Environment Canada Environnement Canada

ANNUAL REPORT ON THE FEDERAL-PROVINCIAL AGREEMENTS FOR THE EASTERN CANADA ACID RAIN PROGRAM

1993

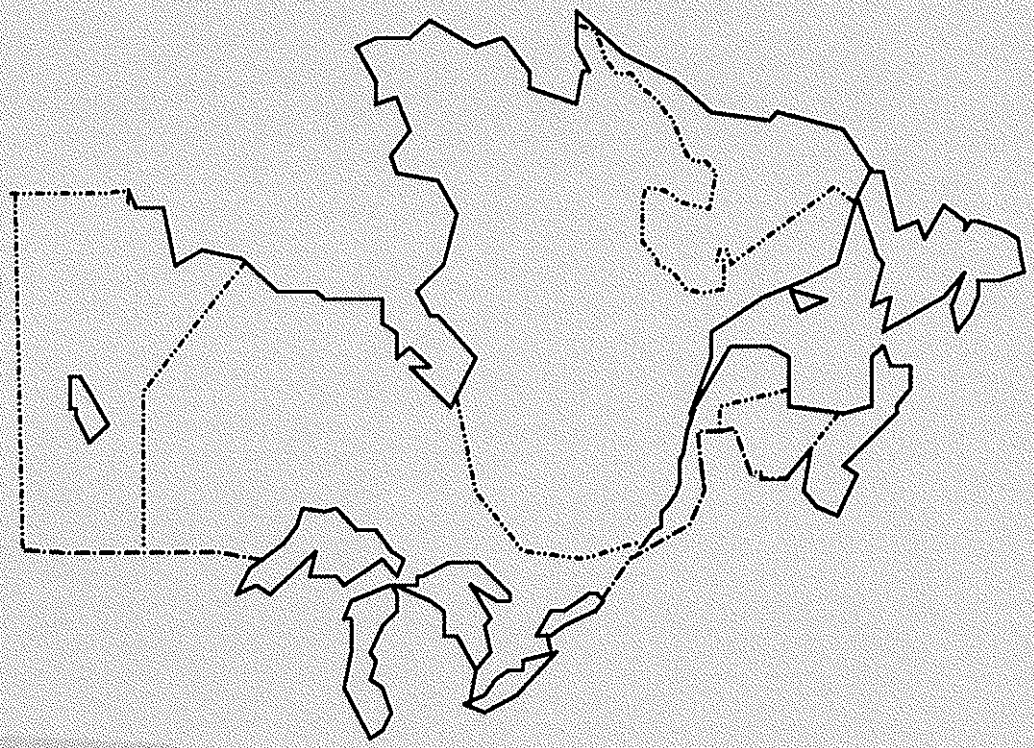

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TABLE OF CONTENTS

LIST OF TABLES

The Eastern Canada Acid Rain Control Program, 1993

Introduction

This is the fifth report on the implementation of the Eastern Canada Acid Rain Control Program. The program has cut sulphur dioxide (SO_2) emissions in the seven eastern provinces to 2.2 million tonnes in 1993, meeting the 1994 cap of 2.3 million tonnes ahead of schedule.

The Eastern Canada Acid Rain Control Program was initiated in 1985 and subsequently formalized in seven federal-provincial agreements. These agreements set out specific SO_2 emission reduction targets and timetables for each of the parties. Participating provinces have agreed to cut their aggregate SO_2 emissions by 40 percent[1] from actual 1980 levels of 3.8 million tonnes to 2.3 million tonnes by 1994, participate in acid rain effects research, monitor ecosystems, and report on progress. For its part, the federal government has undertaken to seek reductions in transboundary flows of SO_2 from the United States, conduct a wide array of research activities, monitor and model deposition, support research and development projects for SO_2 reduction technologies, and reduce emissions from federal facilities.

The reported emissions, reflecting the most recent provincial estimates, are shown in Table 1. Total eastern Canadian SO_2 emissions were 2,172 kilotonnes in 1993, representing a 43 percent reduction from actual 1980 emissions.

Table 2 provides additional SO_2 emissions data from the major sources such as smelters and fossil fuelled-power plants, which accounted for 72 percent of the SO_2 emissions in eastern Canada in 1993.

1. Prior to having actual 1980 emissions data, the acid rain control program for eastern Canada called for a 50 percent reduction from the estimated 1980 base case of 4.52 million tonnes.

TABLE: 1

TOTAL SO_2 EMISSIONS BY PROVINCES (KILOTONNES)[1]

	1980	1990	1991	1992	1993	1994
	Actual					Limits[4]
MANITOBA						
Primary Metals	463	500	543	555	521	___
Other	21	16	16	10	10	___
Total	484	516	559	565	531	550
ONTARIO						
Primary Metals	1096	730	695	506	465	490
Power Generation	396	195	167	157	97	175
Other	272	241	233	239	247	___
Total	1764	1166	1095	902	809	885
QUEBEC						
Primary Metals	641	189	210	218	213	___
Other	457	202	168	182	182	___
Total	1098	391	378	400	395	500
NEW BRUNSWICK						
Primary Metals	15	6	9	12	7	___
Power Generation	123	141	130	149	117	123
Other	80	34	33	32	32	
Total	218	181	172	193	156	175
NOVA SCOTIA						
Power Generation	125	143	144	143	146	145
Other	68	35	33	34	37	___
Total	193	178	177	177	183	189
NEWFOUNDLAND						
Power Generation	18	21	14	18	18	___
Other	38	36	48	57	76	___
Total	56	57	62	75	94	45
PRINCE EDWARD ISLAND						
Total [3]	5	3	4	4	4	5
EASTERN CANADA TOTAL						
Primary Metals	2215	1425	1457	1291	1206	___
Power Generation	662	500	455	467	378	___
Other	941	567	535	558	588	___
Total[2]	3818	2492	2447	2316	2172	2349 [2]

1. Data for 1990 to 1993 are taken from annual reports by the provinces on their SO_2 control programs. The emissions levels represent the best estimate available at the time of writing the report. Note that even historic year estimates may be revised as better inventory data is made available.
2. The 1994 Eastern Canada Program target is 2,300 kilotonnes. The total of provincial objectives is currently being renegotiated from 2,349 kilotonnes to 2,300 Kilotonnes. Renegotiated federal-provincial agreements are in place with Quebec, New Brunswick and Nova Scotia.
3. This value includes a component of power generation emissions.
4. The revised emission limit reflects a renegotiated federal-provincial agreement.

TABLE: 2

MINERAL EXTRACTION AND SMELTING: MAJOR SO_2 SOURCES (KILOTONNES)

	1980	1990	1991	1992	1993	1994
	Actual					Limits
MANITOBA						
INCO (THOMPSON)	215	247	250	267	253	220
HBMS (FLIN FLON)	248	253	293	288	268	220
ONTARIO						
INCO (Copper Cliff)	812	617	572	416	358	265
FALCONBRIDGE (Sudbury)	123	70	70	54	57	100
ALGOMA (Wawa, Iron Ore)	161	43	53	36	50	125
QUEBEC						
NORANDA (Horne)	552	146	165	168	168	272
NORANDA (Murdochville)	91	43	45	50	45	65
NEW BRUNSWICK						
NORANDA (Belledune)	15	6	9	12	7	----

ELECTRIC POWER GENERATION: MAJOR SO_2 SOURCE

	1980	1990	1991	1992	1993	1994
	Actual					Limits
ONTARIO HYDRO	396	195	167	157	97	175
NEW BRUNSWICK POWER	123	141	130	149	117	123
NOVA SCOTIA POWER	125	143	144	143	146	145

Provincial and Industrial Action

Manitoba (1994 target 550 kilotonnes)

Manitoba's SO_2 emissions were 531 kilotonnes in 1993, meeting its 1994 target of 550 kilotonnes.

Manitoba has two sources of SO_2 that account for about 98 percent of total provincial SO_2 emissions. These are the INCO Limited smelter at Thompson and the Hudson Bay Mining and Smelting Limited (HBM&S) smelter at Flin Flon. Manitoba regulations require that, after January 1, 1994, each smelter not emit more than 220 kilotonnes of SO_2 annually.

Both sources are taking measures to ensure their compliance with the regulations. INCO has been optimising its processes to reject sulphur-bearing ore fraction (pyrrhotite rejection) and has indicated that metallurgical changes to their process will be implemented by 1994 to reduce SO_2 production to meet the Manitoba regulation. HBM&S has completed installation and commissioned operation of its new zinc pressure-leaching plant. This will reduce emissions of SO_2 by at least 25 percent and will allow the company to meet the Manitoba regulation. The company is also studying the possibility of a major modification of the copper smelter which could provide the opportunity of additional SO_2 emission reductions.

Two Manitoba Hydro Thermal Generating Stations and other miscellaneous sources accounted for the province's remaining 10 kilotonnes of emissions.

Manitoba was also active in other acid rain work, including daily precipitation monitoring at three sites, and vegetation studies in acid and metal-contaminated soils associated with the smelters. Manitoba forecasts that its 1994 SO_2 emissions will be 450 kilotonnes, 100 kilotonnes below the provincial ceiling.

Ontario (1994 limit 885 kilotonnes)

Ontario's SO_2 emissions were 809 kilotonnes in 1993, well under its 1994 limit. The four major corporate SO_2 sources, which account for about 70 percent of Ontario's total SO_2 emissions, continued to work towards complying with the regulatory limits imposed on them by the province under its SO_2 Control Program (see Table 2).

INCO Ltd.'s emissions were more than 55 percent below 1980 levels at 358 kilotonnes as a result of the essentially completed $612 million SO_2 Abatement Program and Mills Rationalization Program. The switch to bulk smelting of nickel/copper concentrate commenced on November 1, 1993 without major problems. INCO expects its 1994 SO_2 emissions to be within the regulation limit of 265 kilotonnes. Provincial regulations further require INCO to examine the feasibility of going beyond the 265 kilotonne limit to 175 kilotonnes from its Sudbury smelting operations.

Falconbridge Ltd. continues to emit SO_2 at levels substantially below its 100 kilotonne 1994 regulatory limit. In 1993, most modifications were completed on both fluid bed roasters to permit higher sulphur removal rates from the concentrate to ensure that the 1994 limit will be met at the smelter rated capacity. As well, the company is planning to redesign and rebuild its No. 2 electric smelting furnace to optimize smelting operations with concentrate that has a lower sulphur content. These changes coupled with the proposed research program should enable Falconbridge to meet its voluntary SO_2 emissions target of 75 kilotonnes at the smelter rated capacity before 1998.

At 50 kilotonnes, Algoma Steel Inc.'s 1993 SO_2 emissions from the Wawa iron ore sinter plant were again well below its 1994 limit of 125 kilotonnes. The company expects to continue using low sulphur iron oxides and mill scale in sinter plant feed to maintain SO_2 emissions at about the 60 kilotonne level in 1994 and onwards, which is about 50 percent less than the 125 kilotonne limit.

In 1993, Ontario Hydro's SO_2 emissions were down 38 percent from 1992 levels to 97 kilotonnes, considerably under its 175 kilotonne limit. The decline was due to a 36 percent decline in fossil-fuelled electricity generation and low sulphur coal purchases. Hydro's $537 million flue gas desulphurization project at the coal-fired Lambton plant is on schedule and both units are expected to be in service in 1994. Hydro has also installed, and is testing for accuracy and reliability, flue gas emission monitors at all its operating coal and oil-fired boilers.

Quebec (1994 objective 500 kilotonnes)

In 1993, Quebec signed a new federal-provincial acid rain agreement that reduced its 1994 SO_2 objective from 600 kilotonnes to 500 kilotonnes, and successfully met that objective in 1993 with provincial SO_2 emissions of only 395 kilotonnes, i.e., more than 100 kilotonnes under the objective.

In Quebec, copper smelting is the largest source-sector of SO_2 emissions, with Noranda Metals' Horne smelter emitting 168 kilotonnes, or 42 percent of the total SO_2 emissions. Although the smelter is under its limit, Noranda has announced its intention to further reduce the annual emissions to about 55 kilotonnes by the end of the decade, representing a 90 percent reduction from 1980 levels. The other copper smelter in Quebec is at Murdochville and it emitted 45 kilotonnes of SO_2, down 5 kilotonnes from 1992 levels.

Since 1992, the second largest SO_2 emissions source-sector in Quebec has been aluminum smelting. The commissioning of two new smelters, Lauralco and Alouette, raised emissions in this sector to 41 kilotonnes in 1993.

SO_2 emissions from the pulp and paper and petroleum refining sectors remained virtually unchanged from 1992 levels. Emissions from these sectors are expected to increase in 1994 by about 10 kilotonnes as a result of the re-opening of the Port-Cartier pulp and paper factory and the use of higher sulphur fuels in the Montreal oil refineries.

New Brunswick (1994 target 175 kilotonnes)

Compared to 1992, the province's SO_2 emissions decreased by about 20 percent in 1993 to 156 kilotonnes, meeting its 1994 target of 175 kilotonnes.

New Brunswick Power accounted for 75 percent of SO_2 emissions in the province in 1993. It operates five major fuel-burning plants, and in 1993 it began operating the first new coal-fired plant and SO_2 scrubber combination in Canada at its 450 megawatt Belledune plant. A scrubber is also being installed at the 312 megawatt Dalhousie plant as part of a conversion to Orimulsion™ fuel. Other SO_2 control measures include using low sulphur fuel at the Courtenay Bay plant, implementation of conservation and demand side management programs, closure of uncontrolled coal fired units at Grand Lake, and closure of the Chatham plant.

A study of the potential for the province to achieve energy efficiency gains and effect emissions reductions was released in 1993. The province also started to develop an energy efficiency implementation strategy (e.g. using demand side management, cogeneration, and wood waste) and continued to evaluate the potential for access to natural gas.

Pulp mills, which accounted for about 9 percent of SO_2 emissions in 1993, were modernized during the 1980's, cutting emissions permanently and ensuring that their SO_2 releases remain below 20 kilotonnes per year. And Irving Oil, the largest refinery in Canada, operated at high capacity while meeting an annual emission cap of 8,000 tonnes.

The Brunswick Mining and Smelting facility has historically captured over 80 percent of its SO_2. Monitoring and modelling studies indicate that due to low stack heights and other operational parameters, the facility cannot consistently meet the province's air quality standards for SO_2. In the short-term, equipment upgrades, operational improvements, and lower sulphur concentrate resulted in emissions reductions. For the long-term, new stacks and changes in the smelting process are being studied.

New Brunswick operates an extensive acid deposition network in cooperation with NB Power, and Environment Canada. Monitoring techniques and siting criteria continued to be re-examined and improved. The result of this work is a much clearer understanding of the deposition pattern and levels in the province, which, in some areas, are well above the 20 kilograms per hectare per year (kg/ha/yr) target load.

New Brunswick's Clean Air Strategy, introduced in 1993, proposes to focus on the most acid-sensitive areas in a framework that will deal with the long-range transport of pollutants, regional airshed issues and local planning, considering all pollutants in an integrated and coordinated approach.

Nova Scotia (1994 target 189 kilotonnes)

Nova Scotia's SO_2 emissions in 1993 were 183 kilotonnes, up slightly from 1992 levels, but still under its target. The 189 kilotonne target reflects the new federal-provincial acid rain agreement signed in May 1993, which reduced the previous 1994 target of 204 kilotonnes by another 15 kilotonnes.

The major source of SO_2 emissions in 1993, accounting for 80 percent of the provincial total, was Nova Scotia Power. The company continued its program to limit its annual SO_2 emissions so as not to exceed 145 kilotonnes after 1994. The utility has also publicly stated its corporate objective of further reducing emissions to about 90 kilotonnes annually, after the year 2000. Nova Scotia Power is completing, in 1993, the world's largest circulating fluidized-bed coal burning power plant (165 MW) at Point Aconi. The plant is designed to capture 90 percent of the sulphur in the fuel and simultaneously reduce nitrogen oxides emissions.

Wet sulphate deposition in Nova Scotia appears to be generally on a downward trend and is well below the 20 kg/ha/yr deposition level established as a goal for protection of moderately sensitive areas. It is likely, however, that a further reduction will be required in transboundary flows if wet sulphate deposition is to decline to a level considered necessary for the protection of sensitive areas within the province.

Newfoundland (1994 target 45 kilotonnes)

Newfoundland's SO_2 emissions increased abruptly over the period 1992-93 due largely to the oil-fired Holyrood electricity generating station and the Come-By-Chance oil refinery. If the oil refinery emissions are exempted, SO_2 emitted from all other industries actually declined by 62 percent since 1980 due to reduced economic activity, plant closures, energy efficiency, and fuel switching.

SO_2 emissions from Holyrood, which account for 19 percent of total SO_2 emissions, are quite variable from year to year because the station supplies energy whenever hydroelectric sources cannot meet demand. Emissions are therefore dependant on annual rainfall. Discussions with Newfoundland Hydro led to a commitment by the utility to limit emissions from this facility to a maximum of 25 kilotonnes per year in a normal rainfall year commencing in 1991.

The Come-By-Chance oil refinery's SO_2 emissions, which account for 65 percent of provincial emissions, have greatly increased in the last five years due to the increased sulphur content of the crude oil which the operators elected to purchase. The refinery emits relatively more SO_2 compared to other Canadian refineries because of its older technology, and because it specializes in processing sour (high-sulphur) crude oils. Emissions are expected to start trending downwards in 1994 when new owners take possession of the facility. Part of the negotiations on selling the refinery included discussions on new SO_2 emissions limits, which are expected to be phased in between 1994 and 1999.

Long-term projections of SO_2 emissions from Newfoundland and Labrador are difficult to make due to the possibility of major changes in its industrial base, largely as a result of Hibernia and other offshore developments. However, SO_2 emissions are expected to decline to the 50-55 kilotonne level by 1999.

Prince Edward Island (1994 objective 5 kilotonnes)

Virtually all of Prince Edward Island's SO_2 emissions result from the combustion of fossil fuels. Total emissions in 1993 were 4 kilotonnes. This value includes a component of power-generation emissions which contributed 1,100 tonnes.

Emissions of SO_2 from electrical power generation fluctuate due to the variability of economy energy purchases from New Brunswick, and the resulting need to supplement these purchases with on-island generation. Electrical generation within the province in 1993 increased by 85 percent to 65 GWh and this accounted for the increase in total emissions. However, the province's major electrical utility forecasts that it will be able to purchase large quantities of economy power from New Brunswick Power during the period between 1995 and the year 2000. Therefore, barring unusual conditions or unforeseen circumstances, the province should be able to maintain emissions below the 5 kilotonne target in the short term.

Policy and Science Highlights

The previous section summarized provincial and industrial SO_2 emissions control activities under the acid rain program. As well, federal and provincial government agencies continued to support development and use of new industrial processes and emissions control technologies, promoted energy conservation, conducted scientific research, and monitored ecosystems. This section presents some highlights from those activities. It should be noted that it is difficult to do a complete survey of the scientific work done in 1993 because the scientisits are still interpreting the 1993 data.

- The federal government continued to work towards a second United Nations Economic Commission for Europe SO_2 Protocol (which was completed and signed June, 1994), which will commit signatory countries to work towards achieving critical loads, i.e., that level of wet sulphate deposition which will not harm the environment. The target load for eastern Canada is currently 20 kg/ha/yr, but scientists are suggesting that it may have to be reduced to as low as 8 kg/ha/yr in certain regions.

- In accordance with the Canada-U.S. Air Quality Agreement, scientists in Canada and the United States exchanged information on using atmospheric models to anticipate future deposition patterns. The results showed that the models could reasonably estimate current and future rates of sulphur and nitrogen deposition. Deposition monitoring networks were improved taking into account information from the models. Both countries also worked on procedures for notifying the other of actions that would cause significant transboundary air pollution.

- Several activities were underway in Canada and the U.S. to develop, demonstrate, and deploy energy technologies, such as the Integrated Coal Gasification Combined Cycle technology, to reduce emissions of both SO_2 and NOx.

- Analyses of monitoring and survey data confirmed fish population losses due to acidification from some surface waters in many parts of northeastern North America. For example, the estimated number of lakes in Ontario that have either lost their sport fish populations or have residual non-reproducing populations is 228, while one third of the available Atlantic salmon habitat in Nova Scotia has been lost since 1950 because of acidification, representing a loss to the salmon fisheries of about 9,000 to 14,000 fish per year, which is almost equal to the current annual catch.

- Lake monitoring in both Canada and the United States shows that as acidification decreases and lake pH increases, biological populations recover, or can be re-established, relatively rapidly (in less than a decade).

- Reductions in lakewater SO_4 concentrations continued in 1993 in southern Quebec lakes. The recovery of lakes in terms of acidity remains slow and of lesser extent than decreases in lakewater SO_4 concentrations. From 1985 to 1993, the number of lakes that were showing recovery in terms of lakewater acidity is the same as the number of lakes that are acidifying (9 of 37, or 24 percent). An estimatation of critical loads of SO_4 for network lakes permitted the identification of lakes for which critical loads can be as low as 8 kg/ha/yr.

- Forest effects studies showed that there is no large scale decline in the health of North American forests that can be directly attributed to acid rain. The North American Maple Project showed that over 90 percent of trees sampled were healthy and mortality rates were normal. However, there are several areas of concern. Over large areas of Ontario and Quebec, sugar

maples with no visible signs of decline have experienced reduced growth rates over the past 30 years.

- Forest research has also shown adverse effects from acid deposition in local instances on certain species of trees. For example, in southeastern New Brunswick, acid fog was found to have contributed to serious deterioration and death of white birch.

- Preliminary results of a five-year study of more than 10,000 children in 24 North American cities have been published, showing a strong statistical association between decreased lung function in children and long-term exposure to ambient acidic aerosols. Significant differences in acute bronchitis between high- and low-acid communities were also evident in this study. Human clinical studies have also suggested that asthmatics might be more sensitive to short-term high-acid aerosol exposure.

- Environment Canada published protocols and specifications for continuous monitoring of air emissions from thermal power plants.

- Canada met its national SO_2 emissions target of 3,200 kilotonnes, with SO_2 emissions of 3,040 kilotonnes in 1993. SO_2 emissions in Canada in 2000 and 2010 are projected to be 3,000 and 3,100 kilotonnes respectively.

- There is no clearly identified program for control of SO_2 emissions from federally owned facilities. The Canadian Environmental Protection Act (CEPA) will be reviewed in 1994, at which time the "regulatory gap" for federal facilities will be addressed as part of the "Federal House in Order" initiative.

Conclusion

The sulphur dioxide control program in eastern Canada continues to be a success, with emissions in eastern Canada meeting the 2.3 million tonne cap ahead of schedule.

Most of the remedial measures are either operating, under construction, or being implemented. Actual emissions have declined by 43 percent from 1980 levels and the first tentative signs of environmental recovery have been detected in some areas.

Although the program goals are now being met, many acid-sensitive ecosystems are still being damaged. Even after all currently planned reductions are in place in both Canada and the United States, some regions may continue to receive excessive acid deposition post-2000. As a result, the federal and provincial governments will be working with stakeholders to develop a new National Strategy on Acid Rain for post-2000 to protect acid-sensitive areas in Canada.