



City of Torrance

GHG Inventory, Forecasting, Target-Setting Report for an Energy Efficiency Climate Action Plan

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List of Acronyms and Abbreviations

AB	Assembly Bill
ADC	Alternative Daily Cover
BAU	Business-as-Usual
CAFE	Corporate Average Fuel Economy
CH ₄	Methane
CARB	California Air Resources Board
CIWMB	California Integrated Waste Management Board
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalents
EECAP	Energy Efficiency Climate Action Plan
EO	Executive Order
GHG	Greenhouse Gas
GWP	Global Warming Potential
IEAP	International Local Government GHG Emissions Analysis Protocol
IFT	Inventories, Long-Term Forecasts, and Target-Setting
IPCC	Intergovernmental Panel on Climate Change
JWPCP	Joint Water Pollution Control Plant
kWh	Kilowatt-hour
LCFS	Low Carbon Fuel Standard
LGOP	Local Government Operations Protocol
MT	Metric Tons
NDN	Nitrification/denitrification
N ₂ O	Nitrous Oxide
RPS	Renewable Portfolio Standard
RTP	Regional Transportation Plan
SBCCOG	South Bay Cities Council of Governments
SCAG	Southern California Association of Governments
SCE	Southern California Edison
SCG	Southern California Gas Company
SEEC	Statewide Energy Efficiency Collaborative

Key Findings

Community

- The City of Torrance decreased emissions 3% from 2005 to 2012, from 1,611,012 MT CO₂e to 1,563,394 MT CO₂e.
- Residential Energy, Solid Waste, Water, Wastewater, and Off-road Sources sector emissions decreased while On-road Transportation, Commercial Energy, and Aviation sectors increased emissions from 2005 to 2012.
- Energy-related emissions account for 52% of the total community emissions.
- Under the Adjusted Business-as-Usual (BAU) forecast, emissions will be 1,456,485 MT CO₂e in 2020 and 1,301,140 MT CO₂e in 2035. These emissions levels are 10% and 19% lower than 2005 by 2020 and 2035, respectively.
- The State recommends a 15% reduction below 2005 levels by 2020, which would require the City to reduce community emissions 87,125 MT CO₂e from an Adjusted BAU forecast by 2020. This is a 6% reduction from the 2020 Adjusted BAU emissions level.
- To continue reductions consistent with the State's long-term emissions reduction goal of lowering emissions 80% below 1990 levels by 2050, the City would need to reduce emissions in 2035 by 479,524 MT CO₂e from an Adjusted BAU forecast. This is a nearly 37% reduction from the 2035 Adjusted BAU emissions level and would achieve a 49% reduction from 2005 levels.

Municipal

- Municipal emissions have decreased 22% from 2005 to 2012, from 30,818 MT CO₂e to 23,887 MT CO₂e.
- Emissions in Vehicle Fleet & Equipment, Employee Commute, Solid Waste, City-Owned Outdoor Lights, and Aviation sectors decreased between 2005 and 2012, while emissions in the Buildings & Facilities, SCE-Owned Outdoor Lights, and Water Delivery sectors increased.
- Municipal emissions are a subsector of community emissions and account for approximately 2% of community emissions.
- Under the Adjusted BAU forecast, emissions will be 22,562 MT CO₂e in 2020 and 21,097 MT CO₂e 2035. These emissions levels are 27% lower than 2005 by 2020 and 32% lower than 2005 by 2035. The City is on-track to meet a 15% reduction target in 2020 from 2005 levels through federal and state measures (as reflected in the 2020 Adjusted BAU). By 2035, the City will need to reduce emissions by 5,380 MT CO₂e from the 2035 Adjusted BAU emissions level to meet a 49% reduction target from 2005 levels.

Introduction

The Greenhouse Gas (GHG) Inventories, Long-Term Forecasts, and Target-Setting (IFT) Report contains the first steps toward the City of Torrance (City) identifying energy-efficiency measures in an Energy Efficiency Climate Action Plan (EECAP). The inventories describe historic energy use and GHG emissions and the forecasts describe projected future emissions in the City. The target-setting section describes GHG reduction recommendations that are consistent with State goals and may assist the City in establishing local GHG reduction targets. The inventories and recommended reduction targets will help the City in the next step of the EECAP, which is to identify energy efficiency and GHG reduction measures that are relevant, meaningful, and feasible.

Specifically, the IFT Report includes (words and phrases in bold are described in Table 1):

- Historic GHG emissions in **community inventories** and **municipal inventories** for 2005, 2007, 2010, and 2012;
- Future GHG emissions for 2020 and 2035 under a **business-as-usual** forecast scenario and **adjusted business-as-usual** forecast scenario; and
- Recommended GHG **reduction targets** for 2020 and 2035.

Table 1. Key Terms in the Report¹

Term	Definition
Adjusted business-as-usual	A GHG forecast scenario that accounts for known policies and regulations that will affect future emissions. Generally, these are state and federal initiatives that will reduce emissions from the business-as-usual scenario.
Baseline year	The inventory year used for setting targets and comparing future inventories against.
Business-as-usual	A GHG forecast scenario that assumes no change in policy affecting emissions since the most recent inventory. Changes in emissions are driven primarily through changes in demographics.
Community Inventory	GHG emissions that result from the activities by residents and businesses in the city. An inventory reports emissions that occur over a single calendar year.
Emission factors	The GHG-intensity of an activity.
Municipal Inventory	GHG emissions that result from the activities performed as part of the government operations in the city and are a subset of the community inventory. An inventory reports emissions that occur over a single calendar year.
Reduction targets	GHG emissions levels not to be exceeded by a specific date. Local reduction targets are often informed by state recommendations and different targets may be established for different years.
Sector	A subset of the emissions inventory classified by a logical grouping such as economic or municipal-specific category.

¹ A glossary of terms is also included as Appendix A.

GHG Emissions Inventories

GHG emissions inventories are the foundation of planning for future reductions. Establishing an existing inventory of emissions helps to identify and categorize the major sources of emissions currently being produced. In this report, four years of historic inventories are presented to show not only the major sources of emissions in the City, but also how those sources vary over time. For both the community and municipal inventories, the years 2005, 2007, 2010, and 2012 are presented. The 2005 inventory (for both community and municipal operations) is considered the **baseline year**. A baseline year is established as a starting point against which other inventories may be compared and targets may be set, and is generally the earliest year with a full emissions inventory. The most recent inventory (2012) has the most relevant data for planning purposes, while the interim years (2007 and 2010) provide context and may help identify trends or anomalies.

Emissions Reporting

The primary GHGs from the community and municipal operations are from carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Because each of these gases has a different capacity for trapping heat in the atmosphere, known as its global warming potential (GWP), a method of reporting is needed to be able to compare gases in the same terms. As a result, emissions are reported in carbon dioxide equivalents, or CO₂e, with each GHG normalized and calculated relative to CO₂ using its GWP. Table 2 describes the GHGs analyzed in this report, their symbol, GWP, and primary community sources of emissions. While N₂O has the highest GWP and may be considered the most dangerous on a per-molecule basis, CO₂ is by far the most prevalent, accounting for 88% of statewide emissions in 2005 (CARB 2011).

Table 2. GHGs Analyzed in the Inventories

Greenhouse Gas	Symbol	Global Warming Potential	Primary Community Sources
Carbon Dioxide	CO ₂	1	Fossil fuel combustion
Methane	CH ₄	25	Fossil fuel combustion, landfills, wastewater treatment
Nitrous Oxide	N ₂ O	298	Fossil fuel combustion, wastewater treatment

Source: IPCC Fourth Assessment Report, 2007.

Emissions Sectors

The inventories identify the major sources of GHGs emissions caused by activities in sectors that are specific to community or municipal activities. A **sector** is a subset of the economy, society, or municipal operations whose components share similar characteristics. An emissions sector can also contain subsectors that provide more specificity about the source of emissions (e.g., natural gas and electricity are subsectors of the energy sector).

As mentioned above, inventories were completed for the community and municipal operations. Because the majority of municipal activities occur within the boundaries of the City and therefore contribute to the overall emissions of the community, both inventories are interconnected, with the municipal

inventory considered a subset of the community inventory. As a result, municipal emissions are included in numbers reported for the community. The municipal inventory is separated to highlight areas of emissions that the City has more direct control over and to identify where they can begin to set examples for the community on how reduction strategies can be implemented.

The following subsections describe the sectors used in the community and municipal inventories. It is important to note that both inventories capture similar types of information but may be categorized differently. For example, energy is reported in both the community and municipal inventory, but community level energy emissions are reported as “Residential” and “Commercial/Industrial”, whereas municipal energy emissions are more logically reported as “Buildings & Facilities” and “Outdoor Lights”.²

Community Sectors

The community inventory is categorized by sectors based on the sector’s ability to be affected through regional and local programs, incentives, zoning, and other policies. The City’s community inventories were divided into the following sectors:

- **Energy** in the Community Inventory is further broken down into two sectors:
 - **Commercial/Industrial Energy** includes emissions from electricity and natural gas consumption in commercial and industrial buildings and facilities (including outdoor lighting) in the City.
 - **Residential Energy** includes emissions from electricity and natural gas consumption in residential buildings in the City.
- **On-road Transportation** includes emissions from vehicle fuel use in trips wholly within the City (in-boundary) and trips that either originate or end in the City (cross-boundary). Emissions from in-boundary trips are fully accounted for in the inventory, whereas only half of the emissions from cross-boundary trips are accounted for. Trips that pass-through the City, (such as on I-405,) are not accounted for in the inventory because the City has little or no control of these emissions. As a result, this methodology reflects only trips or parts of trips within City borders that the City has the ability to affect.
- **Solid Waste** includes emissions from waste that is generated in the community and sent to landfills.
- **Water** includes emissions from the electricity used to source, treat, and deliver imported water in the community that is not accounted for in the community utility data.
- **Wastewater** includes emissions from treating wastewater generated in the community.
- **Off-road Sources** include emissions from operating equipment for construction, commercial, light industrial and agricultural activities; lawn and garden equipment; and recreational vehicles such as all-terrain vehicles.
- **Aviation** includes emissions from jet and aviation fuel consumed at the Torrance I Airport – Zamporini Field, a municipally-owned airport.

² Outdoor Lights are further categorized as SCE-owned or City-owned as described later.

Cap-and-Trade Covered Entities

Torrance is home to residential, commercial, and industrial users, each of which uses energy. Industrial users include major industrial facilities that emit substantial GHGs that are regulated under the State’s Cap-and-Trade Program. These facilities are known as “covered entities” and derive energy for their industrial uses largely from natural gas, and to a lesser extent, electricity and other energy sources. The emissions associated with covered entities are already regulated at the State level and therefore, the City does not have significant local control over the GHG emissions. The current protocol recommends excluding the covered entities’ GHG emissions from the City’s inventories. In an effort to be consistent with protocol, data were reviewed to determine to what extent covered entities are included.

Data provided by SCG and SCE for this inventory report are protected under privacy restrictions which fall under the 15/15 rule.³ Each utility provides data with these protections applied consistent with their individual corporate reporting protocols. The utilities do not specify if covered entities are included in the data provided. In comparing data from past inventory years, the electricity data are consistent and natural gas data are significantly reduced, leading to the conclusion that once the 15/15 rule was applied, major natural gas users, including covered entities, were likely removed from the total natural gas data. If additional information becomes available that either allows the City to better separate out the energy usage from covered entities or provides better clarity of the current data aggregation, SBCCOG recommends that the City review the information and determine whether adjustments to the inventories and/or associated reports are warranted. If adjustments are made, SBCCOG recommends they be consistent among all inventory years and with current quantification methodology.

Municipal Sectors

Sources of municipal emissions are divided into the following sectors:

- **Energy** in the municipal inventory is further broken down into four sectors:
 - **Buildings & Facilities** includes energy use by the government, including electricity and natural gas.
 - **SCE-Owned Outdoor Lights** includes energy for streetlights on fixtures owned by SCE and outdoor lighting.
 - **City-Owned Outdoor Lights** includes energy for streetlights on fixtures owned by the City, traffic control signals, and outdoor lighting.
 - **Water Delivery** includes energy for water, stormwater, and wastewater pumping and irrigation.

³The 15/15 rule requires that any aggregated information provided by the Utilities must be made up of at least 15 customers and a single customer’s load must be less than 15% of an assigned category. If the number of customers in the compiled data is below 15, or if a single customer’s load is more than 15% of the total data, categories must be combined before the information is released. The Rule further requires that if the 15/15 Rule is triggered for a second time after the data has been screened once already using the 15/15 Rule, the customer be dropped from the information provided.

- **Vehicle Fleet & Equipment** includes emissions from vehicles owned or operated by the government or contracted by the City for services such as street cleaning. It also includes equipment, such as emergency generators.
- **Employee Commute** includes emissions from fuel use in vehicle trips by municipal employees commuting to and from work in the City.
- **Solid Waste** includes emissions from waste generated by municipal employees or at municipally-owned facilities.
- **Aviation** includes emissions from aircraft fuels (Jet A and Aviation gasoline) consumed at the Torrance Airport – Zamporini Field, a municipally-owned airport.

Calculation Methodology

GHG emissions were calculated using activity data available (e.g., kilowatt-hours of electricity) for each sector and protocols for converting activity data to emissions output using relevant **emission factors**. Emission factors relate the activity to GHG emissions and may vary by year (e.g., for electricity) and often are not affected by local actions or behavior, unlike activity data. The U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (ICLEI 2012) and the Local Government Operations Protocol for the Quantification and Reporting of GHG Emissions Inventories (LGOP) (CARB 2010) were the primary protocols used for developing the community and municipal inventories, respectively. Activity data are reported in the community and municipal emissions subsections below, and emission factors are detailed in Appendix B.

Community Emissions

The community inventory includes the GHG emissions that result from activities within City boundaries. This section presents the findings of the community inventory for four years: 2005 (baseline year), 2007, 2010, and 2012. It also provides more specific detail and findings on the energy sectors, which will form the basis of the reduction targets and reduction measures the City identifies in the EECAP.

2005—2012 Emissions Summary

- **The City of Torrance reduced emissions 3% from 2005 to 2012, from 1,611,012 MT CO₂e to 1,563,394 MT CO₂e.**
- **Residential Energy, Solid Waste, Water, Wastewater, and Off-road Sources sector emissions decreased while On-road Transportation, Commercial Energy, and Aviation sectors increased emissions from 2005 to 2012.**

As shown in Figure 1 and Table 3, the On-road Transportation sector was the largest contributor to emissions in both 2005 (43%) and 2012 (44%) by producing 670,670 MT CO₂e in 2005 and 675,221 MT CO₂e in 2012. This change represents a less than 1% increase in emissions from 2005 to 2012. Commercial energy is the second-largest contributor to emissions, contributing 39% of total emissions in 2005 and 40% in 2012. Its total emissions increased by less than 1% from 2005 to 2012, from 617,177 MT CO₂e to 620,690 MT CO₂e. The proportion of emissions from the Residential sector was also steady, at 13% in 2005 and 2012, while its total emissions decreased by less than 3%, from 198,158 MT CO₂e in 2005 to 192,804

MT CO₂e in 2012. Solid Waste comprised 4% of the total (66,013 MT CO₂e) in 2005, and was reduced to 3% of the total (39,906 MT CO₂e) in 2012. Water, Wastewater, Aviation, and Off-road Sources made up the remaining emissions in each year. Water, Wastewater, and Off-road Sources emissions declined from 2005 to 2012. Aviation emissions increased 4% over the period, from 3,270 MT CO₂e to 3,406 MT CO₂e, but accounts for less than one percent of emissions for both years.

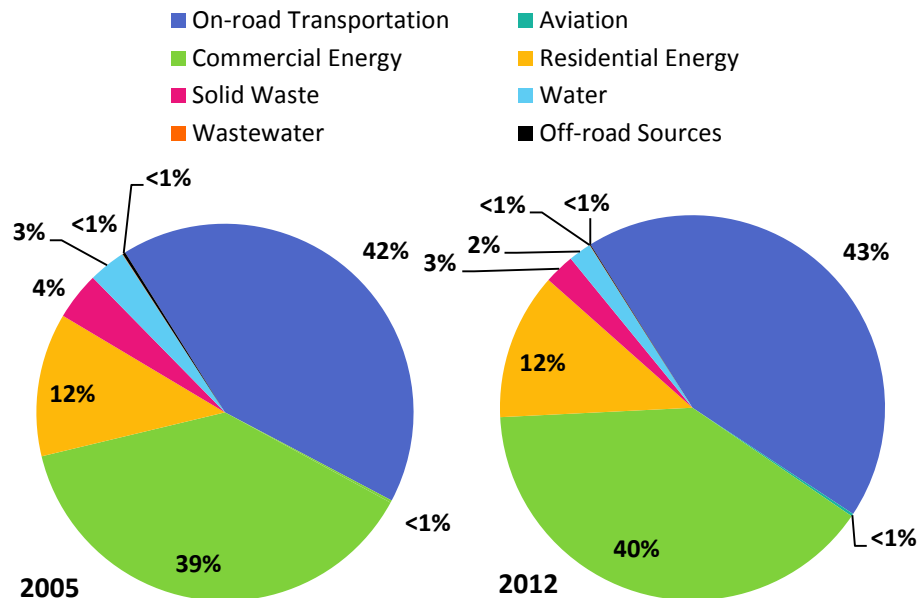


Figure 1. Community GHG Emissions for 2005 and 2012

Table 3. Community-Wide GHG Emissions by Sector for 2005 and 2012

Sector	2005 (MT CO ₂ e)	2012 (MT CO ₂ e)	% Change 2005 to 2012
On-road Transportation	670,670	675,221	0.7%
Commercial Energy	617,177	620,690	0.6%
Residential Energy	198,158	192,804	-2.7%
Solid Waste	66,013	39,906	-39.5%
Water	51,287	29,906	-41.7%
Off-road Sources	3,875	1,018	-73.7%
Aviation	3,270	3,406	4.2%
Wastewater	562	443	-21.2%
Total	1,611,012	1,563,394	-3.0%

2005, 2007, 2010, and 2012 Inventories

Figure 2 and Table 4 show the GHG emissions by sector for all inventory years. Emissions are variable among the inventory years, and may reflect changes in the economy, weather, and programs

implemented to reduce emissions. The table also lists the percentage of each sector relative to total emissions and shows that the proportion of each sector does not vary greatly by year.

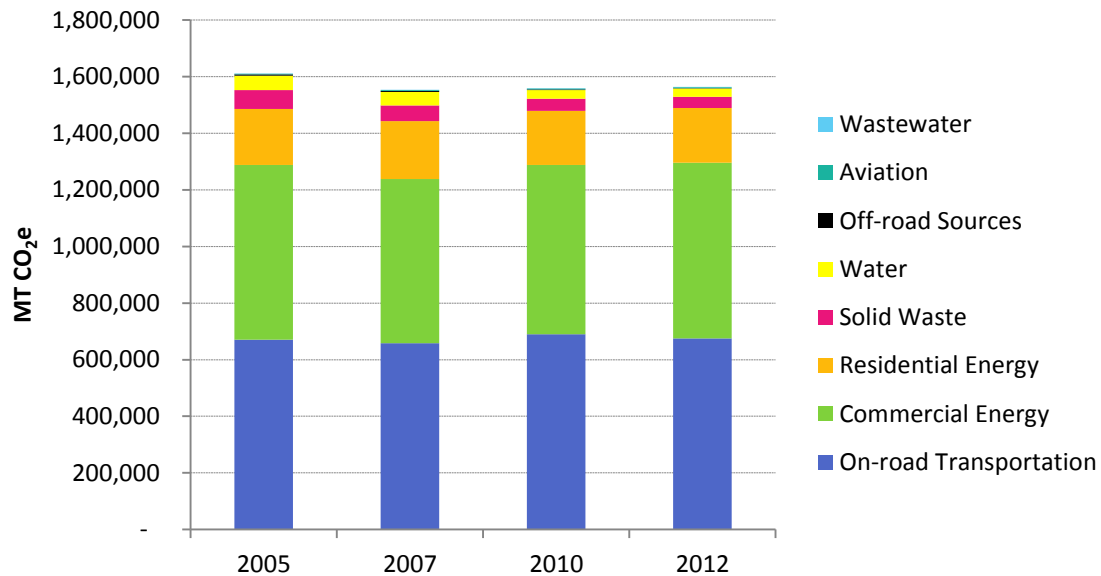


Figure 2. Community GHG Emissions for 2005, 2007, 2010, and 2012

Table 4. Community GHG Emissions for 2005, 2007, 2010, and 2012

Sector	2005 (MT CO ₂ e)	% of Total	2007 (MT CO ₂ e)	% of Total	2010 (MT CO ₂ e)	% of Total	2012 (MT CO ₂ e)	% of Total
On-road Transportation	670,670	42%	658,462	42%	690,224	44%	675,221	43%
Commercial Energy	617,177	38%	580,034	37%	597,409	38%	620,690	40%
Residential Energy	198,158	12%	203,654	13%	191,257	12%	192,804	12%
Solid Waste	66,013	4%	56,033	4%	43,421	3%	39,906	3%
Water	51,287	3%	46,906	3%	30,466	4%	29,906	2%
Off-road Sources	3,875	<1%	3,372	<1%	2,343	<1%	1,018	<1%
Aviation	3,270	<1%	3,320	<1%	3,393	<1%	3,406	<1%
Wastewater	562	<1%	438	<1%	443	<1%	443	<1%
Total	1,611,012		1,552,219		1,558,956		1,563,394	
% Change from 2005	--		-3.6%		-3.2%		-3.0%	

Activity data can provide more insight into behavioral changes in the community, as these data are not affected by emission factors. Table 5 summarizes activity data for each sector and subsector. The activity data show that vehicle miles traveled, natural gas (Commercial/Industrial), solid waste (ADC), and aviation fuel use increased from 2005 to 2012, while electricity (Residential), natural gas (Residential), solid waste (landfilled), and water use decreased from 2005 to 2012. Wastewater and Off-road emissions use indicator data to attribute county-level emissions to the City and the indicator data are also shown in Table 5. Notably, while On-road Transportation emissions increased less than 1% between 2005 and 2012,

vehicle miles traveled increased by nearly 7%. The difference reflects that for each vehicle mile traveled, fewer emissions are generated due to improvements in the fuel efficiency of vehicles.

Table 5. Activity Data used in 2005, 2007, 2010, and 2012 Community Inventories

Sector	2005	2007	2010	2012	% Change 2005 to 2012
On-road Transportation					
Total Vehicle Miles Traveled	1,282,531,135	1,271,121,860	1,367,126,178	1,369,046,211	6.7%
Residential Energy					
Electricity (kWh)	286,098,688	294,591,718	273,302,186	265,113,428	-7.3%
Natural Gas (therms)	20,920,237	22,351,936	21,173,265	20,315,160	-2.9%
Commercial/Industrial Energy					
Electricity (kWh)	1,720,797,117	1,684,882,312	1,491,431,552	1,446,744,854	-15.9%
Natural Gas (therms)	17,754,811	17,873,966	31,613,535	29,721,984	67.4%
Solid Waste					
Landfilled (tons)	236,865	195,127	146,063	131,802	-44.4%
ADC (tons) ¹	1,497	698	282	1,719	14.8%
Closed Municipal Landfill (CH ₄) ⁴	1,315	1,263	1,190	1,143	-13%
Water and Wastewater					
Water (MG) ²	9,647	9,337	8,359	8,635	-10.5%
Recycled Water (MG) ²	2,094	2,124	2,103	2,177	4.0%
Wastewater (City portion of countywide residents)	1.46%	1.47%	1.48%	1.48%	0.9%
Aviation					
Aviation Fuel	383,874	389,765	398,301	399,826	4.2%
Off-road Sources³ (% of LA County emissions attributed to the City)					
Lawn & Garden (% Households)	1.73%	1.72%	1.69%	1.69%	-2.5%
Construction (% Building permits)	1.23%	0.99%	0.58%	0.11%	-91.4%
Industrial (% Manufacturing jobs)	4.35%	4.57%	4.60%	4.57%	5.2%
Light Commercial (% Other jobs)	2.10%	2.20%	2.22%	2.21%	5.6%
Recreation (Population weighted by income)	1.95%	1.95%	1.96%	1.96%	0.6%
Agriculture (% Ag. Jobs)	0.77%	0.81%	0.95%	0.77%	-0.7%

1 ADC is Alternative Daily Cover, which is green waste (grass, leaves, and branches) that is used to cover landfill emissions. They are reported separately by CalRecycle and therefore shown separately here.

2 2005 and 2007 data were not available. Therefore, 2009 data was used as proxy. Data does not include municipal water use from the City of Torrance.

3 Off-road emissions are available at the county level through CARB's OFFROAD model. Emissions attributable to the City were derived using indicator data related to the off-road source. For example, the percentage of households in the City compared to the county was used to attribute the same percentage of lawn & garden equipment emissions to the City. See Appendix B for more methodology details.

4 ARB's Landfill Model Emissions Tool was used to evaluate the estimated emissions from Landfill 19-AA-5321. The CH₄ output was converted using protocol assumptions that 75% of methane gas from landfills is captured.

Demographic data also help provide perspective to changes in emissions over time. Table 6 shows the number of households, jobs, population, and service population (jobs + population) for each inventory year. For example, energy emissions in the Residential Energy sector decreased while the number of households and the population increased, suggesting energy conservation occurred from 2005 to 2012.

Table 6. Demographic Data for 2005, 2007, 2010, and 2012

	2005	2007	2010	2012	% Change 2005-2012
Service Population (Population + Jobs)	248,730	254,130	245,736	247,839	-0.4%
Population	143,738	143,825	145,392	146,115	1.7%
Households	55,148	55,577	56,001	56,056	1.6%
Jobs	104,922	110,305	100,344	101,724	-3.1%

Energy

The EECAP ultimately will focus on increasing energy efficiency and reducing GHG gases from energy; therefore, it is important for the City to understand its current energy consumption to make informed decisions for reducing energy-related emissions. Energy use consists of electricity and natural gas. Emissions from Commercial/Industrial and Residential energy use account for about 51% of the total community emissions in 2005 and 52% in 2012. Table 7 shows the breakdown in activity (kWh or therms) and GHG emissions by sector and energy source.

Table 7. Activity Data and GHG Emissions of Energy in 2005 and 2012

Sector	2005		2012		% Change in Activity 2005-2012	% Change in Emissions 2005-2012
	Activity (kWh or therms)	Emissions (MT CO ₂ e)	Activity (kWh or therms)	Emissions (MT CO ₂ e)		
Commercial/ Industrial						
Electricity	1,720,797,117	522,766	1,446,744,854	462,644	-15.9%	-11.5%
Natural Gas	17,754,811	94,411	29,721,984	158,046	67.4%	67.4%
Residential						
Electricity	286,098,688	86,915	265,113,428	84,779	-7.3%	-2.5%
Natural Gas	20,920,237	111,243	20,315,160	108,025	-2.9%	-2.9%
Total (MT CO ₂ e)		815,335		813,494		-0.2%

Commercial electricity use decreased about 16% between 2005 and 2012; however, emissions decreased by less than 12%. Similarly, Residential electricity use increased by about 7% but emissions decreased by less than 3%. The difference between the change in activity data and emissions data are due to the emission factor used for electricity for 2005 and 2012. Emission factors convert activity data into GHG emissions and electricity emission factors vary annually based on how electricity is generated by the electricity provider (i.e., the amount of renewables, natural gas, coal, etc.). In 2005, Southern California

Edison (SCE) generated electricity that resulted in an emission factor of 669.7 CO₂e. In 2012, SCE's electricity generation resulted in an emission factor of 705.0 CO₂e. Therefore, a kilowatt-hour of electricity used in 2012 emitted more GHGs than a kilowatt-hour of electricity used in 2005. Future emissions could increase or decrease based on changes to SCE's emission factors, which the City cannot directly affect, or through changes in usage, which can be affected by changes in local policy, outreach, or incentive programs.

Unlike electricity, the emission factor for natural gas is estimated on a national basis and remains fairly constant over time. Therefore, the natural gas GHG emissions follow the same trend as usage.

In Torrance, Commercial/Industrial natural gas consumption (therms) increased by 67% from 2005 to 2012; therefore the emissions also increased 67%. Residential natural gas therms used and GHG emissions declined nearly 3% from 2005 to 2012. Figure 3 shows the trend in electricity and natural gas emissions from 2005 to 2012 for the Commercial/Industrial and Residential sectors.

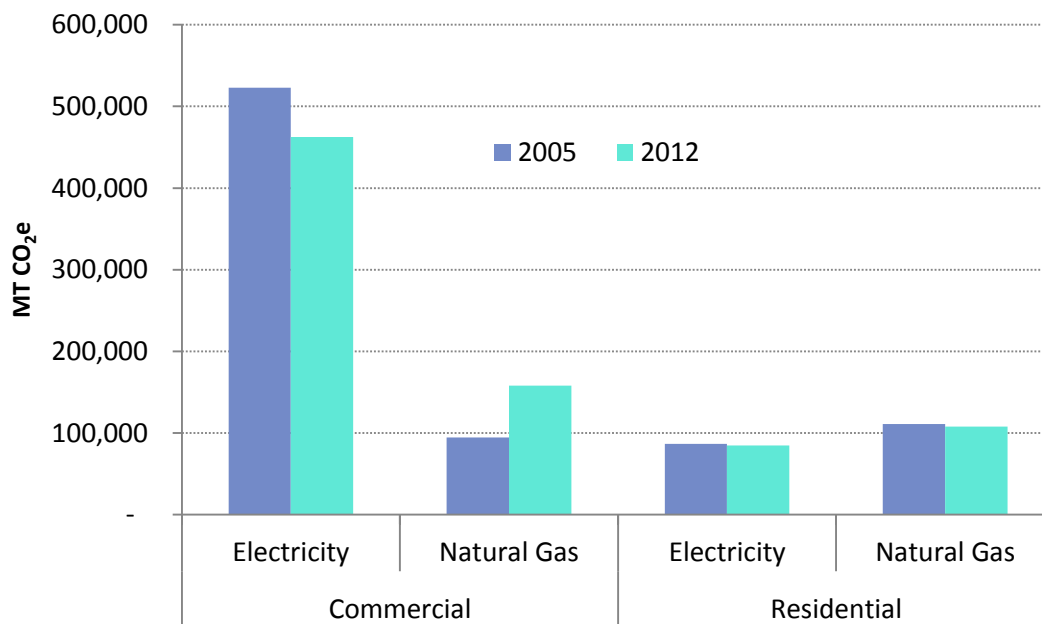


Electricity-Related Emissions



All emissions are comprised of activity data and the emission factor, or GHG-intensity, of that activity. For electricity, the activity data are the kilowatt-hours (kWh) used by the city's residents and businesses and the energy intensity is based on the sources of power that Southern California Edison uses to generate electricity. Changes to either component can affect the GHG emissions from electricity in the City.

Figure 3. GHG Emissions for Community Electricity and Natural Gas, by Sector



Municipal Emissions

As described earlier, a municipal GHG emissions inventory is a subset of the community inventory. The municipal inventory includes emissions from activities conducted as part of government operations in the City. While emissions from government operations are normally a fraction of the overall community emissions, the City has the most direct control over municipal emissions and the City can demonstrate leadership in the community by adopting and implementing energy and GHG reduction strategies. This section presents the findings of the municipal inventory for 2005 (the baseline year), 2007, 2010, and 2012. It also provides more specific detail and findings on the energy sectors, which will form the basis of the reduction measures the City identifies in the EECAP.

2005—2012 Emissions Summary

- **Municipal emissions have decreased 22% from 2005 to 2012, from 30,818 MT CO₂e to 23,887 MT CO₂e.**
- **Emissions in Vehicle Fleet & Equipment, Employee Commute, Solid Waste, City-Owned Outdoor Lights, and Aviation sectors decreased between 2005 and 2012, while emissions in the Buildings & Facilities, SCE-Owned Outdoor Lights, and Water Delivery sectors increased.**
- **The Vehicle Fleet & Equipment sector showed the greatest overall reductions (5,932 MT CO₂e reductions); however, the City lowered emissions in multiple sectors, including Employee Commute, City-Owned Outdoor Lights, and Aviation.**
- **Emissions from municipal operations account for about 2% of community emissions.**

The City's Vehicle Fleet & Equipment is the sector with the largest percentage of emissions in 2005 (30%), although emissions from this sector decreased 65% over the period, from 9,190 MT CO₂e to 3,258 MT CO₂e (Figure 4). The second largest-emitting sector for 2005 was Solid Waste, due to a closed landfill that the City owns. By 2012, due to the significant decrease in emissions from Fleet & Equipment, Solid Waste is the City's largest emissions sector; however, because the landfill is closed and not accepting new refuse, emissions naturally decline over time. Emissions from the Solid Waste Sector have decreased 14% between 2005 and 2012, primarily from the decline in landfill emissions, but also from a decline in community-generated waste. In 2012, Buildings & Facilities is the second highest-emitting sector and emissions have grown 7% from 2005. Employee Commute increased 15% from 2005 and 2012. Other sectors showed significant decreases in emissions from 2005 to 2012, including City-Owned Outdoor Lights (emissions decreased 25%), and Aviation (emissions decreased 19%). Some City-Owned Outdoor Lighting accounts have been re-categorized to SCE-Owned Outdoor Lights from 2005 to 2012 for improved accuracy of categorization. This change may partially contribute to the decrease in City-Owned Outdoor Lighting emissions. Emissions from SCE-Owned Outdoor Lights and Water Delivery increased over time and account for approximately 13% of municipal emissions. A main contributor to the increase in Water Delivery emissions is the replacement of Well #6 with Well #9. Well #9 has a much higher extraction capacity and has used much more energy than Well #6.

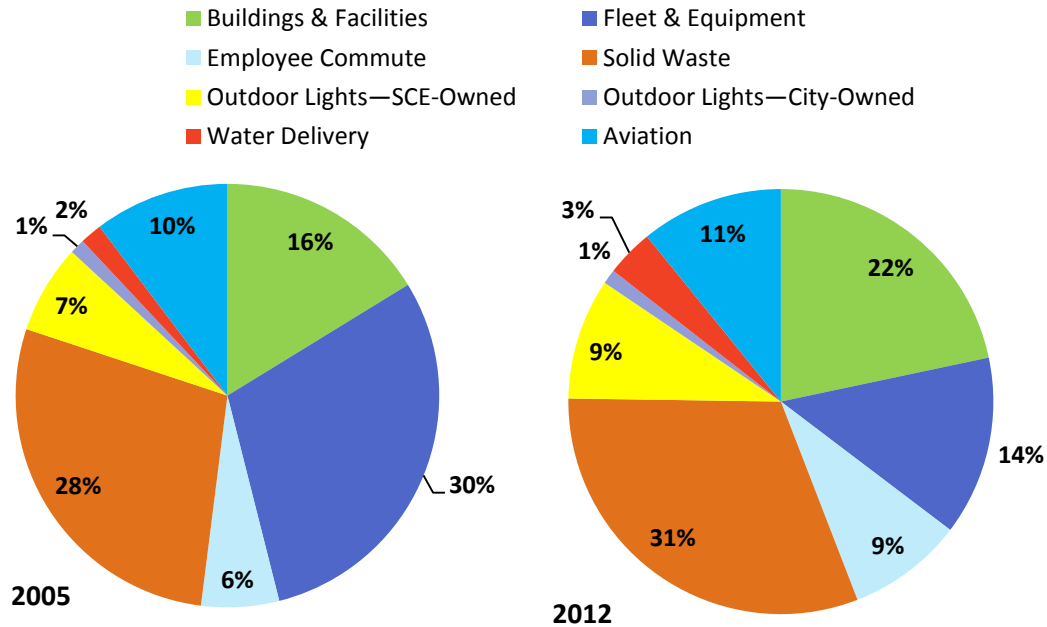


Figure 4. Municipal Emissions for 2005 and 2012

Table 8. Municipal GHG Emissions by Sector for 2005 and 2012

Sector	2005 (MT CO ₂ e)	2012 (MT CO ₂ e)	% Change 2005 to 2012
Fleet & Equipment	9,190	3,258	-65%
Solid Waste	8,655	7,430	-14%
Buildings & Facilities	5,005	5,179	3%
Aviation	3,178	2,590	-19%
Outdoor Lights—SCE-Owned	2,090	2,199	5%
Employee Commute	1,831	2,104	15%
Water Delivery	517	862	67%
Outdoor Lights—City-Owned	352	265	-25%
Total	30,818	23,887	-22%

Note: City-Owned Outdoor Lights includes streetlights, traffic signals, and area lighting. SCE-Owned Outdoor Lights includes streetlights and outdoor lighting. Water Delivery includes water, sewer, and stormwater pumping and irrigation.

2005, 2007, 2010, and 2012 Inventories

Figure 5 and Table 9 show the municipal GHG emissions by sector for all four inventory years. Emissions peaked in 2005 (30,818 MT CO₂e) and were the lowest in 2010 (23,325 MT CO₂e), primarily due to the significant drop in Aviation and Vehicle Fleet & Equipment sector emissions. Because total emissions for municipal operations are relatively low, small changes in a category such as Aviation can greatly affect the inventory.

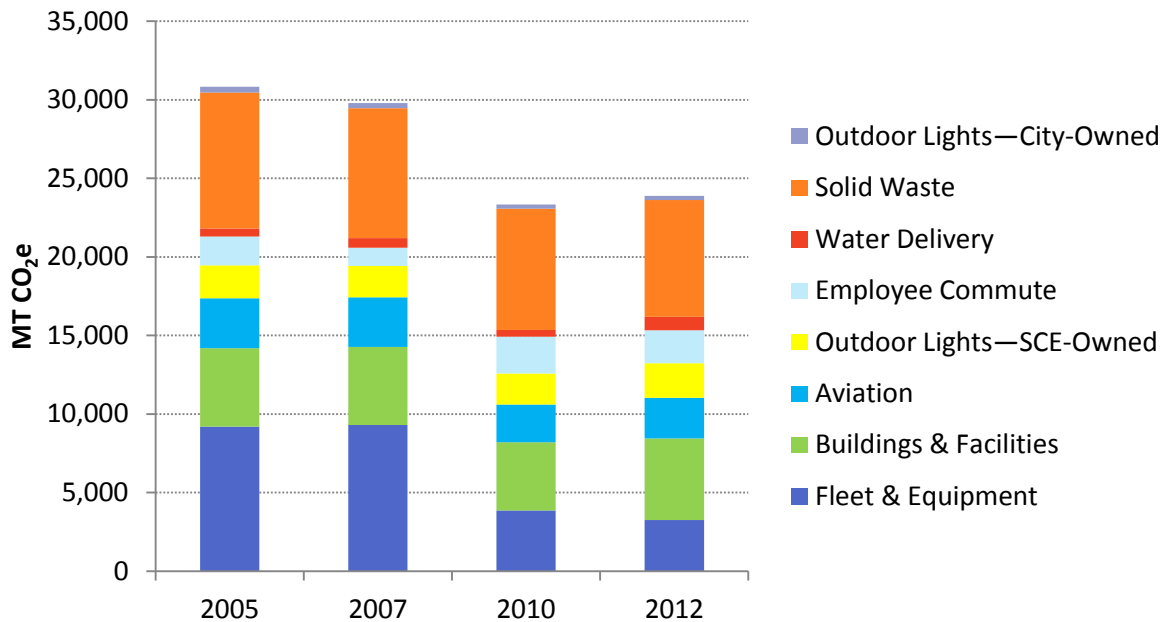


Figure 5. Municipal GHG Emissions for 2005, 2007, 2010, and 2012

Table 9. Municipal GHG Emissions for 2005, 2007, 2010, and 2012

Sector	2005 (MT CO ₂ e)	% of Total	2007 (MT CO ₂ e)	% of Total	2010 (MT CO ₂ e)	% of Total	2012 (MT CO ₂ e)	% of Total
Fleet & Equipment	9,190	30%	9,296	31%	3,854	17%	3,258	14%
Solid Waste	8,655	28%	8,270	28%	7,721	34%	7,430	32%
Buildings & Facilities	5,005	16%	4,980	17%	4,340	19%	5,179	22%
Aviation	3,178	10%	3,152	11%	2,402	11%	2,590	11%
Outdoor Lights— SCE-Owned	2,090	7%	1,989	7%	1,987	9%	2,199	9%
Employee Commute	1,831	6%	1,172	4%	2,334	10%	2,104	9%
Water Delivery	517	2%	605	2%	431	2%	862	4%
Outdoor Lights— City-Owned	352	1%	330	1%	256	1%	265	1%
Total	30,818		29,794		23,325		23,887	

Table 10 summarizes activity data for each sector and subsector.

Table 10. Activity Data used in 2005, 2007, 2010, and 2012 Municipal Inventories

Sector	2005	2007	2010	2012	% Change 2005 to 2012
Buildings & Facilities					
Electricity (kWh)	11,575,233	11,566,648	9,329,877	11,732,813	1%
Natural Gas (therms)	279,738	310,236	307,151	263,657	-6%
Outdoor Lights					
City-Owned (kWh)	1,160,096	1,147,354	883,079	828,120	-29%
SCE-Owned (kWh)	6,878,751	6,908,608	6,903,510	6,876,621	<1%
Fleet & Equipment					
City-Owned Fleet					
Gasoline (gallons) ¹	246,835	272,955	221,559	193,188	-22%
Diesel (gallons)	681,187	667,708	182,063	146,958	-78%
CNG (standard cubic feet)	0	267,495	33,166	288,404	--
Employee Commute²					
Gasoline (vehicle miles traveled)	4,234,596	2,736,947	5,414,335	4,889,690	15%
Diesel (vehicle miles traveled)	0	453	96,148	86,831	--
# Full Time Employee Equivalents	1,767	1,013	1,548	1,398	-21%
Solid Waste					
Generated Waste (tons) ³	1,358	1,164	1,164	1,164	-14%
Closed Municipal Landfill (CH ₄) ⁴	1,315	1,263	1,190	1,143	-13%
Water Delivery					
Electricity (kWh)	1,700,902	2,100,669	1,497,195	2,694,669	58%
Aviation					
Aviation Gasoline (gallons)	109,503	135,752	69,075	100,699	-8%

1 The City's Vehicle Fleet includes Hybrid vehicles. To incorporate the fuel used in hybrid vehicles, half of the fuel (gallons) was added to the Gasoline gallons. Transit Fleet is also included.

2 Employee Commute survey conducted in 2014 and adjusted based on the number of employees in 2010 and 2012

3 Data for 2010 and 2012 were not available; therefore, activity data from 2007 data was used as a proxy.

4 ARB's Landfill Model Emissions Tool was used to evaluate the estimated emissions from Landfill 19-AA-5321. The CH₄ output was converted using protocol assumptions that 75% of methane gas from landfills is captured.

Energy

As with the community emissions, the EECAP will focus on increasing energy efficiency and reducing GHG gases from energy within municipal operations. The City has more direct control over energy-related emissions than other sectors, such as employee commute. Municipal energy use includes Buildings & Facilities, SCE-Owned Outdoor Lights, City-Owned Outdoor Lights, and Water Delivery. Energy accounted for 35% of total emissions in 2005 and 52% in 2012. While both electricity and natural gas are used for Building & Facilities, Outdoor Lights and Water Delivery only use electricity. Emissions from energy increased 6% from 2005 to 2012; however electricity-based emissions increased 9% and natural gas

related emissions decreased 6% (Table 11). Electricity emissions declined for the City-Owned Outdoor Lights sector and increased for the Buildings & Facilities, SCE-Owned Outdoor Lights, and Water Delivery sectors. As with community energy, municipal emissions use variable electricity emission factors and constant natural gas emission factors.

Table 11. Activity Data and GHG Emissions of Municipal Energy in 2005 and 2012

Sector	2005		2012		% Change in Activity 2005-2012	% Change in Emissions 2005-2012
	Activity (kWh or Therms)	Emissions (MT CO ₂ e)	Activity (kWh)	Emissions (MT CO ₂ e)		
Buildings & Facilities						
Electricity	11,575,233	3,517	11,732,813	3,777	1%	7%
Natural Gas	279,738	1,488	263,657	1,402	-6%	-6%
Outdoor Lights—SCE-Owned						
Electricity	6,878,751	2,090	6,876,621	2,199	<1%	5%
Outdoor Lights—City-Owned						
Electricity	1,160,096	352	828,120	265	-29%	-25%
Water Delivery						
Electricity	1,700,902	517	2,694,669	862	58%	67%
Total (MT CO ₂ e)		7,964		8,505	4%	6%

Figure 6 shows the trend in electricity and natural gas emissions from 2005 to 2012 for the municipal energy sectors.

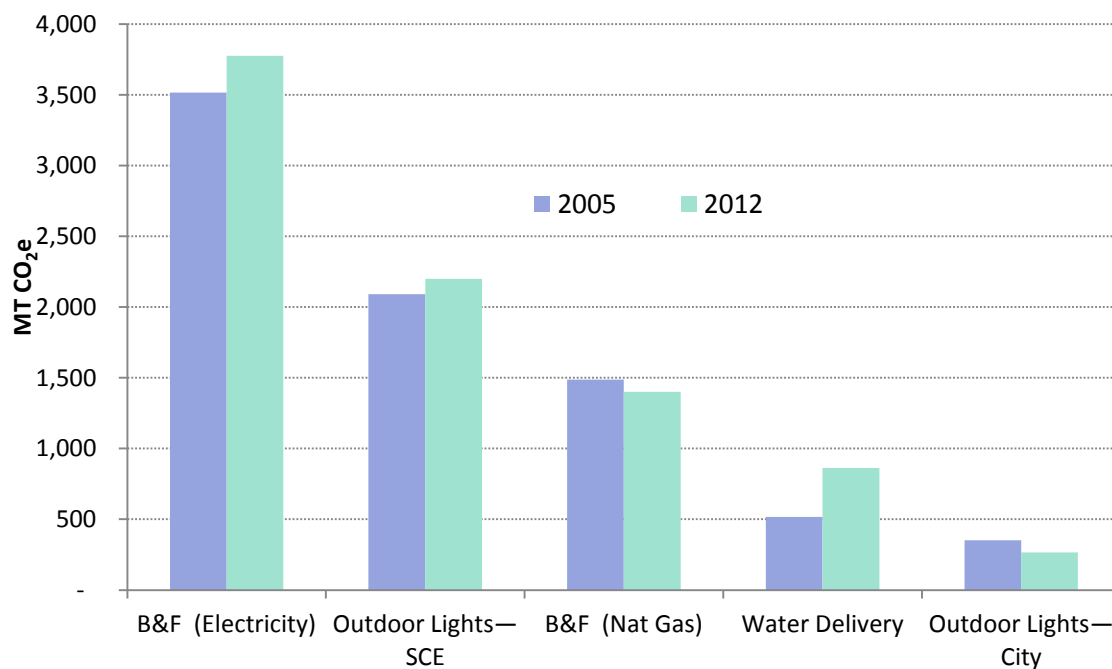


Figure 6. GHG Emissions for Municipal Electricity and Natural Gas, by Sector

Inventory Forecasts

GHG emissions are forecast using two scenarios: a Business-as-Usual (BAU) and an Adjusted BAU scenario. The BAU scenario describes emissions based on projected growth in population and employment and does not consider policies that will reduce emissions in the future (that is, the policies in place in 2012 are assumed to remain constant through 2035). The Adjusted BAU scenario describes emissions based on projected growth *and* considers policies that will achieve GHG reductions in the future. Policies, described in detail below, include State-adopted or approved legislation that will affect future emissions. By evaluating the two scenarios, the City can see the effect that existing policies may have on future emissions and be better able to determine how local measures can provide additional reductions. Two future years are forecasted for each scenario: 2020 and 2035. The 2020 forecast year is consistent with the goals identified in Assembly Bill (AB) 32, which identifies a statewide GHG reduction target by 2020. The 2035 forecast year will allow the City to develop long-term strategies to continue GHG reductions beyond 2020.

Business-as-Usual Forecasts

The BAU forecasts estimate future emissions using current (2012) consumption patterns and emission factors with the anticipated growth in the City. Anticipated growth is estimated using data from regional planning scenarios developed by the Southern California Association of Governments (SCAG), the City, and other relevant sources (Table 12). The most relevant growth factors are used to project emissions by sector. For example, future Residential Energy emissions were developed using current energy use per household (from the 2012 inventory) and the anticipated number of households in the future. Actual energy use is a function of several variables, not only the number of households; however, this approach is supported by current protocols and best practices within the State and provides a consistent approach to forecasting. Compound annual growth rates were developed using the growth projections from 2012 to 2020 and from 2021 to 2035, as shown Table 12.

In general, the City is expecting modest growth to 2020 and 2035 as population, housing, and jobs are all expected to increase. SCAG is projecting fewer vehicle miles traveled from 2012 to 2020 despite population and job growth, but that trend is reversed after 2020, when vehicle miles traveled will again increase. Due to the relatively low growth, the City does not anticipate major staffing changes in its government services.

Table 12. Growth Factors for 2012, 2020, and 2035

Sector	Demographic Indicator	2012	2020	2035	2012-2020 CAGR ¹	2020-2035 CAGR ¹
Transportation	Vehicle Miles Traveled	1,369,046,211	1,255,620,271	1,289,687,106	-1.08%	0.18%
Solid Waste, Water, Wastewater, Off-Road Sources	Service Population (Population + Jobs)	247,839	259,900	271,800	0.60%	0.30%
NA ²	Population	146,115	150,800	158,500	0.40%	0.33%
Residential Energy	Households	56,056	57,800	59,800	-0.38%	0.23%
Commercial/Industrial Energy	Jobs	101,724	109,100	113,300	0.88%	0.25%
Municipal Jobs	Municipal Emissions ³	1,398 FTE	1,398 FTE	1,398 FTE	0%	0%

Source: SCAG 2012

FTE: Full-Time Equivalent is a unit to combine full-time and part-time workers into a single measurement

1 Compound annual growth rate.

2 Not Applicable. Population data are shown for informational purposes but are not used for forecasting any sector.

3 The number of jobs in the City is used as an indicator for all municipal operation emissions except Aviation, which is forecast consistent with the community forecast (by change in service population).

Community Business-as-Usual Forecast

- **BAU community emissions are expected to increase 2.0% from baseline (2005) levels by 2020 but increase by nearly 5.4% by 2035.**

The City's BAU emissions in 2020 are estimated to be 1,594,596 MT CO₂e, a 1.0% decrease from baseline (2005) emissions. By 2035, emissions are estimated to increase 5.4% from the baseline level to 1,647,328 MT CO₂e (Table 13).

Table 13. Community BAU Forecast

Sector	2005 (MT CO ₂ e)	2012 (MT CO ₂ e)	2020 (MT CO ₂ e)	% Change 2012-2020	2035 (MT CO ₂ e)	%Change 2012-2035
On-road Transportation	670,670	675,221	657,509	-2.6%	675,349	0.0%
Commercial Energy	617,177	620,690	661,561	6.6%	687,029	10.7%
Residential Energy	198,158	192,804	198,492	3.0%	205,360	6.5%
Solid Waste	66,013	39,906	40,333	1.1%	40,312	1.0%
Water	51,287	29,906	31,269	4.6%	32,701	9.3%
Aviation and Off-road Sources ¹	7,145	4,424	4,969	12.3%	6,093	37.7%
Wastewater	562	443	463	4.5%	484	9.3%
Total	1,611,012	1,563,394	1,594,596	2.0%	1,647,328	5.4%
% Change from 2005		-3.0%	-1.0%		2.3%	

1 The forecasting tool combines the emissions from the Aviation and Off-road Sources sectors.

Municipal Business-as-Usual Forecast

- **BAU municipal emissions are expected to be 26% below baseline levels in 2020 and 30% below baseline levels in 2035.**

The City is not anticipating much growth in city services by 2020 or 2035 from current (2012) levels; therefore, the activity data for all sectors except Aviation (reported with Vehicle Fleet in forecasts) and the City's closed landfill (reported with Solid Waste) are assumed to remain constant from 2012. Emissions from Aviation, as described in the Community section, are expected to increase proportionally to the change in service population (population + employees). The City's closed landfill (Torrance Municipal Dump) was closed opened in 1939 and closed in 1966. Emissions from closed landfills decline over time and are modeled by a first-order decay model. Therefore, with no growth anticipated for most City services and limited growth in Aviation, the continued decline in emissions from the City's closed landfill will result in slightly lower emissions over time. Coupled with the significant emission reductions already achieved through 2012, the City may expect emissions to be 26% lower than in 2005 by 2020 and 30% lower than in 2005 by 2035.

Table 14. Municipal BAU Forecast

	2005 (MT CO₂e)	2012 (MT CO₂e)	2020 (MT CO₂e)	% Change 2012-2020	2035 (MT CO₂e)	% Change 2012-2035
Buildings & Facilities	5,005	5,179	5,179	0%	5,179	0%
Employee Commute	1,831	2,104	2,104	0%	2,104	0%
Solid Waste	8,655	7,430	6,364	-14%	4,775	-36%
Outdoor Lighting	2,442	2,464	2,464	0%	2,464	0%
Vehicle Fleet ¹	12,368	5,848	5,966	2%	6,090	4%
Water Delivery	517	862	862	0%	862	0%
Total	30,818	23,887	22,939	-4%	21,474	-10%
% Change from 2005	-22%	-26%		-30%		

¹ Vehicle Fleet includes both Vehicle Fleet & Equipment and Aviation. The ClearPath tool reports them together in forecasts.

Adjusted Business-as-Usual Forecasts

State legislation has been approved and/or adopted that will reduce GHG emissions in the City. These policies do not require additional local action, but should be accounted for in the City's emissions forecasts to provide a more accurate picture of future emissions and the level of local action needed to reduce emissions to levels consistent with State recommendations. This forecast is called the Adjusted BAU forecast. The measures are described briefly below.

Low Carbon Fuel Standard. The Low Carbon Fuel Standard (LCFS) was developed as a result of Executive Order S-1-07, which mandates that the carbon intensity of transportation fuels in California are lowered 10% by 2020. The State is currently implementing this standard, which is being phased in and will achieve full implementation in 2020.

Assembly Bill (AB) 1493 and Advanced Clean Cars. AB 1493 directed CARB to adopt GHG standards for motor vehicles through model year 2015 that would result in reductions in GHG emissions by up to 25%

in 2030. In addition, the State’s Advanced Clean Cars program includes additional components that will further reduce GHG emissions statewide, including more stringent fuel efficiency standards for model years 2017–2025 and support infrastructure for the commercialization of zero-emission vehicles. CARB anticipates additional GHG reductions of 3% by 2020, 27% by 2035, and 33% by 2050⁴. These are also known as “Pavley I” and “Pavley II” regulations.

California Building Code Title 24. California’s building efficiency standards are updated regularly to incorporate new energy efficiency technologies. The code was most recently updated in 2013 and went into effect for new development in 2014. For projects implemented after January 1, 2014, the California Energy Commission estimates that the 2013 Title 24 energy efficiency standards will reduce consumption by an estimated 25% for residential buildings and 30% for commercial buildings, relative to the 2008 standards. These percentage savings relate to heating, cooling, lighting, and water heating only; therefore, these percentage savings were applied to the estimated percentage of energy use by Title 24.

Renewable Portfolio Standard. The Renewable Portfolio Standard (RPS) requires energy providers to derive 33% of their electricity from qualified renewable sources. This is anticipated to lower emission factors (i.e., fewer GHG emissions per kilowatt-hour used) statewide. Therefore, reductions from RPS are taken for energy embedded in water, which uses energy sources throughout the state to move from the water source area to the City. However, no credit was taken for this measure for the SCE service region (i.e., for residential and commercial electricity used in the City supplied by SCE). Analysis of SCE’s current portfolio and the sources needed to replace the nuclear generation that has been taken out of service has revealed great uncertainty in how SCE’s emission factors may change over time. Therefore, the emission factor used in the 2012 inventory and the BAU forecast was also used in the Adjusted BAU forecast.

Senate Bill X7-7. California’s SB X7-7 requires water suppliers to reduce urban per capita water consumption 20% from a baseline level by 2020. The City is supplied by Golden State Water and the California Water Service Company. The reductions in GHG emissions from SB X7-7 were calculated by applying the reduction goals established by each water supplier to the City’s population in 2020 and 2035.

Community Adjusted Business-as-Usual Forecast

- **Emissions are expected to decrease under the Adjusted BAU forecast and will be 9.6% lower in 2020 than 2005 and 19.2% lower than 2005 levels by 2035.**

The City’s Adjusted BAU emissions in 2020 are estimated to be 1,456,485 MT CO₂e in 2020 and 1,301,140 MT CO₂e in 2035 (Table 15). This change represents a 9.6% reduction from 2005 by 2020 and 19.2% reduction by 2035. Due to the stringent State vehicle standards, the emissions from the Transportation sector are expected to decrease significantly over time, while the proportion of emissions from Commercial/Industrial Energy will increase. Emissions from Solid Waste are expected to decrease from baseline levels but increase from current (2012) emissions. Emissions from Residential Energy are expected to decrease by 2020, then increase slightly by 2035.

⁴ [CARB Advanced Clean Cars Summary Sheet](#)

Table 15. Community Adjusted BAU Emissions

Sector	2005 (MT CO ₂ e)	2012 (MT CO ₂ e)	2020 (MT CO ₂ e)	2020 % of Total	2035 (MT CO ₂ e)	2035 % of Total
Transportation & Mobile Sources ¹	677,815	679,645	531,980	37%	348,878	28%
Commercial/Industrial Energy	617,177	620,690	654,413	46%	674,557	53%
Residential Energy	198,158	192,804	198,027	14%	204,208	16%
Solid Waste	66,013	39,906	40,333	3%	40,312	3%
Water & Wastewater	51,849	30,349	31,732	2%	33,185	3%
Total	1,611,012	1,563,394	1,456,485	100%	1,301,140	100%
% Change from 2005		-3%	-9.6%		-19.2%	

1 The planning tool combines on-road and off-road (including aviation) sources.

Municipal Adjusted Business-as-Usual Forecast

- **The City will surpass the State-aligned target by 2020 under an Adjusted BAU forecast, meeting a 27% reduction below 2005 levels. By 2035, the reduction will be 32% below 2005 levels.**

The City's Municipal Adjusted BAU emissions in 2020 are estimated to be 22,562 MT CO₂e, which is 27% below the 2005 baseline level (Table 16). In 2035, emissions are estimated to be 21,097 MT CO₂e, which is 32% below the 2005 baseline level. The Adjusted BAU emissions are slightly lower than the BAU emissions due to the Low Carbon Fuel Standard measure described earlier. The Low Carbon Fuel Standard would lower the carbon intensity of fuels used in both the City's Vehicle Fleet and Employee Commute sectors.

Table 16. Municipal Adjusted BAU Emissions

Sector	2005 (MT CO ₂ e)	2012 (MT CO ₂ e)	2020 (MT CO ₂ e)	2020 % of Total	2035 (MT CO ₂ e)	2035 % of Total
Vehicle Fleet ¹	12,368	5,848	5,737	25%	5,861	28%
Solid Waste	8,655	7,430	6,364	28%	4,775	23%
Buildings & Facilities	5,005	5,179	5,179	23%	5,179	25%
Outdoor Lighting	2,442	2,464	2,464	11%	2,464	12%
Employee Commute	1,831	2,104	1,956	9%	1,956	9%
Water Delivery	517	862	862	4%	862	4%
Total	30,818	23,887	22,562	100%	21,097	100%
% Change from 2005		-22%	-27%		-32%	

1 Vehicle Fleet includes both Vehicle Fleet & Equipment and Aviation. The ClearPath tool reports them together in forecasts.

Reduction Targets

The State has set goals for reducing GHG emissions by 2020 and 2050 through AB 32 and Executive Order (EO) S-3-05, respectively. The State has also provided guidance to local jurisdictions as "essential partners"

in achieving the State's goals by identifying a 2020 recommended reduction goal. That goal, stated in the AB 32 Scoping Plan, was for local governments to achieve a 15% reduction below 2005 levels by 2020, which aligns with the State's goal of not exceeding 1990 emissions levels by 2020⁵. The State's long term target is to emit no more than 20% of 1990 levels by 2050 (or, a reduction of 80% below 1990 levels by 2050). The State has not provided an interim target, nor has it provided guidance to local governments beyond the 2020 emissions target recommendations. It is however clear that the issue of climate change will not end in 2020 and continued reductions should be achieved to keep the State on a path toward the 2050 goal. A straight-line projection from the 2020 to 2050 goals would result in a reduction goal of 49% below 2005 levels by 2035 midpoint.

Ultimately, the City will determine the level of reductions that it can and should achieve. The recommended targets provided below are guidance based on consistency with the State's goals.

Recommended Community Targets

In 2020, the Torrance Community would need to reduce 87,125 MT CO₂e emissions below the Adjusted BAU scenario to meet the reduction target. In 2035, the City would need to reduce 479,524 MT CO₂e emissions below the Adjusted BAU scenario to meet the State-aligned target (Table 17 and Figure 7).

Table 17. State-Aligned GHG Reduction Targets

Sector	2005	2012	2020	2035
BAU Emissions (MT CO ₂ e)	1,611,012	1,563,394	1,594,596	1,647,328
Adjusted BAU Emissions (MT CO ₂ e)	1,611,012	1,563,394	1,456,485	1,301,140
State-Aligned Target(% change from 2005)			-15%	-49%
State-Aligned Target (% change from 2012)			-12%	-47%
State-Aligned Emissions Goal (MT CO ₂ e)			1,369,360	821,616
Reductions from Adjusted BAU needed to meet the Target (MT CO ₂ e)			87,125	479,524

⁵ In an analysis, the State concluded that a 15% reduction in emissions from 2005 levels by 2020 would be equivalent to achieving 1990 emissions levels.

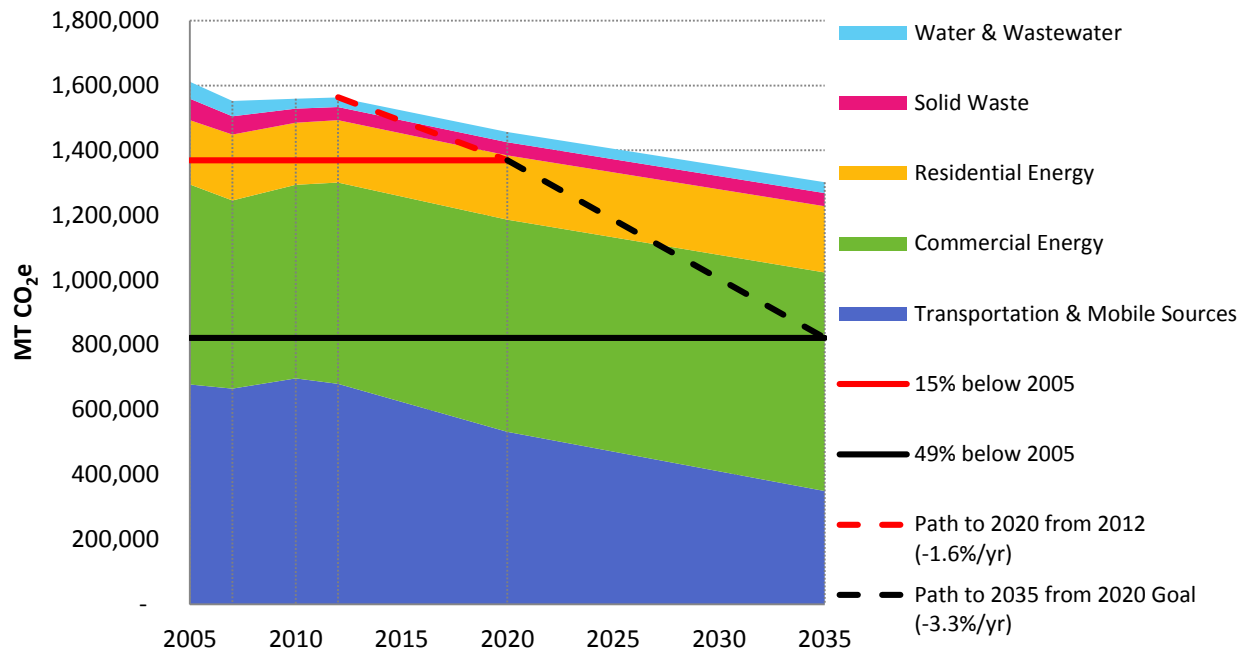


Figure 7. Community Emissions Inventories, Projections, and Targets

Recommended Municipal Targets

In 2020, the City is expected to meet a target of 15% below 2005 levels through implementation of existing legislation (Table 18 and Figure 8). However, the City will need to implement measures to continue to achieve GHG reductions beyond 2020. Early implementation of measures demonstrates the City's commitment to the EECAP, leadership in the community, and allows the City to phase implementation of new strategies so that ongoing reductions may be achieved. By 2035, the City will need to reduce municipal operation emissions by 5,380 MT CO₂e from a 2035 Adjusted BAU forecast to meet a 49% reduction goal (below 2005 levels).

Table 18. State-Aligned Municipal GHG Reduction Targets

	2005	2012	2020	2035
BAU Emissions (MT CO ₂ e)	30,818	23,887	22,939	21,474
Adjusted BAU Emissions (MT CO ₂ e)	30,818	23,887	22,562	21,097
State-Aligned Target(% change from 2005)			-15%	-49%
State-Aligned Target (% change from 2012)			12%	-33%
State-Aligned Emissions Goal (MT CO ₂ e)			26,195	15,717
Reductions from Adjusted BAU needed to meet the Target (MT CO ₂ e)			Target Met	5,380

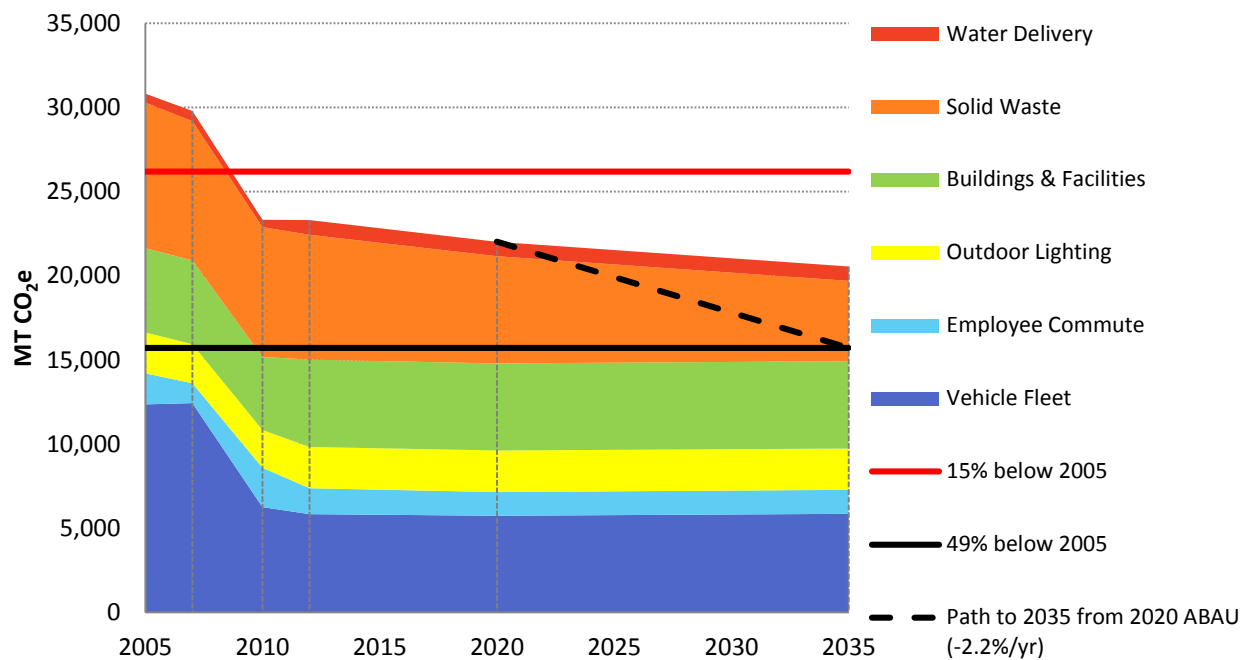


Figure 8. Municipal Emissions Inventories, Projections, and Targets

Conclusions and Next Steps

This Report presents the City's community and municipal inventories, forecasts, and recommended reduction targets. It is the foundation of the EECAP and provides the City a first look at what will be needed to meet emissions reductions that are aligned with the State and to mitigate the City's impacts on climate change. This Report also helps to guide the City in determining feasible energy efficiency reduction opportunities by detailing energy-related emissions, including electricity and natural gas from Residential and Commercial/Industrial sectors.

The next steps in the EECAP process are to review the information provided in this Report and to determine preliminary GHG reduction targets for the community and municipal operations. The South Bay Cities Council of Governments will also begin to work with the City to identify local and subregional energy efficiency measures that could be implemented to reach the City's emissions targets.

References

Association of Environmental Professionals. 2013. The California Supplement to the United States Community-Wide Greenhouse Gas (GHG) Emissions Protocol.

California Air Resources Board. 2010. Local Government Operations Protocol For the quantification and reporting of greenhouse gas emissions inventories version 1.1.

California Air Resources Board. 2011. California Greenhouse Gas Emissions Inventory: 2000-2009.

ICLEI 2012. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions version 1.0.

Intergovernmental Panel on Climate Change. (IPCC) 1996. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Appendix A: Glossary of Terms

Adjusted Business-as-Usual: A GHG forecast scenario that accounts for known policies and regulations that will affect future emissions. Generally, these are state and federal initiatives that will reduce emissions from the business-as-usual scenario.

Baseline Year: The inventory year used for setting targets and comparing future inventories against.

Business-as-Usual (BAU): A GHG forecast scenario used for the estimation of greenhouse gas emissions at a future date based on current technologies and regulatory requirements and in the absence of other reduction strategies.

Carbon Dioxide Equivalent (CO₂e): This is a common unit for normalizing greenhouse gases with different levels of heat trapping potential. For carbon dioxide itself, emissions in tons of CO₂ and tons of CO₂e are the same, whereas one ton of nitrous oxide emissions equates to 298 tons of CO₂e and one ton of methane equates to 25 tons of CO₂e. The values are based on the gases' global warming potentials.

Community Inventory: GHG emissions that result from the activities by residents and businesses in the city. An inventory reports emissions that occur over a single calendar year.

Emissions Factor: A coefficient used to convert activity data into greenhouse gas emissions. The factor is a measure of the greenhouse gas intensity of an activity, such as the amount of CO₂ in one kilowatt-hour of electricity.

Global Warming Potential (GWP): The relative effectiveness of a molecule of a greenhouse gas at trapping heat compared with one molecule of CO₂.

Metric Ton (MT): Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs. or 1.1 short tons.

Municipal Inventory: GHG emissions that result from the activities performed as part of the government operations in the city and are a subset of the community inventory. An inventory reports emissions that occur over a single calendar year.

Reduction targets: GHG emissions levels not to be exceeded by a specific date. Reduction targets are often informed by state recommendations and different targets may be established for different years.

Sector: A subset of the emissions inventory classified by a logical grouping such as economic or municipal-specific category.

Appendix B: Methodology

This appendix provides a detailed description of the data sources, emission factors, policies, and assumptions used to develop the greenhouse gas (GHG) emissions inventories, forecasts under a business-as-usual (BAU) scenario, forecasts under an Adjusted BAU scenario, and the recommended GHG reduction targets.

Protocols

The GHG inventories for 2005, 2007, 2010, and 2012 were calculated using tools and guidance documents developed or supported by government agencies. Calculation protocols have been developed to ensure consistency among community and municipal inventories. Specifically, the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol) (ICLEI 2012) and the California Supplement (AEP 2013) were used for the community inventories and the Local Government Operations Protocol (LGOP) was used for the municipal inventories (CARB 2010). These protocols often have multiple calculation methods for a single emission source depending on the data available. There are two broad approaches for calculating emissions: “bottom-up” and “top-down”. A bottom-up approach relies on end-use data, such as the city-level electricity usage. A top-down approach relies on aggregated data that is allocated to the city based on population, employment, or other relevant indicators. Bottom-up calculations were performed whenever possible to provide the most detailed and likely accurate picture of emissions within a jurisdiction; however, when detailed data were not available, other appropriate methods were used and are described in this appendix. Data were also calculated and managed to best fit the GHG inventory and planning software tool used for this project, called ClearPath. ClearPath was developed by the Statewide Energy Efficiency Collaborative (SEEC) which is a partnership between several statewide agencies, utilities, and non-profits to assist cities and counties in climate mitigation planning. ClearPath is further described at californiaseec.org. In addition, a South Bay Cities Council of Governments (SBCCOG) User’s Guide is being developed as part of this project to help cities and SBCCOG to maintain the data and provide for consistent reporting of emissions over time.

Global Warming Potential Factors

The inventories include the three GHGs most relevant to community and municipal emissions: CO₂, CH₄, and N₂O. Each GHG differs in its ability to absorb heat in the atmosphere based on their molecular properties and expected lifetime in the atmosphere, and it is useful to describe emissions in one unit of measurement. That unit of measurement is a CO₂-equivalent, or CO₂e and Global Warming Potential (GWP) factors are used to standardize emissions from various GHGs. GWP factors, developed by the Intergovernmental Panel on Climate Change (IPCC), represent the heat-trapping ability of each GHG relative to that of CO₂. For example, the GWP factor of CH₄ is 25 because one metric ton (MT) of CH₄ has 25 times the heat-trapping capacity as one MT CO₂ (over a 100-year period). IPCC periodically updates the GWP factors of GHGs based on new science and updated background mixing ratios of CO₂. CO₂ always has a GWP factor of 1 and the other GHGs are calculated relative to CO₂. The California Air Resources Board (CARB) recently updated their GWP factors to align with the IPCC’s Fourth Assessment Report, as shown in Table B-1. GWP factors are unitless. Emissions in the inventories are reported in units of CO₂e.

Table B-1. Global Warming Potentials

	CO ₂	CH ₄	N ₂ O
GWP	1	25	298

Source: IPCC Fourth Assessment Report, 2007.

Activity Data

Activity data is the end-use consumption amount of a sector, such as kilowatt hours of electricity, therms of natural gas, and vehicle miles traveled for on-road transportation. In estimating the City's historic GHG emissions, activity data at the City level were obtained when possible (a “bottom-up” approach). When not available, other data sources were used, generally at the county level (a “top-down” approach). Municipal data for 2005 and 2007 were obtained from the City's previous inventory report. Other data were provided by the sources as identified Table B-2.

Table B-2. Activity Data Sources

Data	Data Source	Notes
Community Electricity	Southern California Edison	
Municipal Electricity	Southern California Edison	Maintained by SBCCOG
Community Natural Gas	Southern California Gas Company	
Municipal Natural Gas	Southern California Gas Company	
Community Water	Golden State Water Company and City	
Vehicle Miles Traveled	Southern California Association of Governments (SCAG)	Origin-destination approach, described below
Demographic Data	SCAG	
Vehicle Fleet	City	
Employee Commute	City	
Off-Road Emissions	OFFROAD Model	County-level data
Waste	CalRecycle	

Origin-Destination VMT

For the community inventory, activity data (vehicle miles traveled) were based on an origin-destination approach used by the State in developing emissions target for metropolitan planning organizations under SB 375. This approach has also been the typical approach used in estimating emission within a city. This approach accounts for:

- Half of the emissions where one endpoint is in the City, for example either the origin or destination of the trip.
- All of the emissions where the trip begins and ends within the City.
- None of the emissions that are “pass-through”; that is, a trip passes through the City but does not begin or end within its boundary.

This approach is used to account for trips or portions of trips that the city may have some control over.

Cap-and-Trade Entities

The City has major industrial facilities within its borders. Through the Cap-and-Trade Program, the State regulates the GHG emissions from some of these industrial facilities. The Cap-and-Trade Program currently includes electric utilities and large industrial facilities with emissions equal to or exceeding 25,000 MT CO₂e and will expand in 2015 to include suppliers of transportation, natural gas, and other fuels with annual emissions equal to or exceeding 25,000 MT CO₂e. Entities that are regulated as part of the Cap-and-Trade Program are called “covered entities” and must obtain compliance instruments equal to their entity’s emissions. Each covered entity is required to procure emissions allowances and/or offset credits equal to their emissions. The allowances and offset credits are the two types of compliance instruments permitted in the Cap-and-Trade Program. Allowances are distributed by CARB to entities directly or by auction and may be traded in the free market. CARB-approved offset credits may be purchased from third-party registries to meet up to 8% of the entity’s compliance obligation. Each compliance instrument is equivalent to 1 MT CO₂e.

Over time, the number of compliance instruments available at the State level will decline and emissions will decrease. The emissions associated with covered entities are already regulated at the State level and therefore, the City does not have significant local control over the GHG emissions. The current protocol recommends excluding the covered entities’ GHG emissions from the City’s inventories. In an effort to be consistent with protocol, data were reviewed to determine to what extent covered entities are included.

Emissions from covered entities that would be included in a city’s inventory are from natural gas and electricity, and major industrial users generally utilize natural gas for their operations to a much larger extent than they utilize electricity. Data provided by SCG and SCE for this inventory report are protected under privacy restrictions which fall under the 15/15 rule.¹ Each utility provides data with these protections applied consistent with their individual corporate reporting protocols. The utilities do not specify if covered entities are included in the data provided. In comparing data from past inventory years, the electricity data are consistent and natural gas data are significantly reduced, leading to the conclusion that once the 15/15 rule was applied, major emitters, including many covered entities, were likely removed from the total natural gas data. If additional information becomes available that either allows the City to better separate out the energy usage from covered entities or provides better clarity of the current data aggregation, SBCCOG recommends that the City review the information and determine whether adjustments to the inventories and/or associated reports are warranted. If adjustments are made, SBCCOG recommends they be consistent among all inventory years and with current quantification methodology.

¹ The 15/15 rule requires that any aggregated information provided by the Utilities must be made up of at least 15 customers and a single customer’s load must be less than 15% of an assigned category. If the number of customers in the compiled data is below 15, or if a single customer’s load is more than 15% of the total data, categories must be combined before the information is released. The Rule further requires that if the 15/15 Rule is triggered for a second time after the data has been screened once already using the 15/15 Rule, the customer be dropped from the information provided.

Community Activity Data

Community activity data are shown in Table B-3, except for off-road emissions, which are shown in Table B-4 for Los Angeles County.

Table B-3. Activity Data used in 2005, 2007, 2010, and 2012 Community Inventories

Sector	2005	2007	2010	2012	% Change 2005 to 2012
On-road Transportation					
Total Vehicle Miles Traveled	1,282,531,135	1,271,121,860	1,367,126,178	1,369,046,211	6.7%
Residential Energy					
Electricity (kWh)	286,098,688	294,591,718	273,302,186	265,113,428	-7.3%
Natural Gas (therms)	20,920,237	22,351,936	21,173,265	20,315,160	-2.9%
Commercial/Industrial Energy					
Electricity (kWh)	1,720,797,117	1,684,882,312	1,491,431,552	1,446,744,854	-15.9%
Natural Gas (therms)	17,754,811	17,873,966	31,613,535	29,721,984	67.4%
Solid Waste					
Landfilled (tons)	236,865	195,127	146,063	131,802	-44.4%
ADC (tons) ¹	1,497	698	282	1,719	14.8%
Closed Municipal Landfill (CH ₄) ⁴	1,315	1,263	1,190	1,143	-13%
Water and Wastewater					
Water (MG) ²	9,647	9,337	8,359	8,635	-10.5%
Recycled Water (MG) ²	2,094	2,124	2,103	2,177	4.0%
Wastewater (City portion of countywide residents)	1.46%	1.47%	1.48%	1.48%	0.9%
Aviation					
Aviation Fuel	383,874	389,765	398,301	399,826	4.2%
Off-road Sources³ (% of LA County emissions attributed to the City)					
Lawn & Garden (% Households)	1.73%	1.72%	1.69%	1.69%	-2.5%
Construction (% Building permits)	1.23%	0.99%	0.58%	0.11%	-91.4%
Industrial (% Manufacturing jobs)	4.35%	4.57%	4.60%	4.57%	5.2%
Light Commercial (% Other jobs)	2.10%	2.20%	2.22%	2.21%	5.6%
Recreation (Population weighted by income)	1.95%	1.95%	1.96%	1.96%	0.6%
Agriculture (% Ag. Jobs)	0.77%	0.81%	0.95%	0.77%	-0.7%

1 ADC is Alternative Daily Cover, which is green waste (grass, leaves, and branches) that is used to cover landfill emissions. They are reported separately by CalRecycle and therefore shown separately here.

2 2005 and 2007 data were not available. Therefore, 2009 data was used as proxy. Data does not include municipal water use from the City of Torrance.

3 Off-road emissions are available at the county level through CARB's OFFROAD model. Emissions attributable to the City were derived using indicator data related to the off-road source. For example, the percentage of households in the City compared to the county was used to attribute the same percentage of lawn & garden equipment emissions to the City. See Appendix B for more methodology details.

4 ARB's Landfill Model Emissions Tool was used to evaluate the estimated emissions from Landfill 19-AA-5321. The CH₄ output was converted using protocol assumptions that 75% of methane gas from landfills is captured.

Table B-4. Emissions from Off-road Categories for Los Angeles County

Off-road Class	GHG Type	2005 (MT CO _{2e} /yr)	2007 (MT CO _{2e} /yr)	2010 (MT CO _{2e} /yr)	2012 (MT CO _{2e} /yr)
Agricultural Equipment	CO ₂	921.79	910.27	893.24	882.09
	CH ₄	0.19	0.17	0.14	0.12
	N ₂ O	0.01	0.01	0.01	0.01
Construction and Mining Equipment	CO ₂	268,646.23	277,541.76	290,911.26	299,875.79
	CH ₄	34.12	31.44	28.24	26.28
	N ₂ O	0.22	0.24	0.25	0.26
Industrial Equipment	CO ₂	8,099.90	8,562.29	9,255.58	9,870.65
	CH ₄	7.16	6.2	4.46	3.89
	N ₂ O	0.69	0.63	0.56	0.55
Lawn and Garden Equipment	CO ₂	2,581.13	2,737.30	2,968.71	3,215.02
	CH ₄	4.98	4.87	4.76	4.96
	N ₂ O	2.01	2.01	2.01	2.13
Light Commercial Equipment	CO ₂	5,300.36	5,572.36	5,979.92	6,387.77
	CH ₄	2.83	2.54	2.18	2.05
	N ₂ O	0.91	0.97	1.02	1.07
Recreational Equipment	CO ₂	286.54	309.8	343.68	369.04
	CH ₄	2.14	2.32	2.58	2.77
	N ₂ O	0.52	0.57	0.64	0.68

Municipal Activity Data

Municipal activity data are shown in Table B-5.

Employee Commute

Data for Employee Commute in ClearPath are entered as gasoline or diesel. Annual vehicle miles traveled is entered as is the percent of miles traveled by passenger cars, light trucks, and heavy trucks. The City participates in the South Coast Air Quality Management District's Average Vehicle Ridership Survey (Survey). Data from the City's 2010 and 2012 Survey were compiled and used to estimate the average commute distance for employees in 2010 and 2012.

Table B-5. Activity Data used in 2005, 2007, 2010, and 2012 Municipal Inventories

Sector	2005	2007	2010	2012	% Change 2005 to 2012
Buildings & Facilities					
Electricity (kWh)	11,575,233	11,566,648	9,329,877	11,732,813	1%
Natural Gas (therms)	279,738	310,236	307,151	263,657	-6%
Outdoor Lights					
City-owned Electricity (kWh)	1,160,096	1,147,354	883,079	828,120	-29%
SCE-owned (kWh)	6,878,751	6,908,608	6,903,510	6,876,621	<1%
Fleet & Equipment					
City-owned Fleet					
Gasoline (gallons) ²	246,835	272,955	221,559	193,188	-22%
Diesel (gallons)	681,187	667,708	182,063	146,958	-78%
CNG (standard cubic feet)	0	267,495	33,166	288,404	--
Employee Commute³					
Gasoline (vehicle miles traveled)	4,234,596	2,736,947	5,414,335	4,889,690	15%
Diesel (vehicle miles traveled)	0	453	96,148	86,831	--
# Full Time Employee Equivalents ⁴	1,767	1,013	1,548	1,398	-21%
Solid Waste					
Generated Waste (tons) ⁴	1,358	1,164	1,164	1,164	-14%
Closed Municipal Landfill (CH ₄) ⁵	1,315	1,263	1,190	1,143	-13%
Water Delivery					
Electricity (kWh)	1,700,902	2,100,669	1,497,195	2,694,669	58%
Aviation					
Aviation Gasoline (gallons)	109,503	135,752	69,075	100,699	-8%

1 The methodology for disaggregating Parks from Other Buildings & Facilities may differ from the 2005 and 2007 inventories to the 2010 and 2012 inventories.

2 The City's Vehicle Fleet includes Hybrid vehicles. To incorporate the fuel used in hybrid vehicles, half of the fuel (gallons) was added to the Gasoline gallons. Transit Fleet is also included.

3 Employee Commute survey conducted in 2014 and adjusted based on the number of employees in 2010 and 2012

4 Data for 2010 and 2012 were not available; therefore, activity data from 2007 data was used as a proxy.

5 ARB's Landfill Model Emissions Tool was used to evaluate the estimated emissions from Landfill 19-AA-5321. The CH₄ output was converted using protocol assumptions that 75% of methane gas from landfills is captured.

Emission Factors

Emissions factors are used to convert activity data to GHG emissions. An emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity. By definition, an emission factor is related to activity data. The emission factors used in the inventories are described by sector below.

Electricity

California utilities report the average CO₂ content per output of electricity on an intermittent basis. The CO₂-intensity of electricity varies by utility and year, due to changes in supply, renewable generation, and other factors. The community and municipal operations use electricity provided by SCE except for embedded energy in water, which travels throughout the state and therefore utilizes electricity from multiple utilities (and are shown under the Water Sector).

Southern California Edison

SCE reported CO₂ factors for 2005 and 2007 through the Climate Registry, and a CO₂e factor for 2012 in their [2012 Corporate Responsibility & Sustainability Report](#). When an emission factor is unknown for a certain year, it is standard to use the most recently-reported historic factor until (and if) there is an updated factor. There is no published SCE emission factor for 2010; therefore the factor for 2007 was used for SCE electricity-related emissions calculations in 2010 (Table B-6).

Table B-6. Southern California Edison Electricity Emission Factors

Year	CO ₂	CH ₄	N ₂ O	Proxy Year	Data Source
2005	665.72	0.03	0.011	NA	CO ₂ : Climate Registry. CH ₄ and N ₂ O: U.S. Community Protocol
2007	630.89	0.029	0.010	NA	CO ₂ : Climate Registry. CH ₄ and N ₂ O: U.S. Community Protocol
2010	630.89	0.029	0.010	2007	CO ₂ : Climate Registry. CH ₄ and N ₂ O: U.S. Community Protocol
2012	705 ¹	NA	NA	NA	2012 Corporate Responsibility & Sustainability Report

NA: Not Applicable.

1 The 2012 factor was reported as CO₂e; therefore, there are no CH₄ and N₂O factors.

Natural Gas Combustion

Emission factors for natural gas do not vary greatly over time or by supplier. Therefore, emission factors are U.S. averages as listed in the Community Protocol and are applied for all years (Table B-7).

Table B-7. Natural Gas Emission Factors

	CO ₂	CH ₄	N ₂ O	Data Source
kg /MMBtu	53.02	0.005	0.0001	U.S. Community Protocol

Transportation and Mobile Sources

EMFAC Model

CO₂ emission factors for transportation and mobile sources are calculated using the State-developed Emissions Factor (EMFAC) model, which can be downloaded at <http://www.arb.ca.gov/emfac/>. Emissions are available at the county level and emission factors were developed and applied to vehicle miles traveled specific to each inventory year. Data are aggregated as annual emissions for all vehicle model years and speeds, but separated by vehicle category. Vehicle categories include light-duty autos,

light-duty trucks, medium-duty vehicles, heavy-duty trucks, and motorcycles.² These categorizations are used to develop an emissions factor for gasoline and diesel vehicles. Emission factors were developed using total CO₂ exhaust, which includes emissions from vehicles in motion, idling, and ignition. While emissions from idling and ignitions are not directly related to mileage, they were included so that reductions from measures that may decrease idling could be accounted for in future inventories.

On-Road Transportation

Emissions were converted to emission factors as grams of CO₂ per mile for gasoline and diesel vehicle using EMFAC and a 3-step process (for each inventory year):

1. Calculate the vehicle-class average fuel efficiency (miles/gallon) using EMFAC vehicle miles traveled and gallons of fuel consumed for Los Angeles County;
2. Calculate the vehicle-class average CO₂ emission factor using EMFAC CO₂ emissions³ and gallons of fuel consumed for Los Angeles County;
3. Calculate the average grams CO₂/mile traveled factor weighted by vehicle class miles traveled for Los Angeles County.

EMFAC does not provide emissions for CH₄ and N₂O; therefore, factors from the Community Protocol were used (Table B-8).

Table B-8. Fleet-Average Emission Factors

	Gasoline On Road Average Factor (grams/mile)			Diesel On Road Average Factor (grams/mile)		
	CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
2005	466.062	0.030	0.034	1329.797	0.001	0.001
2007	464.019	0.028	0.029	1331.634	0.001	0.001
2010	458.638	0.028	0.029	1280.045	0.001	0.001
2012	442.657	0.028	0.029	1302.653	0.001	0.001

Employee Commute

Emissions from employee commute in the municipal operations are calculated using annual vehicle miles traveled for gasoline and diesel. CO₂ emissions are estimated using a default emission factor of 8.78 and 10.21 kg/gallon for gasoline and diesel, respectively⁴ and fuel economy, which is based on EMFAC outputs for each inventory year and vehicle class. Vehicle miles traveled are converted to CH₄

² Vehicle categories may use either EMFAC2007 or EMFAC2011 categorizations and result in the same data for the purposes of these inventories; EMFAC2007 categories were used here EMFAC2011 further disaggregates medium heavy-duty vehicles and heavy heavy-duty vehicles into 29 vehicle categories. This level of detail is not needed for these inventories. More information on vehicle categories is available at <http://www.arb.ca.gov/msei/vehicle-categories.xlsx>.

³ For 2010 and 2012, the emissions accounting for the effects of existing policies (Pavley and Low Carbon Fuel Standard) were used. These standards did not exist in 2005 and 2007.

⁴ Information from ClearPath developers e-mail dated June 19, 2014.

and N₂O emissions using emission factors from the Community Protocol. Table B-6 shows the miles per gallon and grams (CH₄ and N₂O) per mile used to estimate emissions from employee commute by vehicle class.

Vehicle Fleet

Vehicle fleet consists of City-owned and contracted vehicles used to perform City services. Vehicle Fleet requires input of gallons of fuel used by fuel type to estimate CO₂ emissions. Vehicle miles traveled are used to estimate CH₄ and N₂O. The factors used for the City are shown in Table B-9.

Table B-9. Employee Commute and Vehicle Fleet Emission Factors

		2005	2007	2010	2012
Gasoline					
Passenger Vehicle	MPG	21.700	21.875	22.027	22.064
	g CH ₄ /mi	0.030	0.028	0.028	0.028
	g N ₂ O/mi	0.034	0.029	0.029	0.029
Light Truck	MPG	16.575	16.666	16.795	16.823
	g CH ₄ /mi	0.035	0.031	0.031	0.031
	g N ₂ O/mi	0.049	0.043	0.043	0.043
Heavy Truck	MPG	12.754	12.806	12.854	12.856
	g CH ₄ /mi	0.033	0.033	0.033	0.033
	g N ₂ O/mi	0.013	0.013	0.013	0.013
Diesel					
Passenger Vehicle	MPG	21.700	21.875	22.027	22.064
	g CH ₄ /mi	0.030	0.028	0.028	0.028
	g N ₂ O/mi	0.034	0.029	0.029	0.029
Light Truck	MPG	16.575	16.666	16.795	16.823
	g CH ₄ /mi	0.035	0.031	0.031	0.031
	g N ₂ O/mi	0.049	0.043	0.043	0.043
Heavy Truck	MPG	12.754	12.806	12.854	12.856
	g CH ₄ /mi	0.033	0.033	0.033	0.033
	g N ₂ O/mi	0.013	0.013	0.013	0.013

Note: MPG is miles per gallon and is derived from EMFAC at the county level. CH₄ and N₂O emission factors are from the Community Protocol; Passenger Vehicle and Light Truck emission factors have data for 2005 and later; Heavy Truck only have 2010 data.

Off-Road

Off-road emissions include emissions from agriculture, construction, industrial, lawn and garden, light commercial, and recreational equipment. Annual emissions of CO₂, CH₄, and N₂O are available at the county level from the State's OFFROAD model. To estimate values for each city, relevant indicator data are used to estimate the proportion of county-level emissions attributable to the city. Table B-10 lists the indicator used to estimate the City's portion of emissions for each category and Table B-11 shows City-specific data. City- and county-level indicator data were obtained from SCAG.

Table B-10. Off-road Emissions Indicators

Category	Indicator
Agriculture Equipment	Agriculture Jobs
Construction Equipment	Building Permits Issued
Industrial Equipment	Manufacturing Jobs
Lawn and Garden Equipment	Households
Light Commercial Equipment	Non- Manufacturing or Agriculture Jobs
Recreational Equipment	Population, Weighted by Median Income

Table B-11. Off-road Emissions Indicator Data

		Ag. Jobs	Building Permits	Mfg. Jobs	Households	Other Jobs ¹	Population	Income (\$)
2005	City	55	18	12,048	7,080	42,415	16,649	74,016
	County	13,562	25,623	461,099	3,178,736	4,045,922	9,816,200	48,606
	%	0.40%	0.07%	2.61%	0.22%	1.05%		0.26%
2007	City	57	19	12,500	7,091	44,003	16,599	80,037
	County	13,562	20,303	461,099	3,224,053	4,045,922	9,780,800	51,439
	%	0.42%	0.09%	2.71%	0.22%	1.09%		0.26%
2010	City	50	3	9,839	7,410	40,056	16,650	90,000
	County	10,598	7,466	362,157	3,454,093	3,758,244	9,818,605	56,000
	%	0.47%	0.04%	2.72%	0.21%	1.07%		0.27%
2012	City	31	26	10,011	7,412	40,860	16,720	85,511
	County	10,798	18,926	369,005	3,454,093	3,829,313	9,889,632	53,880
	%	0.29%	0.14%	2.71%	0.21%	1.07%		0.27%

Note: Some percentages may appear off due to rounding. Ag. = Agriculture. Mfg. = Manufacturing.

1 Other indicates non-manufacturing and non-agricultural.

Water

Emissions from water are indirect. Water requires energy to move from its source to final treatment and the energy for most of these processes is not captured in local utility data (i.e., the portion that is used in a home or business and therefore contained in the owner's utility bill). This portion is termed the "embedded energy" in water and particularly for southern California, the energy embedded in water is high and should be accounted for in a community inventory. The California Energy Commission (CEC) developed a report, titled [Refining Estimates for Water-Related Energy Use in California](#), which estimates the energy required to supply, convey, distribute, and treat water in northern and southern California. Recycled water is less energy-intensive because it does not require the supply and conveyance energy. Outdoor water infiltrates into the ground and therefore does not have the wastewater energy treatment component. Therefore, the emission factors are adjusted to account for the proportion of recycled and outdoor water. The amount of water used for indoor or outdoor use was not available at the City level; however, the 2010 Los Angeles Department of Water & Power, Urban

Water Management Plan states that 61% of water is for indoor use for the City of Los Angeles. The water usage is assumed to be similar for the South Bay sub-region. Therefore, the embedded energy in a million gallon (MG) of water in the City is estimated in Table B-12 using the CEC report and estimated indoor vs. outdoor water usage in the region.

Table B-12. Energy Embedded in Water

	Conventional ¹ (kWh/MG)	Recycled (kWh/MG)
Supply and Convey	9,727	--
Treatment	111	111
Distribution	1,272	1,272
Wastewater Treatment	1,911	1,911
Total	13,022	3,294
South Bay Factor	12,275.71	2,548.71

From CEC's 2006 Refining Estimates for Water-Related Energy Use in California, for Indoor water use in southern California.

Statewide Average Electricity

For energy embedded in water, a statewide average emission factor is applied because water in the South Bay sub-region is supplied from various regions in the State (Table B-13). Similar to SCE data, statewide emission factors are not available for each inventory year. For 2010 and 2012, the 2009 statewide emission factors were used as the proxy year.

Table B-13. California Statewide Electricity Emission Factors

Year	CO ₂	CH ₄	N ₂ O	Proxy Year	Data Source
2005	948.28	0.03	0.011	NA	U.S. Community Protocol
2007	919.64	0.029	0.010	NA	U.S. Community Protocol
2010	658.68	0.029	0.006	2009	U.S. Community Protocol
2012	658.68	0.029	0.006	2009	U.S. Community Protocol

A: Not Applicable.

Wastewater

The emissions for wastewater include the CH₄ and N₂O emissions from processing which consist of three sources: **stationary**, **process**, and **fugitive** emissions.

Stationary emissions are derived from combustion of digester gas at a centralized treatment facility. The City is served by the Los Angeles County Sanitation District's Joint Water Pollution Control Plant (JWPCP). JWPCP is a centralized treatment facility that uses an anaerobic digester process and does not employ a formal nitrification/denitrification (N/DN) system. Detailed information regarding the amount of digester gas produces was not available, so an alternative method using City population information was used. Default factors from the Community Protocol were applied to estimate CH₄ and N₂O emissions

for stationary emissions. Although CO₂ emissions are also produced, the fuel source is considered a biofuel, and the resulting CO₂ emissions are considered “biogenic” and are not reported⁵.

Process emissions include N₂O emissions as a result of N/DN processes at the treatment facility. All wastewater facilities have emissions from N/DN—some facilities have a formal N/DN process, which would result in greater N/DN emissions, but for the JWPCP, N/DN emissions are solely a result of natural processes. The recommended approach to estimating these emissions is through the population served and default factors listed in the Community Protocol. In an advanced, centralized treatment facility, stationary and process emissions are relatively small compared to fugitive emissions. The Community Protocol, and likewise ClearPath, recommends multiplying the population-derived emissions by 1.25 to account for commercial and industrial discharges to the system. Regions without any commercial and industrial sources should use a factor of 1.0. Because the City is largely residential, a factor of 1.0 was applied to these emissions.

Fugitive emissions occur from inflow (septic systems) and effluent discharge. JWPCP reports facility-wide effluent, and effluent nitrogen content, which are factors used in estimating fugitive emissions (Table B-14). The City’s portion was determined by estimating the proportion of the population served by JWPCP. The ClearPath tool requires the daily N load in kg N per day. This is calculated using the factors listed in Table B-14 and the Community Protocol Equation WW.12:

$$\text{Daily N Load for the City (kg N/day)} = \text{Effluent} \times \text{Effluent Nitrogen Content} \times \text{gallons/liter} \\ \times \text{City Population/Service Population},$$

Where Effluent is the facility-wide discharge in millions of gallons per day (MGD), Effluent Nitrogen Content is the average nitrogen content per volume (mg/L), and gallons/liter is a conversion factor (3.79). The Daily N Load entered into ClearPath was adjusted by a factor of 0.5 to account for the difference in emission factors for direct ocean discharge and stream/river discharge. In ClearPath, ocean discharge is not an option; however, the emissions are estimated to be ½ of those from discharge to a stream or river (see Community Protocol Appendix F). Therefore, the Daily N Load was adjusted by 0.5 to account for this difference.

Table B-14. Los Angeles County Joint Water Pollution Control Plant Data Used in Wastewater Fugitive Emissions

	2005	2007	2010	2012
Effluent (MGD)	403 ^a	296 ^b	237 ^c	264 ^d
Effluent Nitrogen content (mg/L)	40 ^a	36.7 ^b	39.7 ^e	41.1 ^d

^a Default assumption based on influent.

^b 2008 annual report data.

^c 2011 annual report data.

^d 2013 annual report data.

^e Based on communication with Los Angeles County Sanitation District for 2009.

⁵ Emissions from digester gas combustion are automatically calculated in ClearPath when population is entered.

Solid Waste

Emissions from solid waste are primarily in the form of fugitive emissions of methane from decomposition. Emission factors are derived from the Community Protocol, based on the type of waste disposed. The State conducts a Waste Characterization Study (Study) every 4 to 6 years to determine the amount of waste attributable to each waste type. The Study is conducted at the State level by economic sector; therefore, community-level characterizations are not available. For the community inventory, the overall composition of California's disposed waste stream was used to convert total tons into waste types (Table B-15). For the municipal inventory, the characterization for public administration was used (Table B-15). In addition to community-generated waste, some diverted green waste is used as landfill cover rather than importing landfill cover from other regions. This green waste is known as alternative daily cover (ADC) and is reported by CalRecycle for each community. The ADC characterization was determined through communication with the developers of ClearPath and does not vary by year or community. The emission factor to determine methane generation varies if the landfill operates a methane flare or generates electricity from methane capture. The Community Protocol recommends using an average factor of 75% recovery from landfill gas, although some landfills have much higher gas recovery systems, and other landfills do not have any. Carbon dioxide generated by decomposition of waste in landfills is not considered anthropogenic because it would be produced through the natural decomposition process regardless of its disposition in the landfill. Nitrous oxide is not a by-product of decomposition and therefore no fugitive emissions of nitrous oxide are anticipated from this source. The waste characterizations and emission factors used to estimate emissions from solid waste are provided in Table B-15. The "Category in the 2004 and 2008 Studies" detail which Study categories make up the ClearPath Category.

Table B-15. Waste Characterization and Emission Factors for Solid Waste

ClearPath Category	Category in 2004 and 2008 Studies	Alternative Daily Cover ¹	2004 Study ²	2008 Study ³	Public Administration	Emission Factor ¹
Newspaper	Newspaper	0%	2.2%	1.3%	5.5%	0.043
Office Paper	White/Colored Ledger Paper + Other Office Paper + Other Miscellaneous Paper	0%	5.4%	4.9%	13%	0.203
Cardboard	Uncoated Corrugated Cardboard + Paper Bags	0%	6.7%	5.2%	5.1%	0.120
Magazine/ Third Class Mail	Magazines and Catalogs + Remainder/ Composite Paper	0%	6.5%	5.9%	15.4%	0.049
Food Scraps	Food	0%	14.6%	15.5%	9.8%	0.078
Grass	Leaves and Grass	30%	2.1%	1.9%	8.05%	0.038
Leaves	Leaves and Grass	40%	2.1%	1.9%	8.05%	0.013
Lumber	Branches and Stumps + Prunings and Trimmings	0%	2.6%	3.3%	0.1%	0.062
Branches	Lumber	30%	9.6%	14.5%	5%	0.062

Breakdown from ClearPath Developers via e-mail dated June 19, 2014. Used for all inventory years.

2004 Waste Characterization Study for California, Overall Waste Stream. Used for 2005 inventory. Does not total 100% as not all waste is organic.

2008 Waste Characterization Study for California, Overall Waste Stream Used for 2007, 2010, 2012 inventories. Does not total 100% as not all waste is organic.

Forecasts

The forecasts are an estimate of what emissions in the City may be in 2020 and 2035. The forecasts were developed using standard methodologies under two scenarios: Business-as-Usual (BAU) and Adjusted BAU.

Business-as-Usual Forecasts

The BAU scenario uses current (2012) consumption patterns and predicted growth in the City in the absence of state and federal legislation that would reduce future emissions. The growth assumptions are those estimated by SCAG in their 2012 Regional Transportation Plan and are applied to emissions sectors based on their relevance. For example, future Residential Energy emissions were developed using current energy use per household (from the 2012 inventory) and the anticipated number of households in the future. Table B-16 shows the growth factors used to project emissions in the City.

Table B-16. Emissions Sectors and Demographic Growth Indicators

Sector	Demographic Indicator
Residential Energy	Households
Commercial/ Industrial Energy	Jobs
Solid Waste, Water, Wastewater, Aviation, Off-Road Sources	Service Population (Population + Jobs)
Transportation	Vehicle Miles Traveled, modeled by SCAG
Municipal Jobs	Municipal Emissions ¹

SCAG: Southern California Association of Governments

The number of jobs in the City is used as an indicator for all municipal operation emissions except Aviation, which is forecast consistent with the community forecast (by change in service population).

Adjusted Business-as-Usual Forecasts

The Adjusted BAU scenario also uses growth estimates for the City, also accounts for legislation that will reduce emissions in the future, regardless of City actions. Table B-17 summarizes the legislation that will reduce the City's emissions in the future and which sectors the legislation applies to.

Table B-17. Legislation Applied to Adjusted BAU Forecasts

Legislation	Description	Emissions Sector Affected
Low Carbon Fuel Standard	Reduce carbon intensity of transportation fuels 10% by 2020.	On-road Transportation, Employee Commute, Vehicle Fleet
AB 1493 and Advanced Clean Cars	Implement GHG standards for passenger vehicles, implement zero-emission vehicle program, support clean fuels outlet regulation.	On-road Transportation
California Building Code Title 24	Improved energy efficiency standards for new residential and non-residential construction.	Residential Energy, Non-residential Energy
Renewable Portfolio Standard ¹	Provide 33% of electricity from renewable sources by 2020.	Water
Senate Bill X7-7	Reduce urban per capita water consumption 20% by 2020.	Water

Potential GHG reductions from this legislation were not applied to the electricity in SCE's service territory due to the uncertainty in SCE's generation sources after the closure of the San Onofre Nuclear Generating Station.

Low Carbon Fuel Standard, AB 1493, and Advanced Clean Cars

Changes in on-road emissions in Los Angeles County were modeled using EMFAC, which models both the emissions with and without Low Carbon Fuel Standard and Pavley I. Additional modeling was conducted to estimate the change in emissions due to Advanced Clean Cars. The rate of reductions from on-road transportation measures through 2020 was assumed to be 0.0344% per year for gasoline and 0.0106% per year for diesel. After 2020, the rate of reductions was assumed to be 0.03452% per year for gasoline and 0.0251% per year for diesel.

California Building Code Title 24

Title 24 updates will raise the minimum energy efficiency standards for new buildings, thereby decreasing the expected energy consumption of future development in the City. Under the adjusted BAU scenario, it was assumed that the 2013 Title 24 standards that went into effect in 2014 will make new residential and non-residential buildings more efficient than they would be under the 2008 Title 24 standards for new residential buildings. The energy savings were estimated using analyses developed by the California Energy Commission and the applied to the expected new development in the City to 2020 and 2035. The rate of reductions was applied to the City's 2012 energy use (kWh or therms) per household (for Residential energy) or per job (for Commercial energy). Savings were applied to new development anticipated in the City. Detailed energy savings assumptions are below.

Residential

Residential electricity is estimated to be 32.6% lower under the new standards.⁶ This percentage savings is relative to heating, cooling, lighting and water heating only and do not include other appliances, outdoor lighting that is not attached to buildings, plug loads, or other energy uses. Electricity consumption due to heating, cooling, lighting, and water heating accounts for 34% of total household electricity use.⁷ Therefore, the percentage of total residential electricity that will be reduced as a result of the 2013 Title 24 standards is 11.1%.

Residential natural gas savings were estimated 5.8% lower under the new standards. Again, this percentage savings pertains only to the energy sources affected by Title 24 Standards. Natural gas consumption due to space and water heating accounts for 86% of total household natural gas use.⁸ Therefore, the percentage of total residential natural gas that will be reduced as a result of the 2013 Title 24 standards is 5.0%.

Commercial

Commercial Electricity savings were estimated to be 21.8% lower under the new standards. Title 24-related measures would impact 77.2% of total electricity use in commercial buildings⁹; therefore, 16.8% reduction in electricity consumption may be expected in new commercial development.

⁶ CEC Impact Analysis, California's 2013 Building Energy Efficiency Standards, July 2013. CEC-400-2013-008.

⁷ CEC 2009 California Residential Appliance Saturation Appliance Study, October 2010. CEC-200-2010-004.

⁸ CEC 2009 California Residential Appliance Saturation Appliance Study, October 2010. CEC-200-2010-004.

⁹ CEC 2006. California Commercial End-Use Survey. March 2006. CEC-400-2006-005.

Natural gas savings were estimated to be 16.8% under the new standards compared to the previous standards. Heating and cooling account for 69.7% of natural gas consumption in commercial facilities; therefore, 11.7% reduction in natural gas consumption may be expected from 2013 Title 24 standards applied to new commercial development.

Renewable Portfolio Standard

The Renewable Portfolio Standard will be fully implemented in 2020. The level of implementation varies by utility; however, ICLEI estimates that the average statewide level of implementation is 5% per year, compounded annually. As noted in the Report, this reduction is only taken for electricity used in the transport and treatment of water, which moves throughout the State. The reduction is not taken for electricity wholly within SCE's territory.

Senate Bill X7-7

SB X7-7 will be implemented by individual water districts. For the City's water provider, Golden State Water Company, the level of implementation was estimated using an annualized reduction rate from the Company's baseline water consumption rate (126 gallons per capita per day, GPCD) to the target water consumption rate (119 GPCD).

Target Setting

The state-aligned targets are provided to assist the City in determining appropriate emission reduction goals. Recommended targets are based on existing California climate change legislation and State guidance relevant to establishing a GHG reduction target. While State goals are based on a 1990 baseline year, the City's baseline year is 2005. Therefore, the reduction targets are expressed as a percent reduction below 2005 levels. Targets are recommended for 2020 to align with AB 32 and 2035, which is a midpoint between the 2020 goal and the State's long-term 2050 goal. Planning beyond 2035 is considered speculative, as legislation and technology may change significantly before 2050. While it is important for continued reductions well beyond 2035, no local targets are recommended at this time.

Table B-18 provides a summary of the State's goals and the State's guidance to local governments regarding GHG reduction targets. This guidance applies to both municipal operations and communitywide emissions reductions efforts.

**Table B-18. Summary of State Reduction Targets and Guidance on Local Government Targets
Aligned with State Targets**

	2020	Interim Year Between 2020-2050	2050
State Targets (AB 32 and EO S-3-05)	1990 levels	NA	80% below 1990 levels
State Guidance on Local Government Targets (AB 32) Scoping Plan Recommended Target and Attorney General's Office Guidance	15% below 2005-2008 levels	Demonstrate a trajectory toward statewide 2050 levels (e.g., 49% below 2005 levels by 2035)	NA

Table B-19 demonstrates how the local targets are aligned with State targets.

Table B-19. Comparison of 1990 Baseline Targets vs. 2005 Baseline Targets

Target Year	Percent below 1990 Emission Levels	Percent below 2005 Emission Levels
2020	0.0%	15.0%
2021	2.7%	17.3%
2022	5.3%	19.5%
2023	8.0%	21.8%
2024	10.7%	24.1%
2025	13.3%	26.3%
2026	16.0%	28.6%
2027	18.7%	30.9%
2028	21.3%	33.1%
2029	24.0%	35.4%
2030	26.7%	37.7%
2031	29.3%	39.9%
2032	32.0%	42.2%
2033	34.7%	44.5%
2034	37.3%	46.7%
2035	40.0%	49.0%