

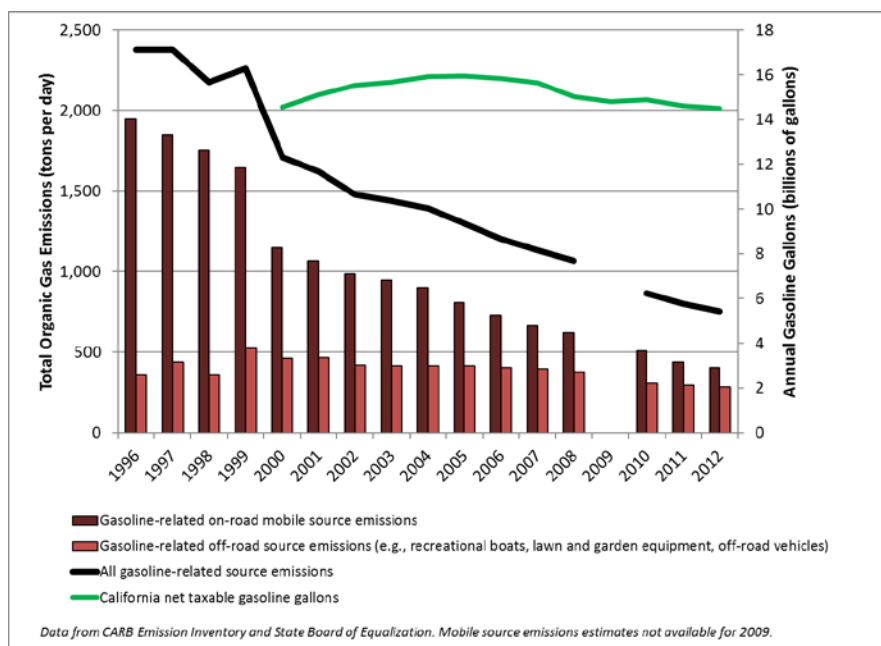
## Gasoline-Related Air Pollutants in California: Trends in Exposure and Health Risk, 1996 to 2014

### Brief Overview

The Office of Environmental Health Hazard Assessment (OEHHA) has completed [an analysis](#) of trends in exposure and health risks for gasoline-related air pollutants from 1996 to 2014. Using emissions data and ambient air-quality measurements from the California Air Resources Board (CARB) and other sources, OEHHA researchers estimated average gasoline-related exposures and associated health risks across five major air basins and statewide. The primary purpose of the analysis was to establish a baseline exposure and health risk “report card” for gasoline use in California, which can be used in later evaluations. Significant findings are summarized below.

#### Gasoline-related pollutant trends

- Estimated emissions of volatile air pollutants<sup>1</sup> from gasoline-related sources have declined by nearly 70% statewide since 1996, when the year-round use of reformulated gasoline began. Ninety-five of the top 100 volatile organic compounds (VOCs) emitted from gasoline-related sources showed lower emissions in 2012 compared to 1996, with reductions of between 20% and 90%. For example, gasoline-related emissions dropped by 74% for the carcinogen benzene, and by 71% for the reproductive toxicant toluene.
- This decline occurred even while gasoline sales remained steady and California’s population continued to grow, demonstrating the success of the state’s regulations on vehicle emissions and its reformulated fuel program. By 2012, total emissions from on-road gasoline-powered vehicles had decreased so substantially that they approached levels similar to those from off-road sources like lawn and garden equipment, recreational boats, and off-road vehicles.
- Ethanol was the only VOC with significantly increased emissions. This was expected due to ethanol replacing methyl t-butyl ether (MTBE) as a fuel oxygenate.
- Ambient air concentrations of both nitrogen dioxide and fine particulate matter (PM<sub>2.5</sub>) dropped by about 50% statewide over the study period, and the estimated portions coming from gasoline-related sources also generally declined. In the South Coast Air Basin, the portions of emissions that come from gasoline-related sources were estimated to have decreased by more than 30% for both pollutants since 1996.



<sup>1</sup> Based on “total organic gases,” which include volatile organic compounds (VOCs) and lower volatility pollutants. The emissions data are for primary sources and come from CARB’s Emission Inventory.

### *Screening cancer and non-cancer risk assessment results*

- Gasoline-related cancer risks to the average Californian from the most highly emitted carcinogens (acetaldehyde, benzene, 1,3-butadiene, and formaldehyde) declined statewide by more than 80% between 1996 and 2014. However, the cancer risks for gasoline-related exposures to both benzene and 1,3-butadiene each still exceeded 1 in 1 million in 2014 (about 50 and 20 excess cancer cases in 1 million, respectively).
- Naphthalene was the most abundant gasoline-related polycyclic aromatic hydrocarbon (PAH) in the South Coast Air Basin, the region with the most ambient air data for PAHs. Estimated cancer risks associated with average gasoline-related exposures to naphthalene dropped in this region from approximately 50 excess cancer cases in 1 million people in 1996 to about 5 in 2014.
- For most of the gasoline-related chemicals associated with non-cancer health effects, such as chronic respiratory toxicity or neurotoxicity, we found that exposures during the time period studied were below levels of potential concern. The notable exception was acrolein, with average gasoline-related exposures statewide and in the South Coast Air Basin estimated to be high enough in 2014 to pose risks for respiratory toxicity.

### *Some limitations on the analysis*

- This screening assessment provides a broad picture of general population exposures and risks, and is valuable for examining time trends for gasoline-related air pollutants. However, evaluating peak exposures that may occur intermittently and exposures in highly impacted communities, such as those near major roadways, was beyond the scope of the current project.
- The analysis was limited by data gaps in ambient air monitoring data, which are available only for a subset of gasoline-related pollutants, and by a lack of health-effects data for many chemicals associated with gasoline use.

*Recommended follow-up research* - While this report documents substantial declines in air pollution from gasoline-related sources, it also shows that an ongoing commitment to air quality improvements is essential in California. Some proposed future research projects are listed below.

- Apply innovative analytical methods and new toxicology screening techniques to better understand the universe of gasoline-related air pollutants and associated health risks.
- Build on other CARB and OEHHA efforts to better characterize air pollutant exposures at the neighborhood level. This could include measuring indicators of volatile chemicals in blood and urine samples collected from people living in heavily trafficked areas. Coordinate this work with CARB's new Community Air Protection Program.
- Further investigate the contributions of gasoline-related sources to ambient particulate matter, particularly for ultrafine particles and particulate matter arising from secondary formation in the atmosphere.

California's continued dependence on gasoline-fueled transportation means the State will need to maintain its efforts to address public health issues associated with vehicle-related air pollution. CARB has already established a broad mobile source strategy, which includes initiatives to promote zero-emission technologies and further tighten emission standards for small off-road engines, such as those used in lawn and garden equipment. California's strong commitment to innovative scientific research and ongoing regulatory efforts will build on the impressive reductions in toxicants already achieved and help ensure clean air for future generations of Californians.