13 landfills in the unincorporated county.

Table 15 Waste-in-Place Emissions from Landfills in the Unincorporated County in 2016

Landfill	Status	Waste-in-Place Tonnage (tons)	Has LFG Capture in 2016	Year Open	Year Closed	MT CH_4	MT CO_2e
Ballard Canyon Road	Closed	76,200[1]	No	1939[5]	1969[6]	26	660
Casmalia Resources	Closed	2,800,000[2]	No	1973	1989	0[2]	0
Cathedral Oaks Dump	Closed	2,667[1]	No	1970[5]	2000[7]	2	42
Cuyama River Site	Closed	10,000[3]	No	1967[5]	1997	6	153
Foothill Landfill	Closed	10,000[3]	No	1937[5]	1967	3	83
Foxen Canyon Sanitary Landfill	Closed	407,278[1]	Yes	1977[5]	2007	69	1,722
Lompoc Burn Dump	Closed	6,667[1]	No	1968[5]	1998	4	103
Monighetti Ranch (private)	Closed	10,000[3]	No	1956[5]	1986	5	122
New Cuyama Sanitary Landfill	Closed	30,800[1]	No	1970[5]	2000[7]	20	488
Ocean View Nursery	Closed	10,000[3]	No	1963[5]	1993	6	142
Santa Ynez Airport Landfill	Closed	11,467[1]	No	1970[5]	2000	7	182
Turnpike Dump	Closed	10,000[3]	No	1925[5]	1955	3	65
Tajiguas Landfill	Open	8,900,414[1]	Yes	1967	2036	2,870	71,743
Total from Closed Landfills		3,385,079	NA	1972[4]	1991[4]	150	3,762
Total from Closed Landfills (Excluding Casmalia Resources)		585,079	NA	NA	NA	150	3,762
Total from All Landfills		12,285,493	NA	NA	NA	3,020	75,505

Notes: ADC = alternative daily cover; MT CH_4 = metric tons of methane; MT CO2e = carbon dioxide equivalents; NA = not applicable

[1] Johnston, pers. comm., 2017

[2] EPA 2017c. No CH_4 emissions assumed due to landfill's primary function as a commercial hazardous waste site.

[3] No tonnages were available. Tonnage here based on other small landfills of similar sizes.

[4] Average open and closure years weighted by tonnage. Used for emissions forecasts.

[5] No open year was available. Assumed a 30-year lifespan.

[6] County of Santa Barbara 2015a

[7] No closure year was available. Assumed closure in 2000.

Source: ICLEI 2012; CalRecycle 2018a; EPA 2017. Data provided by Ascent Environmental 2018.

As shown in Table 15, waste-in-place at landfills accounted for 75,505 MT CO_2e in 2016, or 55 percent of total solid waste emissions.

2.6 OFF-ROAD VEHICLES AND EQUIPMENT

Based on modeling conducted, off-road vehicles and equipment emitted approximately 171,974 MT CO_2e in 2016, or 11 percent of the County's 2016 inventory. These emissions were the result of fuel combustion in off-road vehicles and equipment used in construction, industry, and recreation and were available from CARB's OFFROAD 2017 model. Unfortunately, the OFFROAD model only provides emissions detail at the state, air basin, or county level. Santa Barbara County emissions data from OFFROAD 2017 were apportioned to the unincorporated area using custom scaling factors depending on the off-road fleet type, as shown in Table 16. For example, because of the likely correlation between commercial activity and employment, the unincorporated portion of emissions from light commercial equipment in the County is assumed to be proportional to the number of jobs in the unincorporated county as compared to the County as a whole. On the other hand, emissions from oil drilling are assumed to occur entirely within the County. Note that, although agricultural emissions are addressed in a separate sector, emissions related to

agricultural equipment reported by OFFROAD are included in this sector to stay consistent with the reporting methods used in the 2007 inventory. The estimated annual emissions and scaling factors are presented in Table 16 by fleet type.

The 2016 inventory differs slightly from the 2007 inventory in that more off-road fleet types are included than in the 2007 inventory, as shown in Table 3. The 2007 inventory did not explain the reasons why certain fleet types were excluded from this sector. The 2007 inventory excluded such fleet types as airport ground support equipment, entertainment equipment, pleasure craft, and transportation refrigeration units. However, these fleet types could operate in the unincorporated county. For example, pleasure craft likely operate at Lake Cachuma, which is in the unincorporated county. Thus, additional fleet types were included in the 2016 inventory to better characterize the off-road fleet activity in the unincorporated county. With equalized assumptions, off-road emissions in 2016 were 34 percent higher than in 2007.

All commercial and industrial off-road emissions were scaled from Countywide estimates by the unincorporated percentage of jobs in 2016. Emissions related to lawn and garden, portable equipment, pleasure craft, and recreational equipment were scaled by population or households. Emissions from agricultural equipment were scaled by the portion of agricultural acres located in the unincorporated county per the County's Geographical Information System (GIS) data, which showed that 95 percent of the County's agricultural land use is in the unincorporated area (County of Santa Barbara 2016b). Countywide construction and mining equipment emissions were scaled to the unincorporated area based on the number of new houses constructed in the unincorporated area as compared to the County as a whole. 2015 and 2016 housing unit data were obtained from the Department of Finance (DOF 2018).

The GHG emission factor and quantification method for agricultural diesel irrigation pumps and number of pumps were obtained from CARB reports on diesel irrigation pumps and a public data request to SBCAPCD (CARB 2006; Iorio, pers. comm., 2017c). SCAPCD estimated that 100 pumps were active in 2016. Scaled based on agricultural acres, approximately 95 pumps were in the unincorporated area in 2016. Emission factors were based on the average CO_2 emissions per diesel irrigation pump in CARB's emissions inventory methodology for the Stationary Diesel Engine Control Measure (0.178 tons of CO_2 per day per pump) (CARB 2006: Table D-2).

Table 16 2016 Unincorporated County of Santa Barbara Off-Road Emissions by Fleet Type

Off-Road Fleet Type	MT CO_2/yr	MT CH_4/yr	MT N_2O/yr	MT CO_2e/yr	Scaling Method	Included in the 2007 Inventory?
Agricultural Equipment	64,079	6.490	0.763	64,469	Agricultural Acres[1]	Yes
Agricultural Diesel Irrigation Pumps	5,571	0.000	0.000	5,571	Agricultural Acres[1]	No
Airport Ground Support Equipment	5	0.001	0.000	6	Not scaled. Santa Ynez is only airport in the unincorporated area	No
Construction and Mining Equipment	60,607	5.117	0.222	60,801	New Housing Units[2]	Yes
Entertainment Equipment	85	0.004	0.000	85	Jobs[3]	No
Industrial Equipment	6,414	2.037	0.359	6,572	Jobs[3]	Yes
Lawn and Garden Equipment	2,379	3.577	1.551	2,931	Households[3]	Yes
Light Commercial Equipment	4,278	1.200	0.700	4,516	Jobs[3]	Yes
Oil Drilling	16,405	1.259	0.000	16,436	Not scaled. Assumed all in unincorporated.	Yes
Other Portable Equipment	20	0.001	0.000	20	Population[3]	No
Pleasure Craft	2,161	2.627	0.507	2,378	Population[3]	No
Railyard Operations	1	0.000	0.000	1	Jobs[3]	No
Recreational Equipment	1,762	5.528	2.175	2,549	Population[3]	No
Transport Refrigeration Units	6,115	0.491	0.041	6,140	Jobs[3]	No
Total	169,400	28	6	171,974		
Total (with 2007 Inventory Categories)[4]	153,865	20	4	155,417		
Difference	NA	NA	NA	39,739		
Percent Difference	NA	NA	NA	34%		

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; OFFROAD = California Air Resources Board's Off-road online inventory tool; GIS = geographical information system

[1] Based on GIS data from the County. Ninety-five percent of County's agricultural acreage is in the unincorporated area.

[2] Based on new housing units in the unincorporated county and Santa Barbara County, constructed between 2015 and 2016 per historical housing unit data from the Department of Finance (DOF 2018)

[3] See Table 27

[4] Adjusted to only include fleet types and global warming potential factors used in the 2007 inventory.

Source: Data provided by Ascent Environmental 2018., based on modeling from OFFROAD 2017

2.7 IMPORTED WATER CONVEYANCE

Based on modeling conducted, water imports accounted for 991 MT CO_2e in 2016, less than one percent of the County's 2016 GHG inventory. These resulted from GHG emissions from electricity generation required to deliver and treat water outside unincorporated areas. Water supply, treatment, and conveyance within the unincorporated county, such as conveyance of water from local reservoirs, is assumed to be accounted for under the electricity usage reports from PG&E and SCE. The County's 2007 GHG inventory incorrectly included water conveyance within the unincorporated county under the water sector, resulting in a double counting of emissions associated with water use. To provide a valid comparison to the 2007 inventory, this section only compares emissions from imported water conveyance. In 2016, the unincorporated area

imported over 1,547 million gallons of water from the State Water Project (SWP) and other state water purchased via the Central Coast Water Authority (CCWA), a 111 percent increase from 2007.

To calculate emissions from imported water, California-average electricity emissions factors were applied to the estimated electricity use associated with the conveyance of imported water used in the County. The Santa Barbara County Water Agency (SBCWA) provided the total water volume delivered for each of the 18 water agencies serving the County. SBCWA also provided a breakdown of the water sources used by each water district (e.g., groundwater, SWP, local surface water). Water conveyance and treatment energy rates per gallon vary by water source and type. These factors were available from a 2006 California Energy Commission report, which have not been updated by the time of this writing (CEC 2006). Water conveyed from the SWP requires thirty times more energy than water sourced from local surface water. It was assumed that water purchased from CCWA would have similar water energy intensities as water sources from SWP. Imported water accounted for approximately 20 percent of water used in the unincorporated county. The volume of water delivered by SBCWA in 2016 was apportioned according to the percent of customers located in the unincorporated county. The proportion of unincorporated customers was either based on the service area descriptions for each water agency or the assumptions used in the County's 2007 inventory.

The factors and data to calculate emissions from imported water conveyance are shown in the tables below. Table 17 shows the water energy intensity factors by water source and an average California electricity emissions factor, which is based on reports from EPA's Emissions & Generation Resource Integrated Database (eGRID) model (EPA 2018b). Table 18 shows the breakdown of water sources by water agency and how the water deliveries in 2016 were apportioned to the unincorporated county for each water agency. Table 19 calculates the resulting energy use and emissions associated with imported water.

Table 17 Water Energy Intensity Factors and 2016 California Average Electricity Emission Factors

Source	Value	Units	Reference
Water Energy Intensity Factors			
Local Surface Water	120	kWh/MG	CEC 2006: Table 9
State Water Project (Central Coast)	3,150	kWh/MG	CEC 2006: Table 9
Groundwater	4.45	kWh/MG/foot	CEC 2006: Table 9
Recycled (Average)	2,100	kWh/MG	CEC 2006: Table 9
Electricity Emissions Factors			
California Average	435.3	lb CO_2/MWh	eGRID 2016 for CAMX region
California Average	10.5	lb CH_4/GWh	eGRID 2016 for CAMX region
California Average	1.8	lb N_2O/GWh	eGRID 2016 for CAMX region

Notes: CAMX = California region in EPA's eGRID, CEC = California Energy Commission; eGRID = Emissions & Generation Resource Integrated Database, EPA = U.S. Environmental Protection Agency; kWh = kilowatt-hours; MG = million gallons; MWh = megawatt-hours; GWh = gigawatt-hours; lb = pound; CO_2 = carbon dioxide, CH_4 = methane; N_2O = nitrous oxide

Source: CEC 2006: Table 9, EPA 2018b

Table 18 2016 Water Deliveries by Water Agency in Santa Barbara County

Water Agency	Total Volume Delivered (MG/yr)	Percent of Volume Delivered to Unincorporated County	Water Source Breakdown by Percent				Total Imported Water Delivered to the Unincorporated County (MG/yr)
			Local Surface Water	Imported State Water	Groundwater	Recycled Water	
City of Buellton	298	0%	0%	8%	92%	0%	0
Carpinteria Valley WD	1,140	62%	19%	10%	71%	0%	71
Casmalia CSD	3	100%	0%	100%	0%	0%	3
Cuyama CSD	50	100%	0%	0%	100%	0%	0
Golden State WC	1,594	100%	0%	1%	99%	0%	16
Goleta WD	3,166	71%	0%	42%	50%	8%	950
City of Guadalupe	315	0%	0%	24%	76%	0%	0
La Cumbre Mutual WC	348	100%	0%	38%	62%	0%	132
City of Lompoc	1,274	0%	0%	0%	100%	0%	0
Los Alamos CSD	73	100%	0%	0%	100%	0%	0
Mission Hills CSD	163	100%	0%	0%	100%	0%	0
Montecito WD	1,033	100%	68%	20%	12%	0%	207
City of Santa Barbara	2,844	2%	32%	31%	30%	7%	13
City of Santa Maria	3,522	5%	0%	84%	16%	0%	135
Santa Ynez RWCD #1	1,228	83%	1%	2%	97%	0%	20
City of Solvang	323	0%	0%	33%	67%	0%	0
Vandenberg AFB	349	0%	0%	100%	0%	0%	0
Vandenberg Village CSD	350	100%	0%	0%	100%	0%	0
Total	18,074	14%	10%	37%	51%	2%	1,547

Notes: WD = water district; CSD = community services district; WC = water company; RWCD = river water conservation district; AFB = air force base; MG = million gallons

Source: LaFay, pers. comm., 2017; Data compiled by Ascent Environmental 2018.

Table 19 Energy and Emissions from Imported Water Delivered to the Unincorporated County (2007 – 2016)

	2007	2016	Difference	Units	Percent Change
Water Delivered to Unincorporated County	730	1,547	810	MG	111%
Water-related Electricity Use	3,249	6,886	3,637	MWh	112%
Electricity Emission Factor	0.2913[1]	0.1978	0.0935	MT CO_2e/MWh	-32%
Emissions from Electricity Use	950	991	41	MT CO_2e	4%

Notes: AR4 = Fourth Assessment Report; GWP = global warming potential; MG = million gallons; MWh = megawatt-hours; MT CO_2e = metric tons of carbon dioxide equivalents; IPCC = Intergovernmental Panel on Climate Change

[1] 2007 inventory assumed a straight average PG&E and SCE emission factor would apply to imported water. 2007 inventory factors adjusted for AR4 IPCC GWP factors.

Source: Data compiled by Ascent Environmental 2018.

As shown in Table 19, imported water accounted for 991 MT CO_2e in 2016, four percent higher than in 2007. This is because of the significant increase in imported water use between 2007 and 2016 concurrent with the 32 percent decrease in emissions factor. The previous 2007 inventory assumed a straight average between PG&E and SCE emissions factors, which does not account for the distribution of customers between the two utilities in the unincorporated county and does not reflect the upstream electricity generation associated with the water imported from the State that could occur outside of the County. The 2016 water emissions are based on California-average electricity emission factors to account for use outside the County. Thus, the 2016 emission factor is a correction and an update to the factors used in the 2007 water emissions inventory.

2.8 WASTEWATER GENERATION

Based on modeling conducted, wastewater generation in 2016 resulted in emissions of approximately 2,933 MT CO_2e, or less than one percent of total emissions, primarily from fugitive CH_4. This sector accounts for the CH_4 emissions from wastewater treatment processes and from electricity use for treatment. Electricity-related emissions from wastewater treatment facilities located inside the unincorporated area are assumed to be captured in the building energy sector. Electricity use at those facilities outside the unincorporated area are included in this sector. Wastewater process and electricity use emissions were evaluated in three parts: septic tank emissions, wastewater treatment plant (WWTP) process emissions, and electricity-related emissions associated with County wastewater treated at WWTPs facilities located outside the jurisdiction. Table 20 summarizes the emissions from the three sources of wastewater emissions analyzed in this section.

Table 20 Summary of Emissions from Wastewater Generation in 2016

Source	MT CO_2	MT CH_4	MT N_2O	MT CO_2e
Septic Tank Emissions	0	110	0	2,750
WWTP Process Emissions	0	0.028	0.402	121
WWTP Electricity Use (Outside Unincorporated County)	62	0	0	62
Total	62	110	0.402	2,933

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; WWTP = wastewater treatment plant

Source: Data compiled by Ascent Environmental 2018.

2.8.1 Septic Tank Emissions

Septic tank emissions were estimated using Equation WW.11(alt) from the ICLEI Community Protocol. As shown below this equation is equivalent to the method used in the 2007 inventory, except for the revision of one factor, and is based on the estimated population served by septic systems.

$$CH_4\ Emissions\ from\ Septic\ Systems = (P * BOD_5\ load * Bo * MCF_S * 365.25 * 10^{-3})$$

Where,

CH_4 Emissions from Septic Systems = wastewater emissions from septic systems (MT CH_4)

P = Population served by septic systems

BOD_5 load = Load of 5-day Biochemical Oxygen Demand (BOD_5) treated per day (0.090 kg BOD_5/person/day)

Bo = Maximum CH_4 producing capacity for domestic wastewater (0.6 kg CH_4/kg BOD_5)

MCF_S = CH_4 correction factor for septic systems (0.22) (Note that 0.5 was used in the 2007 inventory.)

365.25 = Days per year

10^{-3} = Conversion from kg to MT (MT/kg)

The 2007 inventory used an MCF_S of 0.5 based on the same factor used in EPA's *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007.* ICLEI updated this factor in Community Protocol, which was released in 2012, using a 2011 study on GHG emissions from septic tanks. Thus, the MCF_S value was updated from 0.5 to 0.22. To obtain the population served by septic systems, the 2007 inventory used a 2010 septic tank survey conducted by the County's Department of Public Health that estimated the number of households that had septic systems. The number of households (8,749) was then multiplied by the average household size in 2007 (2.92) for a total of 25,547 persons served by septic systems. However, another survey has not been conducted since the 2010 survey. To estimate the population served by septic systems in 2016, the number of septic systems in 2007 was scaled by the population growth in the between 2007 and 2016, excluding population in VAFB and UCSB. According to the Department of Finance, population increased by nine percent between 2007 and 2016 (DOF 2017, 2018). The average household size also dropped by about three percent since 2007. Thus, in 2016, it is estimated that septic systems served 26,842 persons, which resulted in emissions of 2,750 MT CO_2e, five percent higher than in 2007 adjusting for MCF_S values. Emissions results are shown in Table 21.

Table 21 Comparison of 2007 and 2016 Unincorporated County of Santa Barbara Wastewater Emissions from Septic Systems

	Units	2007 Inventory (Normalized)[2]	2016 Inventory	Difference	Percent Change
Population of Unincorporated County[1]	population	119,349	129,878	10,529	9%
Number of Septic Tanks	tanks	8,749	9,521	722	9%
Average Household Size	persons per Household	2.92	2.82	-0.10	-3%
Population Served by Septic Tanks	population	25,547	26,842	1,295	5%
BOD_5 Load	kg BOD_5/person/day	0.09	0.09	-	0%
Bo	kg CH_4/kg BOD_5	0.60	0.60	-	0%
MCF_S	unitless	0.22	0.22	-	0%
Days per year	days per year	365.25	365.25	-	0%
Methane Emissions	MT CH_4	105	110	6	5%
Total Emissions	MT CO_2e	2,617	2,750	1533	5%

Notes: Factors and calculation based on Equation WW.11(alt) from the ICLEI Community Protocol.

BOD_5 load = Load of 5-day Biochemical Oxygen Demand treated per day; Bo = Maximum CH_4 producing capacity for domestic wastewater; MCF_S = CH_4 correction factor for septic systems; MT = metric tons; CH_4 = methane; CO_2e = carbon dioxide equivalent, ICLEI Community Protocol = U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions; GWP = global warming potential

[1] Excludes VAFB and UCSB

[2] MCF_S and GWP factors normalized to match the assumptions used in the 2016 inventory.

Source: Santa Barbara County 2017, ICLEI 2012, Data provided by Ascent Environmental 2018.

2.8.2 Wastewater Treatment Process Emissions

Emissions from wastewater treatment accounted for 121 MT CO_2e in 2016, or four percent of wastewater-related emissions. These emissions vary depending on the wastewater treatment method. This sector includes wastewater treatment process emissions from WWTPs. Eleven WWTPs serve over 61,000 persons in the unincorporated county; three of these WWTPs are located outside the jurisdiction. The 11 WWTPs do not all use the same wastewater treatment methods. In general, WWTPs emit CH_4 and N_2O from wastewater treatment process, fugitive, and stationary sources such as anaerobic digestion of biosolids, emissions from residual combustion of digester gases, nitrification and denitrification of effluent, and effluent discharge. CO_2 emissions from the on-site combustion of digester gases are not included in the inventory due because they are biogenic emissions. This means that those CO_2 emissions from the combustion of digester gases are part of the natural carbon cycle in the atmosphere and do not result in a net increase of GHG in the atmosphere the way that the combustion of fossil fuels do. Facilities that treat wastewater aerobically do not generate enough CH_4 to warrant capturing it and, thus, do not require stationary combustion facilities to burn CH_4.

For each facility, Table 22 shows the population served by the WWTP, the WWTP's treatment methods, references to population-based emissions equations from the ICLEI Community Protocol based on those methods, and the resulting emissions. Refer to the ICLEI Community Protocol for further details regarding the various emissions sources from wastewater treatment processes.

The results from the 2016 wastewater treatment processes are an update and a correction to the 2007 inventory. The 2016 inventory uses a similar method to what was used in the 2007 inventory for wastewater treatment process emissions, except that the 2007 inventory was based on the permitted capacity of each WWTP rather than the actual volume of wastewater treated or population served that year. This means that the 2007 inventory overestimated emissions from WWTPs serving the unincorporated county. The 2016 emissions estimates for wastewater treatment process emissions are more reflective of actual wastewater treatment flows.

Table 22 2016 Water Deliveries and Stationary Source and Process Emissions by Water Agency

WWTP	Unincorporated Community Served	Unincorporated Population Served	Treatment Method[5]	ICLEI Community Protocol Equations		Total CH_4 Emissions (MT CH_4)	Total N_2O Emissions (MT N_2O)	Total Emissions (MT CO_2e)
				Stationary Sources	Process and Fugitive			
Laguna County Sanitation District	Orcutt and portions of Santa Maria	34,970[1]	Anaerobic with N/D	WW.1.a and WW.2.a	WW.7 and WW.12.a	0.0273	0.2604	77
Mission Hills Community Services District	Mission Hills	3,453[1]	Secondary (aerobic)	None (Aerobic)	WW.8 and WW.12.a	0	0.0148	4
Montecito Sanitary District	Montecito	8,965[1]	Secondary (aerobic)	None (Aerobic)	WW.8 and WW.12.a	0	0.0385	11
City of Lompoc	Vandenberg Village	5,000[1]	Aerobic with N/D	None (Aerobic)	WW.7 and WW.12.a	0	0.0365	11
Carpinteria Sanitary District	Portions of Carpinteria Valley	500[2]	Aerobic with N/D	None (Aerobic)	WW.7 and WW.12.a	0	0.0036	1
City of Santa Barbara	Mission Canyon	2,381[3]	Aerobic with N/D	None (Aerobic)	WW.7 and WW.12.a	0	0.0174	5
Cuyama Community Services District	New Cuyama	517[3]	Secondary (aerobic)	None (Aerobic)	WW.8 and WW.12.a	0	0.0022	1
Goleta Sanitary District	Portions of Goleta Valley	100[2]	Aerobic with N/D	None (Aerobic)	WW.7 and WW.12.a	0	0.0007	0
Los Alamos Community Services District	Los Alamos	1,890[3]	Aerated Ponds	None (Aerobic)	WW.8 and WW.12.a	0	0.0081	2
Summerland Sanitary District	Summerland	1,448[3]	Anaerobic with N/D	WW.1.a and WW.2.a	WW.7 and WW.12.a	0.0011	0.0108	3
Santa Barbara County Parks Department	Cachuma Lake Recreation Area	2,192[4]	Aerobic with N/D	None (Aerobic)	WW.8 and WW.12.a	0	0.0094	3
Total		61,416	NA	NA	NA	0.0284	0.4025	121

Notes: WWTP = wastewater treatment plant; N/D = nitrification/denitrification; CO_2e = carbon dioxide equivalents, CH_4 = methane; N_2O = nitrous oxide; MT = metric tons. Aerobic treatment methods are assumed to have no stationary source emissions.

[1] Based on personal communications with WWTP or WWTP websites

[2] Approximated based on aerial-assessed portion of community located in the unincorporated area.

[3] Based on population of unincorporated community served in 2016 (DOF 2018)

[4] Based on 800,000 visitors per year divided by 365 (County of Santa Barbara 2012:13)

[5] Based on the assumptions used in the 2007 GHG Inventory.

Source: Gabriel, pers. comm., 2017; Wilder, pers. comm., 2017; Mission Hills Community Services District 2016; Archer, pers. comm., 2017; ICLEI 2012; Data compiled by Ascent Environmental 2018.

2.8.3 Wastewater Treatment Facilities Outside the Unincorporated County

Electricity use at WWTPs outside the unincorporated county resulted in 62 MT CO_2e in 2016, or two percent of wastewater-related emissions. Three WWTPs that serve the unincorporated county are located outside the jurisdiction. Thus, the electricity usage associated with treated wastewater at those facilities is not captured in the data obtained from PG&E and SCE for the building energy sector. These three facilities include WWTPs operated by the City of Lompoc, Carpinteria Sanitary District, and City of Santa Barbara, who together served approximately 8,000 people, or six percent of the population in the unincorporated county in 2016. Wastewater volumes from these WWTPs were obtained through data requests and the wastewater utility websites. The wastewater volumes were adjusted based on the ratio of unincorporated county population served to total population served. Then, using average wastewater energy intensity factors from the CEC, annual electricity estimates were calculated for the WWTPs located outside the unincorporated county. Electricity emission factors from Table 8 were applied to the calculated electricity usage based on the location of each facility relative to PG&E and SCE service territories. Table 23 shows the wastewater energy intensity factors by treatment type. Table 24 summarizes these calculations and results. Note that the 2007 inventory did not address emissions from electricity use in any WWTPs located outside the unincorporated county, even though some served the unincorporated county.

Table 23 Wastewater Energy Intensity Factors

Treatment Type	Factor (kWh/MG)
Trickling Filter	955
Activated Sludge	1,322
Advanced	1,541
Advanced with Nitrification	1,911

Notes: kWh = kilowatt-hours; MG = million gallons

Source CEC 2006: Table 12

Table 24 2016 Emissions from Electricity Use in WWTPs Located Outside the Unincorporated County

Wastewater Utility	Annual Unincorporated Wastewater Treated in 2016 (MG)	Wastewater Treatment Method	Total PG&E Electricity Use Attributable to County (kWh)	Total SCE Electricity Use Attributable to County (kWh)	Total Emissions (MT CO_2e)
City of Lompoc	131[1]	Activated Sludge	173,711	0	23
Carpinteria Sanitary District	15[2]	Advanced	0	23,862	6
City of Santa Barbara	73[3]	Advanced with Nitrification	0	139,163	33
Total	220	NA	173,711	163,025	62

Notes: kWh = kilowatt-hour; MG = million gallons; MGD = million gallons per day MT = metric tons; CO_2e = carbon dioxide equivalent, PG&E= Pacific Gas and Electric, SCE = Southern California Edison

[1] Volume associated with unincorporated county customers directly provided by City of Lompoc (Archer, pers. comm., 2017)

[2] Based on a current rate of 1.4 MGD and the ratio of the unincorporated population of Carpinteria Valley (500) to a service population of 16,500 (CarpSan 2018)

[3] Based on a current rate of 8 MGD and the ratio of the population of Mission Canyon to the population of the Mission Canyon and the City of Santa Barbara in 2017 (DOF 2018, City of Santa Barbara 2018)

Source: Archer, pers. comm., 2017; CarpSan 2018; DOF 2018; City of Santa Barbara 2018. Data provided by Ascent Environmental 2018.

3 GHG EMISSIONS FORECASTS THROUGH 2050

GHG emission forecasts are presented under two scenarios. First, the business-as-usual (BAU) GHG emissions forecasts provide the County with an assessment of how the County's emissions will change over time with growth, assuming the existing federal, state, and local actions do not improve or regress after the current inventory year. Second, an adjusted BAU forecast (ABAU) assesses the County's emissions assuming known policies will continue to be implemented as intended, including any planned updates to emission standards. These policies include regulatory requirements to increase vehicle fuel efficiency or increase renewable energy sources. Both scenarios account for anticipated growth in the County such as in population, jobs, and housing, and account for trends in agricultural land use. These forecasts provide the County with the information needed to focus the County's efforts on certain emissions sectors and sources that have the most GHG reduction opportunities.

The County's emissions are forecasted for the 2020, 2030, 2035, and 2050 milestone years. These years are selected based on the target year in the County's 2015 ECAP and the State's GHG reduction target years established in key state actions, including AB 32, SB32, and EO B-30-15. Primary policies affecting future emission factors include:

- SB 350, which increases the State's renewable electricity procurement goal from 33 percent by 2020 to 50 percent by 2030 and sets a goal of doubling energy efficiency in existing buildings;
- the Advanced Clean Cars Program, which includes low and zero emission vehicle regulations;
- the federal Corporate Average Fuel Economy (CAFE) standards, which establish vehicle fuel efficiency standards;
- SBCAG's 2040 Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS);
- the California Building Energy Efficiency Standards (Title 24 Part 6), which are updated triennially and feature increasingly stringent energy efficiency standards; and
- CalRecycle's 75 percent diversion rate target by 2020, per AB 341.

Accounting for these policies under the ABAU scenario, emissions would decline by 19 percent between 2016 and 2050. Assuming these policies stay stagnant under the BAU scenario, emissions would increase by 28 percent within the same time. These changes would occur alongside an anticipated 23 percent increase in population within the same time frame.

This section discusses the data, methods, and assumptions used to forecast GHG emissions in future years under both scenarios. Section 3.1 describes the scaling factors, such as demographics, used to forecast the emissions and shows how VAFB and UCSB communities were excluded. The BAU scenario forecasts emissions based on these scaling factors. Section 3.2 describes the methods used to calculate emissions from various sectors based on policies affecting each sector. For example, residential building energy emissions were scaled using forecasts in housing units while agricultural emissions were scaled by the County's anticipated change in future agricultural land uses. The ABAU scenario accounts for the scaling factors and policy changes described in Section 3.1 and 3.2.

3.1 SCALING FACTORS

The type of factors used to scale emissions vary by sector. For most emissions sectors, historical, current, and forecasted population, housing, and jobs data used to scale emissions, excluding those from VAFB and UCSB, were based on published data from DOF, EDD, U.S. Census Bureau, and UCSB. Unadjusted

unincorporated county demographics were based on 2016 data from DOF and were scaled to 2050 based on forecasts in SBCAG's 2010-2040 Regional Growth Forecast, shown in Table 25 (SBCAG 2012).

2016 VAFB population, housing, and job data were obtained from the U.S. Census Bureau's *2012-2016 American Communities Survey 5-Year Estimates,* and was assumed to be constant through 2050 (U.S. Census Bureau 2017). VAFB's population was assumed to be constant because the base's population is determined by the United States Air Force for reasons that may change depending on the decisions of elected leaders and appointed officials. Additionally, though VAFB's population has decreased by 46 percent between 2000 and 2010, from 6,151 to 3,338, there are no publicly known plans to change the current size of VAFB as of 2016 (U.S. Census Bureau 2018),

UCSB's population and forecasts were based on the campus's 2015-2016 profile and average annual growth rate used in their Long-Range Development Plan, last updated in 2010 (UCSB 2017, 2014). VAFB and UCSB demographics forecasts were then subtracted from unincorporated county forecasts, to stay consistent with the 2007 and 2016 inventory methodologies. Table 27 shows forecasted demographics data through 2050. The specific factors used to scale each emissions sector are summarized in Table 30.

To forecast agricultural emissions, the County's historical trends in rangeland and farmland were extrapolated to scale livestock and fertilizer emissions, respectively. The agricultural acreage trends were available from the Farmland Mapping and Monitoring Program of the California Department of Conservation and are shown in Table 26. For on-road transportation emissions, 2016 RTAC-adjusted vehicle activity was scaled to 2050 based on boundary-based BAU VMT forecast data between 2010 and 2035, provided by SBCAG (Perucho, pers. comm., 2018). The ABAU VMT forecast was based on the preferred scenario in SBCAG's 2040 RTP/SCS (SBCAG 2017). Both VMT forecast scenarios, which are only used to scale 2016 RTAC VMT calculations, are shown in Table 28. These trends were extrapolated to 2050.

Table 25 Santa Barbara County Regional Growth Forecasts (2015-2035)

	2015	2020	2030	2035
Countywide				
Population	482,600	445,600	495,000	507,500
Employment	213,700	229,900	241,300	250,000
Households	142,100	151,100	170,500	177,400
Unincorporated (Includes VAFB and UCSB)				
Population	145,600	145,581	NA	160,588
Employment	55,800	55,779	NA	60,324
Households	47,600	47,570	NA	52,813

Notes: NA = not available, VAFB = Vandenberg Air Force Base, UCSB = University of California Santa Barbara

Source: SBCAG 2012:2-5.

Table 26 Santa Barbara County Agricultural Acres (1984 – 2050) (for scaling purposes only) (thousand acres)

	From FMMP										Extrapolated			
	1984	1988	1992	1996	2000	2004	2008	2012	2014	2016	2020	2030	2035	2050
Farmland	128	132	131	129	140	136	125	126	127	126	128	127	127	125
Grazing Land	602	597	596	597	584	583	582	580	579	579	574	566	563	552
Total Agricultural Land	730	729	726	726	724	719	707	706	706	706	702	694	689	677

Notes: FMMP = Farmland Mapping and Monitoring Program

Source: CDC 2017. Data provided by Ascent Environmental 2018.

Table 27 Santa Barbara County Demographics Forecasts

	2016	2020	2030	2035	2050
Population					
County	447,295	445,600	495,000	507,500	577,999
Incorporated	305,000	300,019	339,579	346,912	400,857
Unincorporated[1]	142,295	145,581	155,421	160,588	177,142
Vandenberg Air Force Base	2,915	2,915	2,915	2,915	2,915
University of California – Santa Barbara	8,934	9,445	10,854	11,635	14,333
Unincorporated – Adjusted[2]	130,446	133,221	141,653	146,038	159,894
Percent Unincorporated – Adjusted[2]	29%	30%	29%	29%	28%
Employment					
County	205,800	229,900	241,300	250,000	271,857
Incorporated	143,200	174,121	182,531	189,676	206,618
Unincorporated[1]	62,600	55,779	58,769	60,324	65,239
Vandenberg Air Force Base	2,113	2,113	2,113	2,113	2,113
University of California – Santa Barbara	6,423	6,783	7,682	7,682	9,480
Unincorporated - Adjusted[2]	54,064	46,883	48,974	50,529	53,646
Percent Unincorporated - Adjusted[2]	26%	20%	20%	20%	20%
Housing Units					
County	156,520	151,100	170,500	177,400	208,278
Incorporated	105,967	103,530	119,496	124,587	149,644
Unincorporated[1]	50,553	47,570	51,004	52,813	58,634
Vandenberg Air Force Base	969	969	969	969	969
University of California – Santa Barbara	3,516	3,713	4,205	4,205	5,189
Unincorporated - Adjusted[2]	46,068	42,888	45,830	47,639	52,475
Percent Unincorporated - Adjusted[2]	29%	28%	27%	27%	25%

Notes: VAFB = Vandenberg Air Force Base, UCSB = University of California – Santa Barbara

[1] Includes activity within the physical boundaries of the unincorporated area of Santa Barbara County, including VAFB and UCSB and excluding incorporated cities.

[2] Excludes activity in VAFB and UCSB, due to the County's lack of jurisdictional control over those areas

Source: DOF 2018; EDD 2017; SBCAG 2012; U.S. Census Bureau 2017; UCSB 2017. Data compiled by Ascent Environmental 2018.

Table 28 Santa Barbara County BAU and Preferred Scenario VMT Forecasts (2010- 2050) (for scaling purposes only)

SBCAG 2040 RTP/SCS Scenario	2010	2016	2020	2030	2035	2050
BAU	4,673,044	4,939,795	5,560,357	6,458,308	6,907,283	8,303,494
Preferred Scenario	4,673,044	4,939,795	4,523,776	4,711,495	4,805,354	4,775,249
Source	SBCAG[1]	Scaled by HPMS growth	SBCAG[1]	Interpolated	SBCAG[1]	Extrapolated

Notes: BAU = business-as-usual; SBCAG = Santa Barbara County Association of Governments; RTP/SCS = regional transportation plan/sustainable communities strategies; HPMS = Highway Performance Monitoring System

[1] Perucho, pers. comm., 2018

Source: Data compiled by Ascent Environmental 2018.

3.2 LEGISLATIVE ADJUSTMENTS

In addition to the scaling factors described in Section 3.1, the ABAU scenario considers legislative adjustments assuming the known federal, state, and local policies will continue as intended. This section also includes a known major planned project that could affect solid waste emission forecasts, namely the Tajiguas Resource Recovery Project (TRRP). Each emissions sector differs in the legislative adjustments used to forecast the ABAU emissions and are described below accordingly. Scaling factors and applied legislative adjustments are summarized in Table 30.

Building Energy

Electricity Emission Factors

Accounting for the State's measures already in place, emissions from the building energy sector will see gradual declines into the future without additional County action, even with population increase. Under RPS and SB 350, it is assumed that PG&E and SCE will obtain a 33 percent renewable mix by 2020 and a 50 percent renewable mix by 2030. Electricity emission factor forecasts are scaled from PG&E and SCE renewable mixes and emission factors in 2016. In 2016, PG&E already achieved a 33 percent renewable mix, so it is assumed that PG&E's emission factors would stay constant by 2020. Note that the 2016 electricity emission factors already account for the GHG-free content of each utility's electricity sources. Table 29 shows the forecasted emission factors associated with PG&E, SCE, and the State's average. After 2030, emission factors are assumed to stay constant because current regulations have not set a goal for renewable mixes past 2030. The combined emission factors are averages weighted based on the proportion of electricity purchased from each utility in the unincorporated county.

Table 29 PG&E and SCE Forecasted Electricity Emission Factors (MT CO_2e/MWh)

Utility	2016	2020	2030	2035	2050
PG&E (RPS %)	0.134 (33%)	0.134 (33%)	0.100 (50%)	0.100 (50%)	0.100 (50%)
SCE (RPS %)	0.240 (28%)	0.224 (33%)	0.167 (50%)	0.167 (50%)	0.167 (50%)
Combined (RPS %)	0.184 (31%)	0.176 (50%)	0.132 (50%)	0.132 (50%)	0.132 (50%)
California Average (RPS %)	0.198 (25%)	0.177 (33%)	0.132 (50%)	0.132 (50%)	0.132 (50%)

Notes: PG&E=Pacific Gas and Electric, SCE = Southern California Edison; RPS = Renewable Portfolio Standards

Source: CEC 2017a; CEC2017b; Schmitz 2018; SCE 2017; EPA 2018b. Data compiled by Ascent Environmental 2018.

Energy Efficiency

The State has two major policies that would affect the energy efficiency of buildings in future years. The State's Title 24 Building Energy Efficiency Standards and SB 350 would affect energy efficiency rates in new construction and existing buildings, respectively. The 2016 Building Energy Efficiency Standards were adopted in December 2015 and went into effect January 2017. The CEC estimates that new residential buildings built to these standards would be 28 percent more efficient than buildings built to the 2013 standards (CEC 2016). Furthermore, the CEC estimated that the 2013 standards were 25 percent more efficient than the 2008 standards for residential buildings (CEC 2014). Combined, new residential buildings built to the 2016 standards would be 46 percent more efficient than those built to the 2008 standards.

For non-residential buildings, the CEC estimates that new non-residential buildings built to the 2016 standards would be five percent more efficient than buildings built to the 2013 standards (CEC 2015). Furthermore, the CEC estimated that the 2013 standards were 30 percent more efficient than the 2008 standards for non-residential buildings (CEC 2012). Combined, new commercial buildings built to the 2016 standards would be 34 percent more efficient than those built to the 2008 standards.

The CEC is currently developing language for the 2019 Building Energy Efficiency Standards. On May 9, 2018, the CEC board approved a mandate to include rooftop solar panels on new home construction as part of the 2019 standards (Daniels 2018). However, the official language of the 2019 standards have not yet gone through final vetting by the California Building Standards Commission (CBSC). The CBSC approval hearing for the 2019 standards is scheduled for December 2018 (CEC 2018a). Thus, the forecasts currently assume new construction will be built to the 2016 standards.

SB 350, in addition to targeting a 50 percent renewable mix in electricity by 2030, targets a cumulative doubling of statewide energy efficiency savings in electricity and natural gas end uses of retail customers by January 1, 2030 with annual targets established by CEC. SB 350's energy efficiency goals are applicable to existing building stock and new construction, but would have the most impact on existing building stock as of 2016 (CEC 2018b).

Forecasts of future building energy use account for Title 24 and SB 350 policies. It is assumed that all new construction taking place between 2016 and 2050 will have energy efficiencies between 34 and 46 percent better than current energy usage rates (i.e., energy use per household and employment). Although this method does not exactly reflect improvements from energy efficiencies in existing buildings, this method is a conservative approach as the average existing building likely meets standards older than the 2008 standard. In addition, it is assumed that all existing building stock (i.e., buildings built before 2016) would continue to operate through 2050 and use 50 percent less energy starting in 2030. The forecasted energy efficiency improvements in existing building stock are meant to reflect implementation of SB 350 energy efficiency goals met by 2030. As a conservative assumption, estimated energy efficiency levels in existing buildings are assumed to stay constant from 2030 through 2050.

Water and Wastewater

Water imports and wastewater treatment involve use of electricity for pumping and treatment. Many of these activities addressed in the inventory occur in the incorporated Santa Barbara cities. Forecasts for the electricity-related emissions from the water and wastewater sectors assume electricity emissions factors consistent with PG&E, SCE, and the State's progress towards RPS and SB 350 targets.

On-Road Vehicle Fleet

State and federal actions incorporated in the on-road vehicle emission forecasts include:

- Advanced Clean Cars (State)
- Tractor-Trailer Greenhouse Gas (TTGHG) Regulation (State)
- Federal Pavley Regulations (GHG emission reduction standards) (Federal)
- Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (Federal)

These policies are already included in EMFAC's emission factor estimates and forecasts. It should be noted that the Low Carbon Fuel Standard regulation was excluded in EMFAC 2017 forecasts because EMFAC focuses on tailpipe emissions (CARB 2017d:8).

Solid Waste

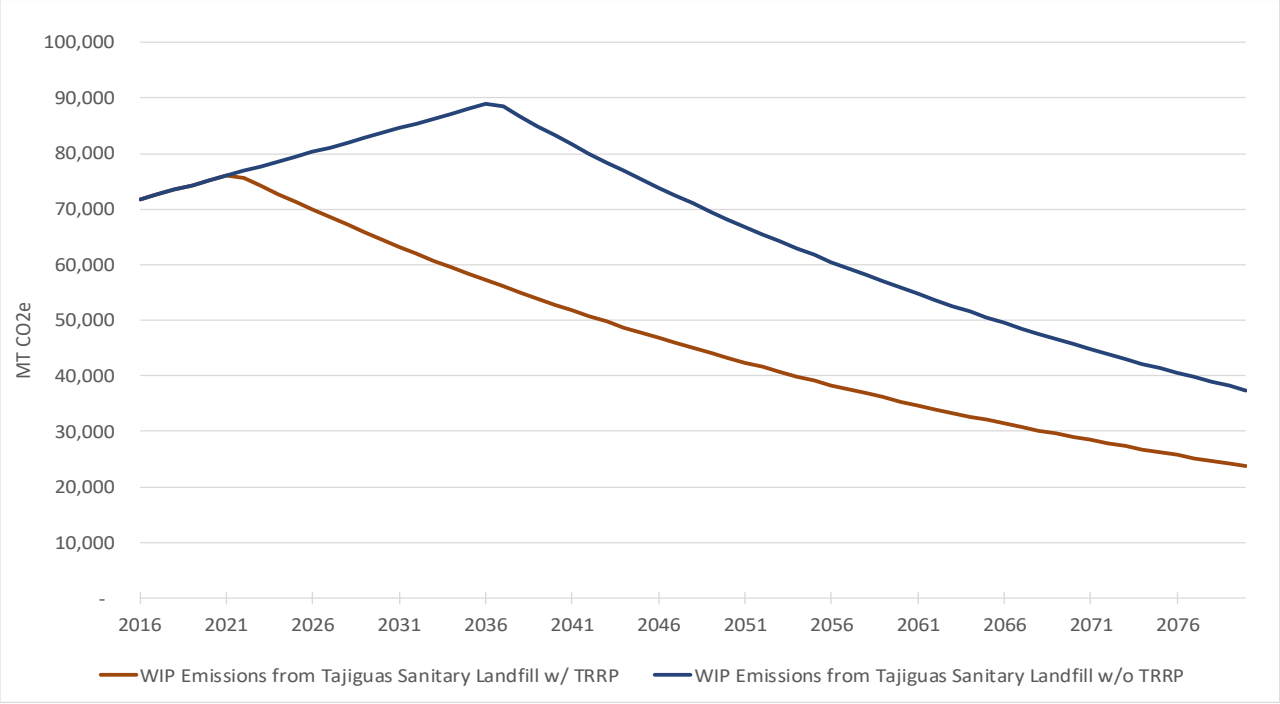
Regarding waste generation emissions, CalRecycle established a target pursuant to AB 341 (Chapter 476, Statutes of 2011) to achieve a statewide waste diversion rate of 75 percent by 2020, or 2.7 pounds of waste per resident per day (lb/resident/day). To meet the State's target, the unincorporated county would need to reduce its disposal rate from 4.1 lb/resident/day to the State's target of 2.7 lb/resident/day or a 34 percent reduction from 2016 disposal rates (CalRecycle 2018b, 2012:7). Accordingly, waste generation emissions in 2020 were scaled down by 34 percent from BAU forecasted emissions levels. For landfills other than Tajiguas Sanitary Landfill, it was assumed that waste generation emissions would continue to be 34 percent below BAU forecasted emission levels after 2020.

As shown in Tables 14, the Tajiguas Sanitary Landfill accounted for nearly 46 percent of waste generation emissions in 2016. For the Tajiguas Sanitary Landfill, waste generation emissions forecasts post-2020 were

based on results from the analysis presented in the TRRP Environmental Impact Report (EIR), which assumed that all organic material would be diverted from the landfill and composted or recycled. The TRRP EIR estimated that, of the emissions that would have been generated through the decomposition of organic waste in the landfill, some CH_4 emissions would be still generated from composting of the organic waste. No CH_4 emissions were assumed to be generated from recycling activities. The TRRP EIR estimated that the proposed composting facility would generate about 26 MT CH_4 per year during the lifetime of the project through 2066 (County of Santa Barbara 2015b: Table 9). According to CalRecycle, 49 percent of Tajiguas Santitary Landfill's waste came from the unincorporated county, inclusive of VAFB and UCSB which could not be disaggregated (CalRecycle 2018c). Thus, approximately 13 MT CH_4 per year, or 317 MT CO_2e per year, would be emitted from waste generation at Tajiguas Santiary Landfill between 2021 and 2050. This number was not adjusted for population growth to be consistent with the estimates reported in the TRRP EIR. Other non-waste emissions estimates from the TRRP EIR, such as for the project's building energy and equipment use, were assumed to already be captured in other sectors (e.g., building energy, off-road vehicles and equipment).

For waste-in-place emissions, future emissions were taken from CARB's LET model based on the natural decay rate of the waste at open and closed landfills, using the data shown in Table 15. Apart from the TRRP, no new LFG capture projects are currently planned for landfills within the unincorporated county.

As shown in Table 15, the Tajiguas Sanitary Landfill accounted for 95 percent of waste-in-place emissions in 2016. The County anticipates that the TRRP will begin operation in 2021 (Johnston, pers. comm., 2018). Thus, it is assumed that no further organic material will be landfilled at the site starting in 2021, effectively stopping the accumulation of organic material beginning in 2021. Applying this assumption to the decay model in LET, results in a reduction in future waste-in-place emissions relative to if the landfill were to continue accepting organic waste through its planned closure date in 2036. Figure 2 shows a comparison of how waste-in-place emissions decay over time with and without the TRRP at the Tajiguas Sanitary Landfill. Forecasted waste-in-place emissions from the Tajiguas Sanitary Landfill account for the proposed operation of the TRRP. These forecasts are consistent with the projected landfill emissions in the TRRP EIR, though the EIR used a different decay model built by the EPA (County of Santa Barbara 2015b: Figure 3-1, Figure 6-3).



WIP = waste-in-place, TRRP = Tajiguas Resource Recovery Project. Based on modeling in CARB's Landfill Emissions Tool.

Figure 2 **Waste-in-Place Emissions Forecasts at Tajiguas Sanitary Landfill with and without the Tajiguas Resource Recovery Project**

Other Sectors

Forecasted emissions from the off-road vehicle and agricultural sectors are based on SBCAG's forecasted changes in employment and population and forecasted agricultural acreages. Although OFFROAD 2017 incorporates regulatory actions such as reformulated fuels and more stringent emissions standards, the model was also developed before the recession and has population forecasts that would not be consistent with current estimates from SBCAG. As such, current off-road emission factors are assumed to stay constant into the future and total emissions are scaled by either job or population growth depending on the off-road equipment type (see Table 30). Agricultural emissions are directly scaled by the anticipated change in acreages. No policies are assumed to change the trend in agricultural acres in the County.

Table 30 Unincorporated County of Santa Barbara: Forecast Methods and Legislative Adjustments, by Emissions Sector

Sector and Subsector	ABAU Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Energy		
Residential Electricity	Scaled by housing units.	RPS scheduled targets applied to PG&E, SCE, and California average emission factors. Accounts for 2016 Title 24 energy efficiency gains for all new construction. Accounts for 50 percent renewable mix by 2050 for PG&E emission factors and 50 percent improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Residential Natural Gas and Propane	Scaled by housing units	Accounts for 2016 Title 24 energy efficiency gains for new construction. Accounts for 50 percent improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Commercial and Industrial Electricity	Scaled by employment	RPS scheduled targets applied to PG&E, SCE, and California average emission factors. Accounts for 2016 Title 24 energy efficiency gains for all new construction. Accounts for 50 percent renewable mix by 2050 for PG&E emission factors and 50 percent improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Commercial and Industrial Natural Gas	Scaled by employment	Accounts for 2016 Title 24 energy efficiency gains for new construction. Accounts for 50 percent improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Agricultural Electricity	Scaled by agricultural acres	RPS scheduled targets applied to PG&E, SCE, and California average emission factors. Accounts for 2016 Title 24 energy efficiency gains for all new construction. Accounts for 50 percent renewable mix by 2050 for PG&E emission factors and 50 percent improvement in energy efficiency in all existing buildings starting in 2030, per SB 350.
Water		
Imported Water	Scaled by population	California average electricity emission factors assumed to follow the RPS and SB 350 target schedule
Wastewater	Scaled by population	Assumes electricity use at all treatment plants outside the unincorporated area follow the RPS and SB 350 target schedule
Waste		
Solid Waste Generation	Scaled by population	Assumes California's 75 percent waste diversion goal will be achieved by the County by 2020. Accounts for operation of the Tajiguas Resource Recovery Project, which is assumed to begin operation in 2021. This project plans to compost all organic waste received by this landfill at the start operation.

Table 30 Unincorporated County of Santa Barbara: Forecast Methods and Legislative Adjustments, by Emissions Sector

Sector and Subsector	ABAU Forecast Methods	
	Scaling Factors	Applied Legislative Reductions
Waste (continued)		
Waste-in-Place	Natural decay rate based on historical waste disposal as modeled in LET	Accounts for operation of the Tajiguas Resource Recovery Project, which is assumed to begin operation in 2021. This project plans to compost all organic waste received by this landfill at the start operation.
Transportation		
Vehicle Miles Traveled	Estimated by SBCAG	EMFAC emission factors considerations include ACC, Pavley, TTGHG, and fuel efficiency standards for medium- and heavy-duty vehicles
Aircraft	Scaled by County-wide population	None
Off-Road Vehicles and Equipment		
Agricultural Equipment	Scaled by agricultural acres	No additional legislative reductions
Agricultural Diesel Pumps	Scaled by agricultural acres	No additional legislative reductions
Airport Ground Support Equipment	Scaled by County-wide population	No additional legislative reductions
Construction and Mining Equipment	Scaled by employment	No additional legislative reductions
Entertainment Equipment	Scaled by population	No additional legislative reductions
Industrial Equipment	Scaled by employment	No additional legislative reductions
Lawn and Garden Equipment	Scaled by housing units	No additional legislative reductions
Light Commercial Equipment	Scaled by employment	No additional legislative reductions
Oil Drilling	Not scaled	No additional legislative reductions
Other Portable Equipment	Scaled by population	No additional legislative reductions
Pleasure Craft	Scaled by population	No additional legislative reductions
Railyard Operations	Not scaled	No additional legislative reductions
Recreational Equipment	Scaled by population	No additional legislative reductions
Agriculture		
Livestock	Scaled by change in grazing land	No additional legislative reductions
Fertilizers	Scaled by change in cropland	No additional legislative reductions

Notes: ACC = Advanced Clean Cars, BAU = business as usual, GWP = global warming potential, LET = Landfill Emissions Tool; RPS = Renewable Portfolio Standard, PG&E = Pacific Gas and Electric, SBCAG = Santa Barbara County Association of governments; SCE = Southern California Edison SB = Senate Bill, TTGHG = Tractor-Trailer Greenhouse Gas

Source: Ascent Environmental 2018.

3.3 GHG EMISSIONS FORECAST

From 2016 levels, BAU emissions would decrease by three percent by 2020, return to 2016 levels by 2030, and increase by 24 percent by 2050. The slight decrease in 2020 under the BAU scenario is primarily because of a seven percent reduction in the number of households between 2016 and 2020. Under the

ABAU scenario, emissions, accounting for applicable legislative reductions, would decrease by 10 percent by 2020, 32 percent by 2030, and 35 percent by 2050 from 2016 levels. Table 31 and Figure 3 show the ABAU forecast broken down by sector alongside the overall BAU forecast that would occur without anticipated legislative reductions and accounting only for population, housing, and employment changes.

As population increases and technology improves, emissions from on-road vehicles and building energy use per capita would decrease with the State's renewable energy supply and significant improvements in energy efficiency. Emissions from the on-road vehicle sector would decrease by 45 percent between 2016 and 2050; and emissions from the building energy sector would decrease by 49 percent during the same time frame. As emissions from the transportation and building energy sectors decrease, the percent contribution of other emissions sectors increases. For example, in 2016, the agriculture sector accounted for 14 percent of total emissions; and, by 2030this increases to 21 percent, under the ABAU scenario. Moreover, in 2030, emissions from the agriculture sector would exceed those from the building energy sector, which would only account for 17 percent of total emissions in that year. Emissions from the off-road sector would be just follow the building energy sector at 16 percent of total emissions in 2030. The solid waste sector would remain at about 10 percent of total emissions between 2016 and 2050. Finally, Emissions from water and wastewater would remain less than one percent of emissions through 2050. Table 32 summarizes the percent contributions from each sector between 2016 and 2050 under the ABAU scenario. Despite increasing emissions between 2007 and 2016, future ABAU emissions would decrease through 2050, even though total population would increase by 23 percent between 2016 and 2050.

Table 31 Unincorporated County of Santa Barbara Emissions Inventory and ABAU Forecasts (MT CO_2e/yr)

Sector and Subsector	2016	2020	2030	2035	2050
Transportation					
On-Road Transportation	586,402	483,613	375,489	349,776	318,905
Aircraft	1,539	1,533	1,703	1,746	1,989
Transportation Subtotal	587,941	485,146	377,192	351,522	320,894
Energy					
Residential	212,256	194,643	94,811	101,088	119,178
Commercial	168,145	144,621	65,230	69,851	79,117
Industrial	16,393	14,216	6,653	7,125	8,070
Agricultural	28,947	28,147	10,198	10,072	9,698
Energy Subtotal	425,741	381,627	176,892	188,136	216,062
Water and Wastewater					
Imported Water	991	988	787	812	890
Wastewater	2,933	2,993	3,166	3,264	3,579
Water Subtotal	*3,924*	3,981	3,953	4,076	4,469
Waste					
Solid Waste Generation (without Tajiguas Sanitary Landfill)	33,174	33,883	36,032	37,157	40,747
Solid Waste Generation (Tajiguas Sanitary Landfill only)	28,178	18,953	317	317	317
Waste-In-Place	75,505	78,614	67,314	60,908	45,122
Waste Subtotal	136,857	131,449	103,663	98,382	86,186
Off-Road Vehicles and Equipment					
Agricultural Equipment	64,469	64,161	63,383	62,998	61,855

Table 31 Unincorporated County of Santa Barbara Emissions Inventory and ABAU Forecasts (MT CO_2e/yr)

Sector and Subsector	2016	2020	2030	2035	2050
Off-Road Vehicles and Equipment (continued)					
Agricultural Diesel Pumps	5,571	5,544	5,477	5,444	5,345
Airport Ground Support Equipment	6	6	6	6	7
Construction and Mining Equipment	60,801	52,725	55,425	56,826	61,244
Entertainment Equipment	82	84	90	92	101
Industrial Equipment	6,393	5,544	5,828	5,975	6,440
Lawn and Garden Equipment	2,924	2,723	2,920	3,024	3,359
Light Commercial Equipment	4,393	3,810	4,005	4,106	4,425
Oil Drilling	16,436	16,436	16,436	16,436	16,436
Other Portable Equipment	20	20	21	22	24
Pleasure Craft	2,368	2,418	2,572	2,652	2,908
Railyard Operations	1	1	1	1	1
Recreational Equipment	2,538	2,592	2,756	2,842	3,117
Transport Refrigeration Units	5,973	5,973	5,973	5,973	5,973
Off-Road Vehicles and Equipment Subtotal	166,403	162,038	164,893	166,397	171,237
Agriculture					
Soil Management	80,437	79,722	78,692	78,182	76,671
Livestock	135,666	137,529	136,353	135,769	134,033
Agriculture Subtotal	216,103	217,250	215,045	213,951	210,704
Total	1,542,541	1,381,492	1,041,637	1,022,465	1,009,552

Notes: ABAU = legislative-adjusted business-as-usual, CO_2e = carbon dioxide equivalents, MT = metric tons

Source: Ascent Environmental 2018.

Table 32 Unincorporated County of Santa Barbara Emissions Inventory and ABAU Forecasts – Percent Breakdown by Sector

Sector	2016	2020	2030	2035	2050
Transportation	38%	35%	36%	34%	32%
Building Energy	28%	28%	17%	18%	21%
Off-Road Vehicles and Equipment	14%	16%	21%	21%	21%
Agriculture	11%	12%	16%	16%	17%
Solid Waste	9%	10%	10%	10%	9%
Water and Wastewater	0.3%	0.3%	0.4%	0.4%	0.4%
Total	100%	100%	100%	100%	100%

Notes: ABAU = legislative-adjusted business-as-usual

Source: Ascent Environmental 2018.

4 ACHIEVEMENT OF COUNTY GHG REDUCTION TARGETS

Under the 2015 ECAP, the County set a goal of reducing emissions by 15 percent below 2007 levels by 2020. Additionally, CARB aims to reduce statewide emissions to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050, per AB 32, SB 32, and EO B-30-15. However, without a 1990 baseline for the County, the State's targets are translated to be in relation to the State's 2016 emission inventory. An inventory update for 2016 was undertaken due to availability of higher quality data and evolution of data collection and emissions quantification methods. Therefore, for future goal-setting past 2020, the County should consider using a 2016 baseline.

The *California's 2017 Climate Change Scoping Plan* recommends that, to be consistent with this statewide goal, local jurisdictions should emit no more than 6 MT CO_2e per capita by 2030 and 2 MT CO_2e per capita by 2050. According to CARB, these per-capita targets are consistent with the State's GHG reduction goals because, when applied to DOF's population forecasts for the state, the per-capita targets reflect a 40 percent reduction in statewide emissions from 1990 levels by 2030 and an 80 percent reduction in statewide emissions from 1990 levels by 2050. These targets are equivalent to the state emitting no more than 265 million MT CO_2e by 2030 and 100 million MT CO_2e by 2050. Currently, CARB has historical GHG emissions inventories for the state from 1990 through 2015. By extending the state's emissions trend to 2016, the state's emissions in 2016 were estimated to be approximately 438 million MT CO_2e. Comparing the state's 2016 emissions with the targeted emissions for 2030 and 2050, an adjusted target relative to 2016, rather than 1990, can be developed. Thus, the post-2020 target for the County that is consistent with the State's goals would be to reduce the County's emissions by 40 percent below 2016 levels by 2030 and 77 percent below 2016 levels by 2050. Additionally, the County's ECAP target for 2020 is equivalent to a 26 percent reduction from 2016 levels by 2020.

The adjustment of the County's baseline from 2007 to 2016 is still consistent with the State's targets because the statewide 2030 and 2050 targets are unchanged. The only difference between using the 2007 baseline and the 2016 baseline is that the relative reductions needed from the chosen baseline to meet the targets would be different, In order to stay consistent with the State's targets and to account for the County's more robust 2016 inventory (compared with the 2007 inventory), the County's percent-based GHG reduction targets are matched with the state-level reduction targets relative to a 2016 baseline.

As shown in Table 33 and Figure 3, without further action from the County, the County will not meet the ECAP goal of 15 percent below 2007 levels by 2020. Under current trends and policies, the County will still have higher emissions in 2020 than in 2007, even though 2020 emissions would be lower than in 2016. Most emissions in 2020 would still be associated with on-road transportation and building energy sectors.

Table 33 Unincorporated County of Santa Barbara Emissions Forecasts and Targets (MT CO_2e/yr)

	2007	2016	2020	2030	2035	2050
BAU Forecast	1,351,731[1]	1,542,541	1,498,994	1,543,136	1,641,790	1,910,075
Percent Change from 2007			11%	14%	21%	41%
Percent Change from 2016			-3%	0%	6%	24%
ABAU Forecast	1,351,731[1]	1,542,541	1,381,492	1,041,637	1,022,465	1,009,552
Percent Change from 2007			2%	-23%	-24%	-25%
Percent Change from 2016			-10%	-32%	-34%	-35%
ECAP Targets (percent change from 2007)			15%	NA	NA	NA
State Target (percent change from 2016)			2%[2]	40%	NA	77%
Combined Targets (percent change from 2016)[3]			26%	40%	NA	77%
Target Emissions			1,148,971	931,329	786,131[4]	350,537
Additional Reductions Needed from ABAU Forecast			232,521	110,309	236,334	659,015
Additional Reductions Needed from 2016			393,570	611,212	756,410	1,192,004

Notes: ABAU = legislative-adjusted business-as-usual, BAU = business-as-usual, ECAP = Energy and Climate Action Plan, CO_2e = carbon dioxide equivalents, NA = Not Available, MT = metric tons

[1] Scaled to 2007 from 2016 inventory based on percent changes by sector shown in Table 2 to adjust for differences in methodologies and assumptions. Does not reflect published value.

[2] Based on the State's GHG inventory in 1990 and 2016. State's 2016 inventory extrapolated from historical trends between 2000 and 2015. (CARB 2017a).

[3] The most stringent of the targets between ECAP and state targets are used. ECAP is the most stringent of the two for the 2020 target year.

[4] Interpolated between 2030 and 2050.

Source: Ascent Environmental 2018.

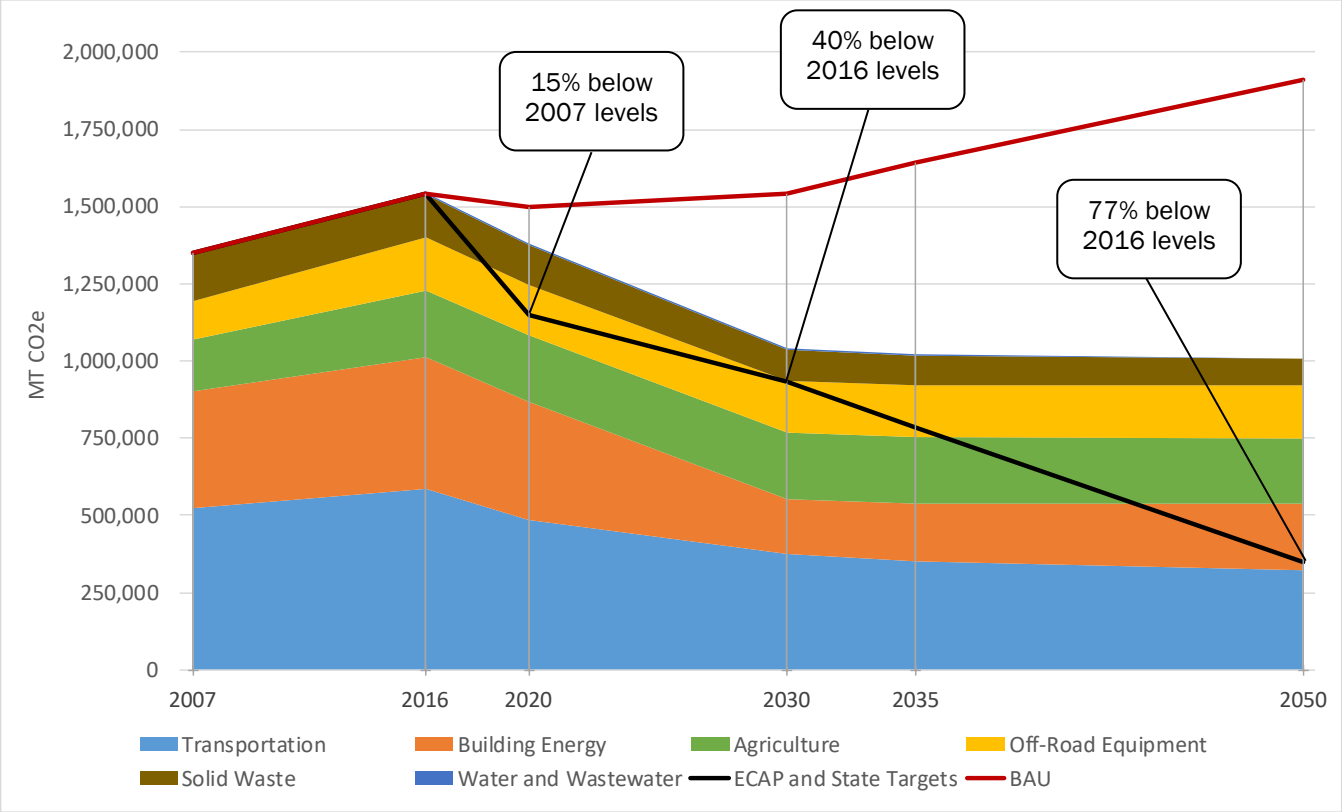


Figure 3 **Unincorporated County of Santa Barbara Emissions ABAU Forecasts by Sector, BAU forecasts, and Targets (2007-2050)**

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PERSONAL COMMUNICATIONS

Archer, Richard. City of Lompoc. September 13, 2017—Phone conversation with Brenda Home of Ascent Environmental regarding the 2016 unincorporated population and volumes served by the city's WWTP.

Fox, Cynthia. Sempra Utilities. Business Analyst. December 11, 2017—Email to Selena Evilsizor of the County of Santa Barbara with 2016 natural gas usage for the unincorporated county of Santa Barbara, excluding usage from VAFB and UCSB for customers of SoCal Gas.

Gabriel, Diane. Montecito Sanitary District. General Manager / District Engineer. September 21, 2017—Email to Brenda Hom of Ascent Environmental with 2016 unincorporated population and volumes served by the WWTP.

Iorio, Paula. Santa Barbara County Air Pollution Control District. Air Quality Permit Technician—September 26, 2017a. Email to Brenda Hom of Ascent Environmental with annual fuel volumes dispensed at Santa Ynez Airport for 2016. September 11, 2017b. Email to Brenda Hom of Ascent Environmental with list of agricultural engines with application and approval dates as of 2017.

Johnston, Carlyle. County of Santa Barbara. Public Works Department. September 12, 2017—Email to Brenda Hom of Ascent Environmental with tonnages at landfills in Santa Barbara County. May 31, 2018—Email to Selena Evilsizor of the County of Santa Barbara regarding the Air Quality and Greenhouse Gas Technical Report written for the TRRP EIR.

Perucho, Julio. Santa Barbara County Association of Governments. Transportation Planner. October 26, 2017a—Email to Naomi Wentworth of Ascent Environmental discussing the status of SBCAG's update to their model's base year to 2015 from 2010. November 10, 2017—Email to Naomi Wentworth of Ascent Environmental with 2010 origin-destination VMT for the unincorporated county. January 23, 2018—Email to Naomi Wentworth of Ascent Environmental with the VMT forecasts for 2010, 2020, and 2030.

LaFay, Tyrone. Santa Barbara County Water Agency. Water Conservation Coordinator. September 28, 2017—Email to Brenda Hom of Ascent Environmental with water delivery volumes by water agency for 2016.

Newvine, Steven. Pacific Gas & Electric. January 4, 2018—Email to Selena Evilsizor of the County of Santa Barbara with 2016 electricity and natural gas usage for the unincorporated county of Santa Barbara, excluding usage from VAFB and UCSB for customers of PG&E.

Wilder, Marty. County of Santa Barbara. Public Works Department. September 27, 2017—Email to Brenda Hom of Ascent Environmental with 2016 wastewater volumes and unincorporated customers for Laguna Sanitation District.