

Technical Challenges of Risk- and Results-Based Multipollutant Air Quality Management

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Purpose of this Presentation

- Review the motivations for this assessment.
- Discuss the scope of NARSTO's review.
- Define risk-based, results-oriented multipollutant air quality management in this context.
- Summarize conclusions and recommendations of the assessment.
- Describe current status.



Motivation for the Assessment

The US National Research Council (2004) conclusions regarding U.S. Air Quality Management (AQM)

- Substantial progress has been made in improving air quality, especially in urban areas
- However, future progress may be hindered due to
 - An overly complex and rigid process.
 - Barriers to technological innovation.
 - The lack of a process for documenting improvements in health and ecosystem outcomes.



NRC Recommendations

AQM should strive to:

- Identify and assess the most significant exposures, risks, and uncertainties.
- Take a multipollutant approach to controlling emissions that pose the greatest risk (both criteria and HAPs).
- Characterize the relative effects of local, regional, national, and international sources and manage accordingly.
- Increase emphasis on protection of ecosystems and other aspects of public welfare.
- Create a system of accountability to assess the effectiveness of AQM actions and adjust them dynamically.



NARSTO Was Asked To

- Assess the state of scientific capabilities for implementing MPAQM and evaluating effectiveness.
- Recommend needed improvements.
- Take into account similarities and differences in approach among the North American nations.



Features of This Approach

- Administrative coordination for multipollutant AQM.
- Risk-based framework for guiding decision making.
- Accountability for evaluating results.



What is Accountability?

Increased probative value



- Were recommended AQM actions implemented?
- Were intended emission reductions achieved?
- Were ambient concentrations or deposition reduced by the amounts expected?
- Was human and ecological exposure reduced as expected?
- Were intended human health and ecosystem benefits realized?

Increasing difficulty



How Does MPAQM Differ from Current Practice?

- Level 1: Focus on individual pollutants and attainment of standards.
- Level 2: Attainment of standards, but with increasing attention to co-benefits attainable through coordinated emissions reduction.
- Level 3: Decisions based on achieving greatest risk reduction based on single-pollutant exposure-dose-response.
- Level 4: Decisions based on achieving greatest risk reduction based on multipollutant exposure-dose-response.



Conclusions and Recommendations: Multipollutant Air Quality Management (MPAQM)



MPAQM Conclusions

1. The basic technical capabilities for coordinating AQM strategies and implementing multipollutant air quality management at Levels 1 and 2 currently exist.
2. Many of the basic capabilities for implementing MPAQM at Levels 3 and 4 exist (e.g., risk assessment frameworks, emissions models, AQ models). The principal missing features are exposure-dose-response information for determining relative risk of exposure to single and multiple pollutants.
3. A step towards relative-risk decision-making might be to assess comparative risk on the basis of exposure to individual pollutants as indicators of the risks of exposure of broad population categories to compositionally complex emissions.



MPAQM Conclusions (cont.)

4. In the future, MPAQM could be complicated by three global-scale influences:
 1. Changes in precursor emissions resulting from actions taken to reduce emissions of GHGs and climate affecting particles.
 2. Changes in atmospheric chemistry, biogenic emissions, and meteorological conditions resulting from climate change.
 3. Intra- and intercontinental transport of pollutants and precursors resulting from increased global emissions.



Of these three, 1 could be the most significant over the longer term.

MPAQM Recommendations

1. Improve the ability to estimate pollutant exposure.
2. Strengthen the multidisciplinary focus of health and ecosystem effects research.
 1. What is the health and ecological damage burden of air pollution relative to other environmental stressors?
 2. Which pollutants or combinations of pollutants cause what effects?
 3. Is it feasible to group pollutants (e.g., by chemical structure or some other measure) in order to expedite research on the effects of exposure to multiple pollutants?
 4. Can we construct objective metrics for prioritizing health and ecosystem effects?



MPAQM Recommendations (Cont.)

3. Improve emissions characterization and emissions control technologies.
 - a) Include all substances thought to pose risks.
 - b) Expand the range of sources and substances that can be measured directly.
 - c) Encourage development of multipollutant control technologies.
4. Modify design of AQ monitoring networks to support MPAQM.
 - a) Measurement of oxidants, speciated VOCs, and speciation of PM organics.
 - b) Modernize instrumentation.
 - c) Coordinate measurement objectives with needs of epidemiological studies.
 - d) Conduct special campaigns to measure exposure-related parameters and non-regulated species.



MPAQM Recommendations (Cont.)

5. Implement one or more nationally-oriented MP air quality management feasibility studies to assess implementation of risk- and performance-based AQM (EPA's Detroit study was a good start).
6. Analyze the potential effects of technological change on future air quality and its implications for human health and ecosystems.



Conclusions and Recommendations: Accountability



Accountability Conclusions

1. There have been no complete formal retrospective analyses, down the accountability chain, of specific air quality management actions (including assessment of the original predicted benefits).
2. Uncertainties in emissions information remain an important barrier to implementing accountability.
3. Given reasonably reliable emissions information, it is feasible to determine whether or not a specific AQM action has had its intended effect in reducing ambient concentrations, deposition, or visibility (visibility is, per se, an AQM endpoint).
4. Demonstrating that specific AQM actions have resulted in the predicted effects on human health or ecosystem function is extremely difficult and takes considerable time to complete.



Accountability Conclusions (cont.)

5. For air pollutants with reliable biomarkers assessing the effects of AQM actions on exposure is relatively straightforward as long as the source and pathway of exposure is clear.
6. If accountability is adopted as a tool for evaluating and adjusting AQM actions, it must become an integral part of the AQM process.
7. For some applications accountability has advanced further for ecosystem effects than for human health effects; however, verification of ecosystem response or recovery to changes in exposure has been difficult to ascertain in many cases.



Accountability Recommendations

1. Two or more retroactive test cases should be undertaken to evaluate current capabilities for demonstrating accountability, particularly the assumption that it is feasible to demonstrate that a specific AQM action has had the predicted effect in reducing ambient concentrations or deposition.
2. Verify and improve emissions from model-estimated source categories.
 - a) Onroad and nonroad mobile source emissions.
 - b) Ammonia sources
 - c) Wildfires, fugitive dust, air toxics.
 - d) Improve information exchange between health-effects and emissions-characterization communities, and focus on emissions thought to represent the greatest health risks.
 - e) Maintain continuity and comparability in time-continuous records of emissions.



Accountability

Recommendations (cont.)

3. Identify reliable biomarkers of exposure for a larger number of pollutants.
4. Rethink current monitoring network design and sampling strategies and focus their mission on providing the information needed for improved exposure assessment.
5. If accountability is adopted as a tool for evaluating and adjusting air quality management actions, it must become an integral part of the air quality planning and rulemaking process.



Status of Assessment

- Executive Summary, containing conclusions and recommendations, is posted on the NARSTO website (www.narsto.org).
- The complete assessment will be published by Springer in 2010.

