

# Trends in California Greenhouse Gas Emissions for 2000 to 2009

## *—by Category as Defined in the Air Resources Board's 2008 Scoping Plan*

The California statewide greenhouse gas (GHG) emission inventory compiles statewide anthropogenic GHG emissions and sinks. It includes estimates for carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), sulfur hexafluoride (SF<sub>6</sub>), nitrogen trifluoride (NF<sub>3</sub>), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). The current inventory covers years 2000 to 2009. A discussion of emission trends for the 2000 to 2009 period and factors affecting different sectors is provided in this document.

Annual emission inventories provide the basis for establishing historical emission trends. Trends are useful in tracking progress towards a specific target or goal. There are many factors affecting year-to-year changes in greenhouse gas (GHG) emissions, including the level of economic activity, demography, improved efficiency, and changes in environmental conditions such as drought. Evaluating emission trends requires recognizing these influences across the overall inventory as well as by sector and sub-sector within the inventory.

In 2009, California's statewide greenhouse gas (GHG) emissions decreased by 5.8% from 2008, which already saw a small decrease in statewide GHG emissions. 2009 reflects the full effect of the economic recession and higher fuel prices, with marked declines in on-road transportation, cement production and electricity consumption. As the economy recovers, GHG emissions are likely to rise again unless mitigation actions are taken.

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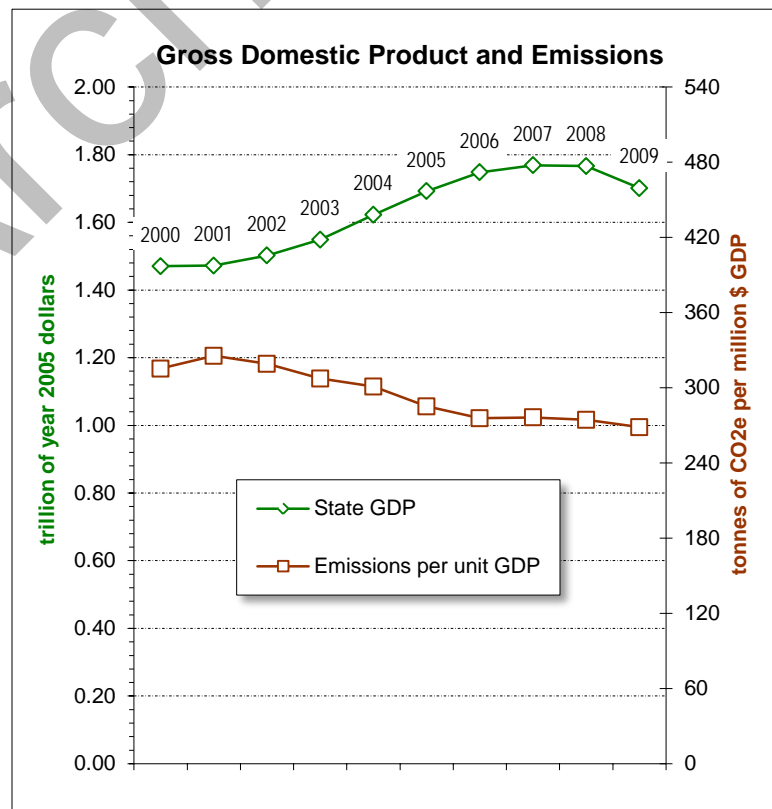
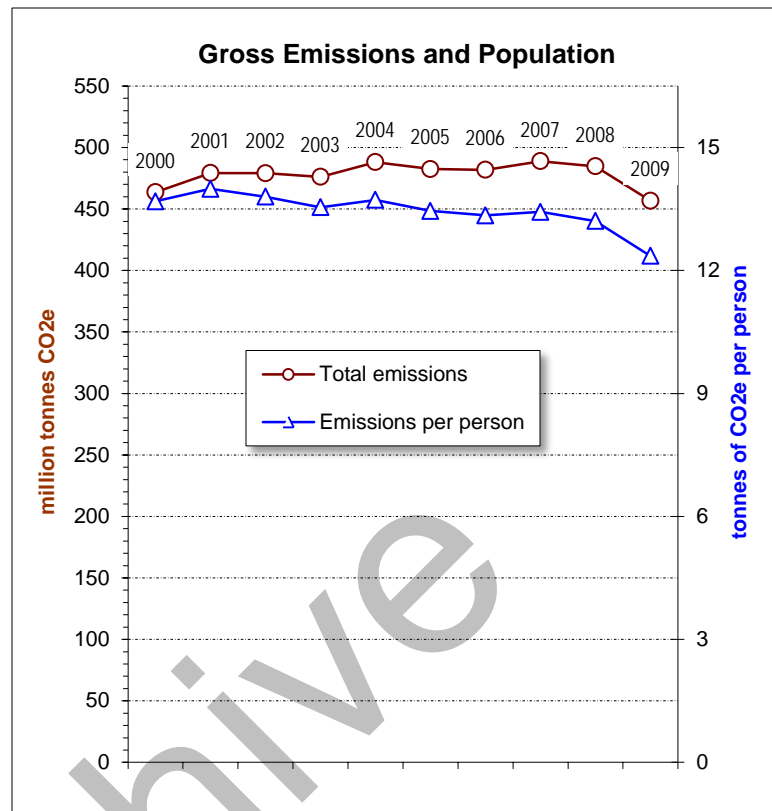
### Overview

California's gross emissions of greenhouse gas decreased 1.5% between 2000 and 2009, from 463.6 million metric tonnes of CO<sub>2</sub>e in 2000 to 456.8 million in 2009, with a maximum of 488.8 million in 2007.

During the same period, California's population grew by 9.1% from 33.9 to 37.2 million people<sup>1</sup> and GHG emissions per person decreased from 13.7 to 12.4 metric tonnes of CO<sub>2</sub>e per person.

In 2009, California's real Gross Domestic Product (GDP) (adjusted for inflation) fell by 3.7%. Over the decade, California's GDP went from \$1.47 trillion in 2000 to \$1.7 trillion in 2009 (in 2005 dollars)<sup>2</sup>. The GHG intensity of California's economy decreased from 315.3 metric tonnes CO<sub>2</sub>e per million \$ of GDP in 2000 to 268.5 per million \$ of GDP in 2009. This decline in GHG intensity has continued in 2009 as the drop in GDP was matched by a more than commensurate decrease in emissions.

For each major sector of the statewide greenhouse gas inventory, a trend summary is provided below along with a time-series graph.



## Transportation

In 2009, GHG emissions from transportation declined noticeably for the second year in a row but transportation remained the largest source with 37.9% of California's gross inventory.

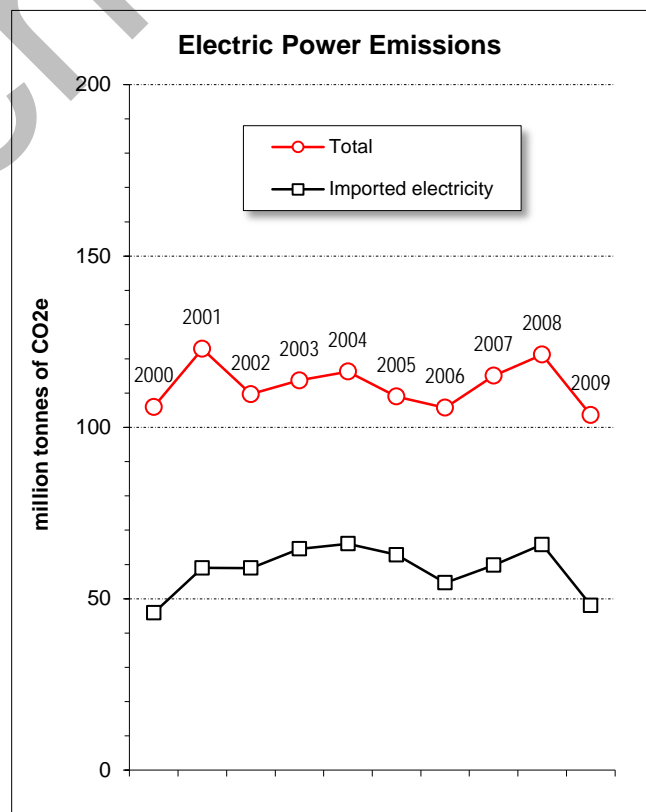
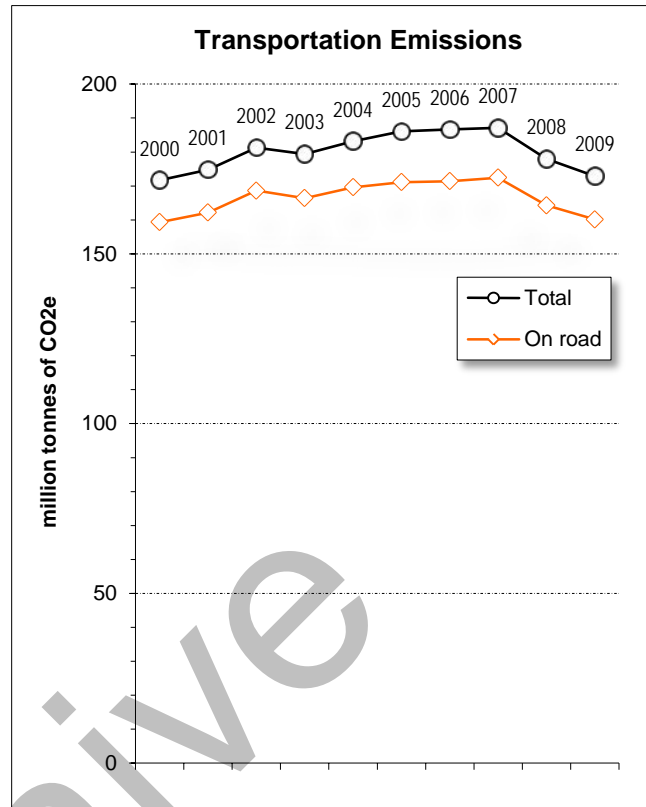
On road emissions (from passenger vehicles and heavy duty trucks) constitute 92.6% of the transportation sector total. On road emissions grew to a maximum of 172.5 million metric tonnes of CO<sub>2</sub>e in 2007, and decreased to 160.1 million in 2009. The amount of gasoline and diesel fuel consumed by on-road vehicles followed a similar trend.

Over this inventory period, the average retail price of gasoline<sup>3</sup> and diesel fuel<sup>4</sup> in California first decreased, reaching a minimum in 2002 before steadily increasing to a maximum in 2008. In the summer of 2008, fuel prices spiked, reaching an historic maximum (\$4.48 per gallon for gasoline and \$4.97 for diesel), before declining substantially in fall of 2008 and 2009. Interestingly, in 2008 there was a year-to-year decrease of -3.5% in vehicle miles travelled on California highways<sup>5</sup>, the first such decrease since 1974. Highway miles travelled did not increase back to 2007 levels in 2009.

## Electric Power

Electric power emissions varied from 106 million metric tonnes of CO<sub>2</sub>e in 2000 to 103.6 million in 2009, without exhibiting a clear trend over the period. California electricity consumption<sup>6</sup> grew from 265.8 TWh in 2000 to 288 TWh in 2008 and fell to 278.8 in 2009. During the same time the electricity consumed per million \$ of GDP decreased from 181 to 164 MWh.

California produces roughly 70 percent

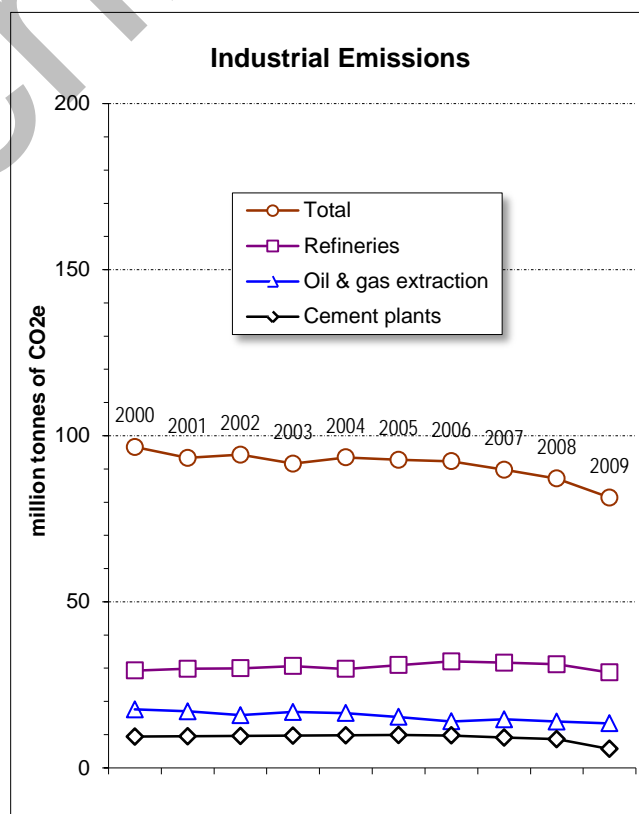
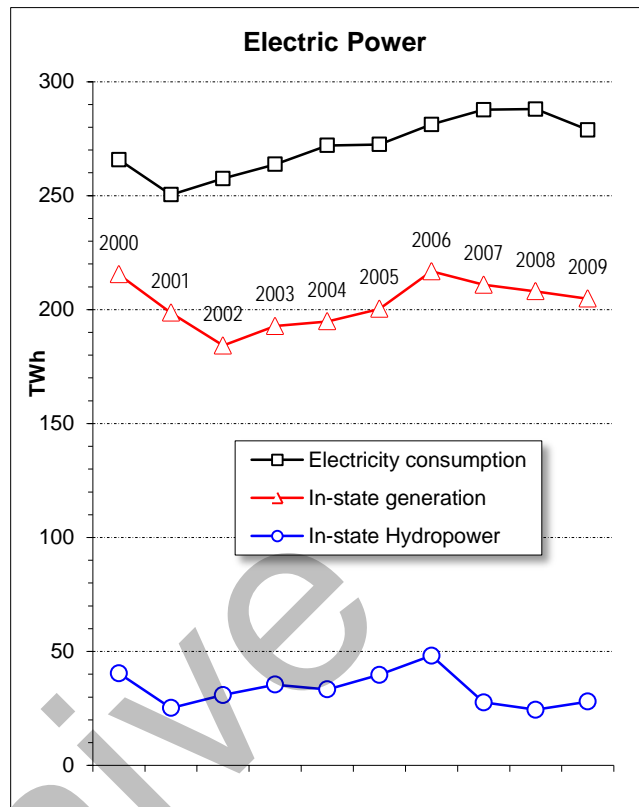


of its electricity from power plants located within the state<sup>7</sup>; the rest is imported from other western states. In-state hydropower production is one of the determinants of how much electricity needs to be imported. In-state hydropower generation varied with hydrologic conditions: 40.5 TWh in 2000 (an above-normal year), 24.4 TWh in 2008 and 28 TWh in 2009 (the second and third year of a drought). It reached a maximum of 48.1 TWh in 2006 (a wet year).

### Industrial

Industrial emissions varied from 96.6 million metric tonnes of CO<sub>2</sub>e in 2000 to 81.4 in 2009. Emissions from refineries represent more than a third of the category's total and have been growing from 29.3 million tonnes of CO<sub>2</sub>e in 2000 to a maximum of 32 million in 2006, followed by a plateau and a decline to 28.7 million in 2009. The total net crude oil input by refineries<sup>8</sup> was 622 million barrels in 2000; it grew to 661 million in 2005 and declined to 598 million barrels in 2009.

Overall, emissions from oil & gas extraction, the second largest industrial source, have declined slightly: from 17.6 million metric tonnes of CO<sub>2</sub>e in 2000 to 13.4 million in 2008. Oil and gas production in California<sup>9</sup> declined substantially during the period: from 307 to 207 million barrels of oil and from 379 billion cubic feet of natural gas to 245 billion. Cement plants' emissions decreased 34% in 2009, reflecting a large decrease in demand for cement. Nationally, demand for cement fell by 26.5% in 2009 to the lowest level since 1983<sup>10</sup>.



### Commercial and Residential

Together, emissions from the commercial and residential sectors have remained about the same over the period, with year-to-year ups and downs. Individually, they exhibit opposite overall trends.

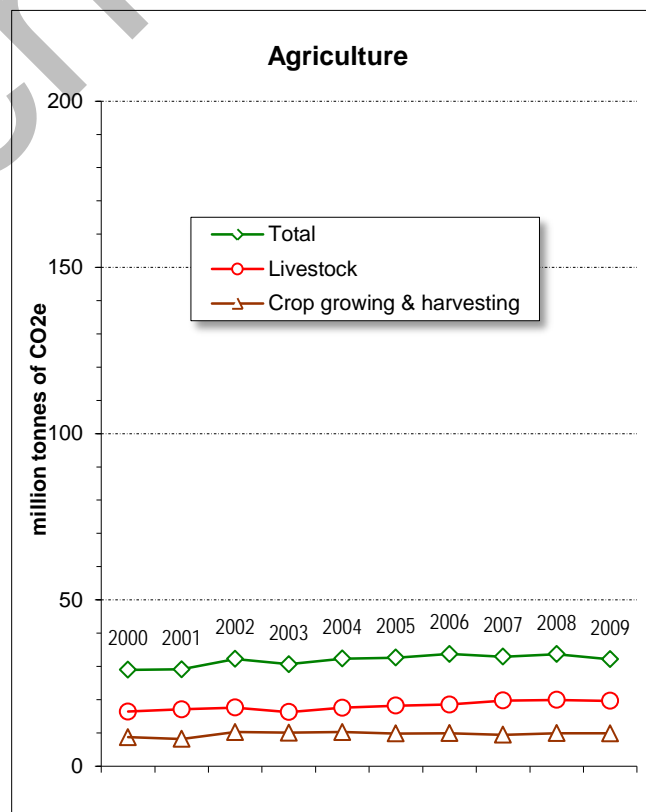
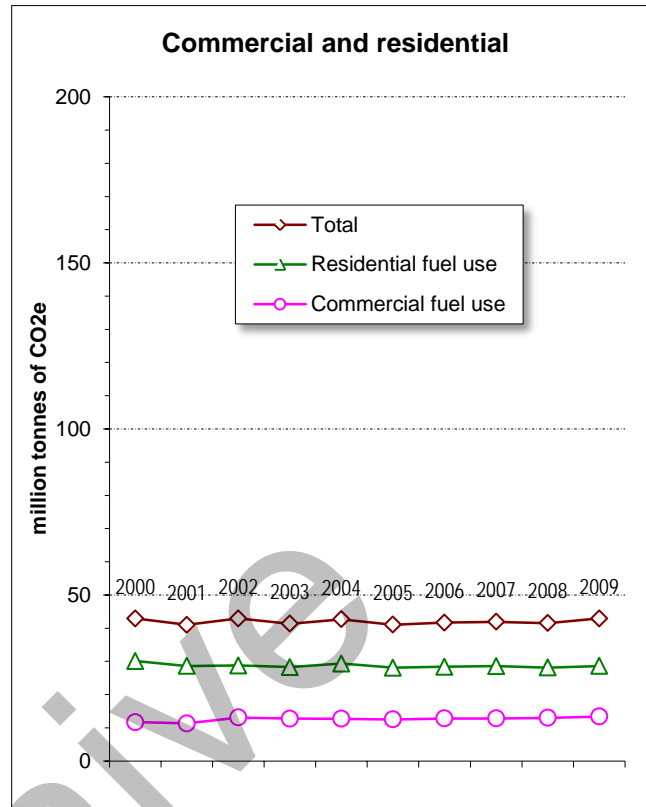
Emissions from residential fuel use declined from 30.1 million metric tonnes of CO<sub>2</sub>e in 2000 to 28.6 million in 2009, mostly from natural gas. At the same time, the number of housing units<sup>11</sup> grew steadily from 12.2 million units in 2000 to 13.4 million in 2009. Thus, the fuel consumption per housing unit has declined, presumably reflecting higher building efficiency standards.

Emissions from commercial (and institutional) fuel use grew from 11.7 million metric tonnes of CO<sub>2</sub>e in 2000 to 13.4 million in 2009. Commercial and institutional floor space grew steadily in California<sup>12</sup> from 6.28 billion square feet to 7.48 billion over the period. This sub-category does not exhibit an apparent change in fuel use per unit of space.

### Agriculture

Emissions from agriculture grew from 28.9 million metric tonnes of CO<sub>2</sub>e in 2000 to 32.1 million in 2009. Over the period, emissions from livestock enteric fermentation and manure management increased from 16.4 million tonnes of CO<sub>2</sub>e to 19.6 million. California dairies (the main contributor to this sub-category of emissions) steadily increased their herds from 1.44 million cows in 2000 to 1.84 million in 2009, and their total milk production from 14.6 to 17.9 million metric tons<sup>13</sup>.

Emissions from crop growing and harvesting started at 8.7 million metric tonnes of CO<sub>2</sub>e in 2000, grew to 10.3



million in 2002 and 2004 and returned to 9.8 million in 2009.

### High GWP gases

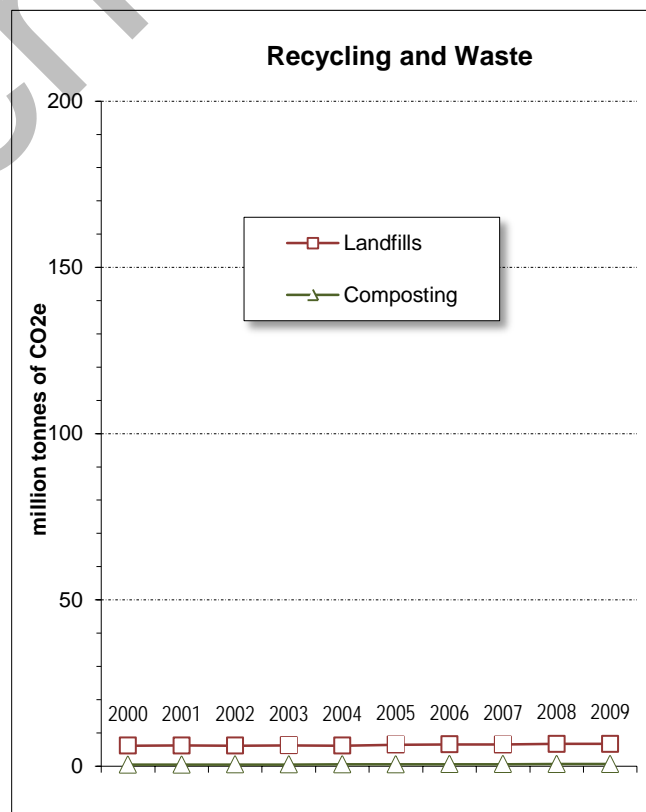
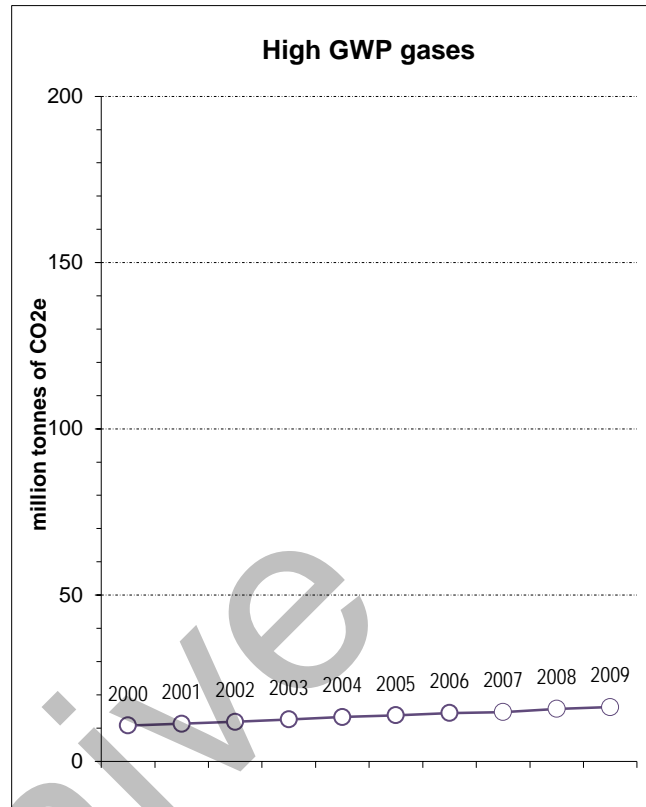
Since the 1990's, use of ozone depleting substances (ODS) substitutes such as HFCs and PFCs has grown progressively as they are phased in as replacements for now banned CFCs and HCFCs. These gases are used in a variety of applications including refrigeration and air conditioning, solvent cleaning, foam production, sterilization, fire extinguishing, and as aerosol propellants.

Emissions of high global warming potential (GWP) gases grew steadily from 10.8 million metric tonnes of CO<sub>2</sub>e in 2000 to 16.3 million in 2008, driven by the 75% increase in emissions of ODS substitutes.

Fugitive emissions of both SF<sub>6</sub> from electricity grid equipment and GWP gases from semiconductor manufacturing are estimated to have decreased over the time period. However, emissions of GWP gases that are used as ODS substitutes more than offset these reductions.

### Recycling and Waste

Emissions from landfills and composting facilities grew steadily from 6.55 million metric tonnes of CO<sub>2</sub>e in 2000 to 7.32 million in 2009. Emissions from landfills constitute more than 90% of the total. 37 million tons of solid waste were deposited in California's landfills in 2000; this amount grew to 42 million tons in 2005 and then declined to 31 million in 2009<sup>14</sup>. This decrease in annual landfill deposits is not reflected in landfill emissions however, because it is the overall amount of waste-in-place accumulated over the years that drives the amount of landfill gas produced.





## References

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- <sup>1</sup> California Department of Finance – California Statistical Abstract (subject to revisions based on 2010 census).
- <sup>2</sup> U.S. Bureau of Economic Analysis – Gross Domestic Product by State and Metropolitan Area
- <sup>3</sup> California Energy Commission - California Gasoline Statistics & Data
- <sup>4</sup> U.S. Energy Information Agency - Weekly Retail On-Highway Diesel Prices
- <sup>5</sup> California Department of Transportation - Monthly Vehicle Miles of Travel
- <sup>6</sup> California Energy Commission - California Energy Consumption Database
- <sup>7</sup> based on California Energy Commission and US Energy Information Agency data
- <sup>8</sup> California Energy Commission – Weekly Fuels Watch Reports
- <sup>9</sup> California Department of Conservation – Annual Reports of the State Oil & Gas Supervisor
- <sup>10</sup> U.S. Geological Survey – 2009 Mineral Yearbook
- <sup>11</sup> U.S. Census Bureau – State Housing Units Estimates
- <sup>12</sup> California Energy Commission – Demand forecasting estimates
- <sup>13</sup> U.S. Department of Agriculture – National Agricultural Statistics Service
- <sup>14</sup> CalRecycle - Solid Waste Disposal Tonnage Summary Data

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