City of Santa Barbara

2015 Community-wide GHG Emissions Inventory Update

Appendix D

October 2017

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Executive Summary

This report provides the data, methodology, and assumptions used to create the 2015 Community-wide Greenhouse Gas (GHG) emissions inventory and how those relate to previous emission inventories and established targets.

The community has made significant progress in reducing total community-wide GHG emissions primarily because of reductions in energy consumption and waste generation emissions. The community-wide emission targets established in the Climate Action Plan (CAP) continue to be met, total GHG emissions have continued to decrease from 1990 levels, and the CAP's forecasted emission reductions by 2020 were met in 2015. It is important to note, however, the CAP GHG emission forecasts were estimated using different GHG emission methodologies.

On-road vehicle emissions have increased above 1990 levels and remain the largest source of GHG emissions in the Santa Barbara community. The upward trend in vehicle emissions since 1990 appears to have reversed between 2010 and 2015 due to improved vehicle fuel economy rather than changes in travel behavior. The 2020 per capita on-road vehicle emission target established in the CAP was achieved in 2015. However, the rate of per capita on-road vehicle emission reductions has occurred significantly slower than forecasted in the CAP.

Introduction

This report provides the data, methodology, and assumptions used to create the 2015 Community-wide Greenhouse Gas (GHG) emissions inventory and how those relate to previous emission inventories and established targets.

BACKGROUND

GHGs include all gases that trap heat in the atmosphere. The four most significant GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and Fluorinated gases. These gases are generated through a variety of activities, ranging from fossil fuel use to landfill decomposition. Each of these gases remains in the atmosphere for a different range of time (from a few years to thousands of years). And, some of these gases are more effective than others in trapping heat. A gas's effectiveness in trapping heat in the atmosphere is called its "Global Warming Potential" (GWP). As a result, the effect of these gases on the environment is a factor of the concentration of each GHG, the duration the GHG stays in the atmosphere, and how effective the GHG is in trapping heat.

According to the Intergovernmental Panel on Climate Change (IPCC)[1] 5th Assessment, there is a scientific consensus that human activities are influencing climate change, GHG emissions are at their highest levels, and climate change is and will continue to impact both human and natural systems.

The City's response to climate change began in 2005, when then-Mayor Marty Blum, along with 1,054 other Mayors endorsed the US Mayors Climate Protection Agreement, which directed cities to meet or surpass the GHG emission reduction target (7% reduction of 1990 values by 2012) established in the

[1] The IPCC is an international body established in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

Kyoto Protocol, which is an international treaty to reduce GHG emissions to a level that, at the time was believed would prevent significant climate impacts.

Since then, the City has engaged in a number of additional efforts to respond to climate change. In 2006, the City's Sustainability Council Committee was created to coordinate environmental efforts between departments and provide policy guidance on environmental initiatives, receive updates on key projects and programs, and make recommendations to City Council.

In 2007 the City became one of the first cities in the nation to certify an annual GHG emissions inventory for City operations through the California Climate Action Registry, and achieved Kyoto carbon emission reduction targets in 2008.

In 2011, the City completed an update to the General Plan, which included the City's first community-wide GHG emissions inventory, a Sustainability Framework to wisely manage resources, and policies to reduce GHG emissions and adapt to climate change.

In 2012, City Council adopted the Santa Barbara Climate Action Plan (CAP), which included 100 strategies to reduce GHG emissions and adapt to climate change. The CAP set a target that community-wide GHG emissions be below 1990 levels by 2020 and that annual per capita on-road vehicle GHG emissions be below 2005 levels in 2020 and 2030. The CAP also anticipated that the community-wide GHG emissions inventory would be updated every five years to track progress towards these targets.

And finally, in 2016, the City committed to participate in the Global Covenant of Mayors for Climate & Energy (formerly the Compact of Mayors), which is an international alliance of cities to reduce GHG emissions and to enhance resilience to climate change.

THE PURPOSE OF A COMMUNITY-WIDE GHG EMISSIONS INVENTORY

GHG inventories provide a litmus test of the extent that human activities are generating GHGs, and therefore, contributing to climate change. Furthermore, the quantitative estimates found in a GHG inventory can be used to track progress towards targets, prioritize management actions, and analyze how communities compare to one another.

HOW GHGS ARE CATEGORIZED

GHG emissions are typically categorized by the sector of activity that generated the GHG emissions. These sectors include Transportation, Energy, Waste, Industrial Process, and Agriculture. In addition, GHG emissions are typically classified by "scope," which is a classification determined by the geographic location of where emissions are generated, and the location of the activities that created them. The criteria for this classification can be found in Table 1.

Table 1: Definition of GHG Emission Scope

Scope	Definition
Scope 1	Sometimes referred to as "Territorial Emissions," this includes emissions from sources located entirely within the inventory boundary.
Scope 2	Emissions from grid supplied energy within the inventory boundary.

Scope	Definition
Scope 3	All other emissions generated outside of the inventory boundary as a result of activities within the inventory boundary[2].

HOW GHGS ARE MEASURED

It is rarely feasible for GHG emissions to be measured through direct sampling of a GHG generating activity. As a result, most community-wide GHG emission inventories use established models, scientifically agreed upon assumptions, and well-vetted protocols to estimate GHG emissions based on GHG generating activity inputs. Ultimately, the calculation used to determine GHG emissions from an activity can be simplified into the following equation, where the "Emissions Factor" (reported in grams of GHG / activity) is a representative value for the extent of emissions for each quantity of activity:

$$Activity\ Rate\ \times Emissions\ Factor = GHG\ Emissions$$

Some activities generate multiple GHG emissions, and as previously described, some GHGs are more effective than others in trapping heat in the atmosphere. To allow for the warming impacts of different gases to be compared to one another, GHG emissions are converted into carbon dioxide equivalent (CO_2e), which is the standard unit of measurement for GHG emissions. To convert a gas into CO_2e, the quantity of gas is multiplied by its GWP factor. The IPCC assessments are the well-established best available science for the GWP factors of all major GHG's relative to carbon dioxide. Consistent with evolving nature of the scientific community's understanding of climate change, these GWP factors have been refined over time, as shown in Table 2.

Table 2: Global Warming Potential (GWP) of Major GHGs

Greenhouse Gas	IPCC 2nd assessment (1995)	IPCC 3rd assessment (2001)	IPCC 4th assessment (2007)	IPCC 5th assessment (2013)
Carbon Dioxide (CO_2)	1	1	1	1
Methane (CH_4)	21	23	25	28
Nitrous Oxide (N_2O)	310	296	298	265

CURRENT STANDARDS

The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) is currently the most comprehensive GHG reporting standard. The GPC is a joint effort by the International Council for Local Environmental Initiatives – Local Governments for Sustainability (ICLEI), the World Resources Institute (WRI), and C40 Cities Climate Leadership Group (C40), in collaboration with the World Bank, United Nations Environment Programme (UNEP), and UN-Habitat. The GPC is built around a framework that provides consistent and standardized reporting to allow both for consistent comparison between jurisdictions and aggregation across jurisdictional boundaries that can add together to match state and national inventories. As a member of the Global Covenant of Mayors for Climate & Energy, the City is required to use the GPC standard for GHG emissions reporting.

[2] As an example, waste generated within the City boundary and disposed of at the Tajiguas landfill (outside of the City) would be classified as Scope 3 emissions.

Past and Current Community-wide GHG Estimates

PAST COMMUNITY-WIDE GHG INVENTORIES

The City's first community-wide GHG emission inventory was conducted as part of the 2011 General Plan Certified Final Program Environmental Impact Report (EIR), and established 2007 as the baseline for the community's GHG emissions because at the time, it was the most recent year with comprehensive information on GHG-generating activities. Using this baseline, emissions for 1990 and 2005 were estimated using "back-casting[3]" techniques in order to track progress towards meeting state targets, which use 1990 and 2005 as baseline years.

The community-wide GHG emissions inventory was later updated while developing the City's 2012 CAP, which includes 100 strategies to reduce GHG emissions and adapt to climate change, and is the City's primary planning tool for addressing climate change. This inventory built upon the previous community-wide GHG emissions inventory to establish a new inventory year (2010) and refine previously made assumptions based on best practice approaches.

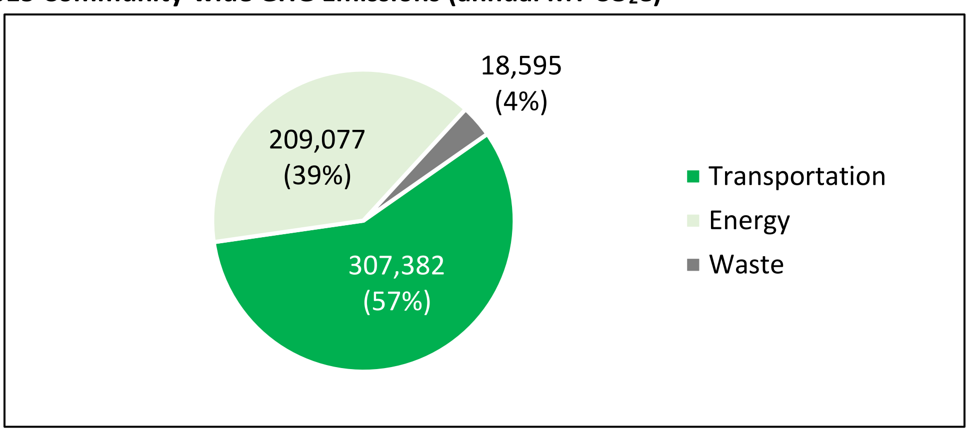
CURRENT COMMUNITY-WIDE GHG INVENTORY

The 2015 update to the community-wide GHG inventory continues to build off the previous inventories to establish a new inventory year (2015) and incorporate changes in assumptions and methodologies based on new standards and software tools (ICLEI's ClearPath[4]). This update also complies with the CAP reporting requirements, meets Global Covenant of Mayors for Climate and Energy requirements, is consistent with the Global Protocol for Community-Scale GHG Emission Inventories (GPC), and tracks progress towards meeting GHG emissions targets established in the CAP.

Results of the Community-wide GHG Emission Inventory

In 2015, it is estimated that 535,055 MT CO_2e of GHG emissions were generated by the community. A summary of these results is found in Chart 1 and Table 3.

Chart 1: 2015 Community-wide GHG Emissions (annual MT CO_2e)



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[3] Back-casting is a reverse forecasting technique that estimates historic conditions based on current conditions and trends over time.

[4] ClearPath is an advanced online software platform capable of GHG emission calculation, management, and forecasting, compliant with GPC reporting requirements.

Table 3: Community-wide GHG Emissions (annual $MTCO_2e$)

	1990	2005	2007	2010	2015
Population	85,571	90,160	89,234	88,410	92,958
Transportation					
Aviation	63,694	55,133	41,007	37,949	42,914
On-Road	177,793	220,385	227,306	227,523	212,527
Offroad	31,285	38,640	38,996	39,572	39,572
Railways	2,548	2,955	2,891	2,335	2,343
Waterborne Navigation	11,664	11,115	10,363	9,563	10,026
Subtotal	286,983	328,229	320,562	316,942	307,382
Per capita	3.354	3.641	3.592	3.585	3.307
Energy					
Electricity	204,847	152,062	147,300	134,900	111,114
Natural Gas	113,157	117,272	115,851	117,782	97,963
Subtotal	318,004	269,334	263,151	252,682	209,077
Per capita	3.716	2.987	2.949	2.858	2.249
Waste					
Solid Waste Disposal	112,652	20,838	18,225	15,609	10,464
Landfill Decomposition	25,399	11,998	10,856	9,344	7,277
Wastewater	606	481	759	689	854
Subtotal	138,657	33,317	29,839	25,642	18,595
Per capita	1.620	0.370	0.334	0.290	0.200
Total					
Total	743,644	630,880	613,553	595,266	535,055
Per capita	8.690	6.997	6.876	6.733	5.756

Trends over time

TOTAL EMISSIONS

There has been a continued decrease in total community wide GHG emissions through time, with 28% fewer emissions in 2015 than in 1990. Per capita emissions decreased 34% from 1990 to 2015.

TRANSPORTATION

In total, transportation emissions have increased 7% from 1990 to 2015. Transportation emissions continue to encompass a progressively larger portion of the community’s total emissions, rising from 24% of the community’s GHG emissions in 1990 to 40% in 2015. This trend is primarily driven by increases in on-road vehicular emissions and significant decreases in energy and waste emissions. Furthermore, on-road vehicular emissions are consistently the largest source of GHG emissions and there was an upward trend in on-road vehicular emissions from 1990 to 2010, which in total increased

28% over this period. However, this upward trend appears to have reversed between the 2010 and 2015 inventory years, and relative to 1990, on-road vehicular emissions are 20% higher in 2015.

This change in trend is likely due to increases in the fuel efficiency of the community's vehicular fleet and increasing state and federal regulatory emission requirements, rather than changes in activity or behavior. Also important to note is that, as described in the methodology section of this report, only 2007 and 2015 VMT is calibrated by traffic counts conducted during those years, and therefore 2007 and 2015 VMT estimates are more reliable than those from 2005 and 2010. Furthermore, while there is less than one percent difference in total vehicle miles traveled (VMT), the measurement used for vehicular activity, between 2007 and 2015, emissions are 7% lower in 2015 than in 2007.

One reason for this change is the increase in electric vehicle use, which is assumed to have no tailpipe emissions. Based on the emission factors used to calculate on-road vehicle emissions (described in the methodology portion of this report), electric vehicle VMT increased 384% from 2010 to 2015. While electric vehicle VMT comprised less than one percent of total VMT in 2015, this change suggests that electric vehicle use will likely increase in the coming years and comprise a larger portion of VMT in the future.

ENERGY

There have been significant reductions in GHG emissions associated with energy use, and as a whole, emissions from energy generation, including both electricity and natural gas, decreased 34% from 1990 to 2015.

Relative to 1990, emissions from electricity generation have decreased by 46% in 2015. The reduction appears to be caused by Southern California Edison's (SCE) continued incorporation of renewable and lower emitting energy sources into their generation portfolio, rather than changes in behavior. Furthermore, the amount of GHGs emitted for each kilowatt hour (kWh) of supplied electricity has continued to decrease with an estimated 50% less GHG emissions per kWh in 2015 than in 1990 and 23% less in 2015 than in 2005. And, while total community electricity use is 9% higher in 2015 than in 1990, this change appears to track population growth as per capita electricity consumption is nearly unchanged (there is a less than 1% difference from 1990 to 2015). However, the community's electricity consumption is anticipated to increase in future community-wide GHG emission inventories due to the activation of the Charles Meyer Desalination Plant in 2017, which requires a large amount of electricity to convert ocean-water into potable water.

The reduction in natural gas emissions from 1990 to 2015 however, is due to a decrease in total community use, and on balance, total natural gas use in the City has decreased 13% from 1990 to 2015. This change, however, has not been consistent across all users. For example, from 1990 to 2015, residential consumption decreased 31%, while commercial consumption increased 24%.

WASTE

The greatest reductions in GHG emissions from 1990 to 2015 are in the waste generation category, which in total decreased by 87% from 1990 to 2015. Solid waste disposal emissions, which comprise the largest portion of this category decreased 91% over this time period. This reduction appears to be largely because of a change in the amount of waste disposed at the landfill. Furthermore, the total tons of waste generated within the City boundary and disposed of at the landfill is 63% lower in 2015 than in

1990, and per capita values have decreased 66%. Additionally, the landfill flare / internal combustion generator that was installed in 2012 captures and combusts approximately 75% of methane generated.

Landfill decomposition at the historic Las Positas landfill (now Elings Park) represents another significant source of GHG emission reduction from 1990 to 2015. This historic landfill, which closed after thirty years in 1970, emits progressively less methane as time goes on and the disposed materials continue to decompose. As a result, emissions in 2015 are 71% lower than in 1990.

Emissions from wastewater is the only activity within this scope to have an increase in emissions relative to 1990. This change is primarily due to an increase in the volume of nitrogen in effluent discharge in 2015. Relative to 1990, emissions have increased 41%. However, wastewater emissions comprise less than one percent of the community's emissions.

Progress Made Towards Targets

The 2011 General Plan Certified Final Program EIR determined that GHG emissions would increase as a result of General Plan implementation and citywide incremental growth to the year 2030. It was concluded that the State AB 32 emission reduction target (reduce emission below 1990 levels by 2020) would potentially not be achieved. To address this, a CAP was developed to establish strategies to achieve this AB 32 target. Furthermore, the CAP established two community-wide GHG emission reduction targets, to match state targets as they existed when the CAP was developed:

1. Keep total annual community-wide carbon emissions below 1990 levels by 2020, per AB32; and
2. Keep annual per capita vehicle GHG emissions below 2005 levels in 2020 and 2030, per SB375.

The CAP also forecasted that in combination with State programs, the CAP strategies would:

3. Reduce total annual community-wide emissions 25% below 1990 levels by 2020;
4. Reduce per capita on-road vehicle emissions by 30% below 2005 values by 2020; and
5. Reduce per capita on-road vehicle emissions by 58% below 2005 values by 2030[5].

The State of California has established increasingly aggressive GHG emission reduction strategies, and both State targets incorporated into the CAP have since been superseded. Furthermore, in 2015, Governor Jerry Brown issued Executive Order B-30-15, which established an interim goal that statewide emissions be reduced by 40% relative to 1990 values by 2030, to increase the likelihood that the State's 2050 greenhouse emissions reduction goal will be achieved (80% reduction from 1990 levels). In 2016, this 2030 State goal was codified through SB32.

SB375, which aims to coordinate transportation and land use planning to create sustainable communities and reduce greenhouse gas emissions, requires that all Municipal Planning Agencies (MPO) in California create a Regional Transportation Plan (RTP) / Sustainable Communities Strategy (SCS) to describe how a region will meet California Air Resources Board (CARB) established target for a region. The RTP / SCS program is administered by the Santa Barbara Council of Governments (SBCAG), in consultation with the City and the other member agencies. In 2010, CARB established a target for SBCAG that per capita emissions remain below the 2005 baseline in 2020 and 2030, which is the target adopted

[5] This 2030 target was established as a proxy for SBCAG's 2035 target, due to the CAP's 2030 planning horizon.

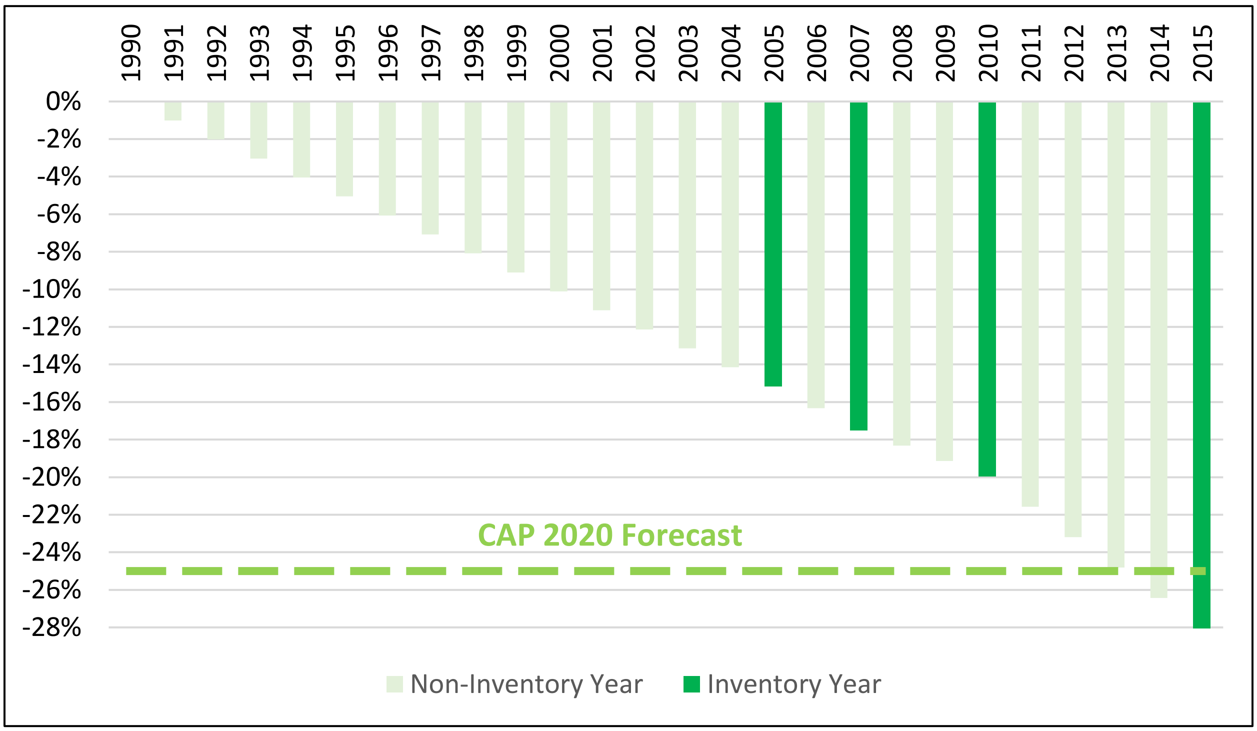
in the City's CAP. In 2015, CARB increased this SBCAG target to a 13% reduction from 2005 values by 2020 and a 17% reduction by 2030.

As described in the previous section, progress has been made in reducing GHG emissions, especially in regards to energy use and waste generation. The AB32 target had already been achieved when the CAP was drafted, and total community-wide GHG emissions have continued to decrease through time, with the total community GHG emissions 28% below 1990 levels in 2015. This reduction has occurred faster than forecasted by the CAP. However, as described in the methodology section of this report, there are changes in the methodology used for many of the emission calculations relative to the CAP's 2010 inventory. For instance, had this inventory included GHG emissions from pass-through on-road vehicular trips (as included in the CAP's 2010 inventory), then 2015 emission levels would have been estimated as only 20% lower than 1990 levels. Achieving state-level targets will be challenging given the limited reductions in on-road vehicle emissions. A summary of total community-wide emissions relative to 1990 is found in Table 4 and Chart 2.

Table 4: Total Community-wide Emissions Relative to 1990

1990	2005	2007	2010	2015
0%	-15%	-17%	-20%	-28%

Chart 2: Total Community-wide Emissions Relative to 1990



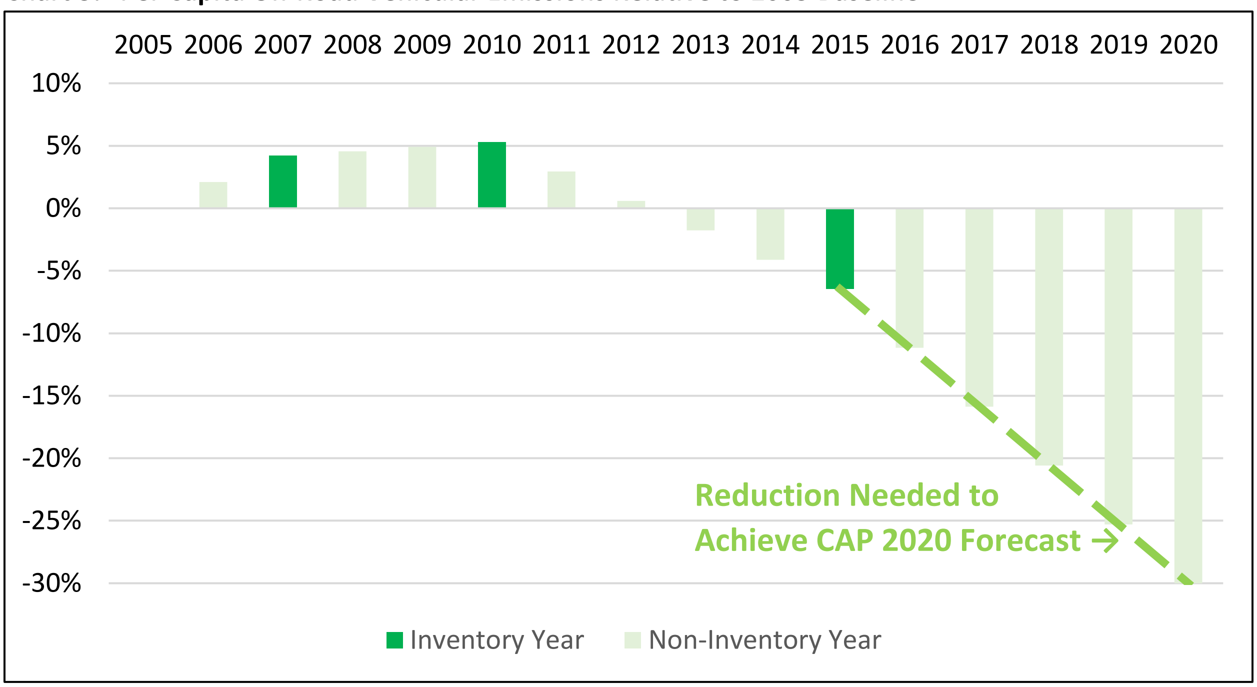
Progress made towards reducing per capita on-road vehicular emissions has progressed at significantly slower rate than total community-wide emissions. As shown in Table 5, the CAP's target of per capita vehicular emissions remaining below 2005 levels by 2020 was achieved in 2015. As described above, this change is primarily due to changes in the characteristics of the community's vehicular fleet that result in fewer GHG emissions generated per mile traveled, rather than changes in activity or behavior.

Furthermore, it was estimated that there was a 3% increase in total VMT from 2005 to 2015, which appears to match population growth, as the per capita values are nearly identical (there is less than one percent difference between estimated 2005 and 2015 per capita VMT). With the return of a strong economy, low fuel prices, and future Highway 101 HOV freeway widening project, it is likely that VMT values will increase in the future. As a result, it will be challenging for capita on-road vehicle emissions to meet the CAP's forecast of a 30% reduction in per capita on-road vehicle emissions relative the 2005 value by 2020, or a 58% reduction relative to the 2005 value by 2030. On-road vehicular emissions are found Table 5 and Chart 3.

Table 5: On-Road Vehicular Emissions (MT CO_2e)

	2005	2007	2010	2015
Population	90,160	89,234	88,410	92,958
Internal Trip Emissions	145,990	149,999	149,580	140,246
Commute Trip Emissions	74,395	77,307	77,943	72,281
Total Trip Emissions	220,385	227,306	227,523	212,527
Per Capita Emissions	2.444	2.547	2.574	2.286
Change from 2005-2015	0%	4%	5%	-6%

Chart 3: Per Capita On-Road Vehicular Emissions Relative to 2005 Baseline



Comparison to Other Cities in California

Directly comparing the City's community-wide GHG emissions to other jurisdictions is inherently problematic because there exists a broad range in the assumptions made, methodologies used, and standards adhered to by other jurisdictions in California. While the GPC aims to provide a standardized approach to community-wide GHG emission estimation, and many communities have adopted this standard, others have chosen to use other standards, such as the International Emissions Analysis Protocol (IEAP) or the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol).

Even when two jurisdictions use the same standard, their community-wide GHG emissions may not be directly comparable because of flexibility allowed within the standard or because of unique local conditions (such as an airport within one jurisdiction's boundary). As an example, the GPC allows four distinct methods[6] of calculating on-road vehicular emissions, which will likely generate four different emission estimates. And because on-road vehicular emission comprise the largest portion of most Californian jurisdictions community-wide GHG emission estimates, this can significantly affect total community-wide GHG emission estimates. However, to provide an indication of how Santa Barbara compares to other jurisdictions, recent per capita emissions are found in Table 6.

Table 6: Per Capita GHG Emissions of Select California Jurisdictions (MT CO_2e)

Jurisdiction	Per Capita GHG Emissions	Year	Population[7]
City of Carlsbad[8]	6.6	2011	106,403
City of Huntington Beach[9]	7.5	2012	191,603
City of Redondo Beach[10]	7.8	2012	67,007
City of San Leandro[11]	7.2	2015	87,209
City of San Luis Obispo[12]	5.9	2005	44,625
City of Santa Barbara	5.8	2015	92,958
City of Santa Cruz[13]	4.8	2008	58,268
City of Santa Monica[14]	11.9	2015	93,093
City of Solana Beach[15]	10.8	2010	12,867
City of Sunnyvale[16]	6.6	2014	147,055
County of Santa Barbara[17]	7.3	2015	140,723
State of California[18]	11.3	2015	38,907,642

[6] The GPC allows a fuel sales based approach as well as three types of VMT estimates (Induced Activity, Geographic, and Resident Activity)
[7] Estimated using Department of Finance (DOF) Population Estimates when not directly provided
[8] City of Carlsbad 2015 Climate Action Plan
[9] 2014 Greenhouse Gas Emissions Inventory and Forecast Technical Report
[10] City of Redondo Beach 2015 Energy Efficiency Climate Action Plan
[11] San Leandro Community and Municipal Greenhouse Gas Emission Inventory for 2015
[12] City of San Luis Obispo Community and Municipal Operations 2005 Baseline Greenhouse Gas Emissions Inventory
[13] City of Santa Cruz Inventory of Municipal and Community Greenhouse Gas Emissions 2010
[14] Sustainable Santa Monica (https://data.sustainablesm.org/dataset/RC-5-GHG-Emissions/sk5f-pnp5/data)
[15] 2017 City of Solana Beach Climate Action Plan
[16] Sunnyvale Climate Action Plan Biennial Progress Report - 2016
[17] Santa Barbara County Energy and Climate Action Plan 2016 Progress Report. Population estimated as DOF "Balance of the County"
[18] CARB 2017 Edition California GHG Emission Inventory

2015 Community-wide GHG Inventory Methodology

The 2015 community-wide GHG inventory estimated emissions from the transportation, energy, and waste sectors compliant with the GPC standard. ICLEI's ClearPath tool was used extensively for this GHG inventory. It was assumed that industrial process and agriculture operations do not occur within the City boundary and therefore, the industrial process and agriculture sectors were not included in this inventory. Furthermore, because flourinated gases are typically only generated through industrial processes, it is assumed that no fluorinated gases emissions occur within the City boundary. The IPCC 5th assessment was used for the GWP of major GHGs. The methodology used to calculate GHG emissions from each estimated GHG generating activities is found below.

TRANSPORTATION

Aviation

Aviation emissions include all air travel. Because the Santa Barbara Airport (SBA) is the sole provider of aviation fuel in the City, it is assumed that aviation emissions are directly proportional to fuel sales at the Airport. As a result, the Airport's fuel sales were used to calculate aviation emissions. To acknowledge that some aviation travel only has one stop at the airport, fuel sales were divided by the type of trip. Furthermore, using FAA's Air Traffic Activity Data System (ATADS) Annual Air Operations information, the percentage of local (both stops at SBA) and itinerant (only one stop at SBA) trips were calculated and applied to fuel sales, to determine the percentage of each trip type.

Consistent with GPC guidelines, only local (Scope 1) and departing (Scope 3) trips are included in aviation emissions. It is assumed that half of itinerant trips are departing, so itinerant fuel sales were divided in half to calculate fuel consumption from departing trips. Total fuel sales were then multiplied by the emission factors established by the EPA for aviation fuel to calculate the City's portion of aviation emissions.

This GPC required change in methodology differs from the CAP's 2010 inventory, which calculated airport emissions separately as an informational item, using estimates of airport aircraft landing and takeoff cycles, auxiliary power units / ground support equipment, and airport motor vehicles. To allow for comparison over time, historic fuel sales estimates were generated using 2010 sales as a baseline. This 2010 baseline was then back-cast as a fixed percentage of the FAA's ATADS for each survey year.

The distribution of flights at the Santa Barbara Airport, fuel sales information, and emission factors used are found Tables 7-10.

Table 7: FAA ATADS Airport Operations for Santa Barbara Airport

Distribution of Flights	1990	2005	2007	2010	2015
Total Operations	188,839	155,271	121,010	106,830	107,593
Itinerant	75.8%	69.2%	75.2%	69.2%	68.6%
Local	24.2%	30.8%	24.8%	30.8%	31.4%
Source: FAA ATADS					

Table 8: Santa Barbara Airport Fuel Sales

Fuel Sales (gallons)	1990	2005	2007	2010	2015
Total Aviation Gasoline Sold	344,379	283,162	220,682	194,822	215,633
Total Jet Fuel Sold	10,134,487	8,332,982	6,494,285	5,733,282	6,455,550
Source: City of Santa Barbara Airport Department					

Table 9: Estimated Aviation Fuel Consumption by Trip Type

Fuel Consumption (gallons)	1990	2005	2007	2010	2015
Aviation Gasoline Consumed By Local Flights	83,367	87,095	54,710	60,028	67,795
Aviation Gasoline Consumed By Departing Itinerant Flights	130,506	98,034	82,986	67,397	73,919
Jet Fuel Consumed By Local Flights	2,453,349	2,563,045	1,610,020	1,766,514	2,029,611
Jet Fuel Consumed By Departing Itinerant Flights	3,840,569	2,884,968	2,442,132	1,983,384	2,212,970

Table 10: EPA Aviation Emission Factors

	g CO_2 / gallon	g CH_4 / gallon	g N_2O / gallon
Aviation Gasoline	8,310	-	-
Aviation Gasoline Aircraft	-	7.06	0.11
Kerosene-Type Jet Fuel	9,750	-	-
Jet Fuel Aircraft	-	0.00	0.30
Source: EPA Emission Factors for Greenhouse Gas Inventories (November 2015)			

Off-Road

Off-road emissions include construction, industrial/commercial equipment, lawn and garden, and miscellaneous equipment. Reliable information for off-road activity is currently unavailable for the City. Current GHG emission models are developed at a gross scale and rely on information that spans multiple years, making annual comparison unreliable. For this reason, many jurisdictions exclude off-road emissions from their community-wide inventories[19]. However, to maintain consistent assumptions with the CAP's 2010 inventory, to provide an acknowledgement that off-road emissions are generated in the City, and to meet GPC requirements, it is assumed that off-road emissions in 2015 are unchanged from 2010. All historic values are reported as calculated in the CAP's 2010 GHG inventory.

On-Road

On-road emissions include all vehicles that use public roads. The primary unit of measurement of on-road activity for GHG emission estimation is vehicle miles of travel (VMT), which is a measurement of the total distance a vehicle travels over a fixed period of time. Calculating annual VMT in a jurisdiction is inherently difficult because it requires knowing both the total number of vehicular trips as well as the

[19] ICLEI Staff. Personal communication, July 2017

origin and destination of every trip. Vehicle activity is typically measured through traffic counts at fixed locations. While these counts provide insight on the activity at that specific location, there is often limited information on where each trip started and ended. Therefore, VMT estimations rely heavily on advanced computer models that feature numerous assumptions about the length and frequency of trips within an area.

This inventory uses VMT information provided by the City's traffic model, which is calibrated to the City based on local land use, traffic counts, and other local conditions. This model was originally developed as part of the 2011 General Plan Update process and was updated in 2016 to include changes in land use and updated traffic counts that were conducted in 2015. The VMT information generated by the City's travel model was provided in the following trip types: 1) internal trips (both the origin and destination of the trip was within the City boundary); 2) commute trips (either the origin or destination of the trip was within the City boundary, but not both); and 3) pass-through trips (trips that traversed through the City but did not stop within the City). Consistent with the GPC guideline for "City-induced Activity," 100% of total VMT of local trips, 50% of total VMT of commute trips, and 0% of pass through trips were included in the emissions calculations. This is a change from the methodology used in the CAP's 2010 inventory. Furthermore, while the CAP's 2010 inventory used the same ratio of VMT for local and commute trips, pass-through trips (which comprised a large portion of the CAP's estimated on-road vehicle emissions) were not excluded from emission calculations. The result of this change is that fewer on-road vehicle emissions are estimated in this inventory.

While the City's traffic model provided VMT by trip type, there was no information on the fuel consumed nor vehicle makeup of the trips that comprised this VMT, making direct GHG emission estimation impossible. As a result, The California Air Resources Board (CARB) EMFAC 2014 model was used to estimate the type of vehicles that comprised this VMT total and the GHG emissions that these vehicles generated. The EMFAC 2014 model was chosen for this purpose because it is the state's most comprehensive model for estimating on-road vehicular emissions, is built on decades of vehicle testing and analysis, includes DMV registration and Smog Check information, and includes relatively fine grain outputs. Because EMFAC 2014 does not provide city-specific outputs, those from the County were used. As a result, it was assumed that all EMFAC 2014 outputs for Santa Barbara County, including VMT and total on-road emissions are directly proportional to those in the City.

The emission factors used to convert the City's traffic model VMT into GHG emissions were calculated by dividing the total EMFAC 2014 Santa Barbara County emissions of all vehicle types by total VMT for each fuel type, to generate the amount of emissions generated per VMT. While the EMFAC 2014 model provides carbon dioxide and methane emissions, it does not directly provide nitrous oxide emissions. As a result, nitrous oxide emissions were calculated using conversion factors established by CARB.[20] For gasoline vehicles, it was assumed that nitrous oxide emissions were 4.16% of NOx and for diesel vehicles, it was assumed that 0.3316 g of nitrous oxide was emitted per gallon of fuel consumed. It is assumed that electric vehicles do not produce tailpipe emissions and all emissions associated with the generation of electricity used to power electric vehicles are included in the energy portion of this report.

This is a change in methodology from the CAP's 2010 inventory, which estimated on-road emissions using the State's Motor Vehicle Stock, Travel and Fuel Forecast (MVSTAFF) for fuel efficiency

[20] https://www.arb.ca.gov/msei/emfac2011-faq.htm

information and ICLEI's Clean Air and Climate Protection (CACP) software for GHG emission estimations. As a result, the previous inventory years were updated using the EMFAC 2014 model emission factors so that trends could be compared over time. No modifications were made to previously estimated VMT values. However, as previously mentioned, pass-through VMT was excluded from emission calculations. Also, it is important to note that the 2005 and 2010 VMT estimates were generated for the CAP's 2010 inventory using forecasting and backcasting techniques, and were not created by individual model runs or influenced by comprehensive traffic counts. As a result, the VMT values for 2005 and 2010 are not as reliable as the values for 2007 and 2015, which were created based on individual model runs and citywide traffic counts. Because no City-specific information exists for 1990 and the EMFAC model does not provide estimates prior to 2000, it was assumed that per capita emissions were 15% lower in 1990 than 2007. This is consistent with assumptions made in the CAP's 2010 inventory and CARB guidance.

The estimated annual City VMT, output totals from the EMFAC 2014 model for Santa Barbara County, and calculated emission factors are found in Tables 11-13.

Table 11: Estimated Annual Vehicle Miles Traveled (VMT)

Trip Type	2005	2007	2010	2015
Internal	309,573,570	312,346,015	315,118,461	313,131,449
Commute	157,756,377	160,978,686	164,200,995	161,383,488
Pass-through	355,178,191	374,090,722	393,003,253	375,031,421
Total	822,508,138	847,415,423	872,322,709	849,546,358
Source: 2012 Climate Action Plan Appendix A and Fehr & Peers				

Table 12: EMFAC 2014 Santa Barbara County Totals by Fuel Type

Year	Fuel Type	VMT / Day	CO_2 (tons)	CH_4 (tons)	NO_x (tons)	Fuel (gallons)
2005	Gas	10,466,618	4,810.09	0.79	9.87	520,905
2005	Diesel	595,866	805.95	0.03	8.25	72,535
2005	Electric	7,743	0.00	0.00	0.00	0
2007	Gas	10,039,568	4,644.70	0.63	8.10	500,704
2007	Diesel	666,136	910.61	0.03	8.62	81,955
2007	Electric	7,219	0.00	0.00	0.00	0
2010	Gas	9,504,950	4,402.31	0.50	6.44	478,686
2010	Diesel	604,059	798.88	0.03	6.83	71,899
2010	Electric	8,268	0.00	0.00	0.00	0
2015	Gas	9,733,723	4,233.87	0.31	4.12	457,031
2015	Diesel	652,817	847.33	0.03	4.56	76,259
2015	Electric	31,785	0.00	0.00	0.00	0
Note: Electric vehicle VMT is included in this table because electric vehicles comprise a portion of total annual VMT and therefore effect the amount of emissions generated per gross VMT. *Source: CARB EMFAC 2014.*						

Table 13: Calculated EMFAC 2014 Santa Barbara County Emission Factors for All Fuel Types

Year	Fuel	g CO_2 / mile	g CH_4 / mile	g N_2O / mile
2005	All	460.22	0.07	0.04
2007	All	470.43	0.06	0.03
2010	All	466.37	0.05	0.03
2015	All	442.45	0.03	0.02

Railways

There is one railway alignment, owned by the Union Pacific Railroad, which traverses through the City of Santa Barbara. The portion of this alignment within City boundaries is estimated as 6.34 miles[21] in length and is used both by Union Pacific Railroad for freight transportation and by Amtrak for passenger rail service. Railway emissions have not been included in past community-wide emission inventories but are required by the GPC. As a result, values were calculated for 1990, 2005, 2007, 2010 and 2015 so that trends could be compared over time.

Union Pacific publishes annual locomotive emissions for their entire fleet of trains. To scale these emissions to the City, it was assumed that Union Pacific's locomotive GHG emissions were evenly generated across Union Pacific's entire 32,036[22] mile railway network. A scaling factor was created as the percentage of Union Pacific route miles that are within the City, and then applied to Union Pacific's estimated total annual locomotive GHG emissions, to calculate to the portion of emissions within City boundaries. Because no published 1990 locomotive emissions were available, the 1990 value is estimated as 15% lower than 2007 emissions, consistent with assumptions made for on-road vehicle emissions in the CAP's 2010 inventory and CARB guidance. The scaling factor and calculated results are found in the Tables 14-15.

Table 14: Union Pacific Scaling Factor

Total Track Miles	Track Miles in Santa Barbara	% in Santa Barbara
32,036	6.36	0.020%

Table 15: Union Pacific Emissions

	1990	2005	2007	2010	2015
Annual Total Locomotive GHG Emissions (MT CO_2e)	11,554,165	13,860,992	13,593,135	10,771,069	10,834,984
% in Santa Barbara (MT CO_2e)	2,295	2,754	2,700	2,140	2,152
Sources: Union Pacific 2011 Sustainability & Citizen Report and Union Pacific 2016 Building America Report					

Because Amtrak does not publish annual locomotive GHG emissions, GHG emissions from Amtrak activities were calculated using Amtrak's total diesel fuel consumption rates. To scale these values to the City, it was assumed that locomotive fuel use was evenly consumed across Amtrak's 21,300 route

[21] Estimated by the City's Community Development Department using ArcGIS
[22] Union Pacific 2016 Building America Report

miles[23]. A scaling factor was created as the percentage of Amtrak route miles in the City, and then applied to Amtrak's total diesel fuel consumption, to calculate the portion of fuel use in the City. This total was then multiplied by the emission factors established by the EPA for mobile combustion of diesel fuel and diesel locomotives to calculate the City's portion of Amtrak's locomotive emissions.

The calculated scaling factor, Amtrak fuel use, and emission factors used are found in Tables 16-18.

Table 16: Amtrak Scaling Factor

Total Route Miles	Route Miles in Santa Barbara	% in Santa Barbara
21,300	6.36	0.030%

Table 17: Amtrak Diesel Fuel Consumption

	1990	2005	2007	2010	2015
Total diesel fuel use (gallons)	82,100,000	65,476,834	61,823,716	63,474,021	62,000,000
Adjusted diesel fuel use in Santa Barbara (gallons)	24,531	19,564	18,472	18,965	18,525
Source: United States Department of Transportation Bureau of Transportation Statistics National Transportation Statistics Table 4-26: Energy Intensity of Amtrak Services					

Table 18: EPA Diesel Locomotives Emission Factors

	g CO_2 / gallon	g CH_4 / gallon	g N_2O / gallon
Diesel Fuel	10,210	NA	NA
Diesel Locomotives	NA	0.80	0.26
Source: EPA Emission Factors for Greenhouse Gas Inventories (November 2015)			

Waterborne Navigation

Waterborne navigation includes all ships, ferries, and other marine vessels. Currently, marine shipping activities are concentrated in the Shipping Lane in the Santa Barbara Channel, which is outside of the City boundary. As a result, marine shipping emissions are not explicitly included in this inventory.

The Santa Barbara Harbor is the primary hub for boating activities in the City, and the Harbor's McCormix Corporation Fuel Dock is the sole source of marine fuel sales in the City. As a result, waterborne navigation emissions were calculated using emission factors established by the EPA for diesel fuel, diesel ships and boats, motor gasoline, and gasoline ships and boats. There is currently no city-specific information on the type, destination, or length of boating trips that occur within City boundaries. As a result, it is assumed that boating activity in the City is directly proportional to fuel sales and all emissions associated with the combusting of fuel sold at the Harbor Fuel Dock occurs within City boundaries.

A limitation of calculating emissions based on Harbor fuel sales is that some boating activity does occur within the City boundary by vessels that purchased fuel at locations outside of the City boundary. For

[23] Amtrak National Fact Sheet FY 2016

instance, visiting cruise ships do not refuel at the Santa Barbara Harbor, and therefore are not included in this GHG emission estimate. However, the GPC recommends using a fuel based approach to calculate waterborne emissions, which is why that method was used.

Waterborne navigation emissions have not been included in past community-wide emission inventories but are required by the GPC. As a result, values were calculated for 1990, 2005, 2007, 2010 and 2015 so that trends could be compared over time. No 1990 fuel sales information was available at the time of writing. As a result, it was assumed that 1990 fuel sales at the Harbor Fuel Dock were identical to those in 1994 because this is the oldest available record and back-casting from more recent values would be unreliable due to an APCD program to convert gasoline engines to diesel engines.

The fuel sales and emission factors used are found in Tables 19-20.

Table 19: Santa Barbara Harbor Fuel Dock Sales

	1990	2005	2007	2010	2015
Diesel Sales (gallons)	700,648	993,500	917,350	857,533	874,381
Gasoline Sales (gallons)	501,347	98,900	102,500	81,882	114,544
Total	1,201,995	1,092,400	1,019,850	939,415	988,925

Note: No information was available for 1990. The 1990 values were assumed identical to 1994 values.
Source: City of Santa Barbara Waterfront Department

Table 20: EPA Ship and Boats Emission Factors

	g CO_2 / gallon	g CH4 / gallon	g N_2O / gallon
Diesel Fuel	10,210	-	-
Diesel Ships and Boats	-	0.06	0.45
Motor Gasoline	8,780	-	-
Gasoline Ships and Boats	-	0.64	0.22

Source: EPA Emission Factors for Greenhouse Gas Inventories (November 2015)

ENERGY

Electricity

Southern California Edison (SCE) is the City's electrical utility provider. As a result, electricity emissions are calculated using the total electricity generated by SCE for customers within the City boundary. Due to the "15/15" rule, which aims to protect customer confidentiality by requiring that any aggregate information be comprised of at least 15 customers with no individual customer consuming more than 15% of a category's total electrical consumption, SCE provided one aggregate total of electricity use in the City.

The GPC requires that energy consumed by residential buildings, commercial and institutional buildings and facilities, manufacturing industries and construction, and energy industries be reported. To determine how much electricity each of these sources consumed in 2015, it was assumed that the relative residential electricity consumption was unchanged from 2010 to 2015. Furthermore, the percentage of residential electricity consumption estimated in the CAP's 2010 inventory was applied to the City's total electricity consumption in 2015 to calculate the amount of electricity consumed by residential buildings in 2015. It was assumed that all other electricity consumption in 2015 was from commercial and institutional buildings / facilities due to an unavailability of City specific information for the electricity consumption of manufacturing industries / construction and energy industries. This categorization of electricity consumption sources differs from the CAP's 2010 inventory, which categorized electricity consumption by residential, commercial, industrial (which included large City operations that SCE classifies as commercial), water pumping, and street lighting sources.

The methodology used to calculate electricity emissions is consistent with those in the past and historic electricity use and emission factors have not been modified. However, the CAP's 2010 estimates were calculated using the IPCC 3rd assessment of the global warming potential for nitrous oxide and methane, while this inventory uses the IPCC's most current 5th assessment. To allow for a consistent comparison over time, the historic emission values were multiplied by a conversion factor to match the IPCC 5th assessment. The City's 2015 electricity consumption, emission factors used, and conversion factor used are found in Tables 21-23.

Table 21: Estimated Distribution of 2015 Energy Use

	Residential	Commercial & Institutional	Total
Energy Used (kWh)	162,819,836	311,000,184	473,820,020
Source: SCE			

Table 22: Southern California Edison Grid Emission Factors

	1990	2005	2007	2010	2015
CO2 lbs / MWh	1031.14	665.72	630.89	606.2949	-
CH4 lbs / MWh	0.014	0.011	0.01	0.00961	-
N2O lbs / MWh	0.04	0.03	0.029	0.027869	-
CO2e lbs / MWh	-	-	-	-	517
Note: 1990 value is CARB CEC Grid average as no SCE value was available.					
Sources: 2012 City of Santa Barbara Climate Action Plan Appendix A2 and SCE 2015 Corporate Responsibility Report					

Table 23: Comparison of SCE Emission Factors CO_2e (lbs/MWh) with IPCC 3rd and 5th Assessments

	1990	2005	2007	2010
CO2e (IPCC 5th Assessment)	1042.13200	673.97800	638.85500	613.94927
CO2e (IPCC 3rd Assessment)	1043.35400	665.72000	630.89000	606.29490
Conversion Factor	0.998829	1.012405	1.012625	1.012625
Note: 1990 value is CARB CEC Grid average as no SCE value was available.				

Natural Gas

Southern California Gas (SCG) is the City's natural gas utility provider. As a result, natural gas emissions are calculated using the total natural gas (expressed as annual therms) distributed by SCG for customers within the City boundary. Emission estimates were calculated using the default emission and conversation factors found in ICLEI's ClearPath tool. This methodology is similar with those used in previous inventories and historic natural gas emission values are left unchanged. However, these historic values were calculated using the IPCC 3rd assessment of the global warming potential for nitrous oxide and methane, while this inventory uses the IPCC's most current 5th assessment.

The City's 2015 natural gas use and emission factors used are found in Tables 24-25.

Table 24: 2015 Natural Gas Use

	Commercial	Industrial	Single-Family	Multi-Family	Total
Annual Therms	8,386,119	81,349	6,533,881	3,475,292	18,476,641
Source: SCG					

Table 25: ICLEI ClearPath Default Emission and Conversion Factors

mmBtu per therm	g CO_2 / mmBtu	g CH_4 / mmBtu	g N_2O / mmBtu
0.1	53,020	1.0	0.1

WASTE

Solid Waste

The Tajiguas landfill (located outside of the City on the Gaviota coast) serves as the primary solid waste disposal location for the City of Santa Barbara. As a result, solid waste disposal GHG emissions were calculated using the volume of waste generated within the City boundary and disposed of at the Tajiguas landfill. The most recent waste characterization study for the Tajiguas landfill was published in 2009. It was assumed that the distribution of waste categories remained unchanged in 2015. Furthermore, a factor set was created in ICLEI's ClearPath tool based on this waste characterization study and applied to the total amount of waste disposed to calculate emissions from waste generation. A flare / internal combustion generator was installed at the Tajiguas landfill in 2002, to capture methane emissions. As a result, the ICLEI ClearPath calculation includes methane collection, which estimates that 75% of methane generated by waste decomposition is captured.

This methodology is consistent with the CAP's 2010 inventory. However, the factor set applied to the waste generation values in ICLEI's Clearpath differs from the one used in the CAP's 2010 inventory, and ClearPath generated outputs are significantly higher than those generated in the CAP's 2010 inventory. As a result, historic emissions were generated based on this new factor, and it was assumed that the distribution of waste categories at the landfill was unchanged from 1990 to 2015. No changes were made to historic waste generation values.

Also included in 2015 solid waste disposal GHG emissions are GHG emissions generated through the composting of foodscraps diverted from the Tajiguas landfill. In 2015, 3,318 tons of foodscraps were generated in the City and diverted from the Tajiguas landfill. GHG emissions from this diversion were calculated using ICLEI's ClearPath tool for "Biowaste" composting, which includes food waste.

The amount of waste generated in the City and disposed of at the Tajiguas Landfill and the GHG emissions factor set applied to these disposal rates is found in Tables 26-27.

Table 26: Waste Generated in the City and Disposed at the Tajiguas Landfill

	1990	2005	2007	2010	2015
Tons of Waste	145,539	107,687	94,182	80,663	53,368
Sources: City of Santa Barbara Climate Action Plan Appendix 1 and City of Santa Barbara Finance Department					

Table 27: Waste Characterization Factor Set

MSW	News-paper	Office Paper	Corrugated Cardboard	Magazine & Third Class Mail	Food Scrap	Grass	Leaves	Branches	Dim. Lumber
7.2%	1.1%	0.5%	2.3%	0.9%	19.2%	3.35%	3.35%	0.7%	7.4%
Source: 2009 County of Santa Barbara Waste Characterization Study for Tajiguas Landfill									

There are also solid waste emissions associated with the continued decomposition of waste at the Las Positas Landfill (now Elings park). The emissions associated with this historic landfill were calculated using the assumptions found in the CAP's 2010 inventory, which is that 839,000 short tons of material were landfilled, that the landfill was operational from 1941 to 1970, and that waste was evenly generated each year over this thirty year period. Using these assumptions, a new run of the US EPA's Landfill Gas Emissions Model (LANDGEM) version 3.02 was created with default waste composition and methane generation values to estimate emissions in 2015. Historic emissions were updated based on this new model run. It should be noted that a methane flare was installed at the Las Positas Landfill. However, because information on the performance of this flare was not readily available, the Los Positas Landfill flare was not considered in GHG emission estimates. As a result, the GHG emissions associated with the decomposition of waste at the Las Positas Landfill may be overstated.

Wastewater

The City's El Estero Wastewater Treatment Plant (EEWWTP) is the City's sole wastewater treatment plant and the primary source of community wastewater emissions. The EEWWTP does not currently include a number of GHG generating processes that are found in other wastewater treatment plants such as using a nitrification / denitrification mode (adding one is anticipated in 2018-2019), using methanol, or combusting biosolids (100% of biosolids were composted off site in 2015 and no established methods exist to quantify these emissions[24]), and emissions associated with electricity use are included in the Energy section. As a result, the primary emissions associated with wastewater treatment at EEWWTP are from the combusting and flaring of anaerobic digester gas and discharge of effluent into the ocean.

Emissions from the anaerobic digester process were calculated using ICLEI's ClearPath tool with the default value for destruction efficiency[25] (0.99) and a laboratory measured value was used for the percentage of CH_4 in digester emissions (0.57). While the 2011 General Plan Certified Final Program EIR did include wastewater emissions, the CAP's 2010 inventory did not. Because the methodology used to

[24] ICLEI 06-21-17 Training Video: SEEC Summer Session Data Collection (https://vimeo.com/222595646).

[25] Destructive efficiency is a measurement of the percentage of digester gas that is destroyed through incineration.

calculate wastewater emissions in the 2011 General Plan Certified Final Program EIR inventory is not documented, new values were calculated based on the quantity of digester gas generated in 1990. While some of the digester gas was used to power a boiler in 1990, there is currently no information available on the quantity of gas that was used for this purpose. As a result, it is assumed that all digester gas generated in 1990 was flared. This inventory caries forward the assumption in the 2011 General Plan Certified Final Program EIR that there were no digester emissions while the EEWWTP fuel cell was online (2005-2010). In 2013, a biogas cogeneration system was installed, which recovers digester gas and converts it to energy that is used by the EEWWTP. It was also assumed that the percentage of methane in the EEWWTP digester gas was constant from 1990 to 2015.

Emissions from effluent discharge into the ocean were calculated using ICLEI's ClearPath tool and annual final effluent ammonia discharge rates. The Clearpath tool calculates this emissions based on the daily kilogram load of nitrogen in the effluent discharge (0.0028672 N_20 per kg / day). Unfortunately the nitrogen load of the EEWWTP effluent discharge is not tracked. However, the ammonia load is tracked, and ammonia comprises the majority of total nitrogen discharged in the effluent stream because EEWWTP does not use a nitrification / denitrification process. As a result, it is assumed that the volume of ammonia in the effluent discharge stream was equal to the total volume of nitrogen in the effluent discharge stream. GHG emissions from effluent discharge was not included in previous inventories. As a result, historic effluent discharge emissions were calculated using historic volumes of ammonia discharge levels so that trends could be compared over time.

Other wastewater emissions are generated through fugitive emissions from septic tanks. The number of septic users was calculated using information created for the City's 2005 Conditions, Trends and Issues (CTI) reports, which mapped the location of parcels (324) with septic service. To convert the number of parcels with septic service to the number of septic users, it was assumed that there was one household on each parcel, and each household is of average size. Emissions were then calculated using the number of septic users and the default BOD_5 load[26] (0.09 kg / day) in ICLEI's ClearPath tool. Septic tank emissions have not been included in previous emission inventories and historic information on the number of users and type of waste stream was unavailable. As a result, it is assumed that the number of parcels and BOD_5 load was constant 1990 to 2015. However, the number of septic users was adjusted based on estimates for the number of people per household.

The digester gas values, effluent discharge volumes, and estimated septic tank users are found in the Tables 28-30.

Table 28: Digester Gas Values

Year	Gas Flared (cf / day)	Gas Recovered in Cogeneration Engine (cf / day)	% of CH_4 in Digester Gas
2015	7,729	164,722	0.57
1990	171,402	-	0.57
Sources: City of Santa Barbara Public Works Department and Eurofins Air Toxics, Inc Laboratory Report of EEWWTP Digester Gas			

[26] Biochemical Oxygen Demand (BOD) is a measurement of the amount of carbon that is aerobically biodegradable. The standard unit of measurement for BOD is calculated with a 5 day test, expressed as BOD_5.

Table 29: Volumes of Ammonia in Effluent Discharge

	1990	2005	2007	2010	2015
Total (kg)	155,815	184,911	318,903	284,794	354,597
kg / day	427	506	873	780	971
Source: City of Santa Barbara Public Works					

Table 30: Estimated Septic Users

	1990	2005	2007	2010	2015
Persons per household	2.414	2.45	2.42	2.46	2.51
Estimated Septic Users	782	795	783	796	815
Source: City of Santa Barbara Community Development Department and California Department of Finance Population and Housing Estimates					