

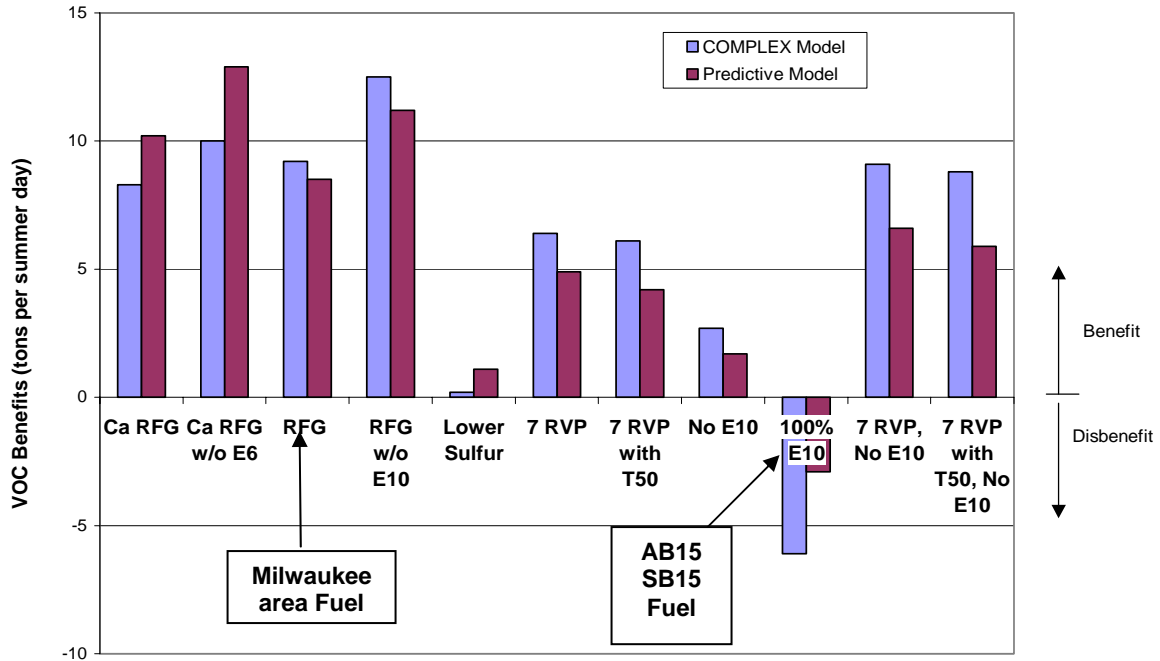
Ethanol Ozone Studies

No.	Date	Author/Title/Link	Key Ethanol Findings
1	Sept. 6, 2005	<p>Wisconsin Department of Natural Resources (DNR)</p> <p><i>Ozone Air Quality Effects of a 10% Ethanol Blended Gasoline in Wisconsin</i></p> <p>http://www.hamilton-consulting.com/updates/docs/dnr_final_e10revised_090805.pdf</p>	<ul style="list-style-type: none"> • There would be an increase in NOx and VOC emissions from an E10 mandate (AB 15). • The increase in NOx emissions would be up to 13 tons per day, which equates to: <ul style="list-style-type: none"> ○ Twice as much as the NOx decrease from SE Wisconsin motor vehicle inspection and maintenance program; or ○ About as much NOx emissions as emitted by a 350 Megawatt coal-fired power plant. • DNR will target electric utilities and manufacturers for NOx reductions to offset the increase in NOx from an E10 mandate. <p>Note: Those studies, below, with an * were referenced by DNR.</p>
2*	Feb. 23, 2005	<p>Southeast Michigan Council of Governments (SEMCOG)</p> <p><i>Emission Reductions from changes to Gasoline and Diesel Specifications and Diesel Engine Retrofits in the Southeast Michigan Area</i></p> <p>http://www.hamilton-consulting.com/updates/docs/022305semcogfuelsreport.pdf</p>	<p>SEMCOG includes over 140 local governments and plays a similar planning role to that performed by the Southeast Wisconsin Regional Planning Commission. They are the designated local air quality planning agency under the Clean Air Act, and work with Michigan Department of Environmental Quality in developing plans and programs that comply with the new ozone standard.</p> <ul style="list-style-type: none"> • The study found that of the 11 fuels evaluated; only E-10 would increase both NOx and VOC emissions and that these increases would be "significant." (See attached charts) The E-10 assessed by SEMCOG is the same fuel that would be mandated by AB 15 and SB 15. • Participants in the SEMCOG fuels report include automobile manufacturing and petroleum industry fuel experts, as well as representatives from Michigan departments of Environmental Quality and Agriculture, and U.S. EPA.
3*	Feb. 2005	<p>California Air Resources Board (CARB)</p> <p><i>A Summary of the Staff's Assessment regarding the Effect of Ethanol in California Gasoline on Emissions (Draft Report)</i></p> <p>http://www.arb.ca.gov/fuels/gasoline/meeting/2005/030105etohrpt.pdf</p>	<ul style="list-style-type: none"> • In 2004, the use of ethanol in on-road vehicles increases VOC emissions from permeation over 27 ton per day (tpd) and NOx emissions by about 8 tpd in Southern California, which equates to more VOC/NOx emissions than from all the oil refineries and fuel distribution systems in Southern California. The ozone benefits from CO reductions were negligible. • CARB also estimated significant increase of VOCs and NOx from small off-road engines, portable containers and other sources. They also emphasized the fact that VOC emissions rise even more sharply on hot days that are of most concern for ozone formation.
4	June 2001	<p>U.S. Environmental Protection Agency</p> <p><i>Technical Support Document: Analysis of California's Request for Waiver of the Reformulated Gasoline Oxygen Content requirement for California Areas</i></p> <p>http://www.epa.gov/oms/regs/fuels/rfg/s01008.pdf</p>	<ul style="list-style-type: none"> • In this EPA's analysis of California's oxygenate waiver request, EPA acknowledged that ethanol increases NOx emissions from so-called "Tech 4" vehicles, which are the 1988-1994 vehicles. • In fact, EPA found that the NOx effect is larger than CARB estimated in the Predictive Model. • However, neither the EPA Complex Model, nor MOBILE6, has been updated for this effect.

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5*	July 2001	<p>Northeast States for Coordinated Air Use Management (NESCAUM)</p> <p><i>Health, Environmental and Economic Impacts of adding Ethanol to Gasoline in the Northeast States</i></p> <p>http://www.nescaum.org/resources/reports/ethanol/index.html</p>	<p>This study evaluates the impacts of moving from MTBE to ethanol as an oxygenate in reformatted gasoline in the Northeast states.</p> <ul style="list-style-type: none"> • Air toxic and ozone precursor emissions would increase if ethanol is blended in conventional gasoline. • Consistent with SEMCOG's study, the ozone benefits of RFG are diminish when ethanol replaces MTBE as an oxygenate. • CO emissions reductions from ethanol only partial offset the adverse ozone impacts from increased NOx and VOC.
6*	Aug. 1999.	<p>Northeast States for Coordinated Air Use Management (NESCAUM)</p> <p><i>RFG / MTBE Issues and Options - Phase II;</i></p>	<p>This study was a starting point for the 2001 NESCAUM study.</p>
7	Sept. 2004	<p>Coordinating Resource Council, Inc.</p> <p><i>Fuel Permeation from Automotive Systems, Final Report; CRC Project E-65</i></p> <p>http://www.hamilton-consulting.com/updates/docs/ethanolstudy_calif.pdf</p>	<p>CARB, in cooperation with the Coordinating Research Council (CRC), sponsored this major study on the permeation effects of ethanol on automotive fuel systems. [Permeation is a diffusion process whereby fuel molecules migrate through rubber and plastic parts that make up the vehicle's fuel and fuel vapor systems. Permeation is a component of the evaporative emissions from the vehicle fleet.]</p> <ul style="list-style-type: none"> • The average permeation emissions with a 5.7 volume percent ethanol gasoline (compared to E10's 10%) were 65 percent higher than for MTBE and 45 percent higher than for a non-oxygenated (conventional) gasoline.
8	Oct. 2004	<p>American Petroleum Institute</p> <p><i>Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory from On-Road and Off-Road Sources;</i></p>	
9*	Apr. 17, 2003	<p>Carter, William P.L.</p> <p><i>Investigation of VOC Reactivity Effects using Existing Regional Air Quality Models (Report to American Chemistry Council)</i></p> <p>ftp://ftp.cert.ucr.edu/pub/carter/pubs/ddmrept1.pdf</p>	<p>According to DNR, this paper shows that ozone formation is a more complex process than what the current modeling indicates.</p> <ul style="list-style-type: none"> • Ozone formation can be either VOC-sensitive or NOx-sensitive. Ozone control measures then have to be developed accordingly. • In regions with high VOC-sensitivity, particularly urban areas, NOx control is counter-productive. In rural regions, which are primarily NOx-sensitive, VOC control can be counter-productive.

SEMCOG VOC & NOx Graphs (Annotated)

**Figure ES-1. Net VOC Benefits in 2007 - All Sources
(tons per summer day)**



**Figure ES-2. Net NOx Exhaust Benefits in 2007 - All Sources
(tons per summer day)**

