

EPA Rule Is Making Ozone Smog Worse

'Weekend effect' makes costly measures backfire

By Joel Schwartz

The U.S. Environmental Protection Agency (EPA), which is forcing Americans to spend billions of dollars per year to address ozone air quality, is actually making the situation worse.

The evidence is an air pollution phenomenon known as the "weekend effect."

Ozone is formed in the atmosphere on sunny days from reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC). Every weekend in cities across America, ozone-forming emissions decline ... but ozone levels stay the same or even rise.

Pollutants Fall, Ozone Rises

For example, in Los Angeles NO_x and VOC decline, respectively, about 20 percent and 15 percent on Saturdays relative to weekdays. Nevertheless, ozone rises about 20 percent. On Sundays, NO_x and VOC decline even more—about 35 percent and 20 percent, respectively, relative to weekdays. Yet ozone levels climb higher still, to about 30 percent above weekday levels.

Los Angeles has one of the worst weekend effects in the nation, but the pattern is similar all over the country. In Atlanta, NO_x and VOC decrease, respectively, 57 percent and 17 percent on Sundays relative to weekdays, but ozone levels don't change. In Cincinnati,

NO_x drops 40 percent on weekends, but with no change in ozone.

This is a problem because EPA and state regulators assume that reducing both VOC and NO_x is necessary for attaining the federal eight-hour ozone standard, and they have built that assumption into NO_x-reduction regulations that are costing Americans billions of dollars each year. But weekend-effect research suggests reducing NO_x is at best slowing the pace at which ozone declines, and is even making ozone worse in some cities.

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NO_x Reductions Backfire

Scientists have observed the weekend effect for years, and numerous studies suggest NO_x reductions are the culprit. Although NO_x and VOC work together to form ozone, the effect is nonlinear and depends on the ratio of VOC to NO_x in the atmosphere. At high VOC-to-NO_x ratios—a condition referred to as being "NO_x-limited"—reducing NO_x reduces ozone, while reducing VOC has

no effect.

On the other hand, at low VOC-to-NO_x ratios—a "VOC limited" condition—reducing VOC reduces ozone, while reducing NO_x increases ozone. (See sidebar for more on how this works.) Under VOC-limited conditions, if both VOC and NO_x are reduced, the NO_x reductions at best blunt the expected benefits of lower VOC—and at worst counteract them.

Over the past few decades, American metropolitan areas have been moving further into the VOC-limited regime, because VOC has been reduced more rapidly than NO_x. Most VOC comes from gasoline engines, mainly automobiles, and total automobile VOC emissions have been dropping about 10 percent per year for more than a decade as the fleet turns over to inherently cleaner cars. NO_x emissions, on the other hand, are about evenly spread among automobiles, diesel trucks, off-road diesel equipment, and power plants, and those emissions have been dropping more slowly.

Eight-hour ozone levels declined only slightly during the 1990s in most of the United States, and even rose in a few areas, despite large reductions in VOC and smaller reductions in NO_x. A decade of VOC and NO_x reductions had little

effect on ozone levels. The NO_x reductions are the leading explanation.

Regulators Reject Facts

Starting in the late 1990s, EPA began pursuing large NO_x reductions. Automobile "Tier 2" standards started phasing in with the 2004 model year, requiring an 80 to 90 percent reduction in automobile NO_x. A 90 percent reduction of NO_x emissions from new diesel trucks begins in 2007, with similar requirements for off-road diesel equipment beginning in 2010. NO_x from coal-fired power plants declined about 60 percent between 1998 and 2004 and will decrease still further under EPA's Clean Air Interstate Rule.

Many coal-fired power plants are in rural areas, and it is possible rural NO_x reductions are effective in reducing rural ozone levels, because ozone formation is

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How Ozone Is Formed

NO_x, shorthand for the sum of NO₂ + NO, is necessary for the formation of ozone (O₃). Even when volatile organic compounds (VOC) are not present, ozone is formed through a series of sunlight-driven reactions among NO₂, NO, and oxygen:



This cycle results in relatively low ozone levels. Ozone can't build up because, although it is formed in reaction (2), it is destroyed in reaction (3).

But add VOC, and ozone builds up. VOC allow NO₂ to be regenerated without destroying ozone. That is, VOC allow reaction (3) to be bypassed. OH radicals (also generated by various reactions among pollutants in the atmosphere) convert some VOC to peroxy radicals, which then regenerate NO₂ as follows:



... where the two oxygen atoms ("OO") are the peroxide group attached to a VOC.

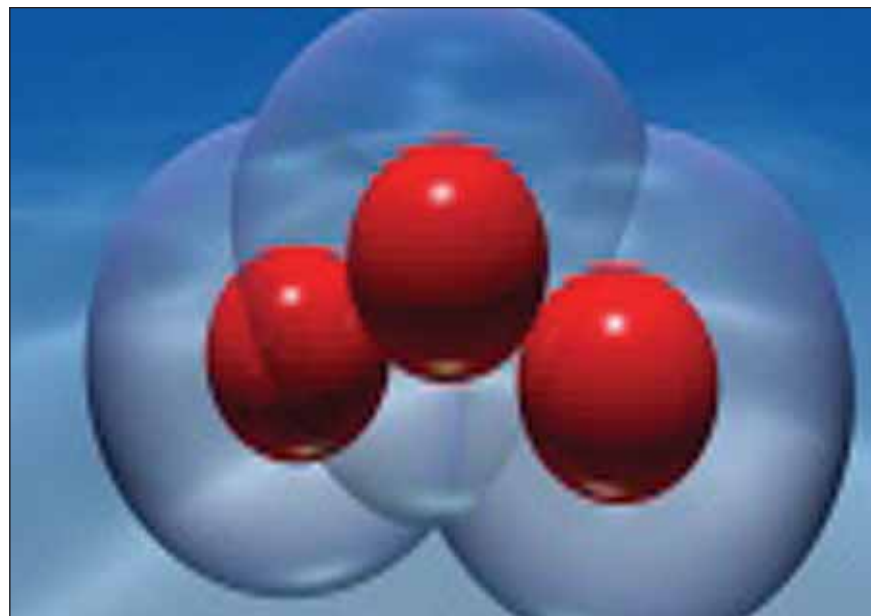
Ozone formation depends on the ratio of VOC to NO_x (VOC/NO_x). At high VOC/NO_x ratios, ozone formation is controlled by the amount of NO_x available, and reaction (4) is the main route to regenerate NO₂ from NO. Under this "NO_x-limited" situation, decreasing NO_x reduces ozone, while decreasing VOC has little or no effect on ozone.

But at low VOC/NO_x, ozone formation is limited by the amount of VOC avail-

able for reaction (4), and reaction (3) becomes the main route to regenerate NO₂ from NO. In addition, at low VOC/NO_x, NO₂ competes with VOC to react with OH radicals, slowing the rate at which VOC is converted to peroxy radicals, and thereby slowing the rate of reaction (4).

Under this "VOC-limited" or "VOC-sensitive" condition, reducing VOC reduces ozone, but reducing NO_x increases ozone. The NO_x reductions increase ozone through two means: First, by slowing down the rate of ozone destruction through reaction (3), and second, by speeding up the rate of NO₂ regeneration through reaction (4), allowing each molecule of NO_x to make ozone more rapidly.

— Joel Schwartz



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more likely to be NO_x-limited there. But “mobile-source” NO_x reductions mainly affect urbanized areas, and are therefore likely to further slow or even reverse progress in reducing ozone levels in the places where most Americans live.

Admitting that NO_x reductions are actually harmful, however, would be a major embarrassment for federal and state regulators. Not surprisingly, they have vigorously resisted the implications of weekend-effect research.

VOC Is Key

Even during the Clinton administration, EPA concluded the measures necessary to attain the federal eight-hour ozone standard would impose costs on the American public far greater than the benefits achieved. And economists within the Clinton administration but outside EPA believed the agency had drastically low-balled the cost estimates. Nonetheless, the Bush administration plans to tighten the ozone standard still further.

Current federal ozone policy can only make Americans worse off. But by rationalizing ozone-control strategy, we can at least reduce the damage. Ideally, EPA should put the brakes on NO_x reductions in urban areas by backing off on NO_x requirements for new motor vehicles and retrofit programs.

At the same time, regulators should speed up VOC reductions. Automobiles contribute most VOC emissions, and the worst 5 percent of automobiles account for half the total VOC contribution by automobiles. These cars can be identified on the road with remote sensing and their owners required to repair or voluntarily scrap their cars for a cash incentive.

What makes this strategy appealing is that VOC reductions will indeed reduce ozone in most places, especially the places where most people live. There is no other means to more substantial, more rapid, or less expensive improvements in ozone air quality.

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INTERNET INFO

The National Renewable Energy Laboratory and its partners have published several papers related to the weekend/weekday ozone effect. Links are available online at <http://www.nrel.gov/vehiclesandfuels/nfti/publications.html>.

“Emissions Down, Smog Up. Say What?” a January 2004 American Enterprise Institute paper by Joel Schwartz and Steven Hayward, is available online at http://www.aei.org/publications/pubID.19746/pub_detail.asp.

Wisconsin Senate Narrowly Defeats Ethanol Mandate

By James Hoare

The Wisconsin Senate on March 9 narrowly defeated legislation that would have required all regular-grade gasoline sold in the state to contain at least 10 percent ethanol.

Amendments Insufficient

The state Assembly in December had approved a similar bill by a vote of 54-38. When it became apparent the bill lacked sufficient votes to pass the Senate, supporters added amendments to the bill to ease some of the concerns of the bill's opponents. Even in its amended form, however, the bill failed to pass the Senate.

One amendment addressed concerns that ethanol might actually increase air pollution. Although ethanol would reduce some forms of air pollution, it remains unsettled whether ethanol might increase ground-level ozone. To address that concern, proponents of the bill added language that would void the mandate if pollution increased.

Another amendment exempted six southeastern Wisconsin counties that already must use specially formulated gasoline to meet federal clean air requirements.

Support, Opposition Bipartisan

Despite the 17-15 defeat, Senate Majority Leader Dale Schultz (R-Richland Center) promised to reintroduce the bill in next year's session. Gov. Jim Doyle (D) has already given his support to the mandate.

Support for and opposition to the proposed legislation were bipartisan. Wisconsin business associations opposed the bill, fearing the ethanol requirement would raise fuel costs.

A focal point of opposition was government taking away consumer freedom to decide what form of gasoline to choose.

Free Choice Called For

“The free market should be allowed to work,” said Jerry Taylor, director of natural resources at the Cato Institute. “Only mischief and inefficiency can come from government picking winners and losers.

“If ethanol is all that its supporters claim it to be, then it should need no special subsidies or government mandates,” Taylor added.

Wisconsin state Sen. Neal Kedzie (R-Elkhorn) agreed. “The public is not ready to be told what they can and can't put in their gas tanks,” Kedzie told the *Milwaukee Journal-Sentinel* for a March 9 story.

Use of ethanol is “growing on its own, it's finding its own market through regular free-market enterprise, and that's how it should work,” Kedzie noted. Four ethanol plants currently operate in Wisconsin, and another is being built.

Could Boost Farm Economy

Proponents of the legislation argued eth-

anol could facilitate energy independence and boost the Midwestern economy.

“We grow corn. We have ethanol plants. Unless we tell the nameless, faceless oil companies, ‘This is what you have to do,’ they'll tell us what to do,” said state Sen. Jon Erpenbach (D-Middleton), according to the March 9 *Journal-Sentinel*.

“There was a time when ethanol did not make scientific or economic sense, but those times are over,” said Jay Lehr, science director for The Heartland Institute. “The technology now exists such that ethanol not only makes environmental sense, it makes economic sense as well.

“We are currently only scratching the surface of ethanol's full potential,” Lehr added.

“The public is not ready to be told what they can and can't put in their gas tanks.”

NEAL KEDZIE
STATE SENATOR - ELKHORN, WISCONSIN

Newspaper Changed Position

The *Milwaukee Journal-Sentinel*, which had opposed an ethanol mandate proposed in the 2005 legislative session, reflected some of the shifting sentiment in favor of a mandate.

“Exactly one year ago, we urged legislators to vote against a bill that would have mandated adding 10% ethanol to regular unleaded gasoline sold in Wisconsin,” observed a March 1 house editorial. “If the final version of this bill contains several key provisions that have been proposed by sponsors and others, legislators this time should give it their support.”

The two amendments addressed two of the *Journal-Sentinel's* concerns but did not alleviate concerns that the fossil fuel



currently used in the ethanol manufacturing process is roughly equal to the fossil fuel displaced by the 10 percent ethanol mandate. The final bill also did not address the *Journal-Sentinel's* admonition that 20 percent of ethanol should eventually come from sources other than corn, such as switchgrasses.

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INTERNET INFO

A March 2002 Environmental Protection Agency factsheet on ethanol is available online at <http://www.epa.gov/OMS/consumer/fuels/altfuels/420f00035.pdf>.

Information about ethanol-powered automobiles offered by General Motors is available online at <http://www.gm.com/company/onlygm/livegreengoyellow/index.html>.

EPA Web Site Provides Updated Ethanol Information

According to the U.S. Environmental Protection Agency (EPA), cars designed to use E85 (a blend of 85 percent ethanol and 15 percent gasoline) provide the following pollution reductions:

- Organic compound emissions are reduced by 15 percent.
- Carbon monoxide emissions are reduced by 40 percent.
- Particulate emissions are reduced by 20 percent.
- Nitrogen oxide emissions are reduced by 10 percent.
- Sulfate emissions are reduced by 80 percent.

EPA also reports that in the Midwest, ethanol blends are sold at prices equivalent to or less than mid-grade gasoline.

“All the resources needed to produce [ethanol] can be supplied domestically,” EPA observes.

For a more complete discussion of the pros and cons of ethanol fuel, visit the EPA Web site <http://www.epa.gov/OMS/consumer/fuels/altfuels/420f00035.pdf>.

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