

# **Projected PM<sub>2.5</sub> Attainment Status of Each County in the U.S. and Strategies for Dealing with Nonattainment Designations**

By: Dr. Howard Ellis, QEP, Allen Dittenhoefer, Ph.D., Adeel Yousuf, Nishat Hydari, Alic Bent and Seema Roy, Enviroplan Consulting, Fairfield, New Jersey and George Hidy, Ph.D., Placitas, NM



## **Purpose of This Study**

1. Project the PM<sub>2.5</sub> attainment status of each county based on 1999-2001 state monitoring results
2. Identify strategies for dealing with the expected widespread nonattainment designations

# **What are the Extent and Magnitude of the Projected PM<sub>2.5</sub> Nonattainment Designations?**

# Procedures

1. Access EPA's Air Quality System database
2. Review the PM<sub>2.5</sub> annual average concentrations in each county where monitoring was conducted from 1999-2001
3. Calculate the 3-year annual average at each PM<sub>2.5</sub> sampler

# Procedures

4. In each county, select for analysis the single sampler with the highest measured 3-year annual average PM<sub>2.5</sub> concentration

# Procedures

5. Evaluate the extent of PM<sub>2.5</sub> nonattainment in each state:

- Determine the % of counties with PM<sub>2.5</sub> samplers projected to be nonattainment
- Sort states by this percentage

## Procedures

6. Evaluate the magnitude of the nonattainment problem in each state:
  - Determine the maximum 3-year annual average PM<sub>2.5</sub> concentration and the % reduction needed to attain the NAAQS
  - Sort results from highest to lowest percent reduction required

## Procedures

- For each state, determine the average % reduction in the highest 3-year annual average PM<sub>2.5</sub> concentration by county needed to attain the NAAQS
- Sort state results from highest to lowest average % reduction required

# **What is the Extent of the Projected PM2.5 Nonattainment Designations?**

31 States plus the District of Columbia are projected to be designated nonattainment for the PM2.5 annual NAAQS

# Results:Percent of Counties with PM2.5 Samplers Projected to be Nonattainment

<b>State</b>	<b>Percent</b>
DC	100%
GA	90%
TN	87%
OH	79%
AL	76%
WV	71%
IN	68%
DE	67%

# Results: Percent of Counties with PM2.5 Samplers Projected to be Nonattainment

<b>State</b>	<b>Percent</b>
MS	56%
KY	55%
NC	50%
PA	50%
CA	48%
IL	45%
VA	44%
MD	43%

# Results: Percent of Counties with PM2.5 Samplers Projected to be Nonattainment

<b>State</b>	<b>Percent</b>
NJ	42%
AR	33%
RI	33%
SC	31%
CT	25%
MO	21%
MA	20%
NY	18%

# Results: Percent of Counties with PM2.5 Samplers Projected to be Nonattainment

<b>State</b>	<b>Percent</b>
MI	16%
NM	10%
MT	8%
TX	7%
LA	6%
WI	6%
MN	5%
OK	5%

# **What are the Magnitudes of the Projected PM<sub>2.5</sub> Nonattainment Designations?**

## Results: Maximum Percent Reduction Required in Annual PM<sub>2.5</sub> Concentration for States with Highest Concentrations

<b>State</b>	<b>Percent</b>
CA	54%
MO	39%
GA	38%
AL	35%
PA	34%
NJ	33%
OH	31%
NY	29%

## Results: Average Percent Reduction Required in Annual PM<sub>2.5</sub> Concentration for States with Highest Concentrations

<b>State</b>	<b>Percent</b>
CA	26%
NY	19%
NJ	19%
DC	18%
CT	18%
GA	17%
OH	16%
DE	15%

# Summary of Results on Maximum % Reductions in PM<sub>2.5</sub> Concentrations Needed to Attain the Annual NAAQS

<b>Needed % Reduction</b>	<b># States</b>
>25%	11
10-25%	15
<10%	6

# Summary of Results on Average % Reductions in PM<sub>2.5</sub> Concentrations Needed to Attain the Annual NAAQS

<b>Needed % Reduction</b>	<b># States</b>
>25%	1
10-25%	15
<10%	16

# Strategies for Dealing with Nonattainment Designations

1. Evaluate the validity of the monitoring data
2. Use spatial averaging for attainment designations
3. Determine if current Federally-mandated emission control programs will result in PM<sub>2.5</sub> NAAQS attainment

# Strategies for Dealing with Nonattainment Designations

4. Focus on a Secondary-First PM<sub>2.5</sub> control strategy
5. Focus on a Primary-First PM<sub>2.5</sub> control strategy

# **Strategy 1: Evaluate the Validity of the Monitoring Data**

## **EPA Required Performance Evaluation Procedures:**

1. Sampler Flow rate audit quarterly: **State**
2. Precision via permanently collocated sampler at 25% of sites: **State**
3. Performance Evaluation with collocated sampler at 25% of sites/year: **EPA**
4. Balance systems and performance audits: **State**

# **Strategy 1: Evaluate the Validity of the Monitoring Data**

## **EPA Required Performance Evaluation Procedures:**

5. Sampler performance audits: **State**
6. Systems audit: **EPA**
7. Systems audit: **State**

## **Strategy 1: Evaluate the Validity of the Monitoring Data as Follows:**

1. Review results of EPA's Performance Evaluation with collocated sampler at 25% of sites/year
2. Conduct independent Performance Audit of samplers with annual average concentrations exceeding 15 ug/m<sup>3</sup>
3. Conduct independent Systems Audit of samplers with annual average concentrations exceeding 15 ug/m<sup>3</sup>

## **Strategy 2: Use Spatial Averaging for Attainment Designations**

State may propose a Community Monitoring Zone (CMZ) based on the spatial average of multiple PM<sub>2.5</sub> samplers in making attainment designations if no sampler exceeds the spatial average by more than 20%

## **Strategy 3: Determine if current Federally-mandated emission control programs will result in PM<sub>2.5</sub> NAAQS attainment**

1. NO<sub>x</sub> SIP Call
2. Phase II Acid Rainb SO<sub>2</sub> Emission Reductions
3. Heavy Duty Diesel Vehicle and Diesel Fuel Emission Reduction Rule

## **Strategy 3: Determine if current Federally-mandated emission control programs will result in PM<sub>2.5</sub> NAAQS attainment**

4. Federal Motor Vehicle Emission Reduction Program
5. Other NO<sub>x</sub> Emission Reduction Programs to Attain the Ozone SIP

## **Strategy 3: Determine if current Federally-mandated emission control programs will result in PM<sub>2.5</sub> NAAQS attainment**

7. Other Organic Carbon Emission Reduction Programs to Attain the Ozone SIP and Certain MACTs

## **Strategy 4: Focus on a Secondary- First PM2.5 Control Strategy**

1. Assemble the multi-state (regional) emissions inventory of PM2.5 and PM2.5 precursor emissions
2. EPA and Regional Haze Organizations conduct regional modeling of various PM2.5 control strategies

## **Strategy 4: Focus on a Secondary- First PM2.5 Control Strategy**

3. EPA and states develop PM2.5 and PM2.5 precursor emission reduction budgets by state in OTAG-like process
4. States develop SIPs to comply with emission reduction budgets

# **Strategy 5: Focus on a Primary-First PM2.5 Control Strategy**

Focus on a SIP development strategy of:

1. Primary PM2.5 emission controls first
2. Secondary PM2.5 emission controls to address remaining nonattainment problems

## **Strategy 5: Focus on a Primary-First PM2.5 Control Strategy**

How much of the annual average PM2.5 concentrations come from Primary PM2.5 emissions?

## 2001 Annual Average PM<sub>2.5</sub> Concentration at Cleveland Speciation Site Assuming 50% of OC is Primary

<b>Primary</b>	<b>ug/m<sup>3</sup></b>	<b>%</b>
Elemental carbon	1.05	5.3%
Organic carbon (OC)	2.40	12.2%
Metals	3.35	17.0%
Other	0.07	0.3%
<b>Total</b>	<b>6.87</b>	<b>34.9%</b>

## 2001 Annual Average PM<sub>2.5</sub> Concentration at Cleveland Speciation Site Assuming 50% of OC is Primary

<b>Secondary</b>	<b>ug/m<sup>3</sup></b>	<b>%</b>
Sulfates	5.23	26.6%
Nitrates	2.77	14.1%
Ammonium	2.39	12.2%
Organic carbon(OC)	2.40	12.2%
<b>Total</b>	<b>12.79</b>	<b>65.1%</b>
<b>Combined Total</b>	<b>19.66</b>	<b>100.0%</b>

# 2001-2002 Annual Average PM2.5 Concentrations at Three Speciation Sites Near Pittsburgh

»

<u>Component</u>	<u>% of annual average</u>
Primary	32-38 %
Secondary	62-68 %.

## **Strategy 5: What is the Feasibility of a Primary-First PM<sub>2.5</sub> Control Strategy?**

State PM<sub>2.5</sub> monitoring data for 1999-2001 indicate that to attain the annual NAAQS:

- 15 states require less than a 10% average reduction in annual PM<sub>2.5</sub> concentrations
- 16 states require from 10% to 25% average reduction in annual PM<sub>2.5</sub> concentrations

## **Strategy 5: What is the Feasibility of a Primary-First PM<sub>2.5</sub> Control Strategy?**

A Primary-First strategy is feasible if the possible reductions in emissions from primary sources will reduce the annual PM<sub>2.5</sub> concentrations by the needed % to attain the NAAQS

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

1. Use existing or establish additional PM<sub>2.5</sub> speciation samplers near the highest measured annual PM<sub>2.5</sub> concentration in each area exceeding the annual NAAQS

**OR**

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

- 1a. Conduct speciation analysis of statistically significant sample of the state's archived refrigerated PM<sub>2.5</sub> teflon filters for samplers exceeding the annual NAAQS to estimate the speciated annual average concentration (estimate OC)

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

2. Estimate fraction of total organic carbon that is Primary versus Secondary by developing the local primary organic carbon and elemental carbon emissions inventory (Cabada, et. al.)

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

3. Conduct Receptor Modeling of each speciated sample to identify the main Primary source categories contributing to the measured PM<sub>2.5</sub> concentration
4. Calculate the 3-year annual average of these Receptor Model source contributions separately for each source category and for each sampler

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

5. Determine the maximum economically and technically feasible reductions in Primary emissions from the major source categories contributing to the 3-year annual average concentrations exceeding the NAAQS

## **Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy**

6. Decide which Primary emission controls to implement and determine the extent of any remaining nonattainment in the state requiring secondary PM<sub>2.5</sub> emission reductions

# Strategy 5: How to Develop a State Primary-First PM<sub>2.5</sub> Control Strategy: Example

<u>Sample</u> <u>No.</u>	<u>3-Year</u> <u>Avg. Conc.</u>	<u>%</u> <u>Primary</u>	<u>% Primary Reduction Needed</u> <u>to Attain the NAAQS</u>
-----------------------------	------------------------------------	----------------------------	---

# Conclusions

1. There are projected to be widespread PM<sub>2.5</sub> nonattainment designations in 31 states plus the District of Columbia.
2. These designations will result in potentially large costs to comply with the SIPs states must develop and implement between 5 and 7 years from now.

## Conclusions

3. A Primary-First PM<sub>2.5</sub> Control strategy offers the potential for more cost effective ways to attain the PM<sub>2.5</sub> NAAQS in many of the states to be designated nonattainment