Transboundary Air Pollution in Europe: A Survey of National Responses*

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I. Introduction

Air pollution is an increasingly important international issue in Europe. The acidification of many of Scandinavia's lakes and the recent discovery of extensive forest damage in Central Europe, believed also to be a result of pollution, have created a charged atmosphere in which vulnerable nations regard transboundary pollution with unprecedented apprehension.

We now know that oxides of sulfur and nitrogen produced through combustion activity in one locality may eventually return to earth, hundreds or even thousands of miles from their source, in the form of dry acid-forming particles or sulfuric and nitric acids in rain and snow. The accumulation of these acids in "sensitive" lakes and streams, those low in natural buffers such as limestone, can cause dramatic impacts, including the complete elimination of fish

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populations and other forms of aquatic life. In addition, recent studies suggest that these pollutants can cause long-term, potentially irreversible changes in the soils and forests of some regions. Other effects that have been attributed to acid deposition include damage to crops, damage to man-made materials such as the paint on automobiles and buildings, and corrosion of cement and marble structures, including irreplaceable monuments. Finally, acid deposition can leach toxic metals such as aluminum and mercury from mineral compounds and wash them into drinking supplies, where they present a danger to human health.[1]

The problem is very much an international one. In Norway, Sweden, Switzerland, Austria, eastern Canada and the Netherlands, more than sixty percent of the sulfur deposition originates in other nations. Even in heavily industrialized West Germany, roughly half of the sulfur deposition comes from foreign sources.[2]

The resolution of the European transboundary pollution problem is a complex matter. Europe's more than twenty nations are closely linked geographically and economically, but their economic, energy and pollution control policies differ dramatically. This article describes in detail recent policy developments in the European countries most deeply implicated in the transboundary air pollution problem: Sweden, Norway, West Germany and the United Kingdom. The other countries of the European Community—Italy, France, Belgium, the Netherlands, Luxembourg, Denmark and Ireland—are briefly examined for comparative purposes, as are Switzerland and Japan.

In general, the responsiveness of Europe's national policymakers to transboundary air pollution problems has been a direct function of the severity of the impacts suffered domestically. Sweden, which has seen 18,000 of its lakes acidified, has reduced its SO_2 emissions by more than 40% over the past decade, and plans to reduce pollution levels by an additional 30% by 1993.[3] Norway, which has

1. *See generally* ECOLOGICAL IMPACT OF ACID PRECIPITATION (D. Drablφs & A. Tollan eds. 1980); ENVIRONMENT '82 COMMITTEE, SWEDISH MINISTRY OF AGRICULTURE, ACIDIFICATION TODAY AND TOMORROW (S. Harper trans. 1982) [hereinafter cited as ACIDIFICATION].

2. U.N. Econ. Comm. for Eur., *EMEP: The Cooperative Programme for Monitoring and Evaluation of Long Range Transmission of Air Pollutants in Europe*, 34 Economic Bulletin for Europe 13, 37 (1982); Executive Summaries, Memorandum of Intent on Transboundary Air Pollution, Aug. 5, 1980, United States-Canada [hereinafter cited as Executive Summaries].

3. *See infra* notes 6-47 and accompanying text.

suffered similarly massive impacts to its freshwater aquatic ecosystems, has pledged to reduce its domestic SO_2 emissions, already among the lowest in Europe, by an additional 30%.[4] West Germany and the United Kingdom, Western Europe's major sulfur dioxide pollution producers, have taken dramatically different approaches to the air pollution problem.[5] Although there are reports that acid rain may be affecting some lake areas in the United Kingdom, government officials do not believe that acidification is a serious problem in Britain, and are unwilling to embark upon new SO_2 control programs. In contrast, West Germany, prompted by recent reports of widespread air pollution damage to its forests, has become increasingly determined to better control its sulfur and nitrogen oxides pollution, for its own benefit as well as for the benefit of its downwind neighbors.

II. Sweden

Acid pollution has seriously impacted Sweden's environment. Like its Scandinavian neighbor Norway, Sweden lies in the path of westerly and southerly winds carrying acid-forming pollutants from Europe's major industrial centers. These winds also pick up water vapor in the journey across the seas surrounding the Scandinavian peninsula. When the moisture precipitates out over the land mass, it washes contaminants from the atmosphere in the process, introducing them to the environment as acid precipitation. Sweden's ecosystems are ill-equipped to withstand this environmental assault, for glacial action thousands of years ago scraped away much of the land's topsoil and natural buffering capacity. The remaining bedrock, consisting mainly of slow-weathering granites and gneisses, has little capacity to neutralize acids.

Of the nation's 85,000 lakes, 18,000 have already been acidified.[6] Swedish officials project that future years may bring much more substantial and diverse acid rain impacts. A recent publication by the Ministry of Agriculture predicts that if current pollution trends continue, the result will be not only more widespread lakewater acidification, but also the acidification of soils and groundwater

4. *See infra* notes 52-83 and accompanying text.
5. *See infra* notes 84-243 and accompanying text.
6. Acidification, *supra* note 1, at 50.

supplies. It is feared that these changes will bring about severe damage to forestry, agriculture and even human health.[7]

Although Sweden releases about 500,000 metric tons of sulfur dioxide into the atmosphere each year,[8] domestic pollution is responsible for only a small part of the country's acidification problem. Between 70 and 80% of the acids deposited in Sweden are derived from pollutants emitted elsewhere. Great Britain, West Germany, East Germany, Poland, the Soviet Union, Denmark, France, Finland and Czechoslovakia all contribute substantially.[9] In its substantial efforts to deal with the acidification problem, Sweden has focused on these foreign emissions.

A. *The Campaign for International Action*

In the face of substantial political and practical constraints, the Swedes and Norwegians have orchestrated a patient but determined campaign to make other nations more aware of international pollution problems. It was at the urging of Sweden and Norway that 114 nations and 37 intergovernmental organizations met in 1972 at the United Nations Conference on the Human Environment at Stockholm,[10] an event heralded by many commentators as the onset of a new level of global environmental consciousness among national governments. The official statement of that gathering still provides the single most important and persuasive multilateral commitment to the principle that nations have a responsibility to assure that their actions do not cause damage to foreign environments.[11]

In the years since the United Nations 1972 Conference, Norway and Sweden have worked to give meaning to this laudable but vague principle. The Swedish Ministry of Agriculture, working closely with Norway, has played a key role in stimulating international action in both the Organization for Economic Cooperation and Development ("OECD"), where key studies on international pollution have been conducted, and in the U.N. Economic Com-

7. *Id.*

8. Interview with L. Lindau, Nat'l Swedish Env't Protection Bd., in Stockholm, Sweden (Aug. 25, 1983).

9. ACIDIFICATION, *supra* note 1, at 45-46.

10. Report of the U.N. Conference on the Human Environment, June 5-16, 1972, Stockholm (1973).

11. Declaration of the U.N. Conference on the Human Environment, in *id.* Principle 21 in the Declaration is set out *infra*; see text accompanying note 275.

mission for Europe ("ECE"), under whose auspices the first multilateral agreement specifically addressing transboundary air pollution was reached.[12]

Sweden hosted another major international environmental meeting in the summer of 1982, when member states of the ECE met at the Stockholm Conference on Acidification of the Environment.[13] A heightened level of concern over international pollution problems, prompted partly by new data on possible acid rain impacts on forests, was apparent at this meeting.[14] Sweden's Minister of Agriculture, Anders Dahlgren, expressed the nation's belief that "any reduction of the acidifying emissions of sulfur and nitrogen compounds will be beneficial to the environment," and stressed the need for achieving emissions reductions as soon as possible.[15] The conference, another thrust in the joint Scandinavian campaign, served to preserve some degree of momentum toward international abatement action.

In view of most nations' resistance to expensive abatement programs, especially those perceived chiefly to benefit other nations, the Scandinavians have made remarkable progress in awakening industrial nations to international air pollution problems. In the words of a senior official in the European Community's Air Management Program, "the Scandinavians deserve a great deal of credit for bringing what we anticipate will be a long-term pollution problem to our attention as early as possible."[16] However, in general, international developments have fallen far short of the concrete abatement programs that Sweden and Norway have repeatedly advocated.

B. *Scientific Efforts*

An expanding arsenal of scientific data has played a major role in Sweden's international lobbying efforts. Swedish scientists have developed detailed documentation of the country's acidification prob-

12. *See* Rosencranz, *The ECE Convention of 1979 on Long-Range Transboundary Air Pollution*, 75 AM. J. INT'L L. 975 (1981).

13. SWEDISH MINISTRY OF AGRICULTURE, THE 1982 STOCKHOLM CONFERENCE ON ACIDIFICATION OF THE ENVIRONMENT: PROCEEDINGS (1982) [hereinafter cited as 1982 STOCKHOLM CONFERENCE PROCEEDINGS].

14. *See infra* notes 237-38 and accompanying text.

15. 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13, at 12.

16. Interview with senior official, Air Management Program, Eur. Econ. Comm'n, in Brussels, Belgium (July 13, 1982).

lems and have contributed immensely to our understanding of the acidification phenomenon.

Europe's first systematic monitoring of precipitation and air was instigated in the 1940's in Sweden. Directed by Stockholm's International Meteorological Institute since 1956, the system, known as the European Air Chemistry Network, has resulted in the collection of invaluable data on precipitation spanning twenty-five years.[17] In 1968, Swedish soil scientist Svante Oden used these data to demonstrate for the first time that precipitation over Scandinavia was gradually becoming more acidic as a result of sulfur emissions from Central Europe and Britain, and that these acids were causing serious environmental damage in Scandinavia.[18] Perhaps more importantly, it was Sweden's case study on the environmental impact of sulfur, presented at the 1972 Stockholm Conference, that brought the acid rain problem to the world's attention.[19] While the report, a basic text on the effects of sulfur emissions, initially met with considerable skepticism, its conclusions have since been reaffirmed by detailed studies.[20]

More recently, in conjunction with the 1982 Stockholm Conference, the Swedish Ministry of Agriculture published *Acidification Today and Tomorrow*, a synopsis of current and predicted impacts of acid rain.[21] A major theme of this volume is that, while past acid rain damages have for the most part been subtle and insidious, future impacts on the nation's lakes and forests are likely to be massive and dramatic.

C. *Domestic SO_2 Emissions: National Control Strategies*

Ever conscious of the international dimensions of the problem, Swedish officials view their domestic pollution control programs as

17. ACIDIFICATION, *supra* note 1, at 13.

18. *Id.* at 16; Oden & Ahl, *Fursurningen av Skandinaviska Vatten (The Acidification of Scandinavian Lakes and Rivers)*, in COMMISSION ON NATURAL RESOURCES, NATIONAL ACADEMY OF SCIENCES, ATMOSPHERE-BIOSPHERE INTERACTIONS: TOWARD A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL FUEL COMBUSTION 145 (1981); Oden, *Nederbordens och Luftens Forsurning, dess Orsaker, Forlopp och Verkan*, and Miljoer, *Statens Naturveten-Skapliga Forskningsrad* discussed in Likens, Wright, Galloway & Butler, *Acid Rain*, 241 SCI. AM. 47 (1979).

19. SWEDISH ROYAL MINISTRY FOR FOREIGN AFFAIRS, SWEDEN'S REPLY TO THE U.N. ENQUIRY IN CONNECTION WITH THE PREPARATION FOR THE U.N. CONFERENCE ON THE HUMAN ENVIRONMENT (1970).

20. *See, e.g.* D. Drablφs & A. Tollan, *supra* note 1; Executive Summaries, *supra* note 2.

21. ACIDIFICATION, *supra* note 1.

a means of enhancing Sweden's international credibility, as much as an effort to directly reduce acid pollution. In fact, the country's emission reduction efforts have a wide international impact, since two-thirds of Sweden's sulfur dioxide is ultimately deposited in other countries. The Soviet Union, Finland and Norway import the largest shares of Sweden's pollution.[22]

In the early 1970's, in response to the acidification problem, the Swedish government embarked on a program to reduce sulfur emissions significantly. Aggregate SO_2 emissions have, as a result, decreased from a peak of about 900,000 metric tons in 1970 to the current annual total of 500,000 metric tons.[23]

In Sweden, unlike most industrial nations, the production of electric power contributes relatively little to national sulfur emissions. Almost two-thirds of Sweden's electricity is provided by pollution-free hydroelectric power; nearly all of the balance is supplied by nuclear power.[24]

The bulk of Sweden's SO_2 emissions comes from sources burning fuel oil to heat homes and commercial establishments. Pollution control is achieved mainly through the use of low-sulfur fuels in industrial processes, home heating and power plants. In 1969, a nationwide maximum fuel oil sulfur content of 2.5% was established. Oil and coal burned in southern Sweden, where 90% of the nation's populace resides, has since 1977 been subject to much stricter limits: 1.0% sulfur for fuel oil and 0.65% sulfur for coal.[25] When supplies of low-sulfur fuel oil are unavailable, pollution sources buying cheaper, higher-sulfur fuel must pay the government the amount saved, a measure intended to deny users of more polluting fuels a competitive advantage.[26]

Sweden's smokestacks are currently not equipped with flue gas desulfurization equipment, and their relatively low height was apparently premised on the continued combustion of low-sulfur oil. While supplies of low-sulfur crude oil from the North Sea and North Africa are presently adequate and available at an acceptable

22. *Id.* at 46, fig. 10.

23. Lindau, *supra* note 8.

24. Extract from Swedish Official Statistics, 4 ALLMAN MANADSSTATISTIK 23 (1982).

25. ACIDIFICATION, *supra* note 1, at 38; TECH. DEP'T, SWEDISH ENV'T PROTECTION BD., REVIEW OF THE EXISTING SITUATION AND FUTURE PROSPECTS IN THE PREVENTION OF AIR POLLUTION IN SWEDEN 1, app. I (1977).

26. SWEDISH ENV'T PROTECTION BD., *supra* note 25, at app. I.

premium over high-sulfur Arabian oil, supplies may prove insufficient in future years.[27] If so, Sweden will have to look to wide-scale use of technological processes for oil desulfurization, or the combustion of low-sulfur coal, to keep emissions in check. Sweden's National Defense Research Institute has produced studies concluding that oil combustion nationwide could be replaced by the year 2015 with energy from biomass, solar and wind sources, and the combustion of forest wastes.[28]

In addition to the low-sulfur fuel strategy, the Swedish government has embarked on an innovative and effective program to promote more centralized home heating. Swedish authorities have encouraged the development of district heating systems to replace small, inefficient combustion installations in individual homes. About 3 million of Sweden's 8.5 million inhabitants now live and work in buildings heated by district systems.[29] Because the centralized systems produce less sulfur dioxide and are more readily adaptable to sulfur control technology, district heating has led to substantially reduced sulfur pollution levels in urban areas since 1976.[30]

D. *Testing of New SO_2 Control Technologies*

Three advanced emission reduction techniques are currently being tested in Sweden: electricity cogeneration, fluidized bed combustion and flue gas desulfurization. Plans are now underway to transport warm water used in the cooling of nuclear power stations to homes and offices in Stockholm, Gothenberg and Malmö. The cogenerated heat could lead to major reductions in SO_2 emissions from fuel oil combustion. In addition, a 200 megawatt Swedish power plant is now being experimentally equipped with a Norwegian-built fluidized bed combustion system. Fluidized bed combustion, although not yet economically viable, is a promising technology that reduces emissions of both sulfur dioxide and nitrogen oxides. Sweden has also become interested in utilizing flue gas desulfurization control technologies in fossil-fueled power plants. At a coal-burning facility for heating near Stockholm, three boilers have been equipped with dry flue gas scrubber systems, all sched-

27. Scott, *Taking a Rain Check*, 16 SWEDEN NOW 24 (1982).
28. *Id.* at 26.
29. SWEDISH ENV'T PROTECTION BD., *supra* note 25, at 4.
30. SWEDISH COUNCIL OF ENVTL. INFORMATION AND NAT'L SWEDISH ENV'T PROTECTION BD., THE ENVIRONMENT AND ITS MANAGEMENT IN SWEDEN 134 (1979).

uled to be in operation by the end of 1983. Another facility further south is using a similar control approach.[31] Finally, an additional new technology, direct oil desulfurization, could become extremely important in Sweden if low sulfur oil supplies become scarce.[32]

E. *Nitrogen Oxides Control*

In Sweden, as in other industrial nations, nitrogen oxides ("NO_x") receive far less attention in the development of control requirements than sulfur oxides. Sweden releases about 100,000 tons of nitrogen oxides into the atmosphere each year.[33] Stationary sources of NO_x emissions, such as power plants, industrial boilers and heating units, are largely unregulated. However, standards have been set to regulate such emissions from new cars. The United States' 1973 emission standard of 1.9 grams NO_x per kilometer (3.1 grams per mile) was adopted for 1976 Swedish autos.[34] In theory, these standards are enforced through mandatory annual auto inspections. In practice, however, enforcement is lax, and, due to poor maintenance, most cars do not comply.[35]

Swedish officials have expressed concern over NO_x emission trends. The Ministry of Agriculture predicts that, while sulfur deposition has been stabilizing, nitrogen deposition levels will continue to increase at a rate of from 2 to 4% per year. At this rate, nitric acid will account for 40% of the wet-deposited acid in Sweden by 1990, and within a few decades the figure will be 50%. Forest experts fear that deposition at such levels could promote the depletion of soil nutrients and ultimately damage the capacity of soils to support new forest growth.[36]

31. Scott, *supra* note 27. Dry flue gas desulfurization depends on the reaction of exhaust fumes with a dry chemical absorbent to remove the sulfur dioxide produced during combustion. Dry scrubbers can remove 70 to 90% of the SO_2 produced during combustion.

32. Emmelin, *Environmental Planning in Sweden, A Program to Reduce Sulfur Emissions*, CURRENT SWEDEN, ENV No. 74, June 1976; *see* Lindau, *Enforcement of the Sulphur Dioxide Reduction Program in Sweden*, in AMERICAN BAR ASSOCIATION, AIR POLLUTION CONTROL: NATIONAL AND INTERNATIONAL PERSPECTIVES 37 (1980) [hereinafter cited as AIR POLLUTION CONTROL].

33. ACIDIFICATION, *supra* note 1, at 38.

34. SWEDISH ENV'T PROTECTION BD., *supra* note 25, at 2.

35. L. Lindau, The National Air Pollution Regulations and Their Application in Sweden (Dec. 1978) (unpublished report).

36. ACIDIFICATION, *supra* note 1, at 158-62, 192.

F. *Governmental Pollution Control Activities*

The Ministry of Agriculture is the government agency primarily responsible for the formulation of environmental policy and the development of proposals for new environmental legislation in Sweden. Subordinate to and working closely with the Ministry is the *Statens Naturvardsverk* ("SNV"). The SNV is the lead national agency for the administration of environmental protection laws and, among other responsibilities, administers the program regulating the sulfur content of fuel. The SNV works cooperatively with each of Sweden's twenty-four county administrations which, under the national Environmental Protection Act, are responsible for supervision of plant operations.

Sweden's 1969 Environmental Protection Act requires industry to take all "economically feasible" and "technically practicable" precautionary measures to prevent pollution.[37] The Act directs the SNV to determine the best available control technology for important categories of pollution sources. In most cases, the choice of controls is left to industry. The Act also establishes a permit system, under which operating conditions and emissions limits are set for major pollution sources such as power plants. Permits are issued by the National Franchise Board based upon noncompulsory emission guidelines set by the SNV. In practice, the permits have corresponded closely to guideline levels.

Exemptions from permit requirements can be sought from the SNV or from the county administrators[38] and, in fact, they are more the rule than the exception. Fully two-thirds of the pollution control cases are handled through the more expedient exemption procedure.[39] A permit exemption does not relieve the polluting industry of the duty to mitigate adverse environmental effects, but only of the duty to apply for a permit. Like the permit, the exemption stipulates specific control measures as conditions for the conduct of a polluting activity.

The denial of a permit or the imposition of penalties for failure to comply with control requirements may be appealed to a quasi-judicial administrative panel. The four-person panel includes a

37. Swedish Statute Book 1969:387 (Foreign Exchange Documents Program of the U.S. Envtl. Protection Agency, No. 00129A).

38. OFFICE OF INT'L ACTIVITIES, U.S. ENVTL. PROTECTION AGENCY, ENVIRONMENT SWEDEN 20 (1977) [hereinafter cited as ENVIRONMENT SWEDEN].

39. Lundquist, *Shaking the Institutions in Sweden*, 16 ENV'T 27 (1974).

lawyer, who chairs the panel, a representative of industry, a representative of the national environmental protection agency and a representative of citizen environmentalists. At present there are four such panels in operation.[40]

The SNV inspects all major facilities at the time a permit is applied for to assure that the facility's equipment and operations will, if properly run and maintained, produce acceptable levels of emissions. As in most countries, governmental efforts to assure that emissions remain within permissible levels become far less vigorous after the permit is granted. County administrators are responsible for the supervision of sources within their counties, and have the right to inspect pollution sources and carry out investigations. Pollution sources are obliged to supply information to the examiner and may suffer criminal penalties for failure to do so,[41] but in practice, county administrators tend to rely on voluntary cooperation with polluters. Monitoring is carried out primarily by the industrial facilities themselves.[42] Enforcement efforts are limited by both resource constraints and the decentralization of authority in the pollution control system.[43] Swedish environmentalists contend that because county administrators usually give higher priority to local economic and employment considerations than to curbing air pollution, jobs and economic concerns often preempt environmental protection in Sweden.

G. *Ameliorative Measures: Liming*

The Swedish Ministry of Fisheries, with the support of the SNV, is attempting to lessen the effects of acidification by treating the affected lakes with lime, a material which, because of its alkaline properties, acts to neutralize acid deposition. Efforts to date have concentrated on lakes where liming is most needed to protect sport fishing and valuable species such as salmon, char, crayfish and river pearl mussels. By the summer of 1982, 1,500 lakes had been treated with lime at a total cost of roughly $15 million.[44] The program has

40. Interview with B. Hagerhill, Director, Swedish Ministry of Agriculture, in Stockholm, Sweden (July 1, 1982).

41. ENVIRONMENT SWEDEN, *supra* note 38.

42. *Id.*

43. Westerlund, *Enforcement of Clean Air Policy in Sweden*, in AIR POLLUTION CONTROL, *supra* note 32, at 35; interview with S. Westerlund, Professor of Law, Uppsala University, in Uppsala, Sweden (Apr. 30, 1979).

44. ACIDIFICATION, *supra* note 1, at 118.

had major beneficial impacts, including raising pH levels in lakewater, causing toxic heavy metals to precipitate out of solution, and enhancing the viability of aquatic species.[45]

Swedish officials emphasize, however, that they regard "liming" as only a "crisis intervention meåsure." The technique has proven incapable of coping with the especially destructive spring snow melt, when large quantities of acids and toxic metals simultaneously enter aquatic ecosystems.[46] Also, liming has not proven effective in protecting terrestrial ecosystems; in fact, Swedish experiments have found that forest growth is retarded by addition of lime to soils.[47] Moreover, the logistical difficulties of supplying adequate quantities of buffering agents to Sweden's 85,000 lakes and other vulnerable resources make liming impractical as a real solution. The strongest ground for the official opposition to liming as a remedy is simply that it does not respond to the causes of acidification, but, at best, only alleviates the most obvious symptoms.

H. *Nongovernmental Environmental Organizations: Their Activities and Perspectives*

The Swedish environmental movement is one of the most active in the world, and one of the largest in proportion to population. The Swedish Society for the Conservation of Nature (*Svenska Naturskyddsforenignen* ("SNF")), Sweden's largest environmental group, has become vitally concerned with Scandinavia's acid rain problem. It has published and distributed to tourists masses of brochures explaining why there are no fish in many Swedish lakes, and what can be done to stem the problem of acid rain.

Noting that lower pollution levels in Sweden's industrial sector are attributable mainly to the retirement of a number of heavily polluting, obsolete facilities, Swedish environmentalists contend that current sulfur reduction programs have not measurably altered industrial pollution practices. They maintain that industry has exclusive access to policy-making processes.[48] Environmentalists also

45. *Id.* at 118-32.

46. *Id.* at 194-202.

47. *Id.* at 203-05.

48. *Cf.* ENVIRONMENT SWEDEN, *supra* note 38. Two examples of such access are royal commissions and the remiss procedure. Royal commissions are investigative committees which study specific issues and recommend legislative action. Members include civil servants, political party representatives and interest groups such as the Swedish Federation of Indus-

complain that the government has an effective monopoly on funds for research on sulfur oxides and acid rain, and can set research priorities congruent with industry's interests. SNF has urged the government to sponsor more research on technologies that enable industry to produce less sulfur in its processes and operations, to conduct more thorough acidification surveys in northern Sweden to assess whether the problem is spreading in that area, to study wastewater treatment to determine whether the chemicals used eventually contribute to acidification of lakes and streams and to explore in greater detail the adverse effects of liming lakes.[49] In addition, SNF has urged the government to adopt a tax on fuels containing sulfur.

Swedish environmentalist organizations have actively supported the country's efforts to promote international pollution control. Matt Segnestam, director of the Swedish Society for the Conservation of Nature, and Sweden's premier environmentalist, has played a leading role in relaying the concerns of Swedish environmentalists at conferences all over the world. At the 1982 Stockholm Conference[50] the SNF and the other participating organizations once again urged governments to reduce SO_2 emissions dramatically by promoting adoption of energy conservation programs and use of the best technologies available.[51]

III. Norway

The proportion of sulfur pollution in Norway's atmosphere that is imported from other countries is one of the highest in Europe.[52] Like Sweden, Norway lies downwind of Europe's major industrial

tries. Ministerial task forces are similar to royal commissions except that they are even more closed communities. Many of their reports are not circulated for comment. Special versions of the reports are sometimes circulated for public comment, but they present no alternatives to the one already favored by the government.

The remiss procedure is a constitutional obligation of Ministries to consult and solicit opinions from relevant administrative agencies before reaching a final decision. Traditionally, they also seek interest group input. On environmental matters, "interest group" usually means industrial trade group.

49. Westerlund interview, *supra* note 43.

50. M. Segnestam, The Problems Caused by Acid Rain (Feb. 3, 1982) (unpublished report).

51. A. Rosencranz, The European Experience with the Problem of Long-Range Transport of Atmospheric Pollution, with Special Attention to the Stockholm Conference of 1982, at 10-11 (Oct. 1982) (unpublished report).

52. U.N. Econ. Comm'n for Eur., *supra* note 2, at 37, table 2.

centers. Its western coast on the North Sea is especially exposed to emissions from Britain, Western Europe's largest sulfur emitter. In fact, Britain contributes more to acid deposition in Norway than does Norway itself.[53] Also, Norway's mountainous terrain is partly responsible for its especially heavy doses of acid precipitation. Prevailing westerly and, in the summer, southerly winds collide daily with low pressure weather systems on the mountains' windward side, producing rainfall that scavenges imported pollutants from the atmosphere.

Heavily industrialized areas, such as Germany's Ruhr Valley, receive comparable levels of acid pollution. But Norway is vastly more acid-sensitive. Norway has a granite bedrock similar to that underlying Sweden, and this bedrock provides little buffering capacity. And fully half of Norway's annual precipitation is snow, which can provide an especially destructive route for the introduction of acids into the environment. As the snow accumulates, so do the acids; when the first snowmelt comes, large quantities of acids are released at once.[54] The result can be a dramatic large-scale fish kill, such as the one that littered ten kilometers of the Tovdal River Valley in southern Norway with dead fish in the spring snowmelt of 1975.[55]

The overall impact on Norway's freshwater aquatic ecosystems, while generally more subtle, has been massive. Populations of fish and other aquatic species have declined dramatically over the past thirty years. Salmon have disappeared from most of southern Norway's waterways, and brown trout populations have been greatly reduced. The major cause for fish decline is believed to be acid-induced deaths to fish eggs and fry. Fish populations in more than half of the lakes of Norway's four southernmost counties have been eliminated. Low alkalinity readings suggest that those lakes still harboring fish are vulnerable to continuing acid deposition.[56]

The loss of freshwater fish on this scale is a serious matter to the Norwegian people, even aside from the larger ecological implications of such destruction. Fishing is extraordinarily popular in Nor-

53. *Id.* at 34, table 1.

54. Johannes, Galloway & Troutman, *Snow Pack Storage and Ion Release*, in D. Drabløs & A. Tollan, *supra* note 1, at 224; Johannessen, Skantveit & Wright, *Streamwater Chemistry Before, During and After Snowmelt*, in *id.* at 260.

55. L. OVERREIN, H. SEIP & A. TOLLAN, ACID PRECIPITATION—EFFECTS ON FORESTS AND FISH 140-41 (1980) [hereinafter cited as OVERREIN].

56. *Id.* at 143-61.

way. Each year, about 900,000 sportsmen fish in Norway's freshwater areas.[57] Many local anglers live within easy access of now acidified fishing spots, especially in the country's more populated, and more impacted, southern areas. In interviews, several Norwegians lamented that the loss of sportfishing changes the country's way of life, eliminating a favorite recreational pastime in one of the most mountainous and sparsely populated nations of the world.

Norwegian officials, like their counterparts in Sweden, fear that the aquatic impacts already observed are only the first signs of a larger ecological response. They are concerned not only about the likelihood of more widespread lake acidification, but also about the potential for acidification of soils, which could lead to damage to forests.[58] The threat to forests, which cover about one-quarter of the country's land area and are one of its most valuable natural resources, is viewed with particular alarm. Norway's growing concern has been manifested through national and international efforts to reduce acid-forming pollutant emissions and through government-funded research projects.

A. *International Activities*

In seeking to protect Norway's ecosystems from further damage, Norwegian officials, noting that they can achieve little through domestic pollution programs alone, have taken every available opportunity to encourage pollution-exporting nations to reduce their emissions. Norway has worked closely with Sweden to promote cooperative abatement action through international organizations such as the Organization for Economic Cooperation and Development ("OECD") and the United Nations. They achieved a modest success in November of 1979 when the thirty-one member nations of the United Nations Economic Commission for Europe ("ECE") reached agreement on the ECE Convention on Transboundary Pollution.[59] The Convention marked a major advance in the level of

57. Royal Norwegian Ministry of Foreign Affairs, *Protection of the Environment in Norway*, in NORWAY INFORMATION, June 1982, at 7.

58. OVERREIN, *supra* note 55, at 140-41; Royal Norwegian Ministry of the Env't, Norwegian Air Pollution Control Policies with Special Reference to Sulphur Dioxide 7 (Feb. 1980) (unpublished report).

59. The 1979 Convention on Transboundary Air Pollution, U.N. Doc. ECE/GE 79-42960, *reprinted in* 6 ENVTL. LAW & POLICY 37 (1980).

international attention given to transboundary pollution and resulted in the establishment of important joint research and monitoring efforts. But Scandinavian endeavors to include specific SO_2 abatement or even "standstill" goals in the agreement were unsuccessful.[60]

Norwegian officials have continued to push for international action in the years since the 1979 accord, and are seeking to convince the rest of Europe that it is in each country's own interest to abate SO_2 emissions. While they profess confidence that nations will gradually, but inevitably, come to this conclusion, senior officials fear the high costs to Norway of continued pollution-induced impacts in the interim. To hasten Europe's recognition of its self-interest, Norway is planning to apply pressure on polluting countries through the use of existing ECE provisions for notification, consultation and information exchange.[61] Hoping to secure at least modest SO_2 reductions, Norway, joining with Sweden and other impacted nations, is pushing to amend the 1979 Convention to incorporate a concrete international abatement program, a goal approved in principle, at least, at the 1982 Stockholm Conference on Acidification of the Environment.[62]

At the June 1983 meeting of the ECE Executive Body in Geneva, Norway joined Sweden and Finland in proposing that the ECE member nations agree to reduce their aggregate national SO_2 emissions by 30% below 1980 levels before 1993. In the face of an unreceptive response to this proposal, the Norwegian delegation pledged to achieve this goal within Norway regardless of the actions of other nations. Norway has already reduced its emissions by 30% over the past decade.[63]

60. E. Lykke, Pollution Problems Across International Boundaries 13 (May 21, 1979) (unpublished report).

61. The 1979 ECE Convention on Transboundary Air Pollution, signed by 31 industrialized nations of Europe and North America, is the first multilateral agreement to specifically address the transboundary air pollution problem. The Convention established important avenues of international cooperation in monitoring and research activities, and put in place a valuable structure to assemble information on national emissions, as well as pollution control and energy policies. The accord also imposed "notice and consultation" requirements, applying to national policy changes likely to have a "significant" impact on levels of transboundary sulfur pollution.

62. Statement of W. Sellaeg, Minister of Env't, Norway, in 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13, at 55-57.

63. Statement of E. Lykke, Director General, Royal Norwegian Ministry of Env't, at the 1983 ECE Executive Body Meeting in Geneva, Switzerland (June 8, 1983).

In the absence of a tougher ECE program, Norway will do all it can to encourage action in the European Economic Community through the offices of sympathetic Community members. Norway itself is not a member.

B. *Scientific Efforts*

In the effort to protect Norway's ecosystems and to strengthen the case for international action, the government has funded major research efforts. In 1972, Norway embarked on the largest multidisciplinary research project in the nation's history, an eight-year, $16 million study. Entitled *Acid Precipitation—Effects on Forests and Fish*, the study was undertaken through the cooperative efforts of more than 150 scientists and 12 Norwegian research institutions. It culminated in March, 1980, with a major scientific conference at Sandefjord, Norway. The proceedings of this conference, along with the study's final report, offer one of the richest sources available on the range of environmental impacts associated with acid rain.[64]

C. *Domestic Emissions: National Control Strategies*

Norway's annual domestic sulfur emissions of 145,000 metric tons are the lowest of Northern Europe, except for Switzerland and tiny Luxembourg. They comprise less than 1% of the 15 million metric tons produced annually by the thirteen Northern European countries.[65] The majority of these emissions, roughly 80,000 metric tons, are produced from the combustion of coal and oil for industrial use and domestic heating. Almost all of the balance is produced in industrial processes, primarily metal smelting.[66] Because sulfur-free hydroelectric power supplies most of Norway's electricity needs, electricity production is not a significant source of SO_2 pollution.

A new and comprehensive Pollution Control Act regulating air, water, noise, waste and waste disposal was adopted by the Ministry in March, 1981, and entered into force in the fall of 1982. This act incorporates and supercedes previous legislation, such as the 1961

64. OVERREIN, *supra* note 55, at 154-55; D. Drablφs & A. Tollan, *supra* note 1.
65. ROYAL NORWEGIAN MINISTRY OF THE ENV'T, *supra* note 58, at 2.
66. *Id.*

Neighbour's Act, but does not alter the basic air pollution control policies already established.[67]

The central means of controlling SO_2 emissions in Norway, as in Sweden, is through the use of low-sulfur oil. Air pollution sources are required to use fuel oil with a maximum sulfur content of 2.5%.[68] Since 1971, polluting facilities in the municipalities of Oslo and Drammen have been required to use fuel oil with a maximum sulfur content of 1%.[69] In 1977, responding to the acidification problem, the Ministry of Environment imposed a maximum sulfur content of 1% for all fuel oils used by new sources or expansions of existing sources in the nine southern and most populous counties of Norway.[70] At the 1983 meeting of the ECE Executive Body in Geneva, Norwegian officials announced plans to reduce aggregate SO_2 emissions by 30% from 1980 levels over the next ten years.[71] It is anticipated that these reductions will be achieved primarily through expanded use of low-sulfur fuel oil.

Technological control devices, such as flue gas scrubbers, do not play an important part in Norway's pollution control regime. At present only one scrubber, at an industrial plant, is in operation in Norway. A second is planned for an oil refinery in the near future. Norwegian officials, cognizant of the importance of setting an example for other countries, are considering a larger role for flue gas desulfurization over the long term. New large SO_2 sources are now required to assure that their design is consistent with possible future installation of flue gas desulfurization systems, or some similarly effective control technologies.[72]

Supplementing Norway's pollution control efforts are economic incentives of several varieties. The government has been actively helping existing sources to incorporate pollution control measures through long-term loans, state guaranteed loans and accelerated depreciation tax breaks. Additionally, a graduated charge on fuel oil has been imposed. One component of the charge is fixed, while

67. Royal Norwegian Ministry of the Env't, Act of 13 March 1981, No. 6, Concerning Protection Against Pollution and Concerning Waste. This act is also known as the Pollution Control Act.

68. Interview with E. Lykke, Director General, Royal Norwegian Ministry of the Env't, in Oslo, Norway (May 2, 1979).

69. *Id.*

70. *Id.*

71. *Id.*

72. ROYAL NORWEGIAN MINISTRY OF THE ENV'T, *supra* note 58, at 3.

the other component is set in proportion to the oil's sulfur content.[73] However, according to officials at the Ministry of the Environment, the charge is too modest to have a real impact on emission levels.[74]

D. *Governmental Pollution Control Authorities*

The Norwegian Ministry of the Environment, established by Royal Decree in 1972, bears central responsibility for environmental protection in Norway. Within the ministry, the Pollution Control Department handles air quality management, and delegates administrative responsibilities to the State Pollution Control Authority ("SPCA").[75] The SPCA is the technical body with responsibility for implementing regulations and permit decisions. It is responsible for drafting permit conditions and assuring compliance through monitoring and enforcement.[76] Additionally, the SPCA drafts certain general air pollution regulations subject to ministerial review and approval, including those dealing with the sulfur content of fuel.

Advising the SPCA is the Smoke Control Council, a nine-member board comprised of individuals representing a variety of interests, including industry, labor and environmental organizations. The Council meets monthly and is chaired by a judge of Norway's Supreme Court. It is especially active in assisting the SPCA in decisions regarding the issuance of permits under Norway's Neighbour's Act of 1961, which requires air pollution sources to obtain licenses.[77]

The SPCA relies principally on civil penalties to enforce permit conditions and general pollution control regulations. Typically, a source will be required to install pollution control equipment by a certain date, after which penalties may be assessed for each additional day until compliance is achieved. The penalties are calculated at a level designed to prevent a plant from deriving an economic benefit from its noncompliance.[78]

73. F. Forsund & P. Waage, Pollution Abatement in Norwegian Manufacturing Industries: Goals, Principles, Measures, Economic Instruments and Macroeconomic Effects (1978).

74. Interview with C. Hambro, Royal Norwegian Ministry of the Env't, in Oslo, Norway (May 1, 1979).

75. Agder & Gaupset, *The Norwegian Air Quality Control Program*, in Air Pollution Control, *supra* note 32, at 40.

76. Royal Norwegian Ministry of the Env't, *supra* note 58.

77. *Id.*

78. *Id.* at 5.

The largest emitters of sulfur dioxide are watched carefully by the SPCA and reportedly have good records for compliance. Typically, the smaller polluters, who are less able to afford pollution control expenses, tend to have a more "anti-regulatory" attitude.[79] But most infractions are minor, and only marginally increase the total output of sulfur dioxide.[80]

Because stringent limits on Norwegian emissions can only marginally affect Norway's sulfur problem,[81] Norwegian industrialists resist stringent sulfur controls as expensive "tokenism."[82] Nevertheless, government and industry work hand-in-hand on air pollution control. The Federation of Norwegian Industries is represented on the permit-granting Smoke Control Council, and has its own research unit which cooperates with government research efforts. In considering requirements for new industrial facilities, representatives of the Ministry of Industry typically meet with the Environment Ministry to review the proposed plant's pollution output and the costs and benefits of environmental safeguards.

E. *Norwegian Environmental Organizations*

Beyond the perfunctory public hearings on projected power plants, there are no opportunities for citizen environmental groups to play a major role in environmental decisionmaking in Norway. However, Norwegian environmental groups have attempted to publicize the acid rain issue in a variety of ways. One informational pamphlet, circulated both within and outside Norway, portrays a father and son standing forlornly with fishing poles beside an acidified, fishless lake. More dramatically, a small group of young environmentalists travelled to Hamburg, West Germany, in 1976 to publicize the effects of acid rain in street theatre, using dead fish and dead flowers as props.[83]

79. Hambro, *supra* note 74.

80. Interview with H. Marstrander, Director, State Pollution Control Authority, in Oslo, Norway (May 2, 1979).

81. The Norwegian Ministry of Environment has estimated that a 25% reduction of Norway's emissions would only give a maximum improvement to precipitation acidity of .02 pH units. Sellaeg, *supra* note 62.

82. Hambro, *supra* note 74. One Norwegian environmental official believes that Norwegian industries have gone far enough in helping to demonstrate to other countries that Norway takes very seriously the problem of sulfur pollution. "Our local economy is losing money and we can't tax industry further . . ." the official said.

83. Interview with T. Holte, *Natur-Ungdom* (Nature and Youth), in Oslo, Norway (May 3, 1979). *Natur-Ungdom* is affiliated with the International Youth Federation ("IYF") which has been active in publicizing the acid rain problem for many years.

IV. The United Kingdom

The United Kingdom is both Western Europe's largest producer of SO_2 pollution[84] and (with the exception of Ireland) Europe's most "upwind" country. Prevailing winds bring Britain little pollution from the west, where the nearest industrial sources are thousands of miles away across open sea.[85] This same westerly air flow carries nearly half of Britain's industrial emissions across the North Sea and the English Channel to the countries of Northern Europe. According to recent studies, Britain contributes more to acid deposition in Norway than any other country, including Norway itself,[86] and is also the largest external contributor to acid deposition in Sweden.[87]

Recent reports indicate that large areas of Britain regularly receive highly acidic rainfall.[88] There have also been reports that in

84. U.N. Econ. Comm'n for Eur., *supra* note 2, at 29. The United Kingdom emits 4.7 million metric tons of SO_2 annually, representing 31% of the total Northwestern European emissions of 15 million metric tons per year.

85. *Id.* at 37.

86. *Id.* at 34, 37.

87. Acidification, *supra* note 1, at 46. British scientists have pioneered the scientific study of air pollution and acid rain. More than 300 years ago, in 1661, John Evelyn wrote of the hazards of sulfur pollution in his book Fumifugium. British scientist Angus Smith first described the acid rain phenomenon in 1872 in his remarkable work, Air and Rain: The Beginnings of a Chemical Climatology. *See also* Gorham, *What to Do About Acid Rain*, 86 Tech. Rev. 59 (1982). In this work, Smith provided detailed documentation of acid rain as an urban problem in the City of Manchester and briefly discussed damage to vegetation, fabrics and building structures. Cowling, *Acid Precipitation in Historical Perspective*, 16 Envtl. Sci. & Tech. 111A (1982). Nearly 60 years later, researchers C. Crowther and H. G. Ruston duplicated Smith's work in the city of Leeds, demonstrating gradients in precipitation associated with coal combustion in the city's center, and conducted pioneering studies on related damages to vegetation. Crowther & Ruston, *The Nature, Distribution and Effects on Vegetation of Atmospheric Impurities in and near an Industrial Town*, 4 J. Agri. Sci. 25-55 (1911) discussed in Cowling, *supra*. Finally, it was in Britain that Eville Gorham, now Professor of Ecology at the University of Minnesota, published a series of papers beginning in 1955 that brought acid rain to the attention of the modern scientific community and first associated the phenomenon with distant, as opposed to local, air pollution. He correlated precipitation acidity in the rural English lake district with air pollution from fossil fuel combustion in distant industrial areas. Gorham, *Atmospheric Pollution by Hydrochloric Acid*, 84 Q. J. of the Royal Meteorological Soc'y 274-76 (1958); Gorham, *The Influence and Importance of Daily Weather Conditions in the Supply of Chloride Sulfate and Other Ions to Fresh Waters from Atmospheric Pollution*, 241 Phil. Trans. Royal Soc'y of London, Series B, 147-78 (1958), discussed in Cowling, *supra*, at 122A. And, with his colleague John Mackereth, Dr. Gorham first associated acid precipitation with aquatic impacts, relating the loss of alkalinity in lakes and the heightened acidity of bog waters to acids in rainfall. Gorham, *supra;* Gorham, *The Ionic Composition of Some Lowland Lake Waters from Cheshire, England*, 2 Limnol. Oceanography 22 (1957) discussed in Cowling, *supra*, at 122A.

88. U.K. Review Group on Acid Rain, Dep't of the Env't, Acidity of Rainfall in the United Kingdom—A Preliminary Report (1982).

southwestern Scotland, an area of poorly buffered lakes similar to southern Scandinavia, some lakes and bogs have been affected.[89] Acidification impacts in Scotland and isolated areas of Britain have not been investigated in detail, however.[90] To date, acid rain has not been an important subject of public interest or serious official concern in the United Kingdom.

A. *Sulfur Dioxide Pollution Levels*

British pollution control efforts have yielded substantial improvement in the nation's air quality. Aggregate SO_2 emissions declined dramatically in Britain in the 1950's, mainly as a result of strict pollution control measures mandated by Parliament and by local governments in the wake of a killer smog which caused thousands of deaths in London in 1952.[91] New regulations sought to eliminate smoke in urban areas, and resulted in a drastic reduction in particulate emissions, as well as corresponding reductions in SO_2 pollution.[92] More recently, aggregate SO_2 emission levels decreased by 24% between 1970 and 1980 to the current national total of 4.7 million metric tons.[93] This improvement was mainly the result of decreased coal and oil combustion associated with Britain's economic downturn and the United Kingdom's growing reliance on sulfur-free nuclear power. In addition, the widespread use of tall smokestacks has contributed to a dramatic lowering of the high ambient SO_2 concentrations associated with health problems in Britain. The Alkali Inspectorate recently reported that urban SO_2 concentrations have decreased by more than 60% in the past twenty years.[94]

B. *Energy Policies*

The United Kingdom is heavily dependent on coal for power generation, perhaps more so than any other Western industrial nation. Roughly 75% of Britain's electric power is currently pro-

89. Wright, Harriman, Henriksen, Morrison & Caines, *Acid Lakes and Streams in the Galloway Area, Southwestern Scotland*, in D. Drabløs & A. Tollan, *supra* note 1, at 248.

90. Pearce, *The Menace of Acid Rain*, NEW SCIENTIST, Aug. 12, 1982, at 423.

91. Interview with L. Reed, Chief Alkali Inspector, H.M. Alkali and Clean Air Inspectorate, in London, England (Aug. 6, 1982).

92. *Id.*

93. *Id.*

94. HEALTH & SAFETY EXEC., INDUSTRIAL AIR POLLUTION: HEALTH AND SAFETY *1982*, *at* 21 (1982).

duced from coal, and Britain's energy plans for the indefinite future call for continued reliance on the nation's ample coal reserves as a major energy source.[95] Oil-fired and nuclear power plants supply the remaining energy, in nearly equal proportions.[96]

Surprisingly, Britain's North Sea oil supplies do not enter into the nation's energy plans in a major way. This is, in part, because British furnaces and boilers are not equipped to burn the light and fine North Sea oil, and because British refineries, adapted to Arabian heavy crude, are similarly ill-equipped to refine North Sea oils. Furthermore, Britain has come to rely on the profits and balance of payments credits that accrue from selling its valuable North Sea oil on the world market. Because the supply and costs of Arabian crude oil are uncertain,[97] oil-fired electricity production is expected to decrease in Britain in future years.

By contrast, nuclear power generation is likely to rise over the next decade. The amount of electricity generated by nuclear power is expected to more than double by 1990, and continue increasing into the next century.[98]

C. *Air Pollution Control in Britain*

A series of British laws dating back over a century establish responsibility for pollution control. Britain's Alkali Act of 1863, the first air pollution control law enacted by any nation, was directed toward limiting emissions from the chemical industry; its successor, the Alkali, Etc. Works Regulation Act of 1906,[99] is still in effect, and defines the broad parameters of Britain's air pollution control regime. The principal national legislative measures relevant to SO_2 emissions today include the Clean Air Acts of 1956[100] and 1968,[101]

95. DEP'T OF ENERGY, OFFICIAL STATISTICAL ENERGY RESEARCH DIGEST OF UNITED KINGDOM ENERGY STATISTICS (1983).

96. International Energy Agency, *1978 Forecasts of 1979 Power Generation*, in ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, ENERGY BALANCES OF OECD COUNTRIES: *1974-1978* (1980).

97. Interview with M. Hill, School for Advanced Urban Studies, University of Bristol, in Bristol, England (Aug. 6, 1982).

98. DEP'T OF ENERGY, PROOF OF EVIDENCE FOR THE SIZEWELL "B" PUBLIC INQUIRY A43, table C (1982).

99. The Alkali, Etc. Works Regulation Act 1906, *reprinted in* INT'L ENV'T REP. (BNA) 291:0501 (1978) [hereinafter cited as Alkali Act 1906].

100. Clean Air Act 1956, *reprinted in* INT'L ENV'T REP. (BNA) 291:0901 (1978). [hereinafter cited as Clean Air Act 1956].

101. Clean Air Act 1968, *reprinted in* INT'L ENV'T REP. (BNA) 291:1301 (1978).

and the Control of Pollution Act of 1974.[102] The overall control approach is mainly local in character; however, the large sources that contribute most to SO_2 pollution in the United Kingdom are subject to national emissions control requirements. Both the local and national programs reflect a strong emphasis on cost-effectiveness.

The 1956 and 1968 Clean Air Acts focus on the control of particulate, rather than SO_2, emissions. They empower local authorities to control smoke, dust and grit from industrial sources and private dwellings.[103] These statutes are incidentally responsible for some SO_2 reductions, because local requirements imposed under their authority frequently mandate the use of low-sulfur fuels, which of course also produce less SO_2 pollution.

More directly relevant are the Alkali Act of 1906 and the Control of Pollution Act of 1974. The Alkali Act requires that major industrial works, including all power plants, be registered with the Alkali Inspectorate. Registering sources must demonstrate that the "best practicable means" will be employed to prevent emissions or to render them harmless.[104] All other sources, *i.e.*, those which pollute less heavily, are subject to locally established control requirements under the Control of Pollution Act of 1974. That act also gives the national government the authority to impose locally enforced limits on the sulfur content of fuel oil.[105]

The major British strategy for the control of SO_2 emissions from major sources is dispersion through tall smokestacks. Ancillary sulfur reduction strategies include the siting of pollution sources away from already polluted areas, the use of cleaner (low sulfur) fuels, energy conservation and the expanded use of nuclear power. Costly technological pollution control devices do not play a significant role. There are currently no flue gas desulfurization scrubbers under construction or in operation in Britain.[106]

1. The Alkali Inspectorate

The Alkali and Clean Air Inspectorate is the national agency that administers control requirements for power plants and the large

102. Control of Pollution Act 1974, *reprinted in* INT'L ENV'T REP. (BNA) 291:7301 (1978). [hereinafter cited as Control of Pollution Act 1974].

103. U.K. Dep't of the Env't, *Air Pollution Control in the United Kingdom*, in AIR POLLUTION CONTROL, *supra* note 32, at 15-16.

104. Alkali Act 1906, Part I, § 2(1), *supra* note 99.

105. Control of Pollution Act 1974, Part IV, §§ 76(1), 76(4)(a), *supra* note 102.

106. HEALTH & SAFETY EXEC., *supra* note 94, at 20-22.

industrial facilities. Established in 1863, it is the world's oldest and longest-running air pollution agency.[107] With a small and unified team of about forty-five professionals, mostly chemists with industrial experience, the Alkali Inspectorate today governs emissions from sixty-one chemical processes and more than 2,200 plants.[108]

The Alkali Inspectorate is almost as conservative and traditional as its nineteenth-century name suggests. Inspectors reportedly operate through cooperation with industry, rather than confrontation. They strive to find ways to control air pollution more efficiently, rather than demanding that a source with pollution problems take costly abatement steps.[109] In general, they prefer to avoid the public embarassment to "registered" works that agency prosecutions would bring. Although in recent years greater attention has been given to enforcement, it is noteworthy that in the years between 1920 and 1966, the Inspectorate brought only two prosecutions in response to industry violations.[110] In contrast, seventeen prosecutions were successfully advanced in 1981.[111]

2. "Best Practicable Means" Standard

Under the Alkali Act, all large industrial and power plants are required to employ the "best practicable means" ("BPM") available to control emissions. It is far from clear, however, exactly what this term entails. The Clean Air Act of 1956 provides a singularly unhelpful definition, explaining that "practicable" means "reasonably practicable, having regard, among other things, to local conditions and circumstances, to the financial implications and the current state of technical knowledge."[112] In the establishment of control requirements, practicability is determined and applied on a case-by-case basis by the individual Alkali inspector, who takes into account the costs of projected control measures, the current state of

107. Frankel, *Accountability in the United Kingdom for Air Pollution Control*, in AIR POLLUTION CONTROL, *supra* note 32, at 17-22.

108. Health & Safety Exec., H.M. Alkali & Clean Air Inspectorate, *Best Practicable Means: An Introduction*, in NOTES ON BEST PRACTICABLE MEANS (1979); U.K. Dep't of the Env't, *supra* note 103, at 15.

109. Interview with J. Beighton, former Chief Alkali Inspector, in London, England (May 16, 1979).

110. 104TH ANNUAL REPORT ON ALKALI, ETC. WORKS, *1967* (1968) [hereinafter cited as 104th ANNUAL REPORT].

111. *Clean Air Inspectorate Says Industry Will Find it Hard to Maintain Standards*, 5 INT'L ENV'T REP. (BNA) 500-01 (1982).

112. Clean Air Act 1956, § 34, *supra* note 100.

technology, and local economic, employment and other considerations. The standard ultimately established can be more than the numerical limit of emissions that most control requirements entail; the Inspectorate may direct sources to utilize specified operational processes.[113]

The Alkali Inspectorate has provided formal "Notes" to guide the establishment of BPM standards for particularly important categories of industrial polluters. The BPM Notes offer emission standards, known as "presumptive limits," and recommend pollution-reducing processes for new sources.[114] The presumptive limits have persuasive effect in court, but are not legally enforceable.[115] Significantly, despite the fact that BPM Notes have been issued for more than sixty industrial processes, none has yet been issued for coal- and oil-fired power plants, the largest category of SO_2 emitters. Notes for these sources are currently "under development."[116]

The Alkali Inspectorate implements BPM requirements mainly through inspections which occur when a major facility applies for registration as a new source. Source-specific control requirements are usually the result of close discussions with industry, and are often formulated with the approval of the industry's trade association.[117] Trade and economic considerations weigh heavily in the inspector's determination of best practicable pollution control. After registration, the inspectors oversee and periodically inspect the 2,200 installations under their purview.[118] Since BPM standards are periodically revised, existing sources can be required to retrofit controls to reflect technological progress and changes in the definition of what is "practicable."[119] However, the failure of an existing source to institute better controls than those used at the outset rarely results in denial of annual renewal of registration.[120]

113. Correspondence with N. Haigh, Program Director, Eur. Envtl. Policy Programme (Aug. 13, 1982).

114. Health & Safety Exec., *supra* note 108.

115. Haigh, *supra* note 113.

116. Interview with senior official, Alkali Inspectorate, in London, England (Aug. 6, 1982) [hereinafter cited as Alkali Inspectorate].

117. M. FRANKEL, THE ALKALI INSPECTORATE: THE CONTROL OF INDUSTRIAL AIR POLLUTION 11 (1974).

118. U.K. Dep't of the Env't, *supra* note 103.

119. Alkali Inspectorate, *supra* note 116.

120. FRANKEL, *supra* note 117, at 10-13.

3. Tall Smokestacks

For power plants located outside heavily urbanized areas, the Alkali Inspectorate has consistently defined BPM to require only the use of tall smokestacks to disperse emissions. Modern 2,000 megawatt power stations rely on chimneys about 200 meters in height to assure that ground level SO_2 concentrations near the source do not reach dangerous levels.[121] These large plants are responsible for an increasingly large share of Britain's aggregate sulfur emissions. Between 1960 and 1980, emissions from smaller emitters dropped substantially (as coal and oil combustion decreased), while emissions from high level emitters increased. According to the Inspectorate's 1981 annual report, high level emitters, which released only about a third of the United Kingdom's SO_2 pollution in 1960, now are responsible for more than 60%.[122]

In its 1981 report, the Alkali Inspectorate defended the nation's often maligned tall smokestack policy:

> There is no doubt that in the light of present knowledge, this policy of dispersion has proved adequate to protect the U.K. environment. It is worth noting that although tall chimneys are often referred to in disparaging terms in international circles as the U.K. approach to pollution control, in fact every other industrial country has adopted similar policies for power station emissions. It is only more recently that alternative approaches have become available but even these do not dispense with the need for tall chimneys.[123]

4. Low-Sulfur Fuels

In heavily industrialized areas where stacks cannot be constructed high enough for adequate dispersal, use of low-sulfur fuels is the central means of reducing pollution problems caused by home heating.[124] The only nationwide fuel sulfur limits in Britain are those required by the European Economic Community "gas oil" directive of 1975. This directive mandates that the sulfur content of light fuel oils not exceed 0.3%, except in specifically designated zones, where a maximum sulfur content of 0.5% may be permitted.[125] Environmental officials in Britain are not favorably disposed

121. HEALTH & SAFETY EXEC., *supra* note 94, at 22.

122. *Id.* at 21, figure 1.

123. *Id.* at 22.

124. A. CLARKE, D. LUCAS & F. ROSS, TALL STACKS—HOW EFFECTIVE ARE THEY? (Cent. Elec. Generating Bd. 1970).

125. Council of Eur. Communities Directive on the Sulphur Content of Fuels, Doc. No. 75/716/EEC-OJ L 307 (1975) *reprinted in* INT'L ENV'T REP. (BNA) 141:1201 (1982).

toward the establishment of nationwide limits on the sulfur content of other fuels, such as coal and heavy fuel oil, which are responsible for a much more substantial portion of Britain's SO_2 emissions. Such a requirement would deprive government and industry of their much-vaunted flexibility in energy choices.

Local governments, however, are empowered to establish such limits. In 1972, the local authority for London's historic small central business district, the City of London, restricted oil burned in new furnaces to a sulfur content of no greater than 1.0%. This move reflected the new wave of interest in London for air pollution control, founded mainly in concern over pollution-related damages to Westminster Abbey and other historic buildings. Local limits on fuel sulfur content may become more widespread in the near future, as municipalities in Britain become more aware of the effects of pollution on historic structures, and as they seek to achieve the new European Community ambient standard for sulfur dioxide which took effect April 1, 1983.[126]

5. Technological Control Devices

Coal washing is the only technological SO_2 pollution control approach widely practiced in Britain today. It is used principally in particulate control efforts, to moderate the ash content of coal. However, washing also has the beneficial effect of lowering the sulfur content of coal.[127] Flue gas desulfurization ("FGD"), the most effective, commercially practical SO_2 control technology, is not utilized in Britain. In the 1930's, however, the United Kingdom pioneered early emission desulfurization efforts. Flue gases from two London power stations were "scrubbed" with innovative FGD systems using water from the Thames River. Although the devices worked effectively for many years, the plants, which are now closed, incurred high costs in operating them; in addition, disper-

126. Hill, *supra* note 97. The new standard is discussed *infra* at note 135 and accompanying text.

127. Sulfur may be present in coal as either a discrete mineral, *pyrite*, or as a chemically-bonded part of the coal itself, termed *organic sulfur*. Pyritic sulfur, comprising anywhere from 30 to 70% of the sulfur in coal, can be physically removed from coal through coal washing techniques. Coal washing can remove from 30 to 40% of the pyritic sulfur from high-sulfur coal but only 10 to 20% of the total sulfur in low-sulfur coal since it tends to contain proportionately less pyrite. J. Kilgroe, Coal Cleaning for Sulphur Oxide Emission Control 1 (April 8, 1980) (unpublished report).

sion of the cold wet plume was problematic, and there were damaging effects on the Thames.[128]

Officials of Britain's Central Electricity Generating Board ("CEGB"), whose power plants are responsible for about 50% of the nation's SO_2 emissions,[129] are firmly opposed to the use of FGD technology. They claim that flue gas scrubbing would increase the costs of building a new 2,000 megawatt power station by $160 to 240 million.[130] CEGB officials also contend that scrubbers cause more problems than they relieve, displacing relatively harmless gaseous waste with more problematic solid waste, or sludge.[131]

British environmental officials have historically held a similar view. In refusing to require the installation of scrubbers on either new or existing facilities, they have stressed the high cost of FGD, the potential for operating problems, sludge disposal difficulties and the uncertain magnitude of the benefits of control.[132] In its 1981 report, however, the Alkali Inspectorate gave an unprecedented positive review of FGD and other advanced control techniques. The report explicitly cited the conclusions of a recent seminar in Salzburg, Austria, which found that FGD could be considered a "feasible technology" for reducing emissions of sulfur dioxide by 90% or more at a cost of 10% to 20% of the power station's investment. The Inspectorate noted that FGD is already in use on many plants in the United States and Japan, and that West Germany has plans to use it on new facilities. Moreover, the annual report expressed official interest for the first time in other advanced technological approaches, including oil desulfurization, fluidized bed combustion and improved coal cleaning techniques.[133]

There is now a prospect that new sources in Britain may utilize advanced control devices. While the Inspectorate did not commit itself to requiring FGD or a similarly effective technology on new coal- or oil-fired plants (none are currently planned), it did send strong signals that such a requirement was likely:

128. HEALTH & SAFETY EXEC., *supra* note 94, at 20-22.

129. H.L. SELECT COMM. ON THE EUR. COMMUNITIES, SIXTEENTH REPORT FROM THE SELECT COMMITTEE ON THE EUROPEAN COMMUNITIES, MINUTES OF EVIDENCE BEFORE SUB-COMMITTEE G 36 (1982) [hereinafter cited as HOUSE OF LORDS].

130. *Id.* at 35.

131. *U.K. Official Says More Evidence Needed Before Adding More SO_2, NO_x Controls*, 3 INT'L ENV'T REP. (BNA) 475 (1980).

132. HOUSE OF LORDS, *supra* note 129, at 41-43.

133. HEALTH & SAFETY EXEC., *supra* note 94, at 22.

> [T]he first duty of the Inspectorate is to prevent emissions to the air where it is practicable to do so. . . . In the U.K., there are currently no proposals for new fossil fuel generating plants, but if and when they come forward, the scope for preventing or reducing the emissions of SO_2 will need to be considered positively in light of experience now gained in other countries.[134]

6. Air Quality Standards

There was no national ambient standard for sulfur dioxide in Britain until the new European Economic Community directive setting air quality standards for sulfur dioxide and suspended particulates took effect April 1, 1983.[135] But under the terms of the directive, compliance can be delayed for up to ten years.[136] It is expected that sources will be able to achieve compliance with the directive's modest standard through the usual tall stack and low-sulfur strategies. In some urban areas, local authorities may have to impose additional limits on fuel sulfur content.[137] However, the Alkali Inspectorate now contends that pollution levels in most areas have already decreased sufficiently to make possible nationwide attainment of the Community standard.[138]

7. Prospects for New Sulfur Dioxide Control Programs

In its 1981 annual report, the Alkali Inspectorate also evidenced a heightened consciousness of the potential inadequacies of Britain's SO_2 programs. With regard to SO_2 control, the Inspectorate noted that:

> A number of factors, such as the introduction of air quality standards for SO_2, a greater future dependence on coal, the concern about transfrontier pollution and "acid rain" and the emergence of reliable and commercial processes to prevent the emission of sulfur dioxide, make it appropriate to review the present position and possible future implications.[139]

This new awareness, however, will probably yield little in terms of actual emission reductions in the foreseeable future. The only

134. *Id.*

135. Council of Eur. Communities Directive on Air Quality Limit Values and Guide Values for Sulphur Dioxide and Suspended Particulates, Doc. No. 80/779/EEC-0J L 229 (1980), *amended by* Doc. No. 81/857/EEC, *reprinted in* INT'L ENV'T REP. (BNA) 141:1301 (1982).

136. *Id.* at Art. 3.2.

137. Hill, *supra* note 97; HEALTH & SAFETY EXEC., *supra* note 94, at 20.

138. HEALTH & SAFETY EXEC., *supra* note 94, at 20.

139. *Id.*

major policy change associated with the new attitude is the apparent commitment to installing FGD in new fossil fuel-fired plants, referred to above.[140] While the symbolic significance of this policy shift is great, no new coal-fired plants are at present being planned in the United Kingdom. The current emphasis in construction and planning of new power plants is on nuclear facilities. Because the United Kingdom intends to rely on its domestic coal well into the next century (if only to keep its miners employed), new coal plants probably will be constructed in Britain, but not until well into the 1990's.[141]

As a strictly legal matter, the Inspectorate does not have the authority under present legislation to establish new control requirements in response to concerns surrounding long-range pollution impacts. BPM requirements are, in theory at least, founded entirely on technological and economic considerations, with no explicit attention to air pollution impacts. The powers of the Alkali Inspectorate flow from legislation intended to protect the population of England and Wales. Domestic legislation does not authorize the agency to take action geared to control of international pollution and the protection of foreign environments.[142]

The Alkali Inspectorate does have the authority to redefine the BPM standards to reflect improvement in technological capacities. Through this mechanism, it could demand that existing sources install more effective control measures. While senior Inspectorate officials concede the possibility of some gradual tightening of SO_2 control requirements for existing sources, especially if a new and inexpensive technology were to become available, they have made it clear that existing facilities would not be required to retrofit FGD technology.[143]

The Alkali Inspectorate considers FGD an "impracticable" technology for existing plants. According to officials of Britain's Central Electricity Generating Board, a retrofit program would be prohibitively expensive, would require shutting down some power plants for at least six months and, in many cases, would not be feasible because there is "rarely" room for an FGD addition to existing

140. HOUSE OF LORDS, *supra* note 129, at 41.
141. *Id.* at 37; HEALTH & SAFETY EXEC., *supra* note 94, at 22.
142. Alkali Inspectorate, *supra* note 116.
143. *Id.*; HOUSE OF LORDS, *supra* note 129, at 40.

plants.[144] Nevertheless, power stations built in recent years have been required to leave sufficient space for the possible retrofit of FGD controls.[145]

D. *The Central Electricity Generating Board*

The CEGB is the government agency responsible for producing most of Britain's electric power. Proud of Britain's historically advanced pollution control programs, CEGB officials are inclined to resist additional control measures as excessively costly and energy intensive. As spokesman A.J. Clarke put it, "[t]he United Kingdom was the first country to become polluted and also the first country to clean up its pollution. Particulate pollutants have been reduced by 80%, and sulfur pollutants have been reduced by more than 50%. We believe we have behaved very responsibly in this area."[146]

In general, the CEGB denies any substantial responsibility for either the acidity of Scandinavian lakes and soils or the remedy of that condition.[147] To aid in assessing the British contribution to Scandinavian acid rain, CEGB scientists are using aircraft to track emissions from the Eggborough power station in Yorkshire. The CEGB's Central Electricity Research Laboratory, in charge of this "flying chemists" program, hopes to clarify whether and to what extent SO_2 emissions are transformed to acid sulfates in the atmosphere, and where and in what form they return to earth.[148] CEGB scientists are investigating the impacts of acid rain on soils and surface waters, as well as the effect of other pollutants, such as hydrocarbons, on the formation of sulfuric acid from SO_2.[149]

CEGB officials have recently expressed concern about the European Community's long-term goal of establishing international SO_2 control programs. In recent hearings, they maintained that the 1979 Convention on Transboundary Air Pollution calls for further

144. Interview with D. Clarke, Planning Dep't, Cent. Elec. Generating Bd., in London, England (Dec. 4, 1979).

145. HOUSE OF LORDS, *supra* note 129, at 41-43.

146. Clarke, *supra* note 144.

147. CENT. ELEC. GENERATING BD., EEC POLICY CONCERNING THE LIMITATION OF EMISSIONS TO THE ATMOSPHERE, SUPPLEMENTARY MEMORANDUM, in HOUSE OF LORDS, *supra* note 129, at 18-21.

148. Pearce, *supra* note 90, at 43; B. SILCOCK, BRITAIN'S FLYING CHEMISTS STUDY POLLUTION (Int'l Writer's Serv. No. 478, 1980).

149. *Reports from the Central Electricity Generating Board*, in D. Drablφs & A. Tollan, *supra* note 1, at 276-83; HOUSE OF LORDS, *supra* note 129, at 19.

scientific and technical research before the development of an international control policy. More rapid development of abatement programs would, in the view of the CEGB, only slow progress toward an effective international approach to transboundary air pollution, and would be contrary to the terms of the 1979 Convention.[150]

E. *Public Participation in Air Pollution Control Efforts*

The Alkali Inspectorate has been called a government agency with a "rare blend of expertise and unaccountability." The Inspectorate has traditionally approached air pollution control matters with an attitude of exclusivity and secrecy toward the public, and an attitude of partisanship toward industry.[151] This attitude was candidly reflected in the agency's 1968 annual report: "Abating air pollution is a technical problem, a matter for scientists and engineers, operating in an atmosphere of cooperative officialdom."[152]

"Cooperative officialdom," as one might suspect, leaves little room for public accountability. Historically, it has been the policy of the Inspectorate not to disclose information regarding the type or quantity of pollution produced by an individual plant, the emission standards applicable to an individual plant, the names of companies not in compliance with emission standards, or even the names of companies prosecuted for violations.[153] The Inspectorate originally claimed that confidentiality was needed to protect trade secrets. However, a Royal Commission discredited that claim a decade ago, pointing out that pollution control processes were well described in available publications.[154] In the years following the Commission report, according to one close observer, the Inspectorate has argued that publications of emissions data will confuse the public, provide ammunition to extremists in the environmental movement, waste inspectors' time, reduce efficiency and harm the trust that exists between the inspector and industry.[155]

In a 1976 report, the Royal Commission on Environmental Pollution concluded that the Inspectorate had "not sufficiently adapted

150. Cent. Elec. Generating Bd., *Draft Action Programme of the European Communities on the Environment 1982-1986*, in HOUSE OF LORDS, *supra* note 129, at 16-18.

151. Frankel, *supra* note 107, at 17-22.

152. 104TH ANNUAL REPORT, *supra* note 110.

153. Frankel, *supra* note 107, at 18.

154. ROYAL COMM'N ON ENVTL. POLLUTION, 2d REPORT, THREE ISSUES IN INDUSTRIAL POLLUTION (1973).

155. Frankel, *supra* note 107, at 18.

to changes in society's attitude to pollution and to public accountability. . . ."[156] Recently, the Inspectorate has evidenced a more enlightened attitude regarding information disclosure. The agency's 1981 annual report for the first time disclosed names of some pollution violators subject to enforcement action.[157]

F. *Environmentalism in the United Kingdom*

The United Kingdom has a tradition of environmental awareness and a large conservation movement represented by long-established organizations such as the National Trust and the Council for the Protection of Rural England. However, British environmental groups are much more active in land use planning and nature conservation issues than in pollution control. Not surprisingly, their concern focuses more on wildlife protection and the expanded use of nuclear facilities in Britain than on the loss of fish in Norway and Sweden.

As in other countries, pollution issues tend to gain importance in the United Kingdom when they are of local concern. Because local impacts from SO_2 pollution are few, the environmental constituency for more strict SO_2 control is limited.[158] Yet as the British population becomes more aware of acid rain impacts in Scandinavia and learns of possible effects on lakes in southwestern Scotland and isolated areas of the United Kingdom, public concern over air pollution could increase. British environmentalists are perhaps most likely to be prompted by increasing concern over pollution-related damages to buildings and other historic structures.

G. *International Efforts to Control Transboundary Pollution*

Having signed the 1979 Convention on Transboundary Air Pollution[159] and endorsed commitments to international environmental responsibility such as the Declaration of the United Nations Conference on the Human Environment,[160] the United Kingdom is officially committed to the principle that nations must control pollu-

156. ROYAL COMM'N ON ENVTL. POLLUTION, 5TH REPORT, AIR POLLUTION CONTROL: AN INTEGRATED APPROACH (1976).

157. HEALTH & SAFETY EXEC., *supra* note 94, at 3.

158. Hill, *supra* note 97.

159. The 1979 Convention on Transboundary Air Pollution, *supra* note 59, at 37-40.

160. U.N. Conference on the Human Env't, *supra* note 11, at 3-5.

tion causing damage to a foreign environment. They part company with the pollution-importing nations, however, where efforts to apply these principles to air pollution control in Europe are concerned.

The United Kingdom has been a leading Western opponent of Scandinavian efforts in international organizations to promote adoption of multilateral abatement programs. When the thirty-four member nations of the U.N. Economic Commission for Europe met in 1979 to negotiate a pact on international pollution,[161] the United Kingdom teamed with West Germany to lead the opposition to the pollution abatement programs advocated by the Scandinavians. The two countries firmly refused to take part in any convention requiring a percentage rollback of SO_2 emissions, or imposing a ceiling which would prohibit increases in national pollution levels. Eventually, the Nordic countries settled for a less ambitious agreement lacking specific abatement requirements. Britain gave reluctant support to the resulting Convention on Transboundary Pollution, signed in Geneva in November, 1979.[162]

British officials have tended to emphasize the scientific uncertainties surrounding acid rain and its impacts. Until recently, they questioned the severity of the aquatic impacts in Scandinavia, the causative role of acid rain, and the existence of a connection between pollution in the United Kingdom and acid deposition in Scandinavia. More recently, they have founded their objections to Nordic proposals for abatement action in a somewhat more refined critique of the current scientific understanding. At international gatherings, the British have emphasized the uncertainty surrounding the transformation processes by which pollutant gases are converted to acids in the atmosphere, pointed to the possibly significant role of pollutants such as nitrogen oxides for which the United Kingdom is a less important source and questioned the scope of the actual benefits in Scandinavia likely to flow from the abatement of emissions in the United Kingdom.[163]

161. U.N. Econ. Comm'n. for Eur., High-Level Meeting on Protection of the Environment, Nov. 13-16, 1979, Geneva [hereinafter cited as High-Level Meeting]; *see also* 6 ENVTL. POLICY & L., Feb. 15, 1980.

162. The British eventually agreed to go along with the Convention, in the belief that their plans for an increased reliance on nuclear power to generate electricity would bring about a net reduction in sulfur emissions. Accordingly, they could adhere to the terms of the Convention without changing their energy or pollution control policies.

163. Statement of G. Shaw, Parliamentary Under Secretary of State, in 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13, at 69-70.

One of Britain's most determined arguments against international controls is that, even presuming that the United Kingdom is responsible for a substantial portion of Scandinavia's acid pollution, only a small fraction of the United Kingdom's emissions is actually deposited in Scandinavia (less than 10%, according to an early OECD study).[164] Yet to reduce this fraction by half, aggregate United Kingdom emissions would have to be reduced correspondingly—a measure viewed as prohibitively expensive and not cost-effective.[165]

The thrust of British diplomatic efforts in international forums has been to pursue more scientific research before the institution of any cooperative and costly new abatement program.[166] British diplomats have dutifully followed this approach in all three international fora for discussion of European transboundary pollution issues: the Organization for Economic Cooperation and Development, the European Economic Community and the Economic Commission for Europe.

to deal with transboundary acid rain, the British have recently evidenced a somewhat more enlightened attitude regarding the nature and severity of the problem. In his official address to the 1982 Stockholm Conference on Acidification of the Environment, the British Under Secretary of State for Environment, Giles Shaw, acknowledged that acid rain is a "grave" problem that has led to "substantial aquatic impacts" in Scandinavia.[167] More significantly, the Chief Alkali Inspector, Leslie Reed, in his agency's 1981 annual report, conceded that the recent recognition of transboundary environmental problems "calls into question the adequacy of former national policies," and that "it is certain . . . that in both Europe and North America acid rain will be seen as a major and pressing international issue over the next few years."[168] Nevertheless, the Inspectorate also conveyed Britain's continued opposition to international programs for greater control of SO_2, arguing that "there is doubt that widespread and expensive measures to reduce sulfur emissions (even if this were possible) would result in a significant improvement in the aquatic environment."[169]

164. Clarke, *supra* note 144.
165. HOUSE OF LORDS, *supra* note 129, at 33, 36.
166. Shaw, *supra* note 163.
167. *Id.*
168. HEALTH & SAFETY EXEC., *supra* note 94, at 22.
169. *Id.*

At present, the United Kingdom has the luxury of being able to voice its concern for Scandinavia's problem and its willingness to participate in an international solution, without having to fear the imposition of stringent emission controls in the foreseeable future. The United Kingdom, very much aware of the limitations of the ECE as a forum for resolution of Western Europe's pollution disputes,[170] views the ECE Convention as the central focus of efforts to deal with transboundary pollution.[171] However, the participation of Eastern European countries in the ECE renders the adoption of strict new international abatement programs in that organization extremely unlikely.[172]

Britain has large reserves of coal which it intends to use to meet its energy needs for the foreseeable future. To mitigate local impacts from burning coal, Britain will rely primarily on tall smokestacks. No steps will be taken to alleviate distant impacts. Modest SO_2 emission reductions can be expected in the United Kingdom as older, heavily polluting coal-fired plants retire in coming years, and as new nuclear power plants come on line. But large-scale abatement is unlikely in the absence of either greatly strengthened international pressure (probably from the European Economic Community), or new scientific data clearly linking British pollution with substantial adverse health, economic or environmental impacts in downwind countries, or in parts of Britain itself.

V. West Germany

West Germany is thoroughly enmeshed in Europe's complex international air pollution problems. The country is a major exporter of acid pollution, a recipient of substantial quantities of imported pollution and the site of potentially serious acid rain impacts. Although it boasts one of Europe's most aggressive air pollution control regimes, highly industrialized West Germany is nevertheless

170. Alkali Inspectorate, *supra* note 116.

171. Shaw, *supra* note 163, at 71. At the 1982 Stockholm Conference, Mr. Shaw made clear Britain's intent to work through the ECE before considering alternate approaches:

> I am convinced that the way forward lies under the Convention. If some countries wish to undertake work outside the framework of the Convention, that must be their own decision. But any future international co-operative action must hinge on the the conclusions reached after the work of the Convention has run its course. *Id.*

172. *See* discussion under the heading *Eastern Europe*, *infra* notes 257-60 and accompanying text.

the third largest SO_2 producer in Western Europe.[173] Roughly half of the country's sulfur emissions are transported to Scandinavia, Eastern Europe and elsewhere. A similar amount of foreign pollution, originating mainly in France, the United Kingdom, East Germany and Belgium, is deposited within Germany's borders.[174] Until recently, West German policymakers were sanguine about the nation's moderately stringent air pollution control policies, and largely unconcerned about international air pollution.

Within the past two years, however, the nation has awakened to mounting evidence that there is something seriously wrong in its forests. Now officials are looking apprehensively at the country's substantial domestic SO_2 sources, and at the large international contribution to West Germany's pollution problem. The country seems increasingly determined to control its own emissions more effectively. Moreover, West Germany has recently stopped resisting international accords to control transboundary sulfur pollution and has begun to support and encourage international abatement efforts.[175]

A. *Effects on German Forests*

In past years, West Germany, with few vulnerable aquatic systems, thought itself largely unaffected by the acid rain problems afflicting nearby Scandinavia. With the discovery of extensive forest damage,[176] however, the nation has suddenly found itself facing a new and potentially far more serious form of ecological damage.

Stands of fir and spruce trees, especially those in high altitude areas, are suffering from an apparently serious but poorly understood malady. The earliest manifestation is a symptom that re-

173. Statement of G. Baum, former Fed. Minister of the Interior, in 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13, at 3; U.N. Econ. Comm'n for Eur., *supra* note 2. The largest Western European SO_2 emitter is the United Kingdom, which is followed by Italy and West Germany.

174. U.N. Econ. Comm'n for Eur., *supra* note 2, at 34, 37; interview with K. Von Moltke, Eur. Inst. for Env't & Soc., in Washington, D.C. (Sept. 22, 1982).

175. Baum, *supra* note 173; FEDERAL MINISTER OF THE INTERIOR, PREVENTION OF AIR POLLUTION: DRAFT RESOLUTION ON LARGE FURNACES (U.S. Cong. Research Serv. trans. 1982) [hereinafter cited as PREVENTION OF AIR POLLUTION].

176. B. Ulrich, *Necessary Countermeasures: Soil Liming and Exhaust Gas Purification*, in DANGERS FOR THE FOREST ECOSYSTEM DUE TO ACID PRECIPITATION (Lit. Research Co. trans. 1982); G. Tomlinson & C. Silversides, Acid Deposition and Forest Damage—The European Linkage (Sept. 1982) (unpublished report).

searchers have termed "crown die-back," where leaves or needles at the tree top turn yellow, then brown and eventually drop off. This problem has affected forests over widespread areas of Germany. In the fall of 1982, a report by a joint committee of forty forestry experts commissioned by the government to assess the extent of forest damage concluded that 560,000 hectares, or fully 7.8% of West Germany's forest area, have been damaged. It is a source of particular concern that symptoms of tree damage have been observed not only near major sources of pollution, but also in distant areas where atmospheric concentrations of acid-forming pollutants are much lower.[177] Given this disturbing indication of the problem's potential geographical scope, and the fact that four of the most important tree species in Germany—norway spruce, white fir, scotch pine and beech—have shown signs of vulnerability,[178] it is not surprising that the nation sees the threat to its forest resources as immense. (As this article went to press, a new report had just been released, concluding that an astonishing 35% of Germany's forest area has been damaged by air pollution.)[179]

The concern of environmental officials was heightened even further when they learned of the severity of damage in the neighboring high altitude forests of Eastern Europe. Visiting West German scientists were shocked to discover that 400,000 hectares of trees in the Krokonose Mountains, a wilderness park on the Polish-Czech border, were seriously damaged. In the Erzgebirge Park area on the East German-Czech border, visiting forestry scientists reported that virtually all of the spruce trees in about 140,000 hectares of the park were either dead or dying.[180]

Dr. Bernard Ulrich of Göttingen University has provided West Germany with the first credible explanation of precisely what is afflicting the nation's forests. Since 1966 he has been studying beech and spruce forests on Germany's Solling Plateau, where crown die-back is prevalent. Dr. Ulrich believes that trees are suffering as a result of pollution-induced changes in the forest soils. Acids from

177. Tomlinson & Silversides, *supra* note 176, at 4-6, 15.

178. G. Tomlinson, Notes on Tree Die-Back in Germany and Central Europe 5 (May 1982) (unpublished report).

179. West German Ministry of Nutrition, Agriculture and Forestry, Neuartige Waldschäden in der Bundesrepublik Deutschland (New Forms of Forest Damage in the Federal Republic of Germany) (Oct. 1983) (unpublished report).

180. Tomlinson, *supra* note 178, at 4; W. Brzezinski, Legal Protection of the Environment (1979) (unpublished report).

rainfall and dry sulfur deposition are leaching important plant nutrients, such as calcium and potassium, from the soils, making those nutrients unavailable to trees. In addition, potentially toxic metals, such as aluminum, are chemically liberated from harmless soil compounds such as aluminum silicate. Dr. Ulrich has hypothesized that, in combination, these two effects interact to produce tree damage.[181] Although the international scientific community has not yet given unqualified acceptance to Dr. Ulrich's thesis, neither have they proven it incorrect, and his theory is now widely accepted by West German environmental officials and the public generally.[182]

Not surprisingly, the discovery of so severe a problem in the forests, which comprise 25% of West Germany's land area and which have been zealously protected for generations, has had a profound effect on the populace. The impact on the nation's domestic and international environmental policies has been dramatic.

B. *Emissions*

Present West German SO_2 emissions total about 3.5 million metric tons annually; most are from coal-fired power plants and from industries burning oil and coal. The aggregate emissions figure has remained roughly constant in recent years. Current projections, presuming no major shift in the nation's pollution control policies, suggest continued stability, or even further improvement over the next decade as a result of stringent control requirements for new sources.[183] While this trend could be reversed if coal use increases dramatically without accompanying new control requirements, the government is now considering a new abatement program that would reduce aggregate SO_2 emissions by about one-third.[184]

With regard to the nitrogen oxides ("NO_x") component of the acid rain problem, the picture is far less stable. Over the past

181. Ulrich, *supra* note 176; B. ULRICH, R. MAYER & P. KHANNA, DEPOSITION VON LUFTVERUNREINIGUNGEN UND IHRE AUSWIRKUNGEN IN WALDÖKOSYSTEMEN IM SOLLING (DEPOSITION OF AIR POLLUTANTS AND THEIR EFFECTS ON THE WOODED ECOSYSTEM IN SOLLING) (Faculty of Forestry, Univ. of Göttingen' No. 58, 1979).

182. PREVENTION OF AIR POLLUTION, *supra* note 175, at 2-4; interview with numerous senior officials, in Berlin, West Germany (July 7, 1982); Tomlinson, *supra* note 178, at 3-4.

183. Baum, *supra* note 173; N. Elam & Trichem Consultants, Ltd., Present and Future Levels of Sulphur Dioxide Emissions in Northern Europe 104, 128, 144 (June 1979) (unpublished report); FED. ENVTL. AGENCY, ANNUAL REPORT *1980*: SUMMARY 16 (1981).

184. *Environmental Controls to be Key Part of New Government's Program, Minister Says*, 5 INT'L ENV'T REP. (BNA) 481-82 (1982) [hereinafter cited as *Environmental Controls*].

decade, NO_x emissions have increased by a staggering 85%, to the current total of about 3.1 million metric tons per year.[185] Automative emissions are responsible for about 40% of the NO_x pollution, while stationary sources contribute most of the remainder.[186] Under a directive established by the European Economic Community,[187] there have been step-by-step reductions in new car emissions of nitrogen oxides since 1975. However, these reductions have not kept pace with increases in the number and use of vehicles. The upward trend in NO_x emission levels is expected to continue in the absence of new, much more stringent control requirements for motor vehicles. West German officials are, in fact, lobbying for the establishment of stricter emission control requirements for new cars in the Community.[188]

C. *Air Pollution Control in West Germany*

Air pollution control in West Germany is achieved through a mix of approaches that utilize technological pollution removal devices, limits on fuel sulfur content, tall smokestack dispersion techniques, and, in a few recent cases, efforts to promote the retirement of old, heavily polluting facilities. These requirements are founded in the mandates of the nation's 1974 air pollution law, the *Bundes-Immissionsschutzgesetz* (Federal Emission Protection Law or "BImSchG").[189] The BImSchG authorizes control programs geared to both the protection of "people, animals, plants and other things from harmful environmental effects" and the taking of "precautions against the occurrence of harmful environmental effects."[190] Supplementing the BImSchG are regulations and guidelines established by the *Bundesregierung*, an executive arm of the federal govern-

185. *Germans Threaten to Act Unilaterally if EEC Does Not Tighten Auto Emission Rules*, 4 INT'L ENV'T REP. (BNA) 923 (1981) [hereinafter cited as *Germans Threaten to Act*]; Baum, *supra* note 173; *Report Says Air Policies Effective, But Stronger Effects Needed in Future*, 5 INT'L ENV'T REP. (BNA) 219 (1982).

186. FED. ENVTL. AGENCY, *supra* note 183, at 17.

187. Council of Eur. Communities Motor Vehicle Emissions Directive, Doc. No. 74/290/EEC-0J L 159 (1974) *reprinted in* INT'L ENV'T REP. (BNA) 141:401 (1982).

188. *Germans Threaten to Act, supra* note 185.

189. Gesetz zum Schutz vor schadlichen Umwelteinwirkungen durch Luftverunreinigungen, Gerausche, Erschutterungen und ahnliche Vorgange of March 15, 1974 (Fed. Envtl. Protection Law), I Bundesgesetzblatt [BGBl] 721 (W. Ger.), *reprinted in* INT'L ENV'T REP. (BNA) 241:1001 (1978) [hereinafter cited as BImSchG].

190. BImSchG § 1, *supra* note 189.

ment.[191] The pollution control system that has emerged from this structure is exceedingly complex.

1. State Responsibilities

The real authority for pollution control in West Germany rests with the country's eleven states, or *Länder*.[192] The *Länder* bear responsibility for establishing requirements necessary to achieve the BImSchG objectives, and are subjected to little federal oversight regarding the adequacy of their efforts.[193] As mentioned earlier, the *Bundesregierung* is empowered to establish binding regulations and nonbinding guidelines which serve to further define the BImSchG mandates for state action. But the *Länder* as a group have the opportunity to approve or block all such initiatives in advance in the *Bundesrat*, the national legislature's upper house composed of state government representatives.[194]

The *Länder* seek to implement their pollution control programs flexibly. As a matter of course, the states informally discuss control requirements and bargain with new industrial sources prior to the formal permitting process. In Germany, as in many other countries, this informal stage is an important part of the control regime. In these discussions, the more heavily industrialized *Länder* often impose "offset" requirements mandating the petitioning source to secure emission reductions at existing sources sufficiently large to more than offset the additional pollution that the new source will produce. This technique for accommodating the economic need for new industrial growth with the need to assure continued environmental improvement was borrowed from the United States pollution control regime. It is now a common practice in West Germany, although offsets are not explicitly provided for anywhere in Germany's extensive formal laws or regulations.[195]

2. Federal Regulations and Guidelines

The most sweeping regulatory effort by the *Bundesregierung* is the promulgation of the Technical Guide for the Purification of

191. Currie, *Air Pollution Control in West Germany*, 49 U. CHI. L. REV. 355, 356 (1982).

192. Berlin, the eleventh *land*, has a special status in West Germany and is not formally considered as a state.

193. Currie, *supra* note 191, at 366, 375; interview with K. Von Moltke, Eur. Inst. for Env't & Safety, in Bonn, West Germany (July 11, 1982); Von Moltke, *supra* note 174.

194. BImSchG §§ 7, 48, *supra* note 189.

195. Von Moltke, *supra* note 174.

Air, or the TA-Luft.[196] The TA-Luft provides information and guidance on a variety of technical matters. Most importantly, it offers ambient standards for key pollutants. These serve as concrete measuring points against which the BImSchG's general directives regarding the avoidance of "environmental harm" can be judged.[197]

The contours of the West German pollution control system are complicated by the cloudy legal status of the TA-Luft.[198] The TA-Luft is not a binding regulation, but only a guideline presenting a suggested interpretation of the BImSchG's terms.[199] Despite its nonbinding nature, it was regarded until recently as a consensus document and a reliable guide of how much control states would require of pollution sources. However, a recent court case has highlighted the uncertainty surrounding the TA-Luft's provisions. The Federal Administrative Court held in 1979 that, while the TA-Luft is presumed correct, a source complying with the guidelines can be required to achieve additional pollution reductions as necessary to prevent "environmental harm."[200] By analogy, the state-of-the-art technological requirements for new sources in the TA-Luft (described below) are also not necessarily the final word. These new source guidelines might eventually be determined to be more or less strict than the BImSchG mandate necessitates. Industry officials have complained that their efforts to plan new facilities and project pollution control costs are hampered by the uncertain status of the TA-Luft.[201]

Until recently, the most important binding federal SO_2 control requirements concerned fuel sulfur content. In 1975, pursuant to a directive from the Environment Office of the European Economic Community, the *Bundesregierung* promulgated regulations (to go into effect in 1979) requiring that light heating oil ("gas oil") and diesel contain no more than 0.3% sulfur.[202]

196. First General Administrative Guidelines Under the Federal Environmental Protection Law, 6 Ministerialblatt [MBl] 426, 452 (1974) (W. Ger.), *reprinted in* INT'L ENV'T REP. (BNA) 241:1201 (1978) [hereinafter cited as TA-Luft].

197. TA-Luft §§ 2.4.2, 2.4.3, *id.*

198. Von Moltke, *supra* note 193.

199. G. FELDUS & H. HANSEL, BUNDES-IMMISSIONSSCHUTZGESETZ (2d ed. 1979), in Currie, *supra* note 193, at 361.

200. Judgment of Feb. 17, 1978, 55 Bundesverwaltungsgericht [BVerwGE] 250 (1979) (W. Ger.), in Currie, *supra* note 193, at 362.

201. Von Moltke, *supra* note 193.

202. Ordinance on the Sulfur Content in Light Fuel Oil and Diesel Oil, I Bundesgesetzblatt [BGBl] 264 (1975), (W. Ger.), *reprinted in* INT'L ENV'T REP. (BNA) 241:1271 (1978).

3. New Source Controls

The country's most rigorous control requirements apply to new sources (those constructed since 1974) in industrial categories regarded as heavily polluting. To obtain the required permit, the source must demonstrate that it will not cause "environmental harm."[203] Additionally, in the TA-Luft, the *Bundesregierung* has interpreted the BImSchG to require all facilities seeking permits to install "state-of-the-art" technology as a precautionary measure to prevent possible future environmental impacts.[204]

Under the TA-Luft guidelines, emission limits achievable with state-of-the-art technology are specified for various important source categories. Major new fossil fuel-fired plants are expected to install flue gas desulfurization equipment.[205] Coal- and oil-fired power plants are normally required to install and utilize desulfurization systems with a collection efficiency of more than 80% on large boilers to assure achievement of the emission standards.[206] For new small boilers, coal or fuel oil with a sulfur content of no greater than 1% must often be used to meet the prescribed emission limits. Other new source SO_2 control requirements apply to gas-fired systems, such as coke ovens and natural gas burners, as well as industrial plants, such as sulfuric acid facilities.[207] Additionally, the TA-Luft specifies techniques that states may adopt to reduce emissions of nitrogen oxides from new facilities, including the recirculation of exhaust gases and the use of low combustion temperatures.[208]

4. Abatement Requirements for Older Sources

As in other nations with aggressive national pollution programs, the stringency with which new source emissions are treated in West Germany contrasts sharply with the control requirements for older facilities. Installations constructed before 1974, which are responsible for most of the country's SO_2 emissions, are regulated by the *Länder* pursuant to fulfillment of the BImSchG directive to avoid "environmental harm." To date, these efforts have been geared

203. BImSchG § 6, *supra* note 189.

204. TA-Luft § 2.2.1.1, *supra* note 196.

205. TA-Luft § 3.1.1.4, *id.*

206. Correspondence with H. Weidner, Int'l Inst. for Env't & Safety (Dec. 1, 1982).

207. Von Lersner, *Clean Air Strategy in the Federal Republic of Germany*, in AIR POLLUTION CONTROL, *supra* note 32, at 28.

208. TA-Luft § 3.1.1.2, *supra* note 196.

toward attainment of the TA-Luft's ambient air quality objectives.[209]

In regions where air pollution is heavy enough that it causes or could be expected to cause "environmental harm," the responsible state agencies are encouraged to adopt Air Quality Maintenance Plans to assure attainment of the ambient standards.[210] This system has not led to the establishment of demanding control requirements. Only a handful of such plans have been prepared. Those which are in place tend to offer only a general picture of expected pollution trends and the state's overall control strategy for the region, rather than a specific list of concrete control requirements. The plans themselves do not have the force of law, and components are enforceable only where the state has adopted specific requirements under separate authority.[211]

The failure to strictly control SO_2 emissions from older sources may be explained, in part, by the laxity of the TA-Luft's ambient standard for SO_2. Although it is difficult to be certain without a careful comparison of measuring techniques, at 140 micrograms per cubic meter ($\mu g/m^3$), the West German standard appears to match up poorly with the ambient SO_2 standards adopted by the World Health Organization (40-60 $\mu g/m^3$), the United States (80 $\mu g/m^3$) and even the European Community (80-120 $\mu g/m^3$).[212]

Additionally, state efforts to control pollution from existing sources have tended to rely on pollutant dispersion rather than technological abatement approaches. In theory, the dispersion of emissions by means of tall stacks is used only as a supportive measure to help alleviate local environmental effects.[213] TA-Luft guidelines do establish limits on the height of smokestacks of large installations.[214] In practice, however, reductions in ambient SO_2 concentrations in heavily polluted areas are often achieved through

209. Currie, *supra* note 191, at 376-80.

210. BImSchG § 47, *supra* note 189.

211. Currie, *supra* note 191, at 375.

212. TA-Luft § 2.4.3, *supra* note 196; WORLD HEALTH ORGANIZATION, ENVIRONMENTAL HEALTH CRITERIA 8: SULFUR OXIDES AND SUSPENDED PARTICULATE MATTER 15 (1979); 40 C.F.R. § 504 (1982); Council of Eur. Communities Directive on Air Quality Limit Values and Guide Values for Sulphur Dioxide and Suspended Particulates, Doc. No. 80/779/EEC-0J L 229 (1980), *amended by* Doc. No. 81/857/EEC, *reprinted in* INT'L ENV'T REP. (BNA) 141:1301 (1982).

213. Von Lersner, *supra* note 207.

214. TA-Luft § 2.6, *supra* note 196.

the use of tall stacks.[215] The current Air Quality Maintenance Plan for the Western Ruhr region of North Rhine-Westphalia, for example, relies heavily on tall smokestacks to help the region attain ambient SO_2 standards.[216]

Also contributing to the laxity of existing source control requirements in some areas is the absence of any federal oversight mechanism to assure state action. The federal environmental agency does not have special authority to adopt measures of its own or to institute sanctions in the absence of adequate state action.[217]

5. New Domestic Abatement Programs

The West German pollution control system is probably better suited than that of any other industrial nation to the establishment of new control requirements to address acid rain. The responsibility which the BImSchG imposes upon all pollution sources, old and new, is to avoid "environmental harm." The TA-Luft ambient standards offer only an administrative interpretation of what this requires, and sources can be subjected under the BImSchG to far more strict control requirements geared to pollutants or pollutant problems not accounted for adequately in the ambient guidelines. A new federal regulatory program mandating substantial new emission reductions to avoid environmental damage due to acid rain was, in fact, enacted in July, 1983.[218]

Prompted by the nation's uncommon devotion to its forests, and by the growing political importance of the environmentalist Green Party, a surprisingly broad consensus has emerged in West Germany in support of stricter control of SO_2 emissions. While other countries may have chosen to wait for more information from ongoing research into possible acid rain impacts and ways to mitigate them, West Germany is apparently too concerned about possibly irreversible forestry damage to wait any longer before taking action. Major changes in both state and federal pollution control programs are now in various stages of development and implementation.

215. MINISTERIUM FUR ARBEIT, GESUNDHEIT UND SOZIALES DES LANDES NORDRHEIN-WESTFALEN, LUFTREINHALTEPLAN RUHRGEBEIT WEST *1978-82, at* 257 (1977) [hereinafter cited as RUHRPLAN-WEST]; Rehbinder, *Implementation of Air Pollution Control Programs Under the Law of the Federal Republic of Germany,* in AIR POLLUTION CONTROL, *supra* note 32, at 31.

216. RUHRPLAN-WEST, *supra* note 215.

217. Currie, *supra* note 191, at 375.

218. *Cabinet Outlines Moves to Save Forests, Rules on Furnace Emissions Draw Criticism,* 6 INT'L ENV'T REP. (BNA) 319 (1983).

The most ambitious new program is embodied in regulations developed by the Ministry of Interior for large fossil fuel-fired generating plants. In September, 1982, the Cabinet of former Chancellor Helmut Schmidt ordered then Interior Minister Gerhart Baum to have his Agency develop new regulations mandating substantial emissions reductions from the large older power plants which contribute most to domestic SO_2 pollution in Germany.[219] The Ministry proposed a program which would give major coal- and oil-fired facilities the option of either retiring within five years or installing controls necessary to reduce their SO_2 emissions to 400 milligrams per cubic meter (mg/m^3) within ten years.[220] There was some doubt as to whether the newly-elected government of Chancellor Helmut Kohl would endorse so aggressive a program, with potentially significant economic impacts. But Friedrich Zimmerman, Baum's replacement as Minister of Interior under the government of Chancellor Helmut Kohl, supported the SO_2 abatement program developed by his predecessor.

It was an indication of the high level of public concern over the fate of the German forests that the program was made more stringent when the regulations were passed on for final approval to the *Bundesrat*, the national chamber comprised of representatives of the *Länder*. The *Bundesrat* enlarged the program to cover all power plants with an electrical generation capacity of greater than 100 megawatts, adding an additional fifty facilities to the list of affected plants. Also, the compliance period for very large plants, those with an electrical generation capacity of greater than 300 megawatts, was shortened. These changes are expected to lead to an additional 200,000 tons in annual SO_2 reductions. It is projected that by 1993 the regulations will have resulted in the reduction of aggregate SO_2 emissions in West Germany from their current level of 3.5 million tons annually by fully one-third, to a total of 2.3 million tons.[221]

In addition, the *Bundesregierung* is considering changes in the TA-Luft's ambient standard for sulfur dioxide.[222] It is widely ac-

219. PREVENTION OF AIR POLLUTION, *supra* note 175; *Cabinet Adopts Wide-Ranging Plan to Reduce Environmental Pollution*, 5 INT'L ENV'T REP. (BNA) 400 (1982).

220. PREVENTION OF AIR POLLUTION, *supra* note 175.

221. *Environmental Controls*, *supra* note 184; *Interior Minister Endorses Without Change Previous Administration's Clean Air Goals*, 5 INT'L ENV'T REP. (BNA) 536 (1982).

222. *Draft Changes to Air Pollution Rules Circulated by Government for Comment*, 4 INT'L ENV'T REP. (BNA) 1043 (1981); *Minister Joins Attack on Proposals to Revise German Air Quality Regulations*, 5 INT'L ENV'T REP. (BNA) 78 (1982).

cepted, even among representatives of German industry, that the current standard is not sufficiently strict to protect environmental quality. Current emissions levels in Germany, although they are generally regarded as high enough to threaten the nation's forests, could increase substantially without exceeding the 140 $\mu g/m^3$ TA-Luft guideline. To remedy this shortcoming, two alternative approaches are being considered. One would lower the ambient standard, while the other would leave the limit itself unchanged, but decrease the size of the measurement grid.[223] According to the Interior Ministry, both measures would substantially strengthen emission reduction requirements.

On the state level, a significant SO_2 abatement program has already been introduced in the industrialized state of North Rhine-Westphalia. The state's major utilities have agreed to an unprecedented emission reduction effort. Sixteen of the state's largest lignite-burning plants with a total capacity of 6,600 megawatts will be equipped with flue gas desulfurization equipment, while six older plants will be closed and replaced with four newer, less polluting power stations. The program is expected to reduce the state's aggregate SO_2 emissions of 400,000 metric tons by roughly 15%. While the new plants are expected to cost nearly $2 billion, the state's Labor Minister has praised the program as one that will "protect old jobs and create new ones."[224]

D. *Innovative Technologies*

West Germany has made important progress in the use of technological abatement measures to control sulfur dioxide. Currently, the nation's flue gas desulfurization capacity, much larger than that of any other country in Europe, is about 2,000 megawatts, and an additional 5,000 megawatts are under construction.[225] West Germany is also a leader in the development and use of fluidized bed combustion systems in power plants. One West German power station using a fluidized bed system is already in operation, and

223. Von Moltke, *supra* note 193.

224. *New Program to Reduce Sulfur Dioxide Pollution*, THE WEEK IN GERMANY, July 23, 1982, at 5.

225. Weidner, *supra* note 206.

another is under construction.[226] However, this technology will probably not be ready for widespread use in the near future.

E. *Environmentalism and West German Politics: The Green Party*

Germany has a long history of concern for the protection of wildlife and natural areas. In the early 1970's, an enhanced sensitivity to environmental concerns developed in West Germany, as in other Western nations. A myriad of local and national environmental organizations were formed in this period, all concerned in one way or another with the ecological effects of industrialization and technological growth. The largest national environmental organizations include the German Nature Protection Ring, the Federation for the Protection of Environment and Nature in Germany and the Federation of Citizen Initiatives for Environmental Protection.

While these organizations have had considerable impact in some instances, opportunities are generally very limited for citizen groups to influence government policy through court action or participation in administrative decisionmaking. Environmental organizations and citizens are allowed to participate in hearings; however, citizen groups have charged that they have no real influence, and their involvement is a mere formality. In addition, the country's strict standing requirements often preclude court action by environmental organizations. Standing requirements have been eased in the states of Bremen, Hamburg and Hesse since 1979, but only in limited instances involving violations of Germany's nature protection laws.[227] Frustrated by these obstacles, many environmentalists have turned to the political process, where they have achieved remarkable success.

In the 1970's, a number of environmentally-oriented political parties organized locally, seeking participation in county and municipal governments. These environmental parties, which were never taken seriously by the West German political establishment, merged in 1980 to form the Green Party. The Green Party adopted a broad program encompassing environmental protection issues,

226. Nelson, *Germany's "Cool" Coal Fire—No Pollution, No Acid Rain, No Chimneys*, POPULAR MECHANICS, Oct. 1982, at 192-93.

227. Section 44 of Bremen's Nature and Landscape Protection Act, Sept. 17, 1979; § 41 of Hamburg's Nature and Landscape Protection Act, July 2, 1981; § 36 of Hesse's Nature Protection Act, Sept. 19, 1980.

opposition to nuclear energy, controls on growth, women's rights and international neutralism.[228] Major political parties continued to view the "Greens" as naive naturalists and expected that the party would prove to be short-lived.

Instead, the 1980's have brought the Greens a string of impressive victories, and their yellow sunflower symbol has been established as an important feature in the country's political landscape. Aided partly by the fact that they are the only major political party in Germany to oppose nuclear power, a position shared by roughly one-third of the population,[229] the Greens have placed representatives in the assemblies of six of Germany's eleven states.[230] In two key states, Hesse and Hamburg, the Greens now hold the balance of power in assemblies where the major parties, the Christian Democrats and the Social Democrats, are deadlocked.[231]

The extent to which the Greens will ultimately influence policymaking in West Germany remains unclear. Observers agree that the Party's presence is only beginning to be felt. In part, the Greens' influence is increasing simply because they are now taken seriously by the parties in power. The Social Democrats, in particular, see the Greens as a real threat to their support and feel the need to project a stronger environmental profile themselves.[232] In the national election of March, 1983, the Greens gained twenty-seven seats in the *Bundestag*, and hence a direct voice in national policymaking.

Given their stated unwillingness to be part of a coalition, it is unclear how the Greens will deal with this new opportunity. Even if they do not join the government, or expand their influence on the state level, the Greens are already the world's most successful environmental political organization. They can be counted on to continue to direct greater attention in Germany to environmental protection and to ecological problems such as acid rain.

228. *"Green Party" Seen as Growing Force as Germany Prepares for National Elections*, 5 INT'L ENV'T REP. (BNA) 329-40 (1982) [hereinafter cited as *Green Party*].

229. *Environment Takes Back Seat to Peace as Issue in October Bundestag Elections*, 3 INT'L ENV'T REP. (BNA) 412 (1980).

230. *Green Party*, *supra* note 228.

231. Markham, *For "Greens" It's Make Waves, Not War*, N.Y. Times, Oct. 3, 1982, § 4, at 2, col. 1.

232. *Id.*

F. *International Efforts*

Germany has been an effective advocate of international pollution control action in the European Economic Community for several years. The Community's limit on the sulfur content of light fuel oil or "gas oil," one of its most effective air pollution actions, was the result of a German initiative.[233] West Germany has also played a key role in the establishment of Community standards for automotive emissions and has advocated their substantial tightening for some time. In July, 1981, then Interior Minister Gerhart Baum told Community environment ministers that West Germany was prepared to act alone, if necessary, should the Community not agree to reduce automobile emissions of nitrogen oxides, hydrocarbons and carbon monoxide by 50%.[234]

In the context of efforts to control transboundary SO_2 pollution, however, West Germany has been far less active. As the second largest Western European contributor to acid rain in Scandinavia,[235] West Germany has, until recently, been a strident opponent of Nordic efforts to promote the establishment of international SO_2 abatement programs. In 1979, when the member nations of the Economic Commission for Europe were negotiating an accord dealing with transboundary air pollution,[236] West Germany joined with Britain to lead the opposition to Scandinavian proposals for abatement action. Both nations firmly refused to take part in any convention requiring a percentage rollback of SO_2 emissions, or even imposing a ceiling which would prohibit increases in national pollution beyond current aggregate levels. The Nordic countries were forced to settle for a less ambitious agreement lacking specific abatement requirements.

But West Germany's sensitivity to the importance of international environmental responsibility was greatly enhanced when the country learned of the magnitude of transboundary pollution impacts on its own forests. This change was made clear in dramatic

233. Council of Eur. Communities Directive on the Sulphur Content of Fuels, Doc. No. 75/716/EEC-0J L 307 (1975) *reprinted in* INT'L ENV'T REP. (BNA) 141:1201 (1982); Von Moltke, *supra* note 193.

234. *Germans Threaten to Act*, *supra* note 185, at 923-24; PREVENTION OF AIR POLLUTION, *supra* note 175, at 2.

235. U.N. Econ. Comm'n for Eur., *supra* note 2, at 34.

236. High-Level Meeting, *supra* note 161. For additional information on this meeting, see 6 ENVTL. POL'Y & L., Feb. 15, 1980.

fashion at the 1982 Stockholm Conference on Acidification of the Environment,[237] where the West German delegation turned a complete about-face on the need for cooperative abatement action. Germany forcefully threw in its lot with the Scandinavians, supporting the establishment of an international program to guide the control of SO_2 pollution through Europe.[238] It was the first time that a major industrial power and a major polluter had joined the Scandinavian cause.

Now West Germany is pushing for vigorous implementation of the 1979 ECE Convention on Transboundary Pollution and seeks, along with the Scandinavian countries, the establishment of aggressive new international abatement programs. At the meeting of the ECE Executive Body in Geneva in June, 1983, West Germany endorsed the Scandinavian proposal for a 30% rollback in annual SO_2 emissions from ECE nations, and proposed in addition that member nations adopt a limit of 0.3% by weight on the sulfur content of light fuel oil and diesel oil.[239] This proposal is noteworthy not only because of its stringency, but also because in offering it, West Germany uncharacteristically broke ranks from its formal alignment with the European Community.

In the European Community, Germany is pursuing establishment of an international strategy which would impose standards based on state-of-the-art technology for important categories of major SO_2 pollution sources (*i.e.*, power plants and industrial boilers). The intent of the proposal is to make all European sources subject to roughly the same level of control, so that a facility taking abatement steps in one nation would not find itself at a competitive disadvantage to similar plants elsewhere not forced to invest in pollution control equipment. Only through such a program, Germany claims, can international controls be equitably instituted.[240]

Neither the ECE nor the Community is likely to adopt an abatement program in the near future, however.[241] Germany is one of

237. 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13.

238. Baum, *supra* note 173.

239. Wetstone, *Long-Range Transboundary Air Pollution, Executive Body, First Session*, in ENVIRONMENTAL POLICY AND LAW (in press).

240. Von Moltke, *supra* note 193; interview with P. Kupfer, Dir. of Int'l Activities, Interior Ministry, in Bonn, West Germany (July 12, 1982).

241. Statement of R. Pedroli, Director, Swiss Env't Protection Office, to the 1982 Stockholm Conference on Acidification of the Environment, 1982 STOCKHOLM CONFERENCE PROCEEDINGS, *supra* note 13, at 43-45; Statement of J. Bucher, Director, Forest Protection Div., Fed. Inst. of Forestry, Switzerland, to the 1982 Stockholm Conference on Acidification of the Environment.

only a few European countries that use sophisticated control devices on new pollution sources. Most nations are unwilling to spend the money for technological abatement devices; they have their own approaches to dealing with SO_2 problems and are resistant to standardized limits. France, for example, considers its increasing reliance on sulfur-free nuclear power an adequate control strategy.[242] Britain's plans, as discussed earlier, are to utilize tall smokestacks for the foreseeable future. And the nations of Eastern Europe may present the most serious long-term obstacle to multilateral abatement programs. Several Eastern European countries, including Poland, East Germany and Czechoslovakia, suffer alarming local air pollution problems and are without effective governmental programs to control their many large sources.[243]

Not surprisingly, Eastern Europe's pollution also has substantial international impacts, especially on nearby West Germany. West German diplomatic efforts to encourage emission reductions from these countries through the ECE will continue. Realistically, however, there is little West Germany can do except be grateful that the prevailing winds are westerly, rather than easterly, leaving West Germany and the rest of Western Europe generally upwind of the overwhelming quantity of SO_2 pollution produced in East Germany, Czechoslovakia, Poland and the Soviet Union ("USSR").

It may take many years, but there is hope for eventual action in the European Community, where Eastern European countries are not members. Until then, West Germany must be content with whatever reductions it can achieve in its own backyard through the domestic abatement programs described above. Meanwhile, the new West German attitude toward international pollution control has already marked a dramatic first, and offered a substantial boost to the continuing Scandinavian campaign to reduce transboundary pollution. The stringent new abatement program may serve not only to lower Germany's export of transboundary pollution, but also to provide an example of how a nation fearing irreversible environmental effects can overcome, through the political process, the scientific uncertainty that so often immobilizes policymakers.

242. *Government Introduces New Restrictions on Air, Noise Pollution by Autos*, 5 INT'L ENV'T REP. (BNA) 496-97 (1982) [hereinafter cited as *Air, Noise Pollution*].

243. A. Staatsen, The Netherlands Situation (unpublished report presented at the International Symposium on the Aspects of Coal Pollution Abatement Control Technologies, May 24-28, 1982, Petten, The Netherlands).

VI. OTHER EUROPEAN COUNTRIES AND JAPAN: A BRIEF OVERVIEW

A. *Western Europe*

Western Europe's international air pollution problems are not confined to the four countries examined in the preceding sections. Many others either contribute substantially to the transboundary air pollution flow, or are on the receiving end of large quantities of imported foreign pollution, or both. Dramatic impacts on the scale of those occurring in Scandinavia and Central Europe have not been observed elsewhere, but other countries have been awakened by news of these damages. And many nations which have not historically given air pollution control a high priority have given more attention to national and international pollution control policies in the last year or two.

Although each country has its own reasons, in several cases these changes are the result of concern over the impacts of acid pollution. Switzerland, for example, has detected tree damage in some areas, and, concerned about possible acid rain-related damage to its forests, has imposed new restrictions on automotive emissions despite the objections of those concerned about impacts on international trade. The new rules are projected to reduce vehicular pollution by 20% by 1993.[244]

Denmark, Belgium and the Netherlands have suffered from especially acidic rainfall for many years. Their policymakers have recently become concerned that the continuing high levels of deposition will eventually deplete the natural buffering capacity which has until now protected their nations' ecosystems from observable damages.[245] The countries most responsible for their imported sulfur pollution include France, the United Kingdom and West Germany.[246]

The severity of pollution-induced damage to historic structures has led Greece, where urban air pollution problems are among the most serious in the world, to alter dramatically its approach to pollution control. In a desperate effort to save the nation's cultural heritage from destruction by acid rain and other similarly corrosive

244. *Air, Noise Pollution*, *supra* note 242.

245. Vermeulen, *Acid Precipitation in the Netherlands*, 12 ENVTL. SCI. & TECH. 1017 (1978); Staatsen, *supra* note 243; Rebsdorf, *Acidification of Danish Soft-Water Lakes*, in D. Drabløs & A. Tollan, *supra* note 1, at 238; ACIDIFICATION, *supra* note 1, at 44.

246. U.N. Econ. Comm'n for Eur., *supra* note 2.

forms of pollution, the government has placed unprecedented restrictions on the use of automobiles in Athens, and has forced several major industrial facilities to cease operations during summer periods when pollution problems are particularly serious.[247] Western Europe's second largest sulfur emitter, Italy,[248] has also become increasingly concerned about pollution damage to its historic buildings and statuary, but is not likely to respond in a similarly strong manner.

Most Western European nations rely primarily on a combination of low-sulfur fuels and tall smokestacks to control air quality. Various other approaches are used to supplement these techniques. In France, the construction of nuclear power plants to replace fossil fuel-fired facilities is considered an important part of the national SO_2 control strategy.[249] Denmark relies on a district heating program similar to Sweden's to produce energy more efficiently and contribute to reductions in SO_2 pollution.[250] Probably the most advanced program is in the Netherlands, where new power plants, including two already under construction, will be equipped with flue gas scrubbers.[251] In addition, a charge keyed to the sulfur content of fuels is levied on stationary sources in the Netherlands; the proceeds are devoted in part to compensating individuals injured by air pollution and reimbursing industries forced to install expensive control devices.[252]

In most of these countries, air pollution control is achieved through decentralized systems. Local authorities in Belgium, Denmark, the Netherlands and Ireland are responsible for the imposition of limits on the sulfur content of fuels burned in major urban areas.[253] In Italy and France, local officials with similar authority

247. *Athens Air Pollution at Worst Ever Levels Prompts Government Ban on Private Vehicles*, 5 INT'L ENV'T REP. (BNA) 223 (1982); *Environment Minister Urges End to Siesta as Way to Reduce Air Pollution in Athens*, 5 INT'L ENV'T REP. (BNA) 497 (1982).

248. U.N. Econ. Comm'n for Eur., *supra* note 2.

249. *Draft of New Government Five-Year Plan Outlines Environmental Policy Guidelines*, 3 INT'L ENV'T REP. (BNA) 319 (1980).

250. *Cuts in Use of Oil for Home Heating Seen Reducing Sulfur Dioxide Levels*, 4 INT'L ENV'T REP. (BNA) 895 (1981).

251. H. Meiners, The Netherlands: Air Pollution Control: National Targets and Regional Implementation Systems for Air Pollution Control 20-21 (Mar. 24, 1982) (unpublished report).

252. Netherlands Air Pollution Act, Arts. 63-65, *reprinted in* INT'L ENV'T REP. (BNA) 281:1001 (1978).

253. Belgian Royal Order of July 26, 1971, *modified by* Decree of Jan. 29, 1974, *reprinted in* INT'L ENV'T REP. (BNA) 211:0102 (1981); Danish Statutory Order of Heavily Polluting

have been less aggressive in responding to urban pollution problems.[254] The new European Economic Community ambient standard for SO_2, which entered into force in April, 1983,[255] will require more concerted efforts to monitor and control urban pollution concentrations in several of these countries.

The Netherlands, Denmark and, more recently, Austria and Switzerland are proponents of international SO_2 abatement. Although France has in the past been largely unconcerned with international air pollution problems, the country is now seeking to reduce SO_2 concentrations domestically.[256] Italy is singularly unreceptive to international control initiatives and uninterested in tightening its domestic SO_2 control requirements. In fact, officials of international organizations are concerned about Italy's response to the new Community ambient standard for SO_2, and see the nation as increasingly isolated with regard to its air pollution control policies.

B. *Eastern Europe*

The greater awareness of long-range air pollution and its impacts has not substantially changed the energy or environmental policies of Eastern European nations. The limited data available suggest that aggregate SO_2 emissions in Eastern Europe are extremely high,[257] as one might expect given the concentration of largely uncontrolled industrial facilities and the high sulfur content of the "brown" coal burned in East Germany, Poland and Czechoslova-

Enterprises, Etc., Stat. Order No. 176 (1974), *reprinted in Int'l Env't Rep.* (BNA) 221:0251 (1981); The Denmark Environmental Protection Act, Act No. 372, as amended Jun. 13, 1973, Part 5, *reprinted in* INT'L ENV'T REP. (BNA) 221:0205 (1981); Meiners, *supra* note 251, at 17-23; Netherlands Air Pollution Control Act, Art. 13, *supra* note 252; Council of Eur. Econ. Communities, *supra* note 233.

254. Decree Concerning the Control of Polluting Emissions Into the Atmosphere and Certain Uses of Thermal Energy, 1974 J.O. 5178-79, *reprinted in* INT'L ENV'T REP. (BNA) 231:3201 (1979); Italian Control of Atmospheric Pollution Act, §§ 2, 13, 19, *reprinted in* INT'L ENV'T REP. (BNA) 261:501 (1978); *Environment Ministry Issues Instructions Implementing EEC Rules on SO_2, Particulates*, 5 INT'L ENV'T REP. (BNA) 402 (1982) [hereinafter cited as *Env't Ministry*].

255. Council of Eur. Econ. Communities, *supra* note 233.

256. *Env't Ministry*, *supra* note 254.

257. U.N. Econ. Comm'n for Eur., *supra* note 2, at 6. Annual SO_2 emissions (in million metric tons) for Northeastern Europe have been estimated at: 3.37—Czechoslovakia, 4.00—East Germany, 1.50—Hungary and 3.00—Poland. For comparative purposes, annual SO_2 emissions from the United Kingdom, the highest in Western Europe, have been estimated at 4.70 million metric tons.

kia.[258] Ambient pollution levels in these countries may already be sufficiently high to present serious health risks and cause widespread materials damage, among other problems.[259] Moreover, these countries reportedly are already experiencing devastating pollution-related damage to their forests.

Eastern Europe's emissions contribute as well to Western Europe's pollution problems. Despite the mainly eastward flow of the prevailing winds, the massive volume of emissions from Eastern Europe often spills over to the north and west, substantially increasing pollution levels in Austria, West Germany and Scandinavia.[260] The USSR and Eastern bloc countries are parties to the ECE Convention on Transboundary Air Pollution. Given the inattention to air pollution control in the past in these countries, most observers doubt that Soviet bloc nations will be willing to take abatement action in the near future for the benefit of West Germany, Scandinavia or other Western nations. They may, however, be awakened to the necessity of taking control steps in response to their own alarmingly serious pollution problems.

C. *Japan*

Japan warrants brief mention here because of the exemplary stringency of its SO_2 control policies. For stationary sources of both sulfur dioxide and nitrogen oxides, Japan has the most rigorous control requirements in the world.[261] The national ambient standards are extremely strict. For SO_2, the daily average of hourly values cannot exceed .04 parts per million (ppm), while for NO_X the daily limit is .02 ppm.[262] Japan is the only country to require the use of NO_X control technology for stationary sources. All major fossil fuel-fired power plants are required to install pollution control devices reducing NO_X emissions by 73%.[263] To encourage pollution

258. Tomlinson & Silversides, *supra* note 176, at 3; *Pollution Grows in Eastern Europe*, N.Y. Times, Sept. 12, 1982, § 1, at 9, col. 1.

259. Brzezinski, *supra* note 180, at 164-90; Timberlake, *Poland—the Most Polluted County in the World?*, NEW SCIENTIST, Oct. 22, 1981, at 248.

260. U.N. Econ. Comm'n for Eur., *supra* note 2.

261. J. GRESSER, K. FUJIKURA & A. MORISHIMA, ENVIRONMENTAL LAW IN JAPAN, 254-55 (1981) [hereinafter cited as GRESSER].

262. ENV'T AGENCY, JAPAN, ENVIRONMENTAL LAWS AND REGULATIONS IN JAPAN 134 (1976).

263. ENV'T COMM., AIR MANAGEMENT POLICY GROUP, ORG. FOR ECON. COOPERATION & DEV., CONTROL TECHNOLOGY FOR NITROGEN OXIDES IN THE ATMOSPHERE, 21 (1981). For a discussion of NO_X control technologies, see app. B.

abatement, Japan imposes a fee based on emission levels for large SO_2 sources in polluted areas. The proceeds are used, in part, to pay for the medical care of patients affected by air pollution.[264] The central government also has prompted the installation of pollution control devices by providing low-interest funds and allowing short-term depreciation for new pollution abatement devices.[265]

These measures have led to the installation of flue gas desulfurization ("FGD") controls at more than 1,000 Japanese power plants. Unlike the United States and West Germany, where coal-fired plants are the focus of FGD efforts, in Japan most of the scrubbing capacity covers small oil-fired boilers and smelters. Those FGD units which do operate at coal-fired plants have a 90% to 95% SO_2 removal rate, proven reliability and, in general, a better performance record than the many FGD systems in place in the United States.[266]

Moreover, flue gas desulfurization has not created a sludge disposal problem in Japan. Japanese scrubbers produce saleable materials such as gypsum, elemental sulfur, sulfuric acid and sodium sulfite.[267] The use of FGD was, in fact, promoted by the short supply of sulfur materials which created a favorable market for these products; their rapid production has now outstripped market demand, however. In the future, FGD waste disposal may become a problem unless new uses now being researched, such as for road surfacing, become commercially practical.

The rapid expansion of FGD use in Japan in the late 1960's and early 1970's was, in part, made possible by the burgeoning of the Japanese economy. Between 1968 and 1974, the Japanese economy was growing at an annual rate of over 10%. Hence, although the total investment for SO_2 control, including FGD and hydrodesulfurization of oil, exceeded $4 billion, the investment did not prove an excessive burden to industry.[268]

264. Ando, SO_2 Abatement for Stationary Sources in Japan (1978) (unpublished report).

265. GRESSER, *supra* note 261, at 267.

266. L. Karlsson, Measures Against Emission of Sulfur Oxides With Flue Gases (Jan. 1981) (unpublished report).

267. M. Maxwell, H. Elder & T. Morasky, Sulfur Oxides Control Technology in Japan (June 30, 1978) (unpublished report).

268. G. Wetstone, Control of Long-Range Air Pollution in the United States, Canada, Europe and Japan (Jan. 15, 1981) (unpublished report).

VII. Conclusion

The energy and pollution control policies which determine the levels of pollutants emitted from major industrial countries are not easily adjusted to accommodate new environmental concerns. This is especially true where the most severe problems occur, in countries downwind of the nation releasing the pollutants. In Europe, as in North America, industrialized nations depend heavily on high levels of energy consumption for their economic livelihoods, if not their lifestyles, and continue to release massive quantities of sulfur and nitrogen pollutant gases into the atmosphere.[269]

National responses to transboundary pollution in Europe have varied with the severity of each country's air pollution problems, and with the extent to which those problems are caused by emissions originating extra-nationally. The players in Europe's complex international acid rain problem fit into three very general categories. These divisions provide some insights into the obstacles to the development of responsible international policies to deal with acid rain and future multinational pollution concerns.

"Victim" countries, those nations with severe environmental problems caused primarily by transboundary emissions, tend to recognize earliest the need for reducing emissions, and to take action most quickly. Sweden and Norway have had major new SO_2 emission reduction programs in place since the early 1970's, as much for the sake of encouraging upwind nations to take similar action as for the sake of direct environmental benefits. Sweden and Norway have now been joined by the other major pollution "importer" nations of Western Europe. Denmark, the Netherlands and Switzerland have all instituted new air pollution requirements in recent years. Similarly, Finland and Austria have joined Nordic efforts to require a 30% reduction in national SO_2 emissions through the ECE Convention.[270] Finally, Canada, which occupies an analogous position in North America, has established emission reduction programs partly to enhance the international credibility of its calls for greater pollution control in the United States.[271]

269. U.N. Econ. Comm'n for Eur., *supra* note 2.

270. Wetstone, *Long-Range Transboundary Air Pollution Executive Body, First Session*, in Environmental Policy and Law (in press).

271. Wetstone, *supra* note 268, at 44.

"Impacted emitter countries," major industrial nations experiencing serious problems for which their own emitters bear a substantial portion of the responsibility, are slower to respond since the direct economic impacts of abatement are generally greater. But the West German example suggests that if the environmental damages are severe, major policy changes will eventually take place in such nations, provided there is an atmosphere of public concern and government responsiveness. In North America, the United States falls into this category. Its slow but apparently steady move toward tighter control of SO_2 pollution is a somewhat less dramatic version of West Germany's turnabout. By contrast, the nations of Eastern Europe, which are responsible for their own severe pollution problems, seem unlikely to alter their energy or pollution policies. The level of government and public awareness is low, and the development of government policy is in any case far less responsive to public concern.

Finally, there are the major emitting nations not experiencing serious impacts. Among Western countries, these are the nations most skeptical of the need for and the practicality of the abatement programs that pollution importers like Sweden and Norway are seeking. Until two years ago, when the problems in its forests were discovered, West Germany fell into this group, as an influential leader in the fight against Scandinavian proposals for international abatement action. Now the clearest example is Great Britain, Europe's most upwind country. Britain denies responsibility for pollution problems in downwind countries and is unreceptive to suggestions that it undertake costly new control programs. Britain has, however, recently indicated that it will take transboundary concerns into account in the future development of energy and pollution control policies. But this vague commitment is little comfort to downwind nations suffering the impacts of Britain's emissions.

Hence, it seems that nations tend to follow a rule of "direct self-interest": they are willing to adjust their national policies only insofar as direct national benefits are clear. Information on domestic impacts caused a major shift in West Germany's position on control of international SO_2 pollution, where more than a decade of Scandinavian entreaties had failed. This precedent suggests that major battles lie ahead in the effort to forge effective international responses to transboundary problems.

Environmental acidification is only the most immediate of a number of serious international pollution problems looming on the

horizon. There is a widening range of severe environmental threats which can only be effectively addressed through cooperative international action.[272] The build-up of carbon dioxide in the atmosphere and the contamination of the oceans with persistent toxic chemicals are two of the more prominent examples. The precedent established in the international response to today's comparatively straightforward acid deposition issue will set the tone for crucial efforts to head off these and other international environmental problems in coming years.

Recent international statements and agreements, such as the 1979 ECE Convention on Transboundary Pollution[273] and the Declaration of the 1972 U.N. Conference on the Human Environment at Stockholm,[274] are encouraging in their tone and symbolic significance. Principle 21 of the Stockholm Declaration remains today the single most important enunciation of the responsibility of nations to assure that their actions do not cause damage to a foreign environment:

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, *and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction.*[275]

However, this laudable principle is neither sufficiently concrete nor sufficiently enforceable to be of much utility in the face of nations' inclinations to attach importance to transboundary environmental problems only when they themselves suffer serious direct impacts.

If the Stockholm Declaration is to guide resolution of transboundary and global pollution problems, nations must apply it uniformly, rather than evaluating the immediate benefit of its application to the particular environmental concern at hand. For any given problem there are likely to be "winners" and "losers." But if the spectrum of international problems is not cooperatively ad-

272. E. Eckholm, Down to Earth: Environment and Human Needs (1982).

273. Rosencranz, *supra* note 12.

274. Report of the U.N. Conference on the Human Environment, *supra* note 10.

275. Declaration of the U.N. Conference on the Human Environment, *supra* note 11 (emphasis added).

dressed in the coming decades, all nations will lose. Only if national policymakers look collectively at the range of international and global environmental problems, and commit themselves to scrupulous adherence to the Stockholm Principle in all matters, will it be possible to protect our common regional and global ecosystems.