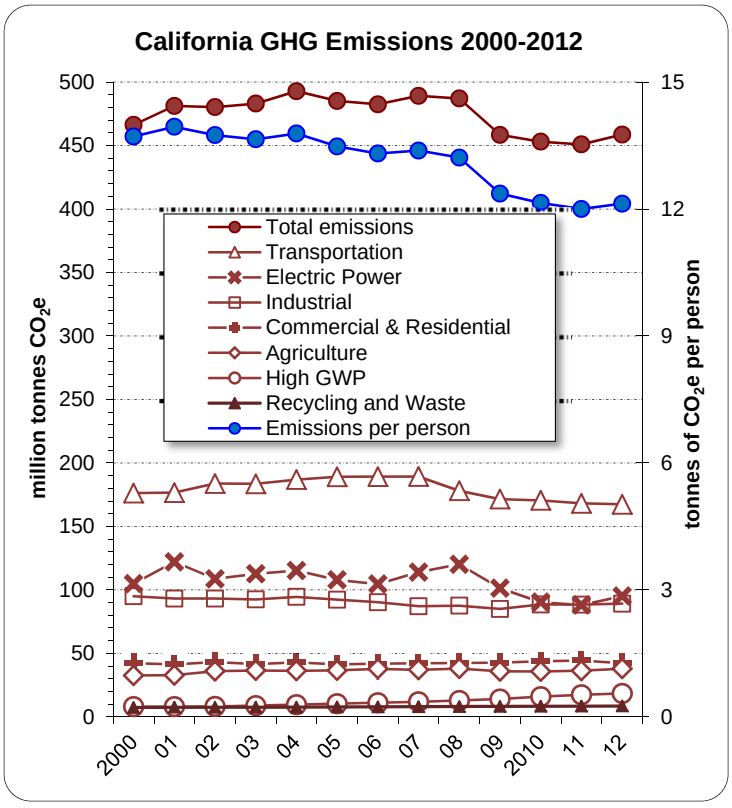
California Greenhouse Gas Emissions for 2000 to 2012 – Trends of Emissions and Other Indicators

Overview

The Global Warming Solutions Act of 2006 (AB 32) set a goal to reduce California's greenhouse gas (GHG) emissions to 1990 levels by 2020. Annual statewide GHG emission inventories provide an important tool for establishing historical emission trends and tracking California's progress towards the 2020 goal. Over the period of 2000-2012, GHG emissions have decreased by 1.6%.



The 2012 inventory demonstrates that as the state's gross domestic product continues to rise –by 5 percent since 2009 – the carbon intensity, which is the amount of carbon pollution related to the state's overall economy, has fallen steadily over the same time period. This demonstrates that California is getting more economic development for each ton of greenhouse gases emitted overall.

Emissions from the transportation sector –still California's largest single source of greenhouse gases, contributing 36 percent of total emissions– declined marginally compared to 2011, even while the economy continued to grow. The long term direction of transportation-related GHG emissions is another clear trend, with a 12-percent drop over the past seven years.

In 2012, total GHG and per capita emissions increased for the first time, albeit only by a single percentage point, in the last five years. This increase was driven primarily by strong economic growth in the state, the unexpected closure of the San Onofre Nuclear Generating Station (SONGS), and drought conditions that limited in-state hydropower.

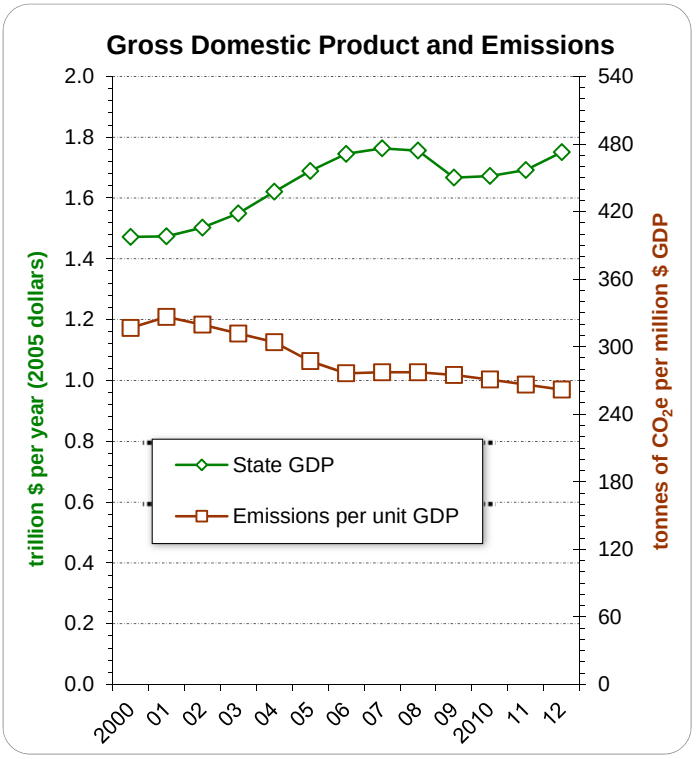
Emissions from sectors other than electricity remained relatively constant from 2011, and the GHG carbon intensity of California's economy continued to decline in 2012.

Beginning in 2013, California's Cap-and-Trade program will ensure that emissions continually decline, even alongside stronger economic growth and potentially drier hydrological conditions, and in the event of any additional unforeseen circumstances.

The 2014 edition GHG inventory represents a transition to global warming potentials (GWPs) from the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report[1] (AR4). Previous GHG inventories relied on GWPs from IPCC's Second Assessment Report (SAR).

Introduction

California's gross emissions of greenhouse gases decreased by 1.6 percent from 466.3 million metric tons (or tonnes) of CO_2e (equivalents of CO_2) in 2000 to 458.7 million in 2012, with a maximum of 492.7 million tonnes in 2004. During the same period, California's population grew by 11 percent from 34 to 37.8 million people[2]. As a result, California's per capita GHG emissions have generally decreased over the last 12 years from 13.7 in 2000 to 12.1 tonnes of CO_2e per person in 2012.

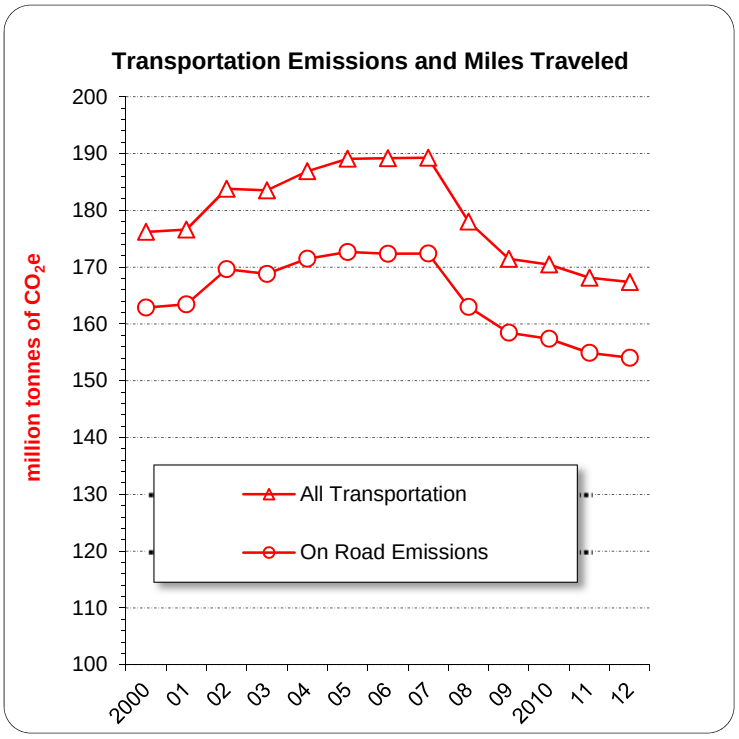


California's Gross Domestic Product (GDP) increased from $1.47 trillion in 2000 to $1.75 trillion in 2012 (in 2005 dollars)[3]. While California's economy has continued to grow, the "carbon intensity" of the economy (tonnes CO_2/ GDP$) has continually declined since 2001, and has decreased from 316.6 tonnes CO_2e per million dollars in 2000 to 261.9 tonnes per million dollars in 2012.

In the IPCC's 4th assessment report[1] (AR4), the GWPs for several GHGs were updated based on the latest science. As a result, the GWP of methane changed from 21 to 25, the GWP for nitrous oxide (N_2O) decreased, and the GWPs for hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) were updated. For comparability between years, the emissions in all of the 2000 – 2012 years have been updated using AR4 GWPs.

A summary of emission trends for each major sector of the statewide greenhouse gas inventory is provided below. Emissions data is organized by categories in the 2008 Scoping Plan.

Transportation



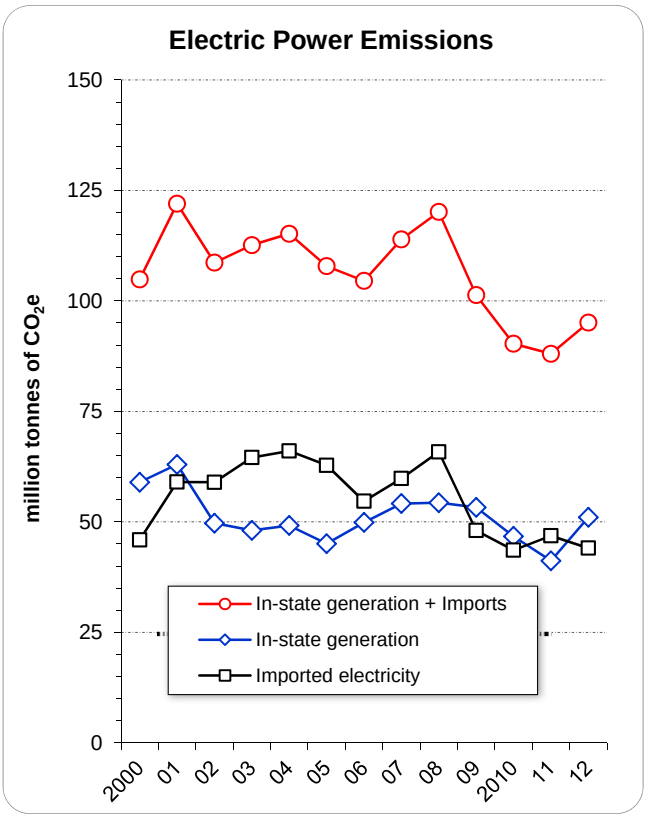
The transportation sector remains the largest source of GHG emissions in 2012, accounting for 36 percent of California's GHG emission inventory. Contributions from the transportation sector include emissions from on-road and off-road vehicles, aviation, rail and water-borne vehicles, and some other minor sources. Transportation-related GHG emissions have dropped 12 percent since reaching a maximum in 2007. In 2012, emissions from the on-road category decreased by 0.5 percent from the previous year.

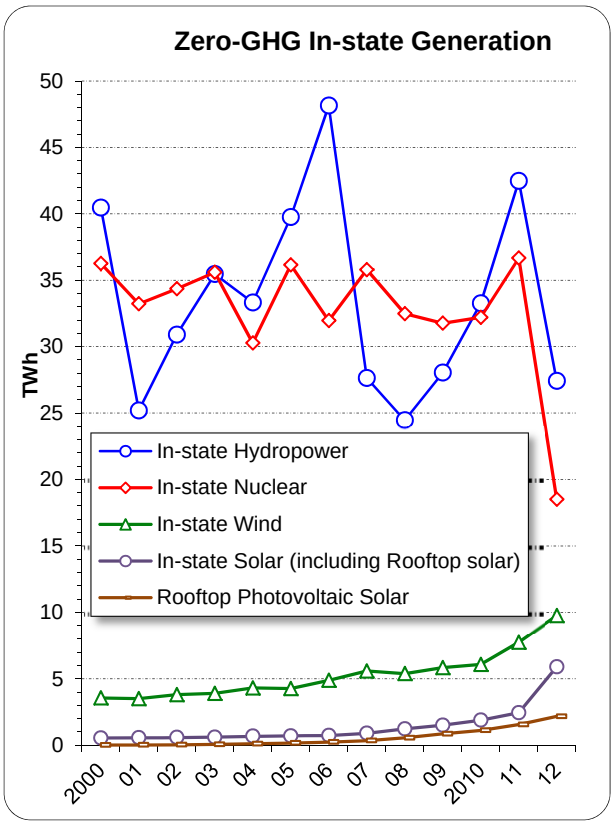
Emissions from on-road sources, which consist of light-duty vehicles (cars, motorcycles, and light-duty trucks), heavy-duty trucks, and buses, accounted for over 92 percent of transportation sector GHG emissions in 2012. Of the on-road vehicles, light duty vehicles accounted for approximately 69 percent of emissions in 2012. On-road emissions have declined each year since 2006. Total transportation sector emissions have continued to decrease since 2007. Emissions from military transportation activities are not included in the inventory total for the State, and would represent less than 1 percent of total statewide emissions.

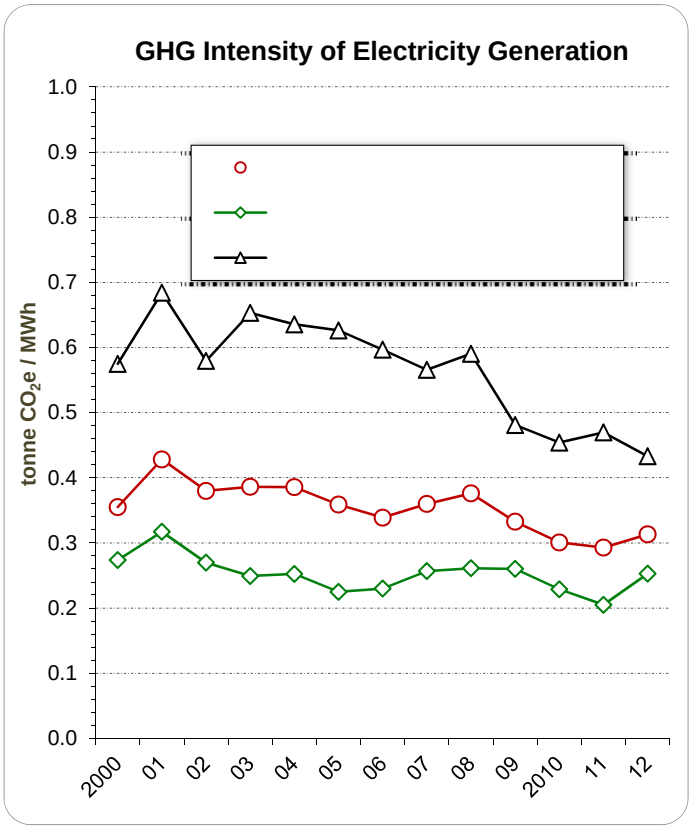
Electric Power

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 GHG emissions from electric power increased in 2012 for the first time since 2008, driven by greater reliance on natural gas electricity generation sources. This increase in reliance on in-state natural gas generation resulted from the loss of generation due to the closure of the San Onofre Nuclear Generating Station (SONGS) as well as the drought in 2012, causing a drop in the in-state hydropower generation. As these two major electricity generation sources dropped (33 TWh from 2011 to 2012), in-state generation by natural gas needed to increase to meet the electricity demand. Beginning in 2013, California's Cap-and-Trade program will ensure that any unexpected event, such as the SONGS closure, does not increase statewide emissions.







Year 2012 also saw a marked increase in in-state solar generation. Total solar generation in 2012 increased by more than 140 percent from 2011 and rooftop photovoltaic solar generation increased by 40 percent in the same period. In-state generation from wind energy also increased by 26 percent from the previous year.

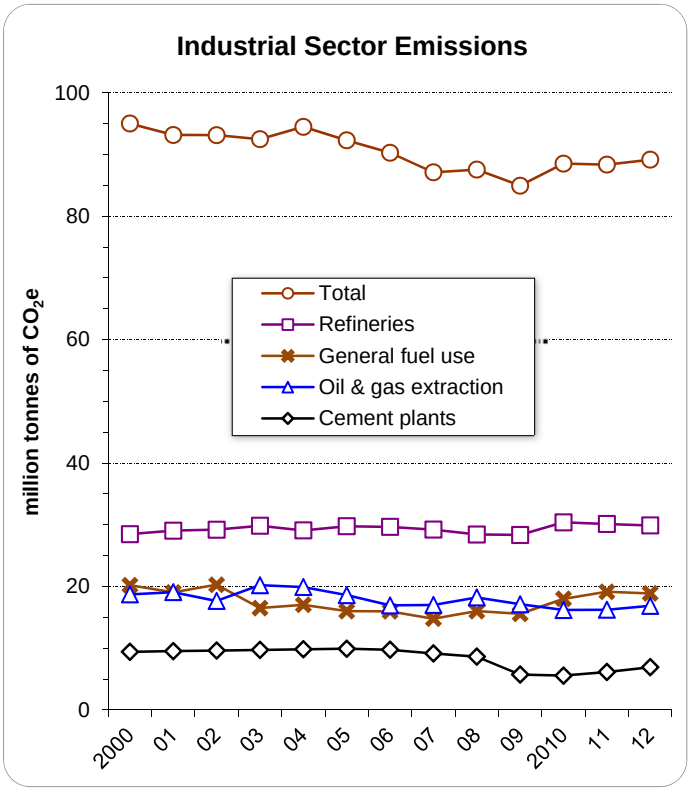
The 12-year trend shows a drop from 104.9 million tonnes CO_2e in 2000 to 95.1 million tonnes in 2012, reaching a high of 122.0 million tonnes in 2001 and a low of 88.0 million tonnes in 2011. During that same period, electricity consumption saw steady growth from 250 terawatt hours (TWh) in 2001 to 288 TWh in 2008, followed by a steady decline to 274.2 TWh in 2011 with a slight rise to 282.1 TWh in 2012[4].

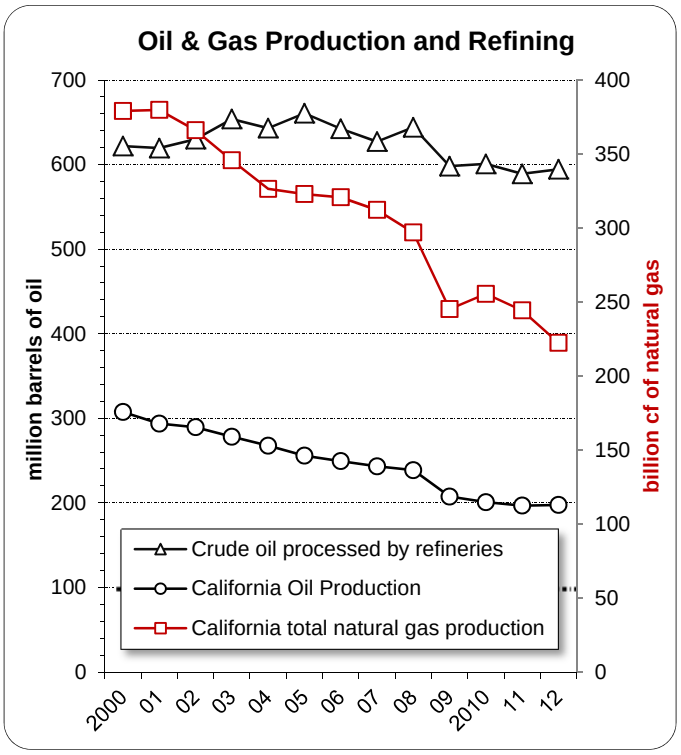
In general, California generates approximately 70 percent of its electricity from power plants located within the state and imports the rest[5]. The GHG intensity of electricity imports declined to its lowest point in 2012, as coal imports continued to decline and greater amounts of renewable imports took their place. Over the last thirteen years, hydropower provided an average of 17 percent of California's in-state power generation. Hydrologic conditions produced two major wet years between 2000 and 2012 — 2006 and 2011. In 2006, hydropower accounted for over 22 percent of in-state power generation and in 2011, it was approximately 21 percent. However, 2012 was a dry year and the hydropower share was only 13.6 percent. The GHG intensity of California electricity peaked in 2001, a year marked by drought and electricity market manipulation. It reached a low point in 2011, a particularly wet year and increased again in 2012, due both to the drought and the closure of SONGS.

Industrial

Industrial emission sources include refineries, oil & gas extraction, cement plants, and other stationary sources that primarily consume fuel. The GHG emissions from industrial sources increased approximately 1 percent between 2011 and 2012. Emissions from this sector have been increasing since 2009.

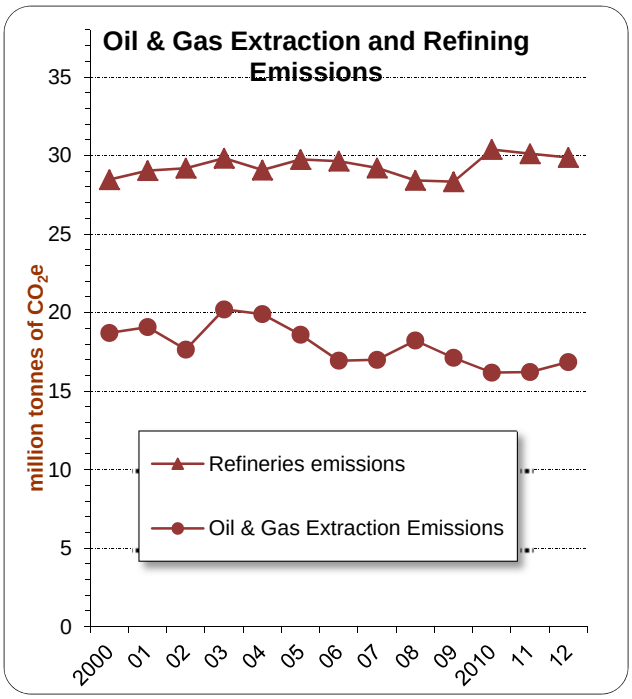
Among the industrial emissions categories, refineries represent about 33 percent of the sector's total emissions. Emissions from refineries remained relatively constant for most of the last thirteen years, with small year-to-year changes. Most recently, refinery emissions increased markedly in 2010 and then declined steadily, to 29.9 million tonnes of CO_2e in 2012. The total net crude oil processed by refineries was 622 million barrels in 2000 and peaked at 661 million in 2005; it dipped to 594 million barrels in 2012[6].

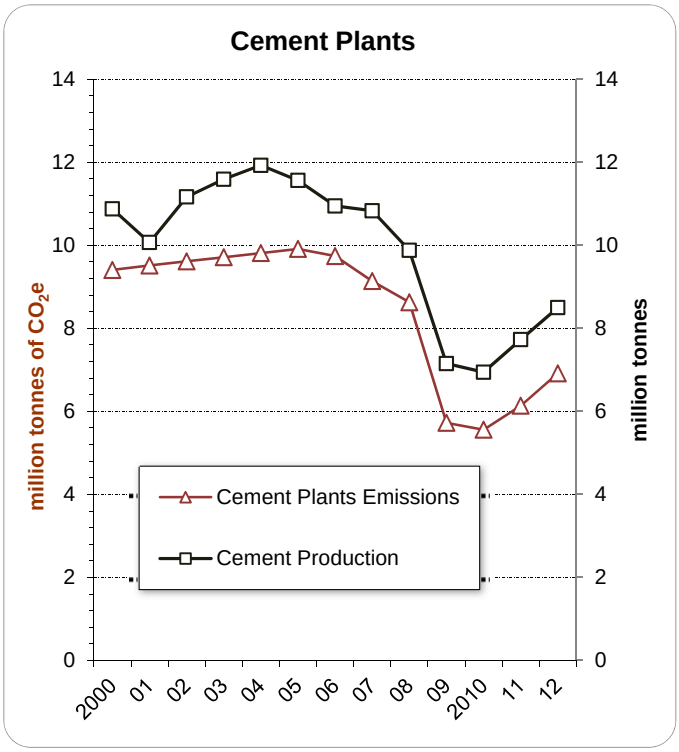




Emissions from oil and gas extraction, another major industrial category, have fluctuated over the last decade from a high of 20.2 million tonnes in 2003 to a low of 16.2 million tonnes in 2010. Emissions increased between 2011 and 2012 by about four percent. Oil and gas production in California declined substantially since 2000: from 307 to 197 million barrels of oil and from 379 billion cubic feet of natural gas to 222 billion in 2012[7]. Declining production from oil wells requires significant fuel use for steam generation which is forced into the wells to stimulate lagging oil production. Although oil production drops, more energy is utilized to extract oil from wells and emissions remain relatively constant.

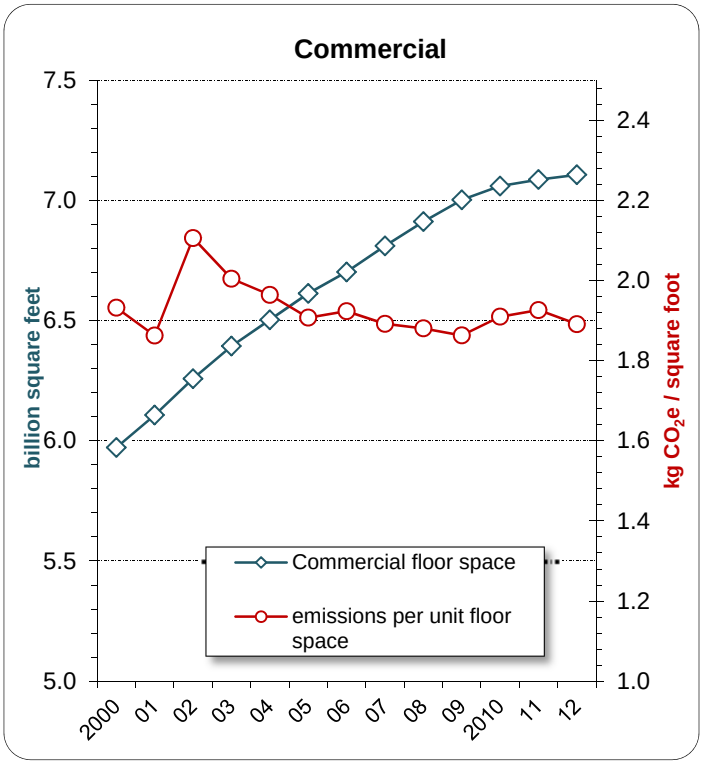
Emissions from cement plants, made up of fuel combustion and clinker process emissions, grew 10 percent in 2012, correlating with the growth in the economy. After 2010, cement production and GHG emissions have grown steadily again since the recession. Longer term trends show that emissions peaked in 2005 with a decrease beginning in 2006 and continuing through 2010. Between 2006 and 2010, cement plant emissions declined 44 percent, reflecting both a large decrease in demand and the closure of three cement plants over the period[8]. This decline continued in 2010 with California cement plants operating at 51 percent capacity[9].



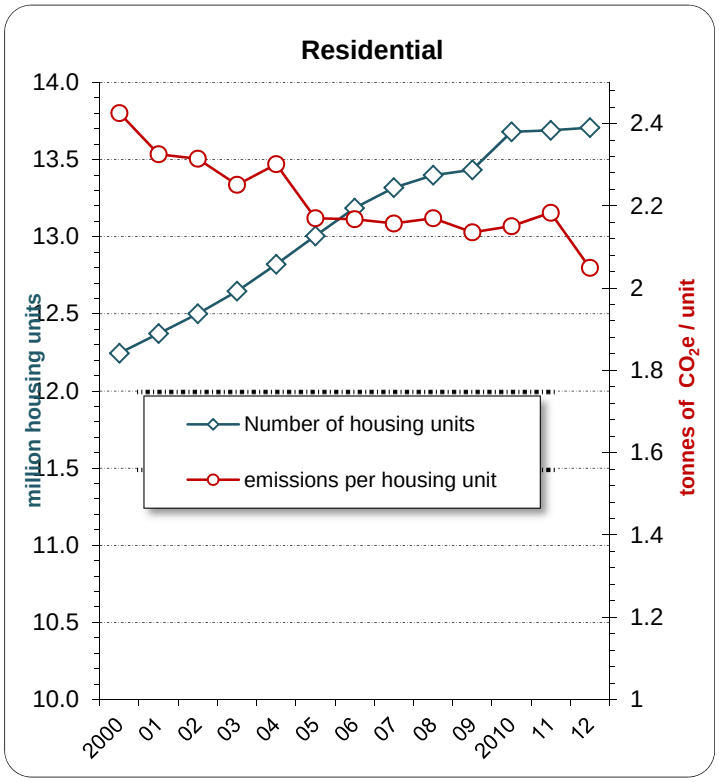


Commercial and Residential

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. In 2012, emissions declined 5 percent from the previous year. While combined emissions from the commercial sector and residential sector have exhibited limited year-to-year variation, individually the sectors exhibit different trends.



The majority of emissions from the residential sector are from natural gas combustion. Although the number of housing units grew steadily from 12.2 million units in 2000 to slightly over 13.7 million housing units in 2012, emissions and fuel consumption per housing unit have generally followed a declining trend during this period[10]. Total emissions from residential fuel combustion show little variation over the last thirteen years ranging from a low in 2005 of 28.1 million tonnes to a high in 2011 of 29.9 million tonnes. The major cause of fuel use fluctuations is annual temperature levels, with colder years resulting in greater fuel use for heating.



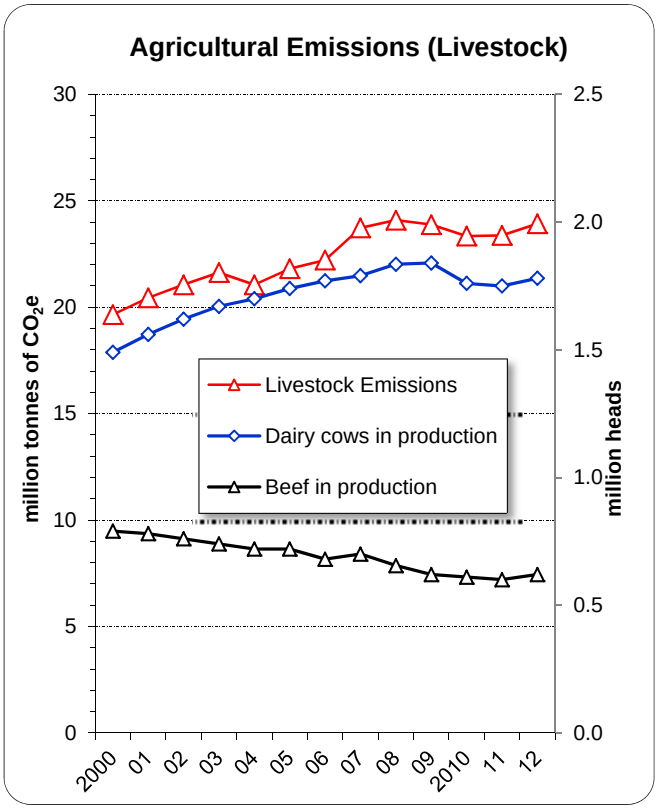
Emissions from commercial fuel use have grown over the period of 2000 and 2012, ranging between 11.5 million tonnes in 2002 to 13.4 million tonnes in 2012. Commercial floor space grew steadily in California from 6.0 billion square feet to 7.1 billion square feet between 2000 and 2012[11]. Like the residential sector, the commercial sector exhibits a slight decline in fuel use per unit of space.

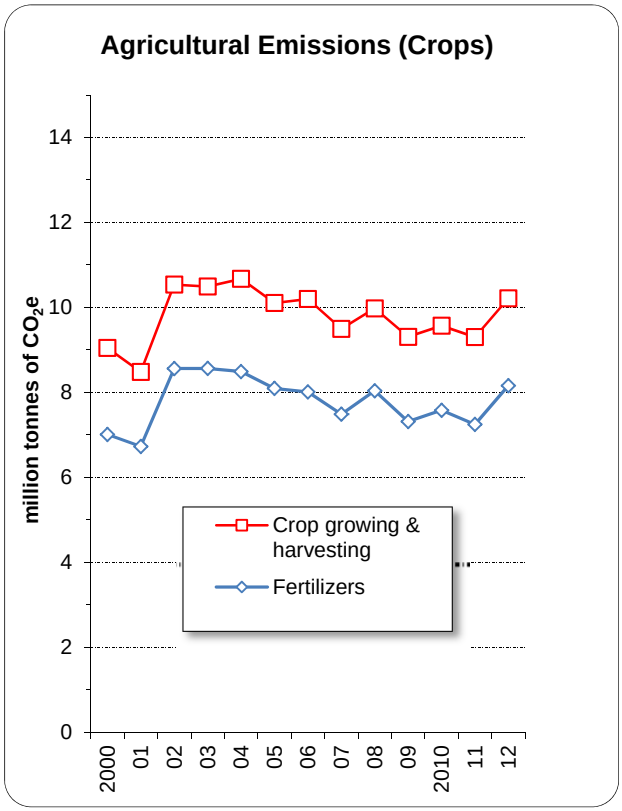
Agriculture

The agricultural sector contributed to more than 8 percent to the total statewide GHG emissions in 2012, mainly from CH_4 and N_2O sources. Livestock account for 63 percent of the total agricultural emissions. Dairy cows are the primary source of these livestock emissions. The enteric fermentation process as well as the manure management practices in dairies give rise to methane emissions, making dairies the major emissions source in the agricultural sector.

California dairies increased their herds from 1.5 million cows in 2000 to 1.8 million in 2012, and their total milk production from 32 to 42 billion pounds[12]. The GHG emissions from livestock manure management and enteric fermentation increased by 22 percent during the same time. Emissions from the agriculture sector grew from 32.5 million tonnes of CO_2e in 2000 to 37.9 million tonnes in 2012.

Emissions from crop growing and harvesting (primarily N_2O emissions from fertilizer use) varied from 9.0 million tonnes of CO_2e in 2000 to approximately 10.2 million tonnes in 2012. About 80 percent of crop related GHG emissions are from the use of fertilizers.

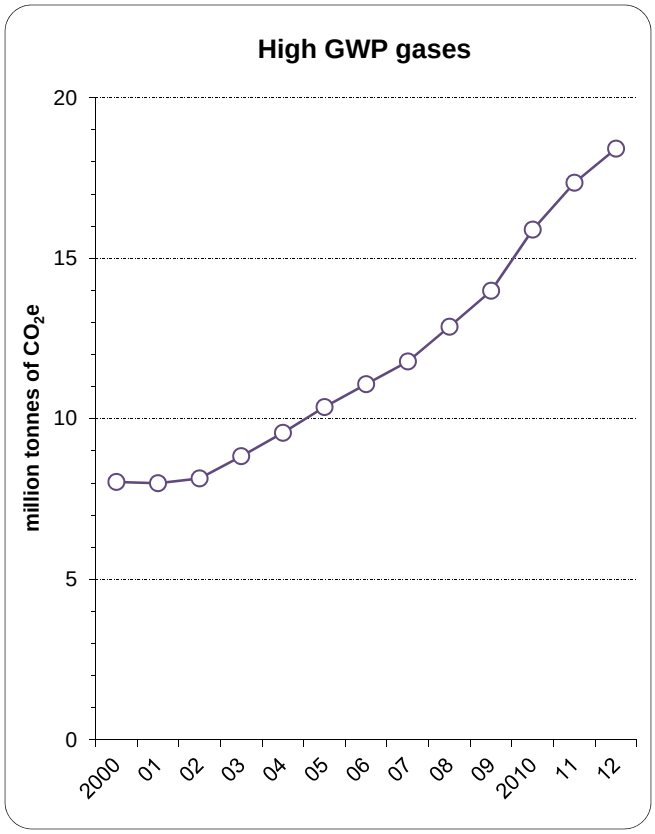




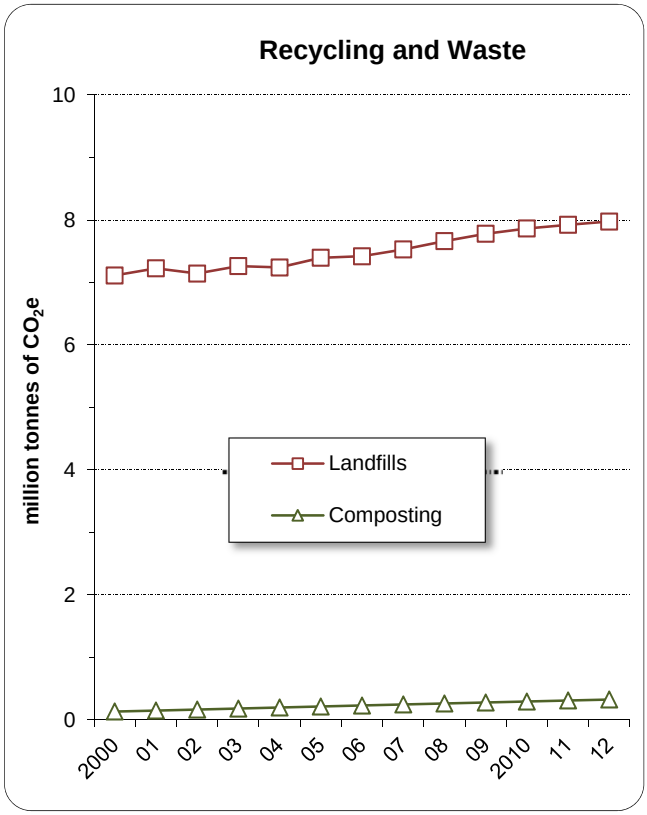
High Global Warming Potential Gases

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 substance (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 4 percent of total statewide GHG emissions in the 2012 inventory. High GWP gas emissions have grown steadily from 8.0 million tonnes of CO_2e in 2000 to 18.4 million tonnes in 2012. This increase is driven both by the increased use of associated applications as well as the displacement of existing ODS gases by these substitutes.



While emissions from most sectors are increasing, some sectors are showing reductions in emissions. Overall, fugitive emissions of SF_6 from electrical switchgears have decreased over the time period 2000 to 2012 by about 29 percent, while high-GWP gases from semiconductor manufacturing have decreased between 2000 and 2012 by about 35 percent. This decrease is believed to have two causes: a sharp increase in the price of SF_6 during the 1990s and a growing awareness of the environmental impact of SF_6 emissions through programs such as EPA's SF_6 Emission Reduction Partnership for Electric Power Systems.



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 7.3 million tonnes of CO_2e in 2000 to 8.5 million tonnes in 2012.

Emissions from landfills account for more than 94 percent of the total sector emissions. In 2000, 37 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 29 million tons in 2012[13]. The decrease in annual landfill deposits does not produce immediate corresponding declines in landfill GHG emissions since it is the momentum of the total waste-in-place accumulated in the past that also influences the amount of landfill gas generated. GHG emissions from composting have remained relatively small over the last thirteen years, accounting for 6 percent of total sector GHG emissions in 2012.

References

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