

4.0 STATUS OF ACID RAIN EMISSIONS

4.1 Stationary Sources

4.1.1 Canadian Developments

Canada Wide Post 2000 Acid Rain Strategy

Currently, the federal and provincial governments are developing activities to carry out the elements of the Canada Wide Post 2000 Acid Rain Strategy within the context of their recent joint harmonization agreement. It has been suggested that the outcome of this discussion will result in a distinctly different approach to the determination of concentrations of acid rain species and subsequent linkage to significant sources.

The Board will continue to review these developments and advise the Commission should any specific proposed actions having the potential to greatly affect the determination and control of acid rain species are brought forward.

OntAIRio Coalition on Acid Gas Emissions

In January 1999, the Citizens Environment Alliance of Southwestern Ontario joined with the Toronto Environmental Alliance and the David Suzuki Foundation in the OntAIRio Campaign to demand strong environmental action to improve Ontario air quality.

The OntAIRio Campaign advocates the following actions:

- Capping emissions of Nitrogen Oxides (NO_x) from Ontario electricity generators (largely Ontario Hydro) at an annual level of 6,000 tonnes per year by the year 2005. This cap is to include all emissions associated with any power purchases from U.S. sources and represents an 84 percent reduction from the existing Ontario Hydro commitments for the year 2000. The 1998 emissions from Ontario Hydro are in the vicinity of 38,000 tonnes per year, an increase of 22 percent since 1995.
- Total emissions of sulfur dioxide (SO₂) in the province should be reduced by least 75 percent from existing cap levels by the year 2005. The coalition suggests that this could mean a reduction of greater than 90 percent from Ontario Hydro's existing cap commitment of 175,000 tonnes.
- Emissions of mercury should be virtually eliminated by the year 2006.

In formulating these recommendations, the Coalition drew on a Position Paper on Ground Level Ozone prepared by the Ontario Medical Association (OMA) in mid-1998. The OMA recommended both of the specific actions on NO_x and SO₂ now advocated by the Coalition and further called for the petitioning of the USEPA Administrator under Section 115 of the Clean Air Act to seek reductions in U.S. emissions of NO_x and SO₂.

The OMA also recommended that, in general, legislation restructuring the electrical generation sector must include more stringent SO₂ and NO_x emission limits, applicable to all market participants. Specifically it suggested that the restructuring legislation include a systems benefit charge to create a fund collected on the basis of usage and dedicated to investment in cost-effective energy efficiency and energy conservation projects. Similar funds are apparently currently operating in California, Maine, Massachusetts and New York. Annual collected funds should be designed to exceed \$100 million Cdn per year.

Finally, the OMA recommended that electrical sector restructuring legislation in Ontario must include disclosure provisions whereby all existing and new electricity generation sources must provide regular, public reports showing emissions data for selected pollutants, particularly SO₂ and NO_x.

Ontario Hydro Activities

Ontario Hydro has negotiated its first sale of NO_x emission reduction credits, selling more than 500 tons of nitrogen dioxide (NO₂), emission reduction credits to the Hartford Steam Boiler Company in Connecticut — the first-ever sale of credits from Canada into the United States.

The credits, discounted 50 percent because of distance and dilution factors, will be used to satisfy a Connecticut Department of Environmental Protection consent order related to the closing of a cogeneration facility in Hartford.

The emission credits were created when Ontario Hydro reduced NO₂ emissions through the installation of low-NO_x burners and modification of the combustion processes at its Nanticoke and Lambton coal-fired generating stations in 1995 and 1996. These initiatives created a total of almost 6,000 tons of NO₂ credits.

Creation of the credits was reviewed by Ontario's Pilot Emission Reduction Trading (PERT) project, in which Hydro is a participant. Under the PERT project, 10 percent of the emission reduction credits created are immediately retired for the benefit of the environment.

On a broader scale, provisions under consideration for the restructuring of Ontario Hydro, as part of energy deregulation in Canada, would allow the importation of up to 49 percent more power from the United States beginning next year. Importation is recognized as one of the significant measures necessary to ensure the emergence of a genuinely competitive market in Ontario. The province's Environment Minister has stated that U.S. producers would be required to meet tough new Ontario standards, although these have yet to be established. Sources generating power for export to Canada are not considered in the current Ontario Smog Plan, which commits to a 45 percent reduction from 1990 levels for some air pollutants by the year 2015.

The Board is currently attempting to secure data from both the United States and Canada that would indicate the current levels of NO_x produced per unit of heat energy input for major utilities within 160 km of the boundary. This would allow comparison to the USEPA benchmark emission rate under their recent NO_x SIP call of 0.15 lbs of NO_x per million BTU and development of advice for the Commission on what particular facilities within this distance of the boundary might be called upon to take further control or preventive action.

In attempting to develop this benchmark, the Board is concerned about recent actions of the Ontario government to exempt a newly restructured Ontario Hydro from the province's Freedom of Information and Protection of Privacy Act.

Last August, the office of the Information and Privacy Commission of Ontario recommended that the legislature creating two new Hydro corporations make them subject to the public access requirements in

Ontario under the Act. However, the current government has responded with a bill, which, as of April 1, 1999 would prevent use of the Act to obtain health and safety information from Ontario Hydro. Emissions of acid gases and persistent toxic substances would apparently be shielded from public access, although Hydro will continue to be a public entity.

If ultimately enacted, this Bill could deny the Board access to data on acid gas emissions, including NO_x, as well as mercury releases. As a result, the Board would be precluded from reviewing NO_x benchmarks, such as outlined above, and tracking mercury emissions from this sector of the utility industry, thus rendering incomplete its joint review of this latter issue with the Commission for Environmental Co-operation (CEC). It may also preclude the public from choosing their source of electrical power based on impact on the environment.

Recommendation:

The International Air Quality Advisory Board encourages the International Joint Commission to advise the governments that public access to information on releases of toxic substances, including persistent toxic substances, should be an ongoing requirement for the electrical utility sector. This should apply to significant electrical power generation facilities on both sides of the boundary, particularly in light of the extensive and interactive restructuring currently underway in that industry.

4.1.2 United States Developments

U.S. SIP outcomes in 22 states

Within the U.S., in the period from 1970 to 1996, emissions of six common air pollutants, including particulate matter (PM), SO₂, volatile organic compounds (VOCs) and carbon monoxide were reduced, while total NO_x emissions increased by 11 percent and electrical utility NO_x emissions increased by 44 percent. The Canadian circumstance is similar.

Several recent Board reports have emphasized the critical role played by emissions of nitrogen oxide in acid rain, fine particulate and ozone formation, all transboundary air quality issues.

Of these three impacts, ozone effects have perhaps received the greatest recent attention. Ozone generation and dispersion in the eastern half of the U.S. and parts of Canada have been the subjects of a multi-year intensive study under the Ozone Transportation and Assessment Group (OTAG), a partnership of the EPA and 37 easternmost states and the District of Columbia. The OTAG study was to further document the sources and factors contributing to elevated ozone concentrations and determine possible remedial actions.

Following completion of the OTAG exercise, the USEPA, in September 1998, issued its Final Rule for reducing regional transport of ground level ozone. That rule and related actions call for substantial reductions in NO_x emissions from 22 states (Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Massachusetts, Maryland, Michigan, Missouri, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, Wisconsin, West Virginia) and the District of Columbia.

The rule requires that the 22 states and the District of Columbia submit State Implementation Plans (SIPs)

within one year, committing to the introduction of measures designed to achieve the NO_x emission reductions deemed necessary by the agency by May 1, 2003. Measures so submitted are to be completed by September 30, 2007. In developing their SIPs, the states are to be granted flexibility in deciding how best to meet these reductions, noting that it is likely that reductions from utilities and large non-utility point sources would be required.

A portion of the flexibility in the rule comes from the allowed use of emission credits. These credits may be issued to sources that achieve reductions early or to those demonstrating need. A multi-state cap and trade system is envisaged, allowing the sale of emission reductions to other facilities that have difficulty in achieving limits.

The rule is predicated on the development of regional strategies rather than the imposition of further local controls. It should reduce summertime emissions of nitrogen oxides by approximately 28 percent or 1.2 million tons, which should bring the great majority of all new ozone nonattainment areas into compliance with the new U.S. 8-hour ozone standard of .085 ppm.

If a state or the District of Columbia elects not to submit an SIP or submits a plan the agency cannot approve, the EPA proposes to place that body under federal requirements, which will include specific NO_x reductions for utilities and other large point sources such as industrial boilers and turbines, large internal combustion engines, and cement manufacturers. The timing of implementation of such reduction programs would also be May 1, 2003.

Specific to the electrical utilities, in the absence of an acceptable SIP, it is anticipated that the agency will mandate a control level of 0.15 lb of NO_x per mm (million) British Thermal Units (BTUs) heat energy input, corresponding to the most protective level recommended by OTAG. The agency has determined this level to be achievable using available cost-effective technology. While this requirement would not be restricted to coal-fired generating stations, they would be the most affected portion of the utility sector. Under requirements for the non-utility sectors, emissions from large industrial boilers would be reduced by 60 percent from uncontrolled levels; 90 percent reductions would be required from large stationary combustion engines and 30 percent from cement kilns.

SIP Court Challenge

Several midwestern states, including Michigan, Ohio and Indiana, along with over 60 other entities, have challenged the SIP NO_x Call in U.S. federal court. Toward mid-February, the Government of Canada, who had already intervened formally as a control advocate in the course of the EPA rule-making development process, was asked to join 24 parties, including a coalition of New England states and environmental and health groups, as friends of the court (*amicus curiae*). This status has apparently been granted.

A day prior to the Canadian request for *amicus curiae* standing, the province of Ontario sought and apparently obtained recognition as an intervener in this case. In doing so, the province noted that the requirements being considered by the EPA in the U.S. either have already been met in Ontario or will be met within the EPA's timeframe. The U.S. court has not ruled on the requests received from either Canada or Ontario.

U.S. Clean Air Act Section 126 Petitions

Roughly simultaneous with the USEPA NO_x SIP Call, under Section 126 of the Clean Air Act, eight north-eastern states petitioned the EPA to make a finding that NO_x emissions from certain stationary sources

significantly contribute to ozone non-attainment in the petitioning states. In their petition, the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island and Vermont identified all the 22 states previously mentioned and the District of Columbia as sources, as well as selected other states.

EPA has found that seven of the eight Section 126 petitions have merit and that sources in 19 states and the District of Columbia do contribute significantly to poor air quality, including non-attainment, in one or more of the petitioning States. The granting of the associated petitions will be deferred to allow for analysis of those SIPs submitted in response to the EPA SIP NO_x Call. Emissions trading programs are envisioned as one of the tools to achieve necessary reductions. In the absence of a submitted SIP, the EPA is proposing control requirements on utilities and large non-utility sources identical to those discussed previously.

Parallel and Post Rule Developments - Electrical Utilities

According to recent USEPA reports, in 1997, 537 electrical utilities subject to Phase 1 Clean Air Act Acid Rain Program requirements demonstrated 100 percent compliance with emission limits for NO_x. A 40 percent reduction from 1990 NO_x emission levels, from an average of 0.69 lbs NO_x per million BTUs to an average of 0.40 lbs/mm BTU is required. Total 1996 NO_x emissions from all electrical generators were 5,900,000 tons.

Transitional Classification

Responding to a directive from the President, the USEPA has established transitional classifications for those areas that, based on current data, will not meet the new 8- hour ozone standard. To be eligible, the areas must attain the 1-hour 0.12 ppm ozone standard previously prevailing by the year 2000. The State must also submit an SIP by the year 2000 indicating how the required further reductions will be met and demonstrate commitment to additional reduction measures, including control on specific sources and local actions as necessary.

4.1.3 Transboundary Developments

New England Governors/Eastern Canadian Premiers Acid Rain Action Plan

As noted in the recent International Air Quality Advisory Board Special Report on Transboundary Air Quality Issues, this region of North America is establishing the groundwork for a co-ordinated binational approach to the determination of air quality impacts associated with acid gas emissions and their amelioration.

In their Acid Rain Action Plan released in June 1998, the Governors and Premiers agreed to a co-ordinated transboundary approach to achieve the further reductions in emissions of sulfur and nitrogen oxides necessary to prevent irreversible damage to their environment. Further delineation of their concern, specifically relating to impacts on forestry, was seen as necessary, but adequate evidence appeared present to call for reductions of current emissions from sources both within and outside the region. Their plan is linked explicitly to fulfilment of specific aspects of the Canada/United States Air Quality Agreement and envisages a prominent support role for both federal governments in its implementation.

The identified Plan action items for reporting to the Governors and Premiers include:

- co-ordinated Data Collection and Management, with the establishment of a pilot program for the cross border electronic exchange of emissions, deposition, air quality, meteorology, water quality and environmental effects data and information. Collaborative assistance from Environment Canada and the United States Environmental Protection Agency (USEPA) in the development and analysis of this information is to be sought; and
- development of maps illustrating the pattern of sensitivity to sulfur and nitrogen oxides, and patterns of such deposition in the region. A review and compilation of current and projected sulfur and nitrogen emission inventories in the eastern portion of the U.S. and Canada adequate to support regional deposition modeling should also be initiated.

These outputs would be used to determine the residual impact following achievement of current U.S. and Canadian acid gas emission reduction commitments. They would also be applied in the determination of transfer matrices identifying the contribution to acid precipitation of specific sources and source regions from individual states and provinces inside and outside the region. Comparisons of prevailing ecosystem sensitivities following additional reductions of 50 percent in sulfur emissions and 30 percent in nitrogen emissions would also be mapped.

The outcome of this Plan initiative is to be a report, tabled prior to the end of 1999, identifying appropriate revisions to critical loads of sulfur and nitrogen deposition necessary to protect sensitive regional ecosystems.

With specific reference to Annex 2 of the Air Quality Agreement, the U.S. and Canadian governments are asked to support establishment of two regional networks, one to monitor the effects of acidic deposition on aquatic ecosystems and a second to determine the levels and distribution patterns of fine particles ($PM_{2.5}$), including sulfates and nitrates, across the region. The state and provincial governments commit to attempt establishment of at least one lake monitoring site and one fine particulate monitoring site in each jurisdiction and to have water quality and fine particulate monitoring networks functional as of June 30, 1999, with the implied assumption of availability of appropriate federal support.

The governors and premiers are also most concerned about air pollution impacts on forest health and have struck a task group to monitor and map the forest system as part of determining critical thresholds for soil acidification.

The extensive transboundary modeling efforts and the associated underlying emissions inventories and meteorology data which the governors and premiers propose are likely to require a substantial degree of technical assistance from their federal counterparts. In turn, these efforts would also provide useful information to the respective federal governments and to state and provincial governments outside the New England/Atlantic Provincial region.

Recommendation:

Given the efforts of the New England States and the Atlantic Provinces to co-ordinate the determination and management of acid deposition in this transboundary region, the International Joint Commission should encourage the governments of Canada and the United States to provide the resources necessary to fully document the current concerns and the future risk in this binational region and to determine appropriate reductions in emissions of sulfur and nitrogen oxides inside and outside the region.

4.2 Mobile Sources

As the Board has reported previously, and as established in the charts in Figures 4-1 and 4-2, the major source sector responsible for NO_x emissions is Transportation. Indeed, if oil and gasoline refining activity is considered as part of the sector, in the Canadian situation, a majority of emissions of this pollutant would be accounted for in this one activity.

Notwithstanding that NO_x emissions from automobiles have been reduced by approximately 90 percent on a per vehicle basis with the introduction and revision of automobile emission regulations, recent projected vehicle emissions have been revised upward to account for the effects of increased vehicle population and usage, aggressive driving and air conditioning use, the growing proportion of sport utility vehicles (SUV), small trucks and minivans, and the impact of gasoline sulfur levels. Environment agencies in both the United States and Canada are moving to address these issues.

Figure 4-1. Total Canadian NO₂ Emissions by Source Sector (1995)

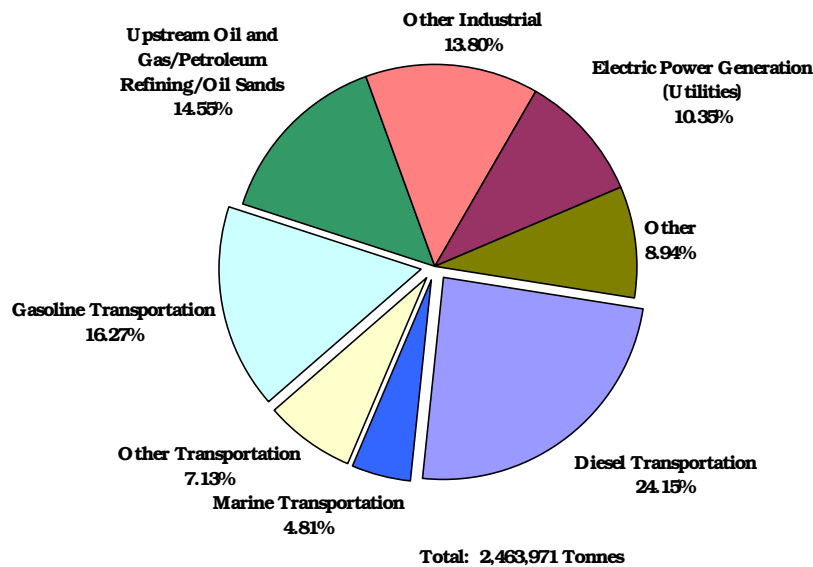
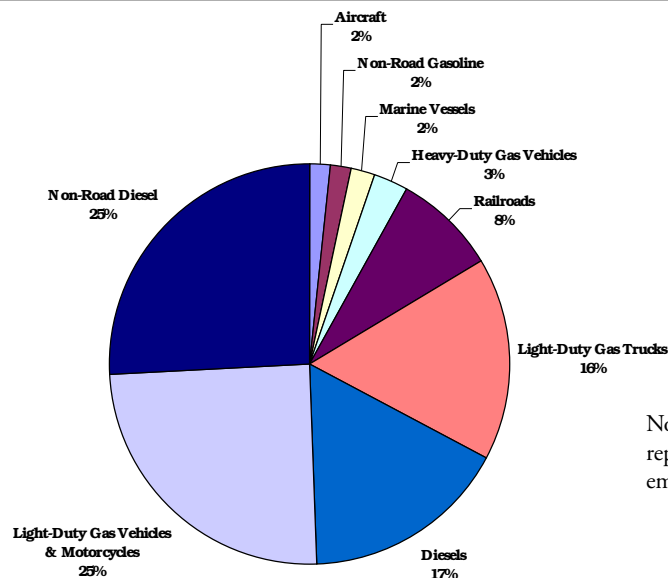


Figure 4-2. 1997 U.S. NO_x Emissions from Transportation Sector



Note: Transportation Emissions represent 49% of the total NO_x emissions of 23,500,000 tons

4.2.1 Canadian Developments

Ontario Drive Clean Program

The Ontario Government has revised its regulations governing the test procedures, technology and emission standards applicable to passenger vehicles, trucks and buses in support of the Drive Clean program initiated by the Ministry of the Environment.

Under this regulation, mandatory emission testing will be introduced in accordance with the following schedule:

- all trucks and buses throughout Ontario are to be tested annually simultaneous with their safety checks;
- passenger vehicles (cars and light duty trucks) over 3 and less than 20 years old in the Great Toronto and the Hamilton-Wentworth areas are to be tested every two years at vehicle registration renewal or at time of resale; and
- expansion of the passenger vehicle testing program to 13 urban areas from Windsor to Peterborough will occur by the year 2000 with a further extension to their commuting zones by 2002.

For heavy duty trucks and buses, testing will consist of a smoke or snap acceleration test for diesels and a two-speed idle test for other fuels. Passenger vehicles will be given a dynamometer test at vehicle registration renewal and a two-speed idle test at time of resale.

Status of the Sulfur in Gasoline Regulations – Canadian Actions

The proposed regulations for establishing the level of sulfur in gasoline in Canada have received publication in the Canada Gazette as of October 31, 1998. During the 60-day comment period allowed as part of the publication process, 18 formal Notices of Objection were received, calling for the Minister of the Environment to conduct a Board of Review to investigate the need for the regulation.

At this time, the minister has not determined if such a board will be called; among her other options is one to proceed with the Part 2 publication in the Canada Gazette, which would establish the regulations.

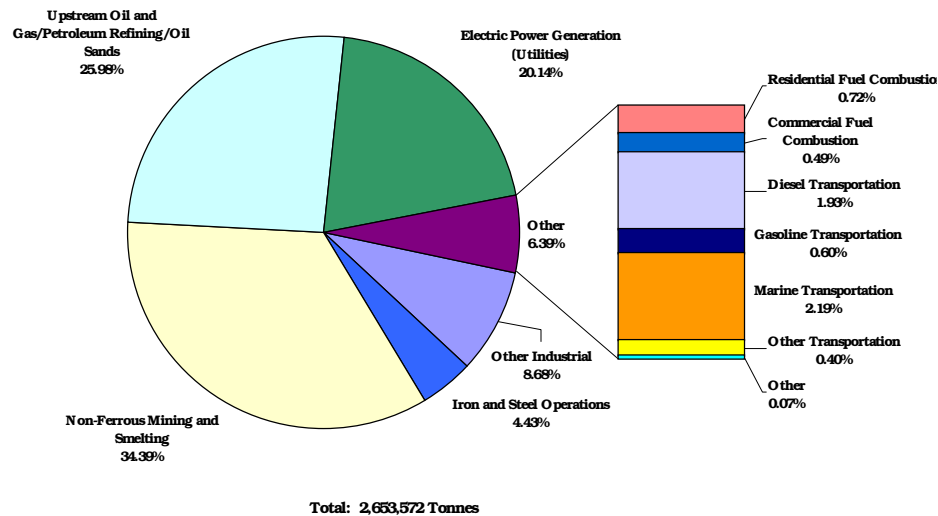
The proposed regulation would lower the level of sulfur in gasoline nationwide in two stages – first, to an average of 150 ppm in the year 2002 and next, to an average of 30 ppm in 2005. This proposal is consistent with the position taken by the Commission in its correspondence with the governments of the United States and Canada on this subject.

Sulfur in Other Fuels – On-Road and Off-Road Diesel

The proposed Canadian sulfur in gasoline regulation was one of the outcomes of the Government Working Group on Sulfur in Fuels. This group also examined the issue of sulfur levels in diesel fuel for on and off-road use.

At the moment, sulfur content in on-road diesel fuel is limited to 500 ppm in Canada; off-road content is apparently not regulated. As Figure 4-3 indicates, the sulfur emissions from the on-road and off-road diesel segment of the vehicle population is substantially higher than those from the gasoline powered segment.

Figure 4-3. Total Canadian SO_x Emissions by Source Sector (1995)



In their final report issued in July 1998, the group recommended that the costs and benefits of reduction in sulfur content of fuel for off-road diesel use be determined. Further, the group recommended that Environment Canada determine an appropriate sulfur level for off-road diesel use as soon as possible. With regard to use of such fuel in heavily populated urban areas, a sulfur standard similar to the on-road standard (500 ppm) was recommended for consideration.

In the case of on-road diesel fuel, the group suggested that a lower priority be assigned to further reductions at this time. However, they did note that a lower sulfur limit may be necessary to protect against adverse health effects of these emissions or to support future diesel engine technologies. They recommended that all emissions from the combustion of diesel fuels be further examined to determine their impact on health.

4.2.2 United States Developments

California action on emissions from Sport Utility Vehicles

In the United States, the federal government is soon expected to follow the lead of the state of California and further restrict emissions from automobiles, particularly the light truck and sport utility (SUV) segment. This segment of the vehicle market has increased from 20 percent in 1980 to almost 46 percent in 1997 and the industry anticipates a roughly equal division between the two types of vehicles will persist for several years.

The California regulations restructure the vehicle weight classifications so that all current light duty trucks and medium duty vehicles having a gross vehicle weight under 8,500 lbs will be subject to the same standards as passenger cars. Only the heaviest SUVs and pick-up trucks would remain subject to separate medium duty vehicle standards.

In the newly structured classes, allowable NO_x emissions would be reduced to 0.05 grams/mile (g/mi) from the current 0.2 g/mi for vehicle operation up to 50,000 miles, with the demonstrated capability of maintaining compliance with a limit of 0.07 g/mi after operation for 120,000 miles. These standards are to be phased in from the 2004 to the 2007 model years. Further restrictions would also be placed on the emissions of organic gases both from operation and evaporation.

At the federal level, the EPA has drafted a new NO_x auto emission standard that would largely conform to the California regulations. The draft plan would require cars to meet a 0.07 gram/mile (g/mi) over 120,000 miles of operation standard with the same timing over the years 2004 to 2007. SUVs would be required to meet a less stringent NO_x limit of 0.20 g/mile between 2004 and 2007, and finally comply with the 0.07 limit by the year 2009. At this time it is unclear whether the largest sport utility vehicles (those over 8500 lbs) will be covered under the proposed regulations.

U.S. Settlement with Diesel Engine Manufacturers

Diesel powered vehicles make up four percent of the total vehicle population but release 40 percent of the nitrogen oxides and 60 percent of the particulate matter from the transportation sector. As Figure 4-2 indicates, the contribution of diesel powered vehicles to total NO_x emissions remains substantial.

Some time ago, the U.S. Department of Justice sued six major diesel engine manufacturers (Caterpillar, Cummins, Detroit Diesel, Mack, Navistar and Volvo) accounting for 95 percent of diesel engine sales, alleging that the manufacturers manipulated their engine control systems to show artificial compliance with emission requirements. The manipulation would allow the engines to demonstrate compliance with NO_x emissions regulations during formal testing at low engine speeds while not adequately controlling NO_x at the higher engine speeds typical of actual operating conditions. The issue was resolved in a series of consent decrees between the engine manufacturers and the government that will provide for a number of corrective measures and result in total costs to the companies in excess of \$1 billion.

USEPA now estimates that engines from these manufacturers emitted an additional 1.3 million tons of NO_x into the atmosphere in 1998 alone. Over the next 27 years, the settlement should prevent 75 million tons of NO_x emissions.

In early 1999, Transport Canada began the same discussions with some engine manufacturers regarding some extension of corrective measures to Canada. The Department estimates that approximately 130,000 of these engines were sold in Canada.

Other Diesel Engine Sources (off-road)

New emission requirements from the USEPA for diesel engines used in construction equipment, farm machinery and other non-road vehicles should result in a one-million ton reduction in emissions of nitrogen oxides by the year 2010. The EPA states that nonroad diesel engines are currently responsible for approximately 13 percent of all U.S. emissions of ozone-forming NO_x.

New emission standards should also lower particulate pollution below their current level of about 16 percent of all U.S. emissions of particulate matter.

The rule does not affect some classes of nonroad diesel engines, which are regulated separately, including locomotives, underground mining equipment, and marine engines of greater than 50 horsepower.

U.S. Proposed Action – Sulfur in Fuels

As of mid-March, the USEPA is expected to transmit its proposed sulfur in gasoline rule to the Office of Management and Budget imminently. The current indication is that the proposed regulation will call for a nationwide program with an 80 ppm sulfur cap and an average 40 ppm requirement, to be phased in between the years 2004 and 2007. The current nationwide average of sulfur in gasoline is approximately 350 ppm.

As illustrated in Figure 4-4, burning of diesel fuel is a more significant source of SO₂ to the environment than gasoline. In the United States, California has had a diesel fuel regulation as of 1993 that limits sulfur content in diesel fuel to 500 ppm and aromatic hydrocarbon content to 10 percent for both on-road and off-road uses. The U.S. national regulation is also 500 ppm for on-road uses only.

The Manufacturers of Emission Controls Association (MECA) has recently stated that sulfur levels must also be reduced significantly before more sophisticated emission control technologies can be used on diesel engines. The association's analysis indicates that sulfur levels of less than 30 parts per million would be needed in diesel fuel.

The Environmental Protection Agency is expected to comment on plans to further regulate the sulfur content of diesel fuel.

European regulation reduced the diesel sulfur content from 1500 ppm to 500 ppm in 1996. Draft EU legislation, proposed for implementation in the year 2000, calls for a maximum sulfur content in diesel fuels of 350 ppm and a maximum volume of PaHs (aromatic compounds) of 11 percent. The Swedish Government has mandated two classes of city diesel fuel and, through tax incentives, ensured that 90 percent of its diesel market is Class I, essentially a heavy jet fuel with a sulfur content of not more than 10 ppm and aromatic content under five percent.

As new information becomes available, the Board will continue to advise the Commission on the impact of emissions from the diesel transportation sector, particularly in the urban environment, as appropriate.

Figure 4-4. 1997 U.S. SO₂ Emissions from Transportation Sector

