California Environmental Protection Agency
Air Resources Board

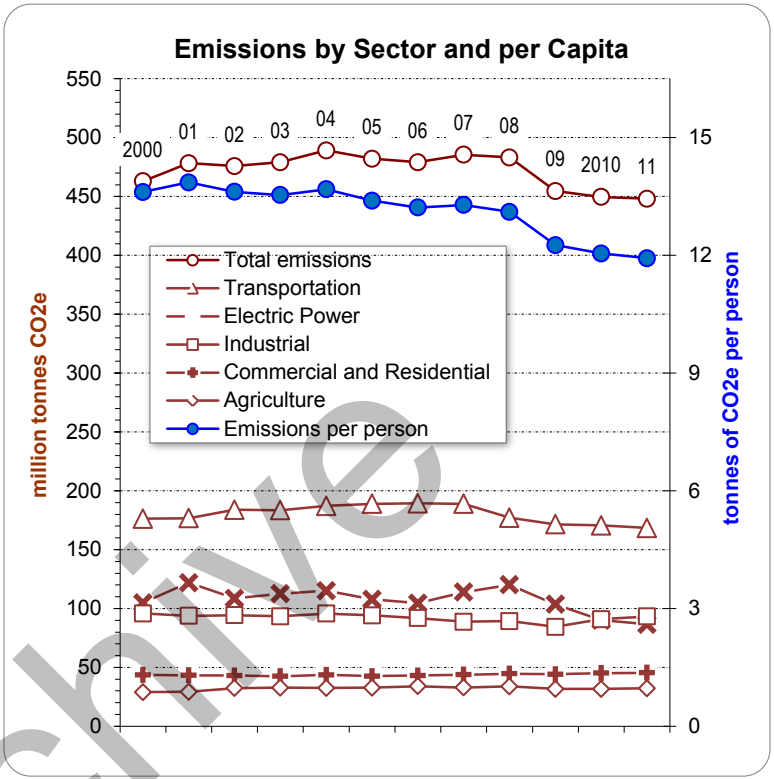
California Greenhouse Gas Emissions for 2000 to 2011 – Trends of Emissions and Other Indicators

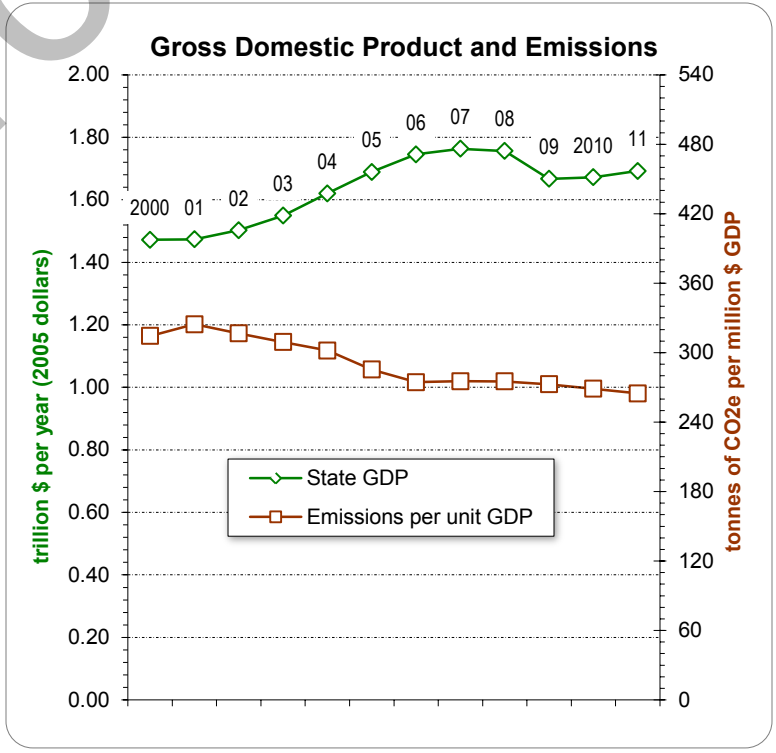
Overview

The Global Warming Solutions Act of 2006 (AB 32) sets a goal to reduce California's greenhouse gas (GHG) emissions to 1990 levels by 2020. Annual GHG emission inventories provide an important tool for establishing historical emission trends and track California's progress towards the 2020 goal.

Many factors affect year-to-year changes in GHG emissions, including economic activity, demographic influences, environmental conditions such as drought, and the impact of regulatory efforts to control GHG emissions. Although the Air Resources Board (ARB) has adopted many GHG emission reduction measures, the bulk of the reductions won't be seen until mid-decade. Most reductions since 2008 have been driven by economic factors (recession), previous energy efficiency actions, renewable power requirements and climate hydrology.

California's gross emissions of greenhouse gases decreased by 6 percent from 478.4 million tonnes of CO2e in 2001 to 448.1 million in 2011, with a maximum of 489.2 million tonnes in 2004. During the same period, California's population grew by 9 percent from 34.5 to 37.6 million people[1]. As a result, California's per capita GHG emissions have decreased over the last 11 years from 13.9 to 11.9 tonnes of CO2e per person. In 2011, emissions continued to decrease for the transportation and electric power sectors. Emissions from all other sectors remained relatively flat or increased slightly from 2010.



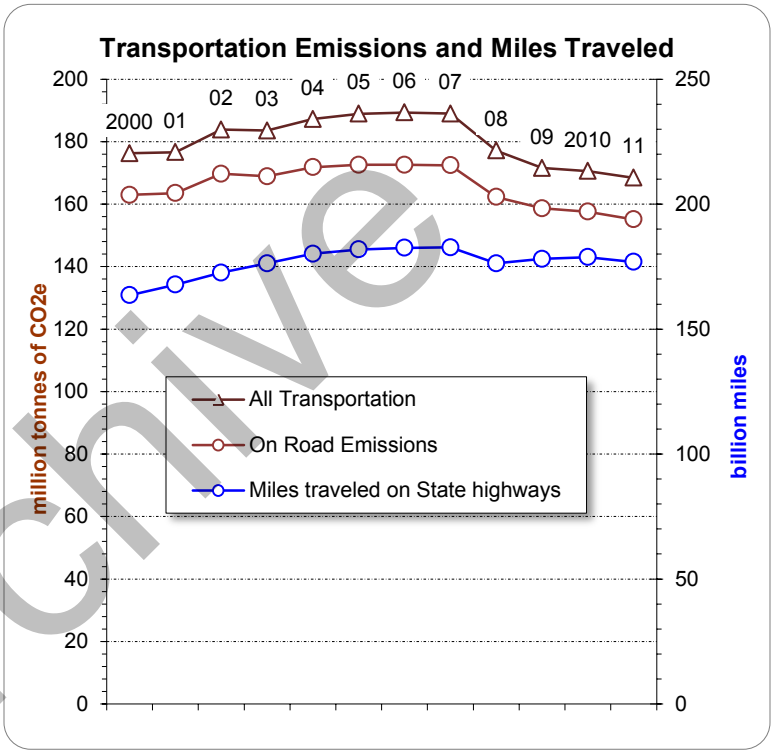


California's Gross Domestic Product (GDP) increased from $1.47 trillion in 2001 to $1.69 trillion in 2011 (in 2005 dollars)[2]. Reflecting the overall decrease in GHG emissions, the GHG intensity of California's economy, measured as GHG emissions per unit of economic output, decreased from 324.5 tonnes CO2e per million dollars in 2001 to 264.8 tonnes per million dollars in 2011. And while California's economy and GDP continued to grow in 2011, the GHG intensity of California's economy continued to decrease.

For each major sector of the statewide greenhouse gas inventory, a trend summary is provided below.

Transportation

The transportation sector remains the largest source of GHG emissions in 2011 with 37.6 percent of California's GHG emission inventory. The largest emissions category within the transportation sector is on-road, which consists of passenger vehicles (cars, motorcycles, and light-duty trucks) and heavy duty trucks and buses. Emissions from on-road constitute over 92 percent of the transportation sector total. On-road emissions have declined each year since 2006 with the greatest decrease occurring between 2007 and 2008, when emissions dropped by 5.9 percent. In 2011, emissions from the on-road category decreased by 1.6 percent from the year before.



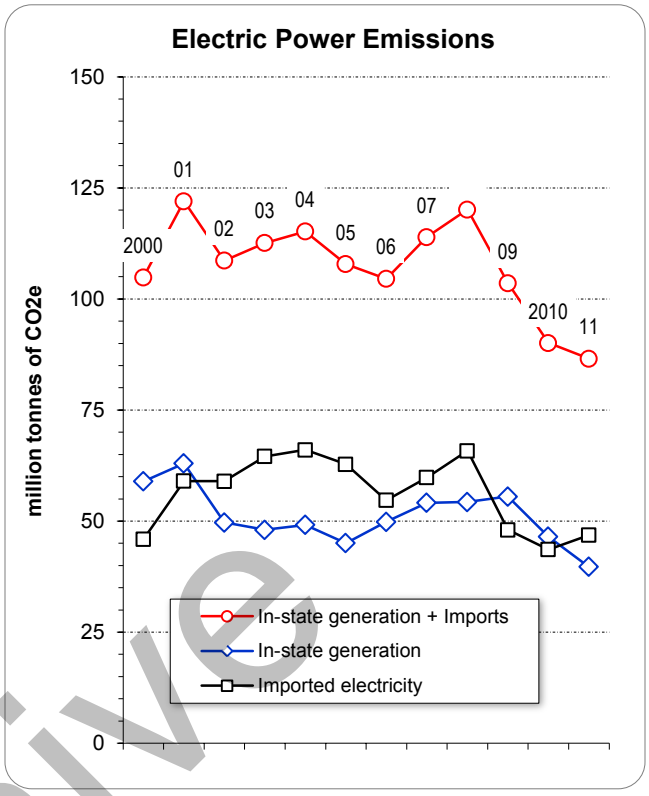
Between 2001 and 2011, the average retail price of gasoline and diesel fuel in California first decreased, reaching a minimum in 2002 before steadily increasing to more than twice the 2002 price in 2008. In the summer of 2008, fuel prices spiked, reaching a historic maximum ($4.48 per gallon for gasoline and $4.97 for diesel)[3]. After a marked decline in 2009, average retail prices climbed again to reach 2008 levels in 2011. The consumption of gasoline and diesel fuel decreased dramatically in 2008 and continued to decline through 2011. Total vehicle miles traveled on California highways[4] declined in 2008, the first such decrease since 1974. Still, on road emissions continued decreasing even with modest VMT gains in 2009 and 2010.

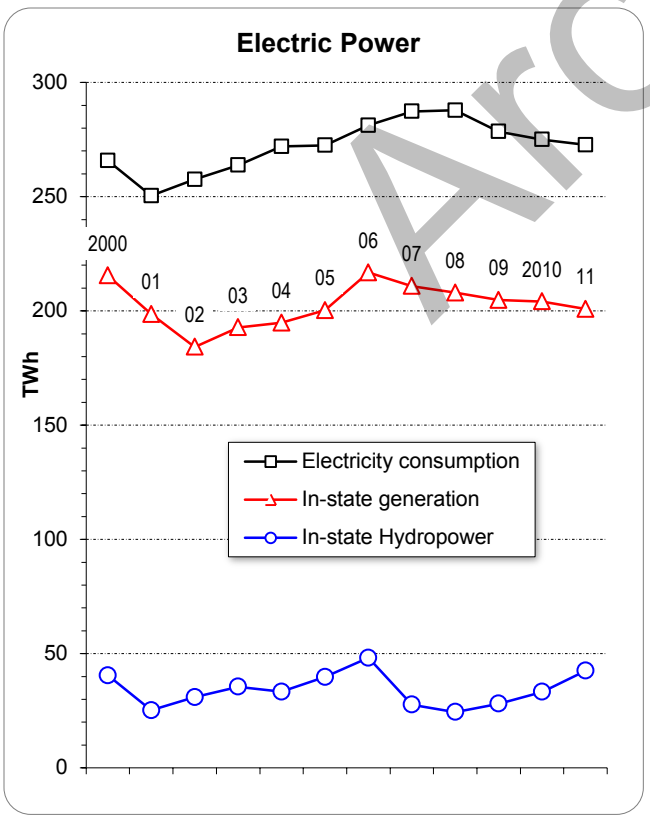
Electric Power

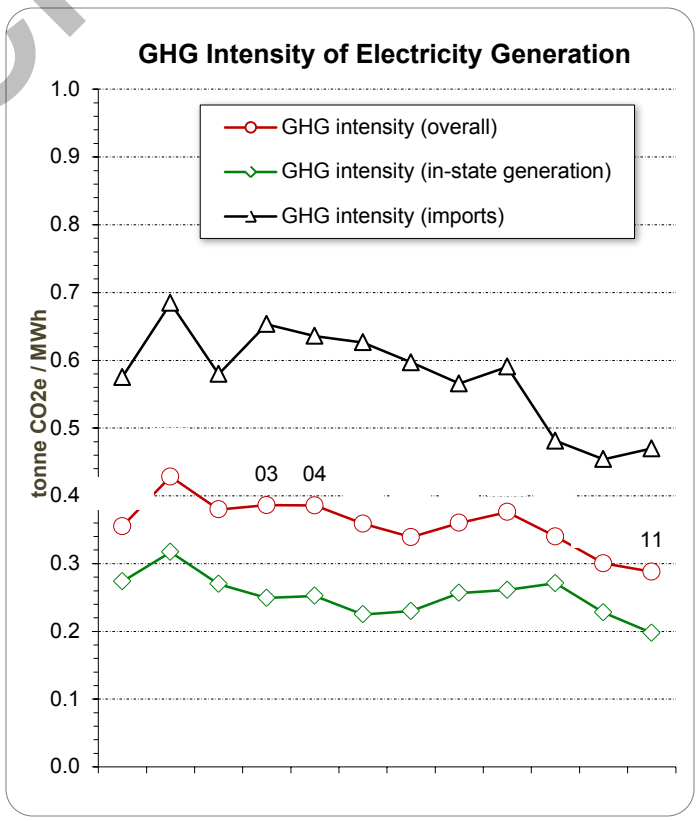
The GHG emission inventory divides the electric power sector into two broad categories, emissions from in-state power generation and emissions from imported electricity. Total greenhouse gas emissions from electric power generation varied over the eleven years between 2001 and 2011 from a high 122.0 million tonnes of CO_2e in 2001 to a low of 86.6 million tonnes in 2011, an overall decrease of about 29 percent. During that same period, electricity consump-

tion[5] grew from 250.4 terawatt hours (TWh) in 2001 to 287.8 TWh in 2008, followed by a steady decline to 272.6 TWh in 2011.

California produces almost 70 percent of its electricity consumption from power plants located within the state[6]; the rest is imported. The amount of power imported in a given year varies due to several factors, including the availability of in-state hydropower. Over the last eleven years, hydropower provided an average of 17 percent of California's electric power generation. The hydrologic conditions produced two major wet years between 2001 and 2011 — 2006 and 2011. In 2006 hydropower accounted for over 22 percent of in-state power generation and in 2011 hydropower contributed approximately 21 percent. Hydropower production, as well as other non-emitting sources of energy, effects the GHG intensity of electricity generation (i.e., the quantity of CO_2e emitted per MWh produced). The GHG intensity of California electricity peaked in 2001, a year marked by drought and electricity market manipulation, and reached a low point in 2011, a particularly wet year. The GHG intensity of electricity imports declined to the lowest



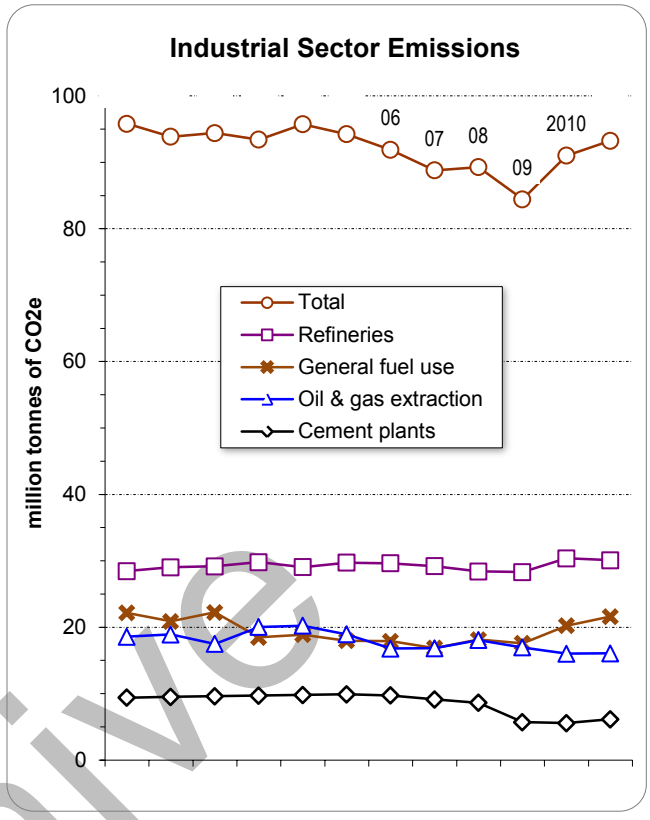




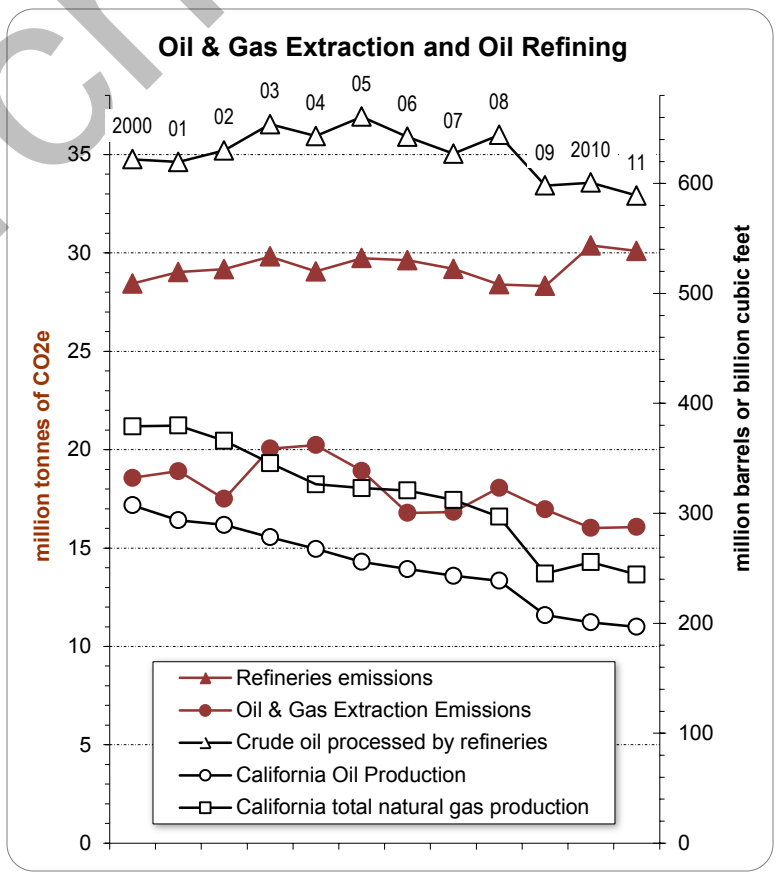
point in a decade in 2010 and increased slightly in 2011.

Industrial

Industrial emission sources include refineries, oil & gas extraction, cement plants, and other stationary sources that consume fuel. Like in the case of other sectors that are closely tied to the State's economic conditions, emissions from the industrial sector saw a 5.4 percent decline in 2009 but then grew by more than 7.8 percent between 2009 and 2010, and 2011 emissions increased about 2.5 percent relative to 2010. Over the last decade, total industrial sector emissions fluctuated from a high of 95.8 million tonnes CO2e in 2004 to a low of 84.4 million tonnes in 2009.

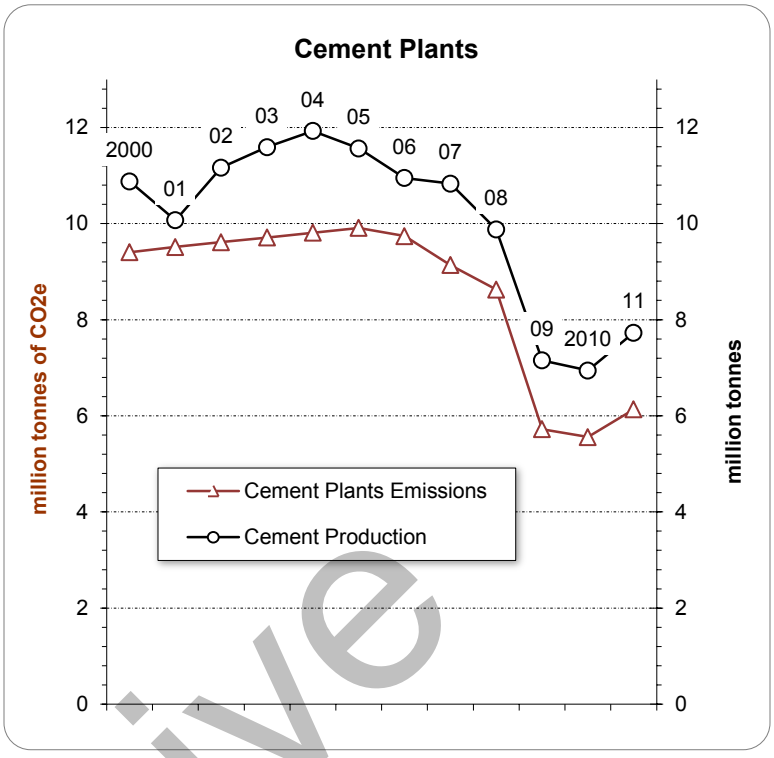


Among the industrial emissions categories, refineries represent about 32 percent of the sector's total emissions. Emissions from refineries remained relatively constant for most of the last eleven years, with small year-to-year changes. Most recently, refinery emissions increased markedly in 2010 and then declined about 1 percent between 2010 and 2011, to 30.1 million tonnes of CO_2e. The total net crude oil processed by refineries[7] was 622 million barrels in 2000 and peaked at 661 million in 2005; it dipped in 2009 and was 589 million barrels in 2011.



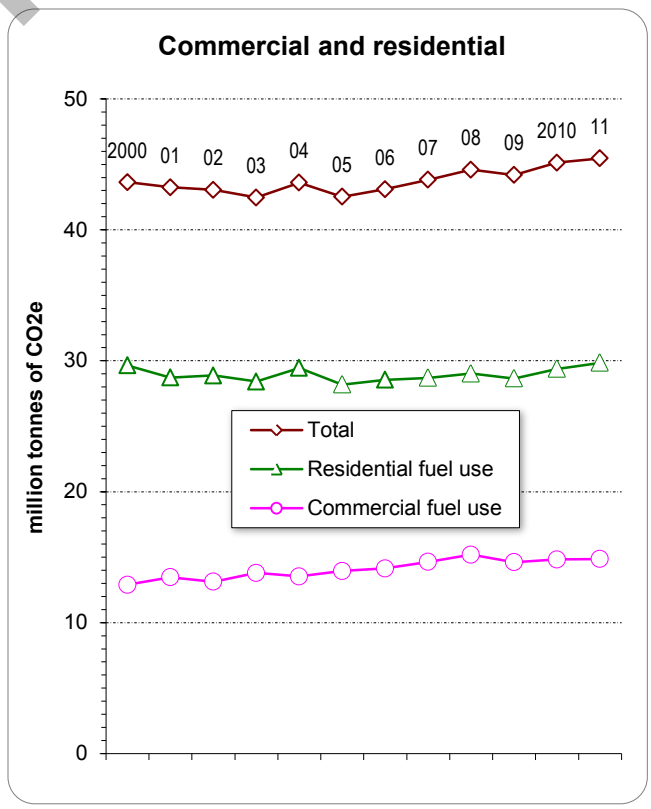
Emissions from oil and gas extraction, another major industrial category, have fluctuated over the last decade from a high of 20.2 million tonnes in 2004 to 16.0 million tonnes in 2010, with a steady decline from 2008 through 2010. Emissions from oil and gas extraction increased between 2010 and 2011 by about one-half of one percent. Oil and gas production in California [8] declined substantially since 2000: from 307 to 197 million barrels of oil and from 379 billion cubic feet of natural gas to 244 billion.

Emissions from cement plants, made up of fuel combustion and clinker process emissions, peaked in 2005 with a decrease beginning in 2006 and continuing through 2010. Between 2006 and 2010, cement plant emissions declined 43 percent, reflecting both a large decrease in demand and the closure of two cement plants over the period. Nationally, demand for cement fell by 26.5 percent in 2009 to the lowest level since 1983[9]. This decline continued in 2010 with California cement plants operating at 51 percent capacity[10]. In 2011, cement production grew 11 percent and manufacturing emissions in California increased about 10 percent from 2010.



Commercial and Residential

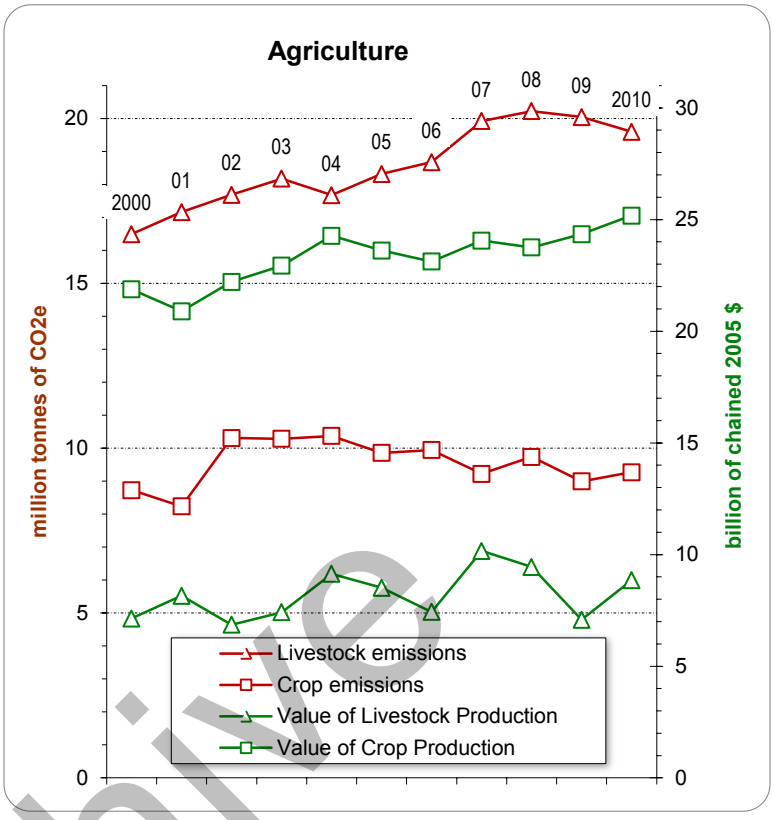
Emissions from the commercial and residential sectors are driven by the combustion of natural gas and other fuels for household use and for providing energy for commercial businesses. Together, emissions from the commercial and residential sectors have remained relatively flat over the last decade with only a minor decline between 2008 and 2009. Post-2009, the emissions trend is upward with a 3 percent increase seen between 2009 and 2011. While combined emissions from the commercial sector and residential sector have exhibited limited year-to-year variation, individually the sectors exhibit different trends.



Emissions from residential fuel combustion show little variation over the last eleven years ranging from a low in 2005 of 28.2 million tonnes to a high in 2011 of 29.9 million tonnes; the majority of emissions from the residential sector are from natural gas combustion. At the same time, the number of housing units[11] grew steadily from 12.2 million units in 2000 to slightly over 13.7 million in 2011. This suggests that the fuel consumption per housing unit has declined.

Emissions from commercial fuel use ranged from a low of 12.9 million tonnes of CO_2e in 2000 to 15.2 million tonnes in 2008. Commercial sector emissions dropped 4 percent between 2008 and 2009. In 2010 emissions from

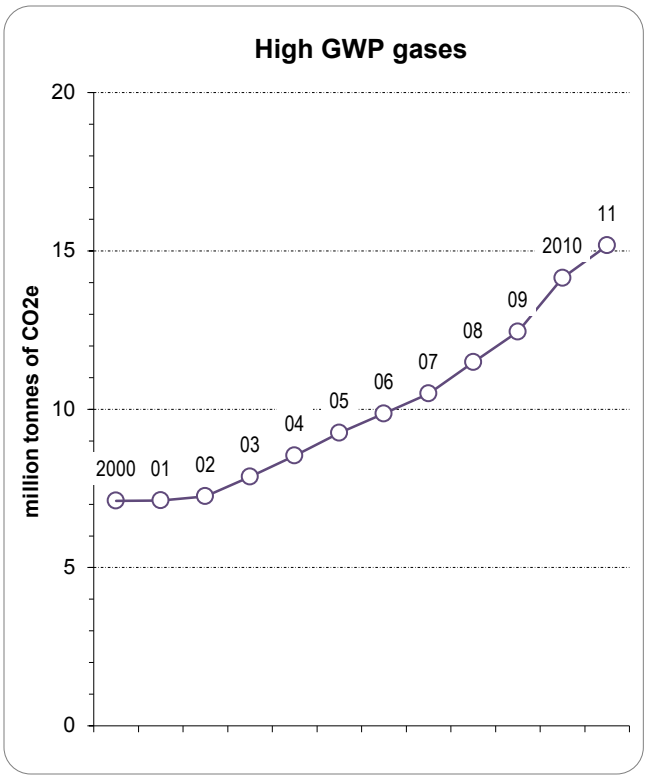
the commercial sector began to increase to their current level of 14.9 million tonnes. Commercial floor space grew steadily in California [12] from 6.4 billion square feet to 7.0 billion between 2001 and 2011. Unlike the residential sector, the commercial sector does not exhibit an apparent change in fuel use per unit of space.



Agriculture

Emissions from the agriculture sector grew from 29.2 million tonnes of CO_2e in 2001 to 32.2 million in 2011. Over the period, overall emissions from livestock enteric fermentation and manure management increased from 17.2 million tonnes to 19.6 million tonnes. During the last decade, California dairies increased their herds from 1.6 million cows in 2001 to 1.8 million in 2011, and their total milk production from 33 to 41 billion pounds[13]. The value of livestock production includes meat, poultry, eggs and dairy products.

Emissions from crop growing and harvesting (primarily N_2O from fertilizer use) varied from 8.2 million tonnes of CO2e in 2001 to 10.4 million tonnes in 2004 and returned to approximately 9.3 million tonnes in 2011. The value of crop production includes field crops, fruits, nuts and vegetables.



High Global Warming Potential Gases

High Global Warming Potential (high-GWP) gases included in the inventory consist primarily of substitutes for ozone depleting substances (ODS)—primarily HFCs and PFCs—that are used in a variety of applications, including refrigeration and air conditioning equipment, solvent cleaning, foam production, sterilization, fire extinguishing, and aerosols. Since the 1990's, use of ozone depleting substances (ODS) substitutes has grown progressively as they are phased in as replacements for CFCs and HCFCs.

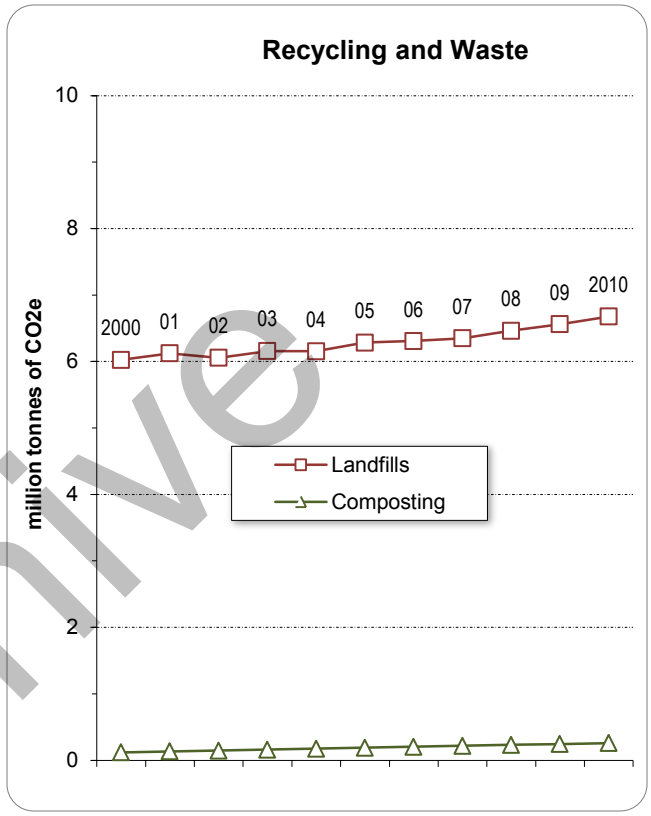
Emissions of all high-GWP gases make up about 3 percent of total statewide emissions in the 2011 inventory. High GWP gas emissions

have grown steadily from 7.1 million tonnes of CO2e in 2001 to 15.2 million tonnes in 2011. This increase is driven by the tripling of ODS substitute emissions over the last decade.

Overall, fugitive emissions of SF_6 from electrical switchgears have decreased over the time period 2001 to 2011 by about 25 percent while high-GWP gases from semiconductor manufacturing have increased between 2001 and 2011 by about 6 percent.

Recycling and Waste

Emissions from the recycling and waste sector consist of methane and nitrous oxide emissions from landfills and from commercial-scale composting. Emissions from recycling and waste grew from 6.3 million tonnes of CO2e in 2001 to 7.0 million tonnes in 2011.



Emissions from landfills constitute more than 97 percent of the total sector emissions. In 2001, 38 million tons of solid waste was deposited in California's landfills; this amount grew to 42 million tons by 2005, followed by a steady decline to 30 million in 2011[14]. The decrease in annual landfill deposits is not seen in landfill emissions however, since it is the total waste-in-place accumulated since the landfills' opening that drives the amount of landfill gas generated. GHG emissions from composting have remained relatively small over the last eleven years, averaging less than 3 percent of total sector emissions.

References

[1] California Department of Finance – California Statistical Abstract (including 2010 census data)
[2] California Department of Finance – California State Gross Domestic Product (GDP) 1963 – 2012.
[3] Gasoline price based on average weekly price per gallon of regular grade gasoline in June 2008 from California Energy Commission – California Gasoline Statistics and Data; diesel price based on average weekly price per gallon of No. 2 diesel in June 2008 from U.S. Energy Information Administration – Weekly Retail On-Highway Diesel Prices
[4] California Department of Transportation - Monthly Vehicle Miles of Travel
[5] California Energy Commission – California Energy Consumption Database
[6] Based on California Energy Commission and U.S. Energy Information Administration data
[7] California Energy Commission – Weekly Fuels Watch Reports
[8] California Department of Conservation – Annual Reports of the State Oil & Gas Supervisor
[9] U.S. Geological Survey – 2009 Mineral Yearbook
[10] U.S. Geological Survey – 2010 Mineral Yearbook
[11] U.S. Census Bureau – State Housing Units Estimates
[12] California Energy Commission – Demand forecasting estimates
[13] U.S. Department of Agriculture – National Agricultural Statistics Service
[14] CalRecycle - Solid Waste Disposal Tonnage Summary Data