# Chapter 4

## Smog

Our Health at Risk

# *Smog: Our Health at Risk*

## *Reader's Guide*

*This chapter has three parts:*

***Part I** sets out Canada's smog problem as the federal government sees it. Environment Canada, Health Canada, and Transport Canada have reviewed this material for completeness, fairness and accuracy. While we have not independently verified the material, we believe those involved in smog management would generally agree that it shows the problems created by smog and the opportunities that reducing smog presents for Canada.*

***Part II** discusses the roles and responsibilities of those involved in smog management and sets out the national approach to the problem, including the federal tools used to combat smog.*

***Part III** focusses on the federal role in implementing Canada's national smog program — the three phases of the 1990 NOx/VOC Management Plan. We report our audit findings on the federal government's own initiatives and on its broader role of leadership in implementing the Plan nationally.*

*The **Main Points**, which follow this guide, provide a concise summary of the chapter, with cross-references to further details.*

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**Appendices**

# Smog

## Our Health at Risk

## Main Points

**Smog poses a serious threat to Canadians**

**4.1** Over the last decade, the federal government has stated repeatedly that Canada's smog problem is a major public health issue and one that poses a serious threat to the environment. Its most significant impact is the adverse effects it has on the health of Canadians, particularly the most vulnerable members of society — the elderly, our children and those with heart disease and lung and other respiratory diseases. Even healthy adults are vulnerable to the adverse effects of smog (paragraphs 4.30–4.47).

**4.2** The federal government estimates that air pollution can be linked to 5,000 premature deaths each year in 11 major Canadian cities. This is a relatively large number of deaths when compared with some of the other involuntary risks that Canadians face. In addition, a far larger number of Canadians experience less serious but more widespread impacts that can place a significant burden on our health care system. For example, exposure to smog can result in respiratory or other problems that can interfere with quality of life and physical performance. Other potential effects include increased use of medication, more visits to doctors or emergency rooms and even admissions to hospital (4.30–4.43).

**4.3** Smog also affects Canada's agricultural and forestry sectors. Millions of dollars are lost each year in the agricultural sector due to the impact of common air pollutants on crops (4.48–4.52).

**4.4** In a 1999 survey conducted for Health Canada, 24 percent of Canadians identified air pollution as their provinces' most serious environmental issue. In addition, 61 percent said they are "very concerned" about air quality problems. While many Canadians are aware that smog is bad for their health and their environment, there is a need to improve their understanding of the problem and what they can do about it (4.107–4.109).

**No time for complacency**

**4.5** While there have been downward trends in some pollutants commonly found in outdoor air, trends now appear to be levelling off or even increasing. Past improvements in air quality are slowly being eroded by increased emissions as a result of greater consumption of energy (4.58–4.67 and 4.96–4.100).

**4.6** The federal government has stated that current scientific knowledge presents compelling evidence of the need for urgent action on smog (4.101–4.103 and 4.125–4.127). Federal strategies on air pollution were originally based on the belief that there were lower limits at which the main pollutants in smog were safe. However, recent research has been unable to identify safe levels of ozone or particulate matter (4.155–4.158).

**4.7** Environment Canada expects that air quality will continue to deteriorate unless governments, industry and individual Canadians make a concerted effort to reduce smog (4.96–4.100).

**Starting out on the right foot — but failing to take the next steps**

**4.8** In 1990, the Canadian Council of Ministers of the Environment (CCME) endorsed a three-phase national plan to reduce levels of pollutants. The plan focussed on nitrogen oxides (NOx) and volatile organic compounds (VOC). Both of these lead to the formation of ozone, a major component of smog. The national plan's objective was to "fully resolve" the ozone problems in Canada by 2005 (4.149–4.154).

**4.9** We believe that the 1990 NOx/VOC Management Plan represented a major achievement by the federal, provincial and territorial governments and provided sound strategic direction for addressing Canada's smog problem (4.168–4.171).

**4.10** However, after endorsing the Plan the partners never reached agreement on the details of a framework for implementing it. The Plan evolved over the past 10 years without many of the key elements of good management (4.172–4.179).

**4.11** Environment ministers originally agreed to negotiate federal-provincial partnership agreements within one year, outlining who would do what by when. When no such agreements were prepared, the Plan was destined to fail (4.175–4.176). An appropriate accountability regime was never put in place to clarify the roles, responsibilities and expected performance of each level of government. As a consequence, it is not clear whom the public and Parliament can hold to account should the Plan fail (4.180–4.182).

**4.12** Although the 1990 Plan was never implemented as originally envisioned, the federal government did most of what it had said it would do under the first of the Plan's three phases. However, the federal contribution to reducing emissions was expected to be modest compared with the size of the problem. Under the Plan, the efforts of others were supposed to achieve the bulk of emission reductions (4.183–4.194).

**4.13** Environment Canada failed to provide the public and Parliament with meaningful, comprehensive and timely information about action on the promises made to Canadians in 1990 and on the results of national efforts. The lack of transparent information means that the public and Parliament cannot determine whether Canada is addressing its smog problem at a reasonable pace (4.195–4.208).

**4.14** The federal government acknowledges that despite years of national effort, progress has been slower than planned and the original target date will likely not be met. Moreover, new pollution concerns must be addressed and levels of smog-causing pollutants significantly reduced. Environment Canada has commented publicly on the need for urgent high-priority action to address this chronic and stubborn problem (4.96, 4.126, 4.147, 4.228).

**Where to go from here?**

**4.15** No one level of government and no one industry can resolve the smog problem alone. There is no one solution; dealing with smog will require a long-term, concerted effort by all Canadians. Arrangements must be developed that will work in this difficult context. Canada will need strong leadership from the federal government to encourage co-operative action in all sectors of society (4.92–4.95 and 4.114–4.121).

**4.16** As the federal leader in protecting Canada's air quality, Environment Canada has a responsibility that goes beyond its own smog-reduction activities and its co-ordination of federal activities. It is also responsible for facilitating federal/provincial/territorial collaboration and working with its partners to develop effective national strategies and plans (4.125–4.134).

**4.17** The federal government has identified the importance of using a broad range of tools to reduce smog. For the most part, however, it has relied on the voluntary co-operation of others and has used regulatory instruments only selectively. It needs to develop a comprehensive federal approach that fully addresses the sources of smog-causing pollutants (4.135–4.144).

**4.18** The approach used for federal/provincial/territorial collaboration has proved ineffective at achieving the results promised to Canadians under the 1990 Plan. It remains to be seen whether the new Canada-Wide Standards process under the 1998 Canada-Wide Accord on Environmental Harmonization will be more effective. Whether the new process will establish clear accountability for results and transparent information to the public and Parliament also remains to be seen (4.228–4.232 and Appendix A).

**Background and other observations**

**4.19** The smog problem is difficult and complex. Smog is made up of various pollutants from many different sources. It crosses borders and affects different people in different ways (4.92–4.112). Although smog is defined by its main components — ozone and particulate matter — the "basket" of pollutants that contribute to the

formation of smog also includes nitrogen oxides, volatile organic compounds, sulphur dioxide and carbon monoxide (4.25–4.29).

**4.20** The air pollutants that cause smog today are largely by-products of industrial activities and the burning of fossil fuels (oil, natural gas and coal). Many of the solutions to the smog problem will require Canadians to change the way they produce and use energy (4.68–4.78 and 4.107–4.109).

**4.21** Environment Canada has taken the federal and national lead, and represents Canada at the international level. In Canada, however, no jurisdiction has sole authority to regulate or control all aspects of smog reduction. While the federal government works to reduce smog nationally, complementary efforts of the provinces, territories and municipalities have a major impact on the pace of progress (4.114–4.134 and Appendix E).

**4.22** To help assess progress in the future, the federal government needs to work with the provinces and territories to identify and prioritize the requirements of the national air pollutant monitoring network. As part of any future commitments, they need to determine their respective roles and responsibilities for maintaining and enhancing the network (4.209–4.227).

**4.23** Ten years after the federal, provincial and territorial environment ministers identified smog as a serious threat to public health and the environment, their governments are still developing national strategies and plans for combating smog. They are considering new standards for ozone and particulate matter, but the proposed targets are far in the future (4.228–4.232 and Appendix A).

**4.24** While finding solutions to smog has often seemed beyond Canada's reach, there is cause for hope. Canada has taken action to reduce some of the components of smog and has had some success in improving air quality in general. Canadian governments and industry have demonstrated that they can tackle difficult problems of air pollution, and similar results should be possible with smog (4.60).

**The response of Environment Canada is included in this chapter (4.239). The Department agrees that smog is an important public health concern that requires further action and sustained investment. It also agrees that sound management principles should be incorporated into future management arrangements under the Canada-Wide Standards for Particulate Matter and Ozone. Environment Canada is committed to providing meaningful and timely information on performance expectations and results.**

# PART I — WHAT, HOW AND WHY?

The federal Minister of the Environment recently stated, “Canadians are especially concerned about air quality. Residents in many areas are subjected to unacceptable air pollution caused by ground-level ozone and airborne particles which combine with other air pollutants to produce smog, particularly in our urban centres. We have taken several steps to reduce smog over the last few years, but a great deal remains to be done... We are committed to clean air... This may eventually mean some changes in lifestyle choices for many Canadians, but I am confident that everyone will appreciate the need for action.”

## What Is Smog?

**4.25** Air pollution is not new. Natural sources of air pollutants have always contaminated so-called “pure air”. However, levels of air pollution have risen as humankind has progressed. The rapid growth of cities in the Industrial Age and the widespread use of coal to produce steam and heat homes and factories cast a pall of polluted air over the urban landscape in Europe and North America. Air pollution today is usually a combination of ozone and the pollutants that lead to its formation, as well as particulate matter and toxic contaminants. Many of the pollutants in the air contribute to one or more problems such as acid rain, climate change, air toxics and smog.

**4.26** People first used the term “smog” to describe the mixture of smoke and fog in the air above cities. Smog “episodes”, periods of dangerously high levels, were recorded throughout the 19th and first half of the 20th centuries. London, England experienced a particularly disastrous episode in December 1952. This was a result of the open burning of coal and a stagnant air mass over the city, leading to a layer of smog that lasted five days and caused about 4,000 deaths. That episode led the industrialized world to make major changes aimed at reducing air pollution.

**4.27** Today, the common air pollutants that cause smog are largely a result of

**Today, the common air pollutants that cause smog are largely a result of personal and industrial activities that involve the burning of fossil fuels.**

*Panoramic view of Toronto harbour from the foot of Bay and York Streets, 1918 (see paragraph 4.26).*

**Source:** A. Beales, National Archives of Canada, PA136350

**The federal government defines the main constituents of smog as ozone and particulate matter.**

personal and industrial activities. Most air pollution is caused by the fossil fuels (oil, natural gas and coal) used for transportation and burned in our homes, thermal power plants and factories. This group of pollutants has the potential to damage the environment and the health of most Canadians. The federal government defines the main constituents of smog as ozone and particulate matter (PM). However, it recognizes that smog is a "basket" of pollutants that also includes nitrogen oxides (NOx), volatile organic compounds (VOC), sulphur dioxide ($SO_2$) and carbon monoxide (CO).

**4.28** NOx refers to compounds of nitrogen and oxygen that include nitric oxide (NO) and nitrogen dioxide gases ($NO_2$). NOx contribute to the formation of ozone and particulate matter, and are themselves pollutants. About 95 percent of human-caused nitrogen oxides come from the burning of fossil fuels in motor vehicles, homes, industries and power plants. VOC also contribute to the formation of ozone and particulate matter and include thousands of carbon-containing compounds that evaporate easily into the air. VOC come mainly from fuel combustion and the evaporation of liquid fuels and solvents. $SO_2$ is a colourless gas with an odour similar to burnt matches; in its acidic form it is the main cause of acid rain. The main sources of airborne $SO_2$ are coal-fired power-generating stations and non-ferrous ore smelters. CO is a colourless, odourless and tasteless gas produced through the incomplete combustion of organic materials.

**Smog-causing pollutants at levels common in Canada are linked to serious health problems.**

**4.29** In this chapter, we define smog as a collection of these air pollutants commonly found in ambient (outdoor) air. For further information on ozone and particulate matter, see the insert on page 4–13.

## Why Should Canadians Care About Smog?

**4.30** Most Canadians are affected by smog in one way or another. It is a serious threat to the health of many Canadians and has significant negative impacts on the environment.

**Smog is hazardous to health**

**4.31** According to the Ontario Medical Association, Canada's smog problem represents a health crisis. The federal government has reported that 20 million Canadians, two thirds of the population, are exposed to harmful levels of pollutants that combine in our outdoor air to form smog. Several studies show that smog-causing pollutants at levels common in Canada are linked to serious health problems. Studies over the last decade demonstrate that daily fluctuations in the levels of these pollutants are reflected in the number of deaths, hospital admissions and emergency room visits.

**4.32** It is difficult to estimate how many Canadians die each year as a result of smog, but the federal government estimates that in 11 major Canadian cities alone, air pollution is responsible for 5,000 premature deaths a year. Although the government cannot say with certainty, it is probable that these are deaths of people with pre-existing conditions. This is a large number of premature deaths when compared with some of the other involuntary risks that Canadians face (see Exhibit 4.1).

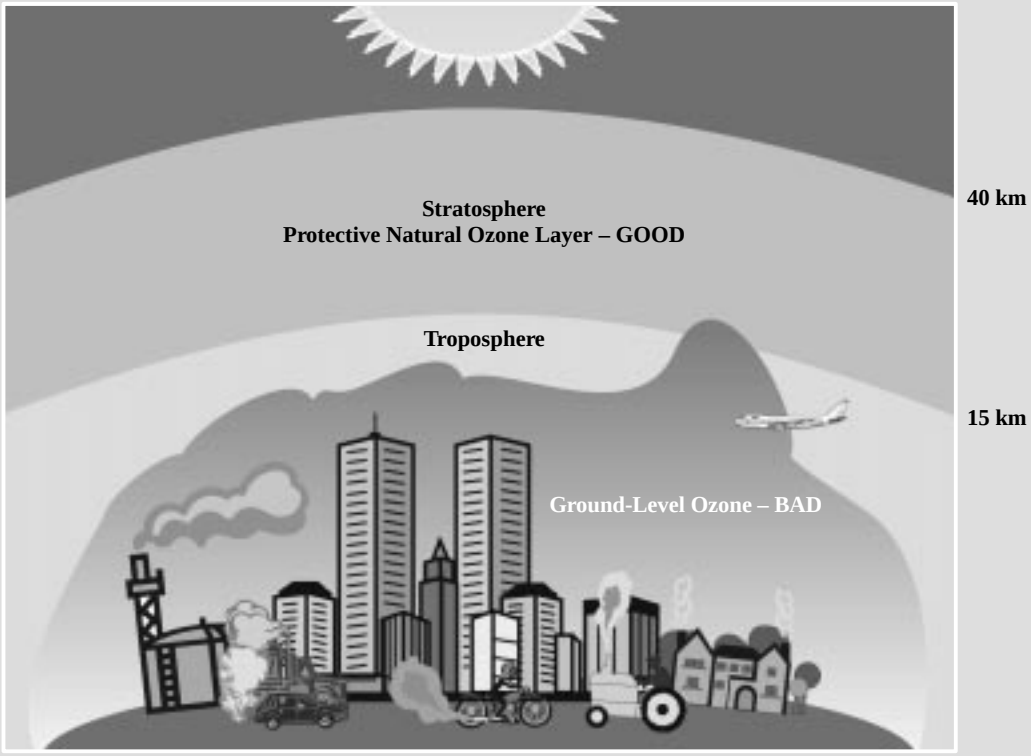
**4.33** How smog affects health depends on the type and amount of pollutant a person inhales, for how long and at what level of physical activity. The severity and type of health effects from ozone and particulate matter vary widely and include both short-term and long-term effects (see Exhibit 4.2). But other constituents of smog, such as nitrogen oxides, volatile organic compounds, sulphur dioxide and carbon monoxide, can also affect health.

## Ozone and Particulate Matter

### Ozone

Ozone in the stratosphere (15 to 40 kilometres above the Earth's surface) occurs naturally and plays an important role as a protective layer around the Earth. It absorbs ultra-violet radiation from the sun and prevents most of it from reaching the Earth's surface. Depletion of this stratospheric ozone leads to the problem known as "the hole in the ozone layer".

**Stratospheric and Tropospheric Ozone in the Atmosphere**




Adapted from: United States Environmental Protection Agency, *Ozone: Good Up High, Bad Nearby,* October 1997

Ozone also occurs naturally in the troposphere (ground level to 15 kilometres), but only in very low concentrations. When pollutants from human activity increase these concentrations, ozone can reach harmful levels. Our chapter addresses ground-level ozone, a major air pollutant and a main component of smog. The chapter uses the term "ozone" to refer to ground-level ozone.

Ozone is a powerful and irritating pollutant that is colourless and invisible to the naked eye. Thus, air can appear to be clean and yet still do harm to human health and the natural environment, as well as to buildings and materials. Ozone is not emitted directly. It forms in strong sunlight when nitrogen oxides (NOx) react with volatile organic compounds (VOC) in stagnant air. This means that efforts to limit ozone must also address the sources of NOx and VOC — which can be both natural and human-made.

Whether ozone forms depends on many factors — weather conditions, the landscape, prevailing winds, and the amount of NOx and VOC in the air. Because its formation depends on strong sunlight and is accelerated by heat, its daytime levels are much higher in the summer than in the winter. Levels of ozone can also vary at night. Usually the natural turbulence of the air subsides after the sun goes down and, depending on the time of year, a certain amount of layering of the outdoor air occurs, trapping emissions at the ground level.

Canada has set a national air quality objective or goal for the maximum concentration of ozone in outdoor air. Regions with significant ozone problems during the ozone season (May through September) may not necessarily exceed the national objective in other months of the year.

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### Particulate Matter

Particulate matter (PM) refers to a mixture of microscopic solids or liquid droplets (except for pure water) that remains suspended in the air for some time. It is emitted directly or formed by secondary reactions in the atmosphere. PM is unique among air pollutants in that it is not defined by its chemical composition. It can include a broad range of chemical species, including elemental carbon and organic carbon compounds, oxides of silicon, metals, sulfates, nitrates and ammonia. Particle size is considered the most important factor in characterizing the physical behavior of PM. This is because its size affects such things as the length of time it stays in the human body, the length of time it remains in the atmosphere and how it affects visibility. Thus, particle size plays an important role in the effects of smog on health and the environment.

Particles range in diameter from about 0.005 to 100 microns (a micron is one thousandth of a millimetre). Total suspended particulates (TSP) — that is, all particles up to about 75 microns — is the only classification of PM currently included under national air quality objectives. When the national objective for TSP was originally set, research was based on the best standardized methods of the day. Since the late 1980s, better measurement technology has led to new standard measurements of PM 10 and PM 2.5. The smaller particles, less than 10 microns in diameter (PM 10), can penetrate the thoracic compartment of the human respiratory tract. PM 10 is generally subdivided into fine particles, 2.5 microns in diameter or less (PM 2.5), and coarse particles, generally larger than 2.5 microns in diameter. The new data have been used by researchers to better understand the health outcomes of smaller particles.

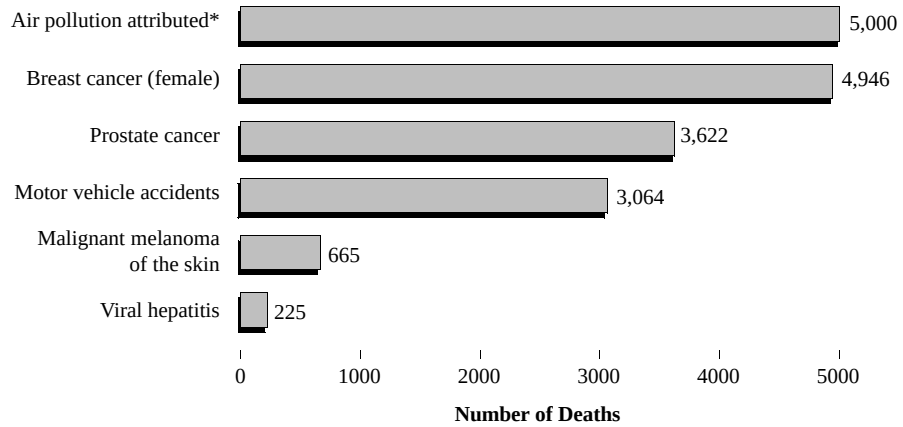
**4.34** A main area of health concern is clearly the respiratory system, through which ozone and particulate matter enter the body. Evidence also links cardiac problems to the effects of air pollution.

**4.35** Coarse particulate matter from dust and soil can be filtered by the nose and upper airways, and the body expels it more easily. Of increasing concern are fine particles, which penetrate or "fall" more deeply into the lungs. They cannot be expelled by breathing or coughing. In fact, the particles segregate at the bottom of the lungs, resulting in irritation, decreased lung function and shortness of breath, and can exacerbate lung disease. Exhibit 4.3 shows the human respiratory system and the degree of penetration of ozone and particulate matter.

**4.36** Individual reactions to smog vary widely. People who are particularly sensitive may show symptoms after only one or two hours outdoors on a smoggy day. Others may display no symptoms at first after exposure to high levels, but may show effects up to a few days later.

**Exhibit 4.1**

**Annual Deaths in Canada Related to Air Pollution Exceed Those From Other Causes**




* The federal government estimates that in 11 major Canadian cities alone, air pollution is responsible for 5,000 premature deaths a year.

Other mortality statistics are drawn from the entire Canadian population for 1997.

**Source:** Government of Canada

**4.37** A large percentage of Canadians are susceptible to smog's damaging effects (see Exhibit 4.4). Those at highest risk include the elderly, children, smokers and people who have heart, lung and other respiratory diseases like asthma, emphysema, bronchitis or pneumonia. One in five Canadians now has some form of respiratory problem.

**4.38** Overall, asthma affects about two million Canadians. Between 1978 and 1994, the prevalence of asthma increased from 2.5 percent to 11.2 percent of children aged 14 and under. The reasons for this increase are still not clear. It may involve several factors, such as changing awareness among the public and health professionals and changing diagnostic practices. Asthma is a complex disorder of the airways in which inflammation obstructs airflow, causing breathlessness, coughing and wheezing. Although the causes of asthma are still under study, smog is known to at least aggravate it in those diagnosed with the disease, giving rise to an attack or making an attack more serious.

**4.39** Chronic obstructive pulmonary disease (COPD) affects 3 percent of all Canadians and 6 percent of those over the age of 55. It results in increasing shortness of breath and eventual death. Smog increases the risk of developing COPD and makes symptoms worse for those with the disease.

**4.40** Healthy children, particularly newborns, are believed to be more vulnerable than adults to the effects of smog because they are small and their lungs take in proportionately several times more air, at a faster rate. Air pollution that may only slightly affect adults can cause a significant obstruction in the narrower airways of a young child. Children are also more susceptible because they are more active when playing outdoors. They also spend more time outdoors in the summer, when ozone levels are at their highest.

**Canadians at highest risk include the elderly, children, smokers and people who have heart, lung and other respiratory diseases.**

**Exhibit 4.2**

**Adverse Health Effects of Smog**

| Pollutants | Health Effects |
|---|---|
| Ground-level ozone | • Inflammation and swelling of the airways, with symptoms of coughing, wheezing, nose and throat irritation, pain and tightness in the chest and shortness of breath<br>• Nausea, eye irritation and headaches<br>• Increased respiratory illness, including bronchitis, asthma, pneumonia and emphysema<br>• Decreased lung function, including decreased exercise capacity, premature aging of the lungs and possibly long-term development of chronic lung disease<br>• Reduction of body's defences against infection<br>• Exacerbation of cardio-respiratory disease<br>• Increased mortality rates |
| Particulate matter (PM 10, including PM 2.5) | • Increased respiratory symptoms<br>• Increased respiratory stress and illness<br>• Decreased lung function<br>• Exacerbation of cardio-respiratory disease<br>• Exacerbation of asthma<br>• Increased mortality rates |

**Source:** Compiled by the Office of the Auditor General

**Good health does not protect adults against the damage that smog causes to lungs.**

**4.41** However, good health does not protect adults against the damage that smog causes to lungs. Those who work or exercise outdoors are susceptible. The more smog they breathe in, the more likely they are to experience effects such as chest tightness, eye, nose and throat irritation, coughing and wheezing. Healthy people exposed to smog breathe less efficiently and faster, taking more ozone into their respiratory tract. Moreover, people who exercise outdoors often do so at midday or in the afternoon, when ozone levels are peaking. Outdoor workers often have no opportunity to seek protection and, when exposed to high smog levels, their work performance could decline. Although not proved, there is also concern that long-term exposure to smog increases susceptibility to heart and lung disease.

**4.42** The health pyramid in Exhibit 4.5 indicates that while some Canadians may be dying of smog-related health effects, many more are affected by milder but more widespread impacts on their health and pocketbooks. On days when smog levels are high, absences from school and the workplace increase. Federal government experts have suggested that about six percent of all respiratory problems that lead to hospital admissions in Canada are smog-related.

**4.43** The associated costs to Canada's health care system are difficult to identify. However, a study conducted for the Canadian Council of Ministers of the Environment (CCME) estimated that in the years from 1997 to 2020, cleaner air resulting from cleaner vehicles and fuels could provide health and ecological benefits of around a billion dollars a year. "Health benefits" denotes the benefits to society of avoiding mortality and morbidity related to air pollution. Benefits include the value of avoided health care

**Exhibit 4.3**

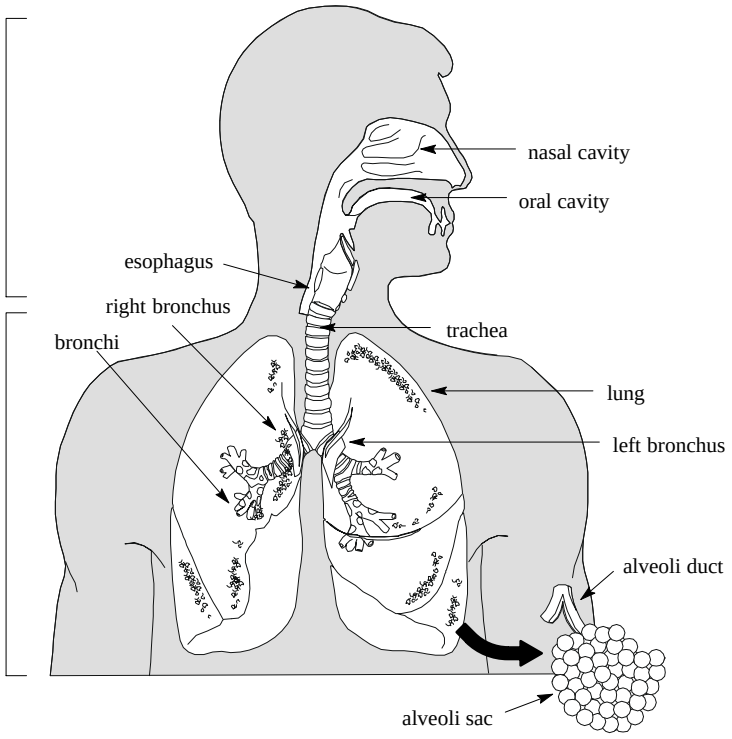
**Smog and the Human Respiratory System**

**Upper respiratory tract**

- Ozone irritates upper respiratory tract
- Coarse particulates may be filtered by the nose and upper airway and are more easily expelled

**Lower respiratory tract (thoracic compartment)**

- Ozone may also penetrate into the lungs
- Fine particles penetrate into the deepest part of the lungs




**Adapted from:** National Ambient Air Quality Objectives for Ground-Level Ozone Summary Science Assessment Document, Federal-Provincial Working Group on Air Quality Objectives and Guidelines, August 1999

costs, increased productivity and avoided pain and suffering. Annual health and other benefits of achieving the most stringent standards have been estimated at about $10 billion. While these assessments are not without controversy, the health benefits of improving air quality appear to be substantial.

*Children are especially susceptible to the effects of smog when playing outdoors (see paragraph 4.40).*

**Source:** Health Canada

**Current objectives do not protect health**

**4.44** To provide a level of health protection, Canada has national objectives or goals for the maximum levels of ozone and total suspended particulates in outdoor air. However, the objective for ozone is not met in many parts of Canada for several days of the year, and the objective for total suspended particulates is no longer viewed as adequate to protect against the finer particles.

**4.45** Moreover, scientists have learned that ozone at concentrations much lower than the current national objective causes adverse health effects. A focus on lowering ozone levels to the current objective would thus fall short of fully protecting the health of Canadians. Many recent scientific studies suggest that the concentrations of particulate matter common across Canada are also potentially harmful. Indeed, recent research has been unable to identify a safe level of ozone or particulate matter.

**Recent research has been unable to identify a safe level of ozone or particulate matter.**

**4.46** National efforts to reduce smog have focussed on regions where ozone levels are a persistent problem. Yet many locations across Canada have ozone levels that are below today's national objective

**Exhibit 4.4**

**Populations Most Affected by Smog in Canada**

*Those at highest risk include children, the elderly, outdoor workers and people engaged in outdoor recreation. People with cardio-respiratory problems are also vulnerable.*

**Source:** Office of the Auditor General

but still considered harmful. There are no national standards for PM 10 (particulate matter less than 10 microns in diameter) or PM 2.5 (particulate matter 2.5 microns in diameter or less), and national efforts to reduce PM are in the early stages (see the insert on page 4–14 for further information). Even so-called clean areas of Canada may require action to reduce emissions and prevent air quality from deteriorating, because the concept of "clean air" is based on the premise that there are levels at which pollutants cause no harm.

**Air pollution also poses a serious threat to the environment.**

**4.47** The CCME has accepted in principle new standards for ozone and PM 2.5; it will consider a possible standard for PM 10 and a more rapid achievement of the ozone standard. Ministers are scheduled to sign accepted standards at the June 2000 meeting of the CCME (see Appendix A for a discussion of Canada-Wide Standards).

### Smog has significant environmental impacts

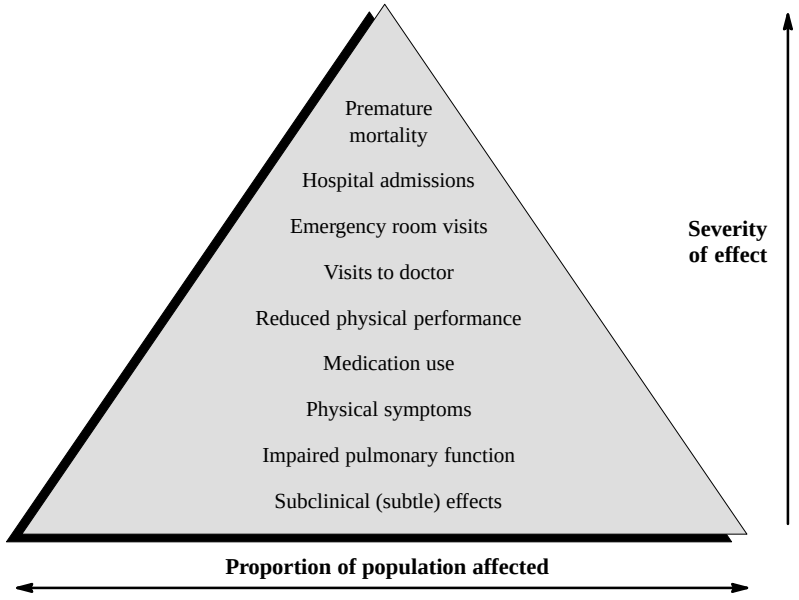
**4.48** We know less about smog's effects on the environment than on human health. Protection of the environment has generally been a secondary part of a broader goal to protect the health of Canadians. In recent years, new studies have presented a more complete picture, showing that air pollution also poses a serious threat to the environment.

**4.49** **Effects on agriculture.** Smog and its components can damage farm crops in a number of ways. In problem areas, the current levels of ozone are affecting sensitive crops. Lowered crop yields occur routinely over large areas of the Windsor–Quebec City Corridor in Ontario and Quebec, and in British Columbia's lower Fraser Valley. Ozone damages foliage, affecting plant growth and reducing productivity. Plants can overcome low levels of ozone, but frequent episodes of high ozone levels are particularly damaging. Certain crops are at greater risk, including corn, beans, tomatoes, tobacco, potatoes, soybeans, hay and wheat. Ozone can also injure ornamental flowers and shrubs as well as grass species used in turf-grass production.

**4.50** Some estimates suggest that the cost of ozone damage to crops could be in the tens of millions of dollars annually. Potential benefits of meeting current national air quality objectives for ozone have been valued at $17 million to

**Exhibit 4.5**

**The Cascading Health Effects of Air Pollution**




**Source:** Government of Canada, Phase 3 Federal Smog Management Plan Draft, November 1999

$70 million a year in Ontario. Benefits for British Columbia's agriculture sector are estimated at up to $9 million.

**4.51** Particulate matter accumulates on leaf surfaces and blocks sunlight, resulting in higher sensitivity to disease, pathogens and climate stresses. Ultimately, this reduces plant growth and yield. Deposits of fine particles can alter the acidity of soils, and eventually affect vegetation.

**4.52 Effects on forests.** Ozone can damage the foliage of forest species, increasing their susceptibility to disease and other stresses. This leads to higher mortality rates and eventually to the overall decline of affected species. Ozone damage may be reducing forest growth and timber yield and contributing to forest decline in some parts of Canada. Many common tree species sensitive to ozone are suffering reduced growth. These include maple, ash, white spruce, white pine, poplar, white birch and red oak. Lowered growth of vegetation and forests can reduce wildlife habitat and degrade ecosystems.

**4.53 Effects on wildlife.** Some studies indicate that breathing ozone causes long-term inflammation and chemical changes in the lungs of animals, reducing their ability to ward off disease. Not enough is known to draw conclusions about the levels of smog that affect birds and animals.

**4.54 Effects on buildings and materials.** Smog-causing pollutants can affect buildings and materials by reducing their aesthetic appeal and hastening their physical and chemical degradation. Particulate matter affects materials such as stone, metals, fabrics and paints by soiling, eroding or corroding the surface. Consequently, numerous household and commercial materials are damaged as well as buildings and monuments. Ozone causes hardening and cracking in elastic materials such as rubber. It weakens synthetic materials such as fabrics and textiles and it fades dyes. Ozone also chips and bleaches oil-based exterior paints, speeds up the corrosive action of $SO_2$ or NOx on metals, and acts in combination with $SO_2$ to corrode marble, sandstone, limestone, brick, concrete and gravel.

**4.55 Visibility and aesthetic effects.** The amount of particulate matter in the atmosphere directly affects visibility — for the public, the most apparent indicator of poor air quality. In less polluted areas visibility can reach 350 kilometres, while in more heavily polluted areas it can drop below 30 kilometres. This is a concern in wilderness areas as well as urban centres.

**4.56** Fine particulate matter (PM 2.5) contributes to visibility problems by absorbing and scattering light. As humidity increases, the problem gets worse. The resulting yellow-brown or white haze makes it difficult to enjoy the scenery. In severe cases, it may make travel by road or air difficult.

**4.57** Particulate pollution is a seasonal problem in the Arctic. Known as "arctic haze", it occurs in winter and early spring when conditions favour the transport and retention of air pollutants. Most of these contaminants originate in the industrial areas of Asia, Europe and North America.

## How Widespread Is Canada's Smog Problem?

**4.58** Smog is made up of various pollutants from many different sources and affects regions of Canada in different ways. In addition, smog does not stop at national borders.

**Smog is made up of various pollutants from many different sources and affects regions of Canada in different ways.**

### The smog problem persists despite improvements in air quality

**4.59** Canadians cannot be complacent about their air quality. Although the quality has improved over the past 30 years through efforts by the federal and provincial governments and industry, new pollution concerns (such as PM 2.5) and a better understanding of already recognized

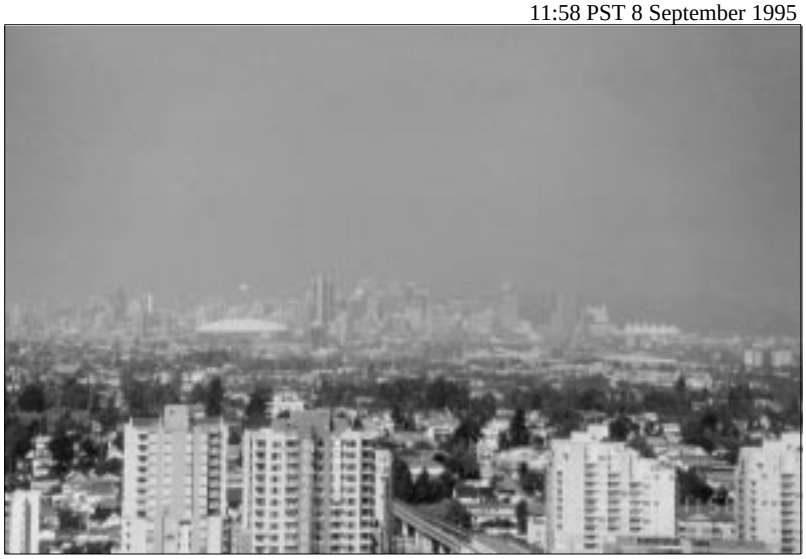
air pollutants have raised new issues. In addition, the federal government has recognized that the current national objectives for levels of ozone and total suspended particulates do not fully protect the health of Canadians. Although air quality across Canada's landmass can be said to be generally good when measured against the current objectives, smog has severe impacts on the urban areas where 80 percent of Canadians live.

**4.60** At the same time, there is no reason to despair about the smog problem. In the past, when Canada has made a concerted effort to tackle certain aspects of air pollution, it has had considerable success (see Appendix B). Catalytic converters as well as enhancements to the overall vehicle emission control system, improved fuel efficiency, new smokestacks and other equipment to control industrial sources of pollution, restrictions on stack flaring, vehicle vapour recovery systems and cleaner-burning technologies have all been helpful in reducing smog. Less burning of coal for domestic heating in

*Effects of smog on the Vancouver skyline (see paragraph 4.56).*

11:58 PST 24 March 1996

11:58 PST 8 September 1995



**Source:** Province of British Columbia – Ministry of Environment, Lands and Parks

winter has also helped. Energy efficiency and alternative energy programs designed to deal specifically with other air issues have also contributed to smog reduction.

**4.61** However, it is important to recognize that in tackling the smog problem, both primary pollutants (emitted directly into the atmosphere) and secondary pollutants (formed in the atmosphere through chemical and physical transformation) must be addressed. Secondary pollutants are much harder to control than primary pollutants, such as lead in gasoline, where the greatest successes have been achieved.

**4.62** Canada's air quality problems are similar to those in other parts of the world. The Ontario Ministry of the Environment and Environment Canada recently compared ozone and particulate matter levels in six Canadian cities with a number of comparable cities in the U.S., Europe and Australia as well as Johannesburg, Osaka and Singapore. The study indicates that Canadian cities have levels similar to those in many cities outside Canada.

**4.63** Environment Canada has assessed trends in air quality up to 1996. The national data show a slight downward overall trend in concentrations of smog-causing pollutants in outdoor air. However, trends vary significantly from one location to another.

**4.64** The trends in ozone levels that exceed the national objective are similar to trends in temperature, demonstrating the link between outdoor air temperature and the production of ozone. For example, in 1988 and 1998 — years of unusually hot weather in central and eastern Canada — episodes of high ozone levels were particularly frequent. Aside from variations caused by climate, ozone concentrations are expected to change little in the near future and the potential for ozone pollution remains as high now as it was a decade ago.

**4.65** Average urban concentrations of NOx decreased by 26 percent between 1989 and 1996. VOC levels showed little change. Trends in $SO_2$ and CO showed a marked decrease between 1974 and 1992, but since then reductions seem to have slowed.

**4.66** Although data on total suspended particulate emissions and ambient measurements are available back to the early 1970s, routine measurement of PM 10 and PM 2.5 did not begin until the mid-1980s. This makes it more difficult to assess trends in these smaller particles over the longer term. However, while it appears that levels in many Canadian cities fell between 1987 and 1996, they seem to be creeping back up.

**4.67** In short, while there have been downward trends in some of the common air pollutants, trends now appear to be levelling off or even increasing as improvements are slowly eroded.

**Smog comes from many sources**

**4.68** Natural sources produce some smog-causing pollutants in all areas of Canada, creating "background levels". For instance, forests produce substantial natural emissions of VOC. These emissions are greatest during the hot summer months but are concentrated outside of urban areas. Natural sources of primary particulate matter include pollen, spores, bacteria, and debris from forest fires. Secondary particulate matter is also formed in the atmosphere by pollutants from natural sources.

**4.69** In the urban areas, however, where the smog problem is the most severe, human-made emissions expose people to the hazards of smog far more than natural sources do. A wide variety of sources emit pollutants that cause smog. These sources can be divided into three types:

- **point sources** — stationary sources such as coal and oil-fired electrical generation plants or industrial facilities;

- **mobile sources** — motor vehicles, trains, planes or ships that burn fossil fuels; and
- **area sources** — small, widely distributed non-mobile sources that have a cumulative impact on a larger area — for example, burning wood in homes, pumping gasoline, and using solvents and paints. Area sources also include contaminants from agricultural operations (pesticides and dust) as well as forest fire debris and dust from roads and construction sites.

**4.70** The 1995 Canadian Emissions Inventory of Air Contaminants contains estimates for emissions of smog-causing air pollutants from more than 60 industrial and non-industrial activities and more than 4,600 industrial sources. Ninety-five percent of the smog-producing emissions come from 38 different sectors. Exhibit 4.6 provides information on emissions of NOx, VOC, SOx (sulphur oxides, including $SO_2$) and CO by category, and indicates the top six sources of each pollutant. (For further information on the major sources of smog-causing pollutants by category, see Appendix C.)

**4.71** The 1995 inventory shows that national NOx emissions were dominated

**Exhibit 4.6**

**1995 Emissions of Nitrogen Oxides, Volatile Organic Compounds, Sulphur Oxides and Carbon Monoxide**

*In this exhibit, the pie charts show the breakdown by category for each pollutant, while the bar charts show the top six sources of each pollutant.*

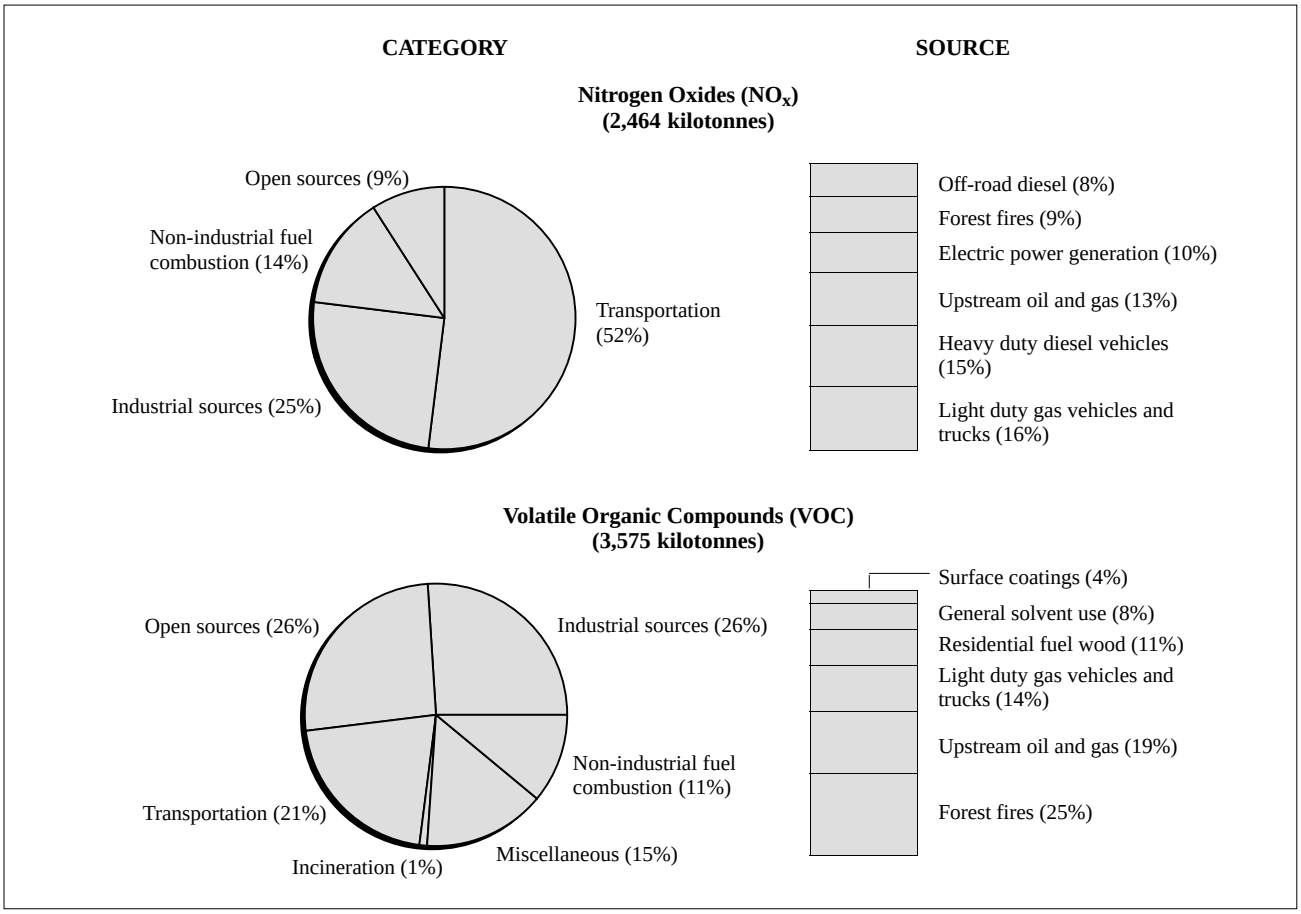
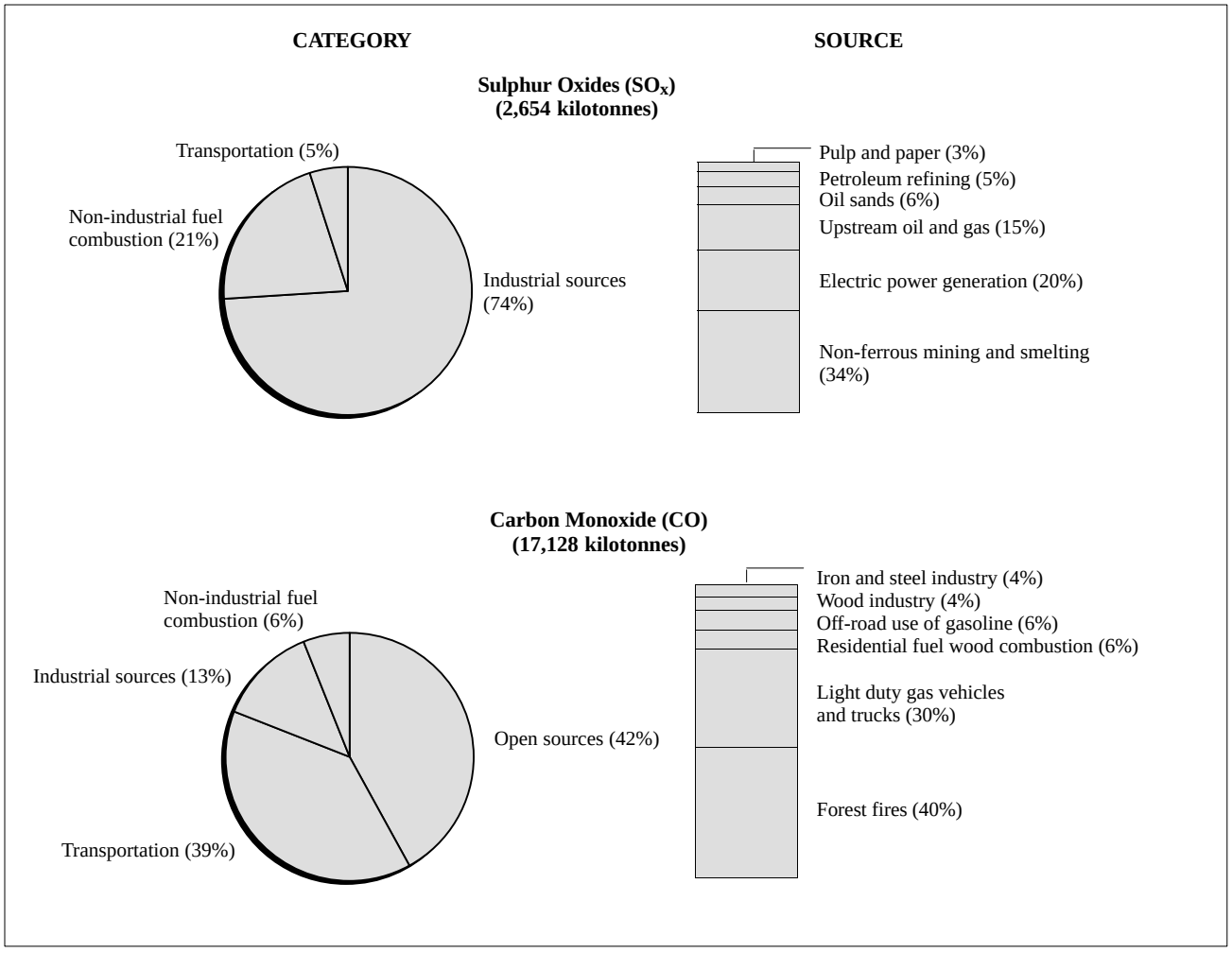


**Exhibit 4.6 (cont'd)**




**Source:** Environment Canada, Canadian Emissions Inventory of Air Contaminants, 1995

by the combined emissions from the transportation category, which accounted for more than 52 percent of the national total. Next highest were emissions from the industrial sources category (particularly the upstream oil and gas industry) at roughly 25 percent, and the non-industrial fuel combustion category (particularly electric power generation) at around 14 percent.

**4.72** The industrial sources and open sources categories each accounted for about 26 percent of national VOC emissions, closely followed by the transportation category at 21 percent. Next was the miscellaneous category with about 15 percent of the national total, and the non-industrial fuel combustion category with an estimated 11 percent.

**4.73** The industrial sources category (particularly the non-ferrous mining and smelting industry) dominated the national total of SOx emissions with an estimated 74 percent, followed by the non-industrial fuel combustion category (particularly electric power generation) at about 21 percent. The sectors in the

transportation category contributed about 5 percent to the national total.

**4.74** The open sources category, particularly forest fires, ranked the highest in CO emissions, at roughly 42 percent of the national total. Close behind was the transportation category, which contributed about 39 percent of national CO emissions. Exhibit 4.7 highlights transportation's role in emissions of CO, NOx and VOC.

**4.75** The combined PM 10 emissions from the open sources category (particularly agriculture tilling and wind erosion, dust from unpaved and paved roads, forest fires and construction) accounted for around 90 percent of the national total. Industrial sources, the second leading category, accounted for only 5 percent of the national total. However, the inventory estimates of some of the open source sectors or activities, notably unpaved roads, are under review and are thought to be overestimates. Exhibit 4.8 provides information on emissions of primary particulate matter.

**4.76** Emissions of PM 2.5 were also dominated by the open sources category (particularly forest fires and dust from roads). However, some of the emissions from open sources are also thought to have been overestimated. In addition, there were significant emissions from the industrial sources category (particularly the wood industry and pulp and paper) and from the non-industrial fuel combustion category (particularly residential fuel wood combustion).

**4.77** It is important to note that the open sources of PM, which the inventory tends to show as major contributors, are usually in remote or rural areas (forest fires, for example). At the same time, secondary particulate matter (which is not reflected in the emissions inventory) is found in more populated areas of Canada and is largely a result of human activity

**Exhibit 4.7**

**Ever-Increasing Number of Vehicles on the Road**

*Transportation in Canada is one of the largest contributors to poor air quality. The transportation sector includes around 17 million cars and light trucks, or roughly one passenger vehicle for every two Canadians. While cars are becoming lighter, more fuel-efficient and less polluting, the increasing number of vehicles on the road erodes the benefits of improved technologies. Vehicles in urban areas are a significant source of smog-causing pollutants, particularly NOx, VOC and CO. Diesel vehicles are also responsible for a significant percentage of particulate matter in urban air.*

**Source:** Office of the Auditor General

(industrial processes and fossil fuel combustion in electric power plants, vehicles, industrial boilers, and residential heating).

**4.78** If Canada is to reduce smog substantially, it is clear that many different sectors will have to be involved. While transportation is one of the largest contributors to poor air quality, other sectors such as energy and industry will also need to continue reducing emissions.

### Not just an urban problem

**4.79** Although cities produce the most smog-causing pollutants, smog is more than an urban problem. As air currents carry pollutants downwind over long distances, ozone continues to form. Smog can affect areas up to a few thousand kilometres away from pollution sources, creating a blanket of pollution over a fairly large region.

**4.80** The reactions that produce ozone are complicated. For example, excessive levels of NOx can destroy (scavenge) ozone in the immediate area surrounding the source while contributing to a larger overall burden of pollutants and more elevated ozone levels downwind. This often means that urban cores experience lower ozone levels than downwind suburban areas.

**4.81** Each region and urban area in Canada has its own pattern of air pollution and its own causes of elevated levels. Regions vary in the level of naturally occurring air pollutants, wind currents, sources and distribution of emissions, industries, population, traffic, geography and weather patterns. Strategies to reduce smog need to factor in these regional conditions. (See Appendix D for a geographical presentation of emissions.)

### Ozone problem areas

**4.82** The number of days when ozone levels exceed the national objective varies greatly from region to region; so does the degree to which emissions of NOx or VOC contribute to the local ozone problems. In some areas with high ozone levels, the main contributor is NOx; in other areas it is VOC. In most urban regions, however, ozone production is dominated by NOx.

**4.83** While ozone problems often extend beyond urban areas, they are nevertheless highly regionalized. Historically, three particular areas in Canada have had unacceptable levels of ozone most often and for the longest periods of time. These areas are the

**Although cities produce the most smog-causing pollutants, smog is not just an urban problem: air currents carry pollutants over long distances.**

**Exhibit 4.8**

**PM 10 and PM 2.5 Emissions in 1995 – Dominant Sectors**

**PM 10 Emissions**

| Sector | % National Total |
|---|---|
| Dust from unpaved roads | 38 |
| Agriculture tilling and wind erosion | 16 |
| Forest fires | 13 |
| Construction operations | 10 |
| Dust from paved roads | 10 |
| Agriculture (animals) | 3 |
| Residential fuel wood combustion | 3 |
| Wood industry | 2 |
| Pulp and paper industry | 1 |

**PM 2.5 Emissions**

| Sector | % National Total |
|---|---|
| Forest fires | 39 |
| Dust from unpaved roads | 20 |
| Residential fuel wood combustion | 9 |
| Dust from paved roads | 9 |
| Wood industry | 4 |
| Pulp and paper industry | 3 |
| Heavy duty diesel vehicles | 2 |
| Prescribed burning | 2 |
| Other industries | 2 |
| Agriculture (animals) | 2 |
| Agriculture tilling and wind erosion | 1 |
| Electrical power generation | 1 |
| Rail transportation | 1 |
| Off-road use of diesel | 1 |
| Construction operations | less than 1 |

**Source:** Environment Canada, Canadian Emissions Inventory of Air Contaminants, 1995

Windsor–Quebec City Corridor of Ontario and Quebec, the Southern Atlantic Region (particularly the Bay of Fundy and Saint John areas), and the lower Fraser Valley of British Columbia (which includes Vancouver).

**4.84** The Windsor–Quebec City Corridor**,** the most urbanized and industrialized part of Canada, experiences the country's highest concentrations of ozone from a combination of local, regional and long-range sources of pollutants. The current ozone objective is exceeded as often as 25 percent of summer days. Southwestern Ontario is the part of the corridor most affected by smog. Elevated ozone levels occur more frequently at rural sites than in urban industrial centres such as Toronto and Hamilton. This is because of the contribution from the U.S., and the scavenging effects of local NOx emissions in the cities. The smoggiest place in Canada is in rural southwestern Ontario along the north shore of Lake Erie, as confirmed by a monitoring site in Long Point Provincial Park. This area typically exceeds the current objective 30 days each year.

**Over 50 percent of the Canadian population is routinely exposed in summer to ozone levels above the national objective.**

**4.85** In the Southern Atlantic Region the majority of NOx and VOC pollutants and days of elevated ozone usually occur around the Bay of Fundy and Saint John, New Brunswick. They are attributed largely to the long-range transport of ozone and NOx and VOC from the U.S. Most of the pollution comes from the northeast and midwest U.S., with a small contribution from the Windsor–Quebec City Corridor.

**4.86** The lower Fraser Valley has had a significant smog problem. Vehicular and other emissions are trapped by the surrounding mountains, resulting in a pocket of stagnant air in which pollutants accumulate. Ozone episodes in this area, including the city of Vancouver, come primarily from local sources of NOx and VOC. Air quality has improved since the early 1980s and the frequency of ozone exceedences is currently low. While this area has ozone pollution, particulate matter is also a significant problem.

**4.87** Canada's national efforts to reduce smog have so far focussed on these three ozone problem areas. However, the impact of the recent ozone science assessment has changed the way ozone's impacts on health are characterized. There is less emphasis on extreme episodic events than on chronic levels. This will change the geographic focus of management efforts, given that the national ozone objective is exceeded regularly in most of Canada's populated areas (see Exhibit 4.9). During peak growing seasons, it is also exceeded in the most fertile areas of crop production. It has been determined that over 50 percent of the Canadian population is routinely exposed in summer to ozone levels above the national objective.

**Particulate matter problem areas**

**4.88** Unlike ozone, particulate matter shows no consistent seasonal pattern. Nationally, it is a year-round problem, with some regions seriously affected in winter and others in summer. Concentrations in outdoor air vary significantly across Canada. Both local and long-range sources affect the amount and type of particulate matter at any location. Industries in the U.S. are a major source of PM in some regions of Canada.

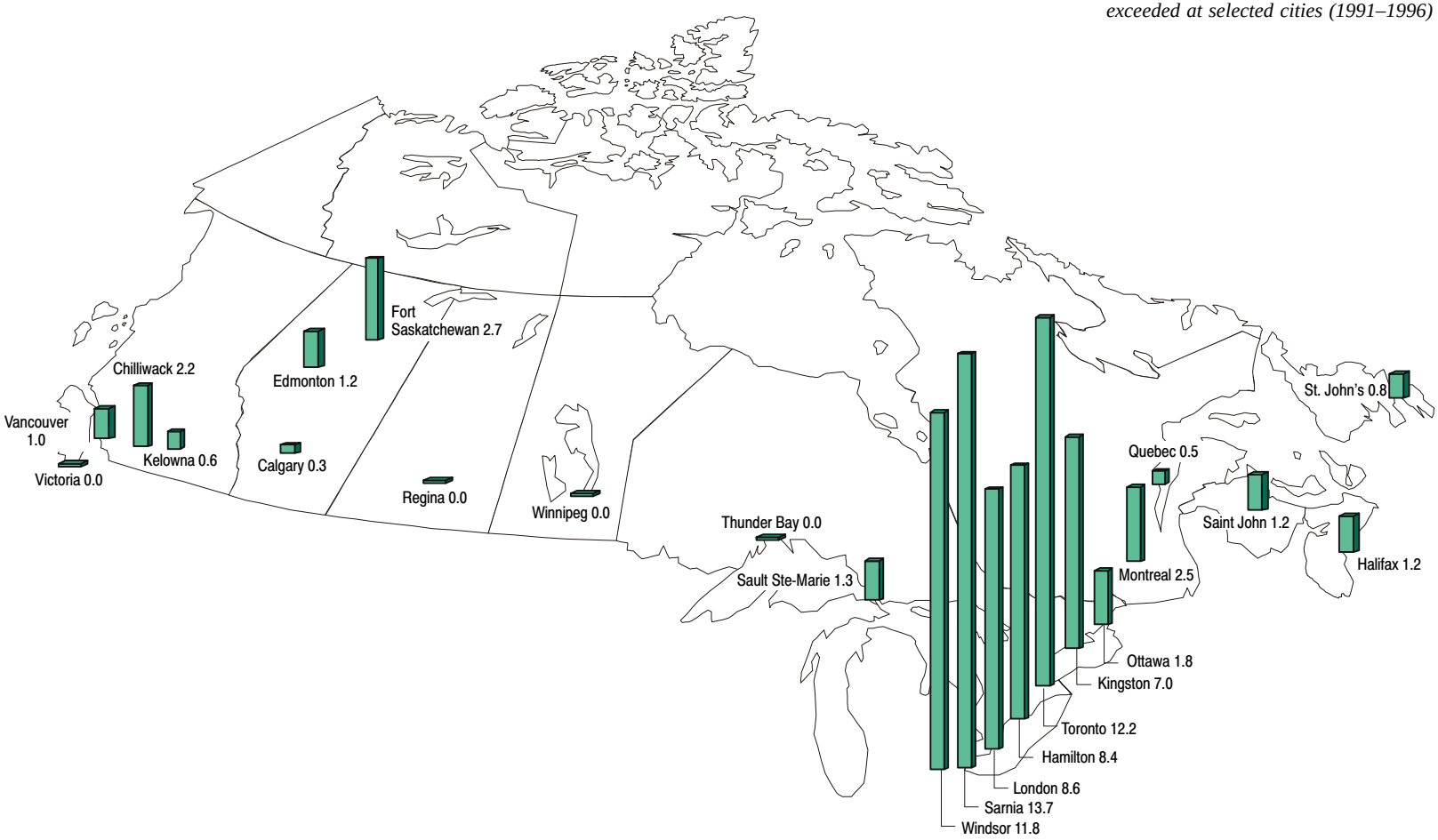
**4.89** Particulate matter is a more widespread problem than ozone. It occurs in larger cities mainly because of construction, industries, motor vehicles, heating plants and residential furnaces. Levels in most large Canadian cities are thought to have significant impacts on human health. These levels are similar to levels in major U.S. cities.

**4.90** The highest concentrations of the coarser particles are often found in small communities with major industry (for example, Temiscaming, Quebec;

**Exhibit 4.9**

**Canadians' Exposure to Ozone Levels Above the National Objective**

*Average number of days per year when the 1-hour ozone national air quality objective (82 ppb) was exceeded at selected cities (1991–1996)*




Adapted from Environment Canada

**Fine particle matter has emerged as another main component of smog that poses serious health concerns.**

Shawinigan, Quebec; Sault Ste. Marie, Ontario; Quesnel, B.C.; and Cranbrook, B.C.). Urban areas such as Montreal, Hamilton, Windsor, Winnipeg, Regina, Calgary, Edmonton and Vancouver also experience high levels of particulate matter. Rural areas experience elevated levels of coarse PM linked to agricultural operations and unpaved roads.

**Smog does not stop at national borders**

**4.91** Because smog moves freely across provincial, territorial and national boundaries, it must be dealt with as a transboundary or international issue. Of most concern to Canada are the pollutants that flow from the U.S. They represent a significant percentage of the air pollutants in some areas of Canada. Exhibit 4.10 shows the regions most affected by U.S. air pollutants that prevailing winds carry into central and eastern Canada in the summer. Environment Canada estimates that air pollutants from the U.S. may cause up to half of the ozone in southwestern Ontario and up to 75 percent of the ozone in the Southern Atlantic Region. Although not reflected in the pollution river diagram, pollutants also flow from Canada into the U.S. The issue of transboundary flows into the U.S. from Canada may become more important since PM, unlike ozone, is also a problem in the winter when predominant airflows are into the U.S.

## Why Is the Smog Problem So Difficult to Solve?

**4.92** In Canada, ozone remains a problem. Moreover, PM 2.5 has emerged as another main component of smog that poses serious health concerns. Why, then, has progress on smog been so slow? What are the challenges to finding solutions?

**Solutions will be as complex as the problem**

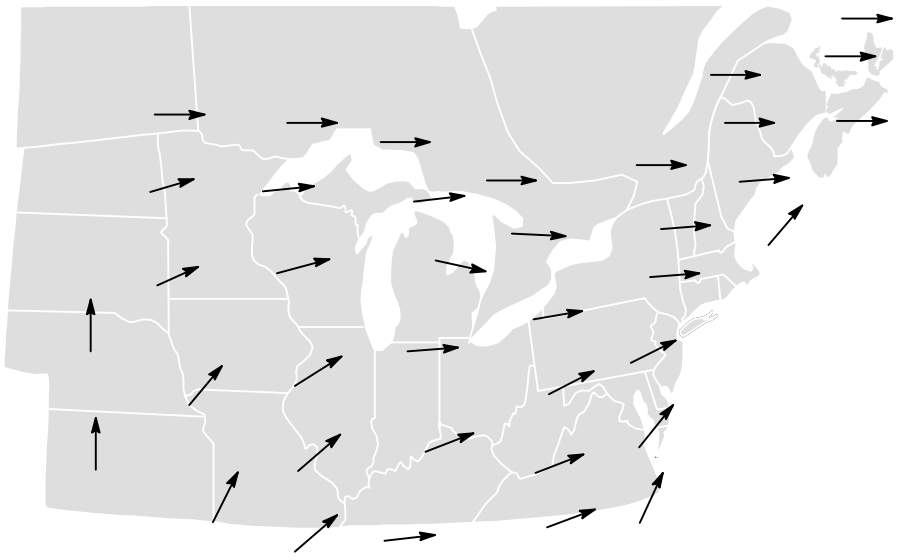
**4.93** To reduce smog, Canada will need to reduce emissions of the various pollutants that cause it. These emissions come from a wide range of sources in many different sectors. Transboundary and natural sources are also a significant factor in many regions.

**4.94** Reducing smog, then, is not simply a matter of cleaning up a few industrial plants. The easiest gains may already have been made, and the eventual solutions will likely be increasingly complex and require a broad range of control measures. Whether these measures work will depend on many factors:

**Exhibit 4.10**

**Summer Prevailing Winds**

*Summer prevailing winds from the U.S. bring air pollutants into central and eastern Canada.*



**Source:** Government of Canada, Phase 3 Federal Smog Management Plan Draft, November 1999 (Adapted from Schichtel and Husar)

weather conditions, levels of NOx and VOC emissions and other relevant pollutants, the transport of both human-made and natural emissions and the natural concentrations present in the air. Tackling the smog problem will require an approach that addresses all the pollutants and integrates initiatives on other air problems like climate change, air toxics and acid rain.

**4.95** It will take a concerted, long-term and continuous effort to solve Canada's smog problem. This effort must involve all levels of government, most economic sectors and individual Canadians. Actions taken now may yield few benefits for 10 to15 years. For example, standards for energy efficiency will take time to have an impact. New, tougher vehicle emission standards and alternative fuels that cause less pollution will take nearly a decade to be fully reflected in the Canadian fleet of vehicles.

**Canada's growth is overtaking improvements in air quality**

**4.96** The federal government believes that significant reductions of 50 percent to 75 percent of NOx and VOC would be needed to meet the current air quality objective for ozone. However, according to the federal government, even full implementation of the first phase of the Canadian Council of Ministers of the Environment Management Plan for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) (hereinafter referred to as the 1990 NOx/VOC Management Plan) would, at best, only offset the impact of growth and result in modest improvements in the ozone problem areas. That is why the 1990 Plan called for up to two more phases to achieve the goal.

**4.97** Population and economic growth, increased emissions from greater use of vehicles, and higher consumption of energy are overtaking national progress against smog. Exhibit 4.11 presents a worrisome picture of trends that are expected to continue into the future, working against improvements in Canada's air quality.

**4.98** Unless Canada and the U.S. significantly reduce their NOx and VOC emissions, little change in annual mean ozone levels can be expected in the near future. Higher levels can also be expected if the number of unusually hot summers increases.

**It will take a concerted, long-term and continuous effort to solve Canada's smog problem.**

**4.99** As no estimates of secondary PM are available, it is difficult to forecast national trends in outdoor levels of PM. It is hoped that domestic and U.S. action to reduce the major contributors to PM formation will lead to a decline in ambient levels of PM.

**4.100** Given the uncertainties in the data and the limitations of methodology, forecasts must be used with great care. Nonetheless, Environment Canada expects that air quality in general will continue to deteriorate and emissions of key pollutants to rise after 2010 unless governments, industry and individual Canadians make a concerted effort to reduce smog.

**Uncertainties in knowledge about smog and related health effects**

**4.101** While the federal government believes that the available scientific information on smog is sound, it has identified significant knowledge gaps. For example, no one knows precisely how the mix of pollutants meet to cause smog, or the exact level of intervention needed to reduce it, nor the nature of the reductions that are needed. This is particularly true of particulate matter.

**Air quality will continue to deteriorate unless governments, industry and individual Canadians make a concerted effort to reduce smog.**

**4.102** In the last decade, much more has been learned about smog's health effects. However, more information is needed on, for example, how long-term exposure affects underlying health, what smog actually costs society, and how health risk is distributed in the population.

**4.103** The government believes that to tackle the smog problem aggressively and

to better protect human health, it must address these gaps in knowledge and improve the use of scientific tools like the monitoring of pollutants in outdoor air. At the same time, it believes the available scientific knowledge provides compelling evidence that smog is a major problem today, posing a serious threat to the health of Canadians.

**There is a trade-off between clean air and what Canadians are willing to pay to get it.**

### Resolving the problem will be costly

**4.104** Even as environmental problems worsen, the federal, provincial and territorial governments have less money to spend on solutions. New and emerging environmental problems such as climate change are stretching the diminishing resources ever thinner.

**4.105** National efforts to reduce smog will have significant costs to governments and to industry. In the 1990 NOx/VOC Management Plan, the federal government suggested that fully resolving Canada's ozone problem by 2005 could cost billions of dollars. As part of the current Canada-Wide Standards process, annual costs of air pollution abatement were calculated as a percentage of Canada's 1995 gross domestic product (GDP). The 1995 GDP was approximately $807 billion. Based on seven alternative target levels for PM and ozone, estimated annual abatement costs ranged from $968 million (0.12 percent of GDP) to $22 billion (2.74 percent of GDP).

**4.106** Governments must weigh the cost of smog's impact on human health and the environment against the costs of reducing the pollutants that cause it. Assessing the economic and social impacts of air pollution is a complex undertaking, and all estimates of costs and benefits are approximate at best. In the end, there is a trade-off between clean air and what Canadians are willing to pay to get it.

### Major changes in lifestyle are needed

**4.107** All Canadians have a role to play in solving the smog problem in Canada. In a 1999 survey conducted for Health Canada, 24 percent of Canadians identified air pollution as the most serious environmental issue facing their provinces and 61 percent said they were "very

**Exhibit 4.11**

**Worrisome Future Trends**

**Population growth.** As Canada's population continues to grow, particularly in urban areas, the demand for goods and services that are linked to sources of smog-causing pollutants will also increase.

**Urban living.** Increased suburban living results in increased dependency on automobiles and longer commutes. More people are living in larger, more polluted urban centres, increasing traffic congestion, while the use of urban transit is declining.

**Transportation trends.** While less-polluting vehicles will help to reduce emissions by the transportation sector, there are offsetting pressures such as more vehicles per family and more miles travelled; heavier vehicles, which may be more polluting; increased yearly travel by most modes (especially by personal-use vehicles and planes); and shifts to more energy-intensive modes of transportation such as trucking.

**Increasing use of fossil fuel.** Emissions from fossil fuels are expected to rise for several reasons: deregulation of electricity generation and increased use of cheaper, more polluting coal to generate electricity; aging nuclear reactors temporarily taken out of service and replaced with coal-burning plants (increasing NOx and SO2 emissions); and fossil fuel prices that discourage such conservation measures as buying smaller cars and using vehicles less.

**Health concerns.** The number of people susceptible to smog (for example, the elderly) is growing.

**Climate change.** Global warming will induce the production of ground-level ozone, and extra electrical energy will have to be supplied to diminish the effects of heat waves (for example, air conditioning). Where electrical power is obtained by burning fossil fuels in power plants, emissions of NOx into the atmosphere may increase unless new technologies are developed.

**Source:** Compiled by the Office of the Auditor General

concerned" about air quality problems. While many Canadians are aware that smog is bad for their health and their environment, there is a need to improve their understanding of the problem and what they can do about it.

**4.108** Federal officials believe that public education is vital to the success of Canada's national smog initiatives and, while people are now more aware that smog is a health hazard, they are not changing the behaviour that contributes to it. Furthermore, there is little evidence that "smog warnings" encourage such change. Environment Canada has developed a Web site that provides the public with more information on smog and on actions they can take. (For more information see http://www.ec.gc.ca/smog/index.htm)

**4.109** The federal government has noted that many of the solutions to the smog problem will require Canadians to change the way they use and produce energy. However, it will be difficult to reduce the use of vehicles that burn fossil fuels when our way of life depends on them. Solutions may include changing production and consumption patterns, developing cleaner fuels, using cleaner modes of transportation, designing more efficient cities and developing new technologies and alternative sources of energy. It will be a huge challenge to secure public support for reductions that will require major changes in the way many people live.

**The federal government cannot solve the smog problem on its own**

**4.110** The complexity of the smog issue is reflected in the number of stakeholders who play a role in tackling the problem. While Environment Canada sees its role as providing national leadership, it must work in partnership and close co-operation with other federal departments and the other levels of government in Canada. For example, to be successful the three-phased 1990 NOx/VOC Management Plan relied on close co-operation between federal and provincial departments, and a co-ordinated response by federal departments.

**4.111** Moreover, improving Canada's air quality will also depend on efforts by other countries, particularly the United States. Air quality problems in parts of Canada can be fully addressed only if action is co-ordinated with U.S. efforts to reduce emissions. Although the scope of our work did not include a review of Canada's international commitments, it is important to note that Canada has entered into several agreements with the U.S. and others to reduce transboundary air pollution. Most recently, the two countries agreed that an Ozone Annex under the Agreement between the Government of Canada and the Government of the United States of America on Air Quality (hereinafter referred to as the 1991 Canada–U.S. Air Quality Agreement; see Appendix E) would be completed in the year 2000. However, the federal government believes that to strengthen its position on the flow of pollutants from the U.S., Canada needs a strong and credible program of domestic smog reduction.

**4.112** Because many industry sectors operate throughout North America, Canadian strategies for smog control have to consider U.S. initiatives. For example, current Canadian regulations on road vehicle exhaust emissions are harmonized with those in the U.S. New initiatives to reduce VOC in common consumer products will closely reflect recently developed U.S. standards.

**4.113** Part II of this chapter describes the federal and national approach to addressing Canada's smog problem and sets out the roles and responsibilities of the various players. Part III examines the federal government's role in Canada's national smog-reduction program, the 1990 NOx/VOC Management Plan.

# PART II — THE NATIONAL APPROACH TO SMOG REDUCTION

## Addressing Smog Is a Shared Responsibility

**4.114** The federal government has an important role to play in addressing Canada's smog problem, in view of its responsibility to protect the "public good". In addition, the fact that smog crosses national, provincial and territorial boundaries clearly places the issue under federal jurisdiction. The federal government provides national leadership to ensure that Canada's air quality supports healthy people and a healthy environment.

**Protecting Canada's air requires collaboration among a number of jurisdictions and interests**

**4.115** Protecting the environment is a complex endeavour that affects many aspects of Canadian life. All Canadians need to participate if we are to preserve our natural environment for future generations.

**4.116** In Canada, no jurisdiction has sole authority to regulate or control all aspects of environmental protection. The federal and provincial/territorial governments share responsibility for Canada's environment, and each has certain powers to regulate actions in its own domain. While the federal government works to reduce smog nationally and internationally, complementary efforts of the provinces, territories and municipalities will have a major impact on the pace of Canada's progress.

**While Environment Canada sees its role as providing national leadership, it has to work in partnership with other federal departments, other jurisdictions and industry.**

**4.117** While Environment Canada sees its role as providing national leadership to address Canada's smog problem, it has to work in partnership with other federal departments, other jurisdictions and industry. Although industry and governments are the primary partners, the success of any national smog program requires the support and participation of individuals and their communities. Improving Canada's air quality also depends on other countries' efforts to reduce emissions, particularly the United States.

**Provinces and territories play a key role**

**4.118** The provinces and territories play a key role in Canada's ability to achieve its national goals for smog reduction. The Canadian Constitution empowers the provinces to make laws governing property and civil rights and gives them jurisdiction over much of the land and resources within their boundaries. They are responsible for most aspects of roads and highways, urban planning and transportation, fuel taxes, vehicle licensing and inspections of in-use vehicle emissions, as are the territories. Territorial jurisdiction in these areas is derived from federal enabling legislation.

**4.119** Some of the most important aspects of air quality management in Canada are at the provincial/territorial level. Provinces and territories establish air quality objectives or criteria for levels of smog-related pollutants in outdoor air. They also have laws and regulations to control emissions from industrial facilities and other sources. They do this largely through operating permits that they issue to individual facilities, stipulating emission limits and other environmental protection requirements.

**Municipalities also play a key role**

**4.120** Many municipalities have authority to enact air quality by-laws. In some special cases, the provinces have delegated formal responsibility to municipalities for managing air quality

and issuing permits. In addition, given their involvement in public transit and land-use planning, municipal governments are important players in "greening" transportation, a key element in addressing the smog problem. The ultimate goal of "greening" transportation is to encourage the general public to opt for alternative means of transportation and cut daily vehicle emissions.

**Provincial, territorial, municipal and industry initiatives under way**

**4.121** A wide range of provincial, territorial, regional and municipal plans and programs address the various components of smog. Many involve co-operative efforts with business, industry, non-governmental organizations and other stakeholders. Some industry sectors have studied their own emissions and have taken voluntary steps to reduce them. Community groups in urban areas have also begun initiatives to improve local air quality.

## Developing Ways of Working Together

**4.122** We would expect the federal government to act on the smog problem in the areas where it has legal responsibility and jurisdiction. However, some of the needed actions are under the jurisdiction of the provinces, territories and municipalities. Accordingly, agreements and co-ordinating mechanisms have been set up for federal, provincial and territorial co-operation in an effort to obtain broad-based agreement for action.

**4.123** The Canadian Council of Ministers of the Environment (CCME) is a key national co-ordinating body on environmental issues. It is made up of federal, provincial and territorial ministers of the environment. Ministers normally meet twice a year to discuss national priorities on which governments agree to work co-operatively. The CCME operates by consensus; while the Council can propose national policies and strategies, it cannot impose its suggestions on its members. Each jurisdiction decides whether or not it will adopt CCME proposals.

**4.124** Throughout the 1980s, ground-level ozone gradually emerged as a focus of concern in Canada. At that time, ozone was viewed as the main component of smog. A historically bad smog season in 1988 brought the issue to a head. That year, the CCME decided to request that a national management plan be developed for the control of nitrogen oxides (NOx) and volatile organic compounds (VOC), the pollutants that form ozone. Exhibit 4.12 gives highlights of developments since then.

## The Federal Approach to Smog Reduction

**Federal roles and responsibilities**

**4.125** Environment Canada says that Canadians are concerned about the health effects of air pollution and want an undiminished federal role in protecting the environment and their health. Canadians look to the federal government to set national goals that protect the environment, their health and their natural legacy.

**4.126** The Department also says there is a need for strong and effective federal government leadership in tackling clean air issues, and it sees itself as providing some aspects of that leadership. It has indicated that improving Canada's air quality is an urgent and high-priority issue for the Department.

**Improving Canada's air quality is an urgent, high-priority issue for Environment Canada.**

**4.127** Environment Canada has taken the lead in co-ordinating the Canadian smog effort nationally and internationally. Although it has the primary federal responsibility for air quality, it shares the work on smog with Transport Canada, Health Canada, Natural Resources Canada

**Exhibit 4.12**

**Chronology of Smog Initiatives**

| | |
|---|---|
| **1990** | Commitment by federal and provincial/territorial ministers of the environment to the 1990 NOx/VOC Management Plan. The Plan outlines the first in a three-phase national program intended to resolve the problem of ground-level ozone by 2005. The Plan encompasses over 60 initiatives, with the work to be shared by the federal, provincial, territorial and municipal governments. The federal government assumes the lead for a number of the initiatives. |
| **1993** | The Canadian Council of Ministers of the Environment (CCME) and their energy counterparts in the Council of Energy Ministers (CEM) sign an agreement outlining a Comprehensive Air Quality Management Framework for Canada. Since that time, federal/provincial/territorial efforts on air issues have been co-ordinated through joint meetings of these two groups of ministers. Meetings between the CCME and the CEM are referred to as Joint Ministers Meetings (JMM). Under the 1993 Agreement, the energy and environment ministers also created a new co-ordinating committee known as the National Air Issues Co-ordinating Committee (NAICC). Comprising assistant deputy ministers from environment and energy departments, it is the main venue for co-operating on and co-ordinating government activities related to air issues in Canada. |
| **1995** | The CCME endorses the recommendations of its task force on Cleaner Vehicles and Fuels to reduce pollution from automobiles through more stringent national fuel and emission standards. Provincial programs of vehicle inspection and maintenance are also endorsed. |
| **1997** | Under the auspices of the NAICC, a working group is tasked with delivering the second phase of a national smog program to the JMM in 1997. However, the JMM does not address the draft plan developed by the working group because there is no consensus on national actions to be taken. The federal government goes ahead on its own and develops the Phase 2 Federal Smog Management Plan, which is not a federal-provincial plan as originally intended. This federal document reports on federal progress under the 1990 Plan, highlights the latest scientific research and outlines next steps for federal departments. Some initiatives under the 1997 federal plan address particulate matter (PM) in addition to NOx and VOC (hence the use of the broader term “smog” as opposed to just NOx and VOC).<br><br>The 1996 NOx/VOC Science Assessment is published. It draws together (for the first time in Canada) all aspects of scientific knowledge related to ozone and identifies gaps in that knowledge.<br><br>Canada and the United States sign an agreement signalling their intent to develop a Joint Plan of Action for Addressing Transboundary Air Pollution. The intent is to eventually develop an annex to the 1991 Canada–U.S. Air Quality Agreement that will deal with ozone. |
| **1998** | Signature of the Canada-Wide Accord on Environmental Harmonization by the CCME (with the exception of Quebec). A key element of the Accord is a sub-agreement on Canada-Wide Standards. This sub-agreement is intended to provide a framework for federal and provincial/territorial environment ministers to work together on key issues of environmental protection and health-risk reduction that require standards applicable across the country. Environment Canada and Health Canada begin to work with the provinces and territories to establish Canada-Wide Standards (CWS) for key air pollutants, including ozone and particulate matter. The federal-provincial Working Group on Air Quality Objectives and Guidelines develops assessments that provide the scientific basis for some of the air-related Canada-Wide Standards. |
| **1999** | Proposed Canada-Wide Standards for Particulate Matter and Ozone are accepted in principle by the CCME, except Quebec. The proposed standards call for a numeric limit on concentrations of these pollutants in outdoor air and a timetable for achieving the limit. The targets are to be achieved through workplans developed and delivered by each jurisdiction (see Appendix A for further information on the CWS).<br><br>Relevant federal departments outline the federal government’s proposed contribution toward achieving the Canada-Wide Standards for Particulate Matter and Ozone. When finalized, the Phase 3 Federal Smog Management Plan will constitute that contribution. |
| **2000** | Canada commences negotiations with the United States on a special annex to the 1991 Canada–U.S. Air Quality Agreement that will address ozone. The principle objective of the annex is to reduce the transboundary flow of ozone and the pollutants that lead to its formation. |

and Agriculture and Agri-Food Canada. Appendix F outlines some of the federal activities aimed at reducing smog.

### Federal powers and legislation for reducing smog

**4.128** Like the provinces and territories, the federal government has certain powers that it can use to address the smog problem. In addition to its taxation and spending powers, it has jurisdiction over international and interprovincial affairs, criminal law, aeronautics, navigation and shipping, railways, coastal waters, harbours and international and interprovincial trade and commerce. It exercises control over federal sources of smog-causing emissions and has the general power under the Constitution to make laws for the "peace, order and good government of Canada."

**4.129** The key legislation that authorizes the federal government to take action on smog is the *Canadian Environmental Protection Act (CEPA)*, administered by Environment Canada (jointly with Health Canada in some instances). The *CEPA* gives the federal Minister of the Environment the authority to conduct research, collect data and establish national objectives, guidelines and codes of practice to protect the environment. It also authorizes the federal government to regulate the content and physical properties of fuels as well as air pollution from federal operations and federal lands.

**4.130** The legislation also provides general authority for the government to control the release and production of polluting substances. However, that authority is restricted to substances that have first been declared toxic under the legislation. To date, neither ozone nor particulate matter has been added to the List of Toxic Substances under the *CEPA*. However, the federal government has declared toxic a select number of volatile organic compounds that are implicated in smog. Particulate matter (PM) has been evaluated through an assessment under the *CEPA*, and a final declaration on its toxicity is expected midway through 2000. If PM 10 (particulate matter less than 10 microns in diameter) is formally declared toxic, Environment Canada says it will develop an approach to control it and the pollutants that are involved in its formation, namely $SO_2$, NOx, VOC and ammonia.

**4.131** In cases where air pollution generated in Canada causes pollution in another country or violates the terms of an international agreement, the *CEPA* also empowers the federal government to take steps to control the sources.

**4.132** Recent changes to the *CEPA* have expanded the federal government's authority to regulate fuels and given it new authority to regulate emissions from off-road engines, such as diesel engines used in construction and farm machinery.

**4.133** Since 1971, Transport Canada has played a key role in reducing smog-causing emissions from new cars and trucks through emission standards and other measures established under the federal *Motor Vehicle Safety Act*. With the recent revisions to the *CEPA*, responsibility for limiting vehicle emissions has moved from Transport Canada to Environment Canada.

**4.134** Other federal laws that are relevant to the federal government's management of this issue include the *Department of the Environment Act*, the *Department of Health Act*, the *Energy Efficiency Act*, the *Canadian Environmental Assessment Act*, the *Aeronautics Act*, the *Canada Shipping Act* and the *Canada Transportation Act.*

### Having a broad range of tools is important

**4.135** The federal government has identified the importance of using a broad range of tools in delivering its mandate to protect public health and the environment

**The federal government has relied mainly on voluntary mechanisms and co-operation, and has made selective use of only a few regulatory instruments for reducing smog.**

from smog. It has stated its intent to achieve its goals through a combination of legislation, regulation, voluntary initiatives and economic instruments. In the 1990 NOx/VOC Management Plan, the CCME endorsed considering the full range of policy instruments. The Comprehensive Air Quality Management Framework for Canada, signed by federal/provincial/territorial energy and environment ministers in 1993, sets out principles of co-operation for the development of plans and strategies to deal with air quality. These include voluntary action, economic measures (including incentives) and public education.

**4.136** Despite the recognized need for a broad and comprehensive tool kit, the federal approach has relied for the most part on voluntary mechanisms and the co-operation of provinces, territories and industry, particularly for stationary or point sources of smog-causing pollutants (see paragraph 4.69 for definitions). Limited use has been made of economic instruments. Moreover, the federal government has made selective use of only a few regulatory instruments for reducing smog (see Exhibit 4.13). For example, there are no regulations to control smog-causing emissions from federal operations and federal lands.

**Voluntary initiatives — a major element in the 1990 Plan**

**4.137** Under the 1990 NOx/VOC Management Plan, Environment Canada participated in two different types of voluntary "national pollution prevention" initiatives to reduce emissions of smog-causing pollutants. It co-ordinated the development of non-binding national guidelines or codes of practice to be adopted and implemented by others. It also facilitated the development of voluntary agreements or reduction plans with manufacturers' associations and industry to reduce smog-causing emissions from their products or operations. The CCME sponsored the development of the national guidelines and codes of practice.

**4.138 Environmental guidelines and codes of practice.** Environment Canada led the development of 17 national guidelines and codes of practice, with federal, provincial and territorial co-operation and the involvement of interested stakeholders. These instruments are essentially advisory (non-binding) documents that outline minimum acceptable national guidelines or approaches for controlling NOx and VOC emissions. They provide a basis for establishing consistent control measures and operating practices across Canada. In most cases they apply only to new sources of emissions, not existing sources. These instruments also provide a useful benchmark for environmental assessments and environmental audits.

**4.139** The initiatives take a variety of forms and address a number of different sectors and sources of smog-causing emissions (see Exhibit 4.14).

**4.140 Implementation by others required.** While the national guidance documents have been developed under federal leadership, it is important to note that these initiatives depend on others for implementation, usually the provincial/territorial governments. Actual reductions in emissions are achieved only if these jurisdictions adopt and implement the codes or guidelines — for example, through air quality regulations or as binding requirements in operating permits. In certain situations, implementation also depends on the adoption of the guidelines and codes by the federal government for its own operations or lands; and adoption by municipalities, specific industries, facility operators and equipment manufacturers or suppliers.

**4.141** Environment Canada periodically reviews the national guidelines and codes to ensure that they are still current. However, no systematic monitoring is

**Exhibit 4.13**

**Federal Regulations to Control Smog**

**Administered by Environment Canada**

***The Canadian Environmental Protection Act (CEPA)***

**Fuel regulations**

- Diesel Fuel Regulations (effective 1999) – restrict the sulphur content of diesel fuel used for on-road vehicles (does not include diesel for marine, railway and off-road uses).
- Fuels Information Regulations (pre-date 1978) – require fuel producers and importers to report information on the sulphur content and the types of additives in liquid fuels such as gasoline, diesel and heavy fuel oil.
- Sulphur in Gasoline Regulations – (first phase of reductions required by 2002) limit the sulphur content of gasoline produced or imported into Canada.

**Toxic Substances**

- Benzene in Gasoline Regulations (effective 1999) – limit the benzene content in gasoline to no more than 1 percent by volume. Benzene is a volatile organic compound (VOC) considered to be toxic as defined under the *CEPA*. This measure was expected to reduce benzene emissions from all gas-powered vehicles by 15 percent.
- Gasoline Dispensing Regulations (effective in 2001) – regulate the flow rate of gasoline during fill-ups at the gas pump in order to reduce vapour emissions of benzene. This will yield reductions in vapour emissions of other VOC in gasoline as well.

**Administered by Transport Canada**

**Road motor vehicle emissions – regulations under the *Motor Vehicle Safety Act***

- Set limits on specific pollutants in motor vehicle exhaust of new vehicles produced in or imported into Canada (amended in 1997).
- Impose a number of other requirements on vehicle manufacturers and importers – for example, requiring the installation of diagnostic systems to monitor the functioning of emission control equipment on vehicles.

(Note: With the recent amendments to the *CEPA*, regulatory authority over motor vehicle emissions has been transferred to Environment Canada from Transport Canada. Canadian emission control standards for vehicles are now fully harmonized with those of the United States, meaning that Canadian and American standards are identical.)

**Marine emissions – air pollution regulations under the *Canada Shipping Act***

- Prohibit heavy smoke emissions from ships within one mile of shore (1964).

**Aircraft emissions – regulations under the *Aeronautics Act***

- Establish air emission standards for certain types of new aircraft engines made in or imported into Canada (designed to limit emissions during take-off and landing) (1991).

**Administered by Natural Resources Canada**

**Energy efficiency – regulations under the *Energy Efficiency Act***

- Establish national performance standards for energy-using products such as household appliances and heating and cooling equipment (beginning in 1995).

Note: Many of the more recent federal regulations arose as a result of several initiatives – the 1990 NOx/VOC Management Plan, the 1997 Phase 2 Federal Smog Management Plan and the 1995 CCME Cleaner Vehicles and Fuels Program.

undertaken to determine whether the measures are being adopted and are leading to actual reductions.

**4.142 Voluntary agreements and reduction plans.** Under the 1990 NOx/VOC Management Plan, the federal government led the development of three initiatives to encourage manufacturers and industry to reduce smog-causing emissions. One is an agreement between Environment Canada and the Railway Association of Canada that sets a cap on total NOx emissions from locomotive engines. The other two are reduction plans that call on manufacturers of adhesives, sealants and consumer paints to voluntarily reduce the amount of VOC in their products.

**4.143** There are other examples of federal voluntary arrangements that promote smog reduction:

- the voluntary arrangement on motor vehicle fuel efficiency between the federal government and the motor vehicle industry (managed jointly by Transport Canada and Natural Resources Canada);

- government/industry pollution prevention agreements. While not directed specifically at smog, these were agreements to reduce emissions of toxic substances, some of which are volatile organic compounds and play a role in smog formation. They include agreements with the printing and graphics industry and automotive manufacturers. At present, only Environment Canada and the Ontario Ministry of the Environment are involved; and

- Environment Canada's new memoranda of understanding (MOUs) with manufacturers of "off-road" engines.

**New national initiatives needed to reduce smog**

**4.144** Although 10 years have passed since the approval of the 1990 NOx/VOC Management Plan, the federal government acknowledges that it still needs to develop and lead further initiatives to combat smog. It plans to address emissions from a wide variety of significant sources, including consumer products, paints and solvents, residential wood heating, off-road engines, steel and chemical manufacturing, as well as the base metals, pulp and paper, lumber and wood products industries. In addition, the federal government has acknowledged that fuel standards and vehicle standards go hand in hand. In some cases, vehicle technology used to lower vehicle emissions requires

**Exhibit 4.14**

**Environmental Guidelines and Codes Developed Under the 1990 NOx/VOC Management Plan**

- Three CCME-endorsed national air emission guidelines recommending NOx emission targets for stationary sources such as boilers and heaters, stationary combustion turbines and cement kilns.
- Twelve CCME-endorsed environmental codes of practice and guidelines that outline a series of recommended environmental management practices and procedures, as well as equipment and operating standards to reduce VOC emissions from certain activities or operations. In some cases, they may contain suggested targets for VOC emissions. The stationary sources include releases from above-ground storage tanks, dry-cleaning operations, commercial and industrial printing, plastics processing, auto body repair shops, gasoline distribution networks and vehicle refueling. One guideline addresses mobile sources of NOx and VOC: the Environmental Code of Practice for Light Duty Motor Vehicle Emissions Inspection and Maintenance Programs.
- One non-binding product "standard" endorsed by the CCME for paints and other related products used exclusively by auto body repair shops (focusses on the VOC content of these products).
- One *Canadian Environmental Protection Act (CEPA)* national air emissions guideline for electric utilities fired by fossil fuels (for NOx, PM and SO2 emissions).

CCME: Canadian Council of Ministers of the Environment

low-sulphur fuels. The government intends to pursue new initiatives in the fuels sector through a comprehensive strategy to improve fuel quality. The strategy is to be worked out with stakeholders over the next decade. Clearly, much remains to be done to develop a comprehensive federal approach that will fully address the sources of smog-related pollutants.

**Implementation of the 1990 NOx/VOC Management Plan**

**4.145** Because the federal government cannot solve Canada's smog problem on its own, it has entered into partnerships or collaborative arrangements with the provinces and territories to address the problem. We audited the federal government's role in implementing its key partnership arrangement, the 1990 NOx/VOC Management Plan. The Plan was intended to fully resolve Canada's ozone problems by 2005. Ten years after introducing the Plan, the federal government acknowledges that progress has been slower than planned and the target date will likely not be met. We examined key aspects of the federal government's management of its own initiatives under the Plan and its broader role of providing national leadership. Part III of this chapter summarizes our audit findings.

**Much remains to be done to develop a comprehensive federal approach.**

# PART III — AUDIT OBSERVATIONS AND RECOMMENDATION

## Introduction

**4.146** The previous Minister of the Environment committed Environment Canada to improving significantly the quality of Canada's environment. This included improving the quality of our air, where science says the risks to human and ecological health are great. Clean air has been designated as an urgent and high-priority issue for the Department.

**4.147** The federal government has acknowledged that national progress in combating smog has been slower than planned, and much more remains to be done. The most compelling reason for a federal role in managing smog is the mandate shared by Health Canada and Environment Canada to protect the health of Canadians from risks in the environment. The federal government sees its role as providing national leadership, co-ordination and facilitation in tackling Canada's smog problem. In the federal government, Environment Canada has the lead responsibility for maintaining and enhancing Canada's air quality, a responsibility it shares with Transport Canada, Health Canada, Agriculture and Agri-Food Canada and Natural Resources Canada.

**4.148** Because responsibility for dealing with smog is not confined to its own jurisdiction, the federal government cannot solve Canada's smog problem on its own. In addition to pursuing actions within its own authority, Environment Canada has to work with other federal departments, other Canadian jurisdictions and the United States. In 1990 the federal government chose to enter into a partnership with the provinces and territories to reduce smog.

**The 1990 NOx/VOC Management Plan set out a broad, three-phased national approach aimed at "fully resolving ground-level ozone problems in Canada by the year 2005. "**

### The 1990 NOx/VOC Management Plan

**4.149** The Canadian Council of Ministers of the Environment (CCME) is an intergovernmental forum for discussion and joint action on environmental concerns that cross jurisdictions. Its members, the federal, provincial and territorial ministers of the environment, meet to discuss national priorities for the environment and to determine the work to be carried out under their auspices. (See paragraph 4.123 for additional information on the CCME.)

**4.150** Recognizing the seriousness of the ozone problem, the CCME decided in October 1988 to request the development of a national management plan for the control of nitrogen oxides (NOx) and volatile organic compounds (VOC), the air pollutants that lead to the formation of ozone. A federal-provincial steering committee reporting to the CCME developed the 1990 NOx/VOC Management Plan.

**4.151** The committee consulted widely with governments, industry and non-governmental organizations to prepare the 1990 Plan. The CCME endorsed the Plan by consensus at its annual meeting in November 1990. The federal, provincial and municipal governments would implement the Plan, with each accountable for its own performance.

**4.152** The 1990 Plan set out a broad national approach and outlined the first of three phases aimed at "fully resolving ground-level ozone problems in Canada by the year 2005." According to the Plan, this would require that by 2005 all areas of Canada would consistently attain the national air quality objective for ozone, 82 parts per billion (ppb). The Plan recognized that regional targets for reducing emissions, to be developed under

the first phase, would not be stringent enough to fully resolve ozone problems. The second and third phases were to set final targets or caps and develop additional remedial measures (see Exhibit 4.15).

**4.153** Phase 1 of the 1990 Plan contained a "base" set of 31 specific initiatives to reduce emissions under the national prevention program. There was also an "illustrative" set of 27 regional initiatives that the other jurisdictions could use in designing remedial programs for areas with major ozone problems. The Plan identified three ozone problem (or "non-attainment") areas: the lower Fraser Valley (British Columbia), the Windsor–Quebec City Corridor (Ontario and Quebec) and the Southern Atlantic Region (particularly Bay of Fundy and Saint John areas).

**4.154** There were also 24 study initiatives aimed at generating the additional information needed to set final caps on emissions, design additional emission control programs and track progress toward the interim reduction targets. The Canadian NOx/VOC Science Assessment, published in 1997, provided a major contribution to scientific knowledge about ozone and particulate matter. The results set the stage for ongoing research on smog, and identified the importance of controlling particulate matter as well as NOx and VOC. Thus, while the 1990 Plan focussed only on controlling NOx and VOC, it was clear that future plans would have to address the emerging problem of particulate matter.

**Future plans would have to address the emerging problem of particulate matter.**

**Ambient monitoring of air pollutants**

**4.155 Canada's current national air quality objectives.** Since the 1970s, Canada has had national air quality objectives that seek to protect human health, crops and forests by specifying target levels for several air pollutants. They are designed to provide a degree of protection while considering other factors such as the social, economic, and technological feasibility of reducing pollution.

**4.156** In Canada, air quality objectives are established under federal, provincial and territorial legislation. Federal legislation sets national air quality objectives for levels of five common pollutants in outdoor air (ozone, total suspended particulates, carbon monoxide, sulphur dioxide and nitrogen dioxide). Each objective represents an air

**Exhibit 4.15**

**Three Phases of the 1990 NOx/VOC Management Plan**

| | |
|---|---|
| **Phase 1 (1990–1994)** | • Establish a strong national prevention program to address new mobile and new stationary sources of emissions, and improve public education.<br>• Set interim targets for reductions in NOx and VOC emissions for 1995 and 2005 in designated ozone problem areas, to be negotiated between the federal government and the jurisdictions involved. Develop regional remedial programs to reach those targets.<br>• Conduct studies and investigations to provide the base for establishing final caps on NOx and VOC emissions in ozone problem areas for 2000 and 2005. |
| **Phase 2 (1994–1997)** | • Establish final caps on NOx and VOC emissions in designated ozone problem areas for the years 2000 and 2005, with the 2005 targets selected to meet the 82 ppb objective for ozone.<br>• Identify additional remedial measures for ozone problem areas and, if appropriate, extend or tighten the prevention program to achieve the 2000 and 2005 caps. |
| **Phase 3 (1997–2005)** | • Make final adjustments to the emission caps and reduction programs in the ozone problem areas. |

management target for concentration of the pollutant in the air at given lengths of exposure. The national objectives are long-term goals, intended only as guidance for the management of air quality. They are not prescriptive or legally binding on the jurisdictions and are not enforceable by law, unless incorporated into regulated standards or facility permits.

**4.157** Provinces and territories can set objectives or legally enforceable standards under their own legislation that may be more stringent than the national objectives. Or they may set none at all. In many cases, provincial objectives are based on the national objectives. But in other cases, provinces develop their own objectives based on their own assessments of relevant factors.

**4.158** When the 1990 NOx/VOC Management Plan was developed, federal air pollution strategies were based on the belief that there was a safe lower limit on the levels of pollutants that make up smog. However, new evidence has been unable to identify a level at which the main pollutants in smog — ozone and particulate matter — have no effect on human health.

**4.159** **National tracking system.** A national tracking system follows Canada's progress in improving its air quality under the 1990 NOx/VOC Management Plan. It involves monitoring outdoor air quality; developing inventories of pollutant emissions — sulphur dioxide ($SO_2$), nitrogen oxides (NOx), volatile organic compounds (VOC) and particulate matter (PM); mathematical modelling of reduction scenarios, using complex computer programs; and forecasting levels of these same pollutants. The information gained from tracking can be fed back into science, policy and program delivery. For example, it can be used to identify trends and assess whether control measures are having the intended results.

**4.160** Monitoring of outdoor air provides an important indication of the state of the environment in a geographic area. Concentrations of pollutants measured at monitoring sites across Canada can be compared with established air quality standards or objectives to indicate the general quality of the surrounding atmosphere. The levels of pollution in the air also indicate whether any adverse human health effects can be expected.

**4.161** Environment Canada and Health Canada have worked with the provinces and territories to establish new numeric Canada-Wide Standards for outdoor concentrations of key air pollutants, such as ozone and particulate matter. These new standards will replace the current national air quality objectives.

**Focus of the audit**

**4.162** Environmental issues are complex, affecting many aspects of Canadian life. No one jurisdiction has authority over all environmental concerns. The federal and provincial/territorial governments each have certain powers to regulate matters within their own domains.

**4.163** Our audit focussed on the federal role in Canada's national smog-reduction program, the 1990 NOx/VOC Management Plan. The Plan was developed as the cornerstone of the federal government's response to Canada's smog problem. We examined the way the Plan has evolved over the past 10 years. We audited key aspects of the federal government's management of its own initiatives under this domestic program, as well as its broader role of providing national leadership. Our audit work was restricted to the federal roles and responsibilities — in particular, those of Environment Canada, the federal leader on air quality issues.

**4.164** Our audit concentrated on how the 1990 Plan was implemented. We asked

some fundamental questions about the Plan:

- Did it provide sound strategic direction?
- Were basic management principles applied in implementing it, including establishing a governing framework with clear accountability for specific results and providing transparent information to the public and Parliament?
- Did the federal government do what it promised to do?
- Was the Plan implemented as intended, and is the achievement of the overall goal in sight?

**4.165** We did not audit the development of the proposed new standards for particulate matter and ozone under the Canada-Wide Standards process. However, we do describe the process in Appendix A.

**4.166** We examined the roles and responsibilities for national monitoring of smog-causing pollutants in ambient (outdoor) air. Ambient air monitoring is viewed as the best means of tracking Canada's progress under the 1990 Plan.

**4.167** Further details on our audit objectives, scope and approach can be found at the end of the chapter in the section **About the Audit**.

# Observations

## Implementation of the 1990 NOx/VOC Management Plan

### The 1990 Plan provided sound strategic direction

**4.168** Planning entails several stages at increasing levels of detail. At the initial stage, it is important to outline a strategic direction. For example, a plan should initially identify the desired goals and objectives, describe the general approach to be followed and establish timetables. It should also identify the risks that must be addressed and the governing framework needed. This includes outlining the roles and responsibilities of the parties involved and the actions they plan to take.

**4.169** The 1990 NOx/VOC Management Plan identified the nature of the health and environmental risks associated with ozone and the need to resolve this serious problem. It also identified an ultimate goal (consistent attainment of the national air quality objective for ozone — 82 ppb in all areas of Canada) and a general approach with a specific date for attaining that goal (by 2005).

**4.170** The Plan recognized the need for a governing framework that would include systems for monitoring, review and adjustment, and reporting. Phases 2 and 3 were to provide an opportunity for major midcourse corrections, if necessary. The Plan indicated when those phases were to be developed. It acknowledged the importance of having a broad range of measures for the federal, provincial and territorial governments to use. It also provided a comprehensive menu of possible solutions, based on what was known about smog at the time.

**The 1990 Plan provided sound strategic direction and was an excellent first step.**

**4.171** In our opinion, developing the 1990 Plan represented a major achievement by the federal, provincial and territorial governments. The Plan provided sound strategic direction and was an excellent first step in the process that would be required to fully address Canada's smog problem.

### No agreement on a governing framework

**4.172** Once partners in a joint undertaking establish a strategic direction, it is important that they agree on a governing framework for implementation. In developing our expectations for such a framework, we drew on Collaborative Arrangements: Issues for the Federal Government (Auditor General's

April 1999 Report, Chapter 5) and Involving Others in Governing: Accountability at Risk (Auditor General's November 1999 Report, Chapter 23). Exhibit 4.16 sets out the key features of a governing framework.

**When the proposed federal-provincial agreements failed to materialize, the 1990 Plan was destined to fail.**

**4.173** We found that the partners in the 1990 NOx/VOC Management Plan agreed on the details of only a few of these elements. They broadly identified roles and responsibilities and agreed on some national performance expectations for the size of reductions in NOx and VOC levels and peak ozone levels to be achieved by 2005. However, the federal government did not clearly define the nature of its leadership role in facilitating development of national strategies and regional remedial programs.

**4.174** If a governing framework is to be effective, in our opinion, detailed agreements must be signed in the early stages of the implementation process. The agreements must specify who will do what by when, what results are expected, and what will be the consequences of non-performance by the partners.

**4.175** The CCME ministers agreed to negotiate federal-provincial agreements by November 1991. The agreements were to provide details of the prevention, remedial and study programs, as well as the specific responsibilities and commitments of each jurisdiction. The agreements were also to define the interim reduction targets. Discussions began but, in the end, there was no formal negotiation of agreements.

**4.176** In the absence of signed agreements, the federal and provincial governments never formally set out their prevention, remedial and study programs, their specific responsibilities, or their commitments to implement the Plan and the consequences of non-performance. Because interim reduction targets for the three ozone problem areas were never set out, there were no milestones or benchmarks by which to assess progress over time toward the ultimate goal. In our opinion, when the proposed federal-provincial agreements failed to materialize by November 1991, the 1990 Plan was destined to fail.

**4.177** In the Plan, the ministers also agreed to establish and maintain a system to track all prevention and study initiatives and their progress. However, there was no agreement on the specific means of monitoring and reviewing all three phases. The federal government has continually acknowledged the need for such a system but has yet to develop one.

**Exhibit 4.16**

**Key Features of a Governing Framework for Collaborative Arrangements**

**A governing framework should include:**

- Jurisdictional commitments, with clear roles and responsibilities identified for each party to the arrangement.
- The specific contributions each party is to make, including co-ordination with each other, and priorities and completion dates for individual initiatives.
- Performance expectations – the results to be achieved.
- Benchmarks (interim and final targets for concrete results) against which to assess interim progress in the years preceding the final target date.
- A monitoring system for ongoing systematic tracking of achievements so that the contribution and performance of each partner can be assessed, as well as the performance of the partnership overall.
- A system of review and adjustment, as required, to achieve the targets.
- A contingency plan for major midcourse corrections, if required.
- Mechanisms for credible and timely reporting to the public and Parliament on performance (activities and results), including provision of transparent information.

Without it, the government cannot say to what extent the partnerships' activities are reducing smog, or whether corrective action will be needed to reach the goal of the Plan.

**4.178** The 1990 Plan also recognized the need for continuous public access to information on the status of all initiatives and programs, and for annual reporting to the CCME. However, no agreement was reached on responsibilities for reporting or exactly how the public would be kept informed over the life of the Plan.

**4.179** The 1990 NOx/VOC Management Plan recognized that the basic elements of a governing framework needed to be in place if the Plan were to be implemented successfully. Although the governments knew what had to be done, in the early stages of implementation they did not agree on the details of the governing framework to be used, and many of the key elements were never put in place.

**Accountability is diffused**

**4.180** Accountability is the obligation to demonstrate and take responsibility for performance in light of agreed expectations. Clearly stated performance expectations are part of a governing framework. Despite the identified need for strong, regionally targeted remediation programs to achieve the goal, the provinces never agreed on the specific contributions they would make. The federal government identified the activities it would complete under the 1990 Plan but not the specific reductions in smog levels it expected to achieve as a result.

**4.181** As already noted, although the CCME endorsed and led the 1990 Plan, it cannot cause the federal government, provinces, territories or municipalities to take action. Its role is limited to co-ordination and facilitation. Governments are accountable for implementing the Plan, with each jurisdiction deciding whether or not to adopt proposals that governments have agreed to through the CCME.

**4.182** We found that an appropriate accountability regime for the 1990 Plan was never put in place to clarify the roles, responsibilities and expected performance of each level of government. It was thus unclear whom the public and Parliament could hold to account should the Plan fail.

**Without an appropriate accountability regime, it was unclear whom the public and Parliament could hold to account should the Plan fail.**

**The 1990 NOx/VOC Management Plan was never implemented as originally envisioned**

**4.183 The federal government delivered its own initiatives.** The 1990 NOx/VOC Management Plan outlined the initiatives the federal government would undertake in areas clearly under its jurisdiction. The government indicated where it planned to take the lead, and it led many of the National Prevention Initiatives. The federal government delivered most of the activities it was responsible for under these initiatives.

**4.184** The National Prevention Initiatives had two parts. The federal government was responsible for the first part — to develop performance standards for new emission sources, measures to control VOC emissions from products, and energy conservation and efficiency measures. The government accomplished this mainly by developing national codes and guidelines. These are essentially advisory documents that outline minimum acceptable national guidelines or approaches for controlling NOx and VOC emissions from a variety of sources (discussed in Exhibit 4.14). The second part of the national initiatives required the responsible parties (the federal government, provinces, territories, municipalities or industry) to implement the new codes and guidelines and thereby actually reduce emissions.

**4.185 Public awareness is still needed.** All Canadians have a role to play in solving Canada's smog problem. People need to be aware of how their actions

contribute to smog and how they can make choices that cause less air pollution. Under the National Prevention Initiatives, the federal government took the lead in delivering four public awareness initiatives to influence consumer choice and lifestyle. In a progress report to the CCME in 1994 and again in the 1997 Phase 2 Federal Smog Management Plan, the government stated that work was continuing on all four of the initiatives. The most recent draft of the Phase 3 Federal Smog Management Plan also recognizes that more public education is needed because it remains vital to the success of smog-reduction measures.

**4.186** The federal government also carried out several studies and investigations under the 1990 NOx/VOC Management Plan. This included leading a major science assessment, published in 1997.

**The phased approach did not unfold as planned.**

**4.187 A need for future phases.** When the 1990 NOx/VOC Management Plan was initiated, the National Prevention Initiatives were not in themselves expected to significantly reduce ozone levels in Canada. The Plan focussed on establishing national prevention measures to protect regions with "clean" air from deterioration and to provide a basis for targeting remediation programs where they were needed. To develop the governing framework and successfully implement the 1990 Plan, phases 2 and 3 had to be completed. However, the phased approach did not unfold as planned.

**Only modest national reductions in NOx and VOC could be expected as a result of the federal activities.**

**4.188 Phase 2 was not developed as originally envisioned.** In the early 1990s, it became evident that air issues were not a matter for the environment ministers alone, and could not be addressed effectively in isolation. Since 1993, federal and provincial/territorial ministries of the environment and of energy have co-ordinated their work on air issues, primarily through joint meetings of the CCME and the Council of Energy Ministers. These meetings are referred to as Joint Ministers Meetings (JMM).

**4.189** Phase 2 was to be produced in 1994 as a continuation of the 1990 Plan. It was to comprise several provincial plans and a federal-provincial plan. However, its development was delayed. A working group was tasked with delivering a national smog management plan to the JMM in 1997. But the JMM did not address the draft plan that was developed. The original concept for Phase 2 ultimately fell apart and, instead, the working group presented a *Status Report and Next Steps on Smog in Canada* to the November 1997 JMM. The report outlined the actions the parties had taken so far but it failed to link the results of those actions to the goal of resolving ozone problems by 2005.

**4.190** The federal government then developed the Phase 2 Federal Smog Management Plan on its own. The Phase 2 Plan was sponsored by the departments of environment, natural resources and transport. They completed it in November 1997, three years behind the schedule envisioned in the 1990 Plan. Because it was not a federal-provincial plan, potential synergies of joint efforts were lost.

**4.191** The Phase 2 Federal Smog Management Plan built on the National Prevention Initiatives in the 1990 NOx/VOC Management Plan. New information from research undertaken during Phase 1 led to plans for specific federal initiatives under Phase 2. These initiatives were to address not only ozone precursors (NOx and VOC) but also particulate matter, which had emerged as a significant part of the smog problem.

**4.192** The 1997 Phase 2 Federal Smog Management Plan stated that even if it were implemented fully, only modest national reductions in NOx and VOC could be expected as a result of the federal activities. The Phase 2 Plan noted that while federal actions would help to reduce smog nationally, focussed regional programs of remediation were still needed to reduce smog in areas of poor air

quality. The Phase 2 Plan did not show how the reduction targets it identified were directly related to achieving Canada's ozone objective; and it included a new target date of 2010 for reducing emissions.

**4.193 Phase 3 is still being developed.** The 1990 NOx/VOC Management Plan called for a third and final phase in 1997 to ensure that the national goal would be achieved. The original three-phase process of the 1990 Plan has evolved since then. The development of the Canada-Wide Accord on Environmental Harmonization and its Canada-Wide Environmental Standards Sub-Agreement in 1998 led to proposed new Canada-Wide Standards for Particulate Matter and Ozone (see Appendix A). The federal government plans in 2000 to produce a third phase of the 1990 Plan, to set out its contribution toward achieving the Canada-Wide Standards.

**4.194 Provincial plans did not unfold as envisioned.** As already discussed, there are no federal-provincial agreements for implementing the 1990 Plan. Two of the provinces did publish provincial smog management plans (British Columbia/ Greater Vancouver Regional District in 1994 and Ontario in 1998). As our audit responsibilities are limited to the federal government, we did not examine the results of the two provincial plans. However, we found that they have different goals and it is difficult to identify how their proposed reductions are linked to achievement of the original goal for 2005.

**Transparent information is essential**

**4.195** A governing framework for a partnership arrangement needs to have mechanisms for credible and timely reporting on performance, including reporting as each key phase or milestone is reached. This includes providing information on activities and results. A national program like smog should provide for keeping the respective legislative bodies and the public informed. Parliament ought to be provided with transparent information to scrutinize federal smog-reduction efforts and to hold the federal government accountable.

**4.196** Each partner has a responsibility to provide information to its partners and its own legislature. The public is an important stakeholder in national smog programs. It needs to be actively involved if this problem is to be solved (see Exhibit 4.17). It is the public who will hold their governments to account for

**Exhibit 4.17**

**Importance of an Informed Public**

**Addressing the smog problem requires an informed public**

- With information, people are better able to make choices that protect their health and reduce their contribution to smog. They are better equipped to take responsibility for their use of energy and transportation. Information also helps them adjust to changes that may be required in their attitudes, lifestyles and behaviour.
- An informed public provides a more solid foundation for public debate. Information helps the public better understand and support decisions, policies and actions of governments. Transparent information would help the public to participate actively with governments in managing and resolving the smog problem.
- Information helps build a national political consensus on national values and the need for action.
- An informed public is the only means of holding jurisdictions jointly accountable, because individual partners cannot be held accountable for the success or failure of the partnership as a whole.
- The federal government needs to win public confidence in its handling of the serious smog problem. It needs to be seen by the public as having taken credible action on smog and to show that its action has made a difference.

Canada's progress in combating smog, and to do this it needs information. An objective assessment of progress, based on good information, enables the public to compare their governments' stated intentions or goals with what they have actually done.

**4.197** To play its role, the public needs ready access to reliable, objective, comprehensive, timely and meaningful information. This would include information on the nature of the smog problem, how the federal government uses partnerships to deliver its mandate, and strategic plans that include the roles and responsibilities of the partners, their goals, and the contribution expected of each. The information would describe the activities of the federal government and its partners in combating smog and the results they have achieved. It would also include projected trends, deviations from plans and progress measured against established benchmarks.

**Both the public and Parliament ought to be provided with transparent information.**

**4.198** The federal government has a responsibility to ensure that all Canadians, including Parliament, are informed about all aspects of the smog problem. We examined its communication to Parliament and the public on the implementation of the 1990 NOx/VOC Management Plan over the last 10 years to see whether it has given them transparent information.

**Poor reporting of results to the public and Parliament**

**4.199** To protect the public interest and enable the public and Parliament to scrutinize smog-reduction efforts, the partners need to agree on a monitoring and reporting regime that specifies who is to provide what information to whom, and when. An appropriate reporting regime would also help the provinces and territories fulfil their own reporting requirements to their own legislatures. When the federal government chooses to deliver its mandate through partnerships, in our opinion it has a responsibility to ensure the implementation of an appropriate reporting regime.

**4.200 Progress reports anticipated but not delivered.** The reporting system for the 1990 NOx/VOC Management Plan was to include continuous public access to information on the status of all the Plan's initiatives and programs. The Plan identified the need for a brief progress report to the CCME in October of each year. That report was to indicate any problem areas and recommend corrective actions. However, we found that only two progress reports had ever been submitted to the ministers — one in October 1994 and one in November 1997. Neither is readily available. The 1997 Phase 2 Federal Smog Management Plan contained some information on progress but only in the form of listed activities. The draft Phase 3 Federal Smog Management Plan provides an update on some activities of the previous phases. Both plans are available on Environment Canada's "Green Lane" on the Internet.

**4.201** The "Green Lane" also has a number of sites dealing with various aspects of the smog problem. These sites provide information on the seriousness and complexity of the problem. They refer to the 1990 Plan and various activities under way to combat smog.

**4.202** Departmental performance reports and reports on plans and priorities submitted each year to Parliament are other potential sources of performance information. Our review of Environment Canada's documents for the last nine years found that they provide very little useful information about progress toward the original goal of the 1990 Plan, or on reductions the federal government has achieved under the Plan.

**4.203** The documents provide only general information on objectives, and they report on activities performed such as studies undertaken and the science assessment that was published. They report the codes and guidelines that were

developed rather than the results they achieved in reducing smog levels.

**4.204** The documents provide insufficient information about progress. Documents from 1992–93 to 1995–96 reported the 2005 goal but gave no indication of how much further Canada needed to go to meet it. Reports after 1995–96 do not refer to the original goal. Further, while the delays in developing the federal-provincial agreements were reported in 1993–1994, later reports make no mention of the agreements.

**4.205** Many of the initiatives under the 1990 Plan involved developing national codes of practice and guidelines. We found that once the CCME had published the codes and guidelines, the federal government reported (in its 1997 Phase 2 Plan) that the initiatives had been completed (see Exhibit 4.18 for examples).

**4.206** Developing and agreeing on a national code of practice are just the first steps. The codes and guidelines have to be adopted and followed if NOx and VOC emissions are to be reduced. We found that Environment Canada relies on others to implement the codes and guidelines.

**4.207** Although various documents have reported progress in developing codes and guidelines, there is no formal mechanism in place to determine whether the guidelines are followed and reductions achieved. Despite having reported that initiatives were completed, the federal government has no assurance that they have actually reduced smog in Canada. The federal government needs to make a more credible case for the contribution these codes and guidelines have made to addressing the smog problem.

**4.208** In summary, we found that the various sources of information provide little information on actual reductions in NOx and VOC achieved by the initiatives, or on progress toward the overall goal. The federal government has not fully outlined the problems it faces in combating smog. For example, it never informed the public and Parliament that the 1990 NOx/VOC Management Plan was “off the rails”, that the partnership and its three-phased approach to dealing with the smog problem were not working as envisioned and that the goal was in jeopardy. Moreover, reporting on the 1990

**Reporting on the 1990 Plan has been fragmented and difficult to find.**

**Exhibit 4.18**

**Examples of Phase 1 Initiatives Identified as Completed in the 1997 Phase 2 Plan**

| Purpose | Results/Progress |
|---|---|
| Limit NOx emission from combustion turbines | *National Emission Guidelines for Stationary Turbines* was published by CCME in December 1992. |
| Reduce tailpipe and evaporative emissions resulting from tampering of vehicle emission control system or poor vehicle maintenance | *Environmental Code of Practice for Light Duty Motor Vehicle Emissions Inspection and Maintenance Programs* was published by CCME in October 1994. |
| Reduce VOC emissions from new and existing VOC storage tanks | *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks* was published by CCME in June 1995. |
| Reduce VOC emissions from organic chemical plants | *Environmental Guideline for the Control of Volatile Organic Compounds Process Emissions from New Organic Chemical Operations* was published by CCME in September 1993. |

Plan has been fragmented and difficult for the public to find. In fact, it would be very difficult for the public and Parliament to assess Canada's actual progress in addressing the smog problem.

## Co-ordination of Air Pollutant Monitoring

**National Air Pollution Surveillance (NAPS) network**

**4.209** Because smog crosses provincial, territorial and national boundaries, monitoring the pollutants in smog is a federal, provincial and territorial concern. Currently, Environment Canada participates in seven major programs that involve monitoring air pollutants. The largest monitoring network and the one most relevant to smog is the National Air Pollution Surveillance (NAPS) network. Provincial/territorial and municipal agencies operate and maintain most of this network. They gather and validate most of the monitoring data as an integral part of their own activities to control air pollution.

**The National Air Pollution Surveillance (NAPS) network, operated by federal, provincial, territorial and municipal agencies, monitors the pollutants in smog.**

**4.210** Environment Canada provides national co-ordination of these monitoring activities. It processes, validates, compiles and annually publishes national data gathered in monitoring. It maintains a national database with archived data dating back to 1974. It also develops criteria for deciding where to locate monitoring equipment. It runs national quality assurance programs, promotes standards for equipment and methods of measuring, and operates two sampling stations in the National Capital Region. The NAPS network supports both the needs of the provinces and territories and the national NAPS program. Environment Canada provides the major portion of the instruments used in the national NAPS program for monitoring, sampling and calibration, as well as some technical assistance to operate the network. The provinces and territories provide instruments that support their needs and those of the national NAPS program.

**4.211** The NAPS network was established in 1969 as a joint program of the federal and provincial governments. Given the concern about human exposure to air pollutants, they saw the need for a network that would provide information to a national database on air quality in the major urban centres.

**4.212** Provinces were contemplating building up their own networks for control purposes. The parties agreed to enter measurements from selected representative stations operated by the provinces into a national information database. It was expected that the provinces would operate and maintain the monitoring stations as an integral part of their pollution control activities, and the federal government would be the logical leader to design and co-ordinate this national network.

**4.213** The initial priority for the NAPS program was to monitor pollutants for which there were national air quality objectives. Accordingly, Environment Canada has reported on sulphur dioxide, carbon monoxide, nitrogen dioxide, ozone and total suspended particulates. These components of smog are measured at over 152 stations in 55 cities of the 10 provinces and two territories.

**4.214** Recent years have seen a number of additional monitoring activities under the NAPS program. For example, in 1984 the NAPS network began to monitor particulate matter. Since 1989, 40 sites have also monitored some volatile organic compounds (VOC). In addition, non-urban sites have been set up to monitor ozone, supplementing NAPS stations in cities.

**4.215** The NAPS program obtains hourly data on ozone and NOx. Validated data are later transferred into the federal database. Information on VOC is collected over a 24-hour period and can be obtained as often as resources permit. VOC information must be collected manually

and analyzed, and then the data are entered into the database. Information on particulate matter is collected manually and on a continuous basis.

**4.216** Data from the NAPS network also support a number of other major national efforts, such as the national acid rain initiatives. The NAPS network recognizes that pollutants other than those currently measured are a concern now, and may be in the future. In addition, the new Canada-Wide Standards for Particulate Matter and Ozone will have a significant influence on the future direction of monitoring outdoor air.

**Lack of formal agreement on roles and responsibilities**

**4.217** Given the importance of the network, we expected that all interested parties would have a written agreement detailing how they would operate, maintain and enhance it. The division of responsibilities among the federal, provincial, territorial and municipal agencies has evolved over the life of the NAPS network. Responsibilities were assigned on a generally informal, ad hoc basis following discussions at regular meetings of a federal/provincial/territorial advisory committee on air quality. Working arrangements arrived at over the years through discussion have become the basis for the network's current operations.

**4.218** In our opinion, these informal arrangements have left the network vulnerable to diminishing or unfulfilled commitments by the participating agencies. There have already been delays in gathering data, and gaps in the data that have been reported. The lack of formal arrangements means that the federal government has no way to be assured of a continuous flow of current and complete data on national air quality.

**4.219** The federal, provincial and territorial governments recognize this vulnerability. We found that the NAPS program managers recently began to document the NAPS mission statement, fundamental principles, major activities and the roles of Environment Canada and provincial, territorial and municipal governments.

**Lack of national direction**

**4.220** Our review found various documents stating that the federal government was to provide leadership in developing criteria and goals for air quality. It would also provide co-ordination to ensure that provinces collected the same kinds of data. It would assemble and distribute scientific and technical information. Although the parties generally agreed on the federal role, this agreement was never formally documented.

**4.221** We expected that in its leadership role the federal government would provide direction on developing the network, identifying current and projected needs (both regional and national) and

*Information on air pollutants is gathered by the ambient monitoring network (see paragraph 4.215).*

**Source:** Ontario Ministry of the Environment

co-ordinating national resource plans to ensure that these needs could be met. The federal government has provided some strategic direction in fulfilling national monitoring requirements by establishing programs such as the particulate matter and VOC sampling programs. However, our review found no documented and agreed-upon national vision or direction for the NAPS network or priorities for maintaining and enhancing it.

**The NAPS network is under considerable strain, including aging instruments.**

**4.222** Although various documents partly identify the national needs and priorities for monitoring outdoor air, no single document formally defines them. Over the last few years, federal/provincial/territorial committees have published studies indicating the pollutants that should be monitored and the kind of network needed to support this monitoring. For example, the Canadian NOx/VOC Science Assessment (a federal-provincial project) published in 1997 recommended that the responsible agencies maintain and enhance the national monitoring network. It also identified priorities for action and suggested what a national network needed. However, there has been no national approval or adoption of the study recommendations.

**4.223** The documents Environment Canada provided to us indicate that federal officials have identified significant weaknesses in the present national monitoring system. NAPS program officials have developed plans that include capital replacement and human resource requirements. They have identified the funds required for future needs. For example, Environment Canada has identified the additional monitoring that it believes will be needed to support the new Canada-Wide Standards for Particulate Matter and Ozone.

**Without financial commitment, national direction and formal national agreement on what is needed, the network may not be enhanced or properly maintained.**

**4.224** Federal NAPS managers have indicated to us, the Department and the other participating agencies that the national monitoring network is under considerable strain. They report that nationally, NAPS instruments are aging and most are well beyond the industry standard lifetime of eight years. They also report that it is difficult to obtain the necessary funding and that program staff are stretched to the limit and have problems handling the existing workload.

**4.225** There is no formal federal commitment to future funding to keep the network operating and to avoid “rust-out”. For example, when the NAPS network operations required significant additional funding in 1999, NAPS managers had to find the funds from federal sources outside the NAPS program. The federal government indicates that it will need to provide funding of more than $4.2 million in the first year to enhance the network and provide the monitoring capability it believes is needed to support the new Canada-Wide Standards. At the writing of this chapter, this amount had not been formally approved.

**4.226** We were informed that when the NAPS network was established, the federal government shared the costs of the network 50-50 with the other participants. The federal government provided the monitoring instruments and the provinces arranged for their operation. Departmental documents indicate that today the other participants are bearing the major portion of the costs of the network.

**4.227** A national monitoring system is essential to provide a national picture of air pollution. Without financial commitment, national direction and formal national agreement on what is needed, the network may not be enhanced or properly maintained. This could limit the federal government’s ability to fulfil its national monitoring role. A weakening of the national monitoring system could mean that the network would be unable to deal with future demands. In our opinion, the requirements of the national monitoring network need to be addressed

as part of the Canada-Wide Standards process.

## Proposed Canada-Wide Standards for Particulate Matter and Ozone

**4.228 The 2005 target for clean air will likely not be met.** The original goal of the 1990 NOx/VOC Management Plan was to consistently attain the national air quality objective for ozone of 82 ppb, (1-hour averaging time) in all areas of Canada by 2005. Since the Plan's introduction, the ozone objective has been regularly exceeded in most of Canada's populated areas. Moreover, new scientific evidence has been unable to identify a level at which ozone or particulate matter has no effect on human health. The federal government acknowledges that the original ozone target date will likely not be met.

**4.229 The Canada-Wide Standard proposed for ozone would extend the timeframe for achieving the goal.** Canada has not had national objectives for particulate matter. The proposed Canada-Wide Standard for PM 2.5 is 30 micrograms per cubic metre (24-hour averaging time) by 2010. The proposed Standard for ozone is 65 ppb (8-hour averaging time) by 2015. In November 1999, the CCME ministers (with the exception of Quebec) accepted these proposed standards in principle. At their June 2000 meeting they will either endorse them or consider other options for the Canada-Wide Standards for Particulate Matter and Ozone, including alternative timeframes.

**4.230** The proposed Canada-Wide Standards recognize that the new air quality targets for ozone and particulate matter cannot protect health fully. The federal government is recommending an incremental approach, with the aim of continuously improving regional air quality by revisiting national standards and programs over time.

**4.231** We found similarities in the approaches of the 1990 NOx/VOC Management Plan and the new process for setting and achieving Canada-Wide Standards. Like the 1990 Plan, the Canada-Wide Standards will rely on each jurisdiction's commitment to develop and implement its plan for meeting the proposed standards by a specified date. Like the 1990 Plan, Canada-Wide Standards include a requirement for public reporting. It is intended that the Canada-Wide Standards for Particulate Matter and Ozone will be signed by each environment minister, unlike the 1990 Plan, which the CCME endorsed as a body.

**4.232** It remains to be seen whether the new Canada-Wide Standards process will prove more effective at obtaining co-operation among the various levels of government and achieving results. Whether the new process will provide for clear accountability for results and transparent information to the public and Parliament also remains to be seen.

**It remains to be seen whether the new Canada-Wide Standards process will prove more effective at obtaining co-operation among the various levels of government and at achieving results.**

## Conclusion and Recommendation

**4.233** Developing the 1990 NOx/VOC Management Plan represented a major achievement by the federal, provincial and territorial governments and provided sound strategic direction. We found that the federal government did most of what it had promised to do under Phase 1 of the 1990 Plan; however, more needs to be done to heighten public awareness. Even though the federal government expected that its contribution to reducing emissions would be modest, the 1990 Plan represented good intentions and the aspects that were completed should make a contribution to Canada's air quality. But the Plan was never implemented as originally envisioned, and this has created an "implementation gap" between strategic planning and the efforts required of the partners to achieve the goal.

**The Plan was never implemented as originally envisioned, creating an "implementation gap".**

**It is clear that after 10 years of effort, the partnership model used to implement the 1990 Plan is ineffective.**

Canada's smog problem is far from being resolved.

**4.234** When the federal government enters into a partnership to fulfil its responsibilities in an area of shared jurisdiction, it needs to ensure that the basics of good management are applied. However, many of the key elements of good management were never put in place in implementing the 1990 Plan.

**4.235** We believe that Environment Canada, as the national leader, is responsible for reporting on not only the federal contribution but also national commitments and the progress of the partnership. However, we found that Canadians have not been given a clear picture of what the federal, provincial and territorial governments are doing about the smog problem. It is not apparent who is to do what and by when. Nor is it clear how much progress they have made so far. This means that the public and Parliament cannot determine whether Canada is moving forward at a reasonable pace to deal with what the federal government has described for the last 10 years as a serious threat to public health and the environment.

**4.236** In our opinion, for the public to be involved in solving the smog problem and Parliament to be able to scrutinize federal action, they need transparent information. Periodic public reporting should provide information on the seriousness of the problem and what is being done about it. However, Environment Canada is not providing transparent information about progress.

**4.237** Canada is continuing to address the stubborn ozone problem and the new problem of particulate matter through the Canada-Wide Standards process. This process is to include the commitments that jurisdictions will make to specific action against smog. As part of these commitments and to help assess future progress, Canada will need to clarify the direction of its national ambient monitoring network, identify national needs and document the roles and responsibilities for maintaining and enhancing the network.

**4.238** Given its responsibility to protect public health from environmental risks, the federal government has a major role in co-ordinating and facilitating integrated national strategies, plans and actions to address the smog problem. This includes choosing federal/provincial/territorial models of collaboration that will achieve the desired results. It is clear that after 10 years of effort, the partnership model used to implement the 1990 NOx/VOC Management Plan is ineffective.

**4.239 Environment Canada should learn from its experiences in implementing the 1990 NOx/VOC Management Plan and apply the lessons learned to the next major national strategy for addressing both the chronic ozone problem and the new and serious issue of particulate matter. It should consider incorporating the following key elements of good management:**

- **written agreements prepared in the early stages of the implementation process that specify each jurisdiction's roles and responsibilities (who will do what and by when);**
- **co-ordinated, detailed plans for action by each jurisdiction;**
- **clear and concrete statements of expected results and timetables for both the short and the long terms, including interim targets and milestones;**
- **a system for monitoring results, to assess progress regularly;**
- **provision for adjustments and midcourse corrections as required; and**
- **provision to the public and Parliament of meaningful, comprehensive, timely and transparent information on commitments and results.**

***Department's response****: Environment Canada agrees with the Commissioner*

*that smog is an important public health concern that requires further concerted action and sustained investment in order to address this problem. The Department is committed to working with other levels of government and with other government departments in continuing to make progress. To that end, Environment Canada will continue to incorporate into future strategies for addressing ozone and particulate matter lessons learned from working together with its provincial and territorial partners.*

*The Canada-Wide Standards for Particulate Matter and Ozone, which have been approved in principle by federal, provincial and territorial ministers of the environment, include sound management principles that are consistent with the recommendations of the Commissioner. Environment Canada agrees that it is important these principles be incorporated into future management arrangements.*

*The Commissioner also emphasized the importance of clear reporting to Parliament and the public on progress. Environment Canada is continuing to enhance its capacity for results-based reporting using a suite of performance indicators and clear targets, and is committed to providing meaningful and timely information on performance expectations and results.*

# About the Audit

## Objectives

Our audit examined key aspects of the federal government's management of its own initiatives under the 1990 NOx/VOC Management Plan, as well as its broader role of providing national leadership. Our audit work was restricted to the federal roles and responsibilities — in particular, those of Environment Canada, the federal leader on air quality. Our audit set out to identify lessons that could be learned and applied in future efforts to implement a domestic smog program.

## Scope

The "basket" of pollutants that make up smog includes ground-level ozone, particulate matter, nitrogen oxides (NOx), volatile organic compounds (VOC), sulphur dioxide ($SO_2$) and carbon monoxide (CO). For the purpose of this audit, we defined smog as a collection of these air pollutants, commonly found in ambient (outdoor) air. While we recognize that smog is defined in various ways, we viewed it in the same way as the federal government by focussing on its main constituents, ground-level ozone and particulate matter.

We did not cover other categories of air pollutants such as hazardous air pollutants (air toxics) or ozone-depleting substances and greenhouse gases that directly affect the atmosphere. Our Office has already reported on these subjects (Ozone Layer Protection, Auditor General's December 1997 Report, Chapter 27; Responding to Climate Change, 1998 Report of the Commissioner of the Environment and Sustainable Development, Chapter 3; and Managing Toxic Substances, Commissioner's 1999 Report, Chapters 3 and 4).

Because we focussed on the pollutants commonly found in outdoor air, indoor air quality was outside the scope of our audit. However, given the amount of time that Canadians spend indoors, this emerging issue will be considered as a subject for future audit work.

Our audit responsibilities are restricted to the federal government and so we did not audit the performance of the provinces or territories.

We did not audit Canada's compliance with its various international commitments related to smog, although a descriptive summary of the commitments is provided in Appendix E.

## Approach

The audit approach consisted of a review of documentation and interviews with a wide range of stakeholders and federal department officials.

## Audit Team

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## Appendix A

# Canada-Wide Standards Process

**The Harmonization Accord**

The process used to determine national air quality management goals in Canada has been in a state of transition since January 1998, when federal, provincial and territorial environment ministers (with the exception of Quebec) signed the Canada-Wide Accord on Environmental Harmonization and its Canada-Wide Environmental Standards Sub-Agreement. The Sub-Agreement is intended to encourage governments to work together on issues like air quality, which require standards that apply across the country.

**Canada-Wide Standards**

The Accord provides for sub-agreements to be developed in areas of environmental management that would benefit from Canada-wide co-ordinated action. Currently three sub-agreements have been developed, including the Canada-Wide Environmental Standards Sub-Agreement. Canada-Wide Standards (CWS) focus on ambient (outdoor) air, and can include qualitative or quantitative standards, guidelines, objectives or criteria for protecting the environment and reducing risk to human health. The CWS sub-agreement was developed with the intention that by participating in the process, all governments will be committed to achieving the standards.

Environment Canada and Health Canada worked with the provinces and territories to establish the proposed CWS for key air pollutants, including ozone and particulate matter. Environment Canada, on behalf of the federal government, led or championed the development of the new standards for particulate matter and ozone, under the general direction of the Canadian Council of Ministers of the Environment (CCME). Environment Canada also chaired a committee of federal, provincial and territorial environment and health representatives to oversee the development of these standards. In addition to developing the science required to set new standards, Environment Canada's role was to lead the committee in developing options and analyzing the costs of implementing them, as well as analyzing social aspects, economic impacts and technological feasibility.

The new ozone and particulate matter standards are intended as a political commitment to action by individual governments. By signing the standards, ministers commit to attain them in the established timeline and to report to the public on progress toward them. Such a commitment is needed for Canada to achieve its comprehensive air quality management goals. Jurisdictions are to formally agree to meet the new standards through autonomous but complementary action. Implementation plans are to be prepared within the next few years. As an initial federal response to the new standards for ozone and particulate matter, the federal government intends to submit a Phase 3 Federal Smog Management Plan.

The federal/provincial/territorial co-ordinating mechanism to implement the new Canada-Wide Standards for Particulate Matter and Ozone is still being developed. The specific roles of key federal, provincial and territorial departments and ministries, such as transportation, energy, health, agriculture and industry, have not been clarified.

## Appendix B

# Successes in Air Pollution Abatement

| Air Issues | Result |
|---|---|
| **Sources of visible air pollution** | These sources have been significantly reduced. The extreme levels of smoke-based pollution that could be found in large Canadian cities like Toronto and Montreal from the late 19th to the early 20th centuries are largely in the past. Soot from coal burning, sawdust and particles from steel making have all been reduced. |
| **Lead in gasoline** | Between 1974 and 1990, lead was slowly phased out of most gasoline in Canada. This resulted in major reductions in levels of lead in the atmosphere. By 1992, lead in the air of most Canadian cities had fallen to trace levels. |
| **Vehicle emissions** | In the last 30 years there have been tremendous strides in cleaning up vehicle exhaust emissions. Emissions of regulated pollutants from new cars have been reduced by up to 99 percent from the days before emission controls. In the same period, the fuel efficiency of new cars has doubled. Low-emission vehicles, with the promise of even cleaner exhaust, started appearing in 1998 and should be in widespread use by 2001. |
| **Sources of $SO_2$** | Sources of sulphur dioxide ($SO_2$) have been reduced by changes in industrial processes, installation of emission-reducing technology and switches to less harmful fuel sources. The Eastern Canada Acid Rain Program developed in the early 1980s and joint Canada/U.S. action have helped to cut Canada's national $SO_2$ levels significantly. Emissions were halved from 1980 to 1997 in the seven easternmost provinces. |

## Appendix C

# Sources of Emissions, by Category

The **Transportation Category** includes air transportation; heavy-duty diesel vehicles; heavy-duty gasoline trucks; light-duty diesel trucks and vehicles; light-duty gasoline trucks and vehicles; marine transportation; motorcycles; off-road use of diesel; off-road use of gasoline; rail transportation; wearing of tires and brake lining.

The **Industrial Category** is a diverse source of smog-causing pollutants. The industries covered in this sector include abrasives manufacture; aluminum; asbestos; asphalt paving; bakeries; cement and concrete; chemicals; clay products; coal mining; ferrous foundries; grain; iron and steel; iron ore mining; mining and rock quarrying; non-ferrous mining and smelting; oil sands; other petroleum and coal products; paint and varnish manufacturing; petrochemicals; petroleum refining; plastics and synthetic resins fabrication; pulp and paper; upstream oil and gas, and wood.

**Non-Industrial Fuel Combustion Category** includes electrical power generation (utilities); residential and commercial fuel combustion; and residential fuel wood combustion.

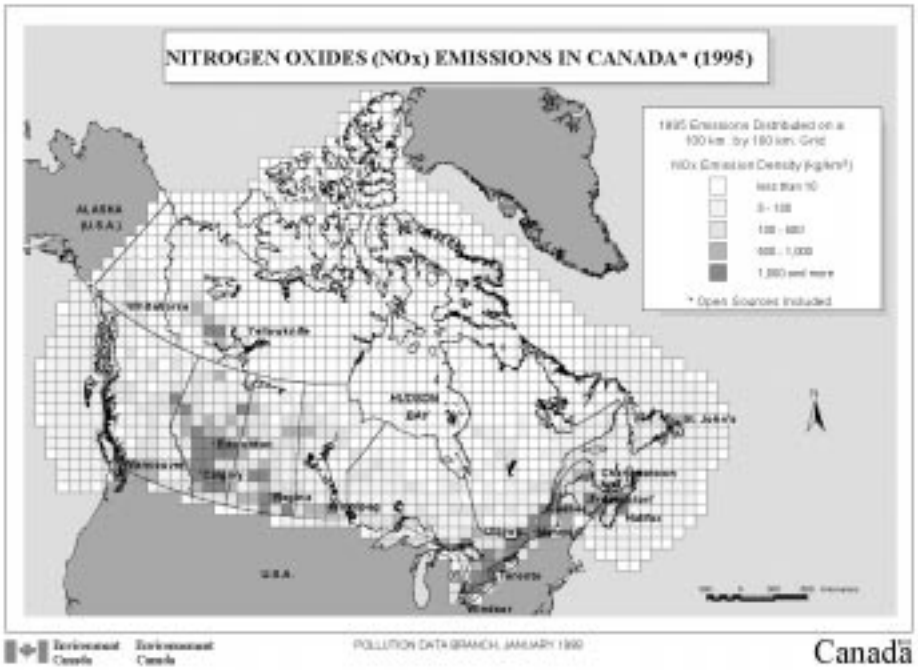
**Open Sources Category** includes agriculture (animals, tilling and wind erosion); construction; dust from paved and unpaved roads; forest fires; landfills; mine tailings; and prescribed burning.

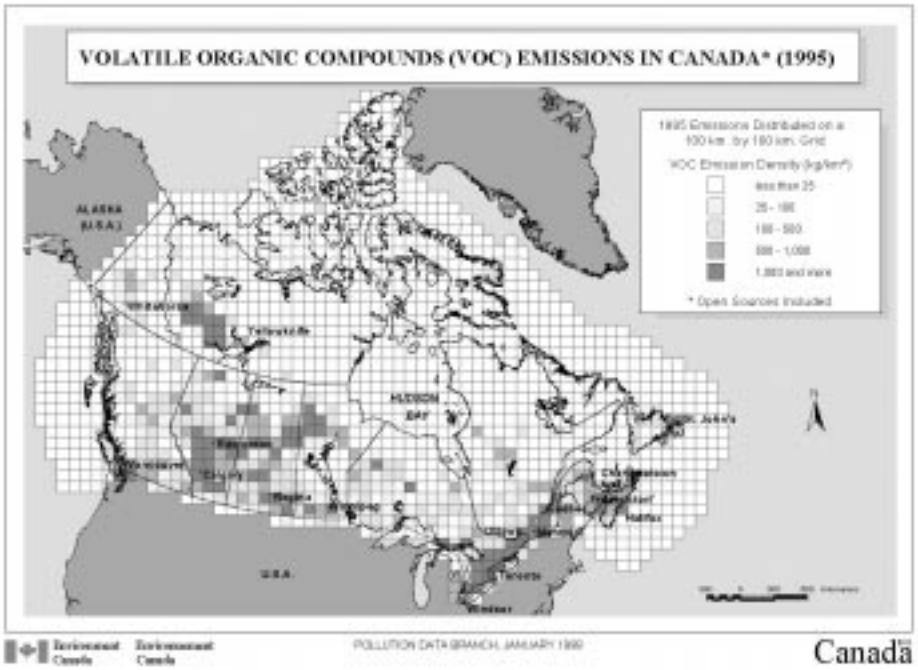
**Incineration Category** includes industrial, commercial, municipal and wood waste incineration; crematoria; and incineration for utilities.

A **Miscellaneous Category** includes cigarette smoking; dry cleaning; fuel marketing; general solvent use; marine cargo handling; meat cooking; pesticides and fertilizer application; printing; structural fires; and surface coatings.

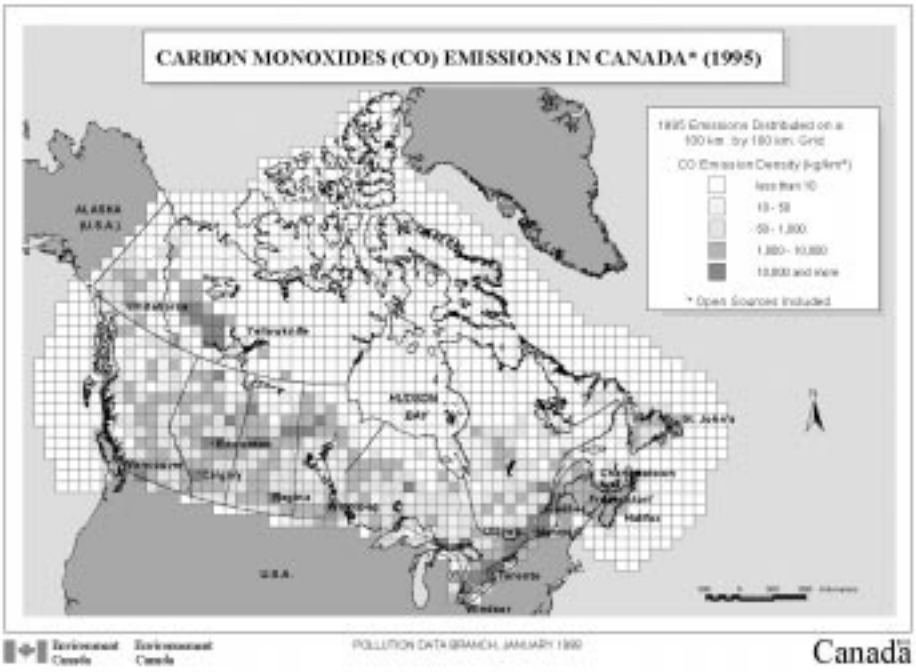
## Appendix D

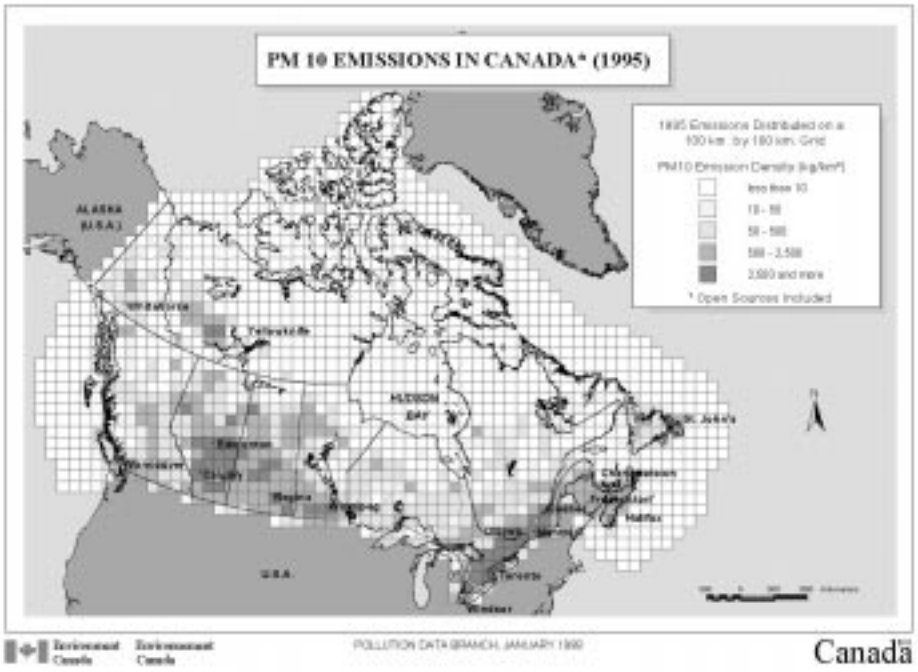
# Geographical Presentation of Emissions

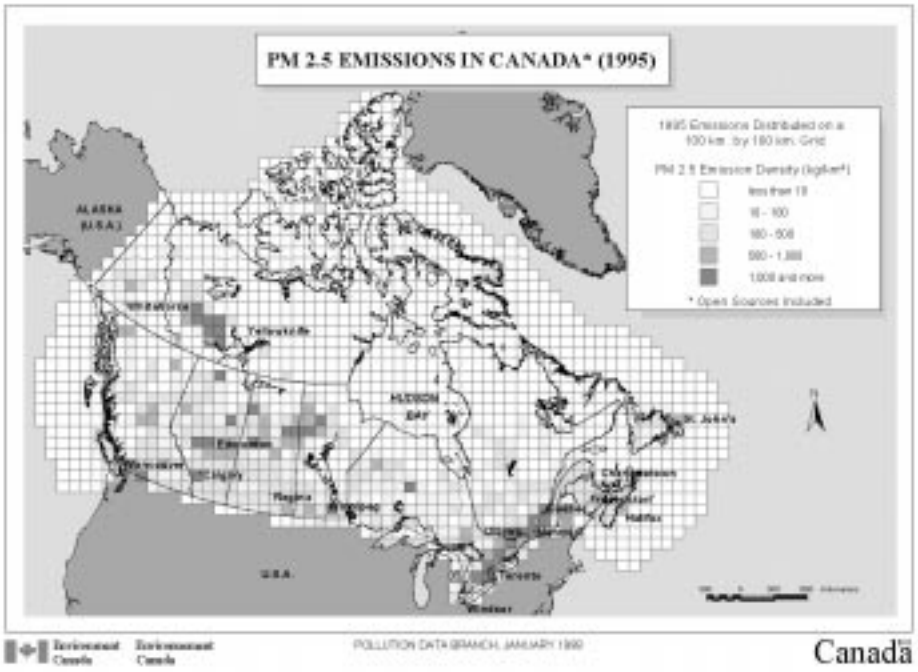



SULPHUR OXIDES (SOx) EMISSIONS IN CANADA* (1995)
1995 Emissions Distributed on a 100 km by 100 km Grid
SOx Emission Density (kg/km²)
less than 5
5 - 100
100 - 500
500 - 1,000
1,000 and more
* Open Sources Included
ALASKA (U.S.A.)
HUDSON BAY
U.S.A.
Toronto
POLLUTION DATA BRANCH, JANUARY 1998
Environment Canada
Environnement Canada
Canada


CARBON MONOXIDES (CO) EMISSIONS IN CANADA* (1995)
1995 Emissions Distributed on a 100 km by 100 km Grid
CO Emission Density (kg/km²)
less than 10
10 - 50
50 - 1,000
1,000 - 10,000
10,000 and more
* Open Sources Included
ALASKA (U.S.A.)
HUDSON BAY
U.S.A.
Toronto
POLLUTION DATA BRANCH, JANUARY 1998
Environment Canada
Environnement Canada
Canada


PM 10 EMISSIONS IN CANADA* (1995)
1995 Emissions Distributed on a
100 km. by 180 km. Grid
PM10 Emission Density (kg/km²)
less than 10
10 - 50
50 - 500
500 - 2,500
2,500 and more
* Open Sources Included
ALASKA
(U.S.A.)
HUDSON
BAY
St. John's
U.S.A.
Toronto
Environment
Canada
Environment
Canada
POLLUTION DATA BRANCH, JANUARY 1999
Canada


PM 2.5 EMISSIONS IN CANADA* (1995)
1995 Emissions Distributed on a
100 km. by 180 km. Grid
PM 2.5 Emission Density (kg/km²)
less than 10
10 - 100
100 - 500
500 - 1,000
1,000 and more
* Open Sources Included
ALASKA
(U.S.A.)
HUDSON
BAY
St. John's
U.S.A.
Toronto
Environment
Canada
Environment
Canada
POLLUTION DATA BRANCH, JANUARY 1999
Canada

## Appendix E

# International Commitments

Canada's international commitments related to smog are based on two international agreements: the 1979 United Nations Economic Commission for Europe (UN ECE) Convention on Long-Range Transboundary Air Pollution (LRTAP), and the 1991 Canada–U.S. Air Quality Agreement. In addition, Canada is a partner with the U.S. in the International Joint Commission (IJC) and with the United States and Mexico in the North American Agreement for Environmental Cooperation (NAAEC). The main international commitments are described below.

**The LRTAP.** This was the first international legally binding instrument to deal with problems of air pollution on a broad regional basis. Signed in 1979, it has created an important framework for controlling and reducing the damage of transboundary air pollution to human health and the environment. Since entering into force in 1983, the Convention has been expanded by a number of protocols largely targeted at reducing a specific pollutant.

Canada has signed and ratified three protocols under the framework of LRTAP related to smog: (i) the 1985 Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at Least 30%; (ii) the 1994 Protocol on Further Reduction of Sulphur Emissions; and (iii) the 1988 Protocol Concerning the Control of Nitrogen Oxides or Their Transboundary Fluxes. Canada has also signed but has not ratified the 1991 Protocol Concerning the Control of Emissions of Volatile Organic Compounds or Their Transboundary Fluxes. It has stated that it is continuing to work toward this commitment.

Under the auspices of the UN ECE, Canada was also involved in negotiation of a new protocol (concluded at the end of 1999) to abate acidification, eutrophication and ground-level ozone.

Canada has used this multilateral convention and its related protocols as a strategic instrument to influence the agenda on Canada/U.S. transboundary smog and acid rain issues.

**The 1991 Canada–U.S. Air Quality Agreement.** The transboundary flow of pollutants from the U.S. has a significant impact on air quality in parts of Canada. Environment Canada, acting on behalf of the federal government, has a responsibility to encourage emission reduction programs in the U.S.

Canada and the United States signed the 1991 Canada–U.S. Air Quality Agreement that provides for the study and control of air pollutants that cross the international boundary. The major goal of this agreement was to reduce acid rain by cutting emissions of $SO_2$ and NOx. As both these pollutants are also major contributors to the smog problem, urban air quality has benefited from the Agreement.

In an agreement signed April 1997, Canada and the U.S. have signaled their intent to develop a Joint Plan of Action to more specifically address the problem of transboundary air pollution and smog. The future bilateral plan will address this type of pollution through joint Canada and U.S. efforts.

The intention is to develop new annexes to the existing Canada–U.S. Air Quality Agreement which will address particulate matter (PM) and ozone, and to consider the possibility of a transboundary emissions trading program and joint regional measures.

The Joint Plan of Action would be developed with the U.S. and in partnership with the provinces. At the time of the audit, negotiations on the ozone annex had started, and plans and timetables were being set up. Environment Canada informs us that a joint assessment of transboundary PM will be completed over the next three to five years, followed by a negotiated annex on PM.

**The International Joint Commission (IJC).** This is a bi-national organization established by the Canada–United States Boundary Waters Treaty of 1909. The IJC's mandate, in addition to considering applications for works or obstructions in boundary or transboundary waters that may impact the water level on the other side of the boundary, also includes the conduct of investigations of other transboundary issues at the request of the governments. Over the

years, the IJC has investigated air pollution problems at the request of the two governments. Under the 1991 Canada–U.S. Air Quality Agreement, the IJC co-ordinates the public review of the reports of progress of the two countries in achieving the objectives of the agreement. The IJC has a permanent International Air Quality Advisory Board that provides advice on transboundary air quality issues. Since its establishment in 1966, the Board has provided a series of progress reports, and a special report in November 1998 on Transboundary Air Quality, to the IJC on significant transboundary air quality issues including the transport, deposition and impact of $SO_2$, NOx, ozone and PM.

**The North American Agreement on Environmental Cooperation (NAAEC).** The NAFTA regime is defined broadly as comprising three agreements: (a) the North American Free Trade Agreement (NAFTA), (b) the North American Agreement on Environmental Cooperation, and (c) the North American Agreement on Labor Cooperation, all having taken formal effect on 1 January 1994, covering trade, investment, environment, and labor. The Agreement on Environmental Cooperation sets out a framework for continental environmental co-operation, including promotion of a co-operative environmental agenda among Canada, the U.S. and Mexico on issues of regional importance and mutual concern such as air pollution.

**The Commission for Environmental Cooperation (CEC)**. Located in Montreal, the CEC was created under the NAAEC to address regional environmental concerns, help prevent potential trade and environmental conflicts and promote the effective enforcement of environmental law. The CEC has a mandate to address air quality issues in a tri-national context while at the same time co-ordinating with and enhancing ongoing bi-national activities. The goals established for the CEC air program are to further co-operation and co-ordination between the air quality management systems of the three North American countries and to provide technical and strategic tools that the three countries may apply in their efforts to combat air pollution and maintain healthy air.

Recent reports by the CEC (1997) and by the IJC (1998) have highlighted the significance of the transboundary transport of ozone and its precursors to air quality management programs in the U.S. and Canada.

## Appendix F

# Federal Activities for Smog Reduction

**Environment Canada**

- co-ordinates federal environmental policies and programs, including action on smog;
- provides support, co-ordination, facilitation and leadership for emission reduction activities and strategies that involve other jurisdictions, such as the 1990 NOx/VOC Management Plan;
- administers the *Canadian Environmental Protection Act (CEPA)*;
- leads the development of national goals, standards, guidelines and regulations and voluntary arrangements to protect Canada's air quality;
- acts as the federal champion in the development of new Canada-Wide Standards for Particulate Matter and Ozone under the federal/provincial/territorial Harmonization Accord;
- participates in education initiatives to increase public awareness about the causes and effects of smog;
- conducts research on the causes and effects of air pollutants, particularly effects on the environment;
- co-ordinates and participates in a number of other science-related activities, including air quality monitoring; quantifying and identifying the sources of smog-causing pollutants through the development of emission inventories; assessing the science of ozone and PM formation; and air quality modelling and forecasting; and
- addresses transboundary air issues and represents Canada's international interests by negotiating international air pollution agreements and instruments to decrease the cross-border transport of air pollutants (see Appendix E for information on Canada's international commitments and activities related to smog).

**Health Canada**

- is responsible for protecting the health of Canadians from the effects of environmental pollution, including exposures to contaminants through the air;
- conducts surveillance on health problems associated with smog and other air issues; works to advance Canadians' understanding of the health impacts of smog-related and other air pollutants and climate change;
- works jointly with Environment Canada to assess the toxicity of substances and develop control options for those substances declared and listed "toxic" under *CEPA*;
- is involved in the science assessment of ozone and particulate matter and the development of national air quality objectives (and more recently, Canada-Wide Standards) for these smog-related pollutants;
- through health promotion activities, positions health as a theme for public education and outreach on air pollution and climate change; and
- promotes the benefits of mitigating air pollution and climate change for health and well-being (active transportation, physical activity).

**Transport Canada**

- plays a role in reducing air pollution from transportation sources under federal jurisdiction (responsibility for regulating emissions from new cars and trucks has been transferred to Environment Canada);
- works to improve fuel efficiency of road vehicles jointly with Natural Resources Canada;
- is responsible for international transportation, the interprovincial aspects of rail, bus and truck transportation and most of the marine sector;

- participates in the development of international environmental standards governing emissions from airplane engines and ships and their application in Canada under federal legislation;
- sees itself as a leader in developing ways to reduce the impact of transportation on the environment; and
- promotes improved air quality at airports.

**Natural Resources Canada**

- is responsible for federal energy policy and natural resource utilization;
- spearheads initiatives that contribute to energy efficiency (including vehicle fuel efficiency — jointly with Transport Canada) and the "greening" of energy development, providing co-benefits for smog reduction;
- supports reductions of smog-causing emissions through its Efficiency and Alternative Energy Program; and
- is involved in research on the impacts of smog on forests and vegetation (through the Canadian Forest Service).

**Agriculture and Agri-Food Canada**

- works with the provincial governments and industry to develop and disseminate information to farmers on agricultural sources of particulate matter (primarily dust from soil erosion and ammonia) and their associated effects, and identifies ways to reduce impacts through improved farming practices;
- monitors how ozone affects the productivity of agricultural crops; and
- conducts research to develop effective methods to reduce soil erosion and increase the efficiency of manure management methods, the two main sources of particulate matter produced by the agriculture sector.

**Other Federal Departments**

Industry Canada and the Department of Foreign Affairs and International Trade are other federal departments with a role to play in reducing smog.