MAPI Manufacturers Alliance

ECONOMIC REPORT

ER-707

September 2010

Economic Implications of EPA's Proposed Ozone Standard

By:
Donald A. Norman
Economist
danorman@mapi.net

1600 Wilson Boulevard, Suite 1100, Arlington, Virginia 22209-2594 Phone: 703.841.9000 Fax: 703.841.9514 mapi.net

Economic Implications of EPA's Proposed Ozone Standard*

I. Principal Findings

There are a number of significant economic impacts associated with EPA's proposed primary ozone standard of 60 ppb:

- The annual attainment cost is estimated to be $1.013 trillion between 2020 and 2030 (in 2010 dollars). This is equivalent to 5.4 percent of projected constant dollar gross domestic product (GDP) in 2020. The present value of attainment costs over this period amounts to $7.1 trillion (based on a discount rate of 7 percent).
- GDP would be reduced by $676.8 billion in 2020 (in 2010 dollars), an amount that represents 3.6 percent of projected 2020 GDP in the baseline case.
- Together, annual attainment costs and reduced GDP in 2020 total $1.7 trillion.
- Total U.S. job losses attributable to a 60 ppb ozone standard are estimated to rise to 7.3 million by 2020, a figure that is equal to 4.3 percent of the projected 2020 labor force.
- The marginal cost of attaining the primary ozone standard rises rapidly as the ozone standard becomes more stringent.

II. Background

In December 2007, the Manufacturers Alliance/MAPI released a report on the U.S. Environmental Protection Agency's (EPA) proposal to change the ozone standard from the equivalent of 84 parts-per-billion (ppb) to 70 ppb.[1] The report estimated that the present value of EPA's projected cost stream of attaining this new standard ranged between $1.1 trillion (based on a discount rate of 7 percent) to $1.4 trillion (based on a discount rate of 3 percent). The full societal cost would be even larger. Further, the EPA's Regulatory Impact Analysis (RIA) claimed that 80 percent of the required reduction in emissions would come from large manufacturers even though previous, and very expensive, restrictions had left so few remaining emissions that there was no chance that any more than a small share of the emission reductions required by the new standard could be provided by the manufacturing sector. Consequently, achieving the tighter standard would require significant and costly reductions throughout the rest of the economy, especially since the new standard would expand the number of areas in the country needing to control precursor emissions.

In January 2010, the EPA proposed to reduce the ozone standard to somewhere between 60 and 70 ppb. The marginal cost of ozone standards rises rapidly as ozone standards become more stringent. Thus, moving from a currently implemented standard of 84 ppb to 60 ppb is likely to be even more expensive. The United States economy in general and the manufacturing sector in particular will bear the cost of a more stringent ozone standard.

This report is based in part on earlier work by NERA Economic Consulting that provided estimates of the attainment costs associated with a 60 ppb standard, the consequent reduction in state gross product, and employment impacts for 11 separate states.[2]

III. Methodology

The cost estimates presented in the 2007 MAPI study were based on net present value calculations of the annual attainment cost as estimated by the EPA in its RIA of the proposed move to a 70 ppb standard. The calculated impacts for the 11 states in NERA's sample were based on actual ozone concentrations and estimates of the needed reductions in Nitrogen Oxides (NOx) and volatile organic compounds (VOCs) necessary to achieve a standard of 60 ppb.

While the states in the NERA study included both large and small states with varying levels of manufacturing and other activities, the extent to which the results in these states are representative of the entire United States is unclear. A number of variables associated with ozone precursors were tested to model the NERA calculations of annual attainment costs, job losses and the reduction in state gross product in the 11 states in its study. The level of manufacturing activity and petroleum refining in each state were the two variables that

[1] Garrett A. Vaughn, *How Much Will Americans Pay to Comply With EPA's Proposed Tighter Ground-Level Ozone Standard*? Manufacturers Alliance/MAPI, ER-462e, December 2007. EPA eventually promulgated a 75 ppb standard in 2008.

[2] NERA Economic Consulting, *Estimated Economic Impacts of EPA 2010 Ozone Proposal,* 2010. The states included in the study were: Arkansas, Colorado, Illinois, Missouri, New Hampshire, New Mexico, Ohio, Pennsylvania, Tennessee and West Virginia.

*This report received financial and technical support from the National Association of Manufacturers and the American Petroleum Institute which made research and publication possible.

had the best explanatory value in predicting the attainment costs found by NERA in the detailed studies of 11 states.[3]

The models that provided the best fit of the NERA data were based on the levels of refining and manufacturing activity. For attainment costs, the estimated model was:

(1) AC_i = constant + $ß_1 Refining_i$ + $ß_2 Manufacturing_i$

AC_i is the annual attainment cost in state i starting in 2020, $Refining_i$ is the refinery capacity throughput in state i as of January 1, 2010, and $Manufacturing_i$ is manufacturing activity in state i as measured by the level of manufacturing gross state product. Data on refinery capacity, as measured by millions of annual barrels of throughput, are from the Energy Information Administration.[4] Data on manufacturing GDP by state in 2008, as measured in billions of dollars, are from the Bureau of Economic Analysis. The results are shown the Table 1.

Table 1
2020 Attainment Costs

Variable	Coefficient	Standard Error
Constant	-4.277	3.36
Refining	0.148	0.024*
Manufacturing	0.176	0.0935**
R-Squared	0.94	

Based on 11 observations
*Significant at the 1 percent level
**Significant at the 10 percent level

Source: Manufacturers Alliance/MAPI

Even though there were just 11 observations, the model yielded an extremely good fit of NERA's data on attainment costs. Using the estimated coefficients, the attainment costs for the 11 states were calculated and compared with the results from the NERA study. The results, shown in Figure 1 (on the following page), give confidence in the estimate of the nationwide assessment.

The second model used job losses in 2020 (as calculated by NERA) as the dependent variable:

(2) $Jobs_i$ = constant + $ß_1 Refining_i$ + $ß_2 Manufacturing_i$

$Jobs_i$ is the number of job losses in state i in 2020 as calculated by NERA. As shown in Table 2 and Figure 2 (on the following page), the model did a very good job at replicating the NERA results.

Table 2
2020 Job Losses

Variable	Coefficient	Standard Error
Constant	8201.81	11718.1
Refining	-806.07	83.2*
Manufacturing	-1566.9	326.2*
R-Squared	0.98	

Based on 11 observations
* Significant at the 1 percent level
Source: Manufacturers Alliance/MAPI

The final model incorporated NERA's estimates of the reduction in state gross product in 2020 as the dependent variable:

(3) SGP_i = constant + $ß_1 Refining_i$ + $ß_2 Manufacturing_i$

SGP_i is the NERA's estimate of the reduction in state gross product in state i in 2020. As shown in the Table 3 and Figure 3 (on page 4), the model again did a very good job in fitting the NERA data.

Table 3
Reduction in State Gross Product (2020)

Variable	Coefficient	Standard Error
Constant	0.584	1.67
Refining	-0.080	0.011*
Manufacturing	-0.121	0.046**
R-Squared	0.95	

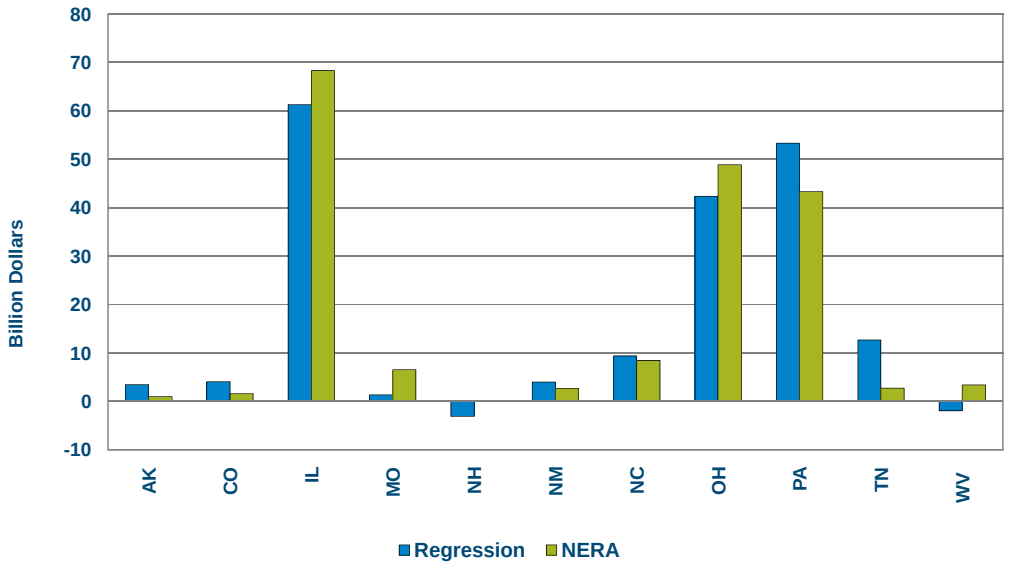
Based on 11 observations
*Significant at the 1 percent level
**Significant at the 5 percent level

Source: Manufacturers Alliance/MAPI

[3] It is important to note, though obvious, that many other factors contribute to ozone levels, including weather patterns that promote the migration of precursor chemicals across borders.

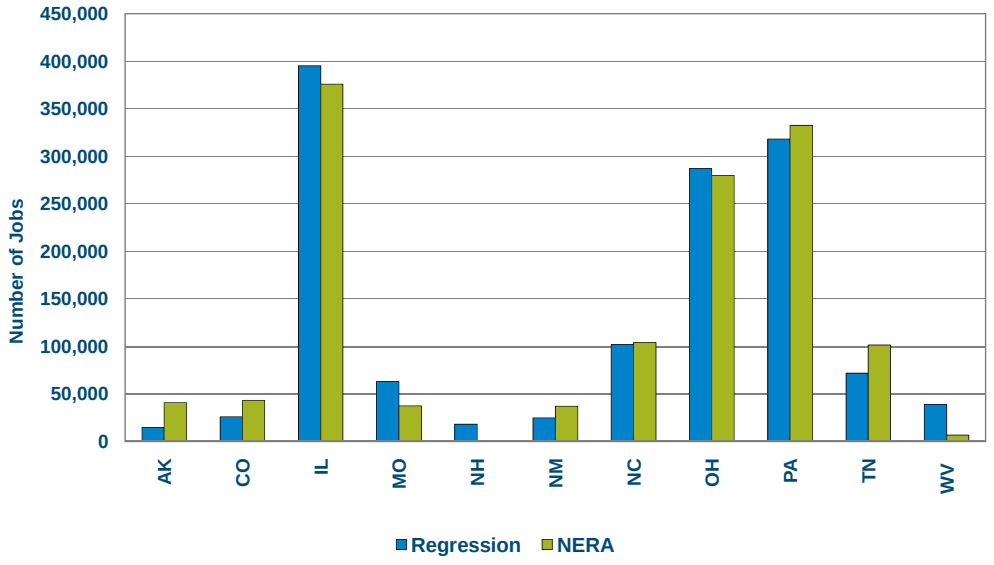
[4] Energy Information Administration, Department of Energy, *Refinery Capacity 2010*.

Figure 1. Attainment Costs: Regression Forecast vs. NERA Study



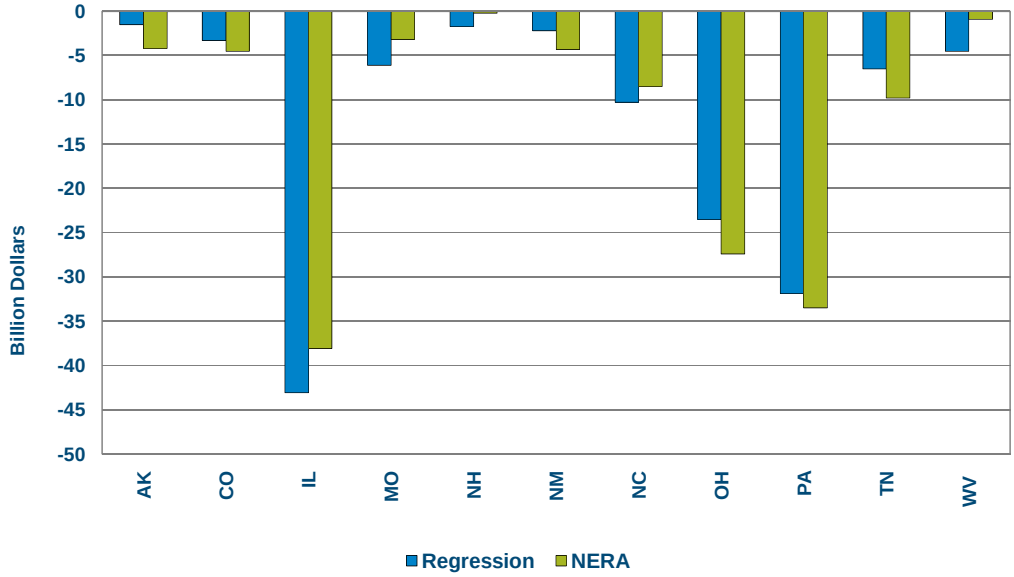
Source: Manufacturers Alliance/MAPI

Figure 2. Job Losses (2025): Regression Forecast vs. NERA Study



Source: Manufacturers Alliance/MAPI

Figure 3. State Gross Product: Regression Forecast vs. NERA Study



Source: Manufacturers Alliance/MAPI

IV. Economic Impacts of a 60 ppb Ozone Standard

The coefficients derived from the regression models were used to calculate estimates of attainment costs, job losses and the reduction in GDP for the entire United States. The results are presented in Table 4. Not surprisingly, the impacts of a 60 ppb ozone standard are largest in states like California, Texas, Louisiana, Ohio, Illinois, and Indiana where there is considerable manufacturing and refining activity.

Attainment Costs

The annual attainment costs beginning in 2020 were estimated to be $1.013 trillion (in 2010 dollars). By way of comparison, the total U.S. attainment costs in 2020 were 5.4 times the calculated impact in the 11 states in the NERA study. These impacts are larger than those suggested by a simple extrapolation based on the ratio of states in the NERA sample to all 50 states.[5] The reason why the multiple is higher is that the impact of a 60 ppb ozone standard would affect states like California, Texas and Louisiana particularly hard. These states were not among the 11 states in the NERA sample.

What does $1.013 trillion mean? GDP in 2010 will approximate $14.6 trillion. Assuming an average annual growth rate of 2.5 percent between 2010 and 2020, real GDP (in 2010 dollars) would rise to $18.7 trillion in 2020. The attainment cost impact of a 60 ppb ozone standard thus would represent 5.4 percent of GDP in 2020. Further, attainment costs are the tip of the iceberg. As Dr. Vaughn pointed out in his paper, it is the present value of the stream of attainment costs that provides a true measure of the impact of the proposed standards. Using a discount rate of 7 percent (following Vaughn) and a cost stream of 10 years, the present value of the attainment costs comes to $7.1 trillion.

Job Losses

The Bureau of Labor Statistics (BLS) projects a total labor force of 166.9 million in 2018. Assuming the labor force continues to grow at the annual rate of 0.8 percent used by the BLS in its labor force projections beyond 2018, the labor force would climb to 169.6 million in 2020. The estimated loss of 7.3 million jobs in 2020 represents 4.3 percent of this projected labor force.

[5] A simple extrapolation of NERA's results based on the fact that these 11 states represented 22 percent of the 50 states would have resulted in a multiple of 4.5. The fact the multiples based on regression analysis are larger can be attributed to the fact that states like California, Texas and Louisiana were not included in NERA's sample.

Table 4
Impacts of a 60 ppb Ozone Standard*

State	Annual Attainment Costs Beginning in 2020	Reduction in State Gross Product (2020)	Total Attainment Cost and Reduction in GDP (2020)	Job Losses (2020)
	(Billions of Constant 2010 Dollars)			
Alabama	7.9	6.8	14.7	75,918
Alaska	13.3	8.9	22.1	87,794
Arizona	-0.8	1.8	1.0	22,396
Arkansas	3.5	4.0	7.5	44,369
California	132.5	77.9	210.3	846,108
Colorado	4.1	4.4	8.5	47,309
Connecticut	0.8	2.9	3.7	37,026
Delaware	-3.5	0.0	-3.5	(1,047)
District of Columbia	-4.2	-0.6	-4.8	(7,899)
Florida	2.0	3.8	5.8	47,769
Georgia	3.4	4.7	8.0	59,621
Hawaii	4.1	4.0	8.1	38,229
Idaho	-3.4	0.0	-3.3	(52)
Illinois	61.3	36.8	98.1	396,332
Indiana	31.2	20.2	51.3	223,399
Iowa	0.7	2.8	3.5	35,939
Kansas	17.5	11.6	29.2	121,711
Kentucky	14.1	10.1	24.2	109,443
Louisiana	173.4	96.2	269.7	983,833
Maine	-3.3	0.1	-3.2	407
Maryland	-1.6	1.3	-0.3	15,606
Massachusetts	1.9	3.6	5.5	46,338
Michigan	12.8	10.2	23.0	122,108
Minnesota	24.1	15.6	39.7	166,596
Mississippi	19.6	12.6	32.2	129,967
Missouri	1.4	3.3	4.7	42,014
Montana	6.5	5.3	11.8	51,387
Nebraska	-2.5	0.6	-1.9	7,253

State	Annual Attainment Costs Beginning in 2020	Reduction in State Gross Product (2020)	Total Attainment Cost and Reduction in GDP (2020)	Job Losses (2020)
	(Billions of Constant 2010 Dollars)			
Nevada	-3.0	0.3	-2.7	2,263
New Hampshire	-3.1	0.2	-2.9	2,011
New Jersey	5.7	6.0	11.7	72,757
New Mexico	4.0	4.0	8.0	40,065
New York	7.9	7.8	15.7	100,129
North Carolina	9.5	8.9	18.3	113,950
North Dakota	-0.5	1.5	1.0	13,892
Ohio	42.4	26.8	69.2	296,952
Oklahoma	28.0	17.2	45.2	177,003
Oregon	1.0	3.1	4.1	39,121
Pennsylvania	53.3	32.5	85.8	351,207
Rhode Island	-3.5	0.0	-3.5	(916)
South Carolina	0.2	2.5	2.6	31,242
South Dakota	-3.7	-0.2	-3.8	(2,661)
Tennessee	12.7	9.6	22.4	108,953
Texas	290.0	162.2	452.2	1,690,205
Utah	7.0	5.8	12.8	60,860
Vermont	-3.8	-0.2	-4.0	(3,656)
Virginia	5.6	5.6	11.2	66,058
Washington	36.7	22.3	59.0	234,055
West Virginia	-1.9	0.9	-1.1	8,639
Wisconsin	6.2	6.4	12.6	78,647
Wyoming	5.6	4.8	10.4	46,451
Total U.S.	$1,012.9	$676.8	$1,689.7	7,277,097

*Variation around the regression estimates account for few instances of negative attainment costs and negative job losses (i.e., job gains). The negative attainment costs and job losses are relatively small. Further, it is plausible that smaller states without refineries and much manufacturing activity might experience net job gains attributable to a 60 ppb ozone standard if jobs are shifted out of states with high attainment costs.

Source: Manufacturers Alliance/MAPI

GDP

Applying the estimated coefficients to the data on the refining capacity and manufacturing activity in every state, the aggregate reduction in GDP in 2020 was found to be $676.8 billion in constant 2010 dollars.[6] If aggregate GDP were to increase by an average of 2.5 percent per year in the baseline case (in which there is no new ozone standard) between 2010 and 2020, constant dollar GDP would total $18.9 trillion in 2020. A reduction in baseline GDP of $676.8 billion represents 3.6 percent of the baseline GDP.

The present value of lost GDP, assuming that the reduction in state gross product averages $676.8 billion per year between 2020 and 2030, equals $4.75 trillion based on a discount rate of 7 percent. This would bring the total present value of the cost of the proposed ozone standards (attainment costs plus foregone GDP) to $11.9 trillion.

V. The Marginal Cost of Ozone Reductions

The estimates presented above raise the question as to how they could be so large. The attainment costs are high because achieving 60 ppb ozone standard would be very difficult. As Dr. Vaughn pointed out in his paper, the marginal cost of incremental reductions in ozone levels increases very rapidly as the standard is tightened. He presented estimates from the EPA 2007 RIA (reproduced in Table 5) on the NOx emission reductions needed to attain various ozone standards. The estimates show that moving from a standard of 84 ppb to 79 ppb requires 102,000 tons of NOx reductions, or 20,400 tons per 1 ppb reduction in emissions. Moving from 75 ppb to 70 ppb requires a reduction of 683,000 tons, or 136,600 tons per 1 ppb reduction in emissions. Finally, if the ozone standard were set at 65 ppb, the required reduction in emissions is estimated to be 247,000 tons per 1 ppb, or 12 times the reduction of tons per ppb that was required to move from an ozone standard of 84 ppb to 79 ppb.

Initial reductions in ozone are relatively less expensive because the reductions can be achieved by using existing technologies ("known controls") to reduce ozone precursors. As standards are tightened, more expensive technologies are required and at some point new technologies ("unknown," yet-to-be-developed controls) are presumed to emerge and then be implemented.

Table 5
NOx Reductions Required for Alternative Ozone Standards*

(A) Starting Ozone Level	(B) Ending Ozone Level	(C) Required NOx Ton Reductions	(D) NOx Ton Reductions per ppb Ozone Reduction
84 ppb	79 ppb	102,000	20,400
79 ppb	75 ppb	219,000	54,750
75 ppb	70 ppb	683,000	136,600
70 ppb	65 ppb	1,235,000	247,000

Source: Adapted from Vaughn (2007). Based on EPA 2007 RIA, Chapter 4, p. 12.
*The reductions apply nationwide with the exception of "two areas of California."

VI. Conclusion: Tighter Ozone Standards and the Manufacturing Sector

The projections of the national economic impacts of a 60 ppb ozone standard, based on the detailed analysis of the economic impacts in 11 states by NERA, suggest that EPA has significantly underestimated the costs of a 60 ppb ozone standard. Given these impacts, the EPA Administrator will now need to make a policy judgment as to whether the benefits of EPA's proposed primary ozone standards compel lowering ozone National Ambient Air Quality Standards (NAAQS). Previous MAPI research has shown that EPA regularly overestimates the benefits of proposed clean air regulations.[7] A tendency toward underestimating costs while overestimating benefits makes it is easier to justify new standards.

It is clear that the manufacturing sector would be seriously affected by EPA's proposal for stricter ozone standards. Production costs would be further elevated while domestic markets would grow more slowly. The net result would likely be another inducement for companies to move operations offshore so as to avoid bearing the attainment costs and to seek to capture markets in faster growing parts of the world. To assist the EPA Administrator in her policy decision regarding new ozone standards, the EPA staff should more accurately quantify the costs of attainment, the likely reduced economic growth, and the jobs that would be put in jeopardy.

[6] NERA calculated that the state gross products in the 11 states it examined would be reduced by a total $131 billion in 2020.

[7] Garrett A. Vaughn, *Regulatory Sleight of Hand: How the EPA's Benefit-Cost Analyses Promote More Regulation and Burden Manufacturers,* Manufacturers Alliance/MAPI, ER-606e, April 2006.