

CALIFORNIA
ENERGY
COMMISSION

**INVENTORY OF CALIFORNIA
GREENHOUSE GAS
EMISSIONS AND SINKS:
1990 TO 2004**

STAFF FINAL REPORT

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EXECUTIVE SUMMARY

This report updates California's statewide inventory of greenhouse gas (GHG) emissions to support evaluation of state policies that address climate change and climate variability or more commonly known as global warming. Information in this report extends the inventory period through 2004, which is the most recent year that data are available from the California Energy Commission (Energy Commission) or the United States Department of Energy's (DOE's) Energy Information Administration. This inventory reports GHG emissions from out-of-state electricity used in California along with in-state generation GHG emissions and estimates future emissions trends using fuel demand and other forecast data from the Energy Commission's *2005 Integrated Energy Policy Report*.

California's economy experienced the second largest percentage growth in terms of gross state product (in dollars, not adjusted for inflation) of any state in the country from 1990 to 2003.¹ During that period, California's GSP grew 83 percent while its GHG emissions grew more slowly at 12 percent. This demonstrates the potential for uncoupling economic trends from GHG emissions trends.

Nonetheless, California's GHG emissions are large and growing. As the second largest emitter of GHG emissions in the United States and twelfth to sixteenth largest in the world,² the state contributes a significant quantity of GHGs to the atmosphere.

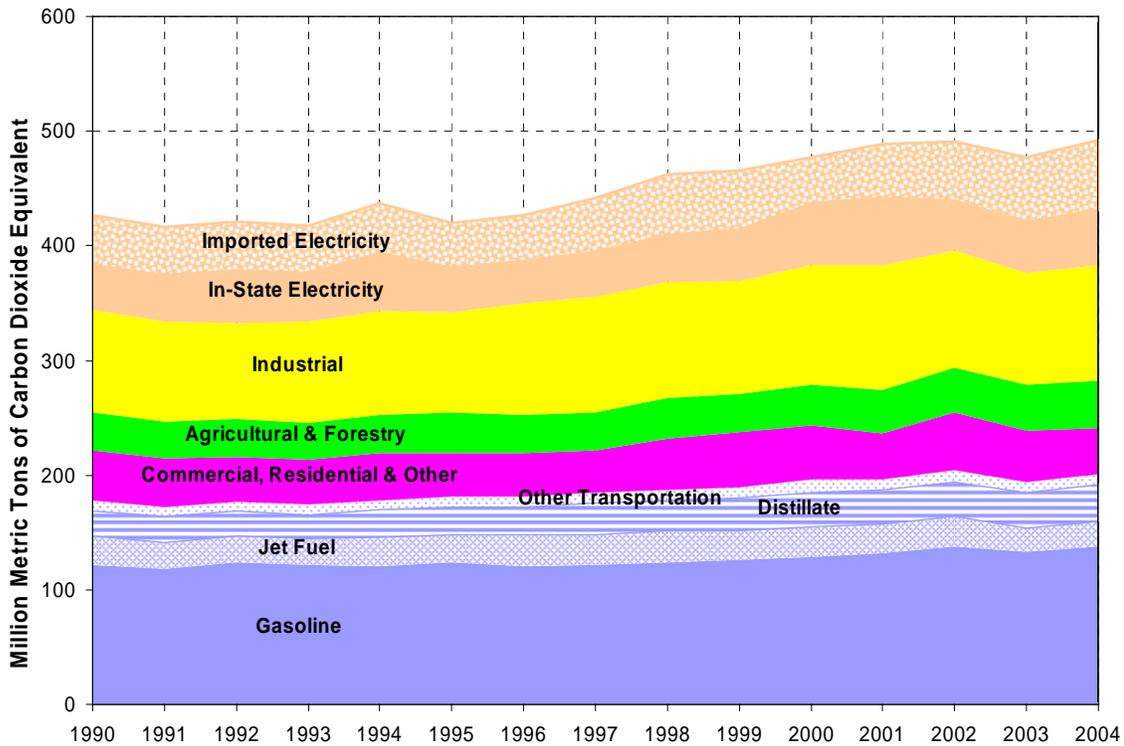
California's ability to slow the rate of growth of GHG emissions is largely due to the success of its energy efficiency and renewable energy programs and a commitment to clean air and clean energy. In fact, the state's programs and commitments lowered its GHG emissions rate of growth by more than half of what it would have been otherwise.³ Moreover, California's energy programs and policies have had multiple benefits that include not only reducing GHG emissions, but reducing energy demand and improving air quality and public health.

Although California's total GHG emissions are larger than every state but Texas, California has relatively low carbon emission intensity. In 2001, California ranked fourth lowest of the 50 states in carbon dioxide emissions per capita from fossil fuel combustion and fifth lowest of the 50 states in carbon dioxide emissions from fossil fuel combustion per unit of gross state product. Emission trends per unit of gross state product are encouraging; most states have reduced their emissions per unit of gross state product over the 1990 to 2001 period.

In 2004, California produced 492 million gross metric tons of carbon dioxide - equivalent⁴ GHG emissions, including imported electricity and excluding combustion of international fuels and carbon sinks or storage.

Figure 1 shows year-by-year trends in GHG emissions for the major energy sectors. Values differ yearly due to changes in fuel uses, meteorological variations, and other factors.

Figure 1 -- California's Gross GHG Emissions Trends



Source: California Energy Commission

The transportation sector is the single largest category of California's GHG emissions, producing 41 percent of the state's total emissions in 2004. Most of California's emissions, 81 percent, are carbon dioxide produced from fossil fuel combustion.

This California GHG emissions inventory excludes all international fuel uses, reporting them separately. Including these international emissions would increase total emissions by 27 to 40 million metric tons of carbon dioxide-equivalent GHG emissions, depending on the year.

Electricity generation is the second largest category of GHG emissions (behind transportation). In particular, out-of-state electricity generation has higher carbon intensity than in-state generation. While imported electricity is a relatively small

methods being used by the EPA. An update²¹ to this inventory was prepared and published in June 2005 to incorporate newer information and to allow policy makers to use the most current information and data available.

Summary of California's 2004 GHG Emissions

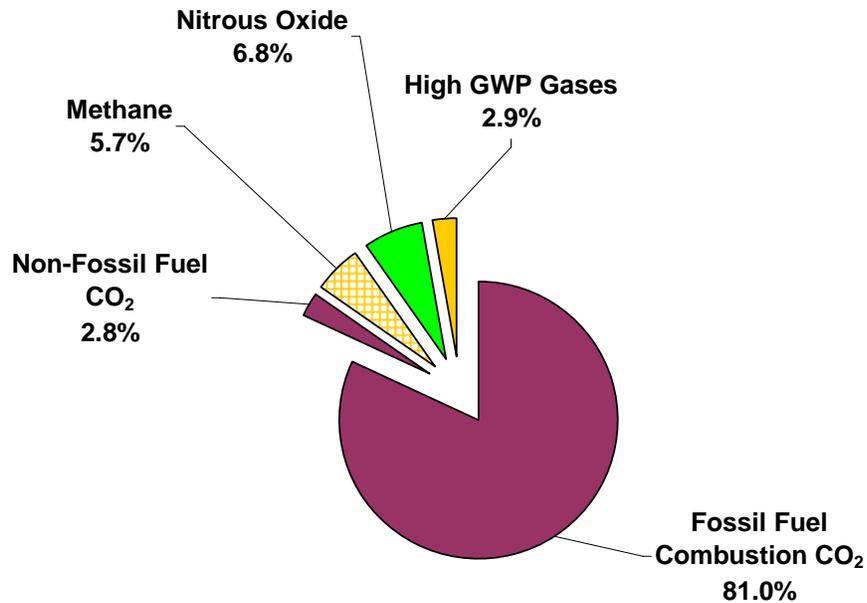
In 2004 California produced 492 million metric tons of CO₂-equivalent GHG emissions, including emissions associated with imported electricity. As shown in Figure 2, 81 percent were emissions of CO₂ from fossil fuel combustion, 2.8 percent were from other sources of CO₂, 5.7 percent were from methane, and 6.8 percent were from nitrous oxide. The remaining source of GHG emissions was high GWP gases, 2.9 percent.

The percentage of climate change associated with each specific gas is similar for each year over the 1990 to 2004 period. However, high GWP gas percentages are rising somewhat.

Composition of California's GHG Emissions

CO₂ emissions represent about 84 percent of California's total GHG emissions in 2004. CO₂ emissions are mainly associated with carbon-bearing fossil fuel combustion with a portion of these emissions attributed to out-of-state fossil fuel used for electricity consumption within California. Other activities that produce CO₂ emissions include mineral production, waste combustion, and land use and forestry changes. Some anthropogenic activities lead to a reduction in atmospheric concentration of CO₂. These are called "CO₂ sinks."

**Figure 2 -- California GHG Composition by Type of Gas in 2004
(Includes electricity imports and excludes international bunker fuels)**



Source: California Energy Commission

Methane emissions also contribute to global warming and they represented 5.7 percent of total GHG emissions in 2004. Methane emissions are reported in CO₂-equivalent units to reflect their GWP compared to CO₂. Agricultural activities (enteric fermentation and manure management) and landfills compose the major sources of these emissions.

Another gas that contributes to global warming is nitrous oxide (N₂O). Agricultural soil management activities and mobile source fuel combustion compose the major sources of these emissions. After using the appropriate GWP adjustment, N₂O emissions comprised 6.8 percent of California's overall GHG emissions in 2004.

A class of gases called "high GWP gases" makes up the final set of gases that contribute to global warming,²² composing about 2.9 percent of total emissions in 2004. These are composed mostly of gases used in industrial applications to replace gases associated with ozone depletion over the Earth with an additional modest

contribution from sulfur hexafluoride (SF₆) used as insulating materials in electricity transmission and distribution.

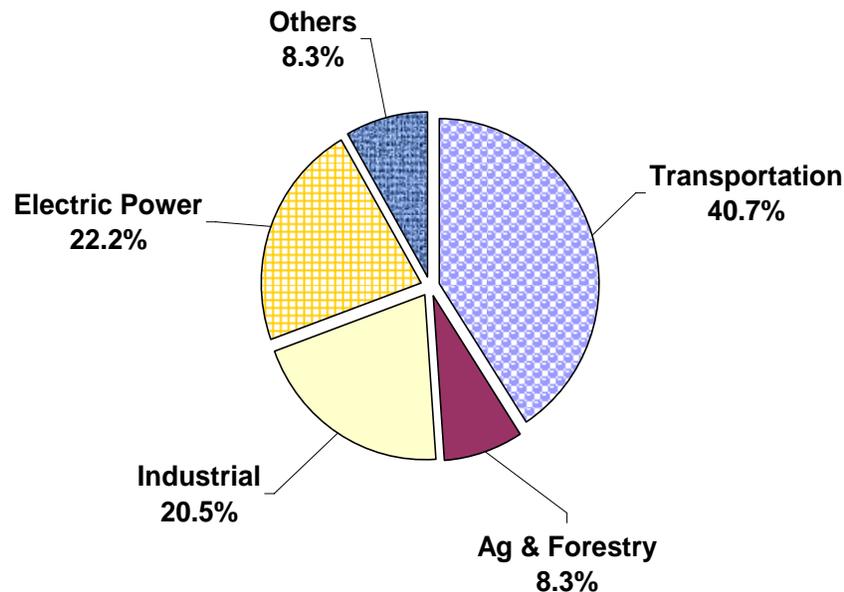
High GWP gases compose a low percentage of overall GHG emissions over this time period, although the estimated emissions are difficult to quantify and are less certain than other emissions categories. Although small in magnitude, emissions of these gases are increasing at a faster rate than other GHGs. In California, high GWP gases are largely composed of refrigerants, although electric utility transmission and distribution equipment are also sources.

End-Use Sectors Contributing to California's GHG Emissions

As shown in Figure 3, fossil fuel consumption in the transportation²³ sector was the single largest source of California's GHG emissions in 2004, with electric power from both in-state and out-of-state sources second, and the industrial²⁴ sector as the third largest source category. Agriculture,²⁵ forestry,²⁶ commercial,²⁷ and residential²⁸ activities composed the balance of California's GHG emissions.

Care must be exercised when looking at emissions from different sectors of the economy. For example, the GHG inventory identifies cement production from clinker manufacturing in a stand-alone category and fuel used to heat the cement production process within the industrial fuel category. Thus, CO₂ from clinker production does not represent total GHG emissions from cement production. Likewise, the GHG inventory reports landfill methane emissions in the methane portion of the inventory and CO₂ sinks associated with landfills in the CO₂ portion of the inventory. Taken together, the landfill CO₂ sinks approximately offset the landfill methane emissions. However, there are additional fuel related GHG emissions from transporting wastes to landfills, and these emissions are included in transportation fuels.

**Figure 3 -- Sources of California's 2004 GHG Emissions (By End-Use Sector)
(Includes electricity imports and excludes international bunker fuels)**



Source: California Energy Commission

Historical GHG Emissions Trends

This section discusses historical trends in California's gross GHG emissions. The values discussed in this section do not account for CO₂ sinks from forest, rangelands, or landfill and yard trimming disposal.

This section also excludes international aviation and marine vessel uses of jet fuel, residual oil,²⁹ and distillate oil because they are international fuel uses and the standard GHG emissions inventory protocol excludes them. Domestic aviation gasoline, jet fuel, residual oil, and distillate oil uses are included in the analysis.

The trends discussed in this section include carbon emissions from imported electricity, including out-of-state coal-fired power plants owned by California electric utility companies that provide electricity to California.

California's GHG emissions are large and growing as a result of population and economic growth and other factors. From 1990 to 2004 total gross GHG emissions rose 14.3 percent; they are expected to continue to increase in the future under "business-as-usual" unless California implements programs to reduce emissions.