

#### PRESENTATION BY THE DELEGATION OF NORWAY

In a presentation of Norway's national policies in the field of acidification two basic considerations should be pointed out.

First: 90% of acidic depositions in Norway come from abroad. Thus, the problem of acidification has a genuine transboundary character and can only be solved through close international cooperation. This implies that a major thrust on our efforts is directed at searching international agreements for the reduction of harmful substances to the atmosphere.

Second: in the field of environment, certain problems are of such nature that one cannot await full scientific certainty on all aspects before the necessary action is taken. Acid rain is a problem of this character. To our minds, the evidence in this case has long been more than sufficient to warrant prompt action. Effective technical solutions are at hand. We can see no valid excuse for any industrialized nation to refuse to take effective steps to reduce their emissions. This is, of course, not to say that we do not need to know more about the effects, causes and mechanisms involved in acid rain.

I should like to start my review by saying some words about monitoring.

#### NATIONAL MONITORING

In 1980 a major monitoring program was established in order to evaluate the status as well as trends in precipitation quality, water and soil acidification and damages to fish and invertebrates. This monitoring program includes daily sampling for registration of precipitation chemistry at 9 stations, daily measurements of sulphur dioxide and sulphate in air at 6 stations, and NO<sub>2</sub> measurements at 3 stations. There are also monthly water sampling in 16-20 rivers in southern and western Norway, weekly water sampling at 4 calibrated catchments and monthly sampling in ground water reservoirs. Included in the monitoring programme is also registration of fish stocks in lakes and rivers as well as sampling of the invertebrate communities.

Our efforts so far have been concentrated mainly on the southern and

western part of the country. However, there is clear evidence that the effects of acidification are growing at an alarming rate in the western and eastern parts of the country as well as extending steadily further north. We are especially concerned about the increasing acidification of the salmon rivers at the West coast of Norway, important as they are both as traditional sites for angling and as a genepool for the atlantic salmon.

So far we have focused on the acidification of lakes and rivers. In South Norway, an area of 33.000 km<sup>2</sup> is affected. In this area, fish populations are either extinct or drastically reduced. Recently, however, researchers have reported signs of effects in Scandinavian forests similar to those observed in the central parts of Europe. The trees become weakened and less tolerant to the natural stress of pests, diseases, drought and so on. In many places, there is a significant reduction in soil pH. A growing number of scientists consider transboundary air pollution as a major threat to our forests.

Another field of increasing concern in Norway are the enhanced levels of toxic metals in the environment due to long-range air pollution and acidification. Our concern is primarily focused on the metals: aluminium, copper, cadmium and mercury. The effects of the increasing levels are already appearing in birds and wild animals. For instance, the level of cadmium in liver and kidneys in game in Southern Norway is the highest in Europe, and clearly exceeds the limits of acceptable daily intake. Another result is the reduced shell thickness of birds' eggs in Norway. Even more disturbing is the result of a statistical survey, showing a significant less increase in the average age of people in the areas most heavily effected by acid rain. Further studies must be conducted, however, before we can establish the cause or causes of this result. At the moment we give financial support to a study concerning possible health effects of increased levels of aluminium in tap water.

#### RESEARCH PROGRAMMES

Norway started coordinated large scale research on the effects of transboundary air pollution in 1972 when several research institutes joined forces in the eight year SNSF programme to analyse the effects of acid precipitation on forest and fish.

At present about 20 million NOK per year is spent on this type of

research in Norway. Of this The Ministry of Environment funds about 5 million NOK, supporting about twenty projects carried out by different institutions across the country. The remaining 15 mill.NOK represent projects carried out at universities and research institutions. All projects are selected and followed up by the research councils.

Specifically, I want to mention two of our largest projects, RAIN and the project "Forest and Environment, growth and vitality".

The RAIN-projects, or Reversing Acidification in Norway, commenced in 1984, as a cooperation between Norway, Sweden and Canada. The basic philosophy of the project is, that it is still possible to restore nature, provided that amounts of deposition are reduced. Preliminary results from the projects show positive results in this respect. The projects will still continue for several years.

This year, Norway has started an extensive research project called "Forest and environment: Growth and Vitality". The project has three main aims: 1) Monitor the health state of Norwegian forests to discover effects of air pollution as soon as possible, 2) Perform experimental studies about the trees tolerance to  $O_3$ ,  $SO_2$  and  $NO_x$ , both testing each factor alone and in combinations, 3) Increase our basic knowledge of the factors which regulate tree growth.

By the end of 1985 the Ministry of Environment together with several national research institutions agreed upon a frame programme outlining the national priorities for research on transboundary air pollution. During this process, the current state of the art was considered. The following areas were pointed out as particularly important:

- the emissions of nitrogen oxides and the formation of photochemical oxydants
- the effects on forest and other vegetation
- dose response relationships between the deposition of acid compounds and the damages to soil, water, fish and other aquatic animals
- effects of aluminium and heavy metals on human health.

As will be well known by the participants to this conference, Norway places high importance in an active and extensive exchange of information on research programmes and scientific results in the field of acid rain.

EXPECTED REDUCTIONS OF SO<sub>2</sub>, NO<sub>x</sub>, HYDROCARBONS AND AMMONIA EMISSIONS

By 1984 our national emissions of SO<sub>2</sub> were 97.000 tonnes. Thus compared with the 1980 emissions we already have achieved a 30% reduction. The Government intends to reduce the emissions further to reach 50% of the 1980 levels by 1993. A plan is under preparation by the State Pollution Control Agency to ensure that the current levels are retained and to recommend actions that have to be taken in order to reach the goal of 50% reduction.

As a first step for further reductions of sulphur emissions, new regulations demanding the use of fuel oil with a maximum sulphur content of 1% in the southern most counties of Norway were introduced in the beginning of this year. It is expected that this provision will reduce SO<sub>2</sub> emissions in Norway by approximately 8.000 tonnes a year.

As regards NO<sub>x</sub> emissions, the Norwegian government in 1984 declared its intention to adopt US emission standards for all new light motor vehicles. The necessary regulations are at present under preparation and are planned to enter into force in 1989. With the present level of automobiles in Norway this is calculated to give a 60-70% reduction of the current level of emissions from this type of source. To prepare for the introduction of catalytic converters, petrol stations in Norway already offer unleaded petrol. Government taxes on petrol have been adjusted to the effect that unleaded petrol carries a price premium.

A plan for stabilizing the emissions of nitrogen oxides at the 1983 level and for further reductions is under preparations. The emissions of NO<sub>x</sub> from stationary sources are rather limited compared to emissions from mobile sources in Norway, which amounted to approximately 85% in 1982. The main reason for this is, that we do not have any fossil fuelled power plants and that control measures already have been implemented in industrial plants which had NO<sub>x</sub> emissions of any significance.

Our plans for the reduction of NO<sub>x</sub> and the further reductions of SO<sub>2</sub>, are expected to be ready by the end of this year. They include an evaluation of alternative actions to be taken, including cost effectiveness analysis. The result will take the form of a package, providing a list of priorities of actions to be taken as well as a time schedule for the actions to be taken.

## LIMING

Rough calculations show that the range of 340.000 tonnes of lime would be needed annually to neutralize the acid water deposition following from transboundary air pollution in the southern parts of Norway only. Costs would amount to approximately 250 million NOK a year in addition to a one time cost of 50 million NOK to lime the acid lakes. One of the reasons for these high figures is that we have a much larger runoff and shorter duration of water in Norway than for instance in Sweden. In the light of such figures, it should be evident to anyone that liming all affected Norwegian watersheds is completely unrealistic.

The Norwegian government is, however, spending an increasing amount of money for liming, from 4 million NOK in 1985 to 7 million NOK in 1986. This is of course far from enough. It is just barely enough to partially treat the most severely affected locations of high economic and regional importance, the aim being to save some of the most valuable fish populations which are threatened.

Liming is, and will continue to be, just an emergency measure to use in limited areas in Norway. To solve the problem of acidification, we have to go to the source, to reduce the emissions. Liming just temporarily takes away the symptoms. It is an ecological aspirin and not a long term solution.

## CONCLUSION

Being now at the end of my statement, I want to draw the line back to where I started. During this Conference a number of scientific results and advanced models have been presented. I would like to remind you that although there still are many scientific uncertainties, we know that at present, the loading of long-range air pollution is too high.

In Norway there is an old saying which goes "while the grass grows, the cow dies". We should see to it that the cow, which in this case is nature, on which we at present are carrying out a gigantic and highly risky experiment, does not suffer irreparable damage while we await full scientific knowledge and perfect models.