

2016 SAN FRANCISCO GEOGRAPHIC GREENHOUSE GAS EMISSIONS INVENTORY AT A GLANCE

By San Francisco Department of Environment, Climate Program

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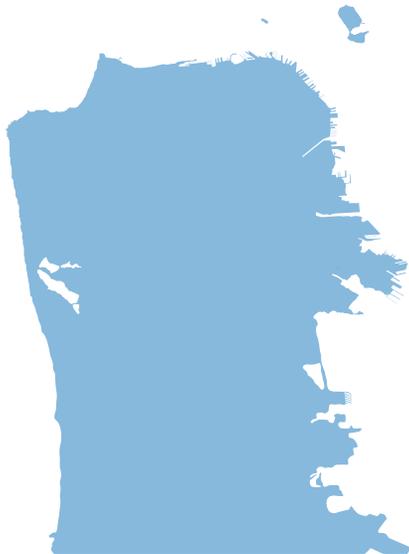
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1990-2016 San Francisco trends



Emissions



2016 total
5.6 million mtCO₂e

≈ weight of
15 Golden Gate Bridges

GDP



2016 total
\$139 billion

≈ stack of \$100 bills the height of
584 Transamerica Buildings

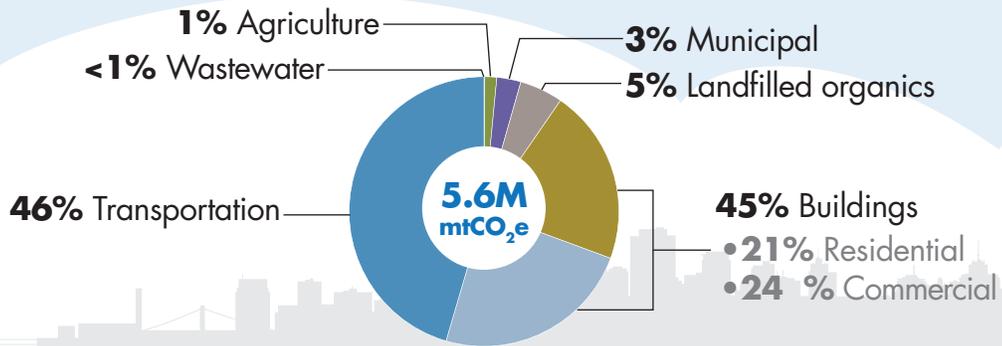
Population



2016 total
870,887 people

≈ the population of
Fiji

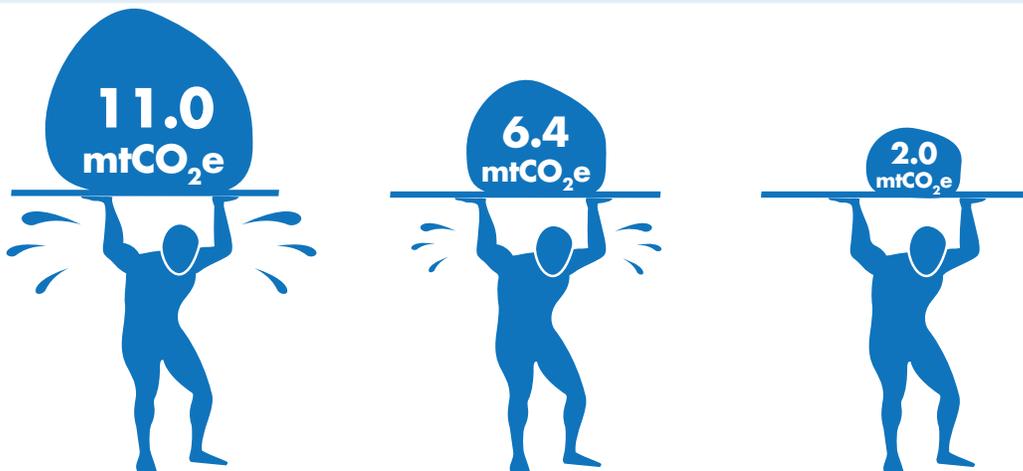
2016 San Francisco emissions by sector



Reductions from
1990 levels:



San Francisco per capita emissions



1990

2016

2030 GOAL

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EMISSIONS OVERVIEW

EMISSIONS TRENDS

In 2016, San Francisco's community-wide greenhouse gas (GHG) emissions, or carbon footprint, totaled 5.6 million mtCO₂e (Fig. 1). The four sectors tracked in the 2016 inventory include:

- The Residential sector accounted for 21% of the city's carbon footprint, with 82% of emissions from natural gas, 16% from electricity and 2% from other fuels (Fig. 2).
- The Commercial sector accounted for 24% of the city's carbon footprint, with 57% of emissions from natural gas, 38% from electricity, and 4% from steam.
- The Transportation sector accounted for 45% of the city's carbon footprint, with 71% from passenger vehicles, 17% from Ships and Boats (non-ferry), 6% from off-road equipment, and 6% from public transportation.
- The Landfilled Organics sector accounted for 5% of the city's carbon footprint¹.
- The Municipal sector, including facilities and fleet, accounted for a little less than 3% of the city's carbon footprint, with nearly all emissions from natural gas and vehicle fuel use.
- The Agriculture and Wastewater sector accounted for 2% of the city's carbon footprint.²

In 2016, San Francisco successfully reduced emissions 30% below 1990 levels from 8.0 million to 5.6 million mtCO₂e (Fig. 1). Declines occurred across the top five of the six sectors tracked.

- The Residential sector declined 40%
- The Commercial sector declined 48%
- The Transportation sector declined 2%
- The Landfilled Organics sector declined 38%
- The Municipal sector declined 29%
- Agriculture and Wastewater sectors increased 4%

Emission reductions were achieved even though San Francisco's population increased 20% during the same time period. In 2016, San Francisco's emissions per capita was 6.43 mtCO₂e compared to 10.99 mtCO₂e in 1990, a 41% decline.

¹ Emissions from Landfilled Organics, previously known as the Waste sector, occur when disposed organics break down (decompose) in a landfill and produce methane.

² Agriculture and Wastewater sectors are relatively new sectors tracked. These sectors will be analyzed and discussed at length during the 2017 A+A-Glance reporting cycle.

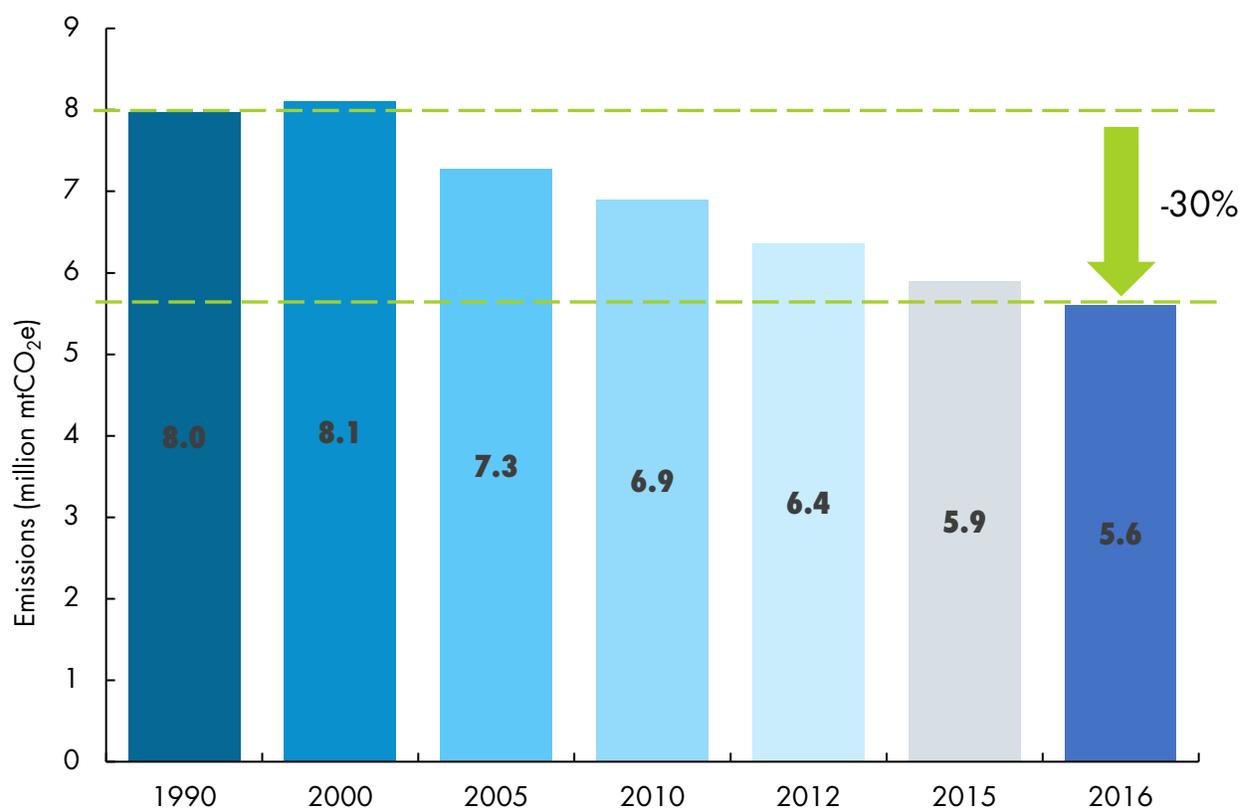


Figure 1. San Francisco's GHG emissions from inventory year 1990 to 2016.

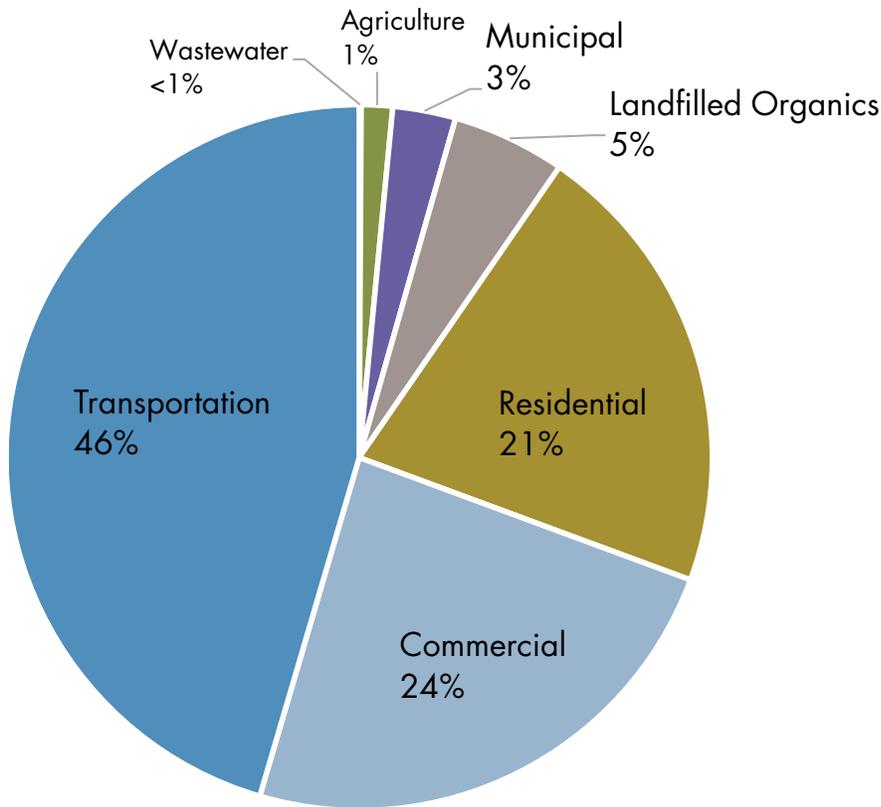


Figure 2. 2016 emissions by sector.

EMISSIONS REDUCTION DRIVERS

Reductions in emissions can be attributed to a variety of factors, including changes in the weather and the implementation of innovative technologies, policies and programs. The main drivers of the emission reductions observed between 1990 to 2016 were:

- Emissions from **Landfilled Organics** has been reduced **38%** since 1990. Recent growth in the economy and population has led to increases in both construction and demolition, resulting in an increase in material sent to landfill. However, the amount disposed per capita, thus emissions per capita from landfilled organics, held steady.
- **The electric grid has become cleaner for all of San Francisco's over time.** City-owned buildings switched to 100% GHG-free electricity in 2012 and there continues to be annual improvements in PG&E's renewables portfolio³ mix which serves the private sector.

³California'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.

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.

- Starting in 2016, **CleanPowerSF**, San Francisco's Community Choice Aggregation program, increased its renewables portfolio and expanded its customer base while reinvesting ratepayer funds locally in energy efficiency programs and new renewable energy facilities.
- **A scale-up in energy efficiency programs** helped stem demand for electricity and natural gas. During 2016, San Francisco's Energy Watch program saved 398 San Francisco commercial and multifamily properties a total of 5.9 million kWh, which is an average of \$2,668 in annual utility costs and reduced carbon emissions by 1,084 mtCO_{2e} tons, an equivalent of avoiding approximately 2.7 million miles driven by passenger vehicles.
- **Progressive green building codes and standards** in San Francisco resulted in more than 596 building projects, totaling over 133 million square feet, becoming LEED certified between 2004 and 2017. In addition, the City had 52 city-owned buildings and interiors LEED certified between 2004 and 2016, totaling 7.2 million square feet.
- **Cleaner fuels helped decouple transportation emissions from growth.** Between 1990 and 2016 commuting into and out of the city increased in parallel with a booming economy. Even with an additional 362.6 million vehicle miles added to San Francisco roads between 1990 and 2016, vehicle emissions declined 11.6%, primarily due to State efforts to reduce the carbon intensity of vehicle fuels.
- By switching to renewable diesel, **emissions from SF MUNI buses and municipal fleet vehicles declined 36%** between 2015 and 2016 at the same time that total fuel usage increased by 4%
- **Improvements in State and Federal appliance and energy standards** reduced electricity and natural gas use in new as well as renovated buildings.

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 2016 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. San Francisco has been tracking its emissions since 1990; hence, it continues to use the ICLEI USCP to report on sectors historically tracked for consistency and trending purposes. San Francisco continues to disclose emissions under the GPC framework for reporting purposes to and compliance with the Global Covenant of Mayors (GCOM).

Below is an in-depth analysis of 2016 emissions trends since 1990 in the Residential, Commercial, Transportation, Landfilled Organics, and Municipal sectors. The Agriculture and Wastewater sectors are new sectors tracked this reporting cycle. These sectors will not be analyzed herein and will be discussed at length during the 2017 At-A-Glance reporting cycle.

RESIDENTIAL

In 2016, emissions in the Residential sector totaled 1,178,841 mtCO₂e accounting for 21% of San Francisco's GHG emissions (Fig. 3). Emissions from the Residential sector have declined 40% 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 4). Residential sector emissions are from energy used to heat household spaces, provide lighting, and power appliances. Emissions from the Residential sector are mostly from natural gas use (82%) compared to electricity (16%) and other fuels (2%) because of San Francisco's push to increase its renewables portfolio (Fig 5).

Between inventory year 2015 and 2016 residential sector emissions decreased from 1,200,641 to 1,178,841 mtCO₂e (2% decrease). With continued improvements in building efficiency and expanded enrollment of customers in CleanPowerSF, energy used in the Residential sector should continue to trend downward over time.

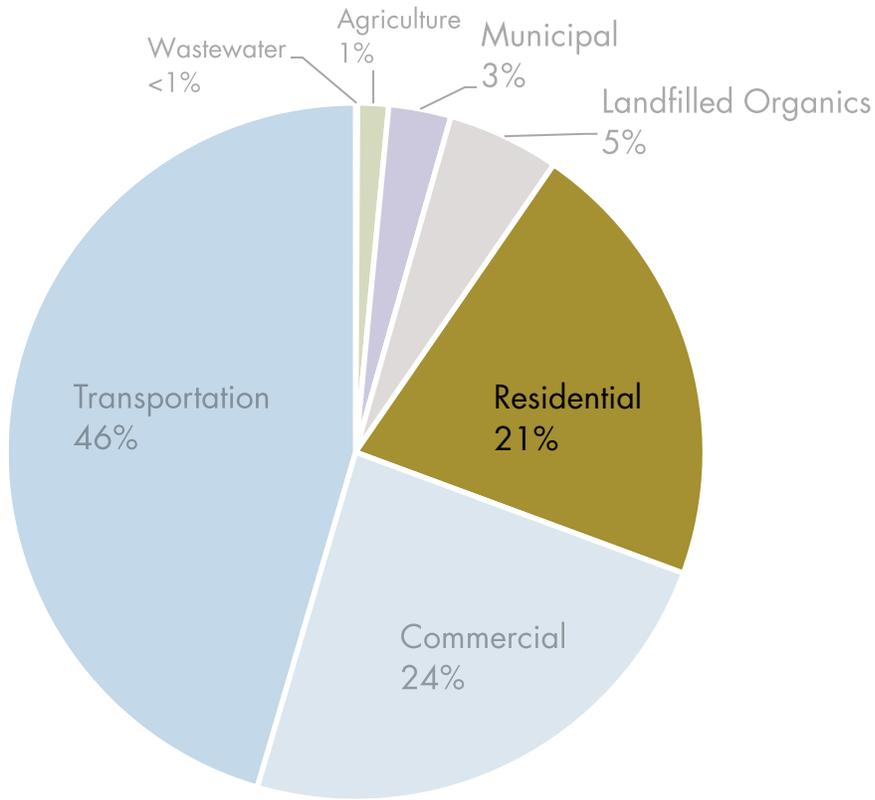


Figure 3. 2015 Residential sector emissions.

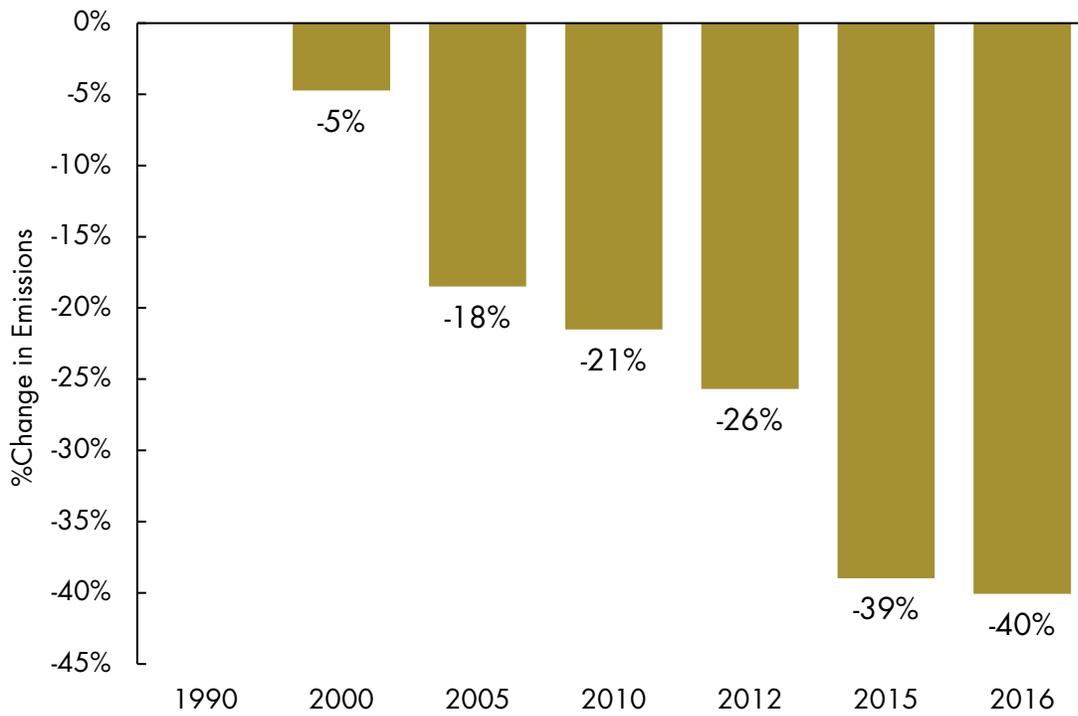


Figure 4. Residential sector emissions changes compared to 1990 levels.

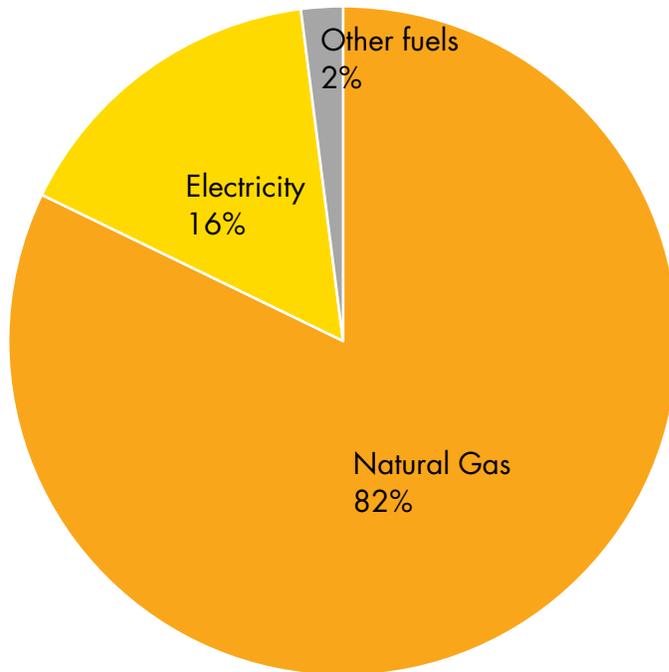


Figure 5. 2016 Residential sector emissions by commodity.

COMMERCIAL

In 2016, emissions in the Commercial⁴ sector (including commercial and industrial, direct access, district, and steam loop customers⁵) totaled 1,339,841 mtCO₂e accounting for 24% of San Francisco’s GHG emissions (Fig. 6). Emissions from the Commercial sector declined 48% 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, and the completion of the downtown district steam loop (Fig. 7). Commercial sector natural gas use was responsible for the largest share of emissions (57%) compared to electricity (38%) and steam (5%) (Fig. 8).

Emissions between 2015 and 2016 steadily declined from 1,616,658 to 1,339,841 mtCO₂e (12% decrease) (Fig 7), even though colder weather in 2016 resulted in more natural gas use. Similar to the Residential sector, with continued improvements in building efficiency and enrollment of customers in CleanPowerSF, energy used in the Commercial sector should continue to trend downward over time.

⁴ There are more commercial buildings than industrial buildings in San Francisco. In addition, the commercial sector includes the Industrial sector because of California’s Data Privacy Aggregation rules, which causes the two sectors to be combined.

⁵ 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.

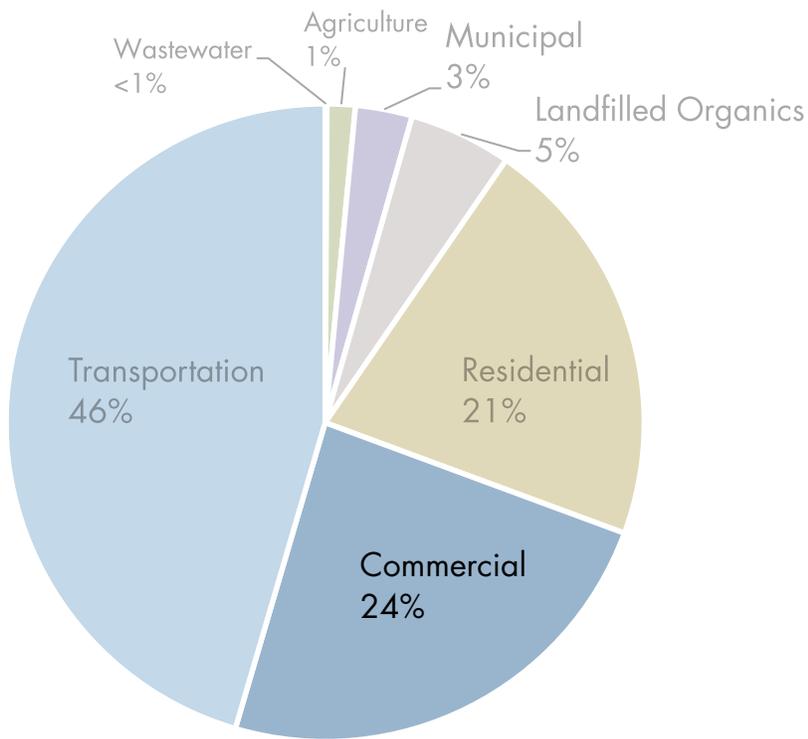


Figure 6. 2016 Commercial sector emissions.

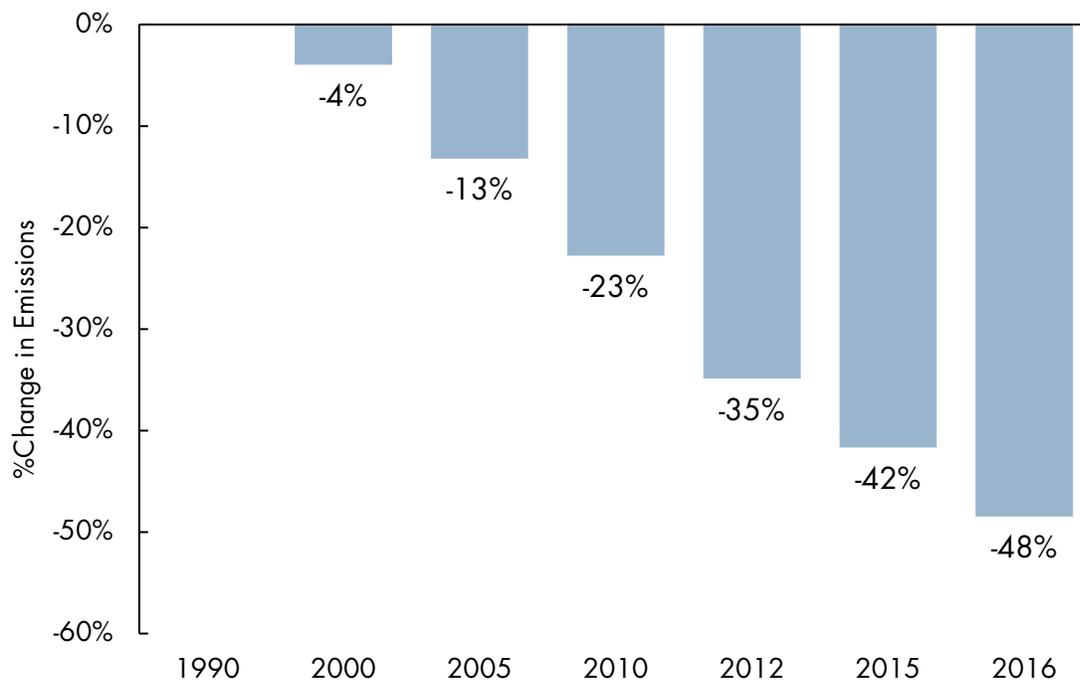


Figure 7. Commercial sector emissions changes compared to 1990 levels.

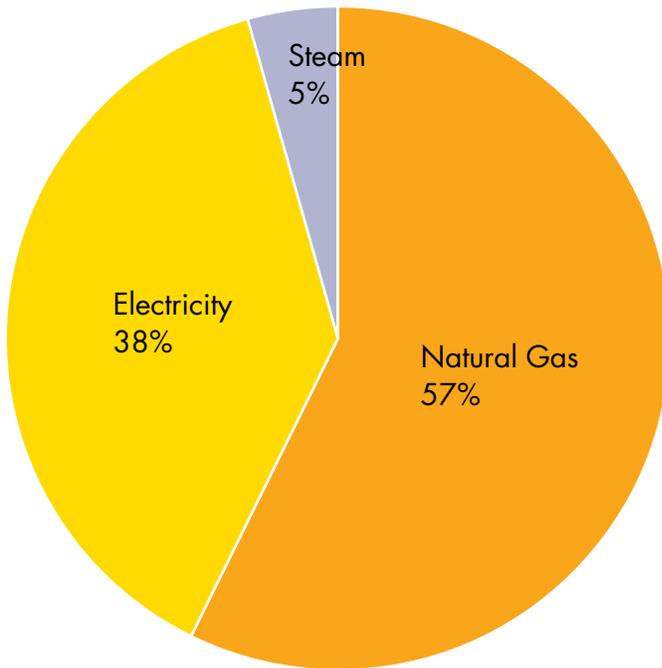


Figure 8. 2016 Commercial sector emissions by commodity.

TRANSPORTATION

In 2016, emissions in the Transportation sector totaled 2,547,222 mtCO₂e, accounting for 46% of San Francisco’s GHG emissions (Fig. 9). Emissions from the Transportation sector have declined 2% below 1990 levels mainly due to higher fuel efficiency standards and cleaner vehicle fuels mandated by the State of California (Fig. 10). Gasoline used by the Transportation sector was responsible for the largest share of emissions (71%) compared to diesel (20%), Other fuels (6%), electricity (3%), and renewable/biodiesel (<1%)⁶ (Fig. 11). Furthermore, passenger vehicles (cars and trucks) were responsible for the major share of emissions totaling 1,802,053 mtCO₂e, accounting for 71%⁷ of total Transportation sector emissions (Fig. 12). Maritime Ships and Boats accounted for 17% of emissions totaling 444,837 mtCO₂e while Off-road Equipment accounted for 6% of emissions totaling 150,681. Public Transportation accounted for the other 6% of emissions totaling 149,893 mtCO₂e. There were significant reductions realized in San Francisco’s public transit fleet with emissions from MUNI declining largely due to light rail services switching to 100% GHG free electricity and buses switching to renewable diesel.

Transportation sector emissions decreased from 2.62 to 2.55 million mtCO₂e (3% decrease) between inventory year 2015 and 2016 despite population and economic growth, an increase in public transportation ridership, and the number of passenger vehicle miles traveled. The decrease in

⁶ Trace amount of emissions from the CH₄ and N₂O portion of renewable diesel and biodiesel.

⁷ Gasoline consumed makes up the major (~94%) share of passenger vehicle emissions with a small portion from diesel (~4%).

emissions was due to a variety of factors. First, passenger and commercial vehicles miles traveling into and out of the city increased in parallel with a booming economy. Even with an increase in vehicle miles traveled from 3.97 to 4.01 billion (~37.5 million vehicle miles traveled increase) on San Francisco roads in 2016, vehicle emissions declined 3%. This reduction was driven by the State's success in reducing vehicle fuel carbon intensity. Second, by switching to renewable diesel, MUNI bus emissions have declined 48% between 2015 and 2016, from 38,613 to 20,008 mtCO₂e, even as fuel use increased by 4.6%. Lastly, commuter ferry diesel consumption slightly decreased between 2015 and 2016, which resulted in a 3.2% emissions decline from 22,640 to 21,923 mtCO₂e even as commuter ferry ridership into and out of San Francisco increased. Similarly, Caltrain commuter rail saw a 4% decline in emissions due to a decrease in fuel use even as ridership increased.

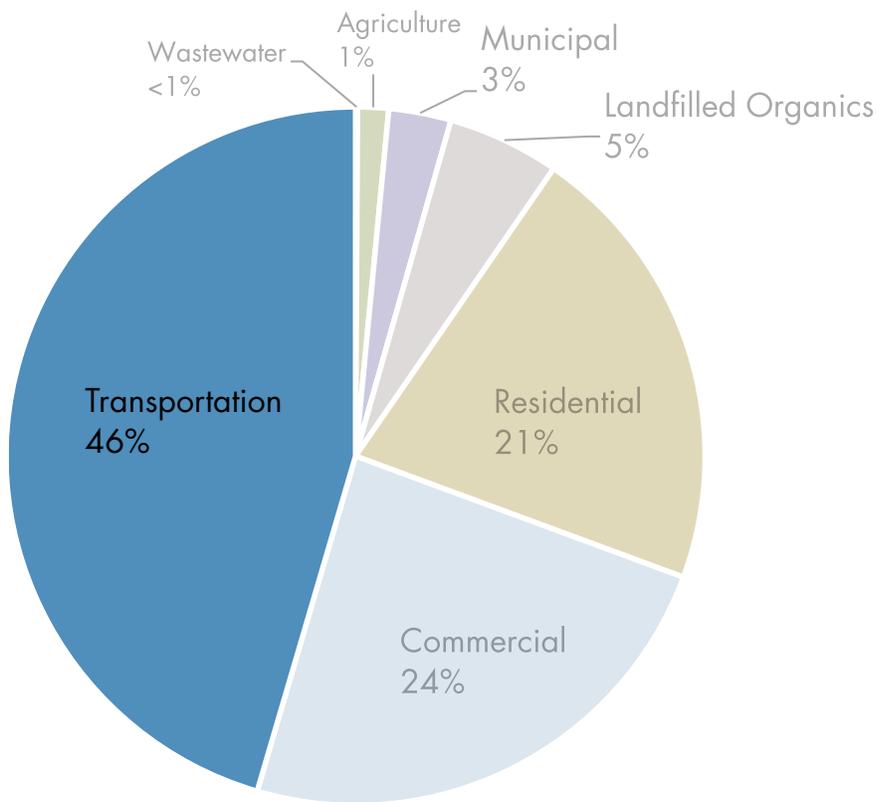


Figure 9. 2016 Transportation sector emissions.

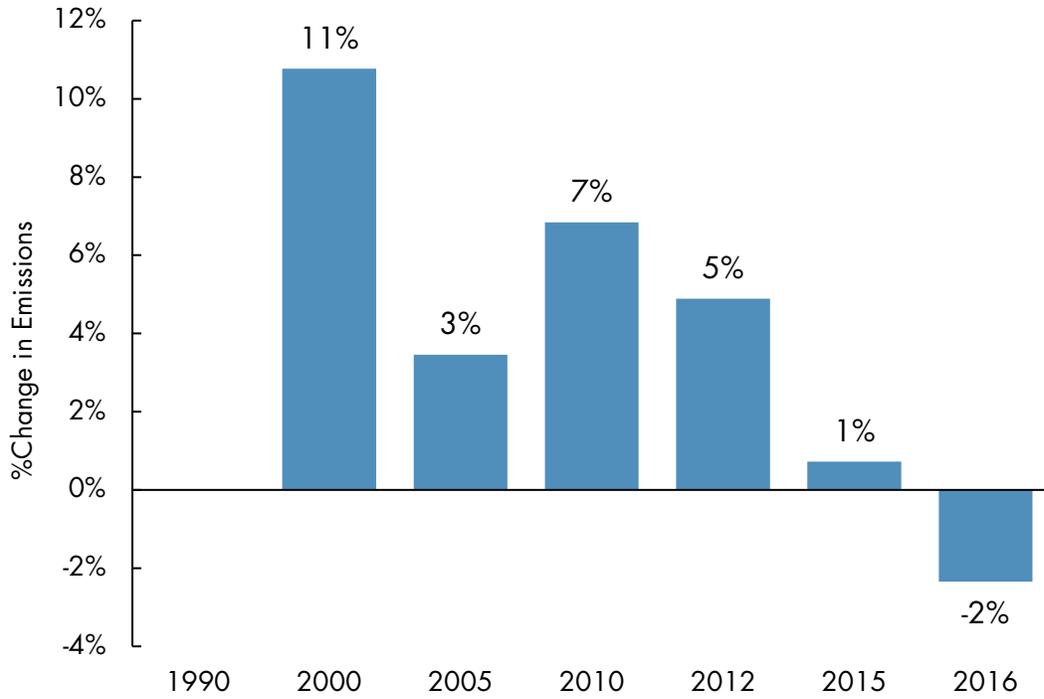


Figure 10. Transportation sector emissions changes compared to 1990 levels.

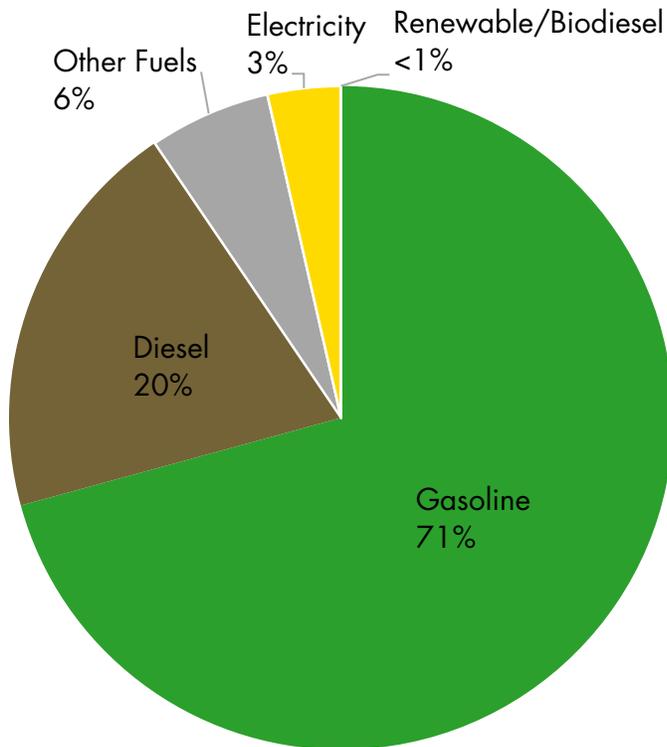


Figure 11. 2016 Transportation sector emissions share by commodity.

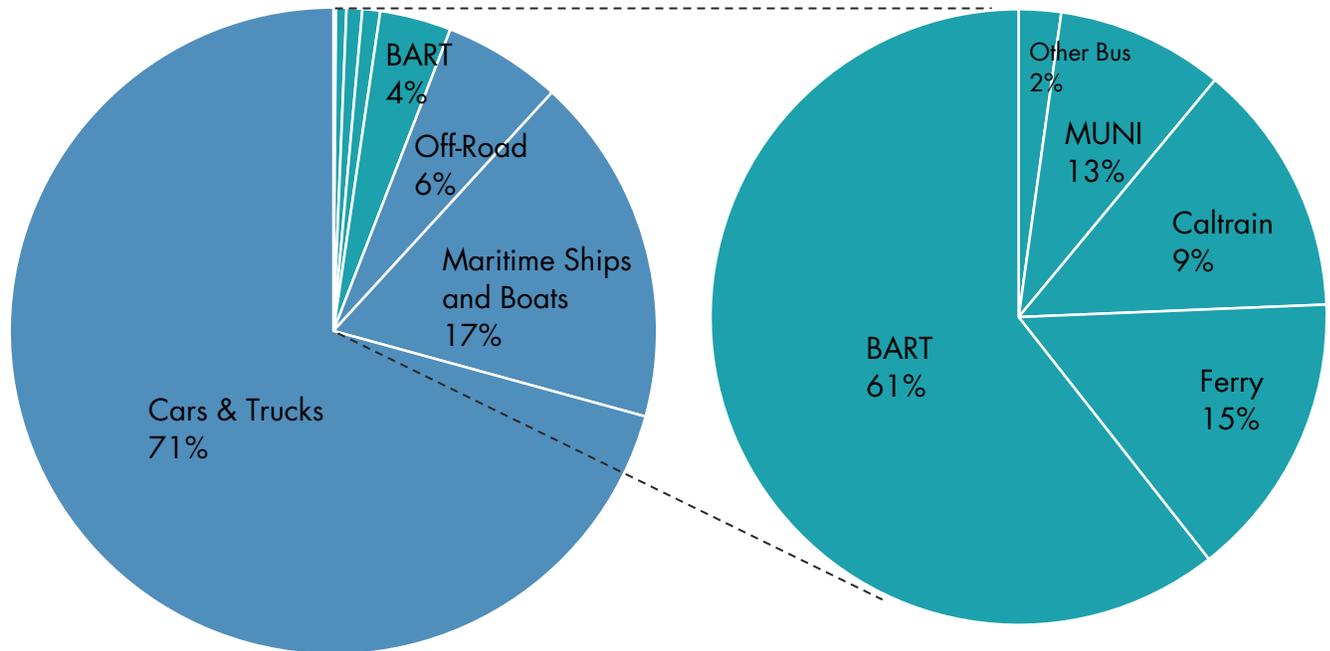


Figure 12. 2016 Transportation sub-sector emissions.

LANDFILLED ORGANICS

In 2016, emissions in the Landfilled Organics sector⁸ totaled 290,230 mtCO₂e, accounting for 5% of San Francisco's GHG emissions (Fig. 13). Organic materials sent to landfill decomposes and releases methane emissions to the atmosphere. Emissions from the Landfilled Organics sector have declined 38% below 1990 levels due to successful diversion, recycling and composting in the city (Fig. 14).

Landfilled Organics sector emissions increased 1.3% between inventory year 2015 and 2016. In recent years, growth in the economy and population has driven a construction and demolition⁹ boom, resulting in an increase in discarded organic and inorganic material sent to landfill. However, the amount of material (in tons) disposed per capita, thus emissions per capita from landfilled organics, held steady even as San Francisco's residential population increased.

⁸ Referred to as the Waste sector during previous inventory years.

⁹ 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. Organic materials decompose in landfills and release methane.

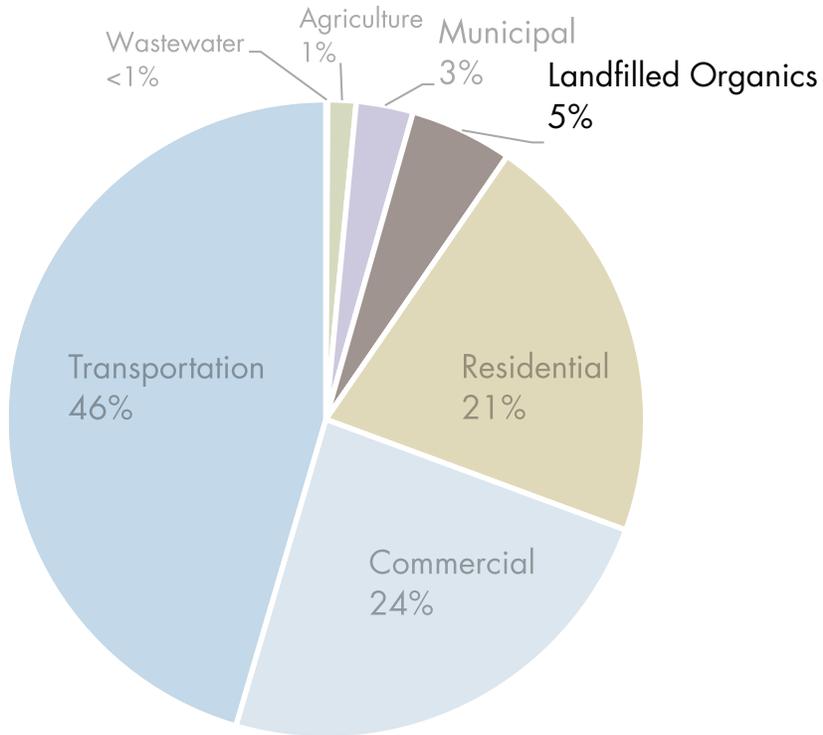


Figure 13. 2016 Landfilled Organics sector emissions.

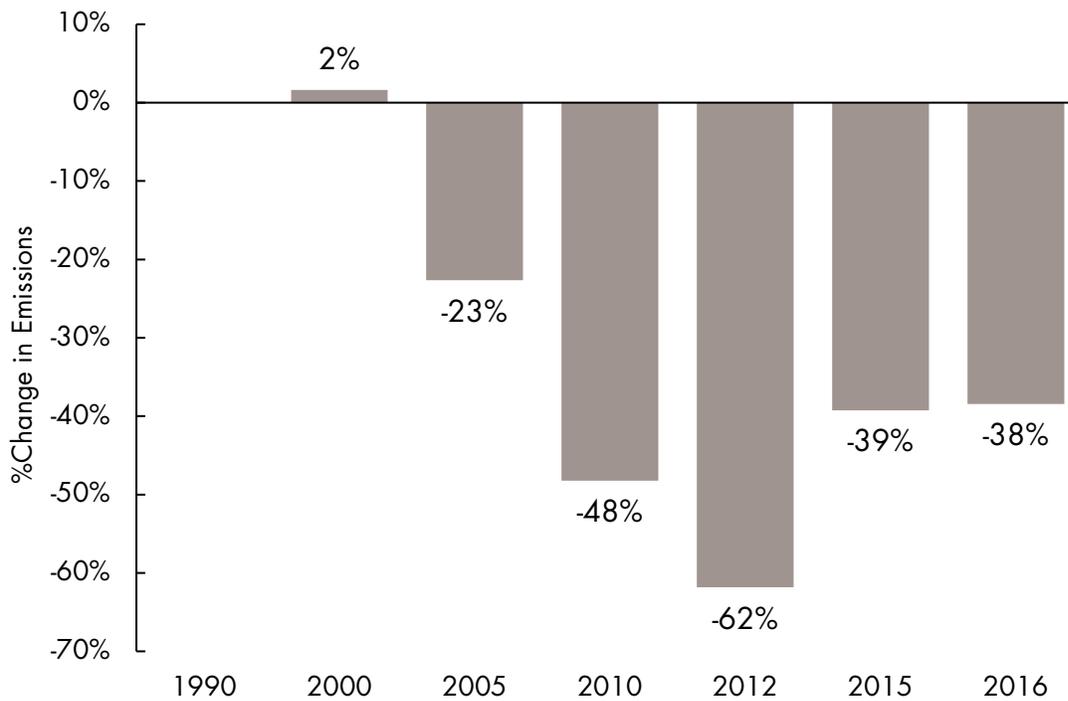


Figure 14. Landfilled Organics sector emissions changes compared to 1990 levels.

MUNICIPAL

In 2016, GHG emissions in the Municipal sector, comprised of city-owned buildings (83%) and vehicles¹⁰ (17%) was 161,528 mtCO₂e, accounting for just under 3% of San Francisco's total emissions (Fig. 15). Emissions from San Francisco's Municipal sector declined 29% below 1990 levels with the steepest declines between 2010 to 2012 due in large part to all city-owned buildings fully sourcing GHG-free electricity¹¹ generated from San Francisco Public Utilities Commission's Hetch-Hetchy hydropower dam (Fig. 16). As a result, natural gas continues to make up nearly 100% of the emissions in the Municipal buildings sub-sector, totaling 133,812 mtCO₂e (Fig. 17).

Municipal buildings emissions increased from 128,244 to 133,812 mtCO₂e (a 4% increase) between inventory year 2015 and 2016. Municipal building emissions are driven by natural gas use, and colder weather in 2016 lead to an increase in natural gas use (4.4 %). Nonetheless, many municipal energy efficiency projects, programs, and energy code improvements served to temper steep emissions increases. For example, the City's annual benchmarking report demonstrates that overall city-owned building energy use intensity (EUI)¹² has decreased 15.6 % between 2009 and 2016. In 2013 the Bayview Linda Brooks-Burton Brach Library became LEED-Gold certified and between 2015 and 2016 saw a 10% decline in its EUI. Overall, the City continues to improve its efforts to green municipal buildings with 52 LEED buildings, totaling 7.2 million square feet, certified from 2004 to 2016.

Countering the increase in building emissions, Municipal fleet emissions decreased from 35,870 to 27,717 mtCO₂e between 2015 and 2016. Municipal fleet emissions were driven by gasoline use, which was 54% of the vehicle fleet emissions share (Fig. 18). The roll out of renewable diesel began during FY2016. Looking forward, city fleet emissions are expected to continue declining independent from the amount of fuel consumed due to a complete transition to 100% renewable diesel.

¹⁰ Since 2015, city-owned fleet emissions were categorized and tracked within the Municipal sector.

¹¹ 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.

¹² 2016 Energy Benchmarking Report San Francisco Municipal Buildings at <http://sfwater.org/modules/showdocument.aspx?documentid=11724>

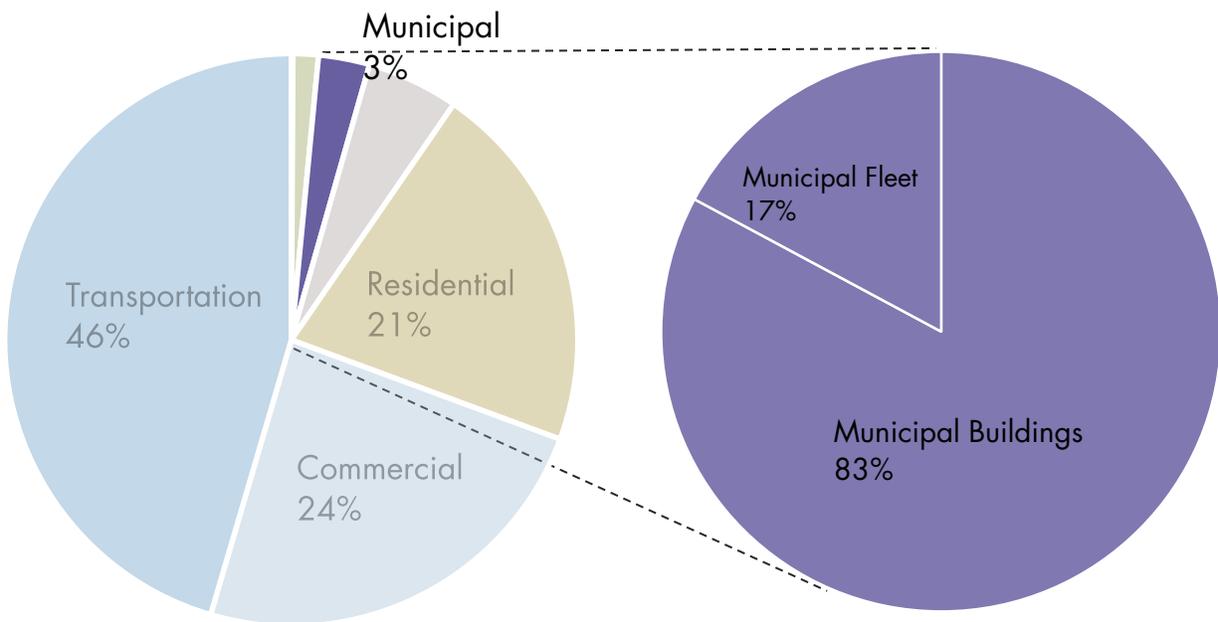


Figure 15. 2016 Municipal sector emissions.

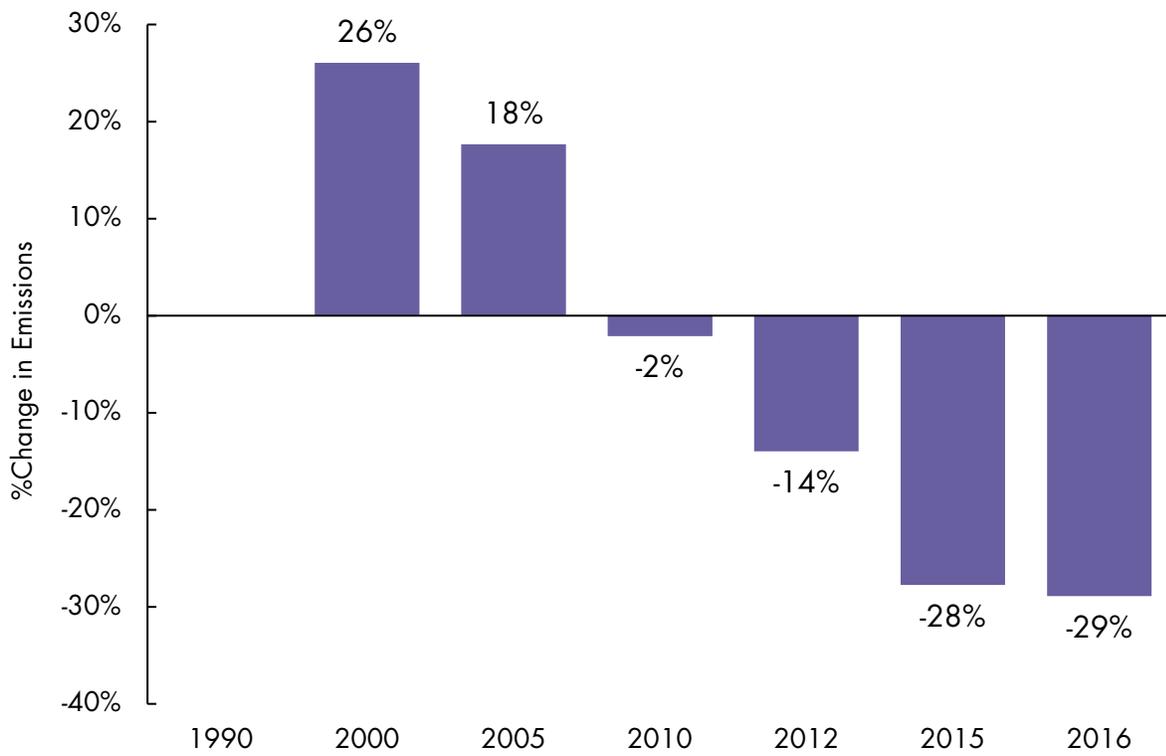


Figure 16. Municipal sector emissions changes compared to 1990 levels.

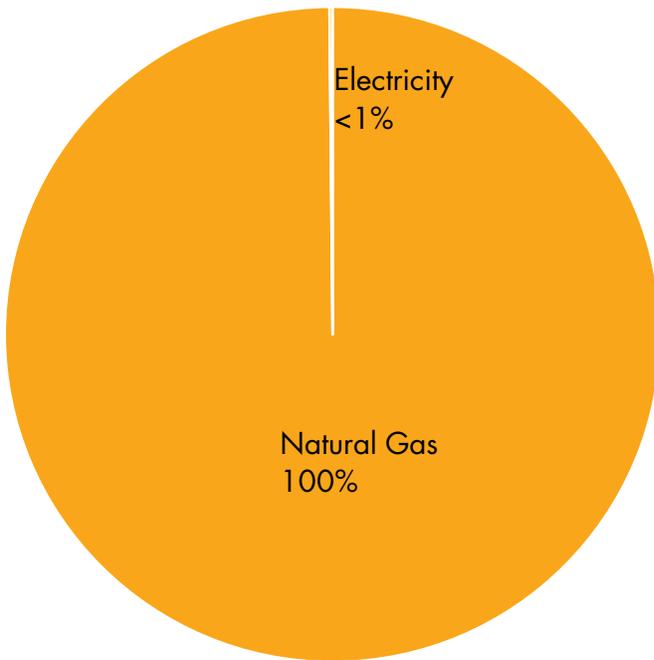


Figure 17. 2016 Municipal buildings sub-sector emissions share by commodity.

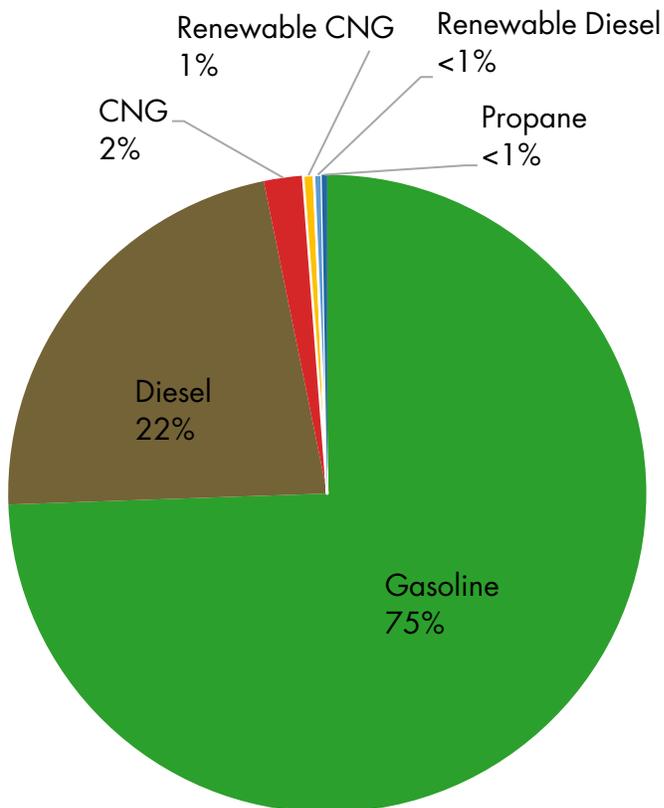


Figure 18. 2016 Municipal fleet sub-sector emissions share by commodity.