OAR Box 1149

Prepped by Candice Davis

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ANALYSIS OF POTENTIAL IMPACT
OF CLASS II NO_X INCREMENTS
ON OZONE REDUCTIONS

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NONCRITERIA POLLUTANT PROGRAMS BRANCH
OFFICE OF AIR QUALITY PLANNING AND STANDARDS
U.S. ENVIRONMENTAL PROTECTION AGENCY

ANALYSIS OF IMPACTS OF ALTERNATIVE NITROGEN DIOXIDE (NO_2) INCREMENTS ON OZONE (O_3) CONCENTRATIONS

Background

Prior to proposal of the Environmental Protection Agency's (EPA's) NO_2 increments for prevention of significant deterioration (PSD) areas, the Office of Management and Budget (OMB) expressed an interest in knowing if nitrogen oxides (NO_x) controls resulting from possible NO_2 increment restrictions could increase O_3 concentrations in some O_3 nonattainment areas. This comment was based on studies which have indicated that, under certain circumstances, reducing NO_2 concentrations in the atmosphere can cause peak O_3 concentrations to increase.

Implementation of the NO_2 increments will not reduce NO_2 concentrations. It will merely place a lid on future NO_2 increases. However, since it is possible that limiting future NO_2 increases can also limit future O_3 reductions, a fairly crude analysis was conducted to estimate the potential for the proposed Class II NO_2 increment to be exceeded on an areawide basis. Initially, for those areas where the proposed Class II increment was estimated to be exceeded, a follow-up analysis was planned to determine if a less stringent increment would have a more beneficial impact on O_3 reductions. However, since few exceedances of the Class II were projected, the followup ozone analysis was not completed as planned.

Methodology

The first step in the analysis was to project growth in NO_2 air quality to estimate those major urban areas to be affected by the proposed Class II increments. Two separate emissions projections were done. The first projections were based on average national growth rates. A follow-up analysis was performed using more city-specific emissions data, primarily with respect to mobile source emissions. The results of each study are described below.

Initial Study Using Nationwide Projections Data

Initially, NO_2 air quality data for 12 major urban areas were obtained from the 1986 National Air Quality and Emissions Trends Report (see Attachment 1). These cities were selected, since they were major urban areas and because these cities had the necessary input data (i.e., NO_2, O_3, and nonmethane organic compound (NMOC) NO_x ratio data) to do the type of O_3 modeling analysis using the Empirical Kinetic Modeling Approach that was initially planned to estimate the impact of the increment on O_3 levels.

Using general NO_x growth projection information developed by EPA for the proposed NO_x Paris Protocol (see Attachment 2), 1986 annual NO_2 air quality concentrations were proportionally increased (using a "roll forward" approach) to the years 2010 and 2020. Separate nationwide growth rates were used for a) stationary sources and b) mobile and area sources. The split between stationary and mobile/area source emissions for each of the 12 cities was obtained from data submitted by States in the State implementation plans (SIP's) and summarized in the 1982 Ozone SIP Data Base Status and Summary Report. Attachment 3 presents the annual air quality concentrations estimated to occur in 2010 and 2020 for each area based on these data.

Results of Initial Analysis

The analysis indicates that future NO_x emissions increases to the year 2010 would not result in an exceedance of the proposed Class II NO_x increment. Projections to the year 2020 indicate that only 1 of the 12 cities would exceed the proposed Class II NO_2 increment (25 ug/m^3). The main reason for this is that mobile source emissions are expected to decline until the mid-1990's and then increase only slowly thereafter. These relatively low emissions rates are important, since mobile source emissions typically constitute 50-60 percent of the total NO_x emissions in an urban area.

While the results are somewhat surprising, they are believed to be conservative (i.e., they overestimate NO_2 predicted concentrations) for the following reason. The NO_x emissions released from elevated stacks from major new stationary sources (e.g. power plants which generally will not be located in urban areas) will generally not contribute to measured NO_2 air quality concentrations in urban areas as high as estimated. Because of their magnitude and proximity, NO_x emissions from ground level sources (i.e., mobile and area sources) are believed to be more important in contributing to ambient NO_2 concentrations measured at NO_x monitors in urban areas.

Since this analysis projects that the 25 ug/m^3 NO_2 Class II increment will only rarely be exceeded, even in the year 2020, the basic question of whether a larger NO_x increment would have a more beneficial impact on O_3 levels appears irrelevant. As such, the follow-up analysis of looking at less stringent increments (i.e., 35 ug/m^3, 50 ug/m^3) that was originally planned was not conducted. Instead, as explained below, a follow-up analysis using more city-specific emissions data was performed to confirm or reject the results of the analysis just described.

Follow-up Analysis Using More City-specific Data

Because the growth assumptions used in the analysis described above are critical, it was suggested by OMB that more city-specific data be used in making these projections. They suggested that data used by EPA's Office of

Mobile Sources in a recent analysis also be used in this analysis for consistency. As a result, a follow-up analysis using the Office of Mobile Sources data base (which includes city-specific vehicle fleet information) was performed.

The the followup analysis was performed in a similar manner to that described in the first analysis. Air quality data from 1986 were used along with emissions data in a proportional model, in a "roll forward" approach, to estimate ambient annual NO_2 concentrations in various projection years. Thirty cities were included in this analysis. Since the results are somewhat dependent upon the length of the projected time period, it was generally agreed prior to the analysis that projections up to the year 2010 were appropriate. Four different growth scenarios were used as described below.

Scenario 1

Only growth (after controls) in mobile source emissions was considered. No growth was assumed for stationary sources, based on the assumption that elevated stationary sources probably have little impact on ground level NO_2 monitors in urban areas.

Scenario 2

Mobile source growth was considered in the same manner as in Scenario 1. Growth of stationary sources was assumed at 1.3 percent, compounded annually.

Scenario 3

Mobile source growth was considered in the same manner as in Scenario 1. Growth of stationary sources was assumed at 3.5 percent, compounded annually.

Scenario 4

Mobile source growth was considered in the same manner as in Scenario 1. Growth in emissions from stationary sources was assumed at 1.75 percent, compounded annually.

Results

Projections of the number of 30 cities that are estimated to exceed the Class II increments in various years for each scenario are listed below. As mentioned above, projections to the year 2010 are believed to be more reasonable than those made for later years.

Scenario	Number Of 30 Cities Where Growth Could Exceed Class II Increment	
	2010	2020
1	0	0
2	0	0
3	16	25
4	0	15

Only Scenario 3 projects that any city will exceed the proposed Class II increment of 25 ug/m^3 increment by the year 2010. However, the growth assumptions for this scenario are believed to be unrealistic and outdated. The assumptions of a 3.5 percent growth rate were originally made in the late 1970's. More recent stationary source/growth projections made by EPA for the NO_x Paris Protocol analysis are believed to be more representative and are genarally consistent with those contained in Scenario 4.

Conclusions

Based on the two analyses, described above, it does not appear that the proposed Class II NO_2 increment of 25 ug/m^3 will be exceeded in urban areas using current growth assumptions, at least through 2010. For this reason, it does not appear that a less stringent Class II increment (i.e., greater than 25 ug/m^3) would have any different impact on O_3 in the foreseeable future than the proposed Class II increment.

It should be noted that the type of analysis that was performed was relatively crude, using a fairly simplistic modeling approach and national growth rate information projected over a 25-35 year time period. As such, the analysis should be viewed as providing only a general sense of what would likely occur, rather than an absolute prediction. Also, given that some cities are growing faster than the national average, it is reasonable to conclude that continued high growth in such areas could cause higher NO_2 concentrations then estimated and possibly violations of the increment.

Attachment 1

CITIES WHICH ARE NONATTAINMENT FOR OZONE [1]

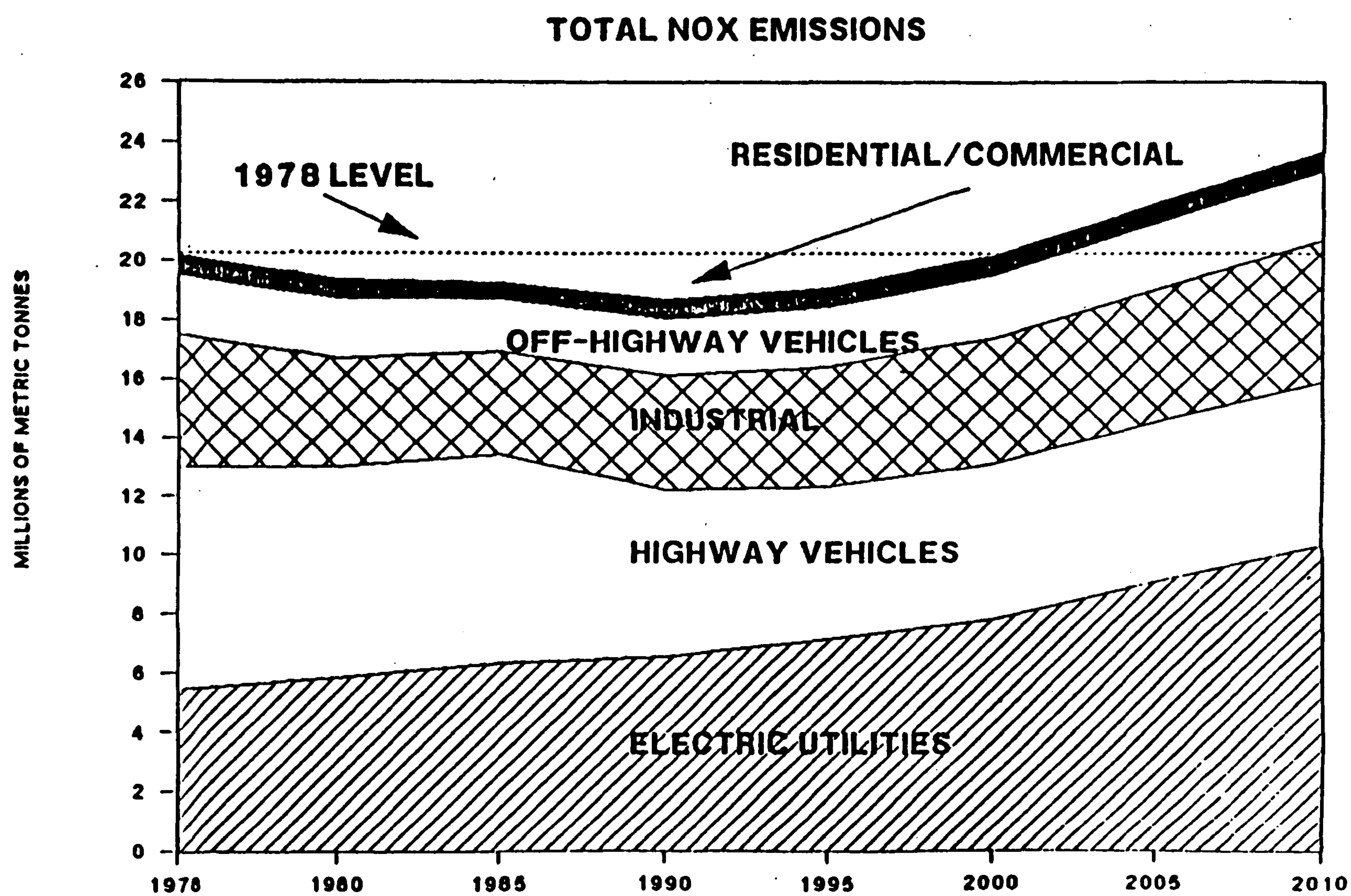
Location		NO_2 [2] concentration (ppm)	NAAQS consumed (percent)	NAAQS available (percent)	Ozone (O_3) [2] concentration (ppm)
I. Cities which could not be impacted by a 25 ug/m^3 or larger increment					
Los Angeles		0.061	115	--	0.34
New York		0.049	92	08	0.16
Denver		0.047	89	11	0.13
Anaheim-Santa Ana		0.045	85	15	0.22
Riverside-San Bernardino		0.042	79	21	0.22
Chicago		0.041	77	23	0.12
II. Cities which could utilize an increment greater than 25 ug/m^3 (0.013ppm)					
Baltimore	*	0.036	68	32	0.15
Philadelphia	*	0.036	68	32	0.15
St. Louis	*	0.035	66	34	0.16
Washington	*	0.035	66	34	0.14
Salt Lake City-Ogden		0.035	66	34	0.16
San Diego		0.034	64	36	0.19
Boston	*	0.033	62	38	0.12
Pittsburgh		0.033	62	38	0.12
San Jose		0.033	62	38	0.12
Newark		0.032	60	40	0.13
Louisville		0.032	60	40	0.17
Fresno		0.032	60	40	0.17
Jersey City		0.032	60	40	0.13
Atlanta	*	0.031	58	42	0.16
Cincinnati	*	0.029	55	45	0.13
Houston	*	0.028	53	47	0.20
Cleveland	*	0.027	51	49	0.12
El Paso	*	0.024	45	55	0.16
Baton Rouge	*	0.022	42	58	0.13
Dallas	*	0.016	30	70	0.16

Comments: 1. Data taken from 1986 Trends Report

2. NO_2 NAAQS = 0.053 ppm (100 ug/m^3)
Proposed NO_2 Increment = 0.013 ppm (25 ug/m^3)
O_3 NAAQS = 0.12 ppm

* Cities selected for further evaluation. These are cities for which EPA has both NO_2 and O_3 data and NMOC/NO_2 ratio data.

Attachment 2



Attachment 3

INCREMENT CONSUMPTION PROJECTION [1]

Location	Source Ratio Sta.	Source Ratio Mobile & Area	NO2 Concentration (ppm) 1986	Allowed by Proposed Increment [2]	2010	2020
Baltimore	47	53	0.036	0.049	0.043	0.049
Philadelphia	45	55	0.036	0.049	0.042	0.048
St. Louis	68	32	0.035	0.048	0.045	$\boxed{0.053}$
Washington	35	65	0.035	0.048	0.039	0.044
Boston	37	63	0.033	0.046	0.037	0.042
Atlanta	59	41	0.031	0.044	0.038	0.044
Cincinnati	50	50	0.029	0.042	0.035	0.039
Houston	55	45	0.028	0.041	0.034	0.039
Cleveland	39	61	0.027	0.040	0.031	0.034
El Paso	18	82	0.024	0.037	0.025	0.027
Baton Rouge	55	45	0.022	0.035	0.027	0.030
Dallas	21	79	0.016	0.029	0.017	0.018

Comments: [1] Growth based on data contained in a briefing to the Administrator on the proposed NO_x Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution (LRTAP), commonly called the NO_x Protocol or the Paris Protocol. Briefing paper prepared by OPAR and dated April 1, 1988.

[2] Proposed NO_2 Class II increment = 0.013 ppm (25 ug/m^3)

Note: ONE NO_2 INCREMENT EXCEEDANCE (1986 concentration plus the increment) IS PROJECTED FOR 2020. NONE ARE EXPECTED FOR 2010.

Attachment 4

Projected Ambient NO_2 Concentrations

Scenario 1: Mobile Source Growth Only

Urban Area		Measured 1986 Air Quality	Projected 2010 Air Quality	Projected 2020 Air Quality
Allentown	PA	0.021	0.024	0.027
Atlanta	GA	0.031	0.035	0.041
Baltimore	MD	0.036	0.046	0.055
Baton Rouge	LA	0.022	0.027	0.031
Boston	MA	0.034	0.039	0.045
Charlotte	NC	0.022	0.025	0.029
Chicago	IL	0.042	0.050	0.058
Cincinnati	OH	0.029	0.034	0.039
Cleveland	OH	0.027	0.031	0.036
Dallas-Ft. Worth	TX	0.016	0.019	0.022
Greater Conn.		0.022	0.024	0.028
Houston	TX	0.028	0.034	0.038
Huntington	WV	0.016	0.019	0.023
Indianapolis	IN	0.020	0.024	0.027
Lexington	KY	0.018	0.022	0.025
Louisville	KY	0.033	0.040	0.046
Memphis	TN	0.024	0.029	0.034
Miami	FL	0.019	0.022	0.026
Milwaukee	WI	0.028	0.032	0.038
New York	NY	0.049	0.055	0.064
Norfolk	VA	0.018	0.022	0.026
Philadelphia	PA	0.036	0.041	0.047
Pittsburgh	PA	0.033	0.038	0.043
Portland	OR	0.019	0.024	0.028
Providence	RI	0.025	0.028	0.032
Richmond/ Petersburg	VA	0.022	0.025	0.030
St. Louis	MO	0.035	0.041	0.048
Tampa/ St. Petersburg	FL	0.021	0.024	0.028
Tulsa	OK	0.021	0.025	0.029
Washington	DC	0.035	0.042	0.049

NO_2 National Ambient Air Quality Standard is 0.053 ppm

Attachment 5

Projected Ambient NO_2 Concentrations

Scenario 2: Stationary Source Growth (1.3%)

Urban Area		Measured 1986 Air Quality	Projected 2010 Air Quality	Projected 2020 Air Quality
Allentown	PA	0.021	0.027	0.031
Atlanta	GA	0.031	0.037	0.043
Baltimore	MD	0.036	0.047	0.055
Baton Rouge	LA	0.022	0.029	0.033
Boston	MA	0.034	0.041	0.047
Charlotte	NC	0.022	0.026	0.030
Chicago	IL	0.042	0.053	0.061
Cincinnati	OH	0.029	0.037	0.042
Cleveland	OH	0.027	0.033	0.038
Dallas-Ft. Worth	TX	0.016	0.020	0.022
Greater Conn.		0.022	0.025	0.029
Houston	TX	0.028	0.036	0.041
Huntington	WV	0.016	0.021	0.024
Indianapolis	IN	0.020	0.025	0.029
Lexington	KY	0.018	0.022	0.025
Louisville	KY	0.033	0.042	0.048
Memphis	TN	0.024	0.031	0.036
Miami	FL	0.019	0.023	0.027
Milwaukee	WI	0.028	0.035	0.040
New York	NY	0.049	0.058	0.067
Norfolk	VA	0.018	0.023	0.027
Philadelphia	PA	0.036	0.044	0.050
Pittsburgh	PA	0.033	0.042	0.048
Portland	OR	0.019	0.024	0.028
Providence	RI	0.025	0.030	0.035
Richmond/ Petersburg	VA	0.022	0.028	0.032
St. Louis	MO	0.035	0.045	0.051
Tampa/ St. Petersburg	FL	0.021	0.027	0.031
Tulsa	OK	0.021	0.026	0.030
Washington	DC	0.035	0.044	0.051

NO_2 National Ambient Air Quality Standard is 0.053 ppm

Attachment 6

Projected Ambient NO_2 Concentrations

Scenario 3: Stationary Source Growth (3.5%)

Urban Area		Measured 1986 Air Quality	Projected 2010 Air Quality	Projected 2020 Air Quality
Allentown	PA	0.021	0.039	0.053
Atlanta	GA	0.031	0.044	0.055
Baltimore	MD	0.036	0.057	0.073
Baton Rouge	LA	0.022	0.040	0.054
Boston	MA	0.034	0.051	0.066
Charlotte	NC	0.022	0.032	0.041
Chicago	IL	0.042	0.072	0.096
Cincinnati	OH	0.029	0.052	0.070
Cleveland	OH	0.027	0.040	0.050
Dallas-Ft. Worth	TX	0.016	0.022	0.026
Greater Conn.		0.022	0.029	0.036
Houston	TX	0.028	0.049	0.064
Huntington	WV	0.016	0.028	0.037
Indianapolis	IN	0.020	0.033	0.043
Lexington	KY	0.018	0.025	0.030
Louisville	KY	0.033	0.056	0.073
Memphis	TN	0.024	0.042	0.056
Miami	FL	0.019	0.027	0.034
Milwaukee	WI	0.028	0.044	0.057
New York	NY	0.049	0.069	0.087
Norfolk	VA	0.018	0.027	0.034
Philadelphia	PA	0.036	0.055	0.071
Pittsburgh	PA	0.033	0.060	0.081
Portland	OR	0.019	0.025	0.030
Providence	RI	0.025	0.039	0.050
Richmond/ Petersburg	VA	0.022	0.039	0.053
St. Louis	MO	0.035	0.063	0.085
Tampa/ St. Petersburg	FL	0.021	0.039	0.053
Tulsa	OK	0.021	0.032	0.040
Washington	DC	0.035	0.055	0.072

NO_2 National Ambient Air Quality Standard is 0.053 ppm

Attachment 7

Projected Ambient NO_2 Concentrations

Scenario 4: Stationary Source Growth (1.75%)

Urban Area		Measured 1986 Air Quality	Projected 2010 Air Quality	Projected 2020 Air Quality
Allentown	PA	0.021	0.029	0.034
Atlanta	GA	0.031	0.038	0.045
Baltimore	MD	0.036	0.049	0.058
Baton Rouge	LA	0.022	0.031	0.036
Boston	MA	0.034	0.043	0.050
Charlotte	NC	0.022	0.027	0.032
Chicago	IL	0.042	0.057	0.067
Cincinnati	OH	0.029	0.040	0.047
Cleveland	OH	0.027	0.034	0.040
Dallas-Ft. Worth	TX	0.016	0.020	0.023
Greater Conn.		0.022	0.026	0.030
Houston	TX	0.028	0.038	0.045
Huntington	WV	0.016	0.022	0.026
Indianapolis	IN	0.020	0.027	0.031
Lexington	KY	0.018	0.023	0.026
Louisville	KY	0.033	0.045	0.052
Memphis	TN	0.024	0.033	0.039
Miami	FL	0.019	0.024	0.028
Milwaukee	WI	0.028	0.036	0.043
New York	NY	0.049	0.060	0.070
Norfolk	VA	0.018	0.023	0.028
Philadelphia	PA	0.036	0.046	0.054
Pittsburgh	PA	0.033	0.045	0.054
Portland	OR	0.019	0.024	0.028
Providence	RI	0.025	0.032	0.037
Richmond/ Petersburg	VA	0.022	0.030	0.036
St. Louis	MO	0.035	0.048	0.057
Tampa/ St. Petersburg	FL	0.021	0.029	0.035
Tulsa	OK	0.021	0.027	0.032
Washington	DC	0.035	0.046	0.055

NO_2 National Ambient Air Quality Standard is 0.053 ppm

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