2000 Annual Progress Report on

The Canada-Wide Acid Rain Strategy for Post-2000

May 2001

National Library of Canada cataloguing in publication data

Main entry under title:

2000 Annual Progress Report on the Canada-Wide Acid Rain
Strategy for Post-2000

Text in English and French on inverted pages.
Title on added t.p. : Rapport d'étape annuel 2000 concernant la
Stratégie pancanadienne sur les émissions acidifiantes après l'an 2000.

Issued also on the Internet.

ISSN 1488-948X
ISBN 0-662-65957-0
Cat. No. En40-11/39-2000

1. Acid rain – Canada – Periodicals.
2. Environmental monitoring – Canada – Periodicals.
3. Pollution – Canada – Measurement – Periodicals.
I. Canada. Environment Canada.

TD195.54 2001 363.738'67'097105

2000

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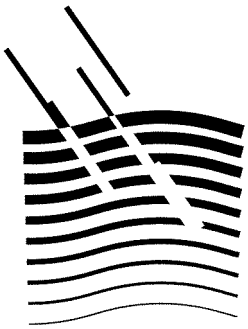

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Introduction

In October 1998, federal, provincial and territorial Energy and Environment Ministers signed The Canada–Wide Acid Rain Strategy for Post-2000. The primary long-term goal of The Strategy is "to meet the environmental threshold of critical loads for acid deposition across Canada". As steps towards the achievement of this goal, *The Strategy* calls for a number of actions, including:

- pursuing further emission reduction commitments from the United States;
- establishing new sulphur dioxide (SO_2) emission reduction targets in eastern Canada;
- preventing pollution, and keeping "clean" areas clean;
- ensuring the adequacy of acid rain science and monitoring programs; and
- annually reporting on SO_2 and nitrogen oxide (NO_x) emissions and forecasts, on compliance with international commitments, and on progress in implementing *The Strategy*.

In the first year of implementing *The Strategy*, governments focussed their efforts on a review of the adequacy of science and monitoring, and on preliminary work towards the development of new emission reduction targets for eastern Canada. A full progress report was provided to Environment Ministers at their fall 1999 meeting. At that meeting, Ministers made it a priority for 2000 to complete the establishment of new targets for emission reductions in eastern Canada. They also instructed officials to examine ways to address identified gaps in science and monitoring.

This annual report, then, reviews progress on *The Canada–Wide Acid Rain Strategy* since fall 1999, with particular emphasis on the two priority areas identified by Ministers. It also reports on emissions of SO_2 and NO_x, the main acid rain-causing pollutants, and on compliance with international commitments, as required under *The Strategy*.

Progress on Specific Commitments

1. Pursuing emission reductions in the United States

By 2010, the United States expects to achieve a reduction in its SO_2 emissions of about 40% from 1980 levels, meeting or exceeding its commitments under the 1991 Canada–U.S. Air Quality Agreement. In Canada, emissions of SO_2 had declined by over 40% by 1999 from the 1980 base year. Despite this progress, acid rain will continue to exceed harmful levels in eastern Canada even after 2010, largely as a result of the transboundary flow of acidifying pollutants. More than half of the acid rain that falls in eastern Canada comes from U.S. sources. The Government of Canada, therefore, continues to seek emission reduction commitments from the United States.

Formal negotiations with the United States to address the issue of ground-level ozone, initiated in February 2000, culminated on December 7, 2000, with the signing of an Ozone Annex under the Canada–U.S. Air Quality Agreement. The Annex calls for reductions of NO_x and volatile organic compounds (VOC) emissions in a Pollutant Emission Management Area (PEMA) consisting of 18 states and the District of Columbia in the United States, and central and southern Ontario and southern Quebec in Canada. The annex provides for NO_x and VOC emission control measures specific to each country. The United States estimates that under the annex total NO_x reductions from

the 1990 base year in the American part of the PEMA will amount to 36% year-round by 2010. For the Canadian part of the transboundary region, Canada estimates that the total NO_x reduction from 1990 levels will be 44% year-round by 2010.

On the issue of fine particulate matter (PM), joint scientific work is currently under way to define the transboundary nature of fine inhalable particles. The negotiation of a PM Annex is expected to follow in the next two to four years. Canada hopes to obtain a commitment from the United States for an SO_2 emission reduction of 50% or more under this annex, as SO_2 is one of the principal precursors of fine PM. Analyses of control options in the United States indicate that such a reduction in SO_2 may be one of the more cost-effective means of controlling PM.

At its meeting in July 2000, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) reaffirmed its call for large emission reductions on both sides of the Canada–U.S. border by resolving to impress upon both federal governments the need for further controls of sulphur and nitrogen emissions. Some member jurisdictions have announced individual reduction plans. Proposed regulations in the State of Connecticut, for example, would reduce SO_2 emissions from major emitting facilities by 30 to 50% beyond current commitments by 2003. Reduction initiatives in other NEG/ECP states and provinces are being developed. New York State, although not a member of the NEG/ECP, has proposed a 50% reduction in SO_2 beyond *Clean Air Act* requirements and a 30% reduction in NO_x.

2. Establishing targets and schedules

The Canada–Wide Acid Rain Strategy committed Ontario, Quebec, New Brunswick and Nova Scotia to the establishment of targets and schedules for further SO_2 emission reductions in their respective jurisdictions. It also committed them to jointly develop a target for the designated Sulphur Oxide Management Area (SOMA—consisting of the south-eastern part of Ontario and the southern part of Quebec, together with New Brunswick, Nova Scotia and Prince Edward Island).

In the course of 2000 and early 2001, new emission reduction targets were announced by Ontario, Quebec and New Brunswick. Nova Scotia expects to finalize a new target later in 2001. The following describes more specifically the progress by each jurisdiction, since the last annual report, on the establishment of new emission targets:

- On January 24, 2000, Ontario announced an SO_2 emission reduction target of 50% from its Countdown Acid Rain Program cap by 2015. It reaffirmed at the same time its commitment to a 45% reduction in NO_x from 1990 levels by 2015. The province has since indicated it would accelerate this NO_x target to 2010 or earlier, contingent on the federal government negotiating equivalent reductions from the United States.
- Quebec has been committed since November 1997 to reduce its SO_2 emissions by 40% from its Eastern Canada Acid Rain Program cap by 2002. On April 26, 2001, Quebec announced that it was increasing this reduction target to 50% by 2010.
- New Brunswick announced new emission targets on March 28, 2001. The new targets lower the provincial SO_2 emissions cap set under the Eastern Canada Acid Rain Program, by 30% by 2005 and by 50% by 2010.
- Nova Scotia is committed to SO_2 reductions. Nova Scotia sources are largely related to energy production, and the province is currently addressing the numerous energy options available as a result of offshore gas

developments, and their environmental implications, through an energy strategy. Nova Scotia will establish definitive targets and timelines for SO_2 reductions in the context of the energy strategy which is anticipated to be released in 2001.

The status of the reduction targets is summarized in Table 1, below.

To support work on the development of targets and schedules, governments undertook two main initiatives in 2000 and early 2001: atmospheric modeling of emission reduction scenarios, and consultations with emitters and other key stakeholders.

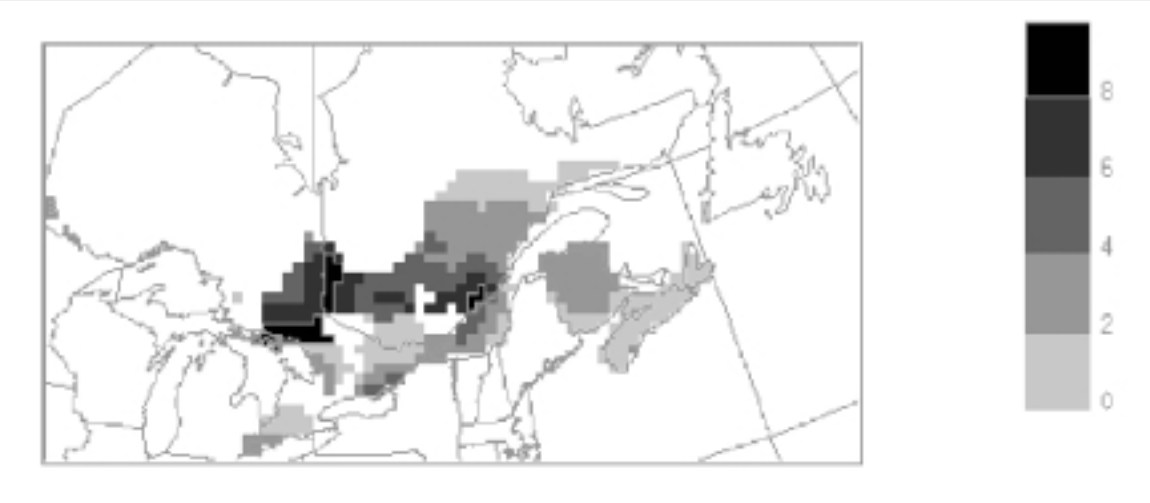
The Acid Deposition and Oxidant Model (ADOM) was used to provide guidance on the magnitude and the location of SO_2 emission reductions which will be needed to reach critical loads across the country. Critical loads are defined as the level of acidic deposition that a specific area can tolerate without harm and are currently based on aquatic ecosystem sensitivity. The baselines for this modeling work were the provisions of the 1991 Canada–U.S. Air Quality Agreement, which included the existing Canadian cap and the U.S. legislated requirements of the time. Under this scenario a large area of Eastern Canada is shown to be exposed to acid rain deposition above critical loads (Figure 1).

Five new modeling scenarios were run to evaluate the effects of different, plausible combinations of SO_2 emission reductions. These scenarios did not necessarily represent policy options, but were run to develop a better quantitative understanding of source-receptor relationships which could then be used to build the policy options. The scenarios included various combinations of the following reductions from existing caps: Nova Scotia–25%, New Brunswick–25 or 30%, Quebec–45 or 50%, Ontario–50%, and the United States–50, 55 or 60%. As well, the distribution of reductions was varied within each jurisdiction. Figure 2 shows a typical result (Scenario E) from these runs, with a much reduced area exceeding critical loads.

Table 1 SO_2 reduction targets for Ontario, Quebec, New Brunswick and Nova Scotia

	Eastern Canada Acid Rain Program Cap	New target under *The Canada-Wide Acid Rain Strategy*	Timeline for new target
Ontario	885 kt	442.5 kt (50% reduction) • announced in January 2000	2015
Quebec	500 kt	300 kt (40% reduction) • announced in November 1997 250 kt (50% reduction) • announced in April 2001	2002 2010
New Brunswick	175 kt	122.5 kt (30% reduction) 87.5 kt (50% reduction) • announced in March 2001	2005 2010
Nova Scotia	189 kt	to be announced	to be announced

Figure 1 **Area of eastern Canada expected to receive SO_4 deposition above critical loads (in kilograms per hectare per year) in 2010, without further controls beyond provisions in the 1991 Canada–U.S. Air Quality Agreement.**



Note: Shaded areas receive from 0 to 8 kilograms per hectare per year of deposition in excess of critical loads.

While these results provide useful guidance, they must be used in their proper context, especially given the fact that deposition for many areas appears to be only slightly below critical thresholds. The use of predictive models always includes a level of uncertainty when making comparisons with actual results. Also, the critical loads themselves are not perfectly defined. The spatial distribution of critical loads based on aquatic systems is somewhat coarse and may not include particularly sensitive local areas. Critical loads for forest ecosystems are in development, and these may be very different from those used for aquatic systems. As well, the modeled emission scenarios deal only with SO_2 emission reductions. The additional contributions of NO_x to acidification have not been assessed in the model runs, although ADOM can predict nitrate deposition as well as sulphate deposition. Policy makers must take these issues and uncertainties into account when developing a comfort level surrounding government commitments.

That being said, the model runs clearly illustrate the need for reductions in SO_2 emissions if critical loads are to be met, and provide additional insight as to the magnitude and location of the reductions which are required. They also show the absolute dependence that some areas have on U.S. reductions of 55% or more.

In addition to atmospheric modeling of emission reductions, jurisdictions also conducted consultations with stakeholders in 2000 and early 2001 to obtain input into the establishment of new emission reduction targets. The consultations included a national stakeholder workshop as well as consultations and information sessions in individual provinces. Environmental and health groups in general expressed the view that targets should be aggressive in both the magnitude of reductions and their implementation schedules. These stakeholders also wanted assurance that the reduction commitments will be enforceable (possibly through the use of a mechanism such as

Figure 2 **Area of eastern Canada expected to receive SO_4 deposition above critical loads (in kilograms per hectare per year) with targeted emission reductions of 50% in Ontario, 50% in Quebec, 30% in New Brunswick, 25% in Nova Scotia and 60% in the United States.**

Note: Shaded areas receive from 0 to 4 kilograms per hectare per year of deposition in excess of critical loads.

federal-provincial agreements to enshrine the new targets and schedules, as was done under the Eastern Canada Acid Rain Program), and advised against the use of overall reduction targets that still allow emission levels in local areas that exceed safe levels for human health or ecosystems. Industry stakeholders indicated a comfort with approaches that were prudent, based on sound science and proper consideration of business cycles and capital turnover rates.

3. Keeping "clean" areas clean / pollution prevention

Measures put in place by various jurisdictions to minimize growth in emissions and control acid rain include the development of pollution prevention plans for key emitting facilities, the use of permitting procedures to control emissions from new and existing sources, pollution prevention outreach and awareness in key sectors, inter-provincial cooperation to assess and limit transboundary flows of pollutants, the use of low-sulphur fuels, and other measures. Alberta has a comprehensive Acid Deposition Management Framework, designed to ensure that progressively more aggressive action is taken to deal with emissions should they exceed specified levels, well before critical loads are reached.

Federal government regulations are in place that will require reductions of sulphur content in gasoline across Canada to an annual average level of 30 ppm by January 1, 2005. The federal government has also announced its intention to further reduce sulphur in diesel in Canada, in line with similar requirements for diesel sold in the United States. It is estimated that the overall annual reduction in emissions of SO_2 will be about 25 kilotonnes.

In addition, in June 2000, federal, provincial and territorial governments (with the exception of Quebec) ratified the new Canada–Wide Standards for Particulate Matter (PM) and

Ozone. Although Quebec did not formally ratify, it has indicated that it intends to act within its area of jurisdiction in a manner consistent with the other Canadian Council of Ministers of the Environment (CCME) member jurisdictions regarding these standards and the deadlines for attaining them. Meeting these ambient air quality concentration targets for ground-level ozone and fine PM for the year 2010 will require a wide range of emission reduction actions by the federal, provincial and territorial governments. The standards will result in significant reductions in emissions of NO_x and SO_2.

4. Compliance with international commitments

As indicated in Table 2, Canada is meeting or exceeding all of its current international requirements related to emissions of SO_2 and NO_x. In December 1999, Canada signed an additional protocol under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UN ECE). This eighth UN ECE Protocol, titled the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, will require parties to further reduce their emissions of SO_2, NO_x and

Table 2 International commitments and compliance on SO_2 and NO_x

Commitment	Compliance
Canada-U.S. Air Quality Agreement	
• cap on SO_2 emissions in seven eastern provinces of 2.3 million tonnes by 1994, until 2000	• eastern Canada SO_2 emissions were approximately 1.6 million tonnes in 1999 (30% below the cap).
• national cap on SO_2 emissions of 3.2 million tonnes by 2000 onward	• national SO_2 emissions were approximately 2.5 million tonnes in 1999 (22% below the cap).
• reduction in NO_x emissions from stationary sources of 100 kilotonnes from forecast levels by 2000	• national NO_x emissions in 1999 from stationary sources had been reduced by 100 kilotonnes from forecast levels.
1985 UN ECE Sulphur Protocol	
• permanent national cap of 3.2 million tonnes of SO_2 by 1993	• national SO_2 emissions were approximately 2.5 million tonnes in 1999 (22% below the cap).
1994 UN ECE Sulphur Protocol	
• regional cap of 1.75 million tonnes of SO_2 by 2000 in the Sulphur Oxide Management Area (SOMA), plus the permanent national cap	• SO_2 emissions in the SOMA were 1.2 million tonnes, or 33% below the cap. National SO_2 emissions also well below the cap in 1999 at 2.5 million tonnes.
1988 UN ECE NOx Protocol	
• stabilize NO_x emissions at 1987 levels by 1994	• NO_x emissions were down to less than 1987 Levels in 1994, as required, and estimates indicate that emissions remained below 1987 levels in 1999.

other pollutants, beyond commitments in earlier protocols. For European countries, mandatory emission ceilings have been set that will require overall emission reductions of 63% from 1990 levels for SO_2 and 41% from 1990 levels for NO_x, both by 2010.

For Canada, as well as the United States, the level of emission reductions required under this protocol will be specified when each country ratifies the protocol. This timing will allow Canada to take into account recent developments such as the Ozone Annex under the Canada–U.S. Air Quality Agreement, the Canada–Wide Standards for Ozone and PM, and the new SO_2 reduction targets under the Canada–Wide Acid Rain Strategy.

5. Ensuring the adequacy of science and monitoring

During the past year the federal/provincial science community supporting the implementation of the Post-2000 Acid Rain Strategy has made considerable progress, as follows:

1. Science requirements have been identified in order to provide a continuing scientific basis for the implementation of *The Strategy*. (Details of the science review may be found in the report *The 1999 Review of Acid Rain Science Programs in Canada*, available on the CCME website.)

2. Environment Canada identified a total of $8.7 million over the five fiscal years 2000-01 to 2004-05 to improve its acid rain science and monitoring program. This will help provide much-needed stability to the program, and has addressed one of the most pressing recommendations of the Science Review, to "Maintain the air and lake monitoring components of the existing program and not subject them to further cuts". Environment Canada will also enhance both its acid rain monitoring programs and its research into the long-term impacts of acid deposition.

3. Discussions are under way between the federal government and Nova Scotia, New Brunswick, Quebec and Ontario on the integration of the acid rain science activities taking place in the various jurisdictions, and on the division of labour and funding between these provinces and the federal government.

6. Reporting on emissions and forecasts

Table 3 shows SO_2 emissions for 1999, by province and for major sectors, and forecasts for the years 2000 and 2005. Table 4 shows emissions and forecasts for NO_x for the same years. Although the information in these tables is the best available data at the time of writing this report, it is important to emphasize that the numbers are estimates, and that they are subject to change as methodologies for estimating and forecasting emissions improve and are applied to historic year data in the future. It should also be noted that the forecast data available at the time of writing do not take into account the projected effects of reduction initiatives such as Canada–Wide Standards for PM and Ozone (which are based on ambient concentrations rather than a set level of emission reduction). Actual emissions, therefore, may be considerably less than those projected.

Table 3 Total SO_2 emissions by province and sector (kilotonnes)						
					Forecast	
	1994-99 cap	1990	1995[4]	1999	2000	2005
British Columbia						
Upstream oil and gas				120	125	126
Transportation				27	26	31
Non-ferrous mining and smelting				18	19	22
Other				26	26	24
Total	**N/A**	**152**	**176**	**191**	**196**	**203**
Alberta						
Upstream oil and gas				295	299	326
Oil sands				99	101	111
Electric power generation				124	123	123
Other				30	30	30
Total	**N/A**	**567**	**608**	**548**	**553**	**590**
Saskatchewan						
Electric power generation				110	111	118
Upstream oil and gas				13	13	14
Other				12	8	9
Total	**N/A**	**88**	**131**	**135**	**132**	**141**
Manitoba						
Non-ferrous mining and smelting				327[3]	432	432
Other				9	9	9
Total	**550[1]**	**516**	**365**	**336**	**441**	**441**
Ontario						
Non-ferrous mining and smelting				263	320	365
Petroleum refining				64	61	65
Electric power generation				144	157	157
Other				138	152	193
Total	**885**	**1,166**	**610**	**609**	**690**	**780**
Quebec						
Non-ferrous mining and smelting (copper and zinc)				138	145	117
Aluminum industry				42	47	51
Pulp and paper				32	27	29
Other				111	97	103
Total	**500**	**391**	**376**	**322**	**315**	**300**
New Brunswick						
Non-ferrous mining and smelting				14	16	14
Electric power generation				84	97	81
Other				28	33	27
Total	**175**	**181**	**116**	**126**	**146**	**122**
Nova Scotia						
Electric power generation				142	142	133
Petroleum refining				6	6	6
Transportation				4	4	4
Other				22	22	19
Total	**189**	**178**	**167**	**173**	**173**	**162**

Table 3 Total SO_2 emissions by province and sector (kilotonnes) (cont'd)

					Forecast	
	1994-99 cap	1990	1995[4]	1999	2000	2005
Prince Edward Island						
Electric power generation				1	1	1
Other				2	2	2
Total	**5**	**4**	**3**	**3**	**3**	**3**
Newfoundland						
Petroleum refining				22	21	15
Electric power generation				9	10	14
Other				13	16	16
Total	**45**[1]	**66**	**65**	**44**	**47**	**45**
Yukon						
Total	**N/A**	**N/A**	**<0.5**	**<0.5**	**<0.5**	**<0.5**
Northwest Territories						
Mining and rock quarrying				11	0	0
Upstream oil and gas				0	1	5
Other				1	1	1
Total	**N/A**	**17**	**16**	**12**	**2**	**6**
Nunavut[2]	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
SOMA	**1,750**	**1,916**	**1,224**	**1,183**	**1,277**	**1,317**
Canada	**3,200**	**3,326**	**2,633**	**2,499**	**2,698**	**2,793**

1. Cap applies to 1994 only.
2. Numbers for Nunavut will be reported separately in the future, but for the purposes of this report are included in the NWT totals.
3. Manitoba emissions from non-ferrous mining and smelting decreased in 1999 because of a work stoppage at INCO Thompson of about three months.
4. Data for 1995 reflect some recent revisions provided by provinces and territories.

Note: Numbers may not add due to rounding.
N/A = Not applicable
Source: Data provided by the CCME Emissions and Projections Working Group. Data are a combination of estimates provided by provinces and territories, and forecast data based on 1995 inventory numbers.

Table 4 Total NO_x emissions by province and sector (kilotonnes)

				Forecast	
	cap for 1994 and beyond	1995[2]	1999	2000	2005
British Columbia					
Stationary sources			75	74	74
Transportation			169	169	176
Total	**N/A**	**260**	**245**	**245**	**250**
Alberta					
Stationary sources			445	442	431
Transportation			193	191	180
Total	**N/A**	**639**	**639**	**634**	**611**
Saskatchewan					
Stationary sources			69	70	89
Transportation			75	74	69
Total	**N/A**	**169**	**144**	**144**	**158**
Manitoba					
Stationary sources			14	14	12
Transportation			51	50	44
Total	**N/A**	**74**	**65**	**64**	**57**
Ontario					
Stationary sources			199	155	176
Transportation			346	302	270
Total	**N/A**	**509**	**545**	**457**	**446**
Quebec					
Stationary sources			58[3]	56	61
Transportation			282[3]	265	230
Total	**N/A**	**373**	**340**[3]	**321**	**291**
New Brunswick					
Stationary sources			29	31	31
Transportation			40	43	43
Total	**N/A**	**63**	**70**	**74**	**74**
Nova Scotia					
Stationary sources			39	39	38
Transportation			37	29	25
Total	**N/A**	**73**	**76**	**68**	**63**
Prince Edward Island					
Stationary sources			1	2	2
Transportation			6	6	5
Total	**N/A**	**8**	**7**	**8**	**7**
Newfoundland					
Stationary sources			28	29	30
Transportation			10	13	15
Total	**N/A**	**43**	**38**	**42**	**45**

Table 4 Total NO_x emissions by province and sector (kilotonnes) (cont'd)					
				Forecast	
	cap for 1994 and beyond	1995[2]	1999	2000	2005
Yukon					
Stationary sources			2	2	2
Transportation			3	3	2
Total	**N/A**	**5**	**5**	**4**	**4**
Northwest Territories					
Stationary sources			9	9	15
Transportation			3	3	3
Total	**N/A**	**10**	**12**	**12**	**18**
Nunavut[1]					
Stationary sources					
Transportation					
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Canada					
Total	**1987 level**	**2,226**	**2,186**	**2,073**	**2,024**

1. Numbers for Nunavut will be reported separately in the future, but for the purposes of this report are included in the NWT totals.
2. Data for 1995 reflect some recent revisions provided by the provinces and territories.
3. Data for Quebec are for 1998 (data for 1999 not available).

Notes: Stationary sources include both point and area sources.
Numbers may not add due to rounding.
N/A= Not applicable.
Source: Data provided by the CCME Emissions and Projections Working Group. Data are a combination of estimates provided by provinces and territories, and forecast data based on 1995 inventory numbers.

Next Steps

With the completion of the acid rain science and monitoring program review in 1999, and the progress accomplished in 2000-2001 on the development of new emission reduction targets and in addressing identified gaps in science and monitoring, significant steps have been taken in implementing The Canada–Wide Acid Rain Strategy for Post-2000.

However, further work will be required to move toward full implementation. Following up on the progress achieved to date, governments expect that the focus of activities for the coming year will include the following:

- the completion of targets and schedules for eastern Canada, including the establishment of a SOMA target;
- the development of agreements to formalize the new targets for emission reductions, and to confirm the respective commitments of federal and provincial governments to science and monitoring activities;
- an emphasis on pursuing further emission reduction commitments in the United States;
- activities to keep "clean" areas clean;
- further scientific work on the role of nitrogen in acidification and base cation depletion.

Progress domestically will help ensure a strong Canadian position in seeking further emission reductions south of the border. And, together, domestic actions and the pursuit of emission reductions in the United States will help move Canada closer to the long-term goal of *The Strategy*, i.e., to achieve critical loads for acid deposition across the country, and will help ensure that measurable progress can be reported in the next acid rain science assessment, tentatively scheduled for 2004.

Notes

Notes