Environment Canada Environnement Canada

STOP ACID RAIN Canada

Acid Rain: What it is and what it does

Acid Rain
The Canadian Control Program

Acid rain has been called the greatest environmental threat that Canada has ever faced. The rains and snows that were once cleansing and pristine have now become, as a result of human activity, dangerously acid and destructive.

Two common by-products of our modern industrial lifestyle—sulphur oxides and nitrogen oxides—cause acid precipitation. When these pollutants are discharged into the atmosphere, they can be transformed into sulphuric acid and nitric acid, respectively. They are carried along by winds and fall to earth as acid rain or snow many kilometres from the original source of pollution.

What are the sources of acid rain?

The main sources of sulphur oxide emissions in North America are coal-fired power generating stations and non-ferrous ore smelters. The main sources of nitrogen oxide emissions are automobiles and other vehicles.

What is the impact of acid rain?

Acid precipitation can have many harmful effects. It can increase the acidity of lakes and streams to a point where fish and other aquatic creatures such as frogs and salamanders cannot reproduce—ultimately, they become extinct in overly acidified bodies of water. Acid rain can also increase the acidity of soils and, particularly in combination with other atmospheric pollutants such as ozone, is suspected of slowing down the growth rate of trees or making them more vulnerable to disease. Acid rain erodes buildings and monuments, including those of cultural significance, causing millions of dollars worth of damage annually.

The fishery, tourism, agriculture and forestry resources at risk due to acid rain sustain about 8% of Canada's Gross National Product.

Of the over two million lakes in Quebec and Ontario, 43% are vulnerable to acidification; 10% of the salmon rivers in Nova Scotia can no longer support salmon, another 10% are becoming acidified. About $8 million and 90,000 jobs are at risk in the eastern Canadian commercial fisheries.

Of the 16,000 fishing camps and lodges in Ontario, 600 may be closed because of acid rain by the year 2000, resulting in losses of $28 million and 600 jobs.

Over 175 million acres (or about half) of Canada's productive forests are in areas receiving high levels of acid rain. These forests generated $14 billion worth of forest products in 1982.

About 50% of the soils in Ontario and Atlantic Canada and 87% of the soils in Quebec are very sensitive to acid rain. The value of the crop resources at risk in eastern Canada is $3 billion.

Over 86% of Canada's population lives in areas of high acid deposition. Links between respiratory problems and exposure to sulphates have been established. The annual costs of lost productivity and health care related to respiratory ailments are put at over $500 million, a proportion of which can be attributed to sulphates.

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Acid Rain: The development of controls

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Controlling acid rain poses a challenge that is unique and typical of the environmental problems that confront Canadians in the 1980s. It requires that we consider impacts of pollution beyond the area surrounding the pollution source. It requires pollution controls beyond those initiated by industrialized countries in the 1970s to ensure clean air in our cities. It requires significant reductions in sulphur dioxide (SO_2) and nitrogen oxide (NO_x) emissions.

Controlling emissions from smelters

The six nickel and copper smelters located east of Saskatchewan and operated by INCO, Noranda Inc., Hudson Bay Mining and Smelting, and Falconbridge produce 60% of eastern Canada's SO_2 emissions.

The smelting industry has devoted resources to reducing SO_2 emissions by improving the production processes of its facilities. Some existing smelting operations are using sulphuric acid gas plants to eliminate up to 85% of the sulphur from the smelting furnaces. In addition to adding an acid gas plant to its Sudbury facility, INCO has improved its ability to remove sulphur from nickel ores through a process known as pyrrhotite rejection.

Smelters (such as Kidd Creek Mines in Timmins, Ontario) built in Canada since 1980 have incorporated pollution control technology which ensures that over 90% of the sulphur in the ore is not emitted into the atmosphere.

According to a government-industry-labour study released in May 1984 by the federal Department of Energy, Mines and Resources, Canada's nickel and copper industries could become more productive, competitive and cleaner, with the development and application of new technology. Monies to assist technology demonstration projects for SO_2 emission control are available from the federal Department of Regional Industrial Expansion. For example, the feasibility and effectiveness of using a dissolution rather than a burning process to smelt copper is now being studied by industry with federal financial assistance.

Provincial governments are also working with industry to design effective and environmentally sensitive control measures. The Quebec provincial government and Noranda Inc. are jointly funding a $3 million project to design a sulphuric acid gas plant for Noranda's smelter in Rouyn-Noranda and to study its environmental impact.

Coal

Over 15% of SO_2 emissions in eastern Canada are generated by coal-fired electricity generation. By 1989, governments and industry will have spent more than $70 million on developing and testing new coal-burning processes, on blending different varieties of coal and on cleaning—or removing the sulphur from—coal.

In addition, a federal-provincial task force is examining the costs and benefits of increasing the use of low sulphur coal from western Canada by electric power plants in Ontario.

Canadian utilities have reduced emissions by more efficient use of their facilities and by using other methods to generate electricity, e.g. nuclear or water power.

Research and monitoring

About $30 million per year ($1.20 per capita) is also being spent, primarily by governments, in monitoring the impacts of acid rain, in assessing the effectiveness of pollution control measures and in refining our scientific knowledge of the problem.

Science has given us an understanding of the nature, causes and solutions to the acid rain problem. Science has identified trends in acid deposition and an environmental objective to protect moderately sensitive lakes and rivers from acid rain damage. Science has also pointed to the emission reductions necessary to achieve the objective.

Based on the science, Canada's politicians have announced a commitment to reducing emissions to control damage caused by acid rain. Industry and governments are working together to ensure the reductions are made in the most effective and efficient ways.

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Acid Rain: The Canadian approach

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The Canadian acid rain program is the most ambitious environmental protection program that the country has ever launched and one that is not surpassed anywhere.

- Canada is the only country to set an acid rain policy based on achieving an environmental objective
- Canada's commitment to reduce sulphur dioxide emissions in eastern Canada by 50% by 1994 is the largest cut-back promised by any nation to control acid rain
- new motor vehicle emission standards are as tough as any other national standard and tougher than most
- the program includes the largest and most comprehensive scientific research and monitoring effort ever undertaken by Canada in the environmental field. Current expenditures equal $30 million or $1.20 per capita, with more than $18 million contributed by the federal government.
- Canada's program is an example of cooperation among provinces, between regions of the country, of federal and provincial governments, the private sector and citizens of all ages

What levels of government are responsible?

The Canadian constitution, which defines the federal and provincial jurisdictions, requires a particular approach to the acid rain problem. In Canada, the responsibility for regulating stationary sources of air pollution rests with provincial governments. The responsibility for controlling emissions from vehicles (cars, trucks and busses) is a shared one: the federal government defines standards at the manufacturing stage and provincial governments regulate and inspect motor vehicles thereafter. The transboundary aspects—interprovincial and international—of acid rain are of particular interest to the federal government. Both levels of government are concerned about the economic and environmental damage being caused by acid rain.

Canada's efforts to control acid rain are concentrated in the seven eastern provinces: Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. Much of the SO_2 produced in Canada originates within this area and prevailing winds transport the pollution towards the eastern portions of the country.

What action have Canadian governments taken?

Canada's system is one of co-operative federalism and the strengths of that system have now been brought to bear on the threat of acid rain.

- In 1982, federal and provincial governments agreed that the Canadian environment would be protected from acid rain damage if acidic deposition were reduced to a level of 20 kilograms per hectare per year (18 lbs/acre). This level was defined as a result of cooperative scientific research. Many areas in eastern Canada now receive up to twice that amount of acid. The 20 kg/ha/year goal could be attained by reducing emissions of sulphur oxides in Canada and the United States.
- March 1984, federal and provincial environment ministers agreed to a two-phase emission reduction program, cutting 1980 SO_2 emissions by 25% by 1990 and a further 25% by 1994. Again, scientific research indicated that by cutting eastern Canada's SO_2 emissions by 50% (or to 2.3 million tonnes per year based on 1980 emissions of 4.6 million tonnes) and with compatible emission reductions in the United States, acid deposition could be limited to the accepted (20 kg/ha/year) target in many areas.

  To meet the 1990 goal, provincial governments in Ontario and Quebec regulated emission reductions at INCO (Sudbury), Ontario Hydro, Noranda (Rouyn) and Noranda (Murdochville).

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- February 1985, an agreement was reached by the Ministers of the Environment of Canada, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland. Prince Edward Island supported their decisions. The agreement spelled out how much emissions will be reduced in each province in order to meet the 1994 target date. The federal and provincial governments further agreed to support financially to the extent necessary the abatement efforts needed to meet emission reduction targets.

- March 1985, the federal government agreed to tighten standards for automobile emissions. The standards will have the effect of reducing nitrogen oxide emissions from new cars by 45%.

Each provincial government now has identified the SO_2 emission reductions it must achieve to safeguard the Canadian environment from acid rain—and each has committed itself to make those cuts. The process of developing regulatory orders is underway.

Are any regulations now in place?

Quebec announced its emission control plans on February 8, 1985, modifying its Environmental Quality Act. These apply to automobile emissions, the combustion of fossil fuels, and smelting operations. Quebec's sulphur emissions will be cut back by 45% overall. In some cases, actions must be initiated immediately to respond to the regulations.

- existing continuous reactor smelting facilities must reduce SO_2 emissions from 1980 levels by 35% by 1989 and 50% by 1990

- all other existing smelting facilities cannot emit more than 275 kilograms of SO_2 per tonne of mineral concentrate

- all new smelting facilities must control 95% of the sulphur contained in the concentrate or ore being processed

The implementation of these regulations means that Quebec will have done its share in helping Canada meet the 1994 reduction target.

Ontario passed two regulations in 1981. The first required reductions in annual SO_2 emissions from INCO's smelter in Sudbury, from 1,072,000 tonnes to 646,000 tonnes by December 31, 1982. The second limited annual SO_2 emissions from the province's electrical utility to 390,000 tonnes in 1986 and 260,000 tonnes in 1990. The utility emitted over 510,000 tonnes of SO_2 in 1984.

Ontario plans further actions. The other eastern provincial governments are expected to announce their own emission control regulations during 1985.

How much will it cost?

The cost of designing and installing acid rain control measures to reduce emissions by 50% is about $1.5 billion, of which $750 million may be spent in the nickel and copper smelting industry.

Industry has the primary responsibility for carrying these costs. Federal and provincial governments have agreed to provide financial assistance to those companies whose economic situation does not permit them to bear the cost of pollution controls entirely on their own.

Towards a cooperative Canada/US program

Canadian actions alone cannot safeguard the Canadian environment. They will substantially reduce acid rain damage in Canada and the northeastern U.S. However, the 20 kg/ha/year target can only be met if both countries reduce their sulphur emissions by 50%.

Acid rain is an international problem which requires international solutions. A Canadian plan of action has already been established and is being carried out. Canada is ready to develop a cooperative emission reduction program with the US.

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Acid Rain: The role of NO_x emissions

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Until now, the principal focus in reducing acid rain has been on controlling sulphur dioxide emissions. This is because damage caused by sulphur dioxide emissions is most harmful in the long run. Nitrogen oxides (NO_x) are, however, responsible for about one third of the acidity in precipitation. In Canada, NO_x emissions, under current regulations, are expected to increase by 20% by the end of the century.

What are the major sources of NO_x?

In 1980, North American man-made NO_x emissions totalled 21.3 million tonnes, of which 1.7 million tonnes were produced in Canada, primarily by the transportation sector.

In eastern Canada, the area under greatest threat from acid rain, they total 1.0 million tonnes. Canadian automobile emissions account for 21% of NO_x emissions. Other vehicles, including heavy duty trucks and machines, produce 41%, power plants 13%, and industrial, commercial and residential sources 25%.

What are the major effects of NO_x?

Nitrates deposited during the winter months are of particular concern. They accumulate in the snowpack, and when the snow melts in the spring, the accumulated acid is released into lakes, rivers and streams, all at once. This jolt of acidity, known as "spring shock", occurs at the most critical stage in the life cycle of many aquatic species. The acid bath can kill fish eggs and fry and also harms the eggs of amphibians, such as frogs and salamanders.

Nitrogen oxides can damage human lungs, reducing their ability to function efficiently. There is also evidence which suggests that exposure to NO_x increases our susceptibility to respiratory infections. Children are particularly at risk—even brief exposures to NO_x can cause respiratory problems such as coughing, runny noses and sore throats. NO_x can also aggravate asthma symptoms.

Ozone or smog is another problem caused by NO_x emissions from the transportation sector. Although smog is often associated with cities like Los Angeles, it occurs in Canadian cities as well. Ozone is formed when nitrogen oxides and hydrocarbons, another pollutant from automobiles and trucks, react together in the presence of sunlight. In cities and urban areas across Canada, acceptable air quality levels for ozone are being exceeded.

Evidence is mounting that ozone also affects our rural areas. Ozone pollution can stunt tree and crop growth. The commercial value of ozone-sensitive crops—corn, wheat, potatoes, soybeans, tomatoes, onions, cucumbers, lettuce, white beans and tobacco—in eastern Canada is about $2 billion per year.

Finally, there is the view that the effects of acid rain, ozone and climatic stress, such as drought, can combine to provide highly damaging effects, particularly to forests. Evidence of these effects has emerged in Europe.

What can be done to control NO_x emissions?

Given the current state of technology, NO_x emissions from most sources can be controlled. For example, low NO_x burners exist for utility boilers. Canadian utilities produce 250,000 tonnes of NO_x per year. Low NO_x burners can cut those emissions by up to 25%.

Motor vehicle emission control is important to any NO_x reduction strategy. Adding catalytic converter technology can reduce by 45% the NO_x emissions from cars. A recent public opinion survey showed that 51% of the respondents favoured stricter emission standards for cars.

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Present and future NO_x Standards

For the past several years, officials of Environment Canada and Transport Canada have studied existing levels of motor vehicle emissions and the costs and benefits of adopting tighter emission standards. The areas reviewed include the historical differences in car prices in Canada and the US, benefits of lower emissions standards, and the automobile's contribution to environmental impact of oxidants and oxides of nitrogen.

Based on these studies, the Canadian government decided to move towards the implementation of tighter automobile emission standards for cars of model year 1988.

Canadian automobile emission standards (grams per mile driven)

Current		1988 models
3.1	Nitrogen oxides (NO_x)	1.0
2.0	Hydrocarbons	0.41
25.0	Carbon monoxide	3.4

The Impact of the New Regulations

Three-way catalytic converters will be placed on all new cars sold in Canada for the 1988 model year.

The manufacturers' cost for improved control technology will be about $150 per car. Catalytic converters require the use of unleaded gas, which is more expensive. However, for the car owner, lower maintenance costs for cars using unleaded gas offset increased gas prices. Fuel consumption should be unaffected by the additional technology.

Some new cars currently sold in Canada are equipped with emission control systems to meet the current US requirements. These cars compete effectively in the marketplace.

To benefit from the emission control system that is fitted on any new vehicle, proper maintenance is important. A misfuelled or poorly maintained car can pollute 200 to 300% more than a properly tuned vehicle.