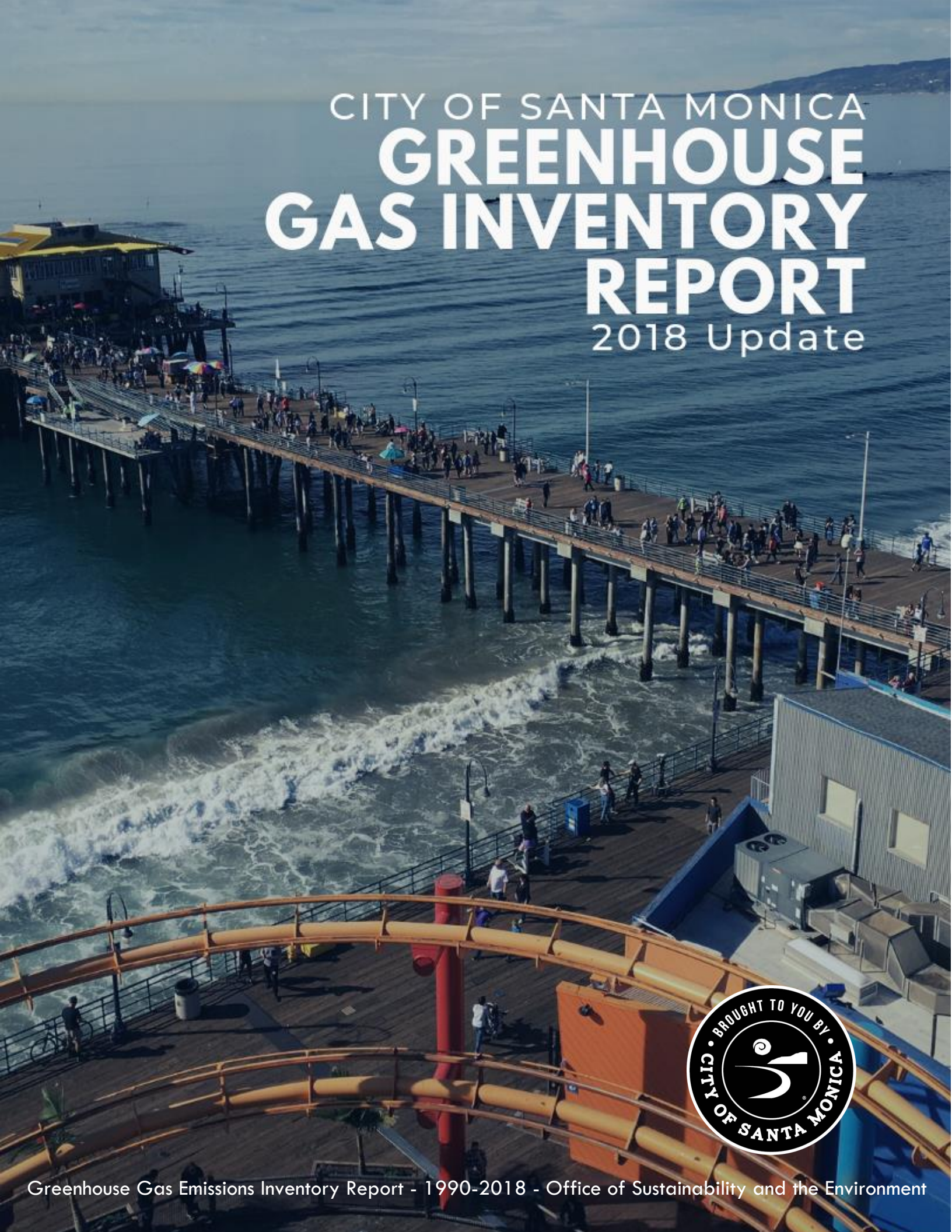

CITY OF SANTA MONICA

GREENHOUSE GAS INVENTORY REPORT

2018 Update

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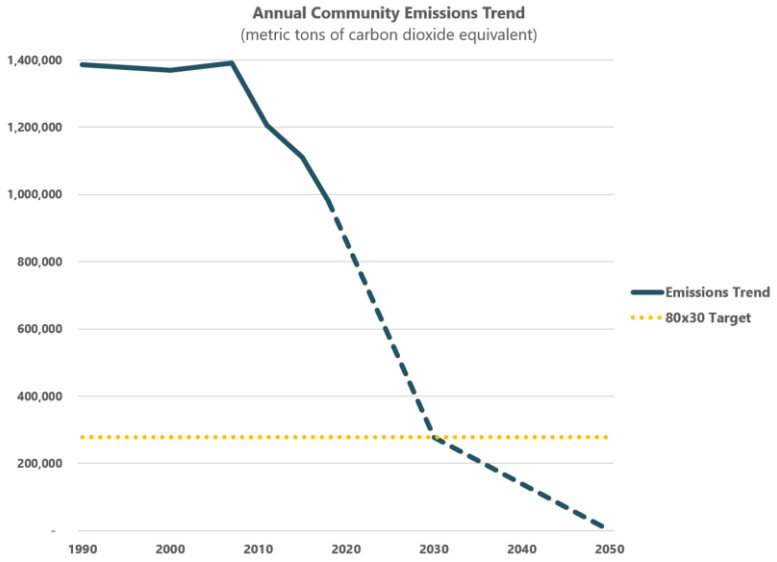
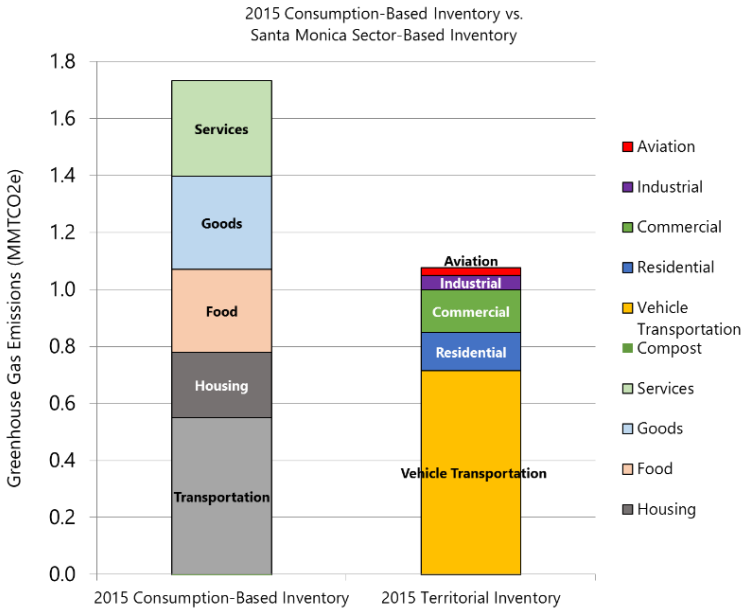
OVERVIEW

Daily life activities generate carbon emissions. Creating a greenhouse gas, or carbon, emissions inventory helps to provide a snapshot of a community's impact as well as identify areas to reduce carbon emissions. It is a best practice to monitor progress over time and ensure accountability.

Santa Monica has been tracking local greenhouse gas (GHG or carbon) emissions for over 20 years through an annual community (sector-based) emissions inventory. ***Santa Monica's emissions have declined since 1990 by 29%*** (2018 data). The changes are largely driven by: increased efficiency in vehicle fuel; increased renewable energy for electricity generation; reduced waste being sent to the landfill; a decline in natural gas consumption; and reduced aviation activity.

A forecast of Santa Monica's emissions was developed using economic and population growth estimates along with State policies that influence local carbon emissions. By 2030, Santa Monica's emissions could decline to 40% below 1990 levels through statewide policies and increased renewable grid electricity.





The City also prepared a consumption-based inventory, which focuses on the consumption of goods and services (such as food, clothing, electronic equipment, etc.) by residents of a city. The consumption-based method results in about 56% higher emissions than the traditional sector-based approach for the City, largely due to higher emissions from air travel, food and household purchases.

The City's municipal emissions have maintained a steady trend relative to 1990 despite growth in operations and facilities.

What determines the year selected for each inventory?

Preparing emissions inventories (whether community sector-based, community consumption-based or municipal operations) takes time to follow protocols, collect available data, conduct calculations and prepare analysis.

Annual utility data, like electricity and natural gas, can be collected relatively quickly after the prior year has ended. However, emission factors associated with the year's consumption can take years to determine after power contracts are reconciled.

Estimating emissions from vehicle transportation relies on land use models, regional transportation studies and trip counts (physically counting pedestrians, bicyclists and vehicles), all of which happen at different intervals.

Where data is not available for the given year, proxy data may be used from a period that is close in time and representative of the factors for that year. These various factors influence how frequent and how precise an emissions inventory can be prepared.

SECTOR-BASED EMISSIONS INVENTORY

A ***Sector-Based Emissions Inventory*** measures the emissions in a given region using data from energy consumption in buildings, vehicles, waste, and industry. Governments and the public can use inventories to better understand emission sources and trends and track progress towards meeting a reduction goal. Reporting this progress is an important climate action for cities to ensure accountability, and supporting broader action at the regional, national and international levels. The City shares its inventory annually via the Carbon Disclosure Project (CDP), carbon*n*, the Climate Registry, as a means to comply with and support the Global Covenant of Mayors.

This inventory method allocates emissions among residential, commercial, industrial, transportation and aviation sectors according to annual energy use and carbon intensity of energy use for each. It also assigns emissions to solid waste disposal based on the tonnage of materials hauled to regional landfills. This emissions inventory method is widely used by local, state and national governments.

Over time, emissions inventory protocols, frameworks and standards have been developed and modified. Updating an inventory may result in changes to the way each sector contributes to the overall inventory. For example, Santa Monica's emissions now include aviation fuel consumed by planes that use the Santa Monica Airport. Vehicle transportation now represents a greater share of local emissions due to a change in methodology that includes half of all vehicle miles traveled from trips that either start or end in Santa Monica.

Emission Sectors

The inventories are organized into categories, or sectors, that represent the commonly understood, major sources of emissions. These sectors are largely consistent between the community and municipal operations inventories, though naming conventions differ slightly, as guided by the relevant protocols.

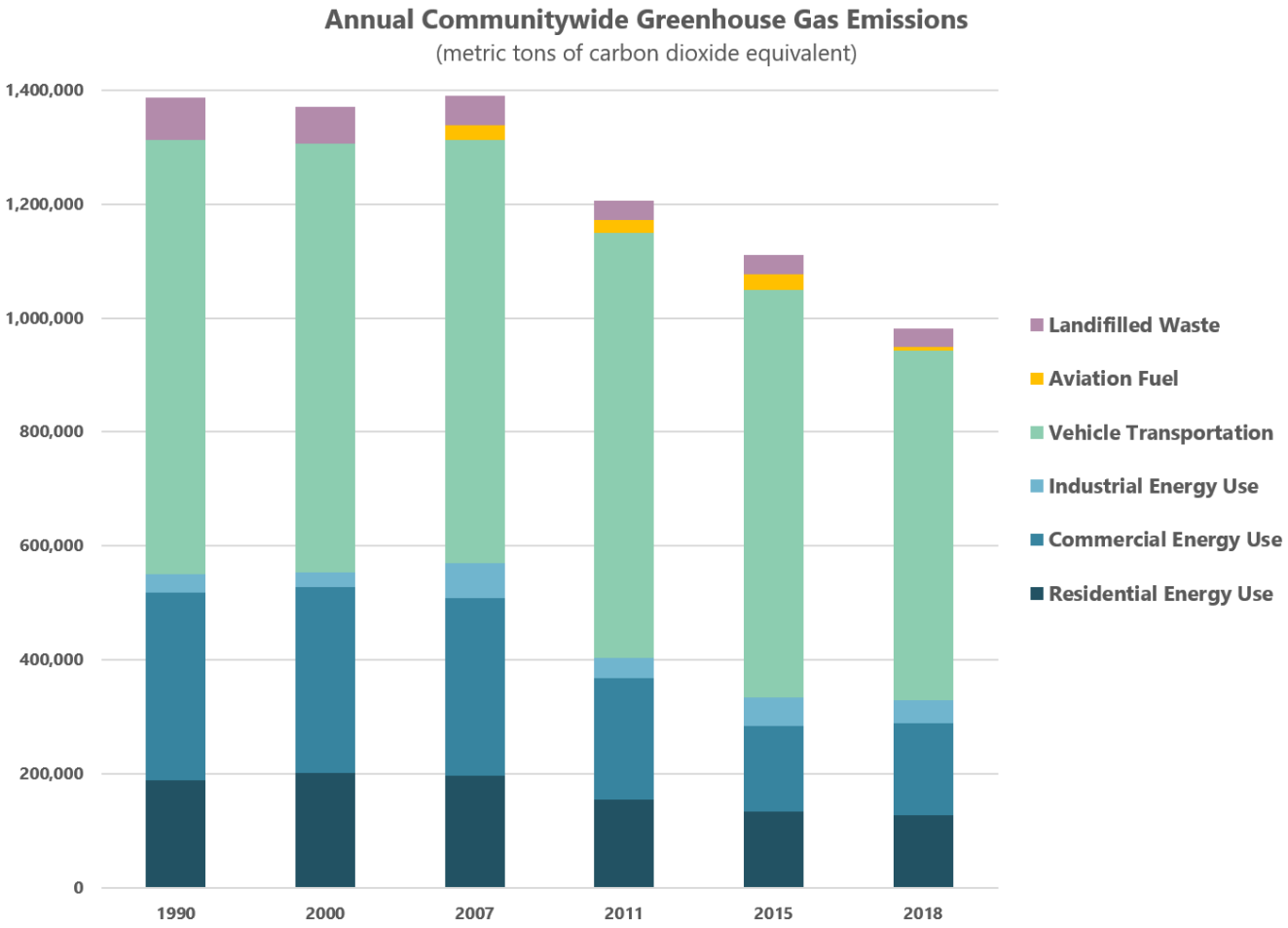
Santa Monica's community inventory includes emissions from the following sectors:

- **Building Energy** is organized into three subsectors: residential, commercial, and industrial buildings. The City obtains community-level data for annual energy use (electricity & natural gas) by sector. Emission factors are then applied to each energy type. Electricity emissions are calculated using the most recent emission factor provided by Southern California Edison through its annual corporate sustainability reports. The emissions factor for natural gas is constant, until renewable natural gas is delivered consistently into the gas supply system.
- **Vehicle Transportation** emissions are estimated using three processes. First, vehicle miles traveled (VMT) are estimated based on observed data and modeled data from the City's travel demand model. The City assumes 100% of all in-boundary trips and half of each trip that starts and ends in Santa Monica. Pass-through trips (i.e. Malibu to Downtown Los Angeles) are not associated with Santa Monica, as each community should claim their respective half of the trip. The VMT data that is generated is then applied to the regional vehicle mix that is assumed for LA County. This assumes a certain percentage of vehicles that use unleaded gasoline, diesel, natural gas and electricity. The data is then computed to estimate total carbon emissions and particulate matter generated from fossil fuel combustion as a result of the activity generated by the city.
- **Waste** emissions includes emissions associated with the decomposition of waste in landfills and compost facilities. Waste materials generate methane gas as they decompose. Landfill methane is a gas that is produced in a landfill because the things in the landfill undergo anaerobic decomposition (without oxygen). A compost pile, on the other hand, undergoes aerobic decomposition. Because it is exposed to oxygen, either by turning it or through the use of worms and other living organisms, it produces carbon dioxide, instead of methane. Total tonnage of materials that are landfilled, recycled and composted are reported by the City.
- **Aviation** emissions are generated from the fuel consumed by airplanes operating at the Santa Monica Airport (SMO). This inventory assumes a greater amount of emissions from SMO because it does not distinguish from flights that originate or end in other jurisdictions. Total annual aviation fuel supplied at SMO is used as the source data for the inventory.

Emissions Trends

Greenhouse gas emissions are influenced by a variety of factors, including factors that are beyond the City's control. These include:

- Weather patterns
- Shifts in demographics
- Economic activity
- Federal and State policies

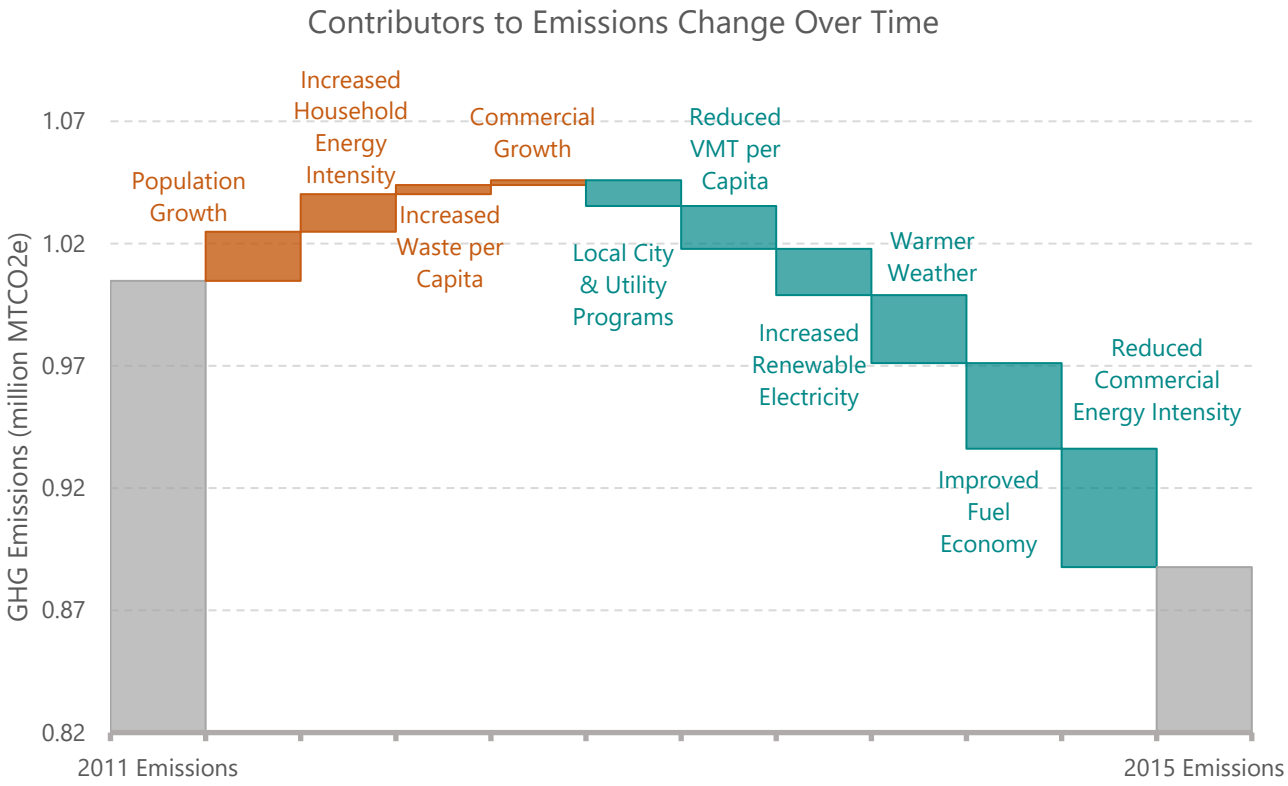


Santa Monica's emissions have declined by 29% (2018 data) since 1990. The changes are largely driven by: increased efficiency in vehicle fuel; increased renewable energy for electricity generation; reduced waste being sent to the landfill; a decline in natural gas consumption; and reduced aviation activity.

Drivers of Change

Santa Monica participated as a steering committee city in a research project, led by ICLEI and funded by Department of Energy, to develop a contribution analysis tool to help local governments understand trends between greenhouse gas inventory years.

Between 2011 and 2015, Santa Monica's emissions had declined by 8%. Despite growth in commercial square footage, Santa Monica experienced reductions in commercial energy usage beyond what was attributable to warmer winters and select energy efficiency programs. Similarly, despite a growth in population, people are overall driving less with a reduced per capita vehicle miles travelled (VMT). When they do drive, their vehicles have better fuel economy or are electric. Local programs for energy efficiency, waste reduction and recycling were effective, but proportionally smaller in impact than state or regional policies such as increasing renewable energy in the electricity grid or improving vehicle fuel economy.



Largest contributors to emissions growth

- Population growth
- Household energy intensity

Largest contributors to emissions decline

- Commercial energy intensity
- Improved vehicle fuel economy

Santa Monica has increased its role in decarbonizing the electric grid and vehicle transportation. As a member agency of the Clean Power Alliance, Santa Monica has elected to default all residential and commercial customers at 100% Green Power. Additionally, the City is aggressively expanding its public charging network to accelerate the adoption of electric vehicles.

FORECASTING EMISSIONS

A forecast of the City's emissions was developed using demographic and economic forecasts, as well as State policies into the year 2030 and beyond. This "business as usual" scenario considers what future emissions will look like without any local mitigation actions. By 2030, Santa Monica's population could near 105,100 people (from approximately 92,000); and the number of local jobs could increase to 104,800 (from 101,600). These trends will create upward pressure on Santa Monica's emissions in 2030.

Adopted State policies have influenced Santa Monica's historic decline in emissions and will continue to do so in the future. State policies that are included in the forecast are:

- Renewable Portfolio Standard – Requires all load-serving entities (utilities and community choice aggregators) to utilize 100% renewable energy by 2040
- Zero Net Energy – Requires zero net energy in residential new construction by 2020 and commercial new construction by 2030
- Low Carbon Fuel Standard – Requires a 10% reduction in carbon intensity of transportation fuels by 2020

The dynamics of economic and population grown coupled with State policies will result in an estimated 4% decline in emissions by 2030. This forecast assumes no local actions taken by the City to reduce emissions, other than eliminating aviation activities at the Airport, which would take place after 2028.

By 2030, Santa Monica's emissions could decline by as much as 40% compared to 1990, without any additional effort by the City, or residents and businesses. The City's local policies, actions and projects, as developed in the Climate Action & Adaptation Plan, propose to further decrease total emissions by 80% compared to 1990.

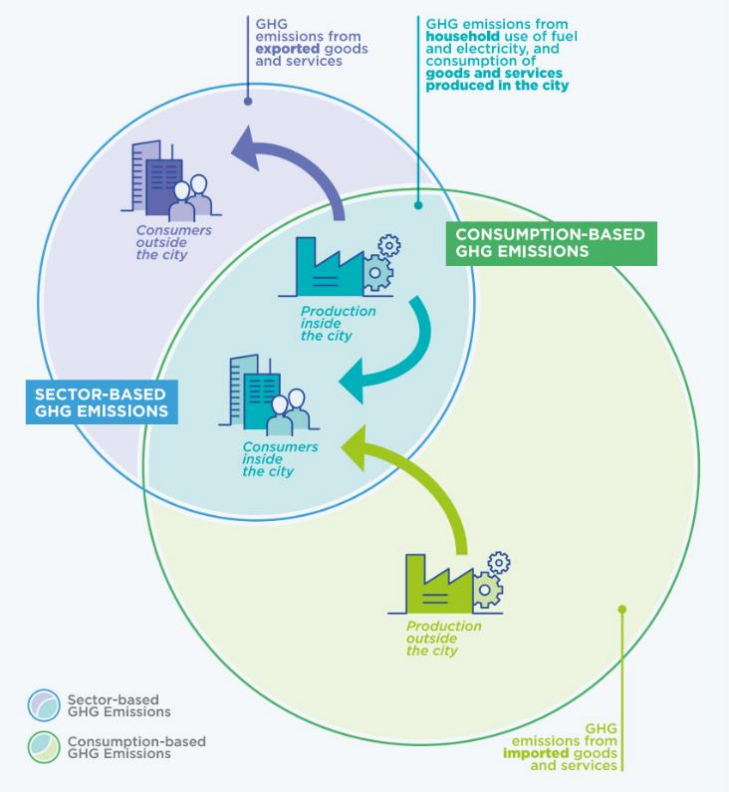
Communitywide Emissions Forecast

Subsector	Units	2015	2030 Business As Usual Forecast	Percent Change
Landfilled Waste	Wet Tons	77,929	81,297	4%
Residential Composted Waste	Tons	7,217	13,563	4%
Commercial Composted Waste	Tons	5,784		
Residential Recycled Material	Tons	11,200	12,520	3%
Commercial Recycled Material	Tons	1,002		
Waste Emissions Subtotal	**mtCO2e**	**34,109**	**35,583**	**4%**
Gasoline Vehicles VMT	VMT	1,366,624,000	1,428,818,125	5%
Diesel Vehicles VMT	VMT			
Electric Vehicles VMT	VMT			
Vehicle Transportation Emissions Subtotal	**mtCO2e**	**715,267**	**523,300**	**-27%**
Industrial Electricity	mtCO2e	188,251,103	144,611,538	-23%
Industrial Natural Gas	therms	377,880	384,774	2%
Industrial Buildings Emissions Subtotal	**mtCO2e**	**50,951**	**39,646**	**-22%**
Commercial Electricity	kWh	432,425,349	332,184,615	-23%
Commercial Natural Gas	therms	6,970,006	7,110,526	2%
Commercial Buildings Emissions Subtotal	**mtCO2e**	**149,501**	**124,196**	**-17%**
Residential Electricity	kWh	208,424,358	150,142,307	-28%
Residential Natural Gas	therms	15,031,796	14,490,789	-4%
Residential Buildings Emissions Subtotal	**mtCO2e**	**134,139**	**116,128**	**-13%**
Aviation Jet A Fuel	Gallons	2,590,027	-	-100%
Aviation Avgas 100LL Fuel	Gallons	165,853	-	-100%
Aviation Emissions Subtotal	**mtCO2e**	**26,348**	**0**	**-100%**
Communitywide Emissions TOTAL	**mtCO2e**	**1,110,315**	**838,853**	**-25%**
Difference from 1990 Baseline	%	**-20**	**-60.5**	40.6%

CONSUMPTION-BASED EMISSIONS INVENTORY

A ***Consumption-Based Emissions Inventory*** is an alternative to the sector-based approach to measuring city emissions. This focuses on the consumption of goods and services (such as food, clothing, electronic equipment, etc.) by residents of a city, and emissions are reported by consumption category rather than emission source category.

The consumption-based approach captures direct and lifecycle GHG emissions of goods and services (including those from raw materials, manufacture, distribution, retail and disposal) and allocates emissions to the final consumers of those goods and services, rather than to the original producers of those GHG emissions. GHG emissions from visitor activities and the production of goods and services within the city boundary that are exported for consumption outside the city boundary are excluded.



Consumption Based Emissions Graphic (Source: C40)

The methodology incorporates local consumption and emissions data wherever possible. In other cases, consumption is approximated using econometric analysis of national and statewide transportation and household consumption survey from a study conducted by UC Berkeley and the Bay Area Air Quality Management District. Due to the many assumptions made in the methodology, the results are only able to provide an indicative approximation of the emissions associated with Santa Monica's consumption activities.

Methodology

The basic approach to calculate a household carbon footprint is to multiply annual consumption of goods and services by appropriate greenhouse gas emission factors. Multiplying average household carbon footprints by the total number of households in each location produces a consumption-based greenhouse gas inventory of each location. Local consumption data, including electricity and natural gas consumption (by zip code), average fuel economy of vehicles (by county), local price adjustments, and energy consumption by public transit authorities was utilized as much as possible.

The inventory was developed using the methodology from a 2015 study[1] conducted for the San Francisco Bay Area. The methodology is summarized below.

In other cases, emissions were estimated based on factors that strongly correlate with each category of emissions. Econometric models of household consumption are developed using local subsamples of large household consumption surveys. Model variables for motor vehicle miles include vehicle ownership, household size, income, number of workers, population density, and household size. Air travel estimated as a function of income. Public Transit is from the Big Blue Bus. Electricity and natural gas consumption is disaggregated from zip codes to census block groups using demographic information, physical characteristics of homes, and geographic data. Household consumption of goods and services is approximated by income and household size, which are the two variables with the most explanatory power in the Consumer Expenditures Survey. Diets of typical residents were obtained from analysis of several data sources, including USDA (2015), the CEX and the Cost of Living Index (C2ER 2014). Other source of consumption include water, waste and home construction.

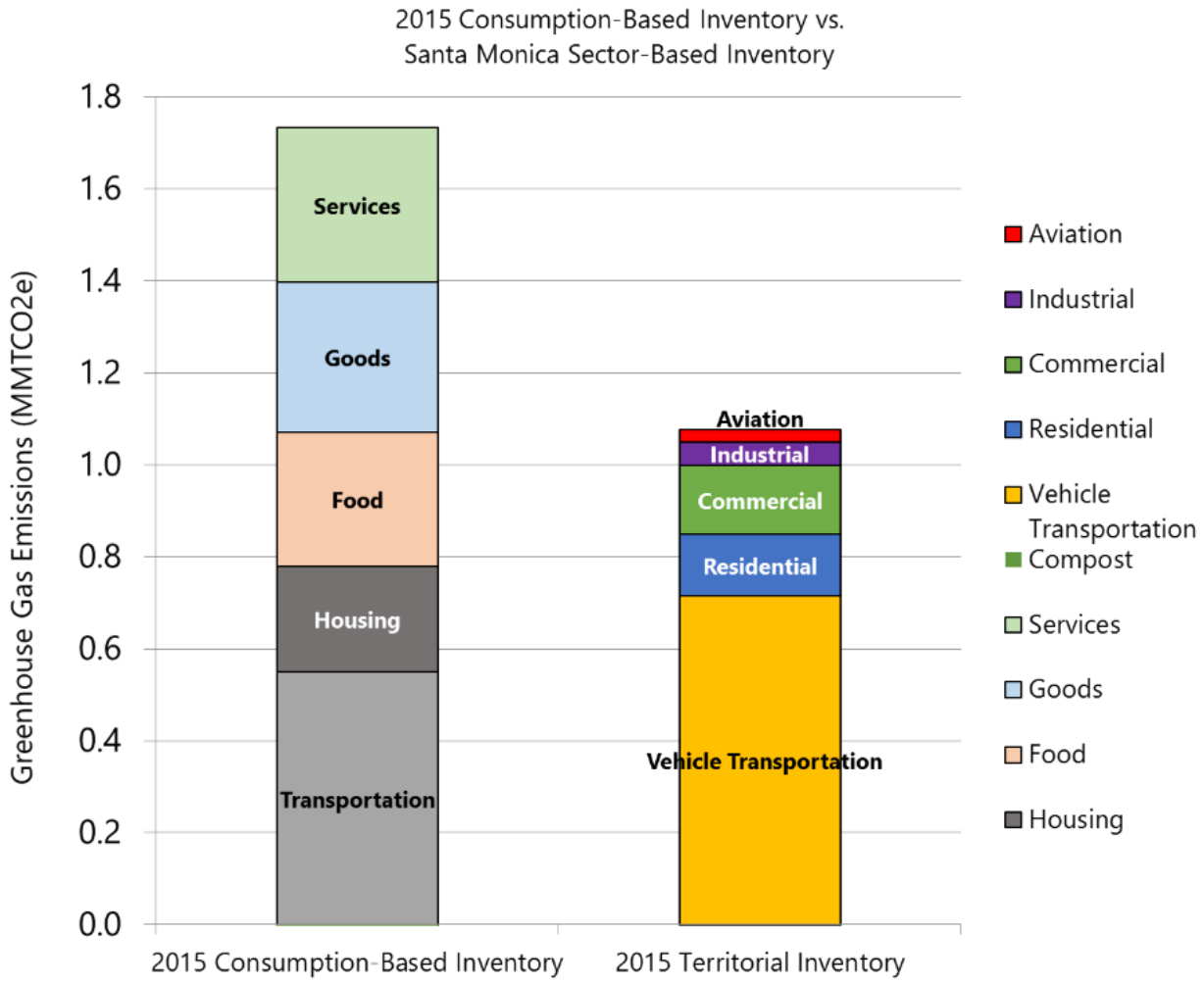
Each category of household consumption is then multiplied by greenhouse gas emission factors to determine the carbon footprint of average households in each location. Emission factors for fossil fuels (gasoline, aviation fuel and home heating fuels) are from the U.S. Office of Air Quality Planning and Standards (2013). Indirect life cycle emission from the production of fuels are from the California Air Resources Board (2015). Emission factors for electricity were provided by each electric utility. Emission factors for food, goods and services are from the Comprehensive Environmental Data Archive, CEDA(Suh 2009). CEDA is an environmentally-extended input output life cycle assessment model of the U.S. economy. It considers all inputs to production resulting from supply chains, including the extraction of materials, processing, manufacturing, transport and trade of goods services.

[1] A Consumption-Based Greenhouse Gas Inventory of San Francisco Bay Area Neighborhoods, Cities and Counties: Prioritizing Climate Action for Different Locations. Jones, Christopher M; Kammen, Daniel M. 2015

	Consumption Based Inventory	Sector/Territorial Based Inventory
What does it measure?	• *Upstream emissions (extraction, manufacturing, transportation)* • *Downstream emissions (disposal)* • *Consumption, use of goods/services/resources* • *Includes services, repair, food, construction* • *May be beyond local jurisdiction*	• *Building Energy Use* • *Vehicle Fuel Use* • *Landfilled Waste* • *Water/Wastewater Treatment* • *Activity occurs within jurisdiction*
What are the inputs?	• ***Dollars spent by category**, waste diversion, demographic data* • *Calculations and assumptions based on research* • *Primary authority: UC Berkeley/Cool California*	• *Annual consumption of resources* • *Data direct from sources* • *Primary authorities: ICLEI, WRI, C40*
How can we measure change?	*Changes will be reflected by **total dollars spent** and **population surveys on daily behavior***	*Changes will be reflected by **resource conservation or efficiency***

Scope Limitations

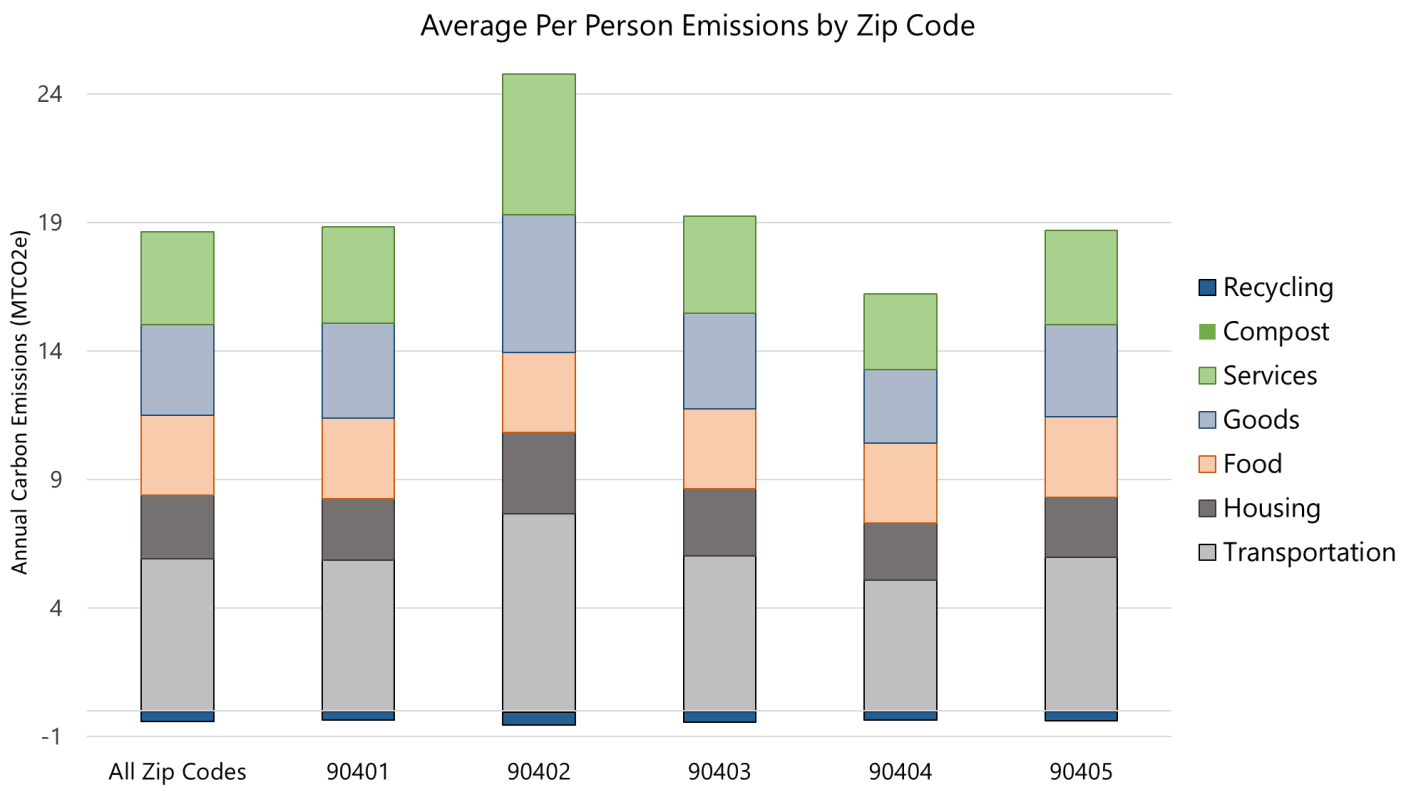
Consumption-based inventories are created using both actual consumption data, like energy use, and modeled data, like household surveys. This information is then used to generate an 'average household'. The model relies on many assumptions, aggregated over a large population. The model also cannot distinguish between preferences of goods and services. For example, the category of food assumes a certain portion of a person's diet coming from meat and vegetables, but cannot differentiate an apple from the local farmers market or one that is imported from Washington.



Results

A consumption-based inventory is a useful tool to illuminate the impact that individuals can have on the environment, through their lifestyle choices.

The consumption-based method results in about 56% higher emissions than the traditional sector-based approach for the City, largely due to higher emissions from air travel, food and household purchases. Vehicle transportation remains the largest source of emissions (24%), followed by food (17%), goods (18%), services (19%), air travel (7%), home construction (3%) and electricity (3%).



When disaggregated by zip code, the results show that income and housing significantly influence household carbon footprints. Individuals and families that live in single-family homes and are wealthier (90402), tend to spend more on transportation, goods & services, and thus, emit more carbon. Individuals and families that live in smaller dwellings like apartments and utilize more public transportation (90404), have less of a carbon footprint.

MUNICIPAL OPERATIONS INVENTORY

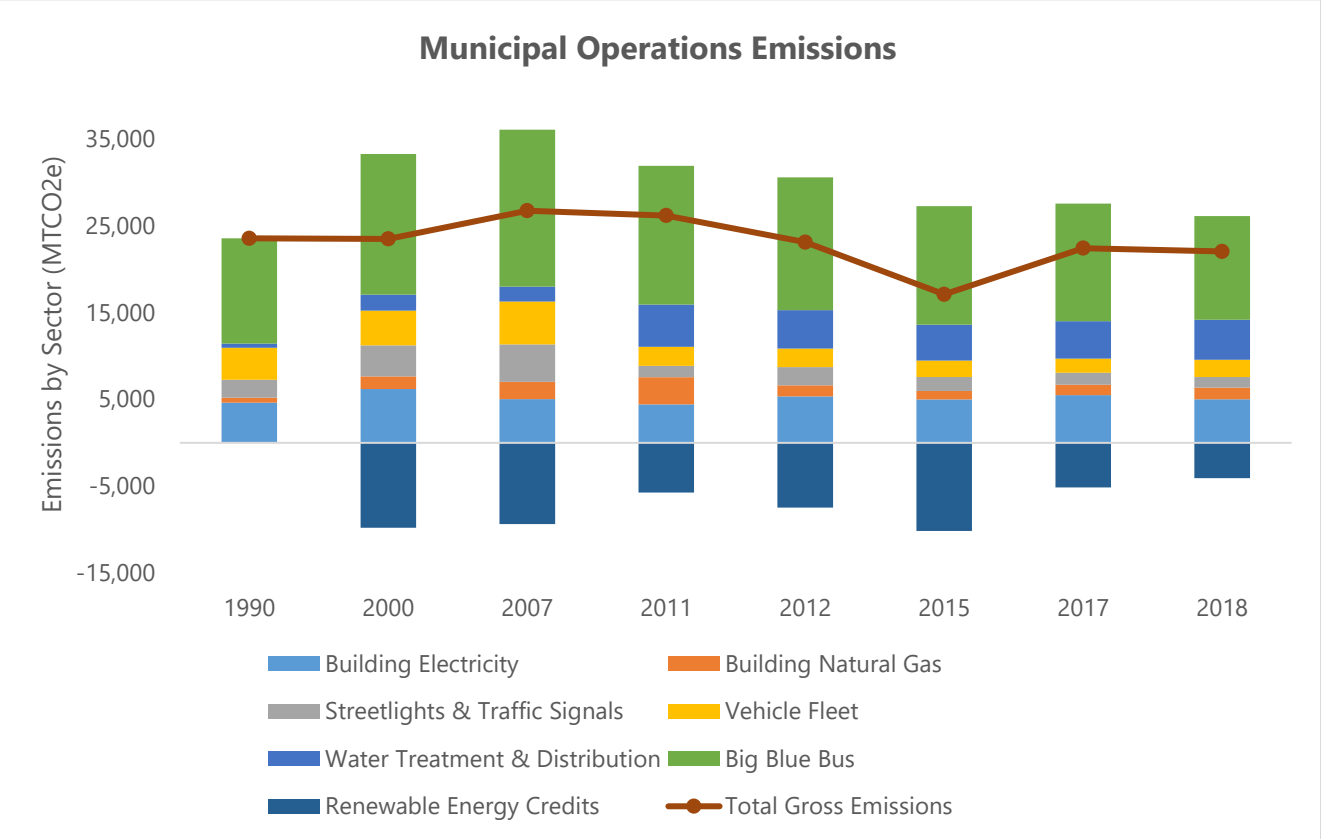
Santa Monica's municipal operations inventory, compared to the community inventory, includes slightly different sectors to more clearly reflect the operations of the City:

- Building & Facility Energy Use (electricity and natural gas)
- Streetlights & Traffic Controls (electricity)
- Water Treatment Facilities (electricity)
- Transit & Fleet Vehicle Fuel Use

Not included in the Municipal Inventory are City employee commute emissions and waste generated by municipal operations as they are accounted for in the Community Inventory. City employee business-related air travel was also omitted.

Emission Trends

Municipal Operations have remained relatively consistent compared to 1990 levels while at the same time expanding its facilities and operations, including new parks, buildings and water treatment plants.



The City has implemented various strategies to avoid growth in its emissions, such as:

- Procuring 100% renewable energy for eligible electricity accounts
- Implementing energy efficiency projects, saving 2 million megawatt-hours of electricity
- Expanding the use of electric vehicles, now over 130 vehicles
- Procuring renewable natural gas for Big Blue Bus and fleet vehicles

Santa Monica Historical Community Emissions

Subsector	Units	1990	2000	2007	2011	2015	2018
Landfilled Waste	Wet Tons	237,776	151,616	123,691	84,822	77,929	76,426
Residential Composted Waste	Tons	N/A	N/A	N/A	N/A	7,217	N/A
Commercial Composted Waste	Tons	N/A	N/A	N/A	N/A	5,784	N/A
Residential Recycled Material	Tons	N/A	N/A	N/A	N/A	11,200	N/A
Commercial Recycled Material	Tons	N/A	N/A	N/A	N/A	1,002	N/A
Waste Emissions Subtotal	**mtCO2e**	**74,546**	**63,364**	**51,705**	**35,001**	**34,109**	**32,687**
Gasoline Vehicles VMT	VMT	1,161,116,620	N/A	N/A	1,274,623,036	1,280,695,180	1,339,159,156
Diesel Vehicles VMT	VMT	55,619,012	N/A	N/A	72,289,156	81,508,123	77,655,918
Electric Vehicles VMT	VMT	N/A	N/A	N/A	1,059,808	4,420,697	9,388,926
Gasoline Vehicles Fuel	Gallons	75,531,320	N/A	N/A	71,066,114	66,936,118	58,261,528
Diesel Vehicles Fuel	Gallons	8,034,669	N/A	N/A	10,387,208	10,990,933	8,665,055
Vehicle Transportation Emissions Subtotal	**mtCO2e**	**762,242**	**752,156**	**742,070**	**746,230**	**715,267**	**613,310**
Industrial Electricity	kWh	52,740,000	49,724,444	130,175,555	120,437,311	188,251,103	171,706,313
Industrial Natural Gas	Therms	1,398,571	477,625	83,712	111,750	377,880	96,352
Industrial Buildings Emissions Subtotal	**mtCO2e**	**32,215**	**25,902**	**61,618**	**35,262**	**50,951**	**40,000**
Commercial Electricity	kWh	477,590,000	553,351,111	531,894,166	510,908,718	432,425,349	414,046,783
Commercial Natural Gas	Therms	19,679,941	12,417,437	11,620,672	12,437,450	6,970,006	12,558,464
Commercial Buildings Emissions Subtotal	**mtCO2e**	**329,123**	**326,084**	**311,762**	**213,219**	**149,501**	**161,797**
Residential Electricity	kWh	187,520,000	212,320,277	211,530,833	206,363,618	208,424,358	202,017,657
Residential Natural Gas	Therms	18,880,761	19,281,900	18,214,865	17,911,170	15,031,796	14,876,684
Residential Buildings Emissions Subtotal	**mtCO2e**	**188,515**	**202,331**	**196,284**	**154,667**	**134,139**	**127,565**
Aviation Jet A Fuel	Gallons	N/A	N/A	2,490,217	254,885	2,590,027	508,906
Aviation Avgas 100LL Fuel	Gallons	N/A	N/A	334,873	254,885	165,853	198,477
Aviation Emissions Subtotal	**mtCO2e**	**N/A**	**N/A**	**26,800**	**21,912**	**26,348**	**5,890**
Communitywide Emissions TOTAL	**mtCO2e**	**1,386,642**	**1,369,836**	**1,390,241**	**1,206,292**	**1,110,315**	**981,249**
Change from 1990 Baseline	**%**	**-**	**-1.2**	**0.3**	**-13.3**	**-20**	**-29.2**

N/A – Data was not collected or estimated

Santa Monica Historical Municipal Emissions

Municipal Operations Emissions (MTCO2e)	1990	2000	2007	2011	2012	2015	2017	2018
Building Electricity	4,620	6,200	5,042	4,424	5,354	4,995	5,492	5,019
Building Natural Gas	585	1,444	1,987	3,141	1,266	982	1,199	1,345
Streetlights & Traffic Signals	2,052	3,572	4,298	1,297	2,104	1,589	1,382	1,202
Vehicle Fleet	3,684	4,001	4,936	2,188	2,124	1,905	1,624	1,998
Water Treatment & Distribution	488	1,839	1,722	4,862	4,433	4133	4,300	4,612
Big Blue Bus	12,109	16,189	18,069	15,971	15,268	13,632	13,540	11,921
Total Gross Emissions	**23,538**	**33,245**	**36,054**	**31,883**	**30,549**	**27,236**	**27,537**	**26,097**
Renewable Energy Credits		**-9,772**	**(9,340)**	**(5,721)**	**(7,458)**	**-10,142**	**-5,131**	**-4,073**
TOTAL NET Emissions		**23,473**	**26,714**	**26,162**	**23,091**	**17,094**	**22,406**	**22,024**
TOTAL Difference from 1990 baseline		**-65**	**3,176**	**2,624**	**-447**	**-6,444**	**-1,132**	**-1,732**
TOTAL % difference from 1990 baseline		**0%**	**13%**	**11%**	**-2%**	**-27%**	**-5%**	**-6%**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