CHAPTER 1 - Introduction

Lorraine Craig[1], John Shortreed[1], Jeffrey R. Brook[2]

[1]Network for Environmental Risk Assessment and Management, University of Waterloo
[2]Air Quality Research Division, Atmospheric Science and Technology Directorate, Environment Canada

1.1 Rationale for the Guidance Document

Air quality projections in several locations in developed and developing countries indicate that pollutant levels may not be significantly reduced over the next 15 to 20 years. In many cases, sizable expenditures and/or significant societal changes will be required to meet ambient air quality standards.

While there are some uncertainties, there is extensive scientific evidence of population health effects associated with short and long term exposure to ambient air pollution, even in areas where the standards are already met. Air quality decision-makers are faced with uncertainties concerning the costs of abatement, identifying pollutants and sources that are most harmful, the magnitude of public health benefits associated with emission reduction measures, and the extent to which present day and future transboundary and intercontinental airflows will compromise local and regional efforts to control air pollution. A more important challenge, however, is that as the more obvious cost-effective emissions control options are implemented, decision-makers are faced with uncertainty concerning how to achieve further reductions with the greatest health benefit per unit cost of reduction.

Given the contribution and importance that emissions from local sources have to regional, continental and global airsheds, it is critical that local emission reduction initiatives are an integral part of national and global clean air strategies. The effectiveness of new market-based mechanisms such as emission trading schemes and legal approaches to air quality management has not been clearly demonstrated. There are opportunities to achieve sizable co-benefits through joint strategies for greenhouse gas mitigation and air pollutant emission reduction.

Clean air is an important aspect of quality of life. As population growth, urban sprawl and the number of vehicles and other sources increases, the impacts of air pollution on quality of life become more apparent, including impaired visibility, breathing difficulties among asthmatics and the elderly, restrictions in outdoor physical activity, etc. Outdoor PM air pollution is estimated to be responsible for about 4% of adult cardiopulmonary disease (CPD) mortality; about 5% of trachea, bronchus, and lung cancer mortality, and about 1% of mortality in children from acute respiratory infection (ARI) in urban areas worldwide. This amounts to a global estimate of 800,000 (1.2%) premature deaths and 6.4 million (0.5%) lost life years (Cohen et al., 2005). Rising public concern and demand for governments to take further action to improve air quality suggest that guidance to support policy-makers in formulating wise air quality management strategies is timely.

This Guidance Document aims to serve as a reference for air quality policy-makers and managers and by providing state of the art, evidence-based information on key determinants of air quality management decisions. The Document reflects the findings of the five annual meetings of the NERAM (Network for Environmental Risk Assessment and Management) International Colloquium Series on Air Quality Management, as well as the results of supporting international research.

The contributors to the Guidance Document are recognized experts in the science and policy dimensions of air pollution and health. They represent a range of international perspectives including academia (Daniel Krewski, McLaughlin Centre for Population Health Risk Assessment, University of Ottawa; Jonathan Samet, Johns Hopkins University; Anthony

Hedley, University of Hong Kong; John Shortreed, NERAM, University of Waterloo); state and national government organizations (Jeffrey Brook, Environment Canada; Michael Moran, Environment Canada; Martin Williams, UK Environment; Jurgen Schneider, Austrian FEA;, Bart Croes, California Air Resources Board); international organizations (Michal Krzyzanowski, WHO European Centre for Environment and Health; William Pennell, NARSTO); and non-governmental organizations (Quentin Chiotti, Pollution Probe; Alan Krupnick, Resources for the Future).

1.2 Strategic Policy Directions for Air Quality Management

The NERAM (Network for Environmental Risk Assessment and Management) Colloquium Series on Air Quality Management was launched in 2001 to bring international science, public health and policy stakeholders together annually to share information and chart a path forward to achieve cleaner air and improve public health. The series was spearheaded by NERAM in collaboration with an international multi-stakeholder steering committee including representatives from national-level regulatory agencies in Canada, the US, Europe, and South East Asia, as well as international environment and health organizations, industry groups, state and provincial regulators, environmental non-governmental organizations, and academia. Five annual meetings were held in Canada (University of Ottawa - 2001), the US (Johns Hopkins University - 2002, Europe (Rome E Health Authority - 2003), Mexico (National Institute for Public Health – 2005), and Canada (Vancouver – 2006).

The Colloquium series over the last five years has seen new and evolving solutions to key issues in air quality risk management and the emergence of a new regulatory paradigm to complement traditional public health standard-setting. While air quality standards have historically and continue to play a central and useful role in regulating air pollutants, the findings of key epidemiological studies suggest that air quality management based on standard-setting for single pollutants is simplistic and probably suboptimal in protecting public health. For example, particulate matter mass is a good starting indicator for a broad class of what is recognized to be a serious threat to human health. However, cost-effective air particulate strategies require an understanding of:

i) local components of the mixture including size, chemical constituents (e.g. ultrafines, organic species, metals);

ii) sources of the various components;

iii) effects on health of the various components, their potential interactions with and synergistic and/or additive effects with gaseous air pollutants, and the benefits likely to accrue from various reductions; and

iv) the costs of reducing the various components. In certain situations, including so called “hot spots,” the estimated costs of additional abatement requirements to achieve incrementally smaller pollutant reductions to meet air quality standards may outweigh any related public health benefits (Maynard, 2003a; Maynard et al., 2003b; Williams, 2005; Craig et al. in press).

Underlying these developments are a series of Statements that identify strategic directions for air quality management. These Statements synthesize the collective thoughts of delegates expressed at NERAM III (Rome 2003), NERAM IV (Mexico 2005), and NERAM V (Vancouver 2006) on future directions for air quality risk management. The Statements capture the current thinking of public health organizations (i.e. WHO Regional Office for Europe, UK Environment) and the NERAM Colloquium international planning committee. The Statements are summarized below with more detailed elaboration available at www.irr-neram.ca.

Current State of Science

1. A diverse and growing range of scientific evidence demonstrates significant effects of air pollution on human health and the environment, thereby justifying continued local and global efforts to reduce exposures.

Communication of Science of Policy Decisions

2. Communication of the evidence on the health effects of air pollution and the benefits of control is critical to enhancing public awareness and demand for policy solutions. Novel approaches are needed for interpretation of scientific evidence to guide air quality managers in formulating local programs and policies.

3. A clearer articulation of the physical and policy linkages between air quality and climate change is needed to inform public opinion and influence policymakers. Care must be taken not to compromise air quality through actions to mitigate climate change. Similarly, air quality solutions must be reviewed in terms of impacts on climate.

Policy Approaches for Air Quality Management

4. Improving air quality is best approached at a systems level with multiple points of intervention. Policy solutions at the local, regional and international scale through cross-sectoral policies in energy, environment, climate, transport, agriculture and health will be more effective than individual single-sector policies.

5. Ambient air quality standards based on exposure-response relationships continue to serve as a basis for air quality management for non-threshold pollutants such as PM. Interim targets set by WHO-Europe in 2006 provide achievable transitional air quality management milestones for parts of the world where pollution is high as progress is made towards reaching long-term air quality goals.

6. Air quality management driven solely by air quality standards may not be optimal for non-threshold pollutants in areas where standards have already been attained or for "hot spots" where measures to achieve further air pollution reductions can be increasingly difficult and costly. Exposure reduction and continuous improvement policies are important extensions to ambient air quality standards.

7. Given economic growth projections, hemispheric transport of pollutants from Asian countries will continue to be a significant contributor to poor air quality globally. International scientific and technical collaboration to assess air quality and assist in controlling emissions, while enabling economic growth is critical.

8. The health effects literature suggests that reducing exposure to combustion-generated particles should be a priority. This includes emission reduction measures related to fossil fuels and biomass. The evidence is sufficient to justify policies to reduce traffic exposures, especially if such policies serve to address other societal problems such as 'grid lock', increasing commute times and distances, and obesity.

9. Prioritization of pollutants and sources for emission reduction based on the potential for exposure may be a useful alternative to rankings based on emission mass. The intake fraction concept assigns more weight to emissions that have a greater potential to be inhaled and therefore to impact health.

10. Air quality management strategies focused on improving visibility may gain greater support from the public and policymakers than those oriented strictly towards the improvement of public health.

11. International harmonization of air pollutant measurements and metrics, emission inventories, modeling tools, assessment of health effects literature and health-related guidelines are needed for efficient policy implementation.

Science and Policy Assessment Needs

12. A major scientific challenge is to advance understanding of the toxicity-determining characteristics of particulate matter (composition, size and morphology, including surface chemistry) as well as the role of gaseous co-pollutants to guide the development of source-specific air quality management strategies.

13. The effectiveness of local, regional and global policy measures must be scientifically evaluated to confirm that the expected benefits of interventions on air quality, human health and the environment are achieved and if not, that alternate measures are implemented quickly.

1.3 Structure of the Guidance Document

Innovative approaches that focus on reducing harmful exposures in a cost-effective way are required to make further gains in air quality and public health. The Guidance Document provides a forward-looking perspective based on lessons learned and best practice in air quality management to guide decision-makers towards the development of cost-effective air quality management strategies.

A conceptual framework for air quality policy development was proposed by NERAM to provide a foundation for the Colloquium series presentations and discussions (see Figure 1.1).

The framework identifies key factors underlying the policy process and illustrates the interplay between scientific assessments of air quality and health effects, policy analysis to assess costs and benefits of proposed options, and aspects of the policy environment (fairness, equity, stakeholder acceptability, technical feasibility, enforceability, government commitment) that influence decision-making. The framework recognizes that scientific uncertainty is inherent in the inputs to the decision-making process. The topics covered in the Guidance Document address the key Framework elements.

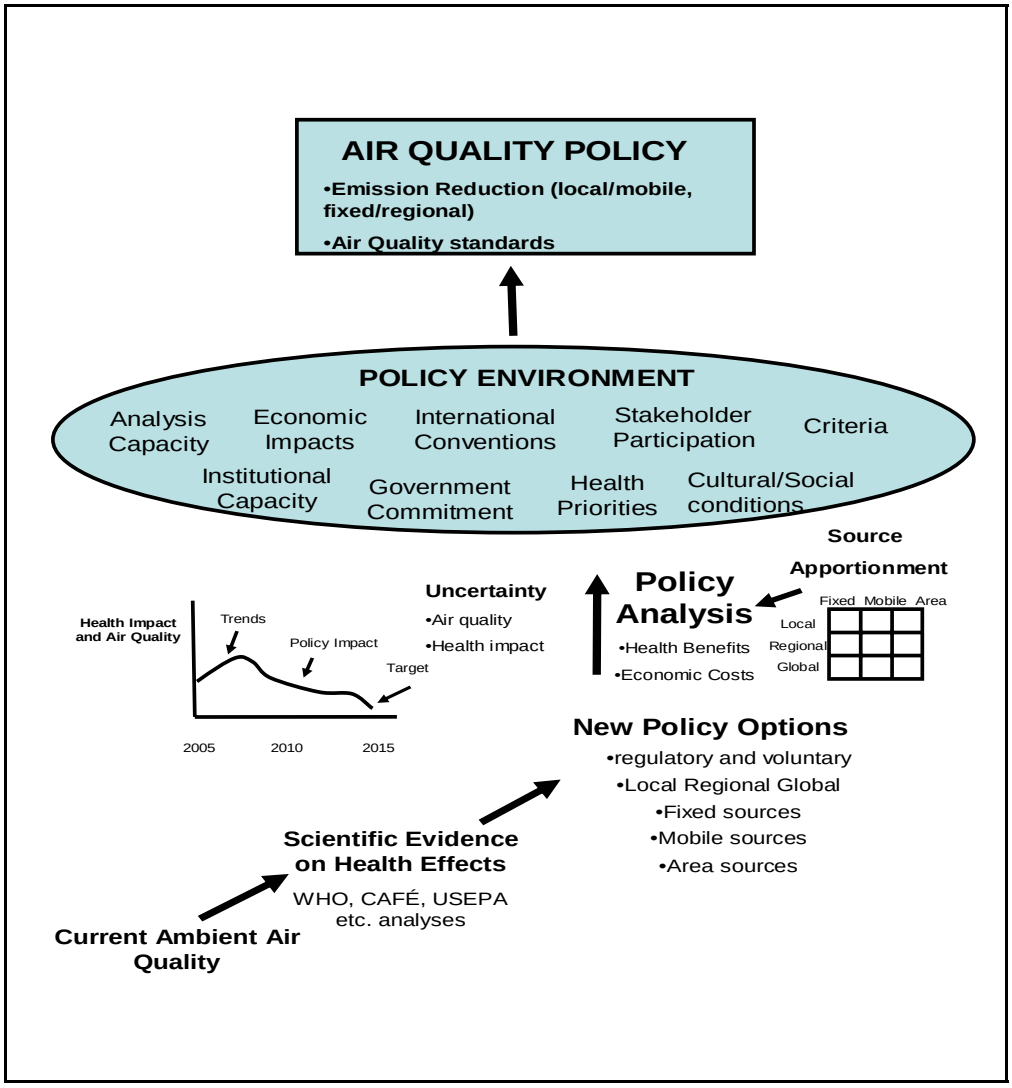

Figure 1.1. NERAM Air Quality Policy Development Framework

Chapter 2 reviews the scientific evidence on the health effects of exposure to ambient air pollution. The chapter reflects the Colloquium series' focus on the health significance of exposures to particulate matter. Evidence from epidemiological, toxicological and clinical studies in Canada, the United States, Europe, and internationally will be presented. The chapter also summarizes new insights from emerging literature and address challenges for risk management.

Chapter 3 provides an overview of the role of ambient air quality measurement, emission inventories and modeling in air quality management. The Chapter provides examples from North America and Europe to illustrate the current status, strengths and limitations of emission inventories, air quality monitoring networks and air quality modeling activities. The Chapter provides guidance on current best practice to inform the development of measurement, monitoring and modeling capacity relevant to air quality management policy development and policy evaluation.

Chapter 4 presents strategies for improving ambient air quality at the local, regional and global levels. Case studies from North America, Europe and Asia provide examples to illustrate each of the approaches and identify factors associated with successful policy development and implementation. Evidence to demonstrate the effectiveness of various air quality management approaches is presented.

Chapter 5 discusses key emerging issues faced by air quality managers and policy-makers with the growing awareness of the health impacts of poor air quality and the increasing costs to achieve further reductions. These issues include the challenges of managing hot spots and environmental justice and equity considerations. Innovative policy initiatives to complement standards-based air quality management approaches are identified, including integrated strategies oriented towards achieving climate change co-benefits and broader sustainability objectives.

1.4 References

Cohen, A.J., Anderson, H.R., Ostro, B., Pandey, K.D., Krzyzanowski, M., Künzli, N., Gutschmidt, K., Pope, A., Romieu, I., Samet, J.M., and Smith, K 2005. The global burden of disease due to outdoor air pollution. *J. Toxicol. Environ. Health Part A*, 68:1301-1307.

Craig, L., Krewski, D., Krupnick, A., Shortreed, J., Williams, M.L., and van Bree, L. in press. *J. Toxicol. Environ. Health*. NERAM IV Colloquium Statement. International Perspectives on Air Quality: Risk Management Principles for Policy Development. www.irr-neram.ca/pdf_files/Mexico_Statement.pdf.

Maynard, R. 2003a. Scientific information needs for regulatory decision making. *J. Toxicol. Environ. Health Part A.* 66:1499-1501.

Maynard, R., Krewski, D., Burnett, R., Samet, J., Brook, J., Granville, G., and Craig, L. 2003b. Health and air quality: Directions for policy-relevant research. *J. Toxicol. Environ. Health Part A*, 66:1891-1903. www.irr-neram.ca/pdf_files/CQ1_policy_priorities.pdf.

Williams, M.L. 2005. Paper presented at NERAM IV. International Perspectives on Air Quality: Risk Management Principles for Policy Development. January 31-February 1, 2005. National Institute for Public Health, Cuernavaca,