

Fuel Trends Report: Gasoline 1995 - 2005

Executive Summary

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This report presents 1995-2005 clean fuel programs implementation data collected and analyzed by the Environmental Protection Agency's (EPA's) Office of Transportation and Air Quality. The data show that significant changes in gasoline composition during this period resulted in emission reductions often substantially greater than regulatory requirements. Future reports on fuel trends will be issued periodically.

Background

As a result of the Clean Air Act (CAA) of 1990, EPA adopted clean fuel programs for gasoline. In 1995, EPA implemented the Reformulated Gasoline (RFG) program, designed to reduce emissions of ozone-causing volatile organic compounds (VOCs) and oxides of nitrogen (NOx), and air toxics such as benzene and formaldehyde. At the same time, EPA implemented an anti-dumping program, to protect the emission qualities of conventional gasoline (CG). In 2000, credit for early gasoline sulfur reduction was provided by EPA's Tier 2 gasoline sulfur program.

These clean fuel programs required gasoline refiners and importers to analyze gasoline, measure certain emission-related parameters, and submit the data to EPA. These data have limitations, but in many respects, provide an unparalleled source of information about gasoline property trends since 1995.¹

Key Findings

- **Gasoline Sulfur Decreases** -- Average annual sulfur content in all gasoline dropped from about 300 ppm in 1997 to about 90 ppm in 2005.
- **RFG NOx Reductions Exceed Requirements** -- RFG exceeded applicable NOx performance standards during both Phase I (1998-1999) and Phase II (2000 and beyond).
- **RFG Toxics Reductions Exceed Requirements** -- On average, Phase I RFG complied with Phase II standards, and toxic performance still improved with the transition to Phase II standards.
- **Conventional Gasoline NOx and Toxics Emissions Decreased** -- Between 1998 and 2005, the summer NOx emissions of conventional gasoline were reduced by 5.7 percent, while summer exhaust toxics were reduced by 4.7 percent.
- **Ethanol Use in RFG Increased and MTBE Use Decreased** -- In the summer of 1996, about 11 percent of the RFG sold contained ethanol while virtually all the remainder contained MTBE. By the summer of 2005, the ethanol share increased to about 53 percent, with corresponding decreases in MTBE.

Gasoline Sulfur Decreases

As Figure 1 demonstrates, average annual sulfur content in all gasoline dropped from about 300 ppm in 1997 to about 90 ppm in 2005. Early decreases in overall gasoline sulfur content were primarily due to decreases in RFG sulfur content linked to the phase-in of increasingly stringent RFG NOx emission performance standards. These NOx emission performance standards did not mandate sulfur reduction, but lowering sulfur content was one of several property changes important to meeting the RFG NOx standards. Post-2000 decreases were also due to early Tier 2 sulfur reductions, applicable to both RFG

¹ EPA lacks information about certain properties, and has only partial information on others. One important limitation of the trend analyses in this report is that, with the exception of certain oxygen and oxygenate analyses, they do not include California gasoline.

and CG. Phase-in of Tier 2 sulfur reductions began in 2004, but credit generation for early sulfur reduction was allowed beginning in 2000.

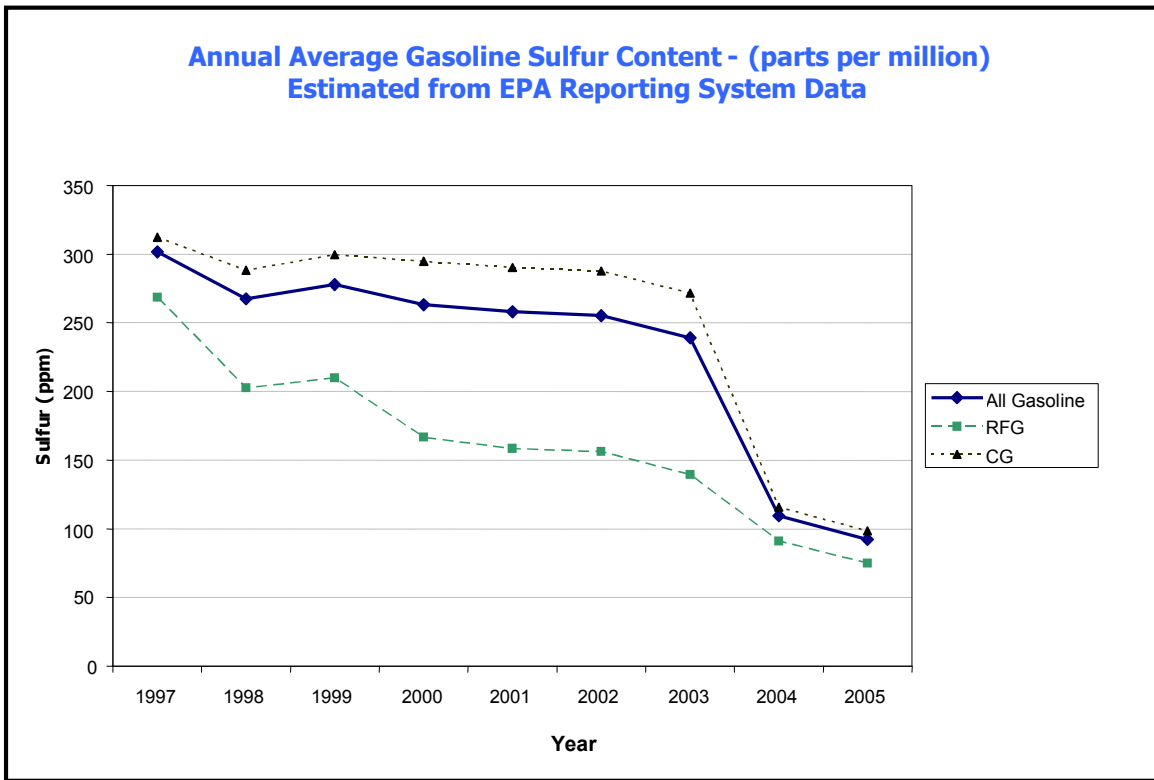


Figure 1

RFG NOx Reductions Exceed Requirements

As Figure 2 demonstrates, RFG exceeded applicable NOx performance standards during both Phase I (1998-1999) and Phase II (2000 and beyond). The summer NOx performance of Phase I RFG exceeded the standard by as much as 3.5 percent, while the summer NOx performance of Phase II RFG exceeded the standard by as much as 4.1 percent.

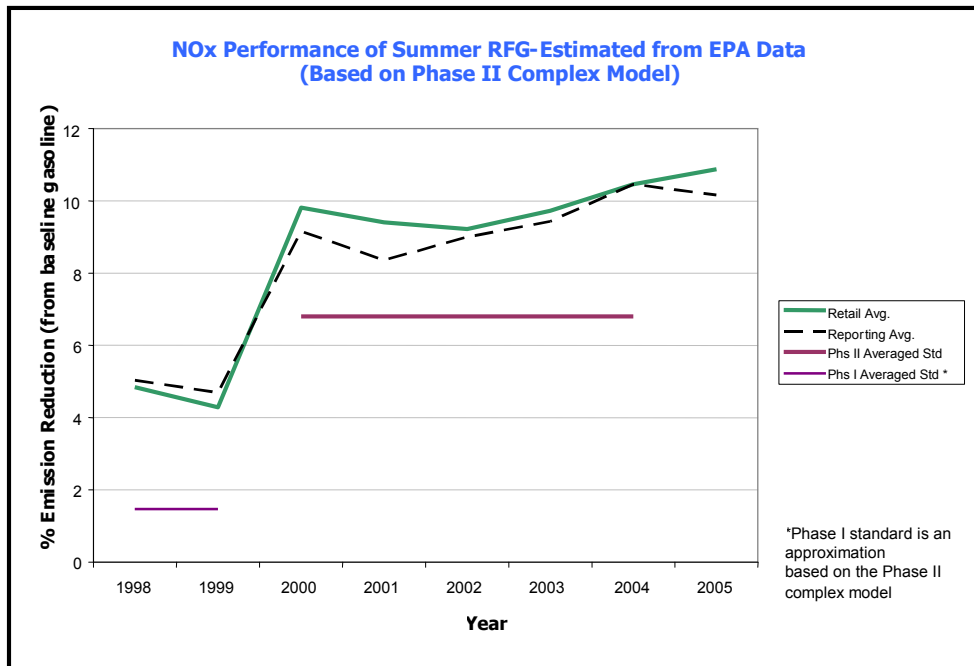


Figure 2

RFG Toxics Reductions Exceed Requirements

RFG also exceeded toxics performance standards. As Figure 3 demonstrates, the summer toxics performance of Phase I RFG exceeded the standard by as much as 15.1 percent, while the summer toxics performance of Phase II RFG exceeded the standard by as much as 12.8 percent. Winter RFG toxics performance also exceeded standards (See Figure 9 in the RFG Trends section). On average, Phase I RFG complied with Phase II standards, and toxic performance still improved with the transition to Phase II standards.

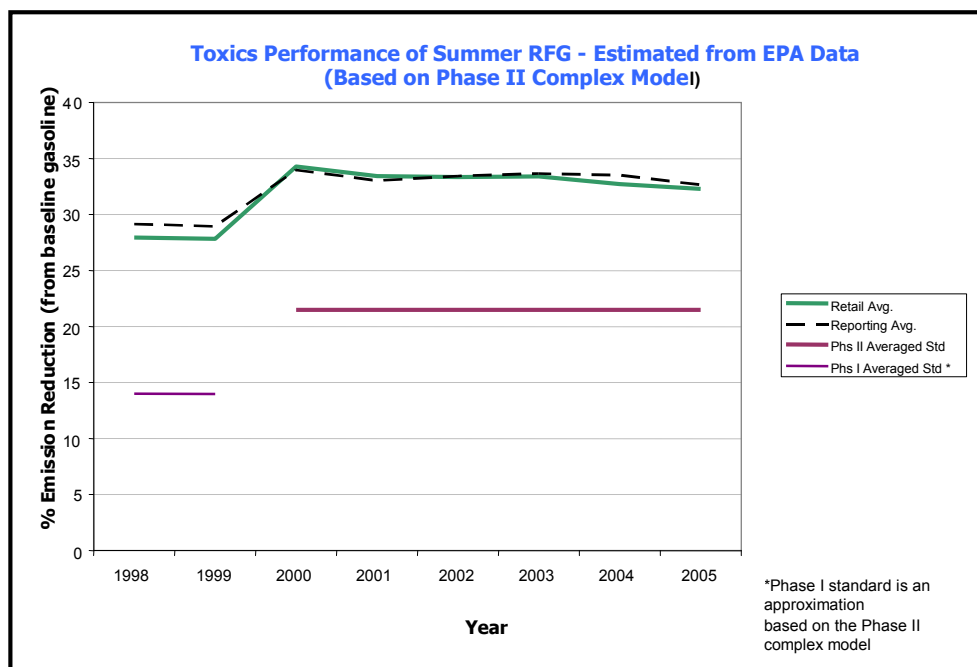


Figure 3

Conventional Gasoline NOx and Toxics Emissions Decreased

As Figures 4 and 5 demonstrate, between 1998 and 2005, the summer NOx emissions of conventional gasoline were reduced by 5.7 percent, while summer exhaust toxics emissions were reduced by 4.7 percent. Winter emissions also decreased during this period (See Figures 3 and 5 in the Conventional Gasoline Trends section). These reductions were not required by EPA regulations; instead, they were a byproduct of Tier 2 sulfur regulation.

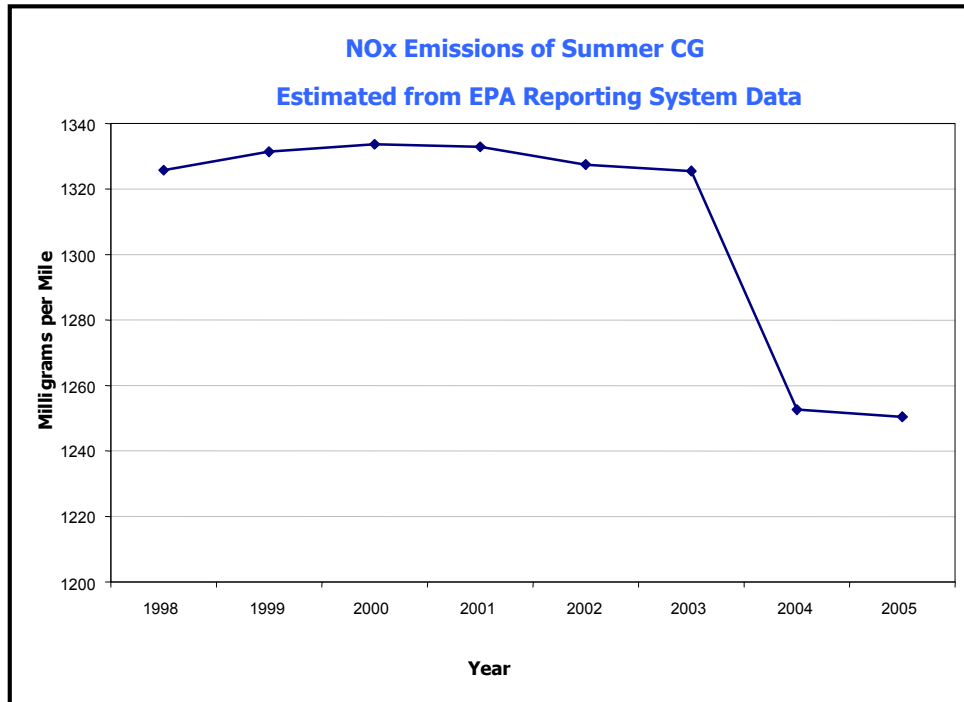


Figure 4

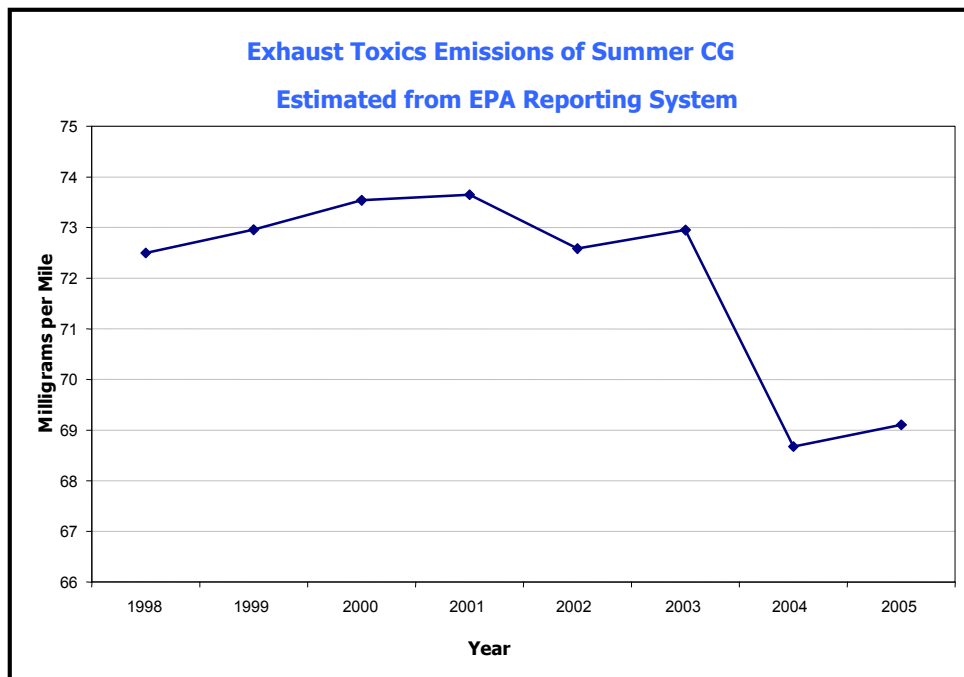


Figure 5

Ethanol Use in RFG Increased and MTBE Use Decreased

The CAA required that RFG contain two percent oxygen by weight. MTBE and ethanol were the primary oxygenates used. Figure 6 shows the increasing use of ethanol in RFG and the decreasing use of MTBE through 2005. In the summer of 1996, only about 11 percent of the RFG sold contained ethanol while virtually all the remainder contained MTBE. By the summer of 2005, the ethanol share increased to about 53 percent, with corresponding decreases in MTBE use.

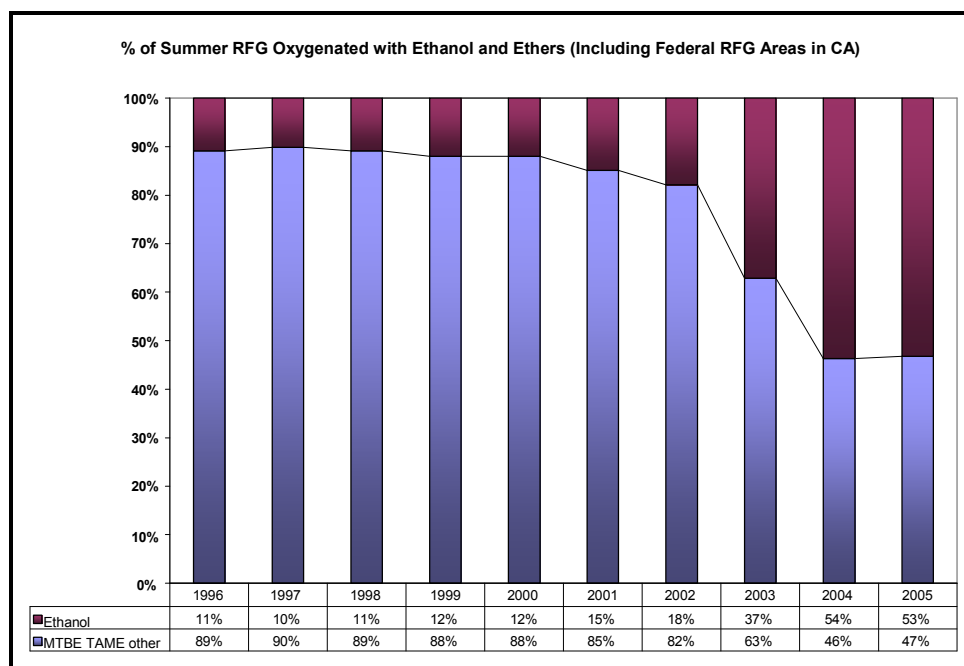


Figure 6

Gasoline oxygen content has been a topic of considerable interest. Concerns over groundwater contamination from MTBE resulted in various state laws banning or phasing out its use in gasoline. The Energy Policy Act of 2005 included a renewable content requirement for gasoline and eliminated the RFG oxygen content requirement. RFG data for 2006, while not analyzed for this report, show that RFG suppliers continued to use oxygen in RFG even after the requirement was removed in May of 2006, and that virtually all of this RFG was ethanol-oxygenated. MTBE use in RFG is currently at near zero levels. EPA finalized Renewable Fuel Standard program regulations in April 2007 to implement the Energy Policy Act renewable content requirement. Like RFG, these regulations include new recordkeeping and reporting requirements designed to track the volume of renewable fuel, including ethanol.