United Nations Commission on Sustainable Development
Thematic Profile:

Air Quality in Canada

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United Nations Commission on Sustainable Development Thematic Profile

UN CSD Thematic Profile: Air Quality in Canada

1. Introduction

The Government of Canada[1] recognizes that the health of our environment is fundamentally linked to the health of our people and our economy. This recognition has put concern for our environment – for protection, conservation, partnerships and innovation – at the forefront of government decision making at every level.

Canada is proud of the progress it has made in addressing air pollution. Through various programs, regulations, international agreements, incentives for change, and cooperation between the federal government, provinces and territories, municipalities, industries, and the Canadian public, there have been major improvements in overall air quality. However, projections indicate that population and economic growth as well as international transport of pollutants will offset improvements in air quality. While significant progress has been made, more work needs to be done domestically and internationally to protect our health and our environment. Canada is continuing to take action and to implement initiatives to ensure clean air for Canadians.

This document presents an overview of how air issues are managed and addressed in Canada. The document is structured as follows:

- Sustainable Development
- Decision-Making and Cooperation
- Strategies, Policies, Programs and Plans
- Capacity Building, Information, Science, Research & Development
- International Cooperation

In addition, two brief cases studies are also presented:

- Vehicles, Engines and Fuels
- Acid Rain

2. Sustainable Development

Since the 1987 World Commission on Environment and Development report that drew linkages between the global challenges of environmental degradation, poverty and development, and the Earth Summit in Rio de Janeiro in 1992, the Government of Canada has been actively engaged in efforts to make sustainable development a reality in Canada and around the world.

Individual Canadians, leading Canadian companies and federal, provincial and municipal governments in Canada are coming to better understand how environmental sustainability is fundamentally important to preserving our high quality of life in Canada, to improving the bottom lines of our companies and to ensuring the competitiveness of our economy.

The Government of Canada believes that achieving environmental sustainability will be a key to Canada's competitiveness in the 21st century. This commitment is reflected in primary policy documents, such as the Speech from the Throne[2], which sets out the

government's commitments to Canadians and outlines the policies and programs that it will be implementing in the current session of Parliament, and the Budget[3], which is its fiscal plan.

But fully realizing the broad transformative change that is required to advance this agenda requires a comprehensive and integrated approach. A new framework is being developed to strengthen Canada's long-term competitiveness, its natural environment, and the health and well-being of its citizens. The Government of Canada is working with provincial and territorial governments, industry, Aboriginal organizations, and non-governmental organizations (NGOs) to develop a shared approach through this framework in order to achieve long-term national environment and health objectives.

The Government of Canada is currently working with its partners on five pillars in support of this framework: first, inclusive and flexible decision-making structures based on results, shared responsibilities, and a recognition of business realities; second, better and more widely-shared information to enable sound predictions, decisions and reporting; third, a coherent national approach to science and technology focused on key priorities; fourth, incentives to encourage sustainable practices as well as consistent, predictable enforcement with tough but fair penalties for those who fail to act; and fifth, outreach and engagement to empower citizens and decision-makers to make informed choices.

This new framework for environmental sustainability and long-term competitiveness is being applied to the full range of sustainability issues, such as climate change, water, waste, biodiversity, and of course clean air. In each of these areas, long-term, ambitious health and environment outcomes will be identified to focus our effort. The Government will work collaboratively with other governments, industry sectors, with Aboriginal People in Canada and with key non-government stakeholders through sector sustainability tables to achieve these long-term outcomes.

By adopting this new framework, the Government of Canada believes it can bring greater coherence and strength to the broad environmental sustainability agenda in Canada, including air issues.

3. Air issues

Air pollution represents a serious threat to human health, the environment, and the competitiveness of Canada's economy. Canadians consistently identify air pollution as the most important environmental issue and a key health concern.

Projections indicate that population and economic growth as well as international transport will offset improvements in air quality. While we have made significant progress, more work needs to be done domestically and internationally to protect our natural environment and improve air quality for all Canadians

Emissions of particulate matter (PM), sulphur oxides (SO_X), nitrogen oxides (NO_X), persistent organic pollutants (POPs), heavy metals, toxic chemicals, greenhouse gases

(GHGs), and other criteria air contaminants, from transportation, energy production, industry, and residential activities are contributing to a variety of air quality issues such as smog, acid rain and climate change. In fact, the combustion of fossil fuels - most prevalent in the transportation, electric power generation and oil and gas sectors - is responsible for 70% of total greenhouse gases (GHG) and a significant portion of NO_X, SO_X and PM emissions.

Air pollution does not affect all people or ecosystems equally nor does it respect political boundaries, whether provincial or national:

- Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics. The elderly, children, and those who suffer from respiratory and cardiac problems are most at risk for health problems related to air pollution.
- Canada's urbanized areas, particularly those located in the Windsor-to-Québec corridor, in British Columbia's Lower Fraser Valley and in the southern Atlantic region, experience higher than average episodes of smog due to the concentration of point and non-point sources of human-made emissions.
- Winds can transport pollutants long distances away from their source, adding to the levels of air pollution that are generated locally, and greatly increasing the intensity of our air quality concerns. In Canada, transboundary sources of air pollution are a significant problem which requires bilateral and international cooperation.
- With soils and bedrock that are sensitive to acid deposition combined with large sources of acidifying emissions, as much as 75% of eastern Canada is receiving levels of acid deposition that cause harm to forests, fish, birds, wildlife, agriculture, infrastructure and human health.
- There is significant concern with respect to air quality in the North due to the long-range atmospheric transportation of heavy metals, such as mercury, as well as persistent organic pollutants (POPs), such as PCBs and DDT. Once released into the air, POPs and heavy metals can travel great distances through a process of multiple cycles of evaporation and condensation. Among the heavy metals, mercury displays similar behaviour. Northerners who pursue a subsistence lifestyle are exposed to higher levels of POPs and mercury compared to people who live in southern Canada because of the increased exposure of northern wildlife to these pollutants. The breast milk of some Inuit women has been found to contain levels of POPs four to five times higher than in women who live in southern Canada.
- Northern latitude Countries like Canada are especially vulnerable to UV radiation due to ozone depletion. Ozone depletion in northern latitudes and the resultant changes in UV radiation have increased markedly during the past decade, with some sectors of the Arctic experiencing short-term reductions in ozone of about 20% and increases of more than 40% in incident UV radiation.

3.1. Smog

Smog is perhaps the most readily recognized air quality problem in Canada. The major components of smog, particulate matter (PM) and ozone, have been identified as contributing factors in more than 5,900 premature deaths[4] across the country each year, as well as increased hospital visits, doctor visits and hundreds of thousands of lost days at work and school. The science demonstrating the negative health effects of air pollution has been reconfirmed with the recent publication of studies demonstrating increased risks of lung cancer and heart disease from air pollution. Particulate matter and ozone are linked to serious health impacts including chronic bronchitis, asthma, and premature deaths.

Particulate matter less than 2.5 micrometers in size ($PM_{2.5}$) is released directly to the atmosphere from industrial smokestacks and automobile tailpipes, but a large percentage is formed in the atmosphere from other pollutants such as sulphur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOC) and ammonia (NH_3). Fine particles are also released from biomass burning, both natural sources, such as forest fires, and anthropogenic sources, such as wood fired boilers and woodstoves. $PM_{2.5}$ is responsible for causing the greatest harm to human health because it can be inhaled deep into the lungs, reaching areas where the cells replenish the blood with oxygen. Smog also poses a serious threat to the environment including crop damage, reduced forest growth and timber and contributing to forest decline, as well as reduced visibility and infrastructure damage.

Air quality is measured by the average concentrations of air pollutants and by trends in peak levels of ground-level ozone in Canada. The yearly average concentrations in urban air across Canada of sulphur dioxide (SO_2) and nitrogen oxides (NO_X), volatile organic compounds (VOC), and fine particulate matter ($PM_{2.5}$) have all decreased since the mid to late 1980's, though there has been no noticeable change in $PM_{2.5}$ concentrations since the mid-1990's. The decreasing trends contrast with the trends in seasonal average levels for ground-level ozone, which have shown an increase over this period.

Levels of ground-level ozone can vary considerably on an hourly, daily and monthly basis, depending on the prevailing meteorological conditions (especially temperature and air stability), the origin of air masses, and emissions. Since the late 1980's, despite the reductions observed in ambient concentrations of NO_X and VOC, the peak levels of ground-level ozone, averaged across all sites in Canada, has remained relatively stable. These levels vary across the country. Levels tend to be higher east of the Manitoba–Ontario border, especially along the Windsor-Québec City corridor.

3.2. Acid Rain

Acid rain (i.e., acid deposition) remains a stubborn problem, affecting humans, their environments (e.g., lakes, rivers, forest, soils, fish and wildlife populations and buildings,) and the economy (e.g., productivity and competitiveness of key Canadian industries). Two common air pollutants, SO_2 and NO_X, cause acid deposition. Prior to falling to the earth, acid-causing emissions (SO_2 and NO_X gases and the related acid particles) contribute to visibility degradation and impact public health.

Acid deposition is a problem in eastern Canada because many of the waters (streams, rivers, ponds, lakes) and soils in this region lack natural alkalinity – such as a lime base – and therefore cannot neutralize acid naturally. Provinces on the Canadian Precambrian Shield, like Ontario, Québec, New Brunswick and Nova Scotia, are hardest hit because their water and soil systems cannot fight the damaging consequences of high levels of acid deposition. More recently, there is growing concern about the potential for acid deposition in western Canada due to the projected increases in acidifying emissions. Although little is known about the impacts on northern and western ecosystems, there is reason to suspect that damage is occurring.

Recent scientific evidence shows that as much as 75% of eastern Canada (1.8 million km^2) receives levels of acid deposition in excess of critical loads.

- At these levels, forest health and productivity are threatened. Acid deposition is responsible for the loss of millions of cubic metres of wood from eastern Canadian forests and the capacity of eastern Canadian ecosystems to recover is hindered as the buffering capacity of the environment continues to decline. Evidence predicts that the North American Maple is dying at a rate of 2.3% for each 100 exceedance units due to the loss of calcium and other nutrients from soils.
- Lakes and streams are also remaining too acidic or are not recovering to the point where they cannot support sensitive fish and aquatic biota. The result is aquatic ecosystems that are unable to support a variety of species; therefore, biodiversity continues to remain below pre-acidification levels.

Under optimistic emission reduction scenarios, recovery of eastern Canadian ecosystems could take fifty to seventy-five years.

As indicated in Figures 3.1 and 3.2, the primary sources of acid-causing gases and particles are electrical power generation, non-ferrous mining and smelting, on-road vehicles, upstream oil and gas and agriculture. These pollutants can be carried over long distances by prevailing winds, creating acidic precipitation far from the original source of the emissions.

As our understanding of the ecosystem effects from exposure to acid deposition improves, it becomes increasingly clear that further reductions in acid-causing emissions are necessary to protect sensitive Canadian ecosystems from damage.

3.3. Criteria Air Contaminant Emission Sources and Trends

Table 3.1 below summarizes the most recent published inventory[5] of criteria air contaminants for Canada (2000). The inventory includes estimates for all anthropogenic sources. Industrial sources, including fuel combustion, account for the largest share of the emissions inventory, followed by the transportation sector. Transportation is the largest source sector of NO_X emissions, a major cause of ground level ozone. For SO_2, the largest source is the industrial sector with nearly half of these emissions resulting from the non-ferrous mining and smelting industry.

Table 3.1: *Anthropogenic Emissions Trends for Canada - All Sectors: 1990-2000. (x thousand tonnes)*

Pollutant	1990	1995	1996	1997	1998	1999	2000
SO_2	3 230	2 512	2 429	2 457	2 466	2 448	2 352
NO_X	2 759	2 608	2 557	2 587	2 620	2 570	2 583
VOC	3 093	2 729	2 555	2 513	2 510	2 449	2 666
NH_3	-	535	553	564	557	573	581
CO	15 451	13 595	12 605	12 154	11 836	11 342	10 589

Source: Pollution Data Branch; Environment Canada. February 2005
Notes: NH_3 data is currently available starting 1995.
Emissions from natural sources such as forest fires are excluded from this table.

Emissions of SO_2 have fallen by about 20 percent in the period from 1990 to 2000. This is primarily due to the completion of the first phase of the acid rain program begun in the mid-1980's.

In Canada, total emissions of SO_2 declined by approximately 50% between 1980 and 2001. In eastern Canada, emissions of SO_2 declined by 63% between 1985 and 2001, due to emission reductions in the electric power generation and non-ferrous mining and smelting sectors. In western Canada, emissions of SO_2 have declined by 6% over this period.

Between 2000 and 2020, SO_2 emissions are projected to decline by approximately 4% in Canada. During this same period, emissions of SO_2 are predicted to decline by 21% in eastern Canada, primarily due to reduced sulphur in fuels, changes in the primary base metal smelting sector and other smaller sectoral reductions. In western Canada however, emissions of SO_2 are predicted to increase by 15% as a result of increases in emissions in other sectors such as upstream oil and gas.

Despite aggressive NO_X and VOC emissions reduction requirements for new motor vehicles and actions to reduce releases from stationary sources, emissions of these pollutants have not substantially declined in the period 1990 to 2000. This can be partially attributed to a sustained growth in economic activity, population, vehicle types and numbers, as well as vehicle usage.

Canadian NO_X emissions were relatively constant between 1985 and 2000. In eastern Canada, NO_X emissions have decreased by 17% due to reductions in the transportation sector (heavy-duty diesel vehicles, light-duty gasoline vehicles) and non-ferrous mining and smelting. Alternatively, emissions in western Canada increased by 29%, due to

increases in emissions from the upstream oil and gas industry, electric power generation and the transportation sector (i.e., light-duty gasoline vehicles).

Between 2000 and 2020, Canadian NO_X emissions are predicted to decline by approximately 17%. During this period, eastern Canadian emissions of NO_X are predicted to decrease by 39% primarily due to predicted decreases in emissions from the on-road and off-road transportation sectors. However, NO_X emissions are predicted to increase by 5% in western Canada during this period as a result of predicted increases in emissions from the upstream oil and gas and electric power generation sectors.

Comprehensive emission inventories have historically been compiled on a 5 year cycle for criteria air contaminants.

Table 3.2 provides a more detailed breakdown of the Canadian emissions of criteria air contaminants for the calendar year 2000.

Table 3.2: *Sector Sources of Canadian Criteria Air Contaminant Emissions, 2000*

Criteria Air Contaminant Emissions for Canada: 2000 (tonnes)					
Sector	**PM10**	**PM2.5**	**SO_2**	**NO_X**	**VOC**
Industrial Sources	255,935	138,931	1591,196	642,396	992,547
Non Industrial Fuel Combustion	164,498	129,732	676,565	376,677	158,686
Transportation	81,623	72,157	82,875	1553,074	727,142
Incineration	676	555	1,540	6,300	2,043
Miscellaneous	14,012	8,432	11	49	550,944
Open Sources	4,618,749	613,499	237	25,029	320,246
NATIONAL TOTAL (with open sources)	5,059,735	899,840	2,352,335	2,582,608	2,665,628

Source: Pollution Data Branch; Environment Canada. May 2005

Notes: Numbers may not add to totals, due to rounding.
The 2000 emissions inventory was compiled with the latest technical and statistical information available.
Forest fire emissions are excluded from the Open sources totals

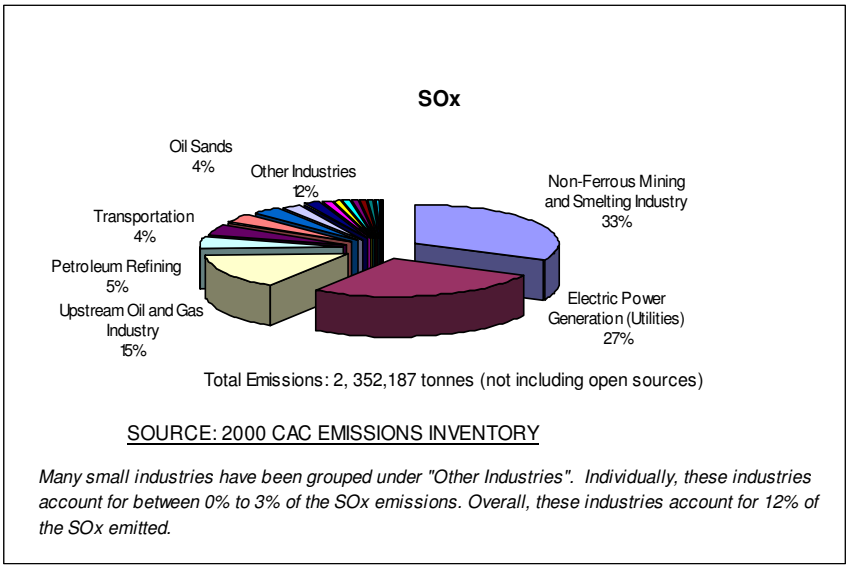

Figure 3.1: 2000 Canadian SO_X Emissions By Sector

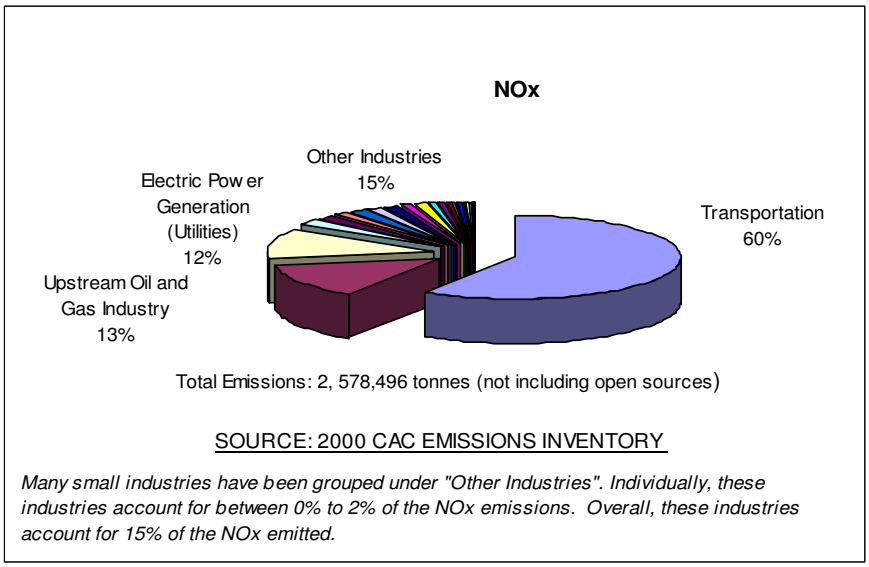

Figure 3.2: 2000 Canadian NO_X Emissions By Sector

3.4. Heavy Metals and Mercury

Heavy metals are a group of toxic metallic elements and their compounds which occur naturally in the environment but with variations in concentration. Although many metals, in the right concentration, are essential to life and have several important functions in biological processes, they can also be poisonous. Examples of heavy metals are mercury, lead and cadmium.

Heavy metals are also released to the environment from a range of human and natural source and are often carried on fine particles. The main sources of mercury and cadmium emissions are coal combustion in power stations and heating plants, production of non-

ferrous metals, domestic waste incineration and chlorine production. The environmental and human health effects of heavy metals depend on the mobility of each metal through environmental compartments and the pathways by which metals reach humans and the environment. The degree of concern about human and environmental health varies with each metal.

Global emissions of mercury are a serious health and environmental concern for all Canadians and particularly for northern Canadians. Once emitted into the air, mercury travels around the globe. This is a toxic that accumulates and causes serious impacts on the human nervous system. Canadian modeling work indicates that Canada receives more mercury from the global atmospheric pool than we emit. Over the past 30 years, Canada's domestic emissions of mercury have been reduced by about 90% and annual emissions stand at about 8 tonnes. Although domestic efforts at reducing emissions continue through a range of activities, including regulations, Canada-wide Standards and other approaches, Canada is a net recipient of atmospheric mercury and must work with other countries to address this common problem.

3.5. Persistent Organic Pollutants (POPs)

Persistent Organic Pollutants (POPs) include certain industrial chemicals such as PCBs; pesticides such as DDT, chlordane and toxaphene; and unintentional contaminants and by-products such as dioxins and furans. They enter the environment as a result of human activity. POPs can travel great distances around the globe through the atmosphere. Touching down on oceans and freshwater bodies, they evaporate into the atmosphere again, and travel further to touch down in another spot until they ultimately gather in colder climates such as Canada's North, as well as in the Great Lakes Basin and the St. Lawrence River. This is known as the grasshopper effect. Northern communities and high-elevation ecosystems, known as alpine ecosystems, are affected by POPs in the food chain. POPs concentrate in the alpine ecosystem because the cold climate causes low evaporation rates. This decreases the grasshopper effect and allows POPs to settle.

POPs are very stable and consequently can last in the environment for years or decades. POPs are also bio-accumulative, meaning they can concentrate in living organisms and accumulate up the food chain through fish, predatory birds, mammals and humans. The weight of scientific evidence strongly suggests that POPs have significant adverse effects on the health of ecosystems, wildlife and people.

Most POPs substances of concern have been banned or severely restricted in Canada for years, but they are still produced, used and stored as waste in a number of other countries. The vast majority of POPs entering Canada's environment, as a result of transport through the atmosphere, come from foreign sources. As a result, reductions of international releases of POPs are required to ensure continued environmental progress in Canada.

3.6. Stratospheric Ozone Depletion

The leading cause of ozone depletion in the stratosphere has proven to be chlorofluorocarbons (commonly called CFCs), a family of human-made chemicals which, until recently, were commonly used in air conditioners, refrigerators, foams, solvents and other products. CFCs are stable chemicals that do not break down in the lower atmosphere. Ozone-depleting substances (ODSs) enter the stratosphere by tropical convection. A single atom of chlorine can destroy 100,000 or more molecules of ozone. Ozone depletion only stops when the chlorine randomly reacts with another molecule to form a long-lived, stable substance. At that point it is no longer free to react with ozone.

An achieved 95% phase-out of ozone-depleting substances has been achieved in developed countries (over 98% in Canada) as a result of the Montreal Protocol. Phase out of remaining substances and uses is becoming more difficult but steady progress is being made.

3.7. Air Quality and Climate Change

Air pollution and greenhouse gases share common sources. The combustion of fossil fuels – most prevalent in the transportation, electric power generation and oil and gas sectors – is responsible for 70% of total GHG and a significant portion of NO_X, SO_X and PM emissions. Actions to reduce emissions of GHGs can also reduce air pollutants such as NO_X and SO_X. The Government of Canada has placed a priority on developing common solutions that contribute to both air quality and climate change objectives.

In general, as average temperatures increase, ground level ozone can be expected to increase, potentially giving rise to more days with smog alerts. In Canada, smog occurrences are most common in the Windsor-Québec corridor and the Southern Atlantic Region, affecting over half of the Canadian population. In addition, higher temperatures are likely to increase the incidence of forest fires in some parts of Canada. An increase in forest fires would give rise to additional particulate matter. Although the full extent of the impacts of particulate matter on the atmosphere is unclear, it appears that cloud formation and thus climate are influenced.

Climate variability and weather changes associated with climate change may affect levels and distribution of airborne allergens, such as pollens and fungal spores, which contribute to attacks of hay fever and exacerbation of asthma in sensitive individuals.

4. Decision-Making

Canada is a constitutional monarchy and a federal state (with ten provinces, three territories and a number of self-governing Aboriginal communities) with a democratic system of government. The Canadian constitution divides powers between the federal and provincial governments, giving the federal government jurisdiction over such matters as inter-provincial and international trade, foreign affairs, communications, criminal law, fisheries, and Aboriginal affairs. Provincial government jurisdiction is over matters such

as property and civil rights, local works and undertakings, municipal institutions and the development and management of natural resources. The federal and provincial governments exercise concurrent powers over areas such as environment and agriculture.

Not explicitly mentioned in the Constitution, the environment has emerged as an area of shared jurisdiction, and each level of government has powers to protect the environment. Air issues management is thus a shared responsibility of the federal government and the provinces and territories.

The shared nature of responsibilities over environmental, social and economic policies among the federal, provincial, territorial and Aboriginal governments adds complexity to the pursuit of broad societal and environmental objectives and requires close cooperation and coordination within and among governments, as well as with the private sector and civil society. To develop national policies and standards for air issues, cooperation and coordination between levels of government has long been recognized. Similarly, because of the transboundary nature of air pollution issues, the need to act internationally through agreements and partnerships has also been important to Canada, and with the case of the Canada-U.S. Air Quality Agreement, has had a large impact on domestic action on air issues. Partnerships and dialogues with stakeholders have also been important, and various stakeholder input and public engagement mechanisms have also been instituted in Canada.

4.1. Federal Role

At the federal level of government, lead responsibility for air pollution matters resides with Environment Canada[6]. Health Canada[7] also has important responsibilities defined under the Canadian Environmental Protection Act, and various other departments such as Transport Canada[8], and Natural Resources Canada[9], also have important roles to play on air issues.

4.1.1. Canadian Environmental Protection Act, 1999

The federal government's principal framework for protecting Canadians and the environment from harmful substances is the *Canadian Environmental Protection Act, 1999*[10] (*CEPA 1999*). *CEPA 1999* is an Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development.

Pollution prevention is the cornerstone of *CEPA 1999*. *CEPA 1999* provides powers and tools to protect the environment and human health, and to contribute to sustainable development through pollution prevention. Specifically, the Act gives Environment Canada the authority to require a company or facility to prepare and implement a pollution prevention plan for a substance that has been added to Schedule 1 of the Act. Environment Canada may also request pollution prevention plans from Canadian sources of international air and water pollution.

The *precautionary principle* is an important concept that applies throughout *CEPA 1999*. Through this Act, the Government of Canada is required to apply the precautionary principle, such that "*... where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*"

The Act enables the Government of Canada to generate the science behind many environment and health issues, including those related to clean air. The Act also contains provisions to develop and implement the regulations for cleaner vehicles, engines and fuels, to ensure accurate and timely reporting on pollutant releases and to honour international clean air agreements (e.g., see section 5.1 for further details on how these regulations have been used).

The goal of the Act is to prevent pollution by managing releases of harmful emissions of toxic substances. Under *CEPA 1999*, both the Minister of the Environment and the Minister of Health are responsible for assessing substances existing in Canadian commerce to determine whether they pose or may pose risks to the environment or human health. Once a substance is assessed as a risk, it may be placed on Schedule 1[11] of the Act and considered for possible risk management measures, such as regulations, guidelines, pollution prevention plans or codes of practice to control any aspect of its life cycle, from the research and development stage through manufacture, use, storage, transport and ultimate disposal.

The Act also requires that all chemical, polymer and biotechnology substances new to Canadian commerce must undergo environmental and health risk assessments prior to manufacture, importation or sale in Canada. It also authorizes the government to control any new or existing substances judged to pose risks to human health or the environment. *CEPA 1999* also represents an important shift in emphasis away from managing pollution after it has been created, towards pollution prevention.

4.1.2. CEPA National Advisory Committee

CEPA 1999 requires the Minister to establish a National Advisory Committee[12] composed of one representative for each of the federal Ministers of the Environment and Health, representatives from each province and territory and six representatives of aboriginal governments drawn from across Canada.

The Committee advises the Ministers on actions taken under the Act, which enables national, cooperative action and avoids duplication in regulatory activity among governments. The Committee also serves as the single window into provincial and territorial governments and representatives of aboriginal governments on offers to consult.

4.1.3. Mandatory Review of the Legislation

CEPA 1999 stipulates that a Parliamentary Committee must review the Act every five years after it comes into force. Since the Act came into force on March 31, 2000, a Parliamentary Committee must conduct a review of the Act beginning sometime after March 31, 2005. The Committee will have up to one year to complete the review from the time it is initiated (but may be granted an extension, if needed). Their advice will then be provided to Parliament and the government will then have 120 days to respond, including deciding whether and how to revise the Act.

4.1.4. Federal Decision Making and Sustainable Development

In order to strengthen the federal government's commitment to examine environmental implications of economic and social policies, as well as economic implications of environmental policies, the Government of Canada amended the *Auditor General Act* in 1995. In addition to creating the position of Commissioner of the Environment and Sustainable Development[13], the amendments require federal departments and agencies to prepare and table a sustainable development strategy in the House of Commons and to update it every three years.

Overall, the steps that the Canadian government has taken allow a more systematic consideration of environmental values in decision-making and increase consultation, transparency and public accountability. The *1999 Cabinet Directive on the Environmental Assessment Policy, Plan and Program Proposals*[14] is an example. The intent of the Directive is to ensure that environmental considerations are integrated into planning and decision-making at the earliest stage for any proposed projects, policies, plans, and programs slated for approval by Ministers or Cabinet, on an equal footing with economic and social considerations.

4.2. Provincial/ Territorial Role

Each province and territory has unique characteristics, including geography, available resources, population sizes, and industries that present different opportunities and require different approaches to dealing with air quality. Provincial and territorial responsibilities for managing air pollution primarily revolve around the development, implementation and enforcement of regulations and standards for industrial, commercial, and other sources of air pollution. They do so through licensing, permitting, and monitoring. (For the territories, control of most industrial emissions, including implementation of Canada-wide Standards, is the responsibility of the federal government as these sources generally are found on federal lands.)

Authority to control pollution sources varies from province to province, but typically rests on provincial legislation. For example, British Columbia derives authority from its *Environmental Management Act*[15], in Alberta the *Environmental Protection and Enhancement Act*[16] is used, while in Ontario work on air issues, among others, is carried out under the *Environmental Protection Act*[17]. Legislation may include, for example, provisions for power and duties of the Minister, prohibiting the release of emissions from industrial and/ or commercial facilities except where authorized (e.g., by permit or

certificate of approval), regulating open burning, regulating ozone depleting substances, addressing some motor vehicle emissions, setting other regulations related to air emissions, and inspection and enforcement. Provinces and territories also undertake a variety of work under other related legislation and constitutional authority, including matters related to energy supply, transportation planning, outreach and information, among others.

Provinces and territories also work cooperatively with the federal government on air issues, particularly through the Canadian Council of Ministers of the Environment and efforts to develop and implement Canada-wide Standards. Provincial and territorial environmental legislation often allows for key aspects of implementation of CWSs.

In Alberta, the provincial Cabinet delegated responsibility for air quality management in 1994 to the Clean Air Strategic Alliance (CASA)[18], a partnership of government, industry and NGOs. CASA is a stakeholder partnership that has been given shared responsibility by its members, including the Alberta Government, for strategic air quality planning, organizing, and coordinating resources, and evaluation of results in Alberta through a collaborative process. Specific air quality planning responsibilities are shared among stakeholders. Regulatory implementation, licensing, compliance, control and enforcement remain with existing government agencies.

For further information on provincial and territorial air quality programs, please see:

- Alberta Ministry of Environment[19]
- BC Ministry of Water, Land and Air Protection[20]
- Manitoba Conservation[21]
- New Brunswick Department of Environment and Local Government[22]
- Newfoundland and Labrador Department of Environment[23]
- Nova Scotia Department of Environment and Labour[24]
- Nunavut Sustainable Development[25]
- NWT Land and Environment[26]
- Ontario Ministry of the Environment[27]
- Prince Edward Island Environment and Land[28]
- Québec Ministère de l'Environnement du Québec[29]
- Saskatchewan Environment[30]
- Yukon Environment[31]

4.3. Canadian Council of Ministers of the Environment

The Canadian Council of Ministers of the Environment (CCME)[32] is the major intergovernmental forum in Canada for discussion and joint action on environmental issues of national and international concern.

CCME works to promote effective intergovernmental cooperation and coordinated approaches to inter-jurisdictional issues such as air pollution and toxic chemicals. CCME members (the 14 ministers of the environment for the federal, provincial and territorial governments in Canada) collectively establish nationally-consistent environmental

standards, strategies and objectives so as to achieve a high level of environmental quality across the country. While it proposes change, CCME does not impose its suggestions on its members since it has no authority to implement or enforce legislation. Each jurisdiction decides whether to adopt CCME proposals.

Environmental concerns and impacts cross physical and political boundaries. While federal, provincial, and territorial governments have legislative authority enabling them to regulate matters respecting the environment, they have recognized the need to work co-operatively on environmental matters. The increasing complexity of environmental issues, their inter-jurisdictional and international scope, and the need for consistent approaches across the country have all led to increased intergovernmental cooperation. While this collaborative approach is at the heart of all CCME activity, governments have also entered into a number of formal agreements to promote coordinated environmental management.

Working as equal partners in an area of shared jurisdiction, the ministers come together at the CCME table:

- to establish and maintain an intergovernmental forum for discussion and joint action on environmental issues of national, international and global concern;
- to harmonize environmental legislation, policies, procedures and programs; and
- to develop nationally consistent environmental objectives, standards and scientific databases and complementary strategies, accords and agreements.

4.3.1. CCME Harmonization Accord and Canada-Wide Standards Sub-Agreement

To help clarify roles and responsibilities and to ensure a standard approach to environmental protection across Canada, the federal, provincial (except Québec), and territorial governments agreed to work together in partnership under the framework of the 1998 *Harmonization Accord*[33] and the *Canada-wide Standards (CWSs) Sub-Agreement*[34].

A major aim of the *Harmonization Accord* is to achieve greater effectiveness, accountability, predictability, and clarity of environmental management for issues of Canada-wide interest. Federal, provincial and territorial roles and responsibilities are assigned, case by case, to the level of government that is best situated to act in the most effective manner. Within the agreements, each level of government still retains its legal authorities and can exercise these when necessary.

Under the *Harmonization Accord*, all governments agree to a number of fundamental principles, including the *polluter pays principle*, the *precautionary principle* and a recognition that *pollution prevention* is the preferred approach to environmental protection. An Annex to the *Harmonization Accord* elaborates on stakeholder participation and public accountability.

Through the *Canada-Wide Standards (CWSs) Sub-Agreement*, the CCME is using a cooperative approach to develop and implement consistent environmental measures in all jurisdictions, including policies, standards, objectives, legislation, and regulations.

The air quality standards (for benzene, mercury, particulate matter, ground level ozone, and dioxins and furans) developed by the CCME are based on the willingness of provinces and territories to cooperate. CWSs are intended to be achievable targets and are based on sound science. CWSs will consider other factors such as social aspects (for example, effects on jobs), economic impacts (for example, costs associated with solving the problem), and technical feasibility (for example, availability of technology).

Governments are responsible for implementing the CWS and are accountable to the public for doing so. CWSs do not themselves have any legal force. In implementing the standards, governments may choose to use their existing legal authorities, or create new ones where necessary. Ontario released its CWS implementation plan in June 2004, entitled *Ontario's Clean Air Action Plan*[35]. Other provinces and territories are currently preparing implementation plans to meet the CWSs. (As Québec is not a signatory to the Canada-wide Accord on Environmental Harmonization or the Canada-wide Standards, Québec is not required to develop an implementation plan. However, Québec has committed to meeting the CWS).

Public input has been a key feature in the development of CWSs and the current CWSs have been developed with the participation of a variety of groups with an interest in the standards, including industry, municipal, environmental, health and Aboriginal groups. Their input has come through a mixture of consultation mechanisms used by CCME and individual jurisdictions, including advisory groups, workshops, mail-outs, and website posting of information with an electronic list-serv to notify interested participants of new information.

The CWSs also committed the jurisdictions to develop jurisdictional implementation plans. The concepts of *Pollution Prevention, Keeping-Clean-Areas-Clean,* and *Continuous Improvement*, are elements of the Standards which will help to guide the implementation plans.

- The *Keeping-Clean-Areas-Clean* principle recognizes that polluting "up to a limit" is not acceptable and that the best strategy to avoid future problems is to keep clean areas clean.
- *Continuous Improvement* (CI) applies to areas with ambient pollutant levels below those of existing standards but still above levels associated with observable health effects. The CI framework encourages jurisdictions to take remedial and preventive actions to reduce emissions from anthropogenic sources to the extent practicable.

The CWSs set out common environmental standards of specific air pollutants: benzene, mercury, particulate matter and ground-level ozone. Each jurisdiction is required to develop an implementation plan that describes the actions taken to implement a CWS and achieve compliance by the deadline set for the Standard.

4.3.2. CCME Cooperation on Air Issues

Under the framework of the *Canada-wide Accord on Environmental Harmonization*, the federal, provincial and territorial governments are working together to achieve the air quality targets of the CWSs. Ministers have endorsed the following CWSs for air issues: fine particulate matter, ground-level ozone, benzene, mercury from incineration and base metal smelting, dioxins and furans for waste incinerators and pulp and paper boilers burning salt-laden wood, and dioxins and furans emissions from iron sintering, and steel manufacturing. These Standards will help protect air quality, which in turn will provide significant health benefits for Canadians by preventing thousands of premature deaths and reducing the number of asthma episodes and other breathing disorders. Currently, additional CWSs are under development for: dioxin and furan emissions from conical waste burners; and mercury emissions from electric power generation. (*CWS specifics are provided below in section 5 for relevant cases.*)

Under CCME, governments across Canada are also working together to take action on acid rain and ozone-depleting substances, two issues of national, international and global concern. Under the *Canada-Wide Acid Rain Strategy for Post-2000*, signed by Energy and Environment Ministers in 1998, governments cooperate in developing coordinated approaches to the management of acid rain and the development and maintenance of scientific information required to support sound environmental decision making. (*Acid deposition specifics are provided below in section 5.2.2.*)

4.4. Municipal Role

Municipal governments influence the day-to-day activities of most Canadians who live and work in cities. Unlike federal, provincial and territorial governments, municipal governments do not have constitutional responsibilities for environmental management. Many municipalities can and do take action on some sources of air pollution through enacting local bylaws and indirectly through planning measures that influence land-use and transportation. As such, they can assist other levels of government achieve their clean air goals. In two particular cases, provinces have delegated authority to manage air pollution.

Under British Columbia's *Environmental Management Act*, the Greater Vancouver Regional District (GVRD)[36] has been given delegated authority to control and manage air quality within its boundaries, which includes 21 cities and municipalities in the Greater Vancouver area. As part of its duties, the GVRD monitors air quality, controls the industrial, commercial and some residential sources of air pollution, creates long-term plans and inventories emissions. The neighbouring Fraser Valley Regional District (FVRD)[37] has delegated authority, under ministerial order, to conduct airshed planning, but has no delegated authority to manage air quality.

In Québec, the City of Montréal[38] has the legislated authority (since 1981) to control air emissions from industrial, commercial, residential and institutional sources in its territory. Bylaw 90, adopted in 1994, is the focal point for these efforts, establishing emission

limits for a range of pollutants from point sources, such as large industries and incineration plants. The City has also looked at reducing emissions from residential wood stoves, and has instituted a comprehensive smog monitoring and warning system (InfoSmog[39]) in partnership with Environment Canada.

4.5. Decision-Making and International Cooperation

Canada is intricately linked to other countries around the globe economically, environmentally and socially, and these links play an important role in decision-making in Canada. While global and regional air pollution problems impact on Canada's vast geography (e.g., smog, ozone depletion, persistent organic pollutants, climate change), Canada also has a responsibility to reduce its contributions to these problems. Canada has a long history of international cooperation across a broad range of environmental issues. Arrangements range from informal sharing of information to the adoption of formal cooperative agreements to achieve common goals. *CEPA 1999* provides the means and opportunity to cooperate with international governments to achieve Canada's environmental policy and regulatory goals.

The international pollution provisions of *CEPA 1999* allow the federal Minister of the Environment to address Canadian sources that pollute or may pollute the air in another country or where that pollution violates an international agreement binding on Canada. This section addresses any type of release of substances that contribute to international air pollution, not just those that may have been determined to be toxic. Before using the powers in this division, the Minister must first consult with the provincial, territorial or aboriginal government responsible for the area in which the pollution source is located to determine if that government is willing or able to address the problem. If that government is not willing or able to take action, the Minister must take action to reduce or prevent the pollution including: requiring pollution prevention planning; recommending the making of regulations; or issuing an interim order for emergency situations.

The Government of Canada has signed various bilateral and international agreements to reduce global and continental transport of air pollution that affect Canadians and our environment (e.g., *Canada-U.S. Air Quality Agreement*[40], *Convention on Long-Range Transboundary Air Pollution and its Protocols*, and the *Stockholm Convention on Persistent Organic Pollutants*; see *Section 7*). Of these, the *Canada-U.S. Air Quality Agreement* has significant bearing on other domestic decision making and action on smog, including the federal Clean Air Agenda and federal and provincial implementation of CWSs.

4.5.1. Canada-United States Air Quality Agreement

In March 1991, after more than a decade of scientific research and discussions, the *Canada-U.S. Air Quality Agreement* was signed. The *Agreement* established a formal and flexible method of addressing transboundary air pollution and paved the way for cooperation on a variety of air quality issues. While the initial focus of the *Agreement* was on acid rain, the two nations recently expanded cooperative efforts to control

transboundary ground-level ozone and to conduct joint analyses on transboundary particulate matter.

The main body of the *Agreement* lays out overall air quality objectives and specific requirements for both countries, including regular communication, exchange of information, and consultation on and settlement of issues of concern.

A bilateral Air Quality Committee is responsible for coordinating the overall implementation of the Agreement. Two subcommittees – Program Monitoring and Reporting, and Scientific Cooperation – meet annually with the Air Quality Committee and carry out yearly activities. The two nations prepare a joint progress report[41] every two years and conduct a regular five-year review and assessment of the Agreement.

The *Air Quality Agreement* was signed in 1991 and included two annexes:

- Annex 1, the *Acid Rain Annex*[42], focuses on the commitments of both nations to reduce sulphur dioxide and nitrogen oxides emissions, the primary precursors of acid rain. Under Annex 1, both Canada and the United States have committed to monitoring utility emissions. Continuous emission monitors (CEMs) are widely utilized in the United States; Canada uses CEMs along with other alternative methods.
- As of 2003, Canadian sulphur dioxide emissions were approximately 49 percent below 1980 levels, and the U.S. will achieve a comparable reduction as of 2010. Under Annex 1, Canada and the United States have also committed to prevent air quality deterioration and to protect visibility from sources that could cause significant transboundary air pollution.
- Under Annex 2, the *Scientific and Technical Activities and Economic Research Annex*[43], Canada and the United States agree to coordinate their air pollution monitoring networks; use compatible formats and methods for monitoring and reporting; and cooperate and exchange information about the causes and effects of air pollution and the use of market-based programs, such as the U.S. Acid Rain Program, to address air pollution issues.

In December 2000, Canada and the United States added Annex 3, the *Ozone Annex*[44], to the Agreement.

- This *Annex* commits the two nations to reducing emissions of NO_X and volatile organic compounds (VOCs)-the precursor pollutants to ground-level ozone, which is the major component of smog.
- Actions taken under the *Ozone Annex* are expected to reduce smog-causing nitrogen oxide emissions and volatile organic compounds in the transboundary ozone area of Ontario and Québec by 39 and 35 percent respectively as of 2010 (when compared with 1990 levels), and curb the flow of pollution into Canada from the U.S.

The United States and Canada have ongoing notification procedures, established in fall 1994, to identify possible new sources and modifications to existing sources of transboundary air pollution within 100 km of the border. Notifications can occur for new

and existing sources located outside of the 100 km region if governments believe that there is the potential for transboundary pollution. (Transboundary notification information is available on the Internet sites for Canada[45] and the United States[46].)

4.6. Involvement of Major Groups

4.6.1. CEPA and Public Participation

The role of the public in government decision-making processes is critical, as public trust and broad acceptance of risk management measures are acknowledged to be key for effective risk management implementation.

CEPA 1999 provides a structured predictable approach to risk management decision-making that provides for the input and full consideration of public values and concerns at all stages of the decision-making process. The *CEPA 1999* decision-making framework:

- enables the government to be informed on an ongoing basis of the public's concerns;
- allows the public to influence the identification of environmental problems to be assessed;
- engages a wide spectrum of stakeholders including environmental groups, industries, aboriginal people, other governments and communities;
- provides an opportunity for public values to influence environmental objectives and solutions; and
- allows the public to articulate the levels of risks that are tolerable or acceptable, which influences the choice of appropriate risk management instruments.

Industry and individuals are continually invited to participate in a wide variety of public consultations through notices published in Canada's official parliamentary journal, the *Canada Gazette*[47]. All consultations are also posted on the CEPA Environmental Registry website[48]. The primary objective of the Environmental Registry is to communicate various types of initiatives under *CEPA 1999* to better allow for public participation in the consultation process and to increase public understanding of the Act. The "Public Participation" section of the CEPA Environmental Registry website highlights all consultation opportunities and provides the background information needed for informed environmental decision-making. The Environmental Registry enables the public to monitor the progress of proposed regulations and other *CEPA 1999* instruments.

4.6.2. Women

The federal government is currently taking steps to ensure that women are involved and represented in decision-making in relation to sustainable development, as outlined in the document *Setting the Stage for the Next Century: The Federal Plan for Gender Equality*[49]. This document was prepared as Canada's response and action plan to the Fourth World Conference on Women, which was one of many conferences held in response to the objectives outlined by *Agenda 21.*

Status of Women Canada[50] (SWC) is a government agency that is involved in Canada's initiatives to promote the involvement of women in decision-making. SWC is dedicated to promoting gender equality, and the full participation of women in the economic, social, cultural and political life of the country.

4.6.3. Aboriginal Peoples

Aboriginal people in Canada are involved in decision-making with respect to the environment in many ways. As previously mentioned, the CEPA National Advisory Committee includes up to six representatives of aboriginal governments.

In May 2003, Environment Canada entered a three year contribution agreement with the Inuit Circumpolar Conference[51] (ICC). This agreement builds on the involvement of the ICC in Canada's international efforts related to POPs. For example, the ICC has been actively involved with the current implementation phase of the Stockholm Conference on POPs. This agreement will also allow the ICC to be more involved in the identification, monitoring and assessing issues associated with emerging hazardous air pollutants such as persistent organic pollutants and heavy metals that are not currently addressed by protocols such as the Stockholm Convention or UNECE Protocols on POPS or Heavy Metals. This agreement with the ICC will also bring about more involvement in international consultations and other forms of engagement on initiatives such as: the implementation of the obligations under the United Nations Economic Commission for Europe's Long-range Transboundary Air Pollutants Persistent Organic Compounds (POPs) and Heavy Metal Protocols; and the UN Environmental Programme's Global Mercury Assessment.

4.6.4. Environmental Non-Government Organizations

Environment Canada's commitment to establishing effective consultations with Canadians and with environmental non-government organizations on key policy and program decisions around the environment is demonstrated through its relationship with the Canadian Environmental Network (CEN). The department has provided core financial support to the CEN since 1987. This support enables the CEN to strengthen and build capacity for networking among environmental organizations throughout Canada, and to present views of non-governmental organizations (NGOs) to the department and the federal government. The CEN maintains a national network involving over 700 Canadian environmental groups, through 11 regional networks. The CEN also coordinates the work of 10 national caucuses, composed of representatives from affiliate groups, on issues such as climate change, clean air, toxics and children's health. Each year, the CEN participates in over 100 consultations, providing the department with concrete information on Canadians' opinions on a variety of environmental issues.

4.6.5. Youth and the Environment

Youth are involved in environment and sustainable development issues in Canada in several ways. Information about environmental issues is available to youth through

Environment Canada's Youth and the Environment website[52], as well as information about conferences and volunteer opportunities regarding the environment. Information about funding opportunities is also available, giving youth more access and empowerment to make a difference in actions that are taken to protect the environment.

A main venue in Canada by which youth are able to gain access to and influence decision-making with regard to the environment is the Youth Round Table on the Environment[53] (YRTE). Started in 1997, the YRTE is an active and non-partisan forum of up to 18 youth (with up to 5 members staying on for a second year to ensure continuity) that brings together young Canadians of diverse regional, cultural, educational, and linguistic backgrounds. During a one-year term, which begins in September, the group meets up to three times a year to provide input on Environment Canada's programs and policies and to advise on ways to make these programs more accessible to youth. Members also recommend ways to reach out to a broader youth community, and provide recommendations to the department on environmental issues that are of concern to them and their peers. The YRTE also acts as a venue to involve youth participants in departmental/ ministerial events and activities. There are also youth non-governmental organizations (YNGOs) that are dedicated to keeping youth informed and active about environmental issues. These groups include the Youth Environmental Network[54] (YEN) and Youth Affecting Environmental Change[55] (YAEC).

4.6.6. Environmental Petitions

The 1995 amendments to the *Auditor General Act* created an environmental petitions process. Under this process, residents of Canada can forward a written petition to the Auditor General. Petitions must relate to environmental matters that are the responsibility of specific federal departments and agencies. The Commissioner monitors the status of these petitions and the government's response to them. For example, *Petition 55*[56] called for a review of Government of Canada policies, laws, and regulations on air pollution and air quality. A joint response was prepared by the Ministers of the Environment, Health, Finance, Transport, Industry, and Natural Resources.

5. Strategies, Policies, Programs and Plans

Action on air pollution issues is being taken by all levels of government in Canada, and a mix of policy and program instruments – including cooperative efforts, regulation, multi-pollutant strategies, memoranda of understanding, economic instruments – are used to respond to the range of issues and diverse contexts across the country. Actions are taken on air issues by the level of government most suited to address the problem. For many air pollution problems, joint actions are taken by federal and provincial and territorial governments, often under the framework of the CCME. The federal government is taking action on smog and acid rain through its 10-year *Clean Air Agenda*[57], and is actively pursuing action on other priority air issues such as POPs, mercury, and ozone depleting substance. The provinces and territories are actively pursuing their own clean air objectives and priorities. Cooperation between levels of government in support of Canada-Wide Standards continues. In some cases, actions are taken that support multiple

policy objectives, such as acting on smog and acid rain through reducing SO_2 and NO_X emissions, and meeting the goals of the Canada-Wide Standards, the Canada-Wide Acid Rain Strategy and the *Canada-US Air Quality Agreement*.

5.1. Smog

5.1.1. Canada-Wide Standards for Particulate Matter and Ground Level Ozone

In June 2000, the federal, provincial and territorial governments except Québec signed the Canada-wide Standards (CWSs) for Particulate Matter (PM) and Ozone[58] (Québec has agreed to meet the same targets). These standards commit government to significantly reduce PM and ground-level ozone by 2010. The CWSs for PM and ozone are an important step towards the long-term goal of minimizing the risks of these pollutants to human health and the environment. They represent a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing the pollutant emissions that contribute to PM and ground-level ozone in ambient air.

Particulate matter and ground-level ozone are the main ingredients of smog, and cause serious health effects for Canadians, including thousands of premature deaths, hospital admissions, and emergency room visits every year. The primary commitment in the CWSs is to meet ambient CWS target concentrations for fine particulate matter ($PM_{2.5}$) and ozone, by the year 2010.

Another important commitment is the implementation of *continuous improvement*, *pollution prevention*, and *keeping-clean-areas-clean* programs in areas with ambient concentrations below the CWS levels.

- The CWS for PM is focused on the fine fraction of PM, smaller than 2.5 microns, known as $PM_{2.5}$. The Standard for $PM_{2.5}$ is 30 $\mu g/m^3$ averaged over 24 hours, to be achieved by 2010.
- The CWS for ozone is 65 ppb averaged over 8 hours, to be achieved by 2010.

Each jurisdiction will be responsible for its share in meeting the Standards for particulate matter and ozone, by reporting on achievement once the target dates are reached. Comprehensive reports on the Standards will be produced every five years, beginning in 2006 with a report on progress and followed by annual reports on achievement and maintenance of the Standards starting in 2011.

The first step in achieving the CWSs was to complete a set of joint initial actions, through actions undertaken collectively by all Canada's jurisdictions. These actions include:

- directory of energy efficiency and alternative energy programs in Canada[59];
- overview of multi-pollutant emission reduction strategies for the PM and ozone Canada-wide Standards[60];
- guidance for vehicle emission inspection and maintenance[61];
- report on Canadian in-use vehicle emission reduction programs[62];
- report on Canadian alternative transportation programs[63].

The Government of Canada contributes to the achieving air pollution reduction and meeting the CWSs on particulate matter and ozone, through its efforts under the Clean Air Agenda. This includes investments in the transportation sector, the industrial sector, transboundary air quality, science and engagement.

The CWSs also committed the jurisdictions to develop jurisdictional implementation plans. Jurisdictional plans are the primary vehicle for CWS implementation. Jurisdictional implementation plans will outline more comprehensive actions being taken within each jurisdiction to achieve the Standards for PM and Ozone by the 2010 target date. A different "level of effort" is required in each jurisdiction given that air quality varies significantly from region to region. These implementation plans have been or will be developed in consultations with stakeholders.

The concepts of *pollution prevention, keeping-clean-areas-clean,* and *continuous improvement*, are elements of the Standards which will help to guide the implementation plans.

Implementation details for select jurisdictions can be found at:

- Government of Canada
- British Columbia
- Alberta
- Saskatchewan
- Newfoundland and Labrador
- Ontario

In addition, individual jurisdictions may continue to apply their existing air quality objectives or guidelines for the coarser fraction of PM to guide management actions.

In order to ensure consistency and comparability in reporting by jurisdictions, commitments were made in the CWS document to develop guidance on achievement determination and monitoring activities. The *Guidance Document on Achievement Determination*[64] elaborates on information, methodologies, criteria and procedures related to each of the basic elements of achievement reporting.

5.1.2. CEPA Listing of PM and Ozone and Precursors

As part of the *Clean Air Agenda* and the implementation of the CWSs for PM and Ozone, the federal government has taken steps under *CEPA 1999* on PM and ozone. In May 2001, PM_{10} was added to Schedule 1 of *CEPA 1999*. On July 2, 2003, the federal government also added the precursors to PM_{10}, and ozone and its precursors, to Schedule 1. The reason for adding the precursors to PM_{10} and the precursors to ozone to Schedule 1 of *CEPA 1999* is that up to two-thirds of fine PM ($PM_{2.5}$) and almost all of ground-level ozone is formed in the atmosphere from gaseous precursors. The precursors to PM_{10} are identified as sulphur dioxide, nitric oxide, nitrogen dioxide, gaseous ammonia, and VOCs. Precursors to ozone are identified as nitric oxide, nitrogen dioxide, and VOCs. By

adding PM_{10} and its precursors and ozone and its precursors to Schedule 1 of *CEPA 1999*, the federal government is putting in place the authority it needs to take action to meet its domestic commitments on clean air. In order to deliver on these commitments, the federal government needs access to all "CEPA tools", which are only available if a substance is listed on Schedule 1.

5.1.3. Transboundary Smog and the Ozone Annex

The *Ozone Annex* to the *Canada-U.S. Air Quality Agreement* commits both countries to reduce emissions of NO_X and volatile organic compounds (VOCs) - the precursor pollutants to ground-level ozone. The Annex defines a transboundary region in each country, known as the Pollutant Emission Management Area (PEMA) that is the region from which there are transboundary flows of ozone pollution and precursor emissions. The provinces and states within this region are the areas where emission reductions are necessary to reduce transboundary pollution that creates ozone. In Canada, the region includes central and southern Ontario and southern Québec, covering more than 50 percent of Canada's population. In the United States, the region covers 18 states and the District of Columbia (approximately 40 percent of the U.S. population).

Emission Reduction Requirements

- Canada estimates that by 2010, annual NO_X emissions in the Canadian transboundary region will be reduced by 39 percent from 1990 levels.
- Aggressive annual caps by 2007 of 39 kilotonnes (kt) of nitrogen dioxide (NO_2) emissions from fossil-fuel power plants in central and southern Ontario and 5 kt of NO2 in southern Québec, aligned with U.S. standards year round.
- New stringent emission reduction standards regulated to align with the United States to reduce NO_X and VOCs from vehicles and fuels, including cars, vans, light-duty trucks, off-road vehicles, small engines, diesel engines, and fuel.
- Measures required to attain the CWS for Ozone that address NO_X emissions from industrial boilers and VOC emissions from solvents, paints, and consumer products.

Reporting Requirements

- Report ambient air quality within 500 km (310 miles) of the border beginning in 2002.
- Report annual emissions from major source categories beginning in 2004.
- Improve public access to information on emissions and air quality.
- Develop joint analyses on ground-level ozone and precursors.

Canada's commitments in the *Ozone Annex* reflect key actions to reduce emissions of NO_X and VOCs that are necessary to achieve the CWS for Ozone. Canada is on track to meet its commitments in the Annex as described in the *Canada-United States Air Quality Agreement, 2004 Progress Report*[65].

Canada- U.S. Border Air Quality Strategy Pilot Projects[66]

In June, 2003, three major air quality pilot projects were announced under the Canada-U.S. Border Air Quality Strategy:

- In southwestern British Columbia and northwestern Washington State, the Georgia Basin/Puget Sound International Airshed Strategy is identifying measures to prevent air quality deterioriation as the transboundary region's population grows and address transboundary pollution;
- In southeastern Michigan and southwestern Ontario, the Great Lakes Basin Airshed Management Framework is exploring the development of a coordinated airshed management approach; and
- A joint study to explore the feasibility of NO_X and SO_2 emissions caps and cross-border trading. NO_X and SO_2 emissions are key contributors to smog and acid rain problems in the transboundary region.

These projects are expected to serve as a foundation for developing new strategies to improve air quality and address transboundary air pollution of concern to Canadians and Americans. Reports on the findings of these three projects are to be delivered to the two governments in June 2005.

Transboundary Particulate Matter Science Assessment[67]

As an outgrowth of *the Joint Plan of Action for Addressing Transboundary Air Pollution*, signed in 1997, the governments of Canada and the United States have completed a joint science assessment report on PM. This document represents the first Canada-United States science assessment of an air pollution issue and provides the scientific foundation to support the development of future-joint strategies to help target smog and smog-forming pollutants. This assessment will provide initial scientific knowledge required to determine whether to negotiate a new annex to the *Air Quality Agreement* to address transboundary particulate matter and acid rain. Results from three binational workshops between 1999 and 2003 identified several key objectives for a Canada-United States transboundary PM science assessment. The Transboundary PM Science Assessment concludes that fine particulate matter ($PM_{2.5}$) and its constituents (SO_4, NO_2, NH_4) are of concern in the Canada-U.S. transboundary region, although the concentrations of these pollutants vary geographically. The transport of particulate matter and its precursors from the U.S. to Canada appears to be greater than the transport from Canada to the U.S. Reductions in PM and its precursors would have co-benefits on other air quality issues, including ground-level ozone, acid deposition and visibility.

5.1.4. Reducing Transportation Sector Emissions

The Government of Canada is carrying out a comprehensive 10-year *Federal Agenda on Cleaner Vehicles, Engines and Fuels*, which sets out a plan of action to reduce emissions from these sources. These actions include regulations for on-road vehicle emission, off-road engine emissions, and fuels.

On-Road Vehicle Emission Regulations

On January 1, 2003, the new *On-Road Vehicle and Engine Emission Regulations*[68] were passed. These Regulations introduce more stringent emission standards for 2004 and later model year on-road vehicles and engines. These stringent new standards are now being phased in, and will reduce allowable emission levels from new on-road vehicles by up to 95 per cent. When fully phased in (in 2009), the Regulations will subject all cars and light-duty trucks to the same set of stringent emission standards.

On September 29, 2004, a discussion draft of regulations amending the *On-Road Vehicle and Engine Emission Regulations* was released. These regulations address volatile organic compounds (VOCs), nitrogen oxides (NO_X) and carbon monoxide (CO) from 2006 and later model year on-road motorcycles (inclining scooters and mopeds). Formal publication of these on-road regulations, in *Canada Gazette*, Part I is expected in the first quarter of 2005 and publication in *Canada Gazette,* Part II is expected in the fourth quarter of 2005.

In April 2005, the Government of Canada and the Canadian automobile industry signed a Memorandum of Understanding (MOU) on climate change action. Under this MOU, the auto industry has agreed to voluntarily reduce greenhouse gas (GHG) emissions from light-duty vehicles in Canada (cars, minivans, SUVs and pick-up trucks) by 5.3 megatonnes as of 2010 through advances in vehicle technology. This new agreement recognizes that, from the climate change perspective, it is important to reduce emissions of all GHGs related to vehicle operation. These include emissions of carbon dioxide, methane and nitrous oxide, as well as hydrofluorocarbons from air-conditioning systems. The MOU represents a strong commitment on the part of the automobile industry to work with the Government of Canada, and all Canadians, toward our economic and environmental goals. It also builds upon a long tradition of co-operation between the Government of Canada and the auto industry in improving vehicle safety and addressing emissions issues.

Off-Road Equipment Emission Regulations

On November 19, 2003, the new *Off-Road Small Spark-Ignition Engine Emission Regulations*[69] were passed. These Regulations establish emissions standards for engines rated up to 25 horsepower (19 kilowatts). These are, typically, gasoline engines used in lawn and garden machines, light-duty industrial machines and light-duty logging machines. The new Regulations are expected to reduce smog-forming emissions (combined hydrocarbons (HC) and nitrogen oxides (NO_X)) from this category of engines more than 40 per cent as of 2025.

On February 23, 2005, the *Off-Road Compression-Ignition Engine Emissions Regulations*[70] were published in *Canada Gazette Part II*. These regulations, to come into force in 2006, introduce emissions standards to reduce, by up to 70 per cent the maximum allowable emissions of hydrocarbons, carbon monoxide, and particulate matter for construction, agricultural and forestry equipment.

Environment Canada is currently developing the *Marine Spark-Ignition Engine and Off-Road Recreational Vehicle Emission Regulations*[71]. The planned regulations will introduce emissions standards for outboard engines, personal watercraft, all-terrain vehicles (ATVs), snowmobiles and off-road motorcycles starting in 2007. Pre-publication in Canada Gazette Part I is planned for mid-2005.

As part of the *Climate Change Plan for Canada*[72], the Government is reviewing ways to reduce greenhouse gases from off-road vehicles and equipment. A discussion paper was released on October 6, 2004, and written comments were due by January 28, 2005. The Government is now reviewing the comments and will be developing a plan of action.

Fuels

Canada has a number of federal regulations setting environmental requirements for fuels:

- *Sulphur in Diesel Fuel Regulations* (2002)[73] ensure that the level of sulphur in diesel fuel used in on-road vehicles in Canada will not impede the effective operation of advanced emission control technologies. The regulations limit sulphur in on-road diesel fuel to 500 milligrams per kilogram (mg/kg), reduced to 15 mg/kg by June 1, 2006. (On October 2nd, 2003, amendments to the Regulations *w*ere proposed. These amendments will introduce limits for sulphur in diesel fuel for off-road, rail and marine uses in alignment with the timing and levels of the US EPA rule.)
- *Sulphur in Gasoline Regulations* (1999)[74] limit sulphur in gasoline to an average level of 30 mg/kg with a never-to-be-exceeded maximum of 80 mg/kg.
- *Benzene in Gasoline Regulations* (1997)[75] limit benzene in gasoline to one per cent and control the benzene emissions number.
- *Gasoline Regulations (1990)*[76] also prohibit leaded gasoline and limit the concentration of phosphorus in gasoline. Gasoline for use in aircrafts and competition vehicles are exempt from these regulations.
- *Gasoline and Gasoline Blend Dispensing Flow Rate Regulations* [77] (Feb. 1, 2001) reduce refueling vapour emissions of benzene and other VOCs by 95% and to perform effectively with fuel dispensing flow rates of up to 38 litres per minute.

As part of the *Climate Change Plan for Canada*, the Government has established targets for biofuels of:

- 35 per cent of gasoline to have 10 per cent ethanol content by 2010; and
- 500 million litres of bio-diesel fuel used by 2010.

Environment Canada and Friends of the Earth have jointly produced a *Low Sulphur Procurement Guide*[78] (June 2003) that is aimed at encouraging government and other organizations to take leadership by procuring low sulphur fuels where available and feasible. Environment Canada has evaluated economic instruments, such as emissions trading, and fiscal measures such as taxes and accelerated capital cost allowances, in its consideration of management options to reduce the sulphur emissions associated with the use of fuel oils, and as a means to promote early introduction of lower sulphur fuel oils and/or complement potential regulatory action.

Public Transit

Responding to the related transportation issues of congestion, air pollution, and climate change is one of the most critical environmental, social, and economic issues that Canada faces today. It is a complex and difficult task, with no easy solutions, and it requires consideration of current transportation practices of people and goods, and the impacts they have on the environment. The government's goal is to help achieve a transportation system that is safe, secure, cost-effective, and environmentally responsible. A more integrated and efficient transportation system in cities is not only key to long-term economic competitiveness, but also beneficial to the environment. Federal funding is being made available to establish, maintain, and improve public transit systems as part of the *New Deal for Cities and Communities*[79] (see Section 5.13.1).

Other On-Road Transportation Measures

In many regions in Canada, periodic vehicle emission testing is a licensing requirement required by provinces. These include AirCare[80] for Vancouver and the Lower Fraser Valley, Drive Clean[81] for Ontario, and a heavy-duty vehicle inspection and maintenance program in Québec.

The *LET'S DRIVE GREEN*[82] vehicle emissions clinics held by Environment Canada (in partnership with a variety of local host organizations) across the country – in areas where no mandatory emission testing programs are in place - every summer also assist Canadians with vehicle check-ups. The clinics are a significant opportunity for highlighting the significance of personal transportation in clean air/climate change issue to Canadians.

Voluntary vehicle scrappage programs are developed and run by local community organizations with support from Environment Canada. Owners of pre-1994 model year vehicles who qualify can choose to scrap their vehicle in exchange for one of the incentives offered in their localities. These may include: transit pass, rebate toward the purchase of a new or newer vehicle, or rebate toward the purchase of a bicycle.

The government's voluntary fuel consumption program for new vehicles was initiated in the late 1970s, as an alternative to proclamation of the *Motor Vehicle Fuel Consumption Standards Act*[83] (1981). Motor vehicle manufacturers agreed to meet voluntary annual company average fuel consumption (CAFC) targets, matching U.S. mandatory standards, for new automobiles sold in Canada. The program is administered by Transport Canada, in partnership with Natural Resources Canada. The fuel efficiency of the new vehicle fleet has more than doubled since the program was implemented.

Transport Canada is also involved in numerous initiatives to reduce the growth of greenhouse gas (GHG) emissions in the transportation sector that will also result in reductions of other air pollutants. These include a range of partnerships,

commercialization of near-term fuel-efficient technologies, and sharing the risks and costs of innovation.

- Partnerships established through the Moving on Sustainable Transportation[84] program and the Urban Transportation Showcase Program[85] help foster more sustainable urban transportation.
- Continuous energy-efficiency improvements are underway within the freight system through the Freight Efficiency and Technology Initiative[86] and the Freight Efficiency Program[87].
- More fuel-efficient vehicles for Canadians are supported and promoted through the Advanced Technology Vehicles Program[88].

Key activities under these programs include demonstrations and pilot projects, technology purchase incentives, industry awareness and capacity-building initiatives, and the negotiation of voluntary GHG reduction agreements with modal associations.

Transport Canada and Environment Canada also participate on the UN ECE World Forum for Harmonization of Vehicle Regulations (UNECE/WP.29). With the growing need for harmonization of vehicle safety and emission related regulations, a new Global Agreement was created in 1998 enabling the development of worldwide-harmonized Global Technical Regulations. There is no shortage of emerging technologies in on-road vehicles. Canada believes that early adoption of global standards could speed up their progress, reduce development cost and facilitate their global introduction.

Marine, Rail, and Aviation

Environment Canada and the U.S. EPA have started to work together to reduce emissions from large shipping vessels. The goal of this collaboration is to develop an application to have the coasts of North America declared as a zone where marine bunker fuel with reduced sulphur content must be used. If an analysis reveals that the application would meet the required criteria, then it would be proposed to the International Maritime Organization for approval.

In 1995, Environment Canada entered into a 10-year Memorandum of Understanding[89] (MOU) with the Railway Association of Canada regarding locomotive emissions. Under the MOU, the RAC agreed to voluntarily cap NO_X emissions from locomotives at 115,000 tonnes per annum and to provide an annual report[90]. Negotiations to renew the 1995 MOU with Railway Association of Canada to align emission standards for locomotives in Canada with those of the U.S. EPA are underway.

Transport Canada is working with partners - Air Transport Association of Canada (ATAC); International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) - to develop new aircraft emissions standards and operational practices that address concerns regarding local air quality and global climate change. Transport Canada is co-chairing, with France, ICAO/CAEP Working Group 2, which is addressing aircraft emissions from the technical and operational perspectives, on an ongoing basis. Working with ICAO, Transport Canada is promoting the ICAO circular, *Operational Opportunities to Minimize Fuel Use and Reduce Emissions*.

Transport Canada joined the Federal Aviation Administration and the National Aeronautics and Space Administration as a sponsor of the Center of Excellence (COE) for Aircraft Noise and Aviation Emissions Mitigation. This partnership provides access to a large range of resources and expertise from academic institutions as well as manufacturers.

5.1.5. Reducing Industrial Sector Emissions

To address emission associated with industrial sectors, provinces and territories actively regulate levels of industrial pollution through permitting requirements. In addition, much of this work is undertaken as part of cooperative efforts between provinces and the federal government towards CWSs implementation.

The federal government is working with provinces and stakeholders on multi-pollutant analysis for key sectors to support decisions on emission reduction actions in jurisdictional plans on PM, ground-level ozone and mercury (with the exception of electric power generation, mercury is not one of the pollutants that is being targeted in the multi-pollutant emission reduction strategy). Key industrial sectors being considered in this multi-pollutant analysis (i.e., major emitters common to a number of jurisdictions) include electric power, iron and steel, base metals smelting, pulp and paper, concrete batch mix and asphalt mix plants, and lumber and allied wood products.

Good environmental practices for various stages of a steam electric power project are outlined in the Environmental Codes of Practice for Steam Electric Power Generation (SEPG). The Codes of Practice encompass the siting, design, construction, operations and decommissioning phases of the power plant life cycle and deal with multi-media (air, water and land) considerations.

On April 1, 2003, the *New Source Emissions Guidelines for Thermal Electricity Generation*[91] came into force. The *Guidelines* contain limits for emissions of sulphur dioxide, nitrogen oxides and particulate matter from new power plants, based on the performance of the best available, economically feasible technologies. The intent of the *Guidelines* is that new power plants are built clean. The *Guidelines* are aligned with new plant requirements in the U.S., and will help Canada develop a level environmental playing field with the U.S. electricity sector.

The Environment Canada report, *Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation,* outlines specifications for the design, installation, certification and operation of automated continuous emissions monitoring (CEM) systems used to measure gaseous releases of SO_2 and NO_X from fossil fuel-fired steam electric generating facilities. The procedures used to determine the various CEM system parameters during initial certification testing and subsequent long-term operation of the monitoring systems are presented. An updated version of this 1993 report will be made available in 2005.

The CCME stationary combustion equipment guidelines developed in 1992 continue to support cogeneration projects in industry. These guidelines contain limits to NO_X emissions in a form that encourages highly efficient combined heat and power (cogeneration) plants. Many provinces have adopted these guidelines in their own environmental initiatives.

The Government of Canada published a Notice of Intent in *Canada Gazette,* Part 1 in winter 2004 that describes a series of federal actions to reduce emissions of VOCs from the use of consumer and commercial products. These actions will be implemented over the period 2004-2010 and will include a mix of strategies and measures to achieve VOCs reductions from this sector. Reduction of VOCs emissions from consumer and commercial products is an important aspect of achieving the CWS for $PM_{2.5}$ and ozone in Canada and will result in improvements in air quality.

Work is currently under way to ensure that Canada complies, in 2007, with the *Ozone Annex* NO_X cap commitment for fossil fuel-fired electricity generators with capacities over 25 MW in both the Ontario and Québec portion of the Pollutant Emissions Management Area (PEMA). Québec is working on a regulation that will ensure that by 2007 NO_2 emissions, in the Québec portion of the PEMA, do not exceed 5 kilotonnes. Ontario has also introduced a regulatory strategy to reduce NO_X emissions in response to the *Ozone Annex* 39-kilotonne NO_X cap. The plan outlines the details of a proposed regulation that would set new NO_X and SO_2 emissions limits for six industrial sectors including iron and steel, cement, petroleum refining, pulp and paper, glass and carbon black and non-ferrous smelting. Ontario has also committed to phase-out coal-fired power plants by 2007 and is taking actions that will help meet part of this commitment.

National actions under the Border Air Quality Strategy will support federal and provincial guidelines and codes of practices for key sectors of the industry (e.g., iron and steel, wood processing, sustainable transportation). One example is the *National Framework for Petroleum Refinery Emissions Reductions*[92] which is a CCME initiative that has been developed to reduce air emissions from petroleum refineries in Canada. This is an innovative example of an industry-proposed initiative, in which all levels of government, industry and health and environment NGOs have worked together. Implementation of the Refinery Framework is expected to lead to substantial reductions.

5.2. Acid Rain

5.2.1. Canada-Wide Acid Rain Strategy for Post-2000

The Canada-Wide Acid Rain Strategy for Post-2000[93], signed by the federal, provincial and territorial governments in 1998, is a framework for addressing the remaining acid rain problem in eastern Canada, and for ensuring that this problem does not occur in western and northern Canada. Since its signing, governments have been responsible for implementing each of the commitments as steps towards achieving the long term goal – meeting the critical loads for acid deposition across Canada.

A main element of the *Strategy* is to reduce emissions of acid rain-causing pollutants (sulphur dioxide and nitrogen oxides) in eastern Canada. Under the *Strategy*, Québec,

New Brunswick, and Nova Scotia announced additional sulphur dioxide reductions, by 2010, that are 50 per cent beyond their existing caps under the Eastern Canada Acid Rain Program. Ontario's commitment is for a 50% reduction beyond the existing cap by 2015.

For those areas in Canada not currently exceeding critical loads, the *Strategy* commits them to put in place measures to keep clean areas clean and prevent pollution to protect their sensitive ecosystems. Currently, western and northern Canada, northern Ontario, northern Québec, and parts of Atlantic Canada including Newfoundland and Labrador receive acid deposition below critical loads.

The Government of Canada contributes to the implementation of the *Strategy* by maintaining an active role in science and monitoring, reducing NO_X emissions from the transportation sector and by aggressively seeking further emission-reduction commitments from the U.S. Now that the aforementioned four provinces have committed to reductions, Canada's negotiating position with the U.S. has been enhanced.

5.2.2. Acid Rain Annex

The Acid Rain Annex was developed as part of the original Canada-United States Air Quality Agreement in 1991 to address SO_2 and NO_X emissions, particularly from electric power generation and non-ferrous mining and smelting, as well as visibility protection, preventing air quality deterioration in clean areas, and emissions monitoring.

Canada's commitments under the Acid Rain Annex include:

SO_2 Emission Reduction Requirements

- SO_2 emission reductions in the seven easternmost provinces to 2.3 million tonnes by 1994.
- Maintenance of 2.3 million-tonne annual cap for eastern Canada through December 1999.
- Permanent national cap for SO_2 emissions of 3.2 million tonnes by 2000.

NO_X Emission Reduction Requirements

- By 2000, reduce stationary source emissions 100,000 tonnes below the forecast level of 970,000 tonnes.
- By 1995, develop further annual emission reduction requirements from stationary sources to be achieved by 2000 and/or 2005.
- Implement a NO_X control program for mobile sources.

The United States and Canada have taken significant actions to address acid rain. Both countries have established objectives for emission limitations or reductions, programs to implement these objectives, as well as timetables for implementation. Measures to implement the permanent national cap of 3.2 million tonnes per year by 2000 and the 2.3 million-tonne eastern Canada cap were initially undertaken through the Eastern Canada Acid Rain Program, under bilateral agreements between each respective province and the

federal government. This program, which ended in 2000, was succeeded by the *Canada-Wide Acid Rain Strategy for Post-2000*.

Commitments in the *Acid Rain Annex* to the *Canada-U.S. Air Quality Agreement* have resulted in significant reductions in SO_2 and NO_X emissions since 1990. The more recent Ozone Annex is expected to achieve reductions in transboundary ground level ozone pollutants, including NO_X, an acidifying pollutant. Canada will seek further commitments for cuts in U.S. acid rain-causing emissions, SO_2 and NO_X, as part of future negotiations to reduce transboundary particulate matter under the C*anada-U.S. Air Quality Agreement*.

5.2.3. Acid Deposition Science Assessment

Canada recently completed their latest (2004) *Acid Deposition Science Assessment*[94], building upon the results presented in the 1997 *Canadian Acid Rain Assessment*[95].

- Results show that despite substantial reductions in SO_2 emissions in North America, acid rain continues to be a serious issue. Critical loads for aquatic ecosystems and, as new results show, for terrestrial ecosystems, are still being exceeded across much of southeastern Canada. According to best and worst cases, approximately 0.5-1.8 million km^2, including ~550,000 lakes, receive levels of acid deposition in excess of critical loads (i.e. the amount of acid deposition that a particular region can receive without being adversely affected). Lakes located in affected areas generally exhibit declining sulphate levels in response to emission reductions but, as yet, do not exhibit widespread increases in pH or alkalinity. The only exception to this response is lakes located near smelters in Ontario and Québec that have dramatically reduced emissions.
- The lack of chemical recovery of many aquatic ecosystems in southeastern Canada is affecting the rate of biological recovery. As with the chemical response, there is little evidence of biological recovery (e.g., improved loon breeding success) outside of lakes located near smelters in Ontario and Québec that have dramatically reduced emissions.
- Recent research on the effects of acid deposition on forests indicates that damage is occurring over large regions of eastern Canada. Observed effects include depletion of nutrients from the soil, which results in decreased growth rates and increased susceptibility of trees to climate, pest and pathogen stress. The overall impact is reduced timber yield.
- As with the 1997 Assessment, the 2004 Assessment is revealing significant gaps in knowledge and data about water and soil chemical and biological status and trends, particularly in western Canada. Research continues to show confounding links and interactions with other air quality issues such as climate change, PM and ozone. Although progress has been made, we are still unable to quantify the economic costs and benefits of acid deposition and mitigation.

5.3. Mercury

Mercury[96] presents a risk to the environment and human health, because it is toxic, persistent, and can bioaccumulate in the form of methylmercury in fish and fish-eating predators. Mercury can also travel long distances on air currents, and can settle on land and water far from the source of emissions. Canada is taking several approaches to combat the negative effects of mercury on human health and the environment.

The Canadian Atmospheric Mercury Measurement Network[97] has been established to survey mercury in air and precipitation across 11 sites in five regions in Canada.

Mercury has been designated as a Toxic Substance[98] under the CEPA. Under the federal Toxic Substances Management Policy, it is proposed to manage mercury through a life cycle approach to prevent or minimize its release into the environment, and to ban its use where appropriate.

Mercury has also been addressed through CWSs[99]. Federal, provincial and territorial governments have developed CWSs for mercury from dental amalgam waste and lamps, and for mercury emissions from selected industries, including base metal smelting and waste incineration. A CWS for mercury emissions from the electricity-generation sector is under development.

5.3.1. International Cooperation on Mercury

As Canada is adversely affected by mercury emissions from foreign sources, it also played a leadership role in the development and implementation of international mercury management. Globally, it was under Canadian leadership that the global mercury assessment, which has evolved into the current global mercury programme, was initiated in 2001 by the UNEP. From 2001 to 2003 a global assessment of mercury was undertaken. From 2003 to 2005, the global mercury programme focused on capacity building and awareness raising. Canada has been actively engaged in the programme since its initiation. Other initiatives include the Aarhus (Heavy Metals) Protocol under the UN ECE Convention on Long-range Transboundary Air Pollution, the UNEP Global Mercury Program, the Arctic Council[100], the Great Lakes Binational Toxics Strategy[101] and various national and bilateral monitoring programs.

Canada is also taking action with the United States and Mexico by participating in the North American Regional Action Plan on mercury[102]. This plan serves as an indication of North America's commitment to control mercury, and to demonstrate to other countries that global cooperation is needed to deal with the long-range transport of pollutants in the air. Canada is also currently engaged bilaterally with India (through the Canada-India Environmental Institutional Strengthening Project, which has involved capacity building and information sharing, including for coal-fired power plant and chlor-alkali plants) and with China.

5.4. Benzene

Benzene has been classified as carcinogenic to humans, and is considered a substance posing some probability of harm at any level of exposure. In Canada, transportation, natural gas dehydrators, residential wood combustion and miscellaneous combustion are considered the major sources of benzene releases caused by human activity. Vehicle emissions are the biggest source of benzene exposure for non-smokers, and smokers are exposed to even higher levels. Through the CWS for benzene[103], the following sectors are targeted for reductions in benzene emissions: oil and gas, transportation, petroleum refining, chemical manufacturing and steel manufacturing. National application of best management practices, and of the best available pollution prevention and pollution control techniques, are in place for new and expanding facilities. Significant emissions reductions have been achieved, with more targeted through 2010.

5.5. Persistent Organic Pollutants (POPs)

In May 2001, Canada became the first country to both sign and ratify the Stockholm Convention on Persistent Organic Pollutants (POPs) – the global Convention on POPs. This Convention aims at reducing and eliminating the major international sources of these toxic substances that are a significant concern for all Canadians. The Convention entered into force in May 2004 and has been ratified by over 90 countries to date. Canada has developed a draft National Implementation Plan to meet one of the obligations of the Convention and to explain how Canada intends to comply with this legally binding agreement. The plan will be completed prior to May 2006, and also includes an action plan for reducing unintentionally produced POPs such as dioxins and furans.

Canada recognizes that human health in the Arctic is being compromised by transboundary contaminants - particularly persistent organic pollutants, and is taking action domestically through the Northern Contaminants Program (NCP)[104]. The NCP aims at reducing, and where possible, eliminating contaminants in country foods harvested in the North, while providing information that assists decision-making by individuals and communities in their food use. The program brings together federal departments, territorial governments and indigenous organizations to develop projects aimed at reducing and, where possible, eliminating contaminants in country food. Key features of the NCP include full partnerships with the northern Aboriginal organizations in the overall management of the program, and the use of traditional knowledge in project implementation and communication strategies. Canada is also assisting internationally to address POPs sources (see section 7.2.3)

5.5.1. Dioxins and Furans

CWSs for dioxins and furans[105], signed in 2001, set emission limits for coastal pulp and paper boilers and incinerators. Standards, signed in May 2003, set emission limits for iron sintering plants and electric arc furnaces.

5.5.2. International Cooperation on POPs

Canada established in the 2000 budget the $20 million Canada POPs Fund to provide capacity building assistance to developing countries and countries with economies in transition to deal with their POPs problems. The World Bank administers the overall Fund and, with the United Nations Environmental Programme (UNEP) and the Global Environmental Facility (GEF) supports POPs projects based on criteria agreed to by Canada for dispensing funds.

At the federal level, Canada and the U.S. participate in a number of bilateral, regional and global level activities related to POPs. At the regional and global levels, these include:

- Stockholm Convention on POPs;
- POPs Protocol to the UNECE Convention on Long range Transboundary Air Pollution;
- Arctic Council – Arctic Monitoring and Assessment Program[106].
- Canada –US-Mexico/ CEC – North American Regional Action Plans;
- Canada-US Great Lakes Binational Toxics Strategy.

5.6. Ozone Depleting Substances

Canadian governments have cooperated through CCME since the early 1990's to address the phase-out of substances such as CFCs and halons that can deplete the ozone layer. The Federal-Provincial Working Group on Ozone-Depleting Substances and Halocarbon Alternatives has a mandate to develop and coordinate the implementation of nationally consistent measures to prevent and minimize releases of ozone-depleting substances, and ultimately eliminate their uses, and has developed *Canada's Strategy to Accelerate the Phase-Out of CFC and Halon Uses and to Dispose of the Surplus Stocks*[107], to achieve an orderly and affordable phase-out of CFCs and halons in Canada.

An important component of the Strategy is the *National Action Plan for the Environmental Control of Ozone-Depleting Substances (ODS) and their Halocarbon Alternatives*[108] (revised 2001). The *Action Plan* provides a national framework for a harmonized approach by the federal, provincial and territorial governments to implement an ozone layer protection program.

5.6.1. Montreal Protocol Bilateral and Multilateral Fund

Canada contributes to the Montreal Protocol Multilateral Fund and undertakes bilateral projects[109] under that Fund to assist developing countries in their efforts to phase out ozone-depleting substances (ODSs). In recent years, Canada has collaborated with Australia to establish a recovery and recycling centre for halon, a potent ODS, in India, allowing the country to gradually eliminate its need for producing and importing new halons. In addition, Canada is implementing projects to transfer technology and expertise for the phase-out of CFC use in refrigeration in several Latin American and Caribbean

countries, including Bolivia, Chile, Cuba and Jamaica. A project with Mexico to phase out certain uses of methyl bromide will also be initiated this year.

5.7. Climate Change

The federal government released its updated 2005 Climate Change Plan, *Moving Forward on Climate Change: A Plan for Honouring our Kyoto Commitment*[110], on April 13, 2005. The Plan builds on Budget 2005, which introduced new mechanisms and significant resources for achieving our climate change objectives to reduce greenhouse gas emissions. The Plan will be instrumental in achieving Canada's clean air goals, since emissions of air pollutants and greenhouse gases often originate from the same sources.

The Plan's two key objectives are to 1) enable Canada to meet its Kyoto targets, and 2) create the transformative change in public behaviours and business practices that support economic growth at the same time as emissions reduction.

The Plan marks a shift to a more market-based approach and is based on the following principles:

- *Balance* – short term action to protect the environment and long-term measures to spur transformation;
- *Competitiveness* – weighing the transition to a sustainable economy with the impact on short-term competitiveness;
- *Partnership* – investments that lever outside funds and encourage responses from all sectors;
- *Innovation* – promoting innovation and new technologies creating both new opportunities and long-term improvement in our environmental performance;
- *Cost-effectiveness* – achieving environmental goals at the lowest possible cost.

Canada believes these same fundamental principles have application on the world stage as well. They are guiding our thinking as we engage in a new conversation on post-Kyoto international cooperation.

Canada's Kyoto target is a 6% reduction below 1990 emission level for the period 2008 to 2012. This requires an emission reduction of some 270 megatonnes below projected business-as-usual levels.

Main elements of the Plan include:

- **Large Final Emitter System:** which covers about 700 companies in the mining, manufacturing, oil and gas and thermal electricity sectors that account for half of Canada's total GHG emissions. Emission reduction targets will be aggressive – as demanding as those in the European trading system – yet achievable – setting intensity targets which will allow companies to thrive and grow, while reducing

greenhouse gases. The system is market based, providing companies with the flexibility to achieve their targets in a way that fits their unique circumstances.

- **The Climate Fund:** will provide incentives for emission reduction across all sectors of the economy. The Fund is a permanent institution that will purchase domestic emission reduction credits towards Canada's Kyoto commitment on behalf of the Government of Canada. The Fund will also invest in internationally recognized emissions reductions as long as these help to advance Canada's broader sustainability interests.

- **The Offset System**: will provide credits for emission reductions across the economy. The credits can then be purchased by Large Final Emitters as well as the Climate Fund. The Offset System will use the market to incent innovation in emission reductions across the economy.

- **The Partnership Fund:** will cost share key strategic projects in the energy sector with provinces and territories – for example in clean coal technology, CO_2 capture and storage, east-west transmission, energy efficiency and renewables, agriculture and forestry and inter-modal freight. Through this fund, provinces and territories will have opportunities to put forward their key priorities for shared funding. The Fund will allow Canada to exploit our oil sands, coal reserves and hydro-electric potential in an environmentally sensitive and sustainable manner.

Other aspects of the Plan include:

- **Targeted incentives for renewable energy development** through the Wind Power Production Incentive and the Renewable Power Production Incentive

- **Tax breaks for renewable energy and energy efficiency** through an expanded Capital Cost Allowance,

- **Incentives, information and tools** to help Canadians fully participate in helping to achieve our commitments, through programs such as the expansion of Energuide for Houses Program and the One-Tonne Challenge.

Canada is making significant headway as we put in place these new mechanisms and opportunities for participation in addressing climate change. The federal government is consulting broadly with provinces and territories, industry, communities, experts, environmental and other non-governmental organizations on the mandate and operation of these institutions and mechanisms to ensure they are effective in achieving our competitiveness and emission reduction objectives.

As called for in the Plan, Canada will review progress on climate change on an annual basis, in order to make needed adjustments as we move forward, in light of our performance in reducing net emissions while remaining economically competitive.

5.8. Renewable Energy, Energy Efficiency and Energy Policy

Canadian energy policy is market-based and oriented toward sustainable development, and is no longer narrowly concerned with production and supply issues. Today, it is more aligned to the broader economic, environmental and public interest goals of the Canadian government. More precisely, Natural Resources Canada's (NRCan) Sustainable Development Strategy[111] states that today's energy needs must be addressed without compromising either the environment or the ability of future generations to meet their needs. NRCan is committed to developing and promoting economic, regulatory and voluntary approaches that encourage sustainable development and use of energy resources. NRCan also reports on energy use in Canada through the *Energy Use Data Handbook*[112] and *Energy Efficiency Trends in Canada*[113].

Development of natural resources in Canada, including energy sources, is mainly under provincial jurisdiction. As such, each province utilizes its resources according to its respective needs and situations. Provinces have, however, adhered to consensus decisions (often negotiated through the federal government) to meet certain minimum environmental standards of operation. This has taken the form of environmental performance standards and guidelines related to such things as stationary fossil-fuel burning equipment such as boilers, and vehicles and transportation fuel composition. Some standards, such as those for combustion turbines used in combined cycle applications, and *New Source Emission Guidelines for Thermal Electricity Generation*, are output based thereby recognizing efficiency as a pollution prevention method.

With the ratification of the Kyoto Protocol, a major goal for Canadians is to achieve environmental and economic excellence. By investing in new technologies that can avoid, reduce, sequester or capture greenhouse gas emissions we can meet the climate change challenge. For example, NRCan's Office of Energy Efficiency[114] manages programs aimed at moving the market towards energy efficiency in the residential, commercial, industrial and transportation sectors. Although the focus is on addressing greenhouse gases, increases in energy efficiency will also lower emissions of other air pollutants. These programs emphasize partnerships and economic investments in the residential, transportation, industrial, commercial/institutional sectors as well as federal government institutions.

Much of the electricity used in Canada is generated from the burning of fossil fuels, which emits GHGs and air pollutants. Therefore, an increased use of emerging, low-impact renewable energy like wind and solar power, along with increased energy conservation, can help address climate change and air quality. Accordingly, the Government of Canada is committed to accelerating the development and use of emerging renewable energy in Canada. To this end, recent investments have included: expansion of the Wind Power Production Incentive[115]; announcement of a new Renewable Power Production Incentive for non-wind-based renewable electricity; funding to develop a Sustainable Energy Science and Technology Strategy[116]; green power purchases for federal operations and leadership on standards to promote green power markets; and various taxation incentives. The development of renewable energy

will be further supported through Canada's new climate change plan, which emphasizes that the advancement of renewable energy will be a cornerstone in Canada's work to honour its Kyoto Protocol commitments.

NRCan and Environment Canada work in partnership with a range of stakeholders from industry and government to develop and deploy innovative, cleaner energy technologies.

5.9. Agricultural Emissions

Initiatives lead by Agriculture and Agri-Food Canada (AAFC)[117] to address agricultural air quality issues include programs, such as the Canadian Adaptation and Rural Development Program (CARD)[118], Agri-Environmental Indicator Project[119], the Agricultural Environmental Stewardship Initiative (AESI)[120] and the Livestock Environmental Initiative (LEI)[121], as well as collaborative, multi-stakeholder efforts to establish and promote standards and best management practices to improve air quality. AAFC closely monitors and directly participates in the various initiatives designed to manage agricultural and other sources of air pollutants. The AESI is a collaborative partnership between AAFC and Environment Canada to develop a set of recommendations aimed at reducing the contribution of agricultural emissions to poor air quality, including both ammonia (particulate matter) and odour components. Significant research and development activities are underway to address the scientific gaps needed to produce scientifically based standards by the end of the program in March, 2008.

AAFC's Research Branch[122] is working to develop ways to reduce the adverse impact of agricultural practices on air quality. Research and development activities are being conducted to support sustainable farming systems and to increase our understanding of air related issues and their impact on agriculture. Education and awareness activities are also being implemented to promote best practices, and policy options that could enhance the sector's capacity to mitigate impacts on air quality, on the ozone layer, and to adapt to climate change are being evaluated.

The Methyl Bromide Industry/Government Working Group[123] examines all issues related to methyl bromide, a Montreal Protocol ozone-depleting substance that is used as a pesticide, including its reduction and eventual elimination. The Working Group provides a forum for government to consult with industry on international and domestic matters relating to the phase out of methyl bromide (e.g., trade or regulations). It also provides members with the opportunity to influence program development and research initiatives. The committee is comprised of representatives of farm organizations, the food processing, milling and pest control industries, environmental organizations, manufacturers of potential alternatives, and federal government departments.

5.10. Economic Policies and the Use of Economic Instruments

The Canadian government recognizes that innovative policy tools such as economic instruments hold promise for promoting environmental excellence. These economic instruments can complement or substitute traditional regulatory command-and-control

measures to reduce air pollution. They include the allocation of property rights, fee-based measures, liability and assurance regimes and tradable permits.

The Government of Canada has a long standing commitment to examine the use of economic instruments. Its regulatory policy requires regulatory authorities to examine alternatives to regulation. However, the policy instruments used thus far include only a limited number of economic instruments. In its 2005 Environmental Performance Review of Canada, the OECD in fact noted that "(i)ncreasing the use of economic instruments is a *matter of urgency* in view of the need for affordable solutions and appropriate cost sharing to reduce environmental degradation".

The economic instruments that have been introduced were implemented mainly by the provinces. Among the key provincial initiatives are Ontario's cap and trade system for NO and SO_2 emissions from power plants and British Columbia's differentiated fees for industrial polluters.

At the federal level, Environment Canada has introduced a cap and trade system to phase out methyl bromide and HCFCs and is implementing tradable unit systems to reduce two toxic substances, tetrachloroethylene (PERC) and trichloroethylene (TCE). The Government of Canada is also developing the details of a trading system for large industrial emitters and analysing GHG, SO_X and NO_X emissions permit systems.

In recent federal budgets, Canada has provided incentives for the use of cleaner-burning ethanol fuels and the production of wind energy. Under the Wind Power Production Incentive companies are eligible for payments of up to 1.2 cents/kilowatt-hour produced. Similarly, a *Green Municipal Fund* supporting environmental projects is managed at arms length from the federal government by the Federation of Canadian Municipalities.

Recent changes by the Government of Canada to the tax system with respect to renewable energy include:

- several improvements to Capital Cost Allowance Class 43.1 in recent budgets, including some additions to the list of eligible equipment and activities (Class 43.1 includes certain renewable energy and energy efficiency equipment that qualifies for an accelerated capital cost allowance rate of 30 per cent);
- the introduction of Canadian renewable and conservation expense (CRCE) for projects primarily using equipment eligible for Class 43.1 (CRCE includes certain intangible expenditures associated with the start-up phase of renewable and energy conservation projects; they are fully deductible and eligible for flow-through shares); and
- consultations with the Canadian wind energy industry on the definition of a test wind turbine contained in the Income Tax Regulations, and the current Natural Resources Canada criteria for a test wind turbine, permitting more than one test wind turbine as part of a taxpayer's wind farm to qualify for special tax incentives and allowing greater flexibility in the timing of investment financed using flow-through shares.

The government continues to assess how to make best use of other economic instruments to improve air quality, and will draw from the work by other organizations. For example, Canada's National Round Table on the Environment and the Economy[124], an independent advisory body appointed by the Prime Minister, is exploring potential strategies. Through its Ecological Fiscal Reform program[125], it can advise on redirection of both government taxation and expenditure programs toward an integrated set of incentives supporting the shift to sustainable development.

5.11. Other Provincial and Territorial Action

In addition to the joint implementation of the Canada-wide Standards, and the various other activities described above (e.g., vehicle scrappage programs, acid rain strategy, ODS regulations), provinces and territories are actively involved in many other actions on air issues. In general, action undertaken by provinces and territories follows from their authority and keeps in mind joint and cooperative action with other levels of government. Provinces and territories work to meet air quality objectives by regulating industrial point sources of air pollutants. Some illustrative examples of recent action by provinces and territories include the following:

- Ontario's plan for addressing smog and acid rain has included:
  - caps on NO_X and SO_2 emissions from Ontario's electricity sector
  - NO_X emission limits on new or modified large boilers in industrial facilities
  - orders to reduce SO_2 emissions at two major smelters
  - many non-regulatory commitments in Ontario's *Anti-Smog Action Plan*[126]
- Nova Scotia has made SO_2 and NO_X reduction commitments in its recent Energy Strategy, and is working on several airshed management initiatives, including community-led initiatives
- In Alberta, the Clean Air Strategic Alliance (CASA) has worked to develop, among others:
  - a framework for reducing solution gas flaring emissions
  - an emissions management framework for the electricity sector
  - re-design of the provincial ambient air quality monitoring system and creation of an online database;
  - an improved SO_2 management system;
  - critical, target and monitoring loads for the evaluation and management of acid deposition.
- British Columbia has recently issued guidance material for integrated airshed management planning.
- Some Canadian provinces and U.S. states have also established partnerships and developed initiatives that focus on transboundary air quality issues. For example, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP)[127] developed a communications plan aimed at gauging public understanding and attitudes toward acid rain and mercury in order to increase its outreach efforts and better inform the public about transboundary air pollution. For mercury, a task force was established to pursue regional mercury reductions. As a further example, the NEG/ECP Forest Mapping Work Group is calculating

and mapping acid deposition critical loads and exceedances for sulphur and nitrogen for upland forest soils to identify forest regions most sensitive to acid deposition. NEG/ECP is also undertaking ozone and PM air quality forecasting and conducting public health outreach.

5.12. Municipal and Community-level Action

Canada is among the world's most urbanized nations, with approximately 80 percent of our population living in cities. Despite our relative abundance of land, pressures related to urban population growth and urban sprawl are beginning to place increasing stress on the quality of life in Canadian cities. Many large urban regions share common challenges, such as infrastructure needs, smog, traffic gridlock, and loss of prime agricultural land and green spaces. Furthermore, cities and municipalities are realizing increased responsibilities with limited access to new resources.

Municipalities have direct control or influence over many sources of emissions that can affect air quality. As a result, many municipalities are taking actions that can lead to improvements in air quality. Example includes smog management plans, investments in public transit, land use planning, greening operations (including municipal fleets) and education campaigns.

Two municipal governments, Montréal and the Greater Vancouver Regional District, have delegated authority from their respective provincial governments. As such they are able to take direct actions to control pollution sources on their territories.
Provincial governments support for municipal level actions on air quality can take many forms in addition to delegated authority, and includes investments in infrastructure and public transit.

5.12.1. New Deal for Cities and Communities

The Government of Canada recognizes the important role of municipalities, and is providing resources as part of its *New Deal for Cities and Communities*. The *New Deal for Cities and Communities* is about the provision of resources to municipalities by the federal government. It is also about all orders of government working collaboratively and in harmony in four priority areas of sustainability: environmental; economic; social; and cultural. The *New Deal for Cities and Communities* respects provincial jurisdiction, while recognizing the need to act at every level of government to alleviate the very real stresses facing cities and communities. The greatest transformative element in the *New Deal* will be the new relationships developed with the provinces, cities, the private and the not-for-profit sector for the benefit of citizens who live in urban and rural communities.

The *New Deal* recognizes that cities and communities require stable, long-term and predictable funding. To that end, recent federal Budgets have provided all municipalities with a 100 % Goods and Service Tax rebate and have allocated gasoline tax funding over the next five years to municipalities. These funds will be allocated to environmentally sustainable infrastructure investments in the areas of public transit, water and wastewater,

community energy systems and solid waste. The three primary outcomes to which these funds are directed and against which results will be measured include: greenhouse gas emissions reductions, cleaner air, and cleaner water.

As part of its commitment to Canada's growth and the quality of life of all Canadians, the Government of Canada launched Infrastructure Canada[128]. In partnership with provincial, territorial, and local governments, First Nations, and the private sector, Infrastructure Canada helps to renew and build infrastructure in rural and urban municipalities across Canada. Federal investment in municipal infrastructure is being implemented through the Infrastructure Canada Program (2000-2006), and more recently the Canada Strategic Infrastructure Fund. Infrastructure Canada's first priority is green municipal infrastructure -- projects that improve the quality of the environment and contribute to national goals of clean air and water. Working in partnership with provinces and municipalities, the Canadian Government is improving local access to technology and projects that promote clean air, clean water and will reduce the threat of climate change in urban and rural centres.

5.12.2. Green Municipal Funds

The federal government also established the Green Municipal Funds[129] to stimulate municipal investments in innovative environmental infrastructure projects and practices to achieve cleaner air, water, and soil and to protect the climate. The Funds are managed by the Federation of Canadian Municipalities[130] (FCM), at arms length from the federal government. The Green Municipal Funds help cities and communities overcome the risk and initial capital costs of implementing greening projects. The Green Municipal Funds provide grants to support feasibility studies to increase municipal expertise and knowledge of leading-edge environmental technologies and provides grants, loans and loan guarantees to assist municipal governments to lever investments in environmental infrastructure projects through a revolving fund. For example, district energy networks providing electricity, heating and cooling and reducing air pollutants and greenhouse gas emissions would be a desirable infrastructure investment.

5.12.3. Smog Summit

June 2005 marks the sixth anniversary of the Smog Summit[131]. The Smog Summit has become an annual one-day event held in Toronto where Ministers, Mayors, Regional Chairs and other officials from all levels of government come together to affirm or reaffirm their commitment to Clean Air and to report progress on commitments made at previous summits. The City of Toronto established the Greater Toronto Area Clean Air Council[132] (GTA-CAC) to facilitate and encourage cooperation among all levels of government in actions to improve air quality in the Greater Toronto Area. The GTA-CAC was established as the result of a joint commitment made by all levels of government at the 2000 Smog Summit. The Greater Toronto Inter-Governmental Declaration on Clean Air makes statements of common understanding concerning air quality issues and contains actions taken jointly by several levels of government. The joint actions are important in demonstrating the cooperation among levels of government.

6. Capacity Building, Information, Science, R&D

6.1. Outreach, information and engagement

As air issues management in Canada is shared among jurisdictions, communities and individuals must also take action. There has been significant activity to engage Canadians to take action on clean air through partnership, public education and outreach.

6.1.1. Clean Air Day and Commuter Challenge

Clean Air Day Canada[133], celebrated every year on the Wednesday of Environment Week, provides a focal point for local and national activities promoting clean air and climate change awareness and actions. As the transportation sector in Canada is the largest contributor to air pollution and climate change, sustainable transportation is chosen as the focus for Clean Air Day activities. The Commuter Challenge[134] continues to be an important Clean Air Day and Environment Week[135] event which encourages communities and municipalities, the private sector, NGOs and all levels of government to engage in a friendly competition to reduce air pollution levels and greenhouse gas emission through sustainable transportation choices like public transit, walking, cycling, car-pooling or tele-working. During Clean Air Day 2003, more than 48,000 Canadians from more than 43 major communities participated in Commuter Challenges across Canada.

6.1.2. Environment and Sustainable Development Indicators Initiative

In their May 2003 report, *Environment and Sustainable Development Indicators for Canada*[136], Canada's National Round Table on the Environment and the Economy (NRTEE) proposed six indicators to better track the state of Canada's natural capital assets. These indicators were identified as measures to augment familiar economic data, such as the gross domestic product (GDP) and the consumer price index (CPI). The proposed indicators included five natural capital and one human capital indicator: forest cover, freshwater quality, air quality, greenhouse gas (GHG) emissions, extent of wetlands, and educational attainment.

In the February 2004 Speech from the Throne, the federal government made a commitment to begin using several of the recommended indicators, announcing that "… building on the recommendations of the National Round Table on the Environment and the Economy, the Government will start incorporating key indicators on clean water, clean air and emissions reductions into its decision making."

The objective of this initiative is to develop, refine and report on water and air quality indicators, along with indicators on greenhouse gas emissions, as the first phase of a longer-term strategy to develop a broad array of environmental indicators which complement existing socio-economic indicators and support responsible decision-making, strong accountability and effective engagement of Canadians on environmental sustainability.

NRTEE proposed a national, population weighted indicator of seasonal average ozone levels as a high level indicator of air quality trends in Canada. The Government of Canada's ESDI initiative will adopt the specific indicator as put forward in NRTEE's ESDI report, subject to an assessment of the implications of population weighting for the indicator.

6.1.3. Air Quality Forecasts and Air Quality Index

A key component in motivating the public to take action is increasing their knowledge of local smog and air quality conditions. Local summertime air quality forecasts in British Columbia, Ontario, Québec, and Atlantic Canada, provide information to more than 60% of the Canadian population. Multi-stakeholder workshops have produced both short- and long-term recommendations for moving forward with the development of a multi-pollutant health-risk-based Air Quality Index, or AQI. Environment Canada, the Ministère de l'environnement du Québec, the City of Montréal and Public Health Departments cooperate on the INFO-SMOG program, which provides health information, air quality forecasts and warnings in addition to environmental messages for the public via the Meteorological Service of Canada web site[137]. This site provides useful daily information and includes links to INFO-SMOG partners' web sites.

6.1.4. National Pollutant Release Inventory

The National Pollutant Release Inventory[138] (NPRI) is legally mandated under *CEPA 1999* and collects and makes publicly available information on releases of over 300 pollutants from industrial and commercial facilities across Canada. Companies that manufacture, process or otherwise use a listed substance at or above the reporting threshold must report their releases or transfers to Environment Canada annually. NPRI is publicly available and searchable by location or substance.

As part of Canada's commitments under the Ozone Annex, the NPRI was expanded to include criteria air contaminants (NO_X, VOCs, PM_{10}, $PM_{2.5}$, TPM, SO_X, CO) for 2002 reporting. In addition, for 2003 reporting, reporting on emissions of individual VOC species was added to improve our capabilities for air quality modeling. Preliminary 2003 NPRI data was made available to the public in December 2004. The final 2003 data, after quality control activities have been completed, will be released later in 2005. The 2003 data includes reporting on emissions of speciated VOCs for the first time, and reporting on releases from many more facilities in the Upstream Oil and Gas Sector than previously reported. The National Overview report series[139], summarizing the 2002 NPRI, was released in January 2005.

6.2. Support for Decision-Making

6.2.1. Emissions Inventories & Projections

The Emissions and Projections Working Group (EPWG) is a technical working group of emissions inventory and projection practitioners in Canada. The EPWG operates under the framework of the CCME. The EPWG is responsible for preparing Canada's emissions inventory of criteria air contaminants (CAC), specifically PM, PM_{10}, $PM_{2.5}$, SO_X, NO_X, VOCs, CO and NH_3. The EPWG has prepared CAC emission inventories for 1995 and 2000 and is in the process of developing Canada's 2002 CAC emissions inventory. The EPWG also prepares backcasts, projections and trends of Canada's CAC emissions. The EPWG estimates these CAC emissions on a national and provincial/territorial basis.

The compilation of the comprehensive 2002 Criteria Air Contaminants[140] emissions inventory has been initiated in Canada and should be completed during the latter part of 2004. It is expected that the 2002 emissions inventory will become the new baseline for scientific analyses, air quality modeling, and the development of emission reduction strategies in both Canada and the United States.

6.2.2. Air Quality Monitoring

Canada maintains several air monitoring networks.

The National Air Pollution Surveillance[141] (NAPS) Network is a joint federal, provincial, territorial and municipal network established in 1969. It is primarily an urban network, with nearly 300 air monitoring stations in over 175 sites/communities reporting to the national database. The NAPS Network gathers measurements on the components of smog. These are ozone, PM, SO_2, CO, NO_X and VOCs. The NAPS network also collects at selected sites samples for the analysis of ions, metals and semi volatile organics such as PAHs and dioxins and furans. Air quality data collected by the NAPS Network have been used to demonstrate the links between air pollution and human health and also to evaluate air pollution control strategies, identify urban air quality trends and forewarn of emerging air pollution issues. Information from the NAPS Network is used by land-use planners, public transportation and urban planners, and many others who must take air quality into account in their decisions.

In addition, there are a number of non-urban networks in Canada. The Canadian Air and Precipitation Monitoring Network[142] (CAPMoN) is a rural network with 29 air and precipitation monitoring stations located in remote and relatively pristine areas. The monitoring stations focus mainly on the tracking of acid rain and smog constituents such as major inorganic ions in precipitation; PM, $PM_{2.5}$ (speciated), PM_{10} , particulate ions, HNO_3, NH_3, SO_2, O_3, NO, NO_2, NOY and PAN. One site in the United States and another in Canada ensures the compatibility of measurement methods between Canada and the US networks. Furthermore, CAPMoN data are used to assess transboundary transport of pollutants, determine spatial patterns and temporal trends of pollutants related to acid rain and smog and provide data for long-range transport model evaluations and terrestrial and aquatic effects research. The CAPMoN also assesses the effectiveness of acid gas emission control programs in Canada and the United States.

Toxics in the Great Lakes Basin such as such as PCBs, organochlorine, pesticides and PAHs are measured by the Integrated Atmospheric Deposition (IADN) Networks. The data is used to determine atmospheric loadings and trends of priority toxic chemicals to the Great Lakes basin, measure air and precipitation concentration measurements and identify their sources.

Total gaseous mercury and elemental mercury in precipitation are measured by the Canadian Atmospheric Mercury Networks (CAMNet). CAMNet data is used to describe spatial and temporal variations in gaseous mercury and mercury in precipitation in Canada, assess the relative contributions of dry and wet mercury deposition; and provide data for model development and evaluation.

Greenhouse gas levels and aerosols are measured at Canadian Baseline Program sites, some of which have records for carbon dioxide dating back to the mid-1970's. The data are used to determine trends of greenhouse gases over Canada, support studies to determine the carbon budget over Canada and to determine the impact of aerosols on climate change. A subset of the existing non-urban network sites, called the CORE network (6 sites in total) has been designated for long-term, high quality data collection of atmospheric constituents in major Canadian airsheds.

The Canadian Brewer spectrophotometer observation network consists of 9 stations, of which three are in the Arctic. The Brewer instruments measure/monitor ozone and nitrogen dioxide columns at several sites and make UV-B measurements at all Canadian sites. This information is used for ongoing scientific research into ozone and climate change issues and to help forecast air quality. In addition, some 300 ozonesondes, which are instrument packages carried aloft by balloons, are launched throughout the year from six locations in Canada, including three in the Arctic. Ozonesondes provide direct measurements of ozone concentrations at different altitudes in the atmosphere.

AEROCAN[143] is a sunphotometer and sky-scanning radiometer network consisting of 14 sites and is part of the AErosol RObotic NETwork (AERONET), a federated group of networks for observing aerosol optical properties globally. These observations can be used to help understand how air pollution events (e.g. smog) affect aerosol optical properties. AEROCAN is a collaborative effort between the University of Sherbrooke, the Canada Centre for Remote Sensing (CCRS) and the Meteorological Service of Canada.

As part of a commitment made in the Ozone Annex, ozone air quality levels were reported for the first time in 2002 for the region across Canada and the U.S. within 500 miles of the common border.

6.2.3. Air Quality Modelling

Air quality modellers at Environment Canada's Meteorological Service contribute to the research on the transport, transformation and removal of pollutants in the atmosphere. Air quality models are developed based on the most current science and technologies to

simulate and predict the changing chemistry of the atmosphere at various scales (global, regional, and local). These models are used to provide air quality forecast and to support domestic and international air quality policy development.

More specifically air quality models are being used to predict, describe and assess the behaviour of atmospheric pollutants in efforts to provide applied scientific support for decision-makers and develop efficient air pollution control strategies. Modellers use models to develop and test scenarios to determine the significance and impact of emissions to the atmosphere and to evaluate the sufficiency and effectiveness of key policies to improve air quality (e.g. CWS for ozone and PM). Models are also being used to generate timely air quality forecasts to Canadians to help protect themselves and their environment from air pollution.

6.3. Research, Science & Technology

6.3.1. Air Quality Research

Scientists in the Meteorological Service of Canada (MSC) study the chemistry and physics of the atmosphere. This research is focused on short-term events (weather), longer-term atmospheric conditions (climate) and air quality issues, such as acid rain, stratospheric ozone depletion and the resulting increase in ultraviolet radiation, ground-level ozone and particulate matter (smog), as well as hazardous air pollutants.

The research focuses to a large extent on understanding the relationship between pollution sources and the resulting ambient levels of air pollution (source-receptor relationships) which consequently permits the definition of the environmental benefits of emissions reductions. MSC scientists also contribute to the assessment of the current state of knowledge and communicate this understanding to relevant stakeholders.

Scientists in Canada are continuing to develop the predictive capability to advise Canadians on tomorrow's air quality as well as advise stakeholders on the impacts of current and potential reductions in emissions of air pollution across Canada. This continued improvement of predictive capability is based on an increased understanding of the changing chemistry of the atmosphere resulting from research on the formation and distribution of air pollutants of concern.

Government scientists frequently work with researchers in universities and other federal and provincial departments, as well as with experts in the private sector, on atmospheric issues of mutual interest. Where human or ecosystem health is affected by atmospheric conditions, cooperative work is also carried out with scientists in these fields.

A primary mandate of air quality science is to develop and provide unbiased, relevant, and scientifically sound knowledge, advice, and data on air quality. The air quality science program provides national leadership and the scientific foundation needed to develop air quality policies and provide timely information (e.g. air quality forecasts) to Canadians. Air quality research is aimed at improving the understanding of the changing

chemistry of the atmosphere in efforts to fill scientific knowledge gaps and improve information for decision-making and policies on air pollution. The science involves research and development based on atmospheric constituents and their properties. Research activities include the investigation of the transport, dispersion, chemical transformations, and deposition of anthropogenic and natural sources that impact air quality and adversely affect human and ecosystem health. These research activities are directed towards the priority issues of acid rain, toxic chemicals, photochemical smog, stratospheric ozone, and greenhouse gases and aerosols.

6.3.2. Health Effects Research

Health Canada is conducting scientific research on acute and chronic health effects of ambient and indoor air pollution. Health Canada is also breaking new ground in personal and spatial exposure analysis, and in developing tools such as the Air Quality Index to better enable the public to manage the risks from air pollution.

Further scientific understanding of the health effects of air pollution in the Canadian context is required to support risk assessments and risk management, to provide information for policy development, and to better inform health professionals and the public. A key consideration is the health impacts on vulnerable populations, such as children, the elderly or those with pre-existing lung and heart conditions.

Health Canada has conducted air quality research projects and assessments, and communicated the results in a variety of ways, including publications in peer-reviewed journals. Support will continue for cross-departmental and stakeholder-initiated projects to parallel internal work. Health Canada scientists actively participate in national and regional conferences, providing current information to relevant stakeholders on the health effects of air pollution.

As more risk indicators are identified, Health Canada continues to assess and make determinations on how best to communicate those risks to the public. While information delivery links have been developed with a wide range of health and environmental non-governmental organizations (NGOs), it is important to bridge the gaps among delivery of findings, pertinence of data, and the need to inform and educate Canadians.

Health Canada also continues to examine the health effects of climate change on air quality. One study on the effects of weather conditions on daily mortality and hospitalizations found a strong increase in daily nonaccidental mortality and cardio-respiratory mortality for increases in maximum temperature. Further research is planned on other Canadian cities to examine the differential and combined impacts of summer and winter weather and air pollution on human health, paying particular attention to vulnerable groups such as the elderly, children, those with respiratory and cardiovascular disorders. Recent and ongoing studies are also being conducted to examine the effects on diabetics.

Through the Border Air Quality Strategy[144], Health Canada is collaborating with its partners—American officials, other federal departments, provincial and municipal governments, industry and business interests, non-government organizations, health professionals and academics—to pinpoint the negative impacts of transboundary air pollution on human health and contribute to the development of a framework for coordinated airshed management.

Key research studies include:

- Large scale exposure assessments, including personal exposure and spatial variability, are underway in the Great Lakes Basin and the Georgia Basin / Puget Sound airsheds. Study results will be used to fill knowledge gaps for air health risk assessment and management purposes, and will address whether limited monitoring within cities underestimates human exposure to air pollution and its impact on residents' health.
- An important study undertaken by Health Canada under the Great Lakes Basin Airshed Management Framework[145] of the Border Air Quality Strategy is the Windsor Children's Respiratory Health Study, which will characterize the respiratory health of elementary school children in relation to exposure to both indoor and outdoor air pollution.
- Under the Georgia Basin Puget Sound International Airshed Strategy[146] of the Border Air Quality Study, a childhood respiratory disease birth cohort will be studied to examine the relationship between the incidences of childhood respiratory disorders, such as asthma and bronchiolitis, and air pollution in the airshed.
- Health Canada, along with Canadian and international study partners, is about to undertake a multistage population-based study to determine the association between traffic-related air pollution and childhood asthma. The study objective is to determine whether long-term exposure to urban traffic-related pollutants is independently associated with the development of asthma and respiratory symptoms in young children at levels of exposure currently observed in large North American cities.
- A population-based cohort study of Ontario residents will be conducted to determine connections between long-term exposure to air pollution and patterns of cancer incidence and mortality. .

The Government of Canada is also expanding its national air quality prediction capacity and participating in the development of a national health-based Air Quality Index (AQI). It is used to report upon current and near term air quality conditions. It provides a general idea of the level of air pollution at a particular place and time. This index is a tool that will help Canadians to understand the links between human health and air quality, and empower them to take individual action to protect their health and that of their children.

The Air Quality Benefits Assessment Tool (AQBAT) is a simulation model being developed by Health Canada to assess the health benefits to the Canadian population of pollution reduction scenarios.

6.3.3. Ecosystems Effects Monitoring and Research

Environment Canada conducts several projects to monitor and research the effects of acid rain on the ecosystem. These projects include the monitoring and research of surface water chemistry, chemical and biological recovery from acidification, base cation depletion and nitrogen cycling at three sites in eastern Canada. This work also includes the development of predictive models to investigate wildlife responses to ecosystem acidification and recovery.

6.3.4. Innovation & Technology Support

Reductions in air emissions are also supported broadly through innovation and technology development programs in Canada. In most cases, these tend to be broad-oriented programs with goals for multiple environmental benefits, not simply air quality. In some others, these are programs targeted primarily towards GHG reductions, but which will result in air quality improvements due to improved energy efficiency.

SDTC[147] – Sustainable Development Technology Canada is a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians. SDTC supports clean-technology projects through the pre-commercialization points at which technologies move from the laboratory and are proved in full-scale, real-world test situations. To do so, the Foundation draws from an investment fund of $550 million. SDTC was established by the Government of Canada in 2001. SDTC's mission is to act as the primary catalyst in building a sustainable development technology infrastructure in Canada.

PERD[148] –The Program of Energy Research and Development promotes the development and use of Canada's non-nuclear energy resources in a clean and safe manner and the development of energy-efficient, renewable, and alternative energy sources and technologies. Currently, 86 per cent of PERD's programs are aimed at finding technology solutions to help Canada address its climate change challenges.

TEAM[149] – Technology Early Action Measures is an interdepartmental technology investment program established under the federal government's Climate Change Action Plan. TEAM supports projects that are designed to develop technologies that mitigate GHG emissions nationally and internationally, and that sustain economic and social development. TEAM provides support in five major priority areas: cleaner fossil fuels; energy-efficiency technology; biotechnology; hydrogen economy; and decentralized energy production

7. International Cooperation

The importance of international engagement to implement sustainable development was recognized by the Government of Canada in its April 2005 *International Policy Statement*[150]. The policy statement commits Canada to pursue sustainable development through both domestic and international strategies, and to develop new international environmental policies at home that will provide a management framework that integrates domestic and international goals.

International partnerships continue to play an essential role in Canada's strategy to address air pollution. Pollutant emissions from transportation, energy production, industry, and residential activities enter the atmosphere and are carried long distances, across borders and even halfway around the world. This transboundary movement of pollutants means that air quality is truly a global concern and requires long-term coordination and cooperation internationally. Canada's international cooperation on air issues are described in this section of the report.

7.1. Canada-United States Cooperation

Of particular importance to air quality in Canada is Canada's partnership with the United States. This is because the United States is Canada's most significant trading partner, closest neighbour and a significant source of pollution in many areas of Canada. The *Canada-United States Air Quality Agreement* and its *Acid Rain* and *Ozone Annexes* have been the basis for coordinated action for transboundary air issues (*see Sections 5.1.3-5.2.2*).

Under the auspices of the Canada-U.S. Air Quality Agreement, joint research initiatives looking at the effects of air pollution are also taking place, such as:

- *Health Effects* – In addition to joint research efforts to study the relationship between air pollution and human mortality, independent research efforts in Canada and the United States are also examining the links between PM and a variety of health risks, including lung cancer, heart attacks, and thickening of the blood.
- *Aquatic Effects* – Joint Canadian/U.S. studies, including trends observed from 1989-1999 at sites in the International Cooperative Program on Assessment and Monitoring of Acidification of Rivers and Lakes, have found improvements in water quality from decreased acid deposition amid the complexity of ecosystem responses to multiple stressors.
- *Forest Effects* – The NEG/ECP is undertaking a Forest Mapping Project to determine sustainable levels of acid deposition for forest soils in the northeastern United States and eastern Canada. Joint cooperation through the North American Forestry Commission is also assessing the effects of air pollution on forest ecosystems of North America.
- *Effects on Buildings and Monuments* – The U.S. National Center for the Preservation of Technology and Training (NCPTT) and the Canadian

Conservation Institute[151] are continuing research on innovative conservation methods for historical structures and cultural materials.

Further joint interests in addressing transboundary air pollution issues have lead to such initiatives as the Georgia Basin/Puget Sound International Airshed Strategy. Due to concerns of continuing rapid growth in the Georgia Basin region of southwestern British Columbia and the Puget Sound region of northwestern Washington state, Environment Canada and EPA initiated a collaborative process to develop a Georgia Basin/Puget Sound International Airshed Strategy. This will combine early action, airshed characterization, and strategic planning to address high-priority air quality issues and challenges in these regions.

Other cooperative measures between Canada and the U.S. are also in place, such as the Great Lakes Binational Toxics Strategy[152] (BNS). The strategy works towards the goal of virtual elimination of certain toxic persistent substances, resulting from human activity, from the Great Lakes Basin. The BNS establishes reduction challenges in the time-frame 1997 to 2006 for twelve 'Level 1' persistent toxic substances. Governments are also encouraging through the BNS the promotion and implementation of pollution prevention activities that will lead to a reduction or the elimination of substances deemed to be Level II substances.

7.2. Canada-United States-Mexico Trilateral Cooperation

Canada also works closely tri-laterally with the United States and Mexico to address transboundary air pollution in North America. This cooperation is guided by the North America Agreement on Environmental Cooperation (NAAEC) and its Commission for Environmental Cooperation (CEC). In June 2003, the Commission for Environmental Cooperation – North American Air Working Group was established. This group aims to facilitate cooperation on air issues among representatives from Canada, the U.S. and Mexico, including by establishing improved mechanisms for exchanging technical data and developing strategies to address air quality issues of common concern. Under the CEC, Canada, the United States and Mexico have developed regional action plans on chlordane, DDT, PCBs and mercury.

The Sound Management of Chemicals[153] (SMOC) project is an ongoing North American tri-national initiative to reduce the risks of toxic substances to human health and the environment. By focusing on persistent, bioaccumulative and toxic substances, the project provides a forum for identifying priority chemical pollutant issues of regional concern, developing North American Regional Action Plans (NARAPs) to address these priority issues, overseeing the implementation of approved NARAPs and facilitating and encouraging capacity building in support of the overall goals of SMOC. Activities include the development of a single "cluster" NARAP for dioxins, furans, and hexachlorobenzene. This single NARAP will address all three of these compounds which are typically formed as unwanted byproducts released to the environment during commercial processing or waste burning.

Complementary to the CEC's work, are the air initiatives under the Security and Prosperity Partnership of North America (SPP). The SPP was announced in March, 2005 in Waco, Texas, by the leaders of Canada, the U.S. and Mexico. In their announcement, the leaders asked that work plans be developed to promote cooperation on a number of issues. In June, officials from the three countries announced the first work plans under the SPP, including an Environment work plan. The Environment work plan includes initiatives to reduce sulphur in fuels in Mexico, address ship-source air pollution, and advance air quality reporting in North America.

7.3. Globally

Canada is also working multilaterally with the United Nations through the United Nations Environmental Program (UNEP), the Organisation for Economic Co-operation and Development (OECD), and the World Bank, by providing funding for environmental programs and research and by sharing knowledge and experience through conferences and workshops in areas such as best available technology and policy options to address poor air quality. International and bilateral conferences and workshops provide countries with the opportunity to exchange ideas, learn about new policy tools and technology, and develop partnerships.

Canada maintains strong bilateral relationships with other nations to cooperate on issues of mutual concern. In particular, Canada is concerned about long-range transport of pollutants and consequently engages in projects and policy exchanges on air issues. Examples of such work include:

- through financial support from the Canadian International Development Agency, Environment Canada is working on a bilateral collaborative project with India[154] to strengthen the institutional capacity in India to address environmental issues, including building capacity to analyze, monitor, and control air emissions;
- Vehicle emissions testing in Latin America[155]
- involvement in the Clean Air Initiative in Latin American Cities[156]
- providing expert services to demonstrate air quality benefits of mandated vehicle conversion in Bangladesh
- An MOU with China, which includes air pollution as a priority and workshops share technical expertise.

In addition, the Canadian International Development Agency[157] has also partnered on various energy efficiency and renewable energy projects.

7.3.1. United Nations Economic Commission for Europe and the Convention on Long-Range Transboundary Air Pollution

The United Nations Economic Commission for Europe (UN ECE) is one of five regional commissions of the United Nations and includes Canada, the United States, Europe, Russia and other member countries of the former Soviet Union. Several legally binding Protocols have been negotiated under the auspices of the *Convention on Long-Range Transboundary Air Pollution.*

Canada has ratified five of the seven Protocols and is intending to ratify the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone upon the completion of a number of related domestic and bilateral initiatives (The Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes entered into force in September 1997, but Canada has not ratified the agreement):

The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes (entered into force in 1987, ratified by Canada)	Canada was required to reduce national annual sulphur emissions or their transboundary fluxes by at least 30% as soon as possible and at the latest by 1993, using 1980 levels as the basis for calculation of reductions. As well, Canada was not to increase emissions of national annual sulphur or their transboundary fluxes beyond the 30% reduction (permanent national cap of 3200 kt of SO_2 by 1993).
The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions (entered into force August 1998, ratified by Canada)	Canada is required to reduce its national emissions to 3700 kt by 1990 and to 3200 kt by 2000, the latter of which is a 30% emission reduction from the 1980 base year. Emissions were to be reduced in the regional sulphur oxide management area (including much of eastern Canada) to 1750 kt, which is a 46% reduction from a 1980 base year. Under this Protocol, Canada is, again, required to report annually on emissions of SO_X.
The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (entered into force 1991, ratified by Canada)	Canada is required to control and/or reduce national annual emissions of nitrogen oxides or their transboundary fluxes by December 31, 1994 at or below emissions for 1987 or any previous year specified at signature. Canada has frozen its national annual emissions or nitrogen oxides at 1987 levels of 2131 kt since 1987. Canada is obligated to report annually on NO_X emissions under the provisions of the Sofia Protocol.
1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes (entered into force in September 1997, Canada has not ratified)	If Canada were to become a Party, Canada would be required to reduce its annual emissions of VOCs from Tropospheric Ozone Management Areas by at least 30% by 1999, using 1988 levels as a basis, and ensure that total national annual emissions of VOCs by 1999 do not exceed 1988 levels. As Canada has not ratified the Geneva Protocol, there is currently no obligation for reporting.
The 1998 Aarhus Protocol on Heavy Metals (entered into force in 2003, Canada was the first Country to ratify)	For the three specified heavy metals (cadmium, lead, mercury), Canada is obligated to reduce heavy metal emissions, control atmospheric emissions from new plants in designated industrial sectors, reduce atmospheric emissions from existing facilities by 50% (based on 1990 values), control lead content in gasoline and mercury content in alkaline batteries, and develop and maintain emission inventories for specified heavy metals. When the Protocol comes into effect, Parties will be required to report on emissions of cadmium, lead and mercury on an annual basis. The UN ECE has requested that Canada, being the first country to ratify the agreement, demonstrate leadership and begin to voluntarily report on heavy metal emissions.
The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs) (entered into force 2003, Canada was the first Country to ratify)	For dioxins, furans, hexachlorobenzene and polycyclic aromatic hydrocarbons, Canada is obligated to reduce its total annual emissions from the 1990 emission level. Canada is obligated to maintain/develop emission inventories for these substances from designated industrial sectors. Parties will be required to report on emissions of the specified POPs on an annual basis. The UN ECE has again requested that Canada demonstrate leadership and begin to voluntarily report on POPs emissions.

The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (not yet in force, Canada has not ratified)	This multi-effect, multi-pollutant Protocol will require Parties to further reduce their emissions of SO_2, NO_X, VOCs and ammonia. For Canada, as well as the U.S., the level of emission reductions required under this protocol will be specified when each country ratifies the protocol. Canada's commitments under the Protocol will be based on the Ozone Annex agreement to the Canada-U.S. Air Quality Agreement, the Canada-Wide Standards for PM and Ozone, and the establishment of new SO_2 reduction targets under the Canada-Wide Acid Rain Strategy. Canada will be required to report annually on emissions of SOx, NOx, and VOCs through this multi-pollutant Protocol. There are currently no ammonia related obligations for Canada and the U.S. within this Protocol.

Annex 1: Web Sites

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[5] http://www.ec.gc.ca/pdb/npri/documents/html/CAC_Handout_e.cfm
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[9] http://www.nrcan-rncan.gc.ca/inter/index.html
[10] http://www.ec.gc.ca/CEPARegistry/
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[12] http://www.ec.gc.ca/CEPARegistry/gene_info/nac.cfm
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[37] http://www.gvrd.bc.ca/aqi/
[38] http://services.ville.montreal.qc.ca/air-eau/fr/brocairf.htm
[39] http://lavoieverte.qc.ec.gc.ca/atmos/dispersion/main_e.html
[40] http://www.ec.gc.ca/cleanair-airpur/Pollution_Issues/Transboundary_Air/Canada_-_United_States_Air_Quality_Agreement-WS83930AC3-1_En.htm
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[154] http://www.acdi-cida.gc.ca/cidaweb/webcountry.nsf/VLUDocEn/India-Projects#23

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