CHAPTER 2

THE POLICY CONTEXT: *How do Canada, the United States, and Mexico Apply Science to Manage the O_3 Pollution Problem?*

Air-quality policy makers in the United States, Canada, and Mexico strategically integrate science into ground-level O_3 management decisions. Although by no means exhaustive, Figure 2.1 illustrates the chronological parallel flow of O_3 science/technology and policy/regulation development from 1960 through 2000. In this chapter, we identify the North American objectives and standards that have been established for O_3 and discuss the methodology upon which these values have been determined. Recent policy studies that incorporate the latest scientific tools into the regulatory setting are described. The chapter illustrates the link between science and policy and leads toward the summary of scientific advances presented in Chapter 3.

2. The Policy Context

2.1 AIR-QUALITY STANDARDS AND OBJECTIVES

Criteria for O_3 mitigation in Canada, the United States, and Mexico have been specified as standards (which have direct enforcement implications), as objectives (which are target goals with voluntary emission control), or as some intermediate between the two. Each country has established its objectives or standards based on its assessment of acceptable ambient concentration levels to protect human health and environmental welfare. Here we present an overview of the methodological approaches selected by Mexico, the United States, and Canada to manage and meet established air-quality goals.

Canada has established National Ambient Air Quality *Objectives* (NAAQO). The current Canadian objective is 82 ppb on a 1-hr average. This national objective is used as an enforceable standard by some provinces and as an objective by other provinces. Currently the Canadian objective is in transition, changing from a focus on exceedances of peak values to lower values over longer averaging periods. The new Canada Wide Standard (CWS) for O_3 is to be finalized by the Federal, Provincial, and Territorial Ministers of the Environment in the spring of 2000 and will provide the air quality goal to which jurisdictional implementation programs will be developed.

The United States has established National Ambient Air Quality *Standards* (NAAQS) in the Clean Air Act of 1970 (42 USC 7401-7677, amended 1977 and 1990). These are enforceable standards that must be met according to schedules specified in the Clean Air Act. The United States recently revised the level and averaging time of its standard from 0.12 ppm on a 1-hr average to 0.08 ppm on an 8-hr average.[a,b] Compliance with revised standard is achieved if the 3-year average of the fourth highest 8-hr value in each year is less than or equal to 0.08 ppm.

[a] The NAAQS are stated in units of ppm and to two significant figures. Thus, an exceedance is technically defined as a concentration of at least 0.125 and 0.085 ppm, respectively; i.e., concentrations that when rounded to two significant figures yield values equal to or greater than 0.13 and 0.9 ppm.

[b] At the time this report was written, these revised standards were the subject of ongoing litigation. Regardless of the outcome of this litigation, the development and promulgation of these standards form part of the historical context in which this report was developed.

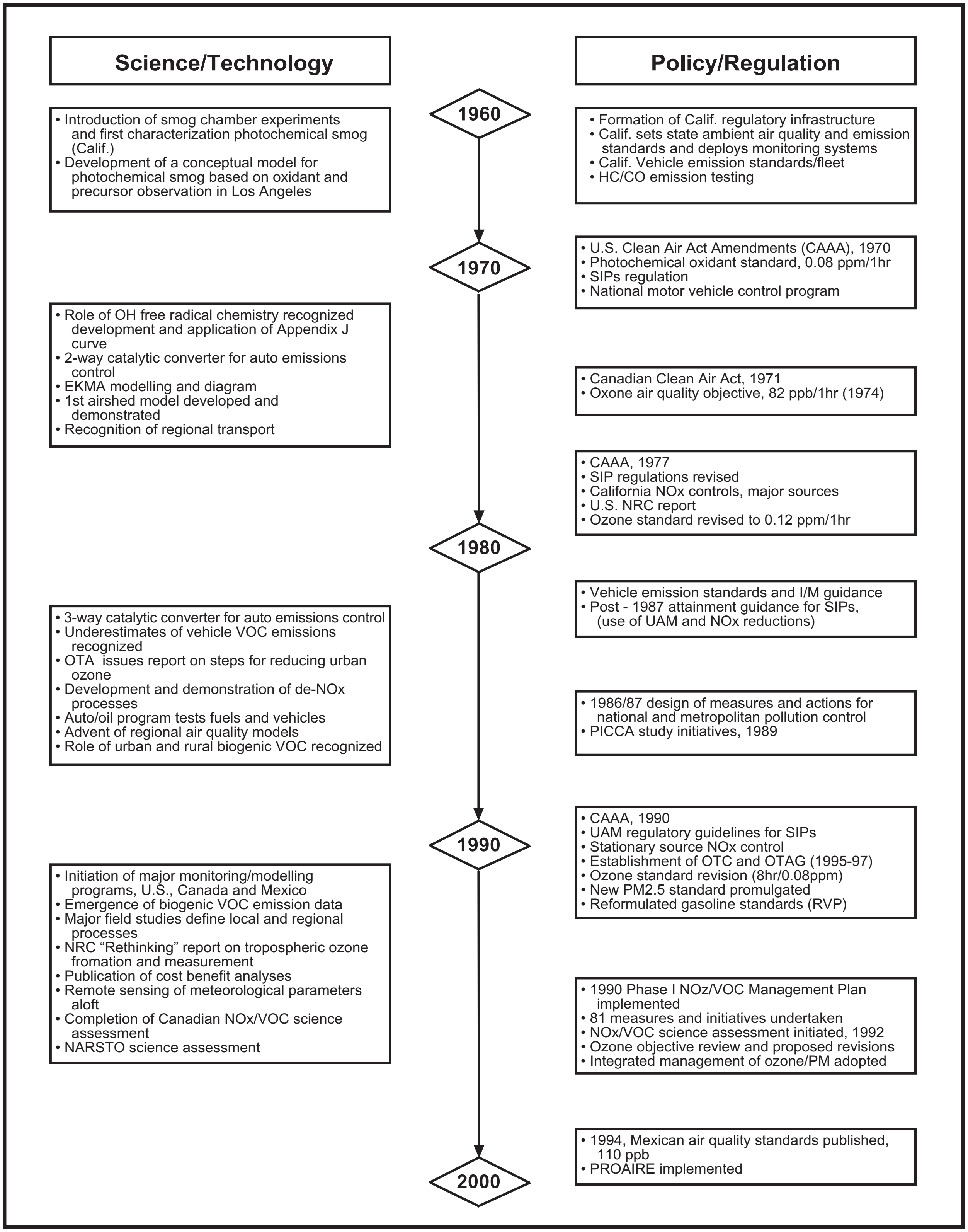

Figure 2.1 History of science and policy in the ground-level ozone issue, North America

The Mexican government has established air-quality *standards* based on evaluation of the extent to which health is endangered. Published in the *Diario Oficial*, the Mexican O_3 standard is a maximum allowable 1-hr average concentration of 110 ppb or 216 $\mu g/m^3$, not to be exceeded more than once per year during a period of 3 years (NOM-020-SSA1; Secretaria de Salud, 1993). While there is no deadline set in Mexico to attain this standard, it is used to design long-term as well as intermittent control measures in Mexico City.

Air quality is reported as an Indice Metropolitano de la Calidad del Aire (Metropolitan Air Quality Index - IMECA). A value of 100 corresponds to the Mexican air quality standard for each pollutant. Levels of IMECA values for O_3 are defined in Table 2.1. An IMECA value of 250 corresponds to O_3 concentrations at which significant evidence of damaged health can be observed in the population.

2.2 AIR-QUALITY MANAGEMENT APPROACHES

Ground-level O_3 management in Canada, the United States, and Mexico is directed toward achieving the answers to a set of key questions: *How and where should O_3 precursors be controlled to gain maximum results? What are the best control methodologies? Are the control decisions cost-effective?* Pursuit of answers to these questions requires timely and effective air-quality management decisions based on the most robust, available scientific understanding.

The three countries have a variety of management options available to them, and science plays a crucial but varied role in each country's air-quality management process. Table 2.2 highlights ground-level O_3 management procedures applied in each country. Significant differences in the management processes relate to:

- The prescriptive versus non-prescriptive nature of the regulatory responses
- The effects review process
- The use of objectives versus standards
- The use of technology and scientific tools
- The degree of reliance on air-quality modeling systems, versus other science, in policy implementation
- The points at which science is integrated into the policy process
- Changes to the standards/objective within the process
- The use of science assessment/management plans versus State Implementation Plans (SIPs).

The management roles of federal, state, provincial and local governments, industry, and academic and non-governmental organizations including the public are summarized in Table 2.3. As noted there, Canada has largely implemented preventative and economically viable remedial measures, primarily through voluntary cooperation. The U.S. approach is driven mainly by regulatory controls and remedial measures mandated by legislative statutes to ensure compliance. Mexico combines strong regulatory controls with voluntary measures. These approaches are influenced by the differences in the degree of legislated steps within each process and the severity of the problem.

Table 2.1 O_3 Concentration in the Troposphere in Relationship to IMECA

IMECA Value	Air Quality	O_3 (1 hr)
0 - 100	Satisfactory	0.11 ppm
100-200	Not Satisfactory	0.23 ppm
200-300	Bad	0.35 ppm
300-400	Very Bad	0.48 ppm
400-500	Dangerous	0.60 ppm

Table 2.2 O_3 Management Procedures Applied in North America

	Canada	Mexico	United States
Effects review process	• No mandatory review period • Stakeholder consultation	• No required period • Stakeholder consultation	• Required review every 5 years • Stakeholder consultation
Air-quality goal	• Effects-based objective (NAAQO[a]) • No legal deadline • 82 ppb, 1 hr[a]	• Effects-based index • Reduction target, considers costs • No legal deadline • Index standard of 100 equivalent to 0.11 ppm, 1 hr	• Effects-based standard (NAAQS), no costs considered • Legal deadlines • Pre-1998: 0.12 ppm, 1 hr • Current: 0.08 ppm, 8 hr[b]
Scientific input	• Integrated science advice, including AQMS[a]	• Statistical assessment	• AQMS[c] plus weight of evidence
Strategies and implementation	•National, provincial and regional strategies • No mandatory attainment deadlines, targets only • Health-based regional public advisory and prediction programs	• National and local strategies • No attainment deadlines • Health-based public advisory program	• National, state, regional strategies • Staturory attainment deadlines • Public advisory program (pollutant standard index, PSI)

[a]in transition, 2000; [b]in litigation, 2000
[c] AQMS = Air Quality Modeling System

2.2.1 Canadian Approach

Until recently, Canadian air-quality management has been handled on the basis of air-quality objectives, employing the best available science and technology to support the policy decision-making process and recognizing the continual evolution of science and technology. The Canadian federal government designs its NAAQO (CWS) to provide protection to human health, vegetation, animals and materials, based on recommendations from the Canadian Environmental Protection Act, Federal/ Provincial Advisory Committee (CEPA/FPAC) Working Group on Air Quality Objectives and Guidelines (WGAQOG). The provincial governments have the option of adopting the NAAQO either as objectives or as enforceable standards.

Canada applies scientific assessments linked with a series of progressive national and regional control implementation plans to determine optimal pathways for progress. This phased and regionally adapted approach is designed to recognize the non-homogenous nature of the O_3 issue and respect the need for an iterative process to assimilate continued scientific and technical progress by the research community. There have been pitfalls in this approach: the lack of specific standards and compliance dates can significantly inhibit progress,

Table 2.3 O_3 Air-Quality Management		
Canada	**Mexico**	**United States**
	Federal Government	
Development of NAAQO Air-quality modeling Air-quality monitoring Control-strategy design Set vehicle and fuel standards Manage transboundary issues Set transportation and energy policy Research	Promulgation of air-quality standards Air-quality modeling Control-strategy development Air-quality monitoring support Enforcement Research	Promulgation of NAAQS Designation of areas Development of implementation guidance Set national controls on vehicles, fuels, large point sources, etc. Air-quality modeling Review of SIP's Enforcement Research
	Provincial, State, Local Governments	
Participation in NAAQO development Air-quality modeling Air-quality monitoring Enforcement Research Participation in control-strategy design	Control-strategy development Air-quality modeling Air-quality monitoring Enforcement Research	Control-strategy development Air-quality modeling Air-quality monitoring Enforcement Research
	Industry	
Implementation of controls Participation in control-strategy design Research	Implementation of controls Participation in control-strategy development Research	Implementation of controls Participation in control-strategy development Research
	Academia & Others (non-governmental agencies, general public)	
Research Participation in control-strategy design Take individual control actions	Research Participation in control-strategy development	Research Participation in control-strategy development Advice on monitoring, modeling implementation strategies Review and comment on SIP's Citizen enforcement

as there is little incentive for those involved to confront the issue with the necessary resources. As a result, the issue can lose priority on both public and private agendas and the process can become protracted and unfocused. Canada has started negotiating its remedial implementation program, but without the coercive mechanism of legal consequences, there is no requirement for stakeholders to act within a specific time frame nor indeed, to act at all beyond responding to the pressure imposed on governments by some public lobbying.

Thus, Canada responded to this issue in the 1990s by somewhat modifying its earlier approach to move in the direction of stronger, more direct remedial measures, which are often more expensive and technologically limited. As an example, continued exceedances of the Canadian NAAQO triggered development of a cooperative NO_x/VOC management plan, which set forth specific preventative initiatives, including national emission standards and new-source performance standards. Responsibility for implementing these initiatives is shared between the various levels of government in cooperation with industry and environmental non-governmental organizations. The federal government leads in science, vehicle and fuel standards, and trans-boundary issues and in transportation and energy policy. Provincial governments regulate emissions from industrial stacks and processes, in-use vehicles, solvents, and operation of energy utilities. Local municipalities have jurisdiction over urban planning and related issues that impact transportation.

2.2.2 U.S. Approach

As in Canada, achieving the NAAQS in the United States is a shared responsibility among cognizant organizations involved in air-quality management. As noted above, the U.S. approach has been driven largely by statutory requirements to meet the specific standards prescribed in the Clean Air Act and its amendments. The U.S. NAAQS, which are established on the basis of health and welfare effects, are reviewed every 5 years. Once the NAAQS are established, air-quality monitoring data are used to designate and classify "nonattainment" areas. "Nonattainment area" refers to the specific geographical area that is considered not to meet an applicable NAAQS. In the case of O_3, a nonattainment area is frequently defined as the Metropolitan Statistical Area or Consolidated Metropolitan Statistical Area that includes a monitored violation of the NAAQS. Areas so designated are required to develop State Implementation Plans (SIPs) for remediation. In order to develop a SIP, the state must propose and evaluate control strategies. Typically, control strategies are evaluated using selected air-quality modeling systems. Such modeling systems are discussed in more detail in Chapter 4.

Once a control strategy has been developed, and the U.S. EPA has approved the SIP, the remedial actions identified in the SIP are enforced and air-quality monitoring is used to track an area's progress toward meeting the NAAQS. When and if an area meets the NAAQS, it may be redesignated to "attainment." Failure by a state to develop or implement a SIP can result in imposition of sanctions (e.g., federal highway funding reductions) and/or promulgation of a federal implementation plan. Failure to attain the NAAQS also can result in a requirement to revise the SIP. For the most part, the noted sanctions have not been invoked. Instead, the U.S. Environmental Protection Agency has worked and continues to work with the states and other stakeholders to develop improved plans for O_3 standards via the extended SIP process.

The ultimate goal of the SIP process in the United States is for states to achieve attainment of the O_3 standard by a designated year. This process started three decades ago with the passage of the Clean Air Act and was followed by two major revisions of the federal law in 1977 and 1990 (see Figure 2.2). Congress set 1975 as the first deadline. When it was not met, the 1977 Amendments extended the deadline for compliance until 1982 and allowed certain areas that could not meet the 1982 deadline extensions until 1987.

At the time of the November 1990 amendments to the CAA, however, almost 100 areas in the United States were in violation of the 1-hr standard. These amendments set new attainment deadlines ranging from 3 years for "marginal" areas to 20 years for "extreme" areas. The SIPs were to be submitted by states to the U.S. EPA by November 1994. Almost all areas were unable to submit an approvable SIP at that time.

The 1990 amendments for the first time officially recognized the wide range in severity of the problem across the country (and thus allowed more time for O_3 attainment for areas with high observed O_3 levels), the regional nature of the O_3 problem, and the important role of NO_x in O_3 formation. One major response to this was the establishment of a Northeast Ozone Transport Region (and a Commission), consisting of the eastern states from Virginia to Maine and the District of Columbia, to develop regional strategies.

Reflecting this regional focus, a substantial number of states in the eastern United States recognized that they could not demonstrate attainment of the O_3 NAAQS simply through the implementation of controls within their respective nonattainment areas. In response, the Ozone Transport and Assessment Group (OTAG) was established by the states and the U.S. EPA with active participation of various regulated industry sectors to address O_3 as a super-regional problem using a modeling approach. This effort is described in more detail in Section 2.3.2.

2.2.3 Mexican Approach

Mexico applies a combination of structured emission-reduction initiatives coupled with contingency planning during extreme O_3 events for

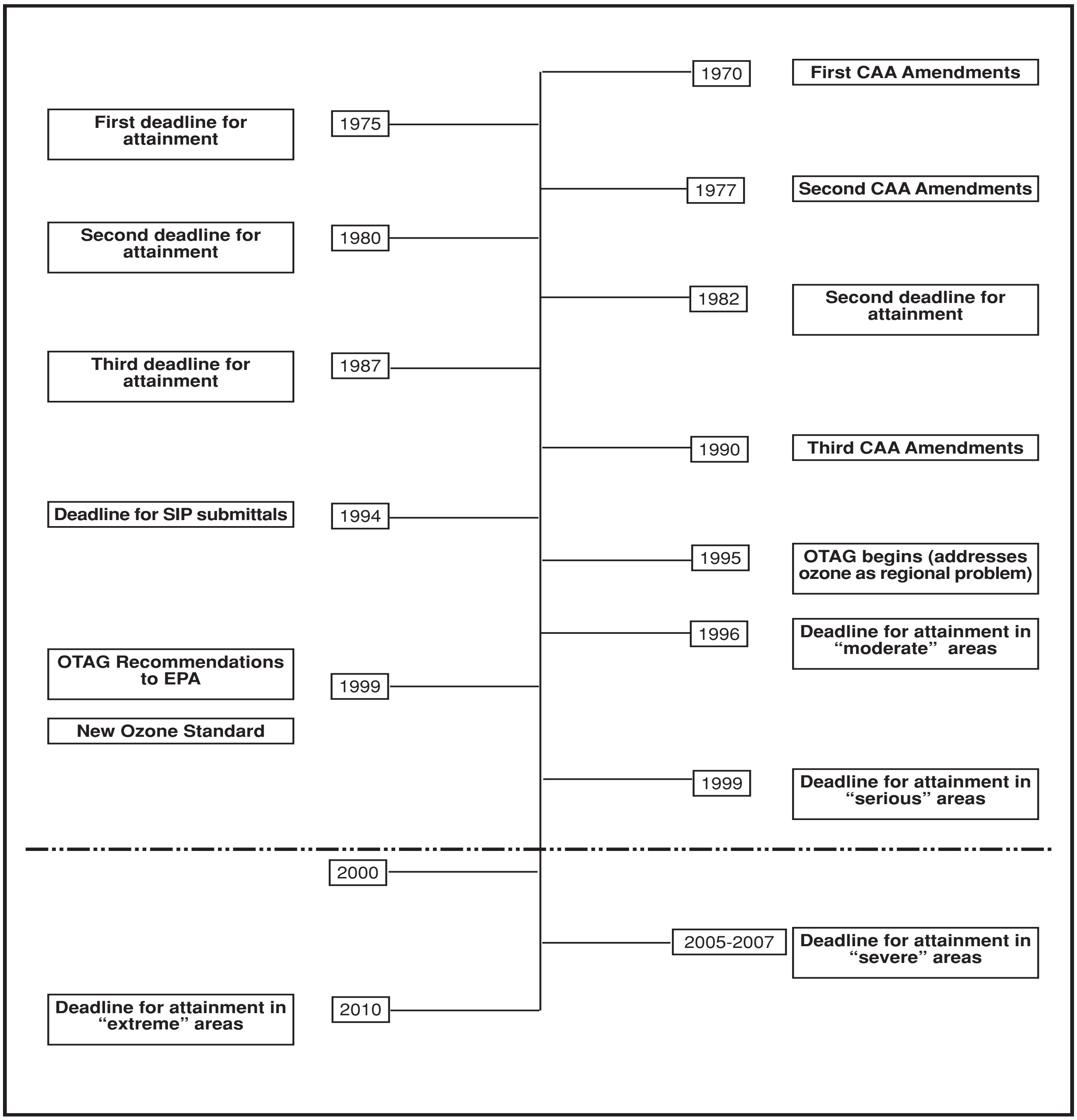

Figure 2.2 History of the SIP Process

a comprehensive management strategy in large urban agglomerations. This approach creates remedial measures to ameliorate the existing problem and fosters public awareness and education in support of air-quality management.

Mexican authorities have implemented an evolving series of programs to manage urban O_3. During the period 1989-1994, the PICCA program (DDF 1990) was implemented, aimed at avoiding extreme episodes with O_3 more than 2.5 times the standard (i.e., above 250 IMECA). In 1995, a new program (PROAIRE - DDF 1996) was adopted to improve on the procedures used in PICCA, as well as to incorporate improved scientific knowledge. PROAIRE is a mid-term program with the following objectives for the year 2000 (DDF 1996, 1997):

- Reduce the probability of occurrence of events above 250 IMECA by 75%
- Double the number of days in compliance with the standard (100 IMECA)
- Reduce the average O_3 to 150 IMECA
- Reduce cases of acute respiratory illnesses during the winter by 300,000 or more.

The program anticipates that the objectives will be achieved through the reduction of:

- Hydrocarbon emissions by 50%
- Nitrogen oxide emissions by 40%
- Suspended particles of anthropogenic origin by 45%.

2.3 RECENT POLICY RESPONSES

Selected examples of North American policy responses to the ground-level O_3 problem, provided below, demonstrate science/policy linkages in the air-quality management decision process. Though the examples differ in scope, each shows the use of scientific knowledge and tools in the process.

2.3.1 Canadian NO_x/VOC Science Assessment and Phase II Smog Strategy

The 1990 Canadian Council of Ministers of the Environment (CCME) Phase I NO_x/VOC Management Plan was formulated as the first phase of a three-phase program aimed at reducing O_3 in Canada to values less than the maximum acceptable air-quality objective (82 ppb 1-hr average). To meet the goal, the Plan launched a program of over 80 initiatives to reduce emissions of NO_x and VOC.

The Plan recognized that there were substantial gaps in scientific knowledge of the ground-level O_3 issue that would have to be addressed before effective emission reduction strategies could be implemented. In February 1992, the Atmospheric Environment Service-led multi-stakeholder NO_x/VOC Science Program was initiated as a series of working groups mandated to respond to science initiatives contained in the Plan. Objectives were established for the working groups and then refined through recommendations from an external peer review conducted early in the process. Further refinement occurred through development of a detailed science program plan, which has directed the scientific efforts to answer policy-relevant questions.

The primary question driving the Canadian NO_x/VOC Science Program and assessment process is: *What reduction in NO_x/VOC emissions (in terms of magnitude, type, emission sector and location) is required to reduce the concentrations of ground-level O_3 below an accepted air-quality objective designed to protect human health and ecosystems, and with what level of confidence can the controls be set?*

The assessment presents a comprehensive set of recommendations that respond to the policy question as thoroughly as possible, using current scientific understanding. (See summary of the recommendations in Textbox 2.1.) All of the recommendations are supported by specific points of science drawn from the peer reviewed NO_x/VOC science reports and reflect the significant advances in scientific knowledge since the publication of the 1990 Plan.

A secondary question addressed by the Canadian Science Program is related to tracking progress in managing the issue (see Chapter 5): *What will be the most effective method of assessing the impact of implemented NO_x/VOC reductions: changes in emission inventories in ambient concentrations of O_3 or precursors, or in health and vegetation effects? With what confidence can the impact of implemented controls be assessed (by each method)?*

The assessment concluded that ambient monitoring in particular, with a few recommended improvements, is currently the best means of tracking the effectiveness of implemented emission reductions. To date, emission-inventory compilations have not been effective owing to limitations in acquiring accurate and timely emission data. It is

2.1 Major Policy-relevant Findings to Emerge from the Canadian NO_x/VOC Science Assessment

NO THRESHOLD

On the basis of recent epidemiological data, it was concluded in the Canadian Assessment that there is no discernible human health threshold for ground-level O_3. The current 1-hr 82-ppb Canadian O_3 objective is not fully protective of human health and vegetation. The apparent continuum of adverse health effects indicates that any improvements in ambient O_3 concentrations are expected to result in public health benefits. Therefore, strategies for O_3 management should focus on continuous improvement reflecting the nature of the health endpoint data.

LARGE REDUCTIONS

Design of emission reduction strategies will be different for each of the O_3 problem areas (Lower Fraser Valley, Windsor–Québec City Corridor and Southern Atlantic Region) due to geographical and meteorological factors, and spatial and temporal distribution of emission sources. Reduction in both NO_x and VOC emissions will benefit large urban areas, while on a regional basis, NO_x reductions may be more effective in lowering widespread O_3 concentrations, benefiting non-urban areas. In all areas, however, large emission reductions will be required in order to meet the current 82-ppb 1-hr O_3 objective or some (as yet undefined) more stringent value.

CONCURRENT U.S. REDUCTIONS

In eastern Canada, transboundary transport plays a major role during smog episodes. Therefore, air-quality improvements will depend on concurrent U.S. emission reductions, and Canada should take action to influence the United States to reduce its emissions.

MONITORING PROGRESS

Responsible agencies should maintain the air monitoring network as a minimum at concentrations recommended in the Ambient Air Monitoring Working Group's report, and implement the network enhancements identified in the Working Group's Implementation Plan. Agencies should also cooperate to improve timeliness and accuracy of emission inventories.

NEXT STEPS IN SCIENCE

Responsible agencies should maintain their support for research to answer the remaining scientific uncertainties and policy and scientific questions in support of Canadian smog policy development. Sound policy is dependent on a sound scientific basis.

expected that when more reliable inventories become available, however, they will be invaluable to the tracking process.

In addressing current and future opportunities for adopting an effects-based approach to tracking progress, the assessment acknowledged that direct measurement of population health impacts in relation to decreasing O_3 concentrations is complicated by many factors, including changes in health-care delivery service over time, the structure of health care, and life expectancy. However, if attention is limited to urban areas and outcomes for which there exist robust O_3 concentration versus human-health response data (e.g., as quantified by hospitalization numbers), then there is confidence in this approach. At present, there is no capability for, and therefore no confidence in, using vegetation effects to track changes in precursor emissions or O_3. If the programs identified in the assessment were implemented, however, confidence in using vegetation effects for this purpose would be higher.

As a result of the 1990 Plan, significant national and federally led O_3-management initiatives were implemented:

- Initiatives to reduce emissions from autos and the Canadian rail system that have resulted in government-led industry agreements.
- National guidelines for new large stationary fuel-burning equipment such as power plants, combustion turbines and boilers that will reduce future NO_x emissions.
- Codes of practice and new-source performance standards for industrial printing and plastics processing that will result in significant VOC reductions.
- Actions to request that the United States strengthen its measures to reduce O_3-causing pollution and to set stricter air-quality standards intended to reduce transboundary air pollution.
- Work with provinces to develop better monitoring, reporting, emission tracking, and emission projections to improve measures of progress.
- A comprehensive science assessment on O_3 to provide important information for future actions to address NO_x and VOC.

The Canadian assessment addresses the need of the policy community for defensible, high-quality scientific information upon which to design and implement the next suite of emission-reduction strategies in Canada. To that end, the second phase of the Plan incorporates the key findings and recommendations of the current science assessment as well as continuing input from the scientific community as essential guidance for implementation of further O_3 management initiatives.

Although the scientific information on ground-level O_3 and its precursors provided in the overall Canadian assessment is of high quality, there are limitations to its use in policy decision-making. Further research and applications are necessary to fill the scientific knowledge gaps in support of policy development. Therefore, the completion of the science assessment is viewed as the starting point for the iterative process between the Canadian policy and scientific communities that is necessary to resolve some outstanding ground-level O_3 issues. Refined policy questions and scientific responses will lead to clearer definition of the current set of directional recommendations and guiding comments.

Close coordination between the science and policy communities is important to making significant progress on the ground-level O_3 problem in Canada over the next decade. This cooperation is and will be integral to fill knowledge gaps and to assist policy implementation and to track the results of the program as it is implemented.

2.3.2 Ozone Transport Assessment Group (OTAG) Project (1995-1997)

The 2-year OTAG effort was established because, although much progress toward O_3 attainment had been made in the United States (especially in reducing the magnitude and frequency of local urban peak values), 27 out of 29 nonattainment areas were unable to submit approvable SIPs by the 1994 deadline mandated in the Clean Air Act Amendments of 1990. This inability was a consequence of a number of factors; however a major factor, apparent from emerging scientific evidence, was that transport of O_3 and precursors from outside the nonattainment areas made it impossible to demonstrate attainment through modeling using solely local emissions management measures. Outside of the Ozone Transport Region, set up to facilitate a regional approach to emission management in the northeastern United States, local options were the only ones prescribed.

Therefore, in June 1995, the National Governors Association and the Environmental Council of States (composed of state Environmental Commissioners/ Directors), with assistance from the U.S. EPA, established OTAG (Keating and Farrell, 1999). This national working group consisted of all stakeholders including affected industry (e.g., automobile, fuels, and utility sectors), environmental groups, the academic community, and Canadian representatives, as well as the U.S. EPA and the relevant states. OTAG was charged with assessing the significance of pollutant transport and then recommending control strategies for reducing the associated effects.

From the beginning, OTAG operated under significant time and budget constraints. The overall technical, scientific, and policy work was to be completed within 18 months (later, the duration was extended to 2 years). OTAG was expected to make policy recommendations that struck a balance between reducing scientific uncertainty and making timely regulatory commitments. OTAG policy makers recognized that the scientific tools and quality of scientific, technical and economic data are constantly improving, but due to time and resource constraints OTAG committed to a specific set of assessment tools early in the process. As a result there was minimal opportunity for further improvement in the tools as the process evolved and deficiencies were identified.

In assessing the O_3 problem in the eastern United States, OTAG relied upon three major activities: 1) photochemical modeling[a] 2) climatological analysis of air quality and meteorology, and 3) the development of current and future emission estimates for use in model applications. Additionally, OTAG addressed the cost effectiveness and technical feasibility of potential control strategies, with emphasis on application of market-based systems. Comparisons of model results and air-quality data indicated some areas of agreement as well some significant inconsistencies. While OTAG communications via the Internet were effective in disseminating information related to progress and interim findings, the methods and final results of the project have not been reported in the peer-reviewed literature. Thus, questions remain as to the methods and the appropriateness of the model application used to meet the OTAG charge and the results thereby inferred.

To its credit OTAG was able to complete its analyses and make recommendations in a timely fashion. In July 1997, the OTAG Project concluded its effort and sent the U.S. EPA a range of control-strategy recommendations based on its model simulations and related analyses. These proposed strategies included electric-utility and non-utility NO_x control levels and implementation of federal measures including controls on architectural and industrial maintenance coatings, reformulated gasoline, and standards for small engines, locomotives, and marine engines.

Since the regulatory process to implement OTAG recommendations (especially the strategy to reduce regional emissions of NO_x) has not been completed, it is too early to tell whether the OTAG strategy will accomplish its estimated O_3 reduction goals.

2.3.3 Mexico City Contingency Plan and Health Effects

The Health Secretariat of Mexico (Secretaria de Salud) has a permanent program to detect, among the general population of the Mexico City Metropolitan Area, health problems such as cough, headaches, sore eyes, etc., that are influenced by air-pollution levels. Analysis of the data has shown that several symptoms increased significantly when

[a] The model applied was version V of the Urban Airshed Model (UAM-V). UAM-V was a proprietary code developed by Systems Applications International of San Rafael, California.

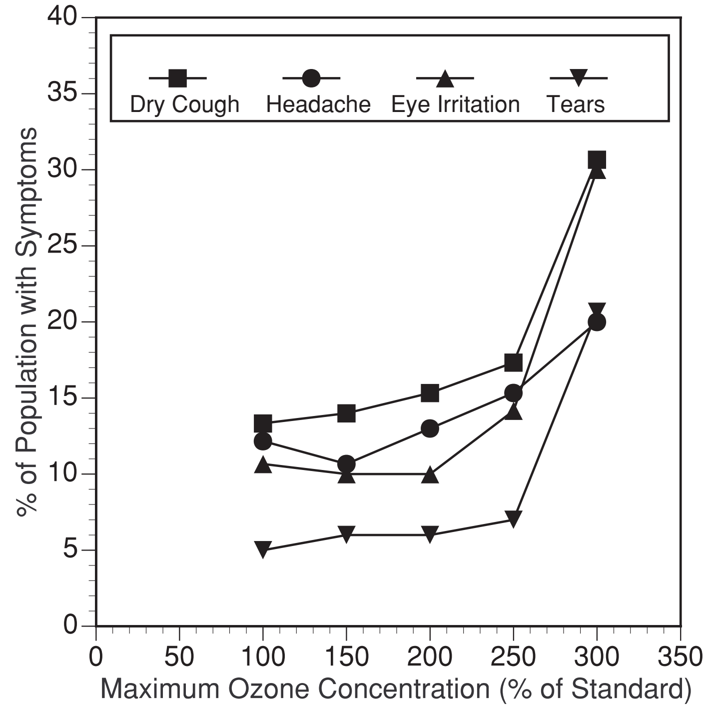

Figure 2.3 Percent of population in Mexico City reporting specific medical ailments as a function of the daily miximim O_3 concentration expresses as a percentage of the Mexican Air Quality Index (IMECA).

pollution reached levels above 2.5 times the standard, as illustrated in Figure 2.3. Observations of this type have supported the modifications of the contingency plan (DGPC 1997) to include, among other items:

- Suspending outdoor activities in schools within an area that has reached O_3 levels above twice the standard.
- Suspending outdoor activities in all the schools in the Metropolitan Area if O_3 levels above 2.5 times the standard have been reached in any place.
- Enforcing the second day without a car rule, as a measure to reduce emissions, when O_3 levels are above 2.5 times the standard.

2.4 THE EVOLVING POLICY CONTEXT

Formal expression of the most effective techniques and tools for managing ground-level O_3 continues to challenge both scientists and policy makers. However, progress in areas of scientific understanding is being integrated into the policy decision process. For example, regional-scale transport is a major concern being addressed collaboratively by both scientists and policy makers. This has led to an increasing focus on international, state, and provincial trans-boundary transport, as well as on the urban/rural interface.

In addition, since the early 1990s, emerging scientific evidence has been driving the reassessment of the effects-based O_3 standards and objectives in the United States, Canada, and Mexico. When O_3 is viewed, as in the Canadian situation, as a non-threshold pollutant, longer averaging periods and lower levels all have potential to significantly change how the issue is managed, as well as the scientific tools and information required for the management task. These challenges and numerous others are discussed in the following chapters.