

2017 SAN FRANCISCO GEOGRAPHIC GREENHOUSE GAS EMISSIONS INVENTORY AT A GLANCE

By San Francisco Department of Environment, Climate Program

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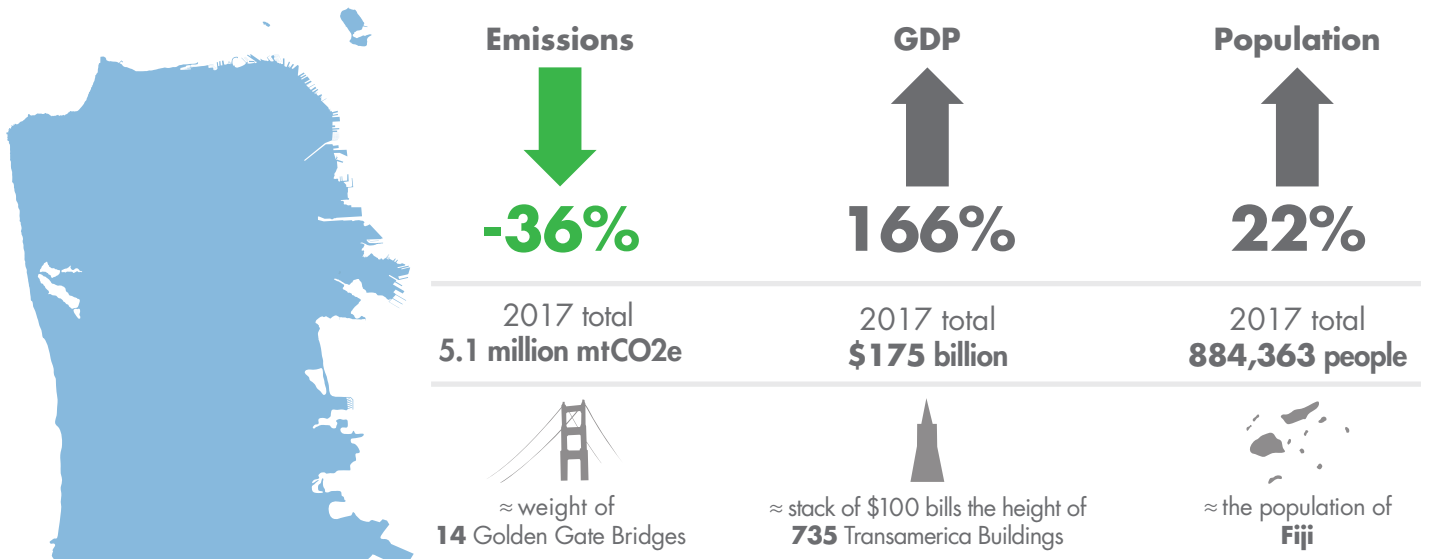
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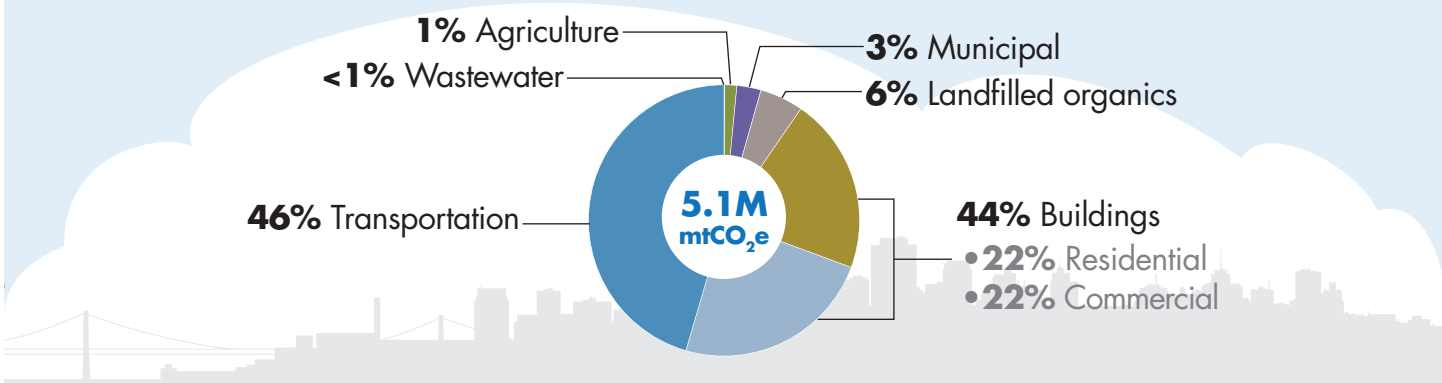
TABLE OF CONTENTS

| | |
|-----------------------------------|----|
| Emissions Overview | 4 |
| Emissions Trends | 4 |
| Emissions Reduction Drivers | 6 |
| Sector Summary | 8 |
| Residential | 8 |
| Commercial | 9 |
| Transportation | 11 |
| Landfilled Organics | 13 |
| Municipal | 14 |
| Agriculture | 17 |
| Wastewater | 18 |

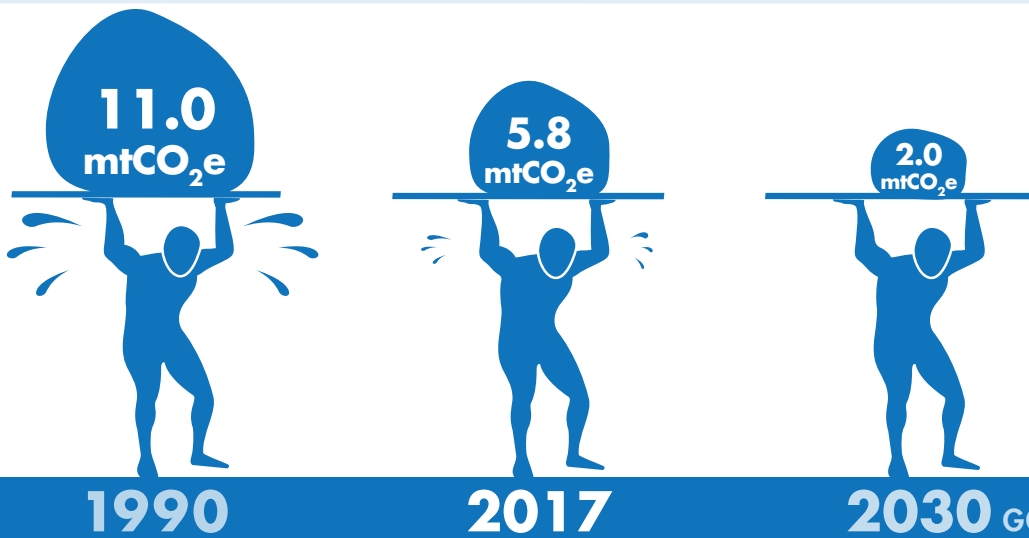
1990-2017 San Francisco trends



2017 San Francisco emissions by sector



San Francisco per capita emissions



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EMISSIONS OVERVIEW

EMISSIONS TRENDS

In 2017, San Francisco's community-wide greenhouse gas (GHG) emissions, totaled 5.1 million mtCO₂e (Fig. 1). The seven sectors tracked in the 2017 inventory include:

- The Residential sector, accounting for 22% of the city's carbon footprint, with 88% of emissions from natural gas, 10% from electricity, and 2% from other fuels (Fig. 2).
- The Commercial sector, accounting for 22% of the city's carbon footprint, with 67% of emissions from natural gas, 28% from electricity, and 5% from steam.
- The Transportation sector, accounting for 46% of the city's carbon footprint, with 71% from passenger vehicles, 18% from Maritime Ships and Boats¹ (non-ferry), 6% from off-road equipment, and 4% from public transportation².
- The Landfilled Organics sector, accounting for 6% of the city's carbon footprint³.
- The Municipal sector, including facilities and fleet, accounting for a little less than 3% of the city's emissions, with nearly all emissions from natural gas and vehicle fuel use.
- The Agriculture sector, accounting for just over 1% of the city's carbon footprint.⁴
- The Wastewater sector, accounting for <1% of the city's carbon footprint.⁵

In 2017, San Francisco successfully reduced emissions 36% below 1990 levels from 8.0 million⁶ to 5.1 million mtCO₂e (Fig. 1). Declines occurred across the top five of the seven sectors tracked.

- The Residential sector declined 44%
- The Commercial sector declined 56%
- The Transportation sector declined 10%
- The Landfilled Organics sector declined 35%
- The Municipal sector declined 31%
- The Agriculture sector increased 8%
- The Wastewater sector increased 53%

Emission reductions were achieved even though San Francisco's population increased 22% and the economy grew 166% during the same time period. In 2017, San Francisco's emissions per capita was 5.80 mtCO₂e compared to 10.99 mtCO₂e in 1990, a 47% decline.

¹ Maritime ships and boats consists of ships and boats within 24 nautical miles.

² Public transportation consists of Muni, BART, Caltrain (rail and buses), commuter ferries, and other buses.

³ Emissions from Landfilled Organics, previously known as the Waste sector, occur when disposed organics (food, yard trimmings, wood waste, paper, etc.) break down (decompose) in a landfill and produce methane.

⁴ Agriculture sector is a relatively new sector tracked starting in inventory year 2016.

⁵ Wastewater sector is a relatively new sector tracked starting in inventory year 2016.

⁶ The GPC framework, which added more emission sources, was implemented for the 2012 inventory forward. During 2018, SFE back-casted emissions back to 1990.

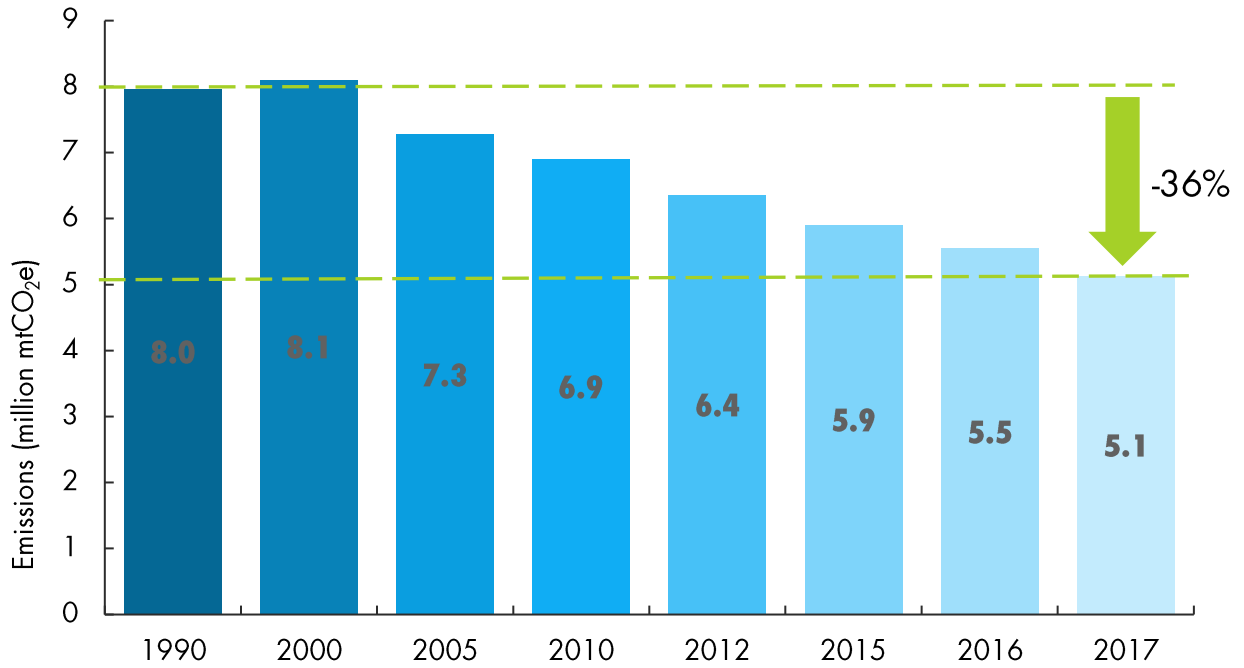


Figure 1. San Francisco's GHG emissions from inventory year 1990 to 2017.

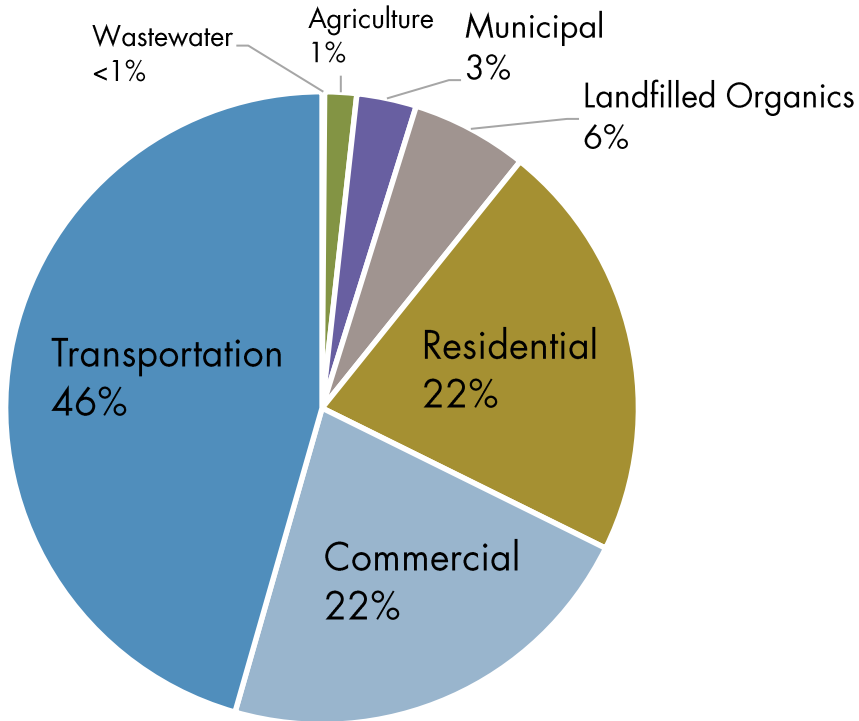


Figure 2. 2017 emissions by sector.

EMISSIONS REDUCTION DRIVERS

Reductions in emissions can be attributed to a variety of factors, including the implementation of innovative technologies, policies, and programs and changes in the weather. The main drivers of the emission reductions observed between 1990 to 2017 were:

- **The electric grid has become cleaner for all of San Francisco in the last few years.** City-owned buildings switched to 100% GHG-free electricity in 2012 and there continues to be annual improvements in PG&E's renewables portfolio⁷ mix which serves the private sector.
- **CleanPowerSF** is San Francisco's Community Choice Aggregation program that started in 2016. The program continues to increase its renewables portfolio and expand its customer base while reinvesting ratepayer funds locally in new renewable energy facilities. In 2017, CleanPowerSF provided 100% GHG-free energy to both Green and Supergreen customers.
- **A scale-up in energy efficiency programs** helped stem demand for electricity and natural gas. During 2017, San Francisco's Energy Watch program partnered with 480 San Francisco commercial and multifamily properties. The program saved over 6.1 million kWh, averaging \$1,897 in annual utility costs. It also reduced GHG emissions by 1,164 mtCO₂e tons in total, an equivalent to removing 245 passenger vehicles from the road.
- **Progressive green building codes** ensure new construction is built to the highest standards for energy, water, and other key environmental performance metrics. Local green building code requirements contributed 122 million square feet of LEED certified space between 2004 and 2017 in commercial buildings. In addition, the City had 56 city-owned buildings and interiors LEED certified between 2004 and 2017, totaling 7.65 million square feet.
- **Cleaner fuels helped decouple transportation emissions from growth.** Between 1990 and 2017 commuting into and out of the city increased along with a booming economy. Even with an additional 445.9 million vehicle miles added to San Francisco roads between 1990 and 2017, vehicle emissions declined 18%, primarily due to State efforts to reduce the carbon intensity⁸ of vehicle fuels.

Impact of Weather on Emissions

It is important to differentiate between long-term emissions reductions driven by new technologies, policies and programs and short-term reductions due to changes in factors such as the weather. Understanding how weather impacts emission levels is important because there are likely to be short-term, year-to-year variations in emissions as San Francisco continues to make progress towards longer-term reduction targets.

⁷California's cleaner grid is driven at the state level through the Renewable Portfolio Standards (RPS), which sets a goal of 33% renewable energy by 2020 and 50% by 2030.

⁸ Carbon intensity is the amount of carbon per unit of energy used.

- By switching to renewable diesel, emissions from SF MUNI buses and municipal fleet vehicles **declined 48%** between 2016 and 2017 while fuel use for these vehicles remained constant.
- In 2017, commuter ferries began the switch to renewable diesel, further reducing carbon emissions in the Transportation sector. This trend will continue in the coming years as more commuter ferries switch to renewable diesel.

SECTOR SUMMARY

San Francisco inventories are completed in accordance with the ICLEI U.S. Community Protocol (USCP) for Accounting and Reporting of Greenhouse Gas Emissions. The methodology and sectors tracked were third party verified in inventory year 2012. The 2017 inventory was completed according to the guidance of the verifiers. In 2015, the City began reporting its emissions to C40 to improve its GHG emissions inventory by using a newer protocol to estimate emissions referred to as the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC). GPC is a framework unifying emissions inventories globally while incorporating new categories to track.

Below is an in-depth analysis of 2017 emissions trends since 1990 in the Residential, Commercial, Transportation, Landfilled Organics, Municipal, Agriculture, and Wastewater sectors.

RESIDENTIAL

In 2017, emissions from the Residential sector totaled 1.10 million mtCO₂e accounting for 22% of San Francisco's GHG emissions (Fig. 2). Emissions from the Residential sector have declined 44% below 1990 levels mainly due to a combination of a cleaner electrical grid, improved energy codes, and continual implementation of city-wide energy efficiency programs (Fig 3). Residential sector emissions are generated from fossil-fuels used to heat household spaces, provide lighting and hot water, and power appliances. Emissions from the Residential sector are mostly from natural gas use (88%) followed by electricity (10%) and other fuels (2%). Emissions from electricity are much lower than those from natural gas because of San Francisco's push to increase its renewable energy portfolio (Fig 4).

Between inventory year 2016 and 2017 Residential sector emissions decreased by 6%. With continued improvements in building efficiency and expanded enrollment of customers in CleanPowerSF, emissions in the Residential sector should continue to trend downward over time.

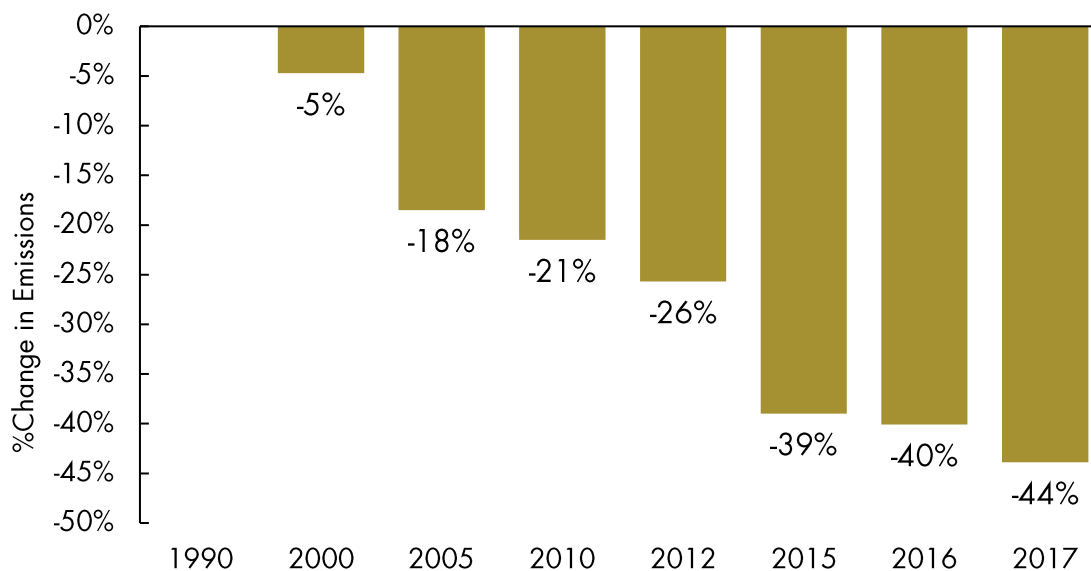


Figure 3. Residential sector emissions changes compared to 1990 levels.

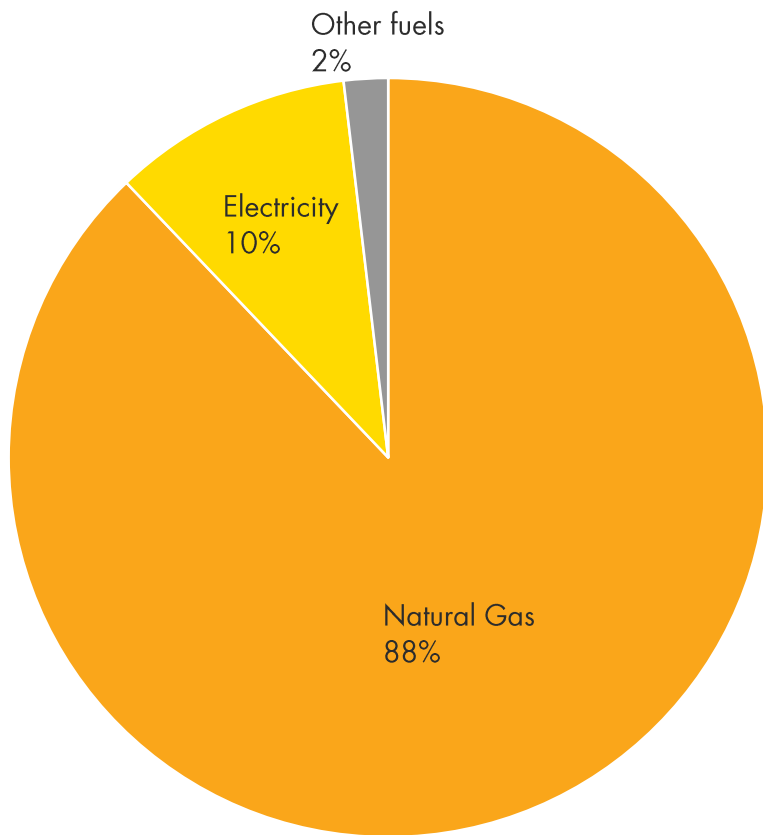


Figure 4. 2017 Residential sector emissions by commodity.

COMMERCIAL

In 2017, emissions from the Commercial⁹ sector (including commercial and industrial, direct access, district, and steam loop customers¹⁰) totaled 1.13 million mtCO₂e accounting for 22% of San Francisco’s GHG emissions (Fig. 2). Emissions from the Commercial sector declined 56% below 1990 levels. Similar to the Residential sector, the decrease in emissions was mainly due to a combination of a cleaner electrical grid, improved energy codes, and the continual implementation of city-wide energy efficiency programs. Furthermore, the completion of the downtown district steam loop (Fig. 5) also contributed to the reduction. Commercial sector natural gas use was responsible for the largest share of emissions (67%) compared to electricity (28%) and steam (5%)¹¹ (Fig. 6).

⁹ The commercial sector includes the Industrial sector because of California’s Data Privacy Aggregation rules, which causes the two sectors to be combined. The Industrial sector is reported as part of the Commercial sector as there are more commercial buildings than industrial buildings in San Francisco.

¹⁰ Direct Access is electricity usage for customers for whom PG&E provides transmission and distribution services, but not electricity generation (Commercial, Industrial, as well as Residential). District electricity includes accounts such as BART, School Districts, Hospital Districts, Water or Sewer Districts, Fire Districts, Junior College Districts, District Fairs, Public Utility Districts, Community Service Districts, Cemetery Districts, Mosquito Abatement Districts, and/or Park Districts. The steam loop is powered by natural gas use and serves only commercial and municipal customers in the downtown core.

¹¹ Two factors affect 2017 steam usage. In 2017, increased steam usage can partly be attributed to a minor leak in the downtown steam loop. In addition, steam loop data for most of 2017 was estimated due to incorrect meter readings from malfunctioning meters.

Emissions between 2016 and 2017 steadily declined 12%, from 1.28 million to 1.13 million mtCO_{2e} (Fig 5). With continued improvements in building efficiency and enrollment of customers in CleanPowerSF, emissions in the Commercial sector should continue to trend downward over time.

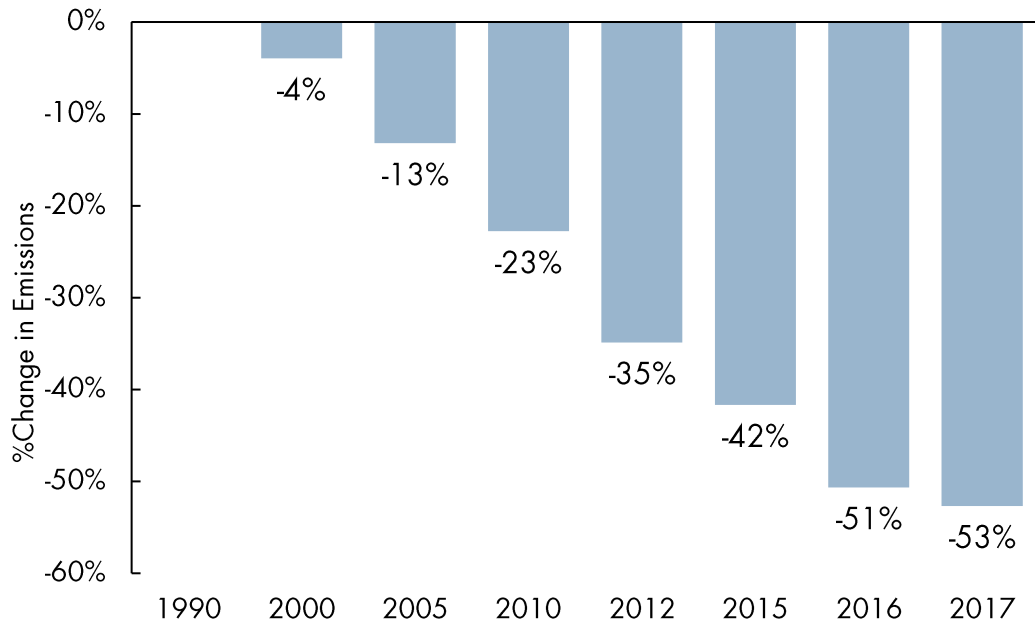


Figure 5. Commercial sector emissions changes compared to 1990 levels.

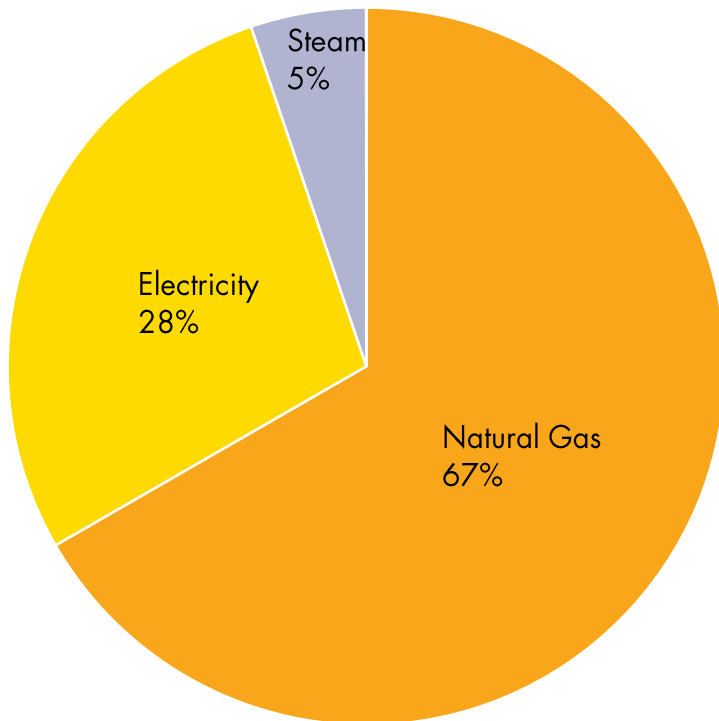


Figure 6. 2017 Commercial sector emissions by commodity.

TRANSPORTATION

In 2017, emissions in the Transportation sector totaled 2.33 million mtCO_{2e}, accounting for 46% of San Francisco's GHG emissions (Fig. 2). Emissions from the Transportation sector have declined 10% below 1990 levels mainly due to higher fuel efficiency standards and cleaner vehicle fuels mandated by the State of California (Fig. 7). Gasoline used by the Transportation sector was responsible for the largest share of emissions (71%) compared to diesel (20%), other fuels (6%), electricity (2%), and renewable diesel (<1%)¹² (Fig. 8). Passenger vehicles¹³ were responsible for the major share of emissions totaling 1.67 million mtCO_{2e}, accounting for 71%¹⁴ of total Transportation sector emissions (Fig. 9). Maritime Ships and Boats accounted for 18% of emissions (427 thousand mtCO_{2e}), while Off-road Equipment accounted for 6% of emissions (145 thousand mtCO_{2e}). Public Transportation accounted for the remaining 4% (97 thousand mtCO_{2e}). There were significant reductions realized in San Francisco's public transit fleet with emissions from MUNI declining largely due to buses switching to renewable diesel and light rail services use of 100% GHG-free electricity. From 2016 to 2017, buses continued to switch to renewable diesel as commuter ferries began this transition. As a result, renewable diesel usage increased by 40% leading to a sharp decline in diesel usage.

Transportation sector emissions decreased from 2.55 to 2.33 million mtCO_{2e} (8% decrease) between inventory year 2016 and 2017 despite population and economic growth and an increase in the number of passenger vehicle miles traveled (VMT). The decrease in emissions was due to a variety of factors. During this time, public transportation ridership increased. The State succeeded in reducing vehicle fuel carbon intensity as vehicle emissions declined 8% while passenger and commercial VMT into and out of the city increased 2% in 2017. By switching to electric use and renewable diesel¹⁵, MUNI bus emissions have declined 96% between 2016 and 2017, down to a total of 741 mtCO_{2e}. Lastly, commuter ferry fuel usage and ridership increased from 2016 to 2017, which means people are choosing more sustainable modes of transportation to get to the city. Furthermore, because ferries are switching diesel for renewable diesel, emissions will continue to decline.

¹² Includes trace amount of emissions from the CH₄ and N₂O portion of renewable diesel.

¹³ Consists of private vehicles such as cars and light duty trucks.

¹⁴ Gasoline consumed makes up all of passenger vehicle emissions.

¹⁵ Renewable diesel used in San Francisco comes from renewable resources such as tallow, used cooking oils, and ethanol byproducts.

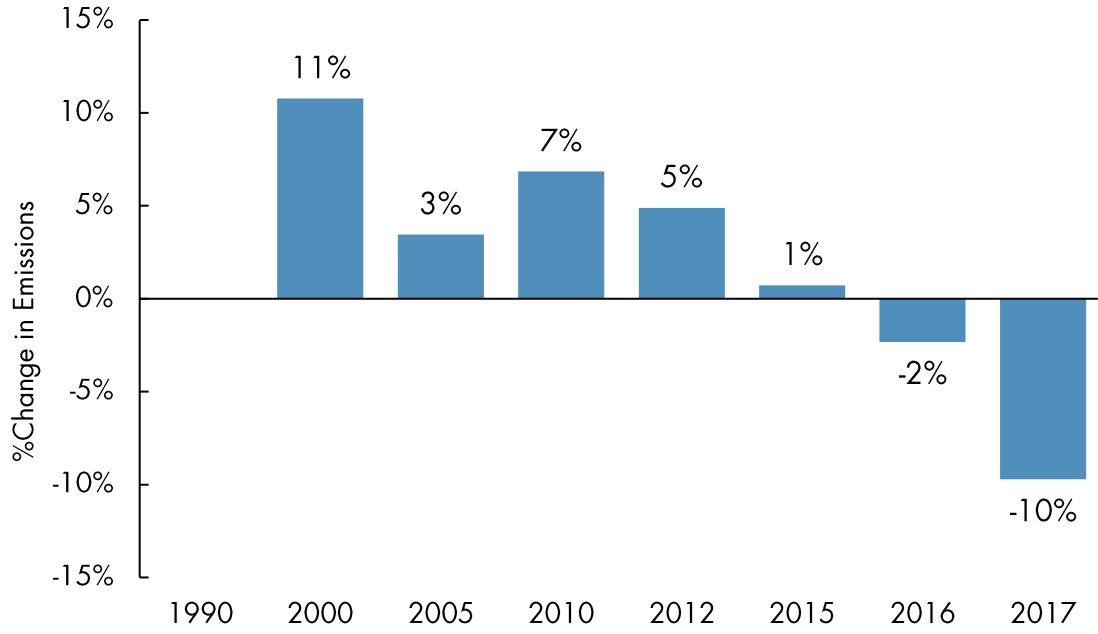


Figure 7. Transportation sector emissions changes compared to 1990 levels.

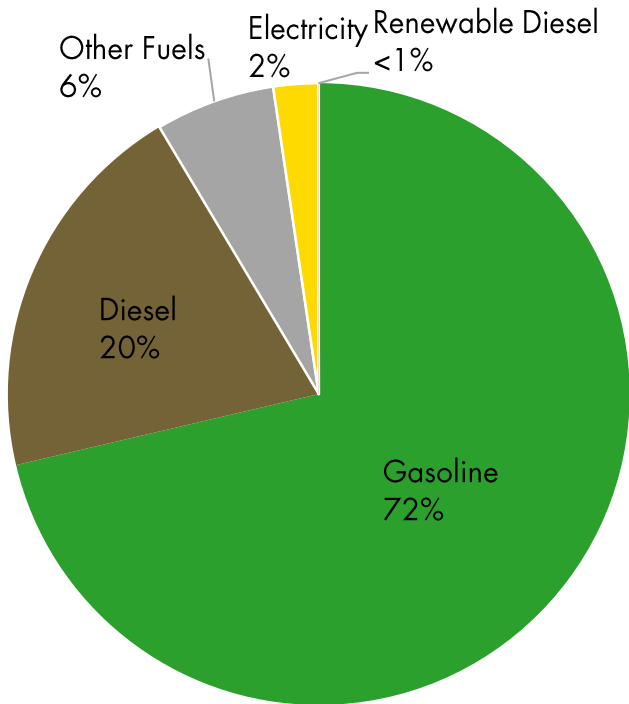


Figure 8. 2017 Transportation sector emissions by commodity.

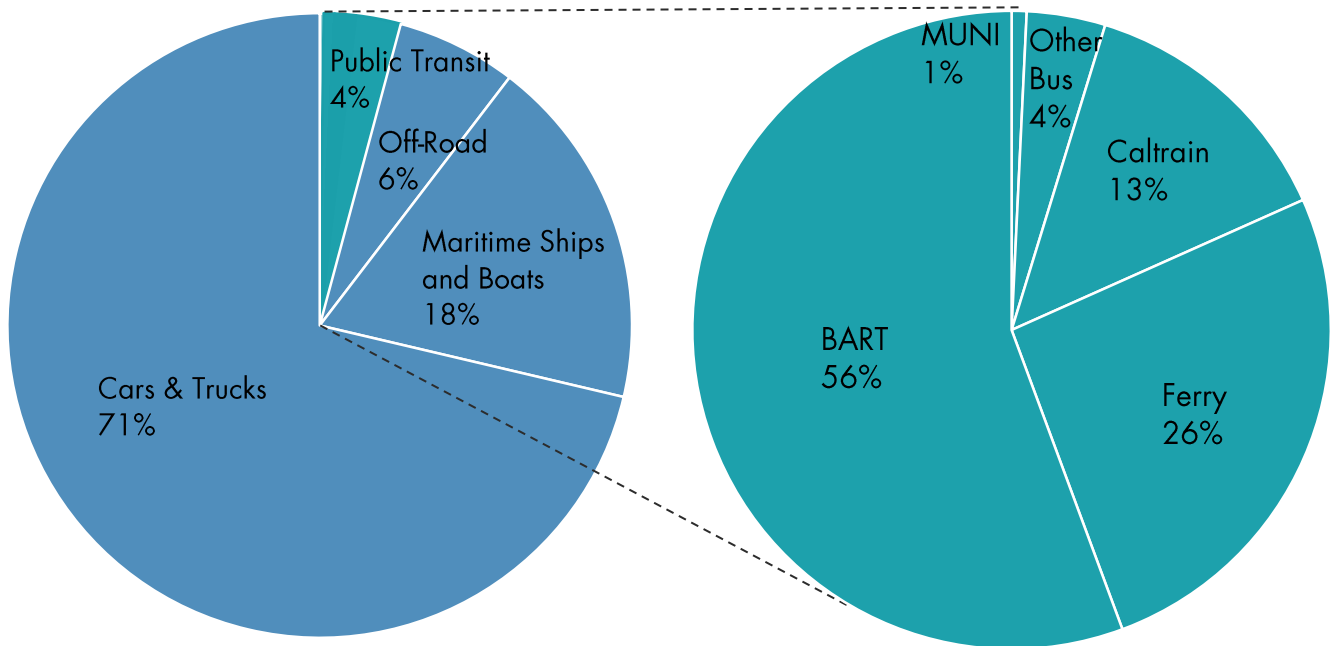


Figure 9. 2017 Transportation emissions by sub-sector.

LANDFILLED ORGANICS

In 2017, emissions from landfilled organics¹⁶ totaled 305 thousand mtCO_{2e}, accounting for 6% of San Francisco's GHG emissions (Fig. 2). Organic materials¹⁷ sent to landfill decompose and release methane emissions to the atmosphere. Emissions from Landfilled Organics have declined 35% below 1990 levels due to successful resource recovery in the city (Fig. 10).

Emissions from Landfilled Organics increased 5% between inventory year 2016 and 2017. In recent years, growth in the economy and population has driven a construction and demolition¹⁸ boom, resulting in an increase in discarded organic and inorganic material sent to landfill. Even with this increase in discarded materials, the tonnage of disposed materials has decreased 8.5% from 1990 levels. Emissions from landfilled organics disposal per capita has decreased 47% from 1990 levels.

¹⁶ Referred to as the Waste sector during previous inventory years.

¹⁷ Organic materials include materials such as yard trimmings, food, wood waste, paper, etc.

¹⁸ Construction and demolition is a mixture of inorganic materials such as concrete, metals and glass as well as organic materials such as wood and cardboard. Only organic construction and demolition materials are included in landfilled organics as organic materials decompose in landfills and release methane.

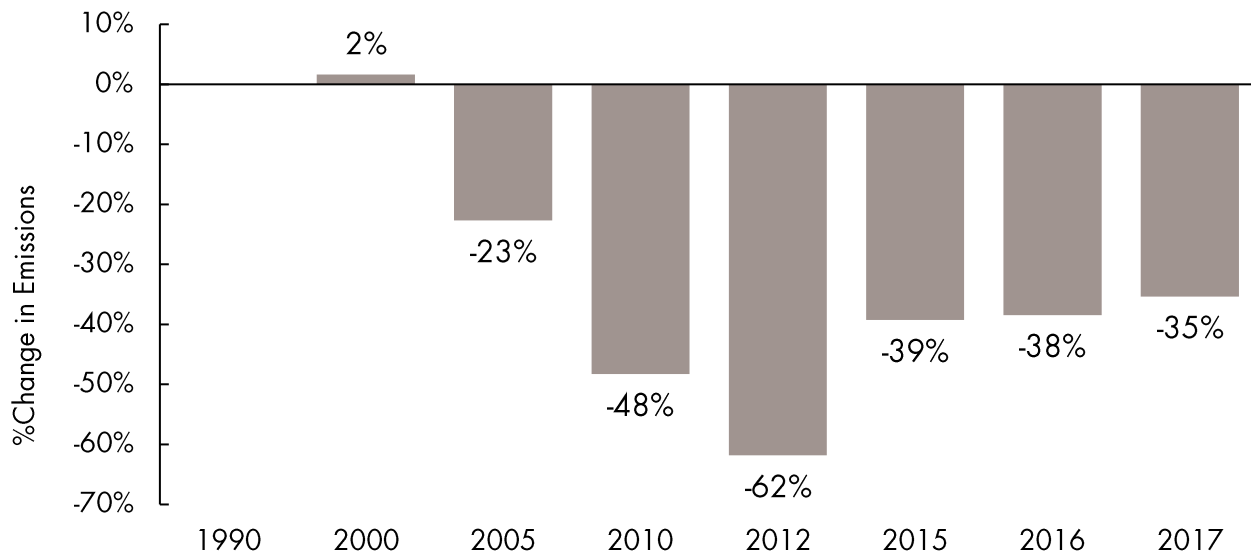


Figure 10. Landfilled Organics emissions changes compared to 1990 levels.

MUNICIPAL

In 2017, emissions in the Municipal sector¹⁹ were generated from city-owned buildings (85%) and non-revenue vehicles²⁰ (15%), totaling 153 thousand mtCO₂e which accounts for just under 3% of San Francisco’s total emissions (Fig. 11). Emissions from San Francisco’s Municipal sector declined 31% below 1990 levels with the steepest declines between 2010 to 2012 due in large part to all city-owned buildings fully sourcing GHG-free electricity²¹ generated from San Francisco Public Utilities Commission’s Hetch-Hetchy hydroelectric dam (Fig. 12). As a result, natural gas makes up nearly 100% of the emissions in Municipal buildings, totaling 129 thousand mtCO₂e (Fig. 13).

Municipal building emissions are driven by natural gas use. Despite colder weather in 2017, natural gas use in Municipal buildings decreased 1% between inventory year 2016 and 2017. Municipal energy efficiency projects, programs, and energy code improvements served to temper emissions increases. The City continues to improve its efforts to green municipal buildings with 56 LEED buildings, totaling 7.65 million square feet, certified from 2004 to 2017.

Municipal fleet emissions decreased 13% between 2016 and 2017. Municipal fleet emissions generated from gasoline use, were 90% of total non-revenue fleet emissions (Fig. 14). Emissions from diesel use have continued to decline with the roll out of renewable diesel which began during fiscal year 2016. Moving forward, city fleet emissions will continue to decline due to (1) ongoing efforts to transition diesel vehicles to renewable diesel, (2) the City Fleet Zero Emissions Vehicles Ordinance, and (3) the

¹⁹ The majority of energy data for the municipal sector is obtained directly from PG&E.

²⁰ Since 2015, city-owned fleet emissions were categorized and tracked within the Municipal sector.

²¹ City owned buildings have been sourcing hydro power since the 1970’s with very little generation coming from carbon intense sources. Starting fiscal year 2011, the SFPUC begun providing power content labels to the CPUC in which all hydro power since has been verified 100% GHG free electric power.

EV Readiness Ordinance. A more detailed analysis of Municipal Emissions can be found in the latest SF Municipal Progress Report on Climate and Sustainability.

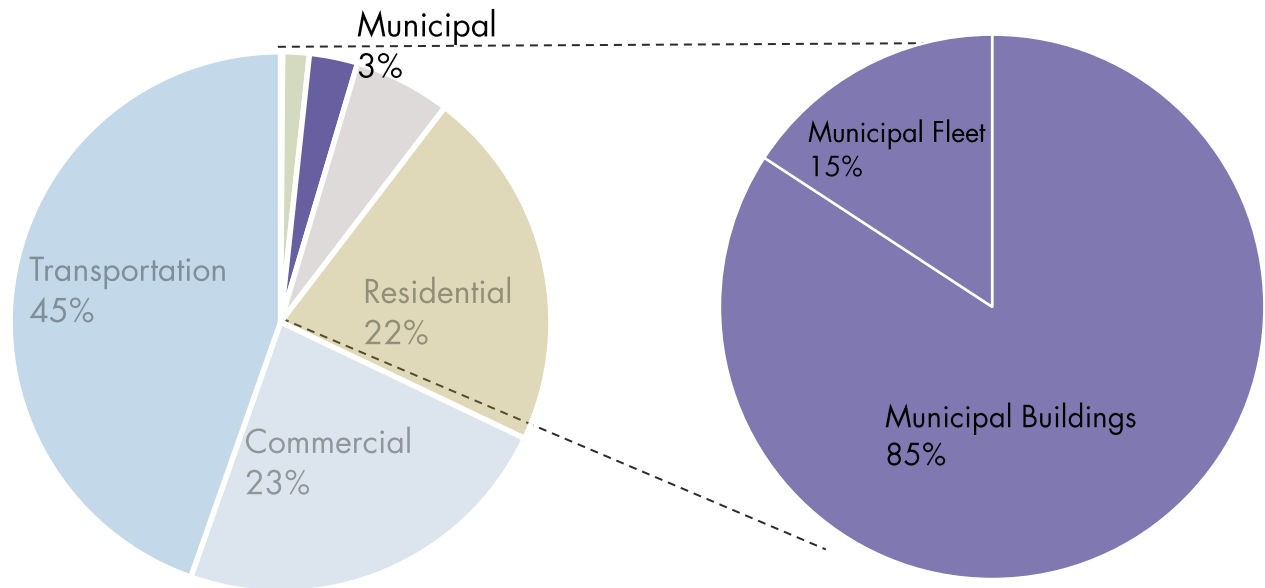


Figure 11. 2017 Municipal sector emissions.

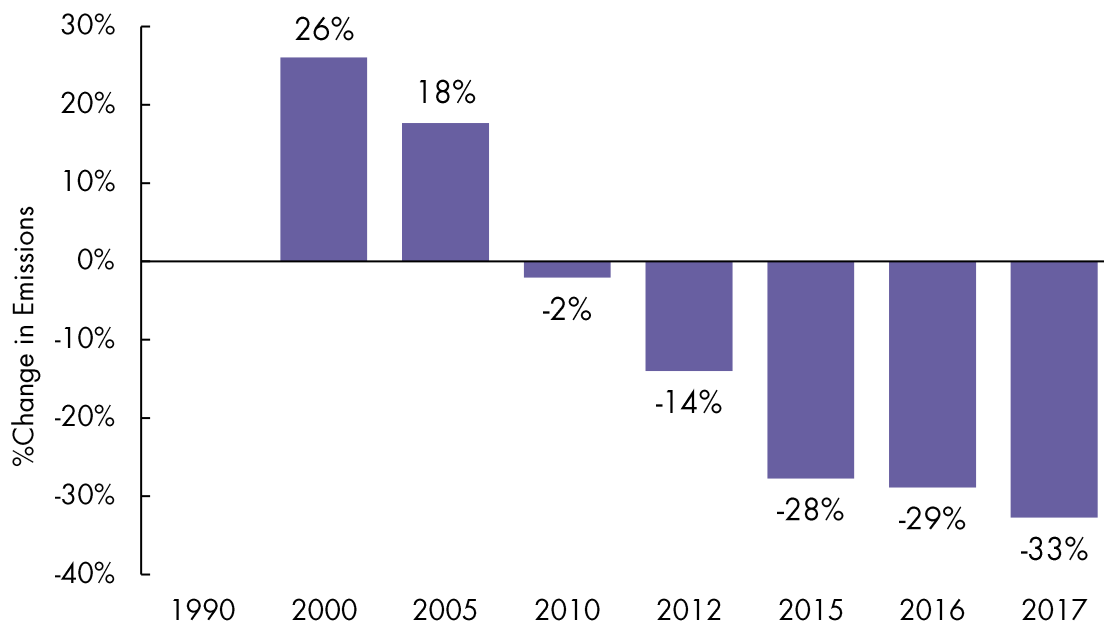


Figure 12. Municipal sector emissions changes compared to 1990 levels.

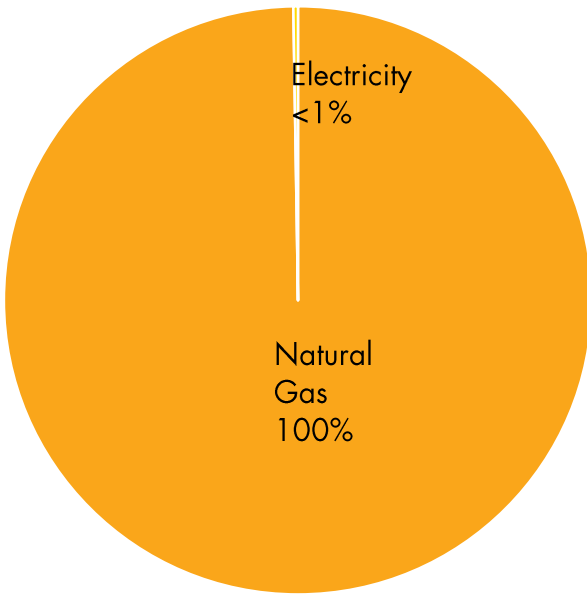


Figure 13. 2017 Municipal buildings emissions share by commodity.

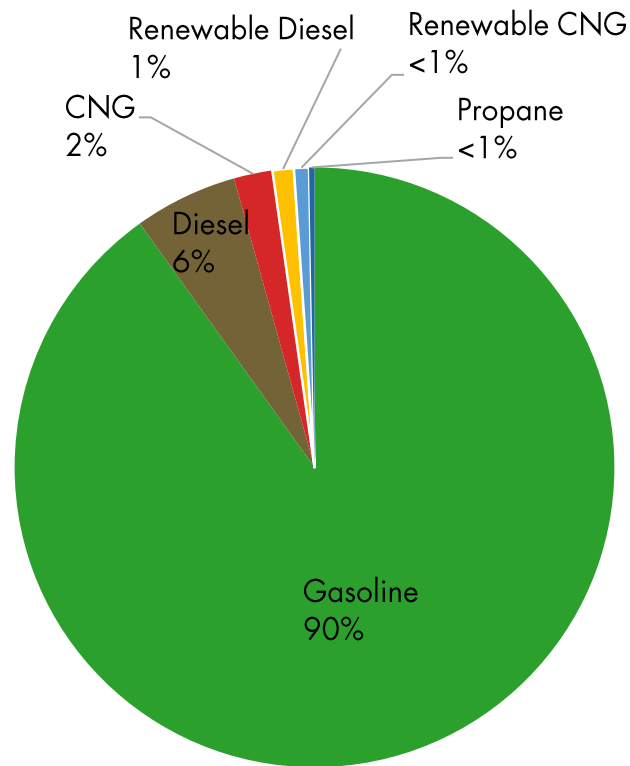


Figure 14. 2017 Municipal non-revenue fleet emissions share by commodity.

AGRICULTURE

In 2017, emissions in the Agriculture sector totaled 83 thousand mtCO₂e accounting for only 1% of San Francisco's GHG emissions (Fig. 2). Emissions from the Agriculture sector have increased 8% from 1990 levels (Fig 15) and are generated mostly from animal waste²² with the remaining share from managing urban soils, according to Bay Area Air Quality Management District's (BAAQMD) models.

Between inventory year 2016 and 2017 emissions, the Agriculture sector increased 4%. Agriculture emissions data is obtained from BAAQMD models, which show an increase in San Francisco's agriculture emissions since 1990. Emissions from this sector represent a small fraction of San Francisco's emissions and, thus, further analysis of this increase was not conducted.

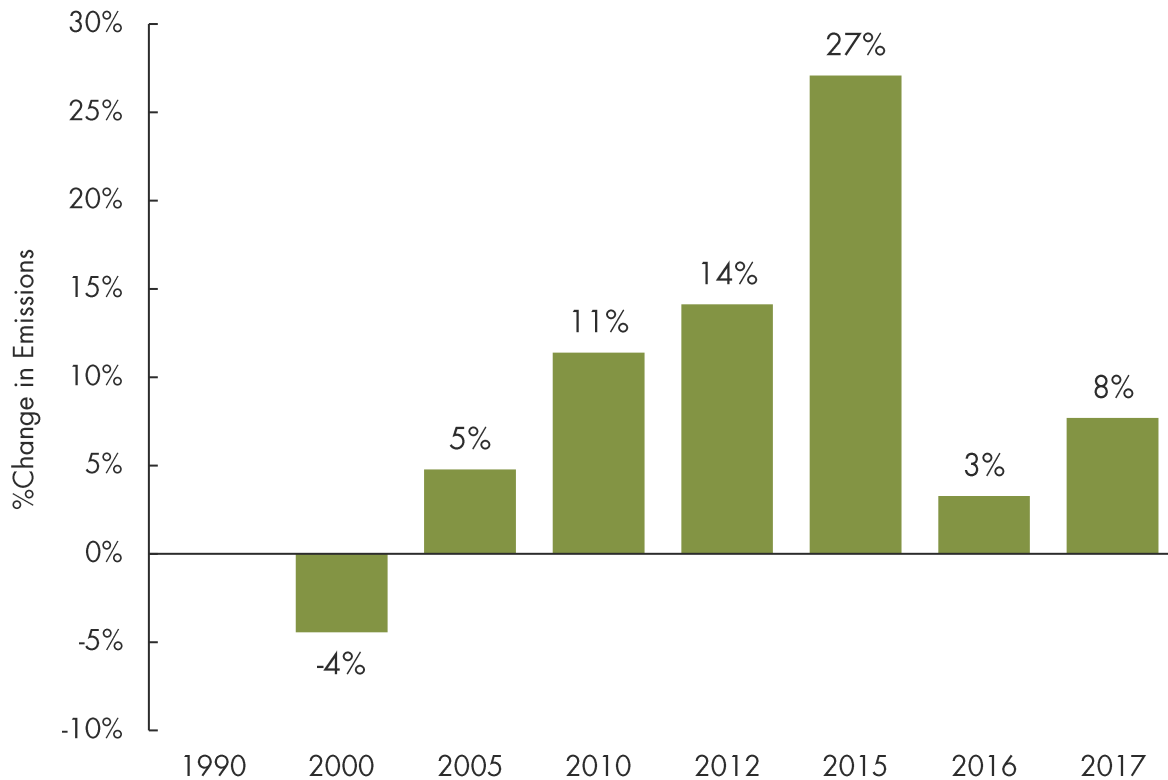


Figure 15. Agriculture sector emissions changes compared to 1990 levels.

²² Agriculture emissions are reported by BAAQMD. According to BAAQMD methodology, animal waste emissions in San Francisco may include waste products from domestic animals (pets) and other native animals.

WASTEWATER

In 2017, emissions in the Wastewater sector totaled 6.6 thousand mtCO₂e accounting for <1% of San Francisco's GHG emissions (Fig. 2). Emissions from the Wastewater sector have increased 53% from 1990 levels mainly due to a 22% increase in population, which increases the volume of wastewater treated at the City's water pollution control plants (Fig 16). Wastewater sector emissions occur mainly from fugitive sources, while the remaining portions occur from the energy used in treating wastewater, other processes associated with the treatment, and gases released during the digestion stage. Fugitive nitrogen emissions were responsible for the largest share of wastewater emissions (84%) compared to process nitrogen emissions (14%) and reuse of captured digester gas to power the treatment plant (1%).

Between inventory year 2016 and 2017 Wastewater sector emissions increased 29%. A 1.5% increase in population, and, thus the volume of wastewater treated was the primary driver of an increase in emissions during this time period.

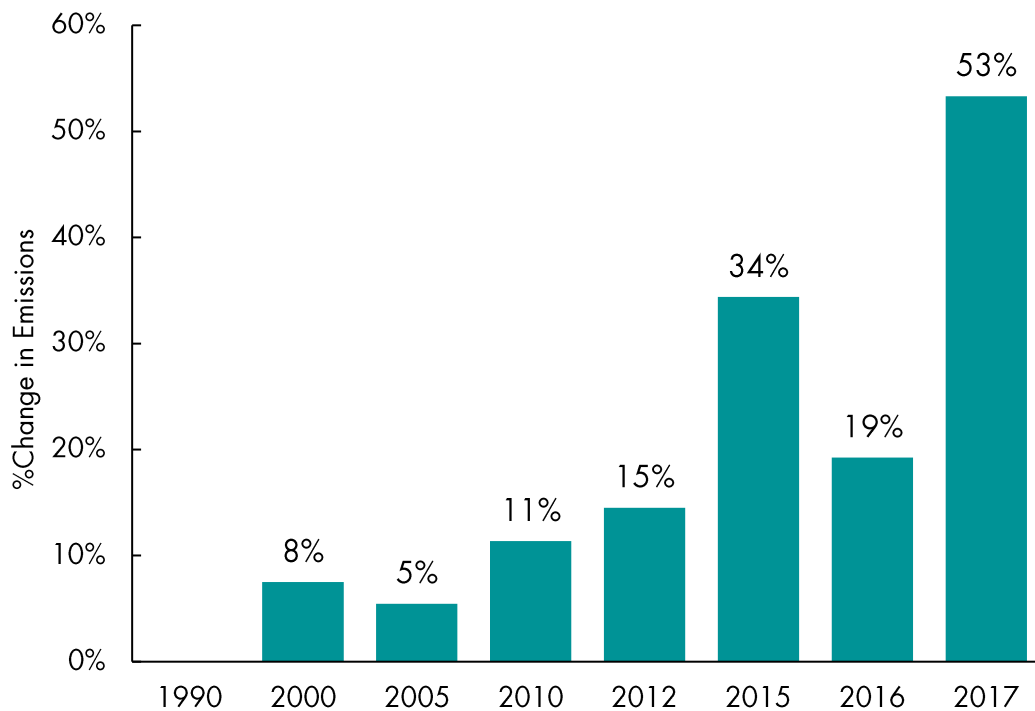


Figure 16. Wastewater sector emissions changes compared to 1990 levels.