Is There Change in the Air?
Examining E-Check and Other Alternatives

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The Ohio Environmental Protection Agency's enhanced vehicle inspection and maintenance program, or E-Check as it is commonly called, has become well known among motor vehicle owners in the Cincinnati, Cleveland, and Dayton-Springfield areas. This paper analyzes the benefits and consequences of retaining E-Check and of repealing it. The author also examines other alternatives for meeting clean air standards and describes general advantages and disadvantages for each pollution control measure.

What is the best way for Ohio to meet the federal clean air standards for ozone? The state's answer, in part, is to implement an enhanced inspection and maintenance (I&M) program, commonly referred to as E-Check, to assist in bringing targeted areas of the state into compliance with the federal ozone standards. However, some people living in those areas believe that E-Check not only imposes too great a financial and regulatory burden, it may not deliver the reductions needed to comply with the federal standards.

In examining Ohio's strategy for attaining the ozone standards, this paper will attempt to layout the oftentimes contradictory information surrounding ozone, and enhanced I&M programs and their alternatives. This paper will not be overly technical or scientific in nature, nor will it recommend specific courses of action. Instead it is intended to allow readers to draw their own conclusions based upon the information provided. Two basic policy options will be addressed: (1) the benefits and consequences of retaining E-Check and (2) the benefits and consequences of repealing E-Check. This paper also explores alternatives to E-Check, including their advantages and drawbacks with respect to Ohio's current air quality and their applicability to the federal requirements and Ohio's clean air strategy.

Forty Years of Federal Clean Air Legislation

In the 1950s air pollution statutes were created by states to address smoke and particulate emissions. The federal government became involved in clean air regulation with the original Clean Air Act of 1963, and expanded their role with the Clean Air Act Amendments of 1970 (CAAA 1970), the birthplace of the EPA. The 1970 amendments, which marked a new era in which the federal government — as opposed to the states — set binding national standards, charged the EPA to complete three major tasks: (1) set National Ambient Air Quality Standards (NAAQS); (2) develop motor vehicle emission standards; and (3) set New Source Performance Standards (NSPS).[1] The standards were set to

In general, enhanced I & M consists of three parts: (1) a tailpipe test measuring vehicle emissions as the car is accelerated and decelerated to simulate driving conditions; (2) testing how well gasoline vapors from the gas tank are captured; and (3) testing for fuel system leaks.

"protect public health" from "any known or anticipated adverse affects" with "an adequate margin of safety."[2] The first ozone standard was for all photochemical oxidants and was set at a .08 parts per million (ppm) daily maximum one-hour average, not to be exceeded for more than one day per year. The standards received very little public comment or controversy.[3] The CAAA 1970 set up state implementation plans (SIP) to ensure attainment of the NAAQS (hereafter, the "standards").[4]

The Clean Air Act Amendments of 1977 mandated automobile emissions and inspection programs for metropolitan areas that could not demonstrate attainment of the NAAQS for ozone or carbon monoxide (CO).[5] The ozone standard was revised to a .12 ppm daily maximum hourly average ozone concentration, not to be exceeded more than three days over a four year period. This standard represented a compromise between those who believed the margin of safety related to adverse health effects should be large, because the concept of an ozone threshold is inappropriate, and those who believed that the adverse effects of ozone were both minor and reversible and that the most sensitive members of the most sensitive group fell outside of the protection of "public" health.[6]

Until the Clean Air Act Amendments of 1990 (CAAA 1990), states were required to demonstrate that their SIP would lead to attainment with the specified time frame and show "reasonable further progress," in reducing emissions of ozone precursors. The CAAA 1990 expanded the complexity of attaining and maintaining the standards by categorizing certain metropolitan areas in terms of non-attainment of the ozone, CO and particulate matter (PM_{10}) standards, and placing specific requirements each categorized area must implement to help bring them into attainment.[7] While CAAA 1990 did not prescribe a new ozone standard, USEPA not proposed to tighten the ozone standard to an eight-hour daily maximum of between .07 and .09 ppm.

Ozone

According to CAAA 1990 one of the six criteria pollutants that are indicative of overall air quality is ozone. Ozone is a major component of smog. It is not emitted directly into the air, but is formed through complex chemical reactions between volatile organic compounds (VOC) and nitrogen oxides in the presence of sunlight.[8] VOCs (also known as hydrocarbons) are emitted from automobiles, chemical manufacturing, paint shops and other sources using solvents and methane gas. Naturally occurring vegetation and decaying biomass also contribute to VOC emissions, although vegetation's impact on VOC emissions is the subject of some dispute. Ozone formation occurs in late spring and summer when sunlight is most intense, temperatures are elevated and air is stagnant.

So why is ozone such a concern? According to USEPA, ozone damages lung tissue, reduces lung function and sensitizes the lung to other lung irritants. USEPA's findings indicate that ambient levels of ozone affect those with impaired respiratory systems as well as healthy individuals. Furthermore, exposure to ozone for several hours at relatively low concentrations was found to significantly reduce lung functions, and induce respiratory inflammation in healthy people during exercise.[9]

Most people agree that decreases in lung function and severe respiratory symptoms generally increase with exposure to higher concentrations of

[1] "National Pollutant Air Emission Trends, 1900-1994." USEPA. Office of Air and Radiation. http://www.epa.gov/oar/emtrnd94/tr_94pdf.html. (October 1995).

[2] "Six Steps to a Healthier Ambient Ozone Policy." Discussion Paper 96-13. Krupnick, Alan J. and Farrell, Dierdre. Resources for the Future. March 1996. p. 33.

[3] *Ibid*.

[4] *Ibid*. p. 4.

[5] "The Ohio AIM Program." OEPA. Mobile Sources Section. June 1993. p. 1.

[6] "Six Steps to a Healthier Ambient Ozone Policy." Discussion Paper 96-13. Krupnick, Alan J. and Farrell, Dierdre. Resources for the Future. March 1996. p. 34.

[7] *Ibid*. p. 4 - 5.

[8] USEPA, Office of Air Quality Planning and Standards, *The Green Book*, http://www.epa.gov/oar/oaqps /greenbk/o3co.html, (1996). p. 1.

[9] USEPA, Office of Air Quality Planning and Standards, *The Green Book*, http://www.epa.gov/oar/oaqps /greenbk/o3co.html, (1996). p. 1.

ozone. There are studies, however, that dispute USEPA's findings of a link between lower concentrations of ozone (i.e. the levels of ozone around the current USEPA standard) and adverse health affects. Some studies indicate that a "...causal relationship between elevated levels of ozone and incapacitating or irreversible health effects in humans remain highly speculative," and that a "...lack of strong epidemiological findings to date in cities with high ozone levels and numerous exceedances...imply that, if chronic effects exist, they are weak relative to other factors affecting the human respiratory system."[10]

The CAAA of 1990

Ozone Non-Attainment Areas

CAAA 1990 classified ozone non-attainment areas — metropolitan statistical areas where levels of ozone exceeded the federal air quality standards of 0.12 ppm — according to the area's severity of pollution. Severity was based upon actual measured air quality data from 1987 through 1989. This time frame draws criticism from some opponents of E-Check, because the summer of 1988 was unusually hot. These abnormally high temperatures may have increased the nation's overall ozone levels during the time period, pushing some areas into categories of ozone non-attainment and further increasing the ozone severity of some areas already exceeding the standard. Utilizing the ozone standard of 0.12 ppm, Table 1 shows the classification of ozone non-attainment areas.

CAAA 1990 prescribed pollution reduction milestones to assist non-attainment areas in gradually complying with the ozone standard. A state's strategy in attaining the standard is found in its state implementation plan (SIP). The SIP is a strategy framework utilizing various programs and controls

TABLE 1: CAAA 1990 Non-Attainment Categories

Category	Years Required to Attain Standard	Range of Measured Air Quality (ppm)
Marginal	3 years	.121 - .138
Moderate	6 years	.138 - .160
Serious	9 years	.160 - .180
Severe	15 years	.180 - .280
	17 years	.190 - .280
Extreme	20 years	.280 +

to: (1) achieve a 15 percent reduction in VOCs and attainment of the ozone standard by the specified time frame shown in the table above (for Ohio's moderate non-attainment areas November 1996); and (2) show how each area will maintain the ozone standard for ten years, a requirement for the area to be redesignated from non-attainment to attainment.

Impact On Ohio

When CAAA 1990 became law, the metropolitan areas of Cincinnati, Cleveland-Akron, Dayton-Springfield, and Toledo were designated as moderate ozone non-attainment. Therefore, OEPA was required to submit a SIP to USEPA outlining the strategies used in the four areas to reduce VOC emissions by 15 percent, demonstrate compliance with the ozone standard by November 1996, and maintain the ozone standard for ten years. In areas of moderate ozone non-attainment, CAAA 1990 *required* the implementation of a basic vehicle inspection and maintenance (I&M)[11] program as well as certain restrictions on industrial sources of VOCs.

In determining the best strategy to provide the 15 percent reduction and comply with the standards, OEPA and local metropolitan planning organizations (MPO) "...quickly came to the conclusion that a basic [I&M] program alone would not give...enough reductions to comply with the requirement."[12] This was true in every non-attainment area except Toledo,

[10] Kenneth Chilton and Christopher Boerner, *Smog in America: The High Cost of Hysteria*, Center for the Study of American Business, Policy Study Number 128, (December 1995) p. 11.

[11] In General, a basic I & M program measures vehicle tailpipe emissions while the car is idling.

[12] Donald R. Schregardus, *Testimony before the House Energy and Environment Committee*, OEPA. (March 28, 1996). p. 2.

where a large cut in industrial emissions from a refinery was enough to achieve the 15 percent reduction requirement, and demonstrate compliance with the standards. According to OEPA, some reductions were attained through mandated industrial controls, such as new rules for paints, air toxics and evaporative emissions at the gas pump.

To achieve the remaining reductions, OEPA believed that they had two viable options at that time, (1) a combination of basic tailpipe testing and an alternative fuels program; or (2) substituting an enhanced I&M program for the basic test.[13]

Ohio's Strategy for Complying with CAAA 1990

In 1993, when legislation implementing a basic I&M program (required by CAAA 1990) was being considered by the Legislature, OEPA expressed concern about the difficulty of reducing VOC emissions in the non-attainment areas, thereby raising their interest in enhanced I&M. However, OEPA was also concerned at that time that an enhanced program would be more costly to the consumer and that they did "...not have the data assimilated to clearly demonstrate how implementing an enhanced program would benefit our non-attainment areas."[14] Additionally, OEPA felt that the decision to implement enhanced I&M should be made on the local level so that local elected officials would be held accountable to the general public for that decision.[15]

To fulfill the CAAA 1990 reduction requirements and demonstrate compliance with the standards, OEPA and the local MPOs believed that the strategy used should target vehicle emissions. According to OEPA testimony, urban area vehicle emissions are the largest contributor of VOC emissions, as high as 45 percent of all VOC emissions in northeast Ohio.[16]

TABLE 2:
Estimates of Costs of Control Strategies

Control Strategy*	Cost per Ton of VOC Reduced
Basic I&M	$5,410
Enhanced I&M	$879
7.8 RVP** Gas	$2,200 - $4,000
RFG**	$5,000

** Details of these control strategies are discussed later.*
*** RVP = Reid Vapor Pressure; RFG = Reformulated Gasoline*

Cost Comparisons Among Control Measures

Despite some of OEPA's earlier concerns, it advocated enhanced I&M, in part, because of the projected VOC reductions and its associated cost effectiveness compared to other pollution control measures. Table 2 shows the cost projections of possible control measures taken from OEPA testimony.[17]

In June 1996, the General Accounting Office (GAO) released a report[18] containing a summary of four different studies comparing automotive emission control strategies. While each study also researched other pollution control measures, Table 3 depicts only those control measures discussed in OEPA testimony for means of comparison. Inclusion of Table 3 is not intended to refute OEPA's testimony, necessarily, but instead is designed to show that other cost analyses exist and should be considered when examining the state's overall clean air strategy.

The GAO report stresses that comparison among the four studies is very difficult. Additionally, "[s]ignificant differences in the analyses' objectives, methodologies, time frames, costs considered and other factors produced varying estimates of the costs per ton of pollutant removed."[19] Furthermore, an analyst

[13] Ibid.

[14] Kate Bartter, *Proponent Testimony on S.B. 18*, OEPA, (March 30, 1993), p. 2-3.

[15] Ibid. p. 3.

[16] Donald R. Schregardus, *Testimony before the House Finance Committee*, OEPA, (July 17, 1996), p. 2.

[17] Donald R. Schregardus, *Testimony before the House Energy and Environment Committee*, OEPA. (March 28, 1996). p. 2-3.

[18] U.S. General Accounting Office *Motor Fuels: Issues Related to Reformulated Gasoline, Oxygenated Fuels, and Biofuels*, (June 1996)

[19] U.S. General Accounting Office *Motor Fuels: Issues Related to Reformulated Gasoline, Oxygenated Fuels, and Biofuels*, (June 1996), p. 20.

TABLE 3: Cost Comparisons of the Control Strategies - Four Studies

Control Measure	USEPA[a]	API[b]	Radian[c]	Charles River[d]
Basic I&M	$5,400	no data	no data	no data
Enhanced I&M	$900-$1,700	$13,261	$5,940	$1,700
RVP	no data	no data	no data	$1,100
RFG	$5,200-$5,900: Phase I additional $600: Phase II	$7,422: Phase I and II	$14,700: Phase I and II	$4,600

[a] "Final Regulatory Impact Analysis for Reformulated Gasoline." USEPA. (Dec. 1993). Since CAAA 1990 mandated RFG, their analysis only focused on the difference in cost of various RFG formulas, and contained only limited information on comparing these costs with other control measures.
[b] "The Cost Effectiveness of VOC and NOx Emission Control Measures." American Petroleum Institute. (Sept. 1994). This study by the American Petroleum Institute represent the weighted average costs among five cities: Chicago, Philadelphia, Houston, Baltimore and Washington D.C.
[c] "Emission Reductions and Costs of Mobile Source Controls." Radian Corporation. (Dec. 1992). This study was prepared for the Virginia Petroleum Council.
[d] "The Cost Effectiveness of Further Regulating Mobile Source Emissions." Sierra Research Inc. and Charles River Associates. (Feb. 1994). This study was prepared for the American Automobile Manufacturers Association.

for the American Petroleum Institute found that determining the cost-effectiveness depends on many factors including "...baseline emission level, whether cost-effectiveness is calculated on a marginal or total cost effectiveness basis, the assignment of control costs for different emission reductions, the extent of emission reductions in the attainment areas, and the seasonality of ozone pollution which would vary from locality to locality."[20]

So obviously, choosing among control measures on the basis of cost comparison is difficult. Therefore, should OEPA use cost effectiveness as a bellwether of which program to choose? Due to the limitations of this type of cost data, maybe not. However, because costs play such a major role in determining policy options in the public arena, OEPA would have been *expected* to consider the cost of the potential control measures. Therefore, OEPA used the cost figures for the control measures that was believed to be the most applicable for Ohio's clean air strategy.

OEPA also believed that the public would more readily accept a program that tests vehicles every other year instead of annually, and that the public would rather face one control program instead of two (i.e. a vehicle testing program *and* an alternative fuel program).

Economic Growth and Transportation Plans

As part of determining the state's strategy for achieving the required VOC reductions and maintaining the standard, local MPOs projected the economic growth rates that they believed would occur in the non-attainment areas for the next ten years. Additionally, future transportation projects and associated traffic patterns were also projected for these areas. The projected economic growth and transportation plans were then taken

[20] *Ibid.*

into account in these areas, to weigh their subsequent impact on VOC emissions over the ten year period.

The projected reductions achieved by enhanced I&M, or any other pollution control measure for that matter, are derived from a USEPA modeling program. In general, different control measures earn USEPA credits that count towards emission reductions. Incorporating the economic growth projections and transportation plans into the modeling program, OEPA determined that an enhanced I&M program along with the other controls on industry, produced enough reductions, in Ohio's three non-attainment areas, to achieve the required 15 percent VOC reduction and demonstrate compliance with the standards.

Therefore, legislation was written to implement a basic I&M program with an option allowing local governments in the affected areas to approve an enhanced I&M program in their own jurisdiction. Failure to vote meant automatic approval. The legislation became law and the affected local governments subsequently approved the implementation of an enhanced program, paving the way for E-Check, Ohio's enhanced I&M program.

Startup Problems

In general, vehicle emissions testing programs across the country have not been particularly popular. Therefore, it was not long after the program's beginning that OEPA and local and state elected officials began receiving complaints about E-Check, ranging from long lines, faulty equipment, and damage to automobiles. As these complaints progressed, several grassroots organizations formed, specifically geared towards the elimination of the program.

OEPA alleviated many of the technical problems of E-Check by implementing certain steps, such as requiring longer hours at testing centers, instituting a check option (instead of cash only) to pay for the test, and creating a repair cap waiver of $300 if the vehicle continued to fail. OEPA also fined the testing companies for significant customer delays.

In the meantime, about a dozen bills were introduced by members of the 121st General Assembly that attempted to alter, delay or eliminate the program. One bill eventually emerged, creating clean air advisory councils to approve alternatives to E-Check, if compliance with CAAA 1990 was maintained. However, as the bill was debated on the floor of the House, the bill's language was replaced with an amendment that eliminated the program entirely. The amendment was approved. A second vote was taken which placed the amended bill into the House Finance Committee. No further action was taken in 1996.

Current Ozone Attainment Situation in Ohio

The three ozone non-attainment areas in Ohio[21], have progressed along different courses towards the clean air standards.

Cleveland and Dayton-Springfield

Cleveland and Dayton-Springfield have been recently redesignated by USEPA as ozone attainment areas. Therefore, the CAAA 1990 mandate requiring the implementation of a basic I&M program no longer apply in these areas (the exception being Cuyahoga County which is required to have a basic I&M program due to past violations of the carbon monoxide standard). The clean air strategy in Cleveland and Dayton-Springfield now

[21] There were actually four areas in Ohio, but Toledo attained the standards through industrial controls.

is guided by a USEPA-approved ten year maintenance plan. E-Check is still being run in Cleveland and Dayton-Springfield because: (1) the program is one of the primary control measures used for maintaining the ozone standard in the two areas based upon the projected VOC reductions delivered by E-Check and (2) the ten year maintenance program is a legally binding document that requires the state to run E-Check unless both OEPA and USEPA can agree on alternatives.

Cincinnati

Cincinnati's air quality situation is quite different. Because of continued ozone violations, the area was not redesignated to attainment by November 1996. Since the area is still designated as moderate non-attainment, the area's air quality strategy is still driven by the CAAA 1990 mandate of implementing a basic I&M program, instituting industrial controls and achieving VOC reductions of 15 percent. OEPA has asked USEPA for a one year extension to meet the 15 percent reduction requirement and attain the ozone standards.

Complicating Cincinnati's situation is that OEPA has initiated termination proceedings against MARTA Technologies, the company implementing E-Check in the area. This action was taken after OEPA discovered "...serious and persistent errors in the test performed by MARTA."[22] In the meantime, OEPA repealed the requirement that vehicle owners in Cincinnati have their vehicle tested as a condition of obtaining their registration for 1996, effectively stopping the program. Envirotest, the company implementing E-Check in the other areas in Ohio, is exploring the possibility of acquiring MARTA. The implications of this acquisition and its relation to administering E-Check, are unclear at this time.

Policy Options

With this background information in mind, we now turn to the following policy options: ***(1) the benefits and consequences of retaining E-Check and (2) the benefits and consequences of repealing E-Check.***

Retaining E-Check

Benefits

Due in part to the implementation of E-Check, Cleveland and Dayton have been redesignated as ozone attainment areas by USEPA and continue to maintain the ozone standard. It appears, then, that the state's clean air strategy for these two areas has been, and continues to be, successful. It is difficult to assess the impact of E-Check in Cincinnati because less than one quarter of the area's vehicles have been tested, due to the current halt in the program. A benefit of retaining E-Check, then, is that it continues to keep two of Ohio's three areas in attainment.

Additionally, USEPA has proposed a tightening of the ozone standard to an 8-hour daily maximum of between .07 and .09 ppm. According to USEPA, there are 26 "[c]ounties that meet current standards, but would not meet EPA's proposed new ozone standard."[23] If this standard is approved, there is speculation that these counties will be required to implement at least a basic program and potentially an enhanced program. So if the state retains E-Check, extending the program to these additional counties would be potentially easier to implement and more fiscally prudent than eliminating the program, only to restart it again due to the tightening of the federal ozone standard.

Finally, CAAA 1990 still *requires* the state to implement a basic I&M

USEPA has proposed to tighten the ozone standard to an 8-hour daily maximum of between .07 and .09 ppm.

[22] Donald R. Schregardus, *Testimony before the House Finance Committee*, OEPA, (September 11, 1996), p. 1.

[23] *USA Today*, Friday November 29, 1996, p. 9A.

program in Cincinnati, because the area has not been redesignated as attainment, and in Cuyahoga County, for past violations of the CO level. Furthermore, in the Cleveland and Dayton areas, OEPA would be required to find alternatives to enhanced testing to maintain the standard. For these reasons, it may be more programmatically efficient and cost effective to continue E-Check, even without the possibility of the tightening ozone standard in the near future.

Consequences

Obviously, one consequence of retaining E-Check is that it will likely continue to be an unpopular program with some who live in the non-attainment areas. While it appears that some of the problems have been worked out of the testing process, damaged cars and large repair costs are still being reported. Additionally, there are those who believe that this program is an example of the government overstepping its bounds with respect to the regulation of people's activities. This tension could potentially be heightened if the ozone standard tightens to 0.08 ppm, enlarging the pool of vehicle owners subject to the testing requirements.

But perhaps there is a more fundamental reason for maintaining the program. The ten-year length of the maintenance program appears to take "up-front" flexibility out of the state's clean air strategy. With the state committed to a ten year program, it is possible that Ohio may not be able to take advantage of other technologies available, such as alternative fuels, remote sensing or on-board diagnostics, to help attain the ozone standard. This becomes an even greater concern if enhanced I&M does not achieve the type of reductions that it is designed to produced in the first place, as some opponents of the program claim.

This raises the issue of the effectiveness of enhanced I&M programs. Do enhanced I&M programs really produce the type of reductions that they are designed to achieve? As stated before, the clean air strategy for the non-attainment areas in Ohio uses E-Check based upon its *projected* emission reductions, in conjunction with the other control measures, to attain the standard. So how well do the projections equal actual reductions? The U.S. General Accounting Office (GAO) issued a report that attempted to assess the effectiveness of I&M programs. In 1992, USEPA promulgated a rule in which states using test-and-repair networks[24] have their emission credits reduced by 50 percent, as opposed to test-only networks which receive the full USEPA emission credits. This study specifically focused on the effectiveness of enhanced I&M in the context of whether test-and-repair networks were less effective than test-only networks, thus warranting the reduction of credit. Basically, the GAO report was unable to make direct comparisons between the two networks because there was little data to analyze. Table 4 summarizes seven studies that the GAO report references that may provide some insight on general I&M effectiveness.[25]

As evidenced in the table, it is difficult to accurately peg the effectiveness of enhanced I&M programs, because there is very little data to make such an analysis. Therefore, it appears that the best gauge for monitoring the effectiveness of E-Check is to continue monitoring ozone levels as the program progresses. To those who believe that E-Check does not produce the reductions in the first place, continuing the program is likely an unacceptable solution.

[24] Where inspectors/ mechanics are allowed to make repairs to vehicles.

[25] US General Accounting Office, *Air Pollution: Limited New Data on Inspection and Maintenance Program's Effectiveness*, (March 1996), p. 21-26.

TABLE 4: Summaries of I&M Studies*

Researcher	Scope of Study	Summary of Conclusion
University of Minnesota	Measuring an I&M program's effectiveness through time-series analysis	Found the ambient CO levels decreased at about the same rate for the first two years after the I&M program began, as the they had for the previous five years.
RAND Corporation for the California State Transportation Committee	Evaluating the analytic, scientific, and empirical basis for USEPA's 50 percent discount	Official evaluations of the I&M program are too unreliable and uncertain for policy-making, but that other data that has been gathered for other purposes imply that certain aspects of the program are approaching failure
Radian Corporation for the British Columbia Ministry of Environment	(1) Estimating emission reductions; (2) determining efficiency of the current program; (3) generating statistics; and (4) identifying needed program enhancements	Found that a test-only network is superior to a test-and-repair network. Found that vehicle failure rates dropped from 14 to 11 percent from 1993 to 1994 and concluded that the program had lasting impact on reducing emissions in the province.
California Inspection & Maintenance Review Committee	Evaluating the scientific basis for USEPA's 50 percent discount	Concluded that running a test-only compared to a test-and-repair has not been an important factor to an I&M programs effectiveness.
Sherman Engineering for the American Lung Association	Documenting reductions in emissions achieved from the Minnesota Vehicle Inspection Program	Tailpipe tests from 1991 through 1993 were used because they directly measured emissions reductions, and demonstrated that significant reductions in mobile source emissions were achieved.
Carnegie Mellon University	Evaluating the automotive testing policies of Pennsylvania	Concluded that IM 240 testing leads to negligible ozone reductions; test-and-repair is more expensive that test-only networks; and achieving emission reductions from mobile sources is more expensive than achieving similar reductions from stationary sources.
Georgia Institute of Technology	Evaluating the effectiveness of the Atlanta I&M program	The four counties with I&M programs have lower emission averages than the nine counties without I&M due to (1) a higher proportion of trucks in the nine counties compared to the four counties and (2) the absence of an I&M program in the nine counties.

** It appears that the studies regarding Minnesota deal with basic I&M programs, while the others are enhanced I&M or a combination of enhanced and basic I&M*

Terminating E-Check

Benefits

To the opponents of E-Check, the benefits of terminating the program are that they would not be subject to this form of vehicle testing anymore. However, to stay in compliance with CAAA 1990, the state would be required to find alternatives to E-Check. For the purposes of this paper, then, a benefit of terminating E-Check is the analysis of the potential alternatives that would have to occur to implement a new clean air strategy.

In testimony presented to the two House committees regarding E-Check, four alternatives have been discussed to varying depth. It should be noted that USEPA pollution modeling shows that enhanced I&M reduces more pollution when compared to the pollution reductions achieved by each alternative alone.[26] While the following sections describe general advantages and disadvantages of each alternative on its own, Table 5 summarizes advantages and disadvantages of some *combined* alternatives.

Alternative Fuels

Alternative fuels are a major component of USEPA's overall strategy for cleaning up the air. In fact, CAAA 1990 requires the USEPA to "...issue regulations that would require gasoline to be 'reformulated' so as to result in significant reductions in vehicle emissions of ozone-forming and toxic

[26] Jackie Radcliffe, National Conference of State Legislatures, memorandum, (December 5, 1996).

[27] USEPA, Office of Air and Radiation, *Reformulated Gasoline and Vehicle Performance*, http://www.epa.gov/OMSWWW/rfg.htm, (1996), p. 1.

air pollutants."[27] The following sections detail the two types of alternative fuel programs that were discussed to some length in committee.

Reformulated Gasoline

Reformulated gasoline (RFG) is "...a new blend of gasoline in which the composition has been altered to reduce polluting automobile emissions."[28] CAAA 1990 requires that all RFG have a minimum oxygen content of 2 percent by weight, to ensure complete combustion of the fuel, thereby reducing CO emissions.[29]

The oxygen content is achieved through the addition of methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE) or ethanol. RFG also contains lower concentrations of certain VOCs and is formulated to reduce hydrocarbons and air toxics.[30] According to USEPA, in 1995 RFG reduced VOC emissions and toxic air pollutants by 15 percent over 1990 conventional gasoline standards, the equivalent of taking 8 million cars of the road.[31] One of RFGs main advantages is that it can be used in existing vehicles without engine or fuel modifications. Additionally, it "...provides the best emissions benefits currently available for gasoline powered vehicles."[32]

In committee, some individuals testified about health problems that have been reported by persons using RFG, specifically that RFG containing MTBE may cause headaches, nausea and dizziness. On the other hand, numerous studies, by USEPA, various state health agencies and Yale and Rutgers universities, both before and after health concerns were raised, indicate that there is "...no verifiable evidence to support adverse health effects of MTBE on human health."[33]

Another potential drawback is the slight reduction in fuel economy that may occur, due to the reduced energy content in RFG. Some studies have concluded that "...vehicle performance may decrease by no more than 1 to 3 percent with the use of reformulated gasoline."[34] Other studies suggest that over time, the cleaner burning nature of the fuel may increase vehicle performance due to the reduction of engine deposits.

Testimony has been mixed on the issue of how switching to RFG would affect the price of gasoline at the pump. According to a spokesperson from the Ohio Petroleum Council, in a 15-state area from late 1994 through early 1996, on average RFG exceeded conventional gasoline by 4.3 cents. This 4.3 cents coupled with the 1 to 3 percent reduction in fuel economy, increases the cost to the consumer to approximately 7 cents per gallon.[35] According to OEPA testimony, in certain parts of the U.S. price increases up to 10 cents per gallon occurred in markets where RFG was used.[36]

Other studies suggest that initially the price of RFG is higher than conventional gasoline "...but actual experience in California, Rhode Island and 17 other states show that there is no differential between RFG and conventional gasoline after the market place stabilizes."[37]

In Jefferson County, Kentucky (Louisville), RFG is used in conjunction with enhanced I & M testing. With respect to the price at the pump, the price per gallon of RFG in Jefferson County is very similar to the counties surrounding Jefferson. According to a spokesperson from the Jefferson County Air Quality Board the market tends to even out the prices between conventional gas and RFG. Whenever the price differential rises above 2 cents, people will start to drive out of Jefferson County to put conventional gas in their car. Therefore, the market tends to keep RFG below this 2 cent differential.[38]

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[28] Hugh K. Wilson, Jackie Cummins, and Jeff Dale, *Alternative Fuels: A Case Study Report,* National Conference of State Legislatures, (March 1996), p. 16.

[29] *Ibid.*

[30] USEPA, *Oxyfuels Information Needs*, EPA/600/R-96/069, (May 1996), p. 1.

[31] Hugh K. Wilson, Jackie Cummins, and Jeff Dale, *Alternative Fuels: A Case Study Report*, National Conference of State Legislatures, (March 1996), p. 4.

[32] *Ibid*. p. 17.

[33] *Ibid.*

[34] *Ibid.*

[35] Robert Leidich, *Testimony before the House Energy and Environment Committee*, (April 11, 1996), p. 2.

[36] Donald R. Schregardus *Testimony before the House Finance Committee*, OEPA, (September 11, 1996), p. 2.

[37] William Johnson, *Testimony before the House Energy and Environment Committee*, Ohio Motorists Association, (May 9, 1996), p. 3-4.

[38] Dick Everhart, Jefferson County Air Quality Control Board, telephone interview, (October 15, 1996).

Reid Vapor Pressure Gasoline

Reid vapor pressure (RVP) is a measure of a fuel's volatility. When RVP gasoline is mentioned as a potential control measure to reduce VOCs, it is because this type of gasoline has a *lower* RVP (i.e. lower volatility) than conventional gasoline. The RVP of gasoline is lowered by removing the lightest components of the fuel such as butane.[39] A lower RVP gasoline affects the rate at which gasoline evaporates and emits volatile components. Therefore, when RVP gasoline (as compared to conventional gasoline) is used, there is a reduced rate of evaporation of the fuels (and thus, the volatile components) into the atmosphere. Lowering RVP in the summer months (during peak ozone production) offsets the accelerated effect that hot temperatures have on the evaporation of gasoline, which in turn decreases the amount of VOCs emitted into the atmosphere.[40] This reduces the VOCs that could potentially combine with NO_x and sunlight to form ground-level ozone.

RVP has a similar advantage to RFG as both fuels can be utilized in existing vehicles without any engine modifications. It also appears that RVP, at least initially, may be more easily distributed into new markets, because the refining process utilized for making RVP is less expensive than RFG. However, the RVP's role in the reduction of ozone forming pollutants may not be as effective. In fact, some studies suggest that when using RVP, nitrogen oxide (NO_x) and CO emissions may actually increase while the VOC reductions RVP achieves appear to vary by region of the country.[41]

Remote Sensing

Remote sensing is a term used for analyzing the emissions of a vehicle while it is driving on the road. Various methods for using remote sensing may include a device set up on the roadside which analyzes emissions from a passing car, or by aiming an infrared beam at tailpipe level while a computer in a nearby trailer analyzes the emissions. Proponents of remote sensing believe that this method best targets "gross polluters" by identifying those vehicles contributing the most to ground level ozone formation. According to *Science* magazine, "[t]he combination of remote sensing programs with IM programs to focus inspection resources on the higher emitting vehicles is an especially attractive strategy."[42]

There are some potential drawbacks in implementing an on-road emissions testing program, which utilizes remote sensing in conjunction with an I&M program. These drawbacks "...include public acceptance (the 'big brother syndrome'); and, for enforcement programs, maximizing the efficiency of identifying high emitters while minimizing errors of commission" (i.e. vehicles flagged as high polluters, but subsequently pass when tested at an I&M center).[43]

Currently, there are a few cities implementing pilot programs that employ various methods of remote sensing in conjunction with I&M testing. In Phoenix, Arizona, a 3 to 5 year program, sponsored by the Arizona Department of Environmental Quality, is utilizing Remote Emissions Sensors (RES) at over 100 sites. Vehicles that travel past these sensors, and are identified twice as high emitters, must report to an I&M testing station.[44] In Canada, the Ministry of Ontario is utilizing "...a specially constructed I&M facility that houses a 'triple RES' prescreening system and conventional IM240 lanes."[45] The RES system allows the vehicle to be prescreened at the facility for levels of CO, hydrocarbons and NO . The prescreening is performed as the vehicle is accelerating, cruising

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[39] David Korotney, Chemical Engineer *A Comparison Between Reformulated Gasoline and Low RVP Gasoline as Alternative Strategies for Meeting NAAQ Standards for Tropospheric Ozone,* memorandum, (March 22, 1996).

[40] USEPA, *Promulgation of Reid Vapor Pressure Standard; Michigan, Federal Register,* Vol. 61, Number 170, , (August 30, 1996), p. 45894.

[41] *Ibid.*

[42] *Achieving Acceptable Air Quality: Some Reflections on Controlling Vehicle Emissions*, *Science,* Vol. 261, p. 43, (July 2, 1993).

[43] M.D. Jack, et. al., *Remote and On-Board Instrumentation for Automotive Emissions Monitoring*, Society of Automotive Engineers, (August 1995), p. 7.

[44] *Ibid.*

[45] *Ibid.*

and decelerating. The data is analyzed and, if the vehicle passes, it is directed out of the facility. If the vehicle does not pass, it undergoes further testing at the facility.[46] These are two brief examples of utilizing remote sensing in conjunction with I&M testing in different ways, and provides some insight on where the future of remote sensing may lead.

On-Board Diagnostics

Another emission testing option is on-board diagnostics (OBD) that are built into the vehicle and may involve "...combinations of sensors, computer diagnostics, and warning lights that alert the driver and maintenance personnel to the problems that affect the emission control system."[47] According to CAAA 1990, extensive OBD regulations are to be built into new vehicles. With these requirements, "[m]anufacturers must include monitoring sensors to detect the malfunction of vehicle emission control systems and record them in the vehicle's computer."[48] Once a warning light is activated, the owner would realize they have an emission problem and make the necessary repairs to the vehicle. Obviously, the drawback to this option is that OBD loses its effectiveness when warning lights are ignored or disabled by the owner, and the vehicle continues to be driven, or the vehicle did not have OBD built into it during manufacturing.

Potentially, one way to combat this drawback is to utilize vehicle-to-roadside communications. For example, a vehicle would pass by an antenna that would read the information contained in the vehicle's OBD system. This type of system "...would enable enforcement officials to remotely and automatically detect vehicle out-of-compliance status."[49] It is difficult to determine, however, when the technology would be available to implement this type of program.

Consequences

If E-Check is terminated, USEPA would likely begin an 18-month sanction clock in Ohio. According to CAAA 1990, USEPA must levy sanctions if: (1) the state fails to submit an adequate SIP; (2) fails to make any submission required by the act; or, (3) fails to fully implement an approved SIP. Because Cincinnati is the only area in non-attainment, USEPA would likely focus first on Cincinnati, before Cleveland-Akron or Dayton-Springfield. Under CAAA 1990, the two sanctions are: (1) barring the approval of projects or awarding grants for transportation projects, unless they are for safety projects, mass transit, and certain other measures that would improve air quality and would not encourage single-occupancy vehicle capacity, and (2) requiring that new plants or plant modifications in the area obtain offsetting emissions reductions from other pollution sources at a ratio of at least 2-to-1. This means that if a new business wanted to open or an existing business wanted to modify its operations, it must find another source that would reduce its emissions by double the amount that the new or modified business would emit.

As mentioned previously, OEPA has asked USEPA for a one-year extension, in the Cincinnati region, for redesignation to attainment. Terminating E-Check may hinder the granting of the extension and create the possibility of Cincinnati being "bumped up" into the category of serious non-attainment. According to testimony from the Director of OEPA, if Cincinnati is bumped up into the serious non-attainment category, this region may face "...tighter restrictions on business growth, a mandatory enhanced vehicle emissions test with a higher repair cost, and possible restrictions on the construction of

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[46] *Ibid*. p. 7-8.

[47] *Achieving Acceptable Air Quality: Some Reflections on Controlling Vehicle Emissions*, *Science*, Vol. 261, (July 2, 1993), p. 43.

[48] Donald T. Davis, *Remote Monitoring of Emissions using On-Vehicle and Vehicle to Roadside Communications*, Lawrence Livermore National Lab, Society of Automotive Engineers, (August 1995), p. 1.

[49] *Ibid*.

major highway projects, even if the funds to build them are available."[50]

Offset Sanction

Again, because Cincinnati is the only region currently designated as non-attainment, it is the primary area where the 2-to-1 offset would have an impact on local economic development. However, it is also possible that this sanction could be implemented in the other two regions if the sanction clock expires and an alternative compliance strategy has not been implemented. If the program is repealed and USEPA imposes this sanction, it is likely that new businesses will avoid these areas and existing businesses may not modify their operations, based on the difficulty of finding such a significant reduction of emissions elsewhere in the area.

Highway Sanction

USEPA's sanctioning of federal highway funds would directly affect the construction of new capacity projects (or major new projects) in the three regions. This sanction can also indirectly affect the construction of future highway projects. The state's SIP identifies the emission reductions required by all categories of sources to meet the NAAQS. As a component of this plan, OEPA determines the "budget," or emissions threshold, to which transportation sources must conform. The means by which conformity to this threshold will occur is implemented through the State Transportation Improvement Plan (STIP), which is produced by ODOT in conjunction with regional MPOs. The STIP contains "...a quantitative analysis of the emissions that are generated by vehicles traversing the State's existing and future transportation system," to determine if these emissions conform to the air quality thresholds established in the State's air plan.[51] This conformity must be achieved for ODOT to gain approval for highway capacity improvement projects contained in the STIP.

Additionally, the current STIP that has been submitted to USDOT conforms to the budgets in the State's air plan, *due in large part to E-Check's projected reduction of emissions*. However, with regard to future STIP submittals, the termination of E-Check would make conformity to the thresholds in the State's air plan difficult to achieve. In other words, if the proposed 1998 STIP cannot achieve conformity to the thresholds in the air quality plan because E-Check has been terminated, then, unless other emissions reduction strategies have been implemented, highway capacity projects in the 1998 STIP proposal could not be implemented.

Contracts

If the state decided to terminate E-Check, the two testing companies would likely sue the state for breach of their contract. If such a suit were successful and the state was required to compensate the testing companies, it is possible that a settlement may include an amount up to the $350 million original estimated value of the contract, minus any amount already received by the testing companies for the performance of their services to date. To find evidence that such a suit is possible, one needs to look only as far as Pennsylvania, where the state repealed their vehicle testing program, and was sued by the testing company for $350 million. The suit was eventually settled for $142 million.

Additionally, revenue bonds in the amount of $64,380,000 were issued (by the Ohio Air Quality Development Authority) for purchase of land, construction of testing centers and purchase of equipment. These bonds, issued at 8.1 percent with a final

[50] Donald R. Schregardus, *Testimony before the House Finance Committee*, OEPA, (July 17, 1996), p. 3.

[51] Ohio Department of Transportation, Office of Planning *The Clean Air Act's Implications for ODOT, March 1996 Update*.

maturity at 2005, have no direct, legal link to Ohio and the state is not liable for the debt. It is unclear, though, how the revenue bonds would be paid back by the testing companies if E-Check is terminated. It may be assumed that the companies would seek to recover the cost of paying back the bonds through the terms of the suit.

Whether one believes that the threat of a law suit by the testing companies is a scare tactic or that the state should pay off the contract, from a budgetary perspective, this could potentially involve hundreds of millions of dollars, a large sum of money even when compared to Ohio's budget as a whole.

Policy Options and Ohio's Clean Air Strategy

As a synopsis of the above policy options and the state's clean air strategy, Table 5 summarizes the

TABLE 5: General Advantages and Disadvantages of Certain Control Measures

Control Measure[A]	General Advantages	General Disadvantages
Enhanced I&M	• Allows CAAA 1990 compliance in Cincinnati and Cuyahoga County • Due in large part to E-Check, USEPA redesignated Cleveland and Dayton as attainment, implying the program's effectiveness	• Unpopular in the non-attainment areas for a variety of reasons • Decreases clean air strategy flexibility because it does not allow for the implementation of other, potentially more effective, control measures
Basic I&M and RFG[b]	• Allows CAAA 1990 compliance in Cincinnati and Cuyahoga County • RFG can be used without engine modifications, and provides emission benefits, through the reduction of ozone forming pollutants	• There may be distribution difficulties associated with RFG, as well as potential health concerns and vehicle performance problems • The public would still be subject to vehicle emissions testing • Potential increase in the price of gas to the consumer
Basic I&M and RVP[b]	• Allows CAAA 1990 compliance in Cincinnati and Cuyahoga County • Lower RVP gas can be used without engine modifications, and may be more easily distributed into a market	• May increase levels of NOx and CO, while VOC reductions vary according to the region of the country • The public will still be subject to vehicle emission testing • Potential increase in price of gas to the consumer
On-Board Diagnostics and I&M[c]	• Allows CAAA 1990 compliance in Cincinnati and Cuyahoga County • May better target high pollutant emitting vehicles • OBD regulations are being built into current vehicles	• The public will still be subject to vehicle emission testing • Is ineffective if driver ignores or disables signals, or the car does not have OBD built in • Potential "big brother" syndrome • Technology to implement is still in the future, especially with regard to outside monitoring of a vehicle's OBD
Remote Sensing and I&M[c]	• Allows CAAA 1990 compliance in Cincinnati and Cuyahoga County • May better target high pollutant emitting vehicles • Pilot programs are currently underway to gauge the effectiveness of this control measure	• The public will still be subject to vehicle emission testing • Potential "big brother" syndrome • Technology for implementation is still in the future, especially in terms of VOC monitoring

[A] Any control measure used would have to be approved by USEPA.
[B] Strategies discussed in OEPA testimony.
[C] Most studies analyzed for this paper suggest OBD and remote sensing are most effective with some form of I&M.

advantages and disadvantages of potential pollution control measures.

The summaries in Table 5 do not attempt to determine how effective each strategy would be in actually reducing pollutants, as that is beyond the scope of this paper. Instead, it is intended to layout the general issues involved with each control measure. Trying to determine the state's strategy on how to best comply with the federal clean air strategies is complicated to say the least. This paper has attempted to touch on the relevant issues involved. The one concrete conclusion that can be drawn is the need for further study of pollution control measures. Any future federal and state pollution control legislation must provide enough flexibility to implement different control measures without penalty, and permit the use of new pollution control measures as they are developed.

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