Air pollution

Innholdsfortegnelse

Air pollution

Published 09.04.2018 by the Norwegian Environment Agency

Air quality in Norway has generally improved since the 1990s. However, poor air quality still causes health problems, especially in larger towns.

Jump to:

Norway has national targets for concentrations of particulate matter and NO2. Oslo and Bergen are the only towns that do not meet the national target for NO2, whereas both these and some smaller towns are still missing the target for particulate matter. Photo: Arne Halvorsen, Flickr

Children and unborn babies are particularly vulnerable to road traffic pollution. Photo: Linn Bryhn Jacobsen, Norwegian Environment Agency

Although newer cars pollute less, the volume of traffic has been growing. Road traffic is the most important source of air pollution in Norway. Foto: John Petter Reinertsen

Pressure

Road traffic dominant source of pollution

Road traffic is the dominant local source of air pollution in Norway, this is due to both exhaust emissions and the widespread use of studded tires from October to April. A car with studded tyres produces up to 100 times more particulate matter than a car with regular tyres.

Wood-burning stoves also make a contribution to the concentration levels of particulate matter, especially on cold days in the winter months.

Other important sources are industrial emissions in Norway, and long-range transport of pollution from traffic and the use of oil and coal in other European countries. The latter also contributes to ground-level ozone and acid rain.

- Read more about local air pollution in Norway
- Read more about acid rain

Impact

Air pollution can cause serious health problems

Air pollution can cause respiratory disease, cardiovascular disease and cancer, and in particular, worsen the situation for those who are already ill.

Limit values for local air pollution set by the authorities have been exceeded the last winters in several Norwegian towns.

The national target for PM10 is also exceeded in both large and small towns. In several towns the levels of particular matter have declined, while in others, they vary from year to year.

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Air pollution does not only contribute to health problems in large towns. Deposition of hazardous substances, acid rain and ground level ozone from the European continent may harm animals and vegetation as well. Fish stocks, especially in southern Norway, have been reduced or lost due to acid rain.

Response

National and international measures required

Norway has international obligations to reduce the emissions of harmful gases and particles. In addition, we have set both national targets and legally binding limit values for the concentration of particulate matter and NO2 in outdoor air.

In order to improve air quality, Norway is implementing measures to reduce emissions from road traffic, wood burning and shipping. However, we also rely on emission reductions in other countries to overcome our problems. Norway takes part in international efforts to reduce long-range pollution.

- Read more about Norway's targets and indicators on air pollution

1. Local air pollution

Published 26.01.2018 by the Norwegian Environment Agency

There has been a general improvement in local air quality in Norway since the 1990s. But there are still problems in several towns, and Norway's national targets for local air quality were not achieved in 2016.

Jump to:

Heavy traffic on a cold winter day. Foto: iStockphoto

State

Limit values and target levels exceeded every year

In Norway, particulate matter (PM10 and PM2.5) and nitrogen dioxide (NO2) are the most important components of local air pollution. Other pollutants such as sulphur dioxide (SO2), ground-level ozone, carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs) and benzene can also contribute to poor local air quality.

Norway has national targets for concentrations of particulate matter (PM10 and PM2.5) and NO2. In several towns these targets are not being met. In addition there are legally binding limit values laid down by the Pollution Regulations.

There has been a downward trend in levels of particulate matter in several towns, but in others levels vary from year to year, and the limit values are exceeded some years. The limit values for NO2 are regularly exceeded in Oslo and Bergen.

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Impact

Air pollution is harmful to people, plants and animals

The health risks associated with local air pollution depend on the concentrations of pollutants and exposure time. Children, pregnant women, the elderly and people with asthma and respiratory diseases or those suffering from cardiovascular disease are particularly vulnerable. It is well documented that air pollution contributes to death and loss of healthy life years in Norway.

Health risks greatest for particulate matter and NO2

Particulate matter is the air pollutant that poses the most serious health risk, although NO2 is also a significant factor, escpecially in Norway's largest towns. Exposure to these substances increases the frequency of various types of respiratory diseases. Particulate matter can also cause cardiovascular disease and higher mortality.

Particulate matter consists of particles of such small size that they can be inhaled. The largest of them are stopped in the upper airways, but smaller particles with a

diameter of less than 10 µm (called PM10) can penetrate deep into the lungs.

Other air pollutants are also harmful. SO2 can result in lung disease in healthy people as well as asthma patients. Benzene and other aromatic compounds such as PAHs are carcinogenic. CO reduces the capacity of the blood to transport oxygen and can cause headaches, nausea and other problems for heart patients.

Effects on ecosystems and vegetation

Local air pollution can be harmful to ecosystems and vegetation. NO2 and SO2 both contribute to acidification and eutrophication of lakes and rivers. CO, NO2 and VOC also contribute to the formation of ground-level ozone, which can damage vegetation and various types of materials. SO2 is also corrosive and erodes buildings and historical monuments.

Driving forces

More transport means more pollution

Road traffic, domestic heating, long-range pollution and industry are all sources of local air pollution. Important factors influencing the emission trends from these sources include:

- economic growth, which results in a higher volume of traffic
- the siting of workplaces and homes, which influences transport needs
- road construction, which influences traffic volumes
- car ownership, which increases mobility
- the size of people's homes, which influences heating needs
- the technology available – abatement technology and efficiency improvements can reduce emissions

Economic growth, expanding international trade, changes in land use patterns and rising private consumption all result in a larger volume of transport. A higher volume of transport reduces the effect of stricter emission limits and improved vehicle technology.

Pressure

Road traffic the dominant source of local air pollution

In Norway, road traffic is the dominant source of local air pollution, including both exhaust emissions and asphalt dust generated by studded tyres. Fuelwood use is another important source of particulate matter.

Road traffic

Road traffic is an important source of particulate matter, though the proportions vary during the year and from place to place. During dry periods in winter and spring the resuspension of asphalt dust contributes to the largest concentration of particulate matter.

NOx-emissions from vehicle exhaust accounts for the largest part of the concentration levels of NO2. Diesel vehicles produce higher emissions of both NOx and particulate matter than petrol vehicles. Stricter European requirements have been introduced, and NOx-emissions from both newer diesel and petrol vehicles are therefore considerably lower than they used to be. The proportion of NO2 in NOx-emissions, however, has increased. We therefore do not see a corresponding decrease in NO2 concentrations.

Wood-burning, industry and long-range pollution

Wood-burning results in emissions of particulate matter and PAHs, especially on cold days in winter, when many people use wood-burning stoves. Other important sources of local air pollution are industrial emissions and long-range transport of pollution from other European countries.

Response

Measures and instruments

Norway has set national targets for the concentrations of particulate matter and NO2 in outdoor air. In addition, there are legally binding limit values, which are the same as those that apply in the EU. These are set out in Chapter 7 of the Pollution Regulations.

In Norway, the municipalities are responsible for control and enforcement of legal requirements relating to local air quality. A number of measures have been implemented to improve local air quality. Examples of such measures include restrictions on the use of studded tires, speed reductions, road maintenance and the replacement of old, polluting stoves. Examples of measures against NO2 are low emissions zones and time and environmentally differentiated tolls. In addition, measures that reduce emissions from ships may have an effect in port areas.

Traffic-reducing measures implemented to reduce greenhouse gas emissions, noise or increase accessibility for public transport will also reduce NO2 levels. In order to get good results a comprehensive use of instruments and good cooperation both locally, regionally and nationally is necessary.

Reducing emissions from road traffic and vehicles

Measures to reduce traffic are most effective when used in combination, for example road pricing combined with parking restrictions and improvements in public transport.

The Planning and Building Act can be used actively to influence the location of workplaces and housing and reduce the need for transport, and to encourage a switch to environmentally sound forms of transport.

Technical measures

Technical measures can be used to reduce emissions from individual vehicles. The European emission limits for vehicles are being made increasingly stricter, and the petrol and diesel quality is being improved. The use of studded tyres can be discouraged through local regulations imposing a charge on their use. Emissions from road traffic can also be reduced by encouraging the use of alternative fuel types such as gas, hydrogen or electricity.

Reducing emissions from wood-burning stoves

Since 1 July 1998, new wood-burning stoves have had to meet legal standards for emissions of particulate matter. To encourage the replacement of old, polluting stoves, muncipalities can introduce a system of partial rebates. Such schemes have for example been introduced in Oslo and Bergen. Older stoves can also be retrofitted with equipment to reduce emissions.

Reducing long-range pollution

Long-range air pollution is being reduced through international agreements and EU directives. These include the Convention on Long-range Transboundary Air Pollution, the EU directive on emissions to air from large combustion plants, and the EU directive on national emission ceilings for certain pollutants (or NEC Directive).

2. Acid rain

Published 09.04.2018 by the Norwegian Environment Agency

A great deal has been done to reduce sulphur emissions in Norway and the rest of Europe, and pollution has been substantially reduced as a result. Nevertheless, much of the southern half of Norway is still suffering from damage caused by acid rain.

Jump to:

In 2020, Norway will still have lakes that are too acid to accommodate viable populations of trout or other fish species. Photo: Svein Nic. Norberg

Liming of rivers and lakes is an important means of remedying the worst of the damage caused by acid rain. The aim is to give animals and plants a chance to re-establish themselves. In Norway, liming is most extensive in Telemark, Aust-Agder, Vest-Agder and Rogaland counties. Photo: Helge B. Pedersen

State

Southern half of Norway still suffering from damage

Deposition of sulfur and nitrogen can lead to acidification of water and soil. In Norway acidification, results in reduced water quality in lakes and rivers in the southern half of of the country, and especially in the southernmost counties. Over the years many fish stocks have been depleted or wiped out, and other aquatic animals and plants are also affected.

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Sulphur causes acidification in Norway

Deposition of sulphur causes acidification in Norway, and sulphur deposition is highest in the most sensitive areas in the south. As sulphur emissions are being reduced more rapidly than nitrogen emissions, the relative importance of nitrogen as a source of pollution is increasing.

Nitrogen also has other effects

Nitrogen has more complex ecological effects than sulphur, because it can also act as a fertiliser and cause eutrophication. Most nitrogen is absorbed by plants or the soil, but the remainder ends up in fjords and coastal waters, where it can fuel eutrophication and excessive algal growth.

Critical loads low in the southern half of Norway

Critical loads are used to define the amount of pollution different ecosystems can absorb without damage to the natural environment. In Norway, freshwater ecosystems are particularly sensitive to acidification. Critical loads for freshwater are based on the effects on trout. They are particularly low in the southern half of the country, mainly because soils are thin and the bedrock consists of acidic rocks such as gneiss and granite.

Impact

Acid rain kills fish

Salmon stocks lost in the southernmost counties

Acid rain has led to a significant reduction of biological diversity in rivers and lakes in Norway. The salmon stocks in southern Norway and south western Norway were hit hard by acidification. At least 25 salmon stocks were lost and at least another 20 were negatively affected. As a result of liming, salmon stocks in 12 watercourses are now secured, and salmon stocks have been re-established in ten other rivers where the salmon was extinct.

About 15,000 stocks of fish in inland, freshwater systems were also lost or affected by acidification. Today it is assumed that lakes in about seven per cent of the area in Norway are significantly affected by acidification.

Little or no damage to Norwegian forests

In the 1980s, acid rain resulted in widespread damage to forests in the border areas between Poland and the former East Germany and Czechoslovakia. There was serious concern about similar damage in Norway, and in 1984 the Norwegian Monitoring Programme for Forest Damage was started.

On the whole, Norwegian forests appear to have tolerated sulphur and nitrogen deposition without serious effects. They showed a decrease in vitality (measured as crown density) during the 1990s, but since then conditions have improved. In the last few years, the health of Norwegian forests has remained stable.

Major economic consequences

In addition to its effects on ecosystems, acid rain has serious consequences for society as a whole. One example is that loss of fishing opportunities can lead to economic losses for businesses in the affected areas. About 90−100 million NOK has been spent annually on liming of rivers and lakes in recent years. Acidification may also damage buildings, sculptures, rock art and other parts of our cultural heritage.

Driving forces

Trends determined by energy use

Acid rain is mainly caused by combustion of fossil fuels. More than 90 per cent of the sulphur and 80 per cent of the nitrogen deposited in Norway originates in other European countries. The UK, Germany, Poland and the North Sea are among the most important sources. This means that the amount of acid rain falling on Norway is to a large extent determined by developments elsewhere in Europe.

The European emissions have been greatly reduced over the last 20−30 years. This is largely due to technical improvements in industrial processes, and a transition from coal to fuels with less sulphur. There has not been a corresponding reduction in the emissions of nitrogen, because these emissions are highly influenced by the use of transport.

Pressure

Industry and transport the main sources

Power plants, industrial processes (especially metal production) and transport are the main sources of acidifying emissions.

Sulphur and nitrogen deposition in Norway declining

Inputs of sulphur and nitrogen to Norway have declined as emissions in Europe have been reduced. However, there has been a much smaller overall reduction for nitrogen (sum of oxidised and reduced nitrogen) than for sulphur. There are several reasons for this:

- it took much longer before people began to focus on the harmful effects of nitrogen
- it took longer before international agreements on the reduction of nitrogen emissions were concluded
- the mix of sources is different for nitrogen, and this has made it more difficult to find effective ways of reducing emissions.

Read more about the data

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Total deposition of sulphur in Norway was reduced from about 200,000 tonnes in 1980 to 27,000 tonnes in 2013, a reduction of more than 85 per cent. In 2014, however, the deposition rose dramatically, and was 3.5 times as high as the previous year. This was due primarily to large sulphur emissions from the volcano Bardarbunga in Iceland. It is estimated that the emission from the volcano was more than three times as high as the annual man-made emissions from all EU countries. Heavy rainfall in southern Norway in 2014 may also have contributed to increased deposition.

Total deposition of nitrogen in Norway was about 110,000 tonnes in 1980, and increased to 117,000 in 1990. From 1990 to 2013, there was a sharp reduction in deposition; from 117,000 tonnes to 66,000 tonnes. However, from 2013 to 2014 deposition of nitrogen increased by about 30 per cent. This is explained by heavy rainfall over southern Norway in 2014.

Norwegian sulphur and nitrogen emissions declining

In Norway, the main sources of sulphur dioxide emissions are metal production, stationary combustion and other industrial processes. Norwegian emissions have been greatly reduced, from about 150,000 tonnes a year in the 1970s to about 15,600 tonnes in 2016.

The main sources of nitrogen emissions in Norway are the oil and gas industry, coastal shipping, fishing vessels and road traffic. In 2016, emissions were about 153,000 tonnes. In addition, there was a total emission of 28,000 tonnes of the nitrogen compound ammonia. Agriculture accounts for about 90 per cent of the emissions of ammonia.

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Response

International agreements are vital

Acid rain does not respect national borders, and is a problem for most European countries. The answer has been to join forces to reduce overall European emissions of sulphur and nitrogen.

Binding international agreements

Most European countries have undertaken to reduce their emissions of acidifying substances through the Convention on Long-range Transboundary Air Pollution (LRTAP). Several binding protocols have been adopted under the convention, including the Gothenburg Protocol, which entered into force in 2005. Initially emissions ceilings were set for 2010, but the protocol was renegotiated in 2012 and new emissions ceilings (to be met in 2020) have been set.

Norway met the 2010 emission ceiling for sulphur dioxide in 2006, while emission ceilings for ammonia and nitrogen oxides were not met. The emissions of ammonia were about 4000 tonnes above the target of 23,000 tonnes in 2010. For nitrogen oxides the emission ceiling was 156,000 tonnes in 2010, while the Norwegian emissions were about 182,000 tonnes.

In the revised Gothenburg Protocol, Norway has undertaken to reduce emissions of sulphur dioxide, ammonia and nitrogen, by respectively 10.8 and 23 per cent relative to emissions in 2005. For Norway, the new requirements represent only minor changes. For sulphur dioxide, the target was reached already in 2007. For nitrogen oxides the target was reached in 2013. Emissions of ammonia must be reduced from 28,000 tonnes in 2016 to 25,000 tonnes in 2020.

Revised EU Directive on National Emissions Commitments by 2030

In 2013, the EU Commission presented a proposal for a revised directive on national emission obligations for sulphur dioxide, nitrogen oxides and ammonia, by 2030. The implementation of the directive will further reduce cross-border air pollution in Europe.

Liming reduces damage

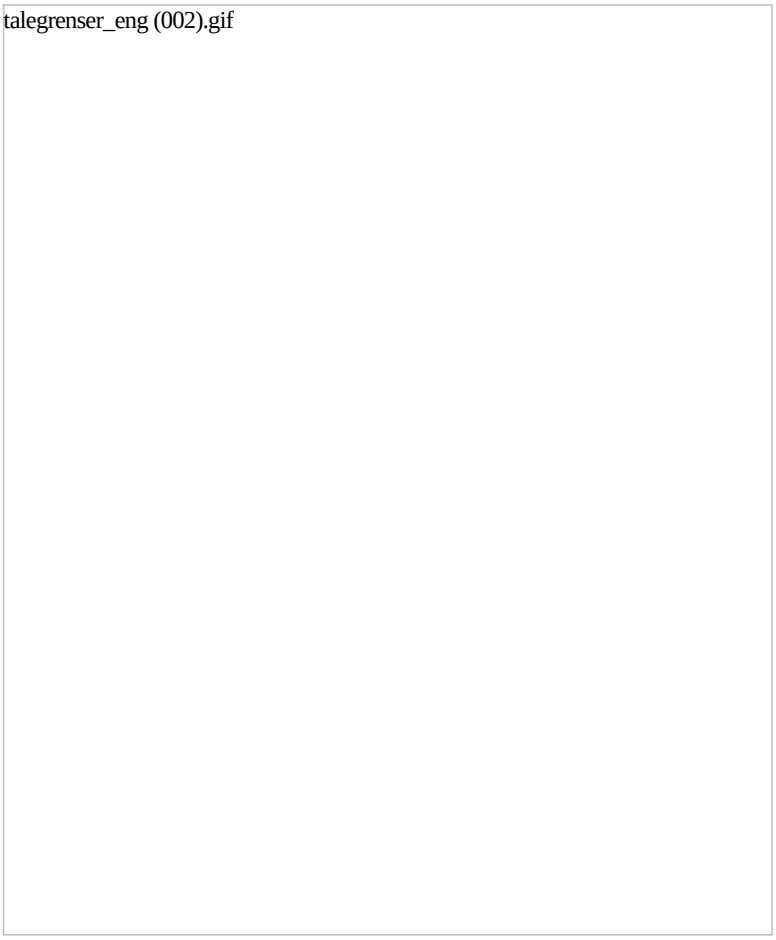
Liming of rivers and lakes is an important means of remedying the worst of the damage caused by acid rain. The aim is to give animals and plants a chance to re-establish themselves. Each year 25,000−45,000 tonnes are applied in Norwegian rivers and lakes. The liming programme is most extensive in Telemark, Aust-Agder, Vest-Agder and Rogaland counties.

2.1. Areas where critical loads are exceeded

Published 15.06.2018 by the Norwegian Environment Agency

Critical loads are used to define the amount of pollution different ecosystems can absorb without damage to the natural environment. In Norway, the area where critical loads are exceeded has decreased since 1980.

In 1980 critical loads were exceeded in 30 percent of the total area. During the period 2002-2005, the area was reduced to 11 percent. Similar figures for 2012-2016 were 7 per cent. The map below shows the reductions in areas where critical loads were exceeded in Norway from 1978 to 2016. New figures will be published in 2022.



3. Ground-level ozone

Published 20.09.2010 by the Norwegian Environment Agency

Ozone in the upper atmosphere protects the earth against dangerous radiation from the sun. Ground-level ozone, on the other hand, is harmful to both people and the environment if concentrations rise too high. Concentrations of ground-level ozone are lower in Norway than in central and southern Europe. In Norway ground-level ozone may exceed recommended limit values in summer.

Jump to:

State

Southern Norway most affected

Ground-level ozone is formed from nitrogen oxides (NOx) and volatile organic compounds (VOCs) when they are exposed to sunlight. In the last hundred years, the concentration of ground-level ozone has doubled in Europe. The highest ozone concentrations are found in countries in central and southern Europe. NOx and VOC emissions are also highest in these countries.

- See up-to-date air quality maps for Europe (provisional data including O3, PM10, NO2, SO2)

In Norway the main source of NOx and VOCs is long-range transport from other European countries. Emissions in Norway also make some contribution to ozone formation, particularly around major point sources. The hourly mean value recommended by the Norwegian Environment Agency is 100 µg/m3, but this level is often exceeded throughout the country. The recommended limit is only slightly higher than the natural background concentration, and is intended to protect the people who are most susceptible to respiratory diseases from ill-effects.

Throughout the year the natural background concentration in Norway, and the rest of Scandinavia, is between 40 and 80 µg/m3. In Norway the highest ozone concentrations normally occur in spring and early in the summer. These pollution episodes last for a few hours or days, and often occur when polluted air is transported to the north due to high pressure over central and southern Europe. The highest values are measured in the southern parts of Norway.

Norwegian monitoring system

Norway has a monitoring system for ground-level ozone from Birkenes in Vest-Agder in the south to Ny-Ålesund on Svalbard in the north. Concentrations of ozone at each of the measuring stations are measured hourly by the Norwegian Institute for Air Research, and are available on-line.

Impact

Effects on health and vegetation

High concentrations of ozone can cause various health problems, such as reduced lung capacity, bronchitis and asthma, headaches, and irritation of the eyes and mucous membranes.

Short episodes involving high ozone concentrations often cause most discomfort and the most serious effects on people's health. People who already have reduced lung capacity may be affected at concentrations over 160 µg/m3.

Healthy people do not feel any discomfort or effects on their health until concentrations reach 240 µg/m3. At such high concentrations, even healthy people may experience discomfort and health problems. We have never measured such high levels in Norway, but they do occur in central and southern Europe.

In Norway only people who are particularly sensitive are likely to notice symptoms caused by high ozone concentrations. People without lung problems are unlikely to notice any discomfort, but should not take part in strenuous physical activities when ozone levels are high.

Vegetation is also damaged by high ozone concentrations

Crops, forests and other vegetation are also affected by ground-level ozone. Both pollution episodes when ozone concentrations are high and long-term exposure to lower concentrations can result in acute or lasting damage. Slightly elevated ozone concentrations that last for long periods of time cause most damage to vegetation. Ozone affects a number of processes in plants. It slows down photosynthesis and growth, but accelerates ageing and causes early leaf drop.

Direct ozone damage, for example to foliage, is rare in Norway, but there is reason to believe that ozone reduces crop yields and the productivity of forests in the southern half of the country. Grass production in lowland areas is most affected. The costs of the losses in crop yields caused by ozone (based on yields of wheat, potato and cultivated meadow) are believed to be of the order of NOK 100-400 million per year.

Ozone pollution is thought to have considerably less effect on plant production and yields in Norway than in many other countries in Europe. This is mainly because the growing season starts late in Norway, so that plants are not so vulnerable in the periods when the pollution load is highest.

Damage to materials

Together with nitrogen dioxide (NO2) and sulphur dioxide (SO2), ozone reduces the strength and durability of various materials. These gases are highly corrosive and severely damage buildings and materials, rubber and plastics in particular are affected by high concentrations.

Pressure

Tranport and petroleum industry important sources

The NOx emissions that contribute to ozone formation are mainly generated by transport. The combustion of fossil fuels containing nitrogen, for example in car engines and power plants, involves NOx emissions. In addition, NOx is formed directly from the combustion air in furnaces and motors, regardless of the nitrogen content of the fuel itself.

In Europe, the volume of road traffic, shipping and air traffic determines the level of emissions. In Norway, coastal shipping, the fishing fleet and the petroleum industry are important sources, in addition to road traffic.

Petroleum activities an important source of VOC emissions

Evaporation during the handling of crude oil and petrol is the main source of VOC emissions in Europe. For example, the vapour you can see rising as you fill up your car contains VOC emissions. The largest source of VOC emissions in Norway is the petroleum industry. Measured per capita the Norwegian VOC emissions are among the highest in Europe. The main reason is the emissions from handling of crude oil. Road traffic is another important source.

In addition, the use of other products containing oil and solvent-based products such as paints and varnishes adds to emissions. As is the case for NOx, VOC emissions in Europe are determined by the volume of transport and sales of fossil fuels.

Response

International cooperation to reduce emissions

The Convention on Long-range Transboundary Air Pollution provides the framework for international agreements to reduce emissions of NOx and VOCs in Europe.

Norway is a signatory to the Convention, and has undertaken to reduce its emissions to a maximum of 156 000 tonnes of NOx and 195 000 tonnes of VOCs by 2010. This corresponds to reductions of 28 and 37 per cent, respectively, from the 1990 levels. For Europe as a whole, NOx emissions are to be reduced by 41 per cent and VOC emissions by 40 per cent by 2010, compared with the 1990 levels.

If all countries follow up their commitments to reduce emissions, we expect to see fewer pollution episodes involving ground-level ozone in Norway in the future. There is already a tendency for the maximum values recorded in Norway to decrease. This is because emissions of NOx and VOCs in Europe have been reduced through earlier agreements.

Recommended concentrations will still be exceeded

Despite the agreements to reduce emissions, it is highly probable that the maximum recommended concentration of ground-level ozone in the air quality guidelines issued by the Norwegian Environment Agency and the national health authorities will continue to be exceeded in the future.

Norway is required by the European Economic Area (EEA) Agreement to comply with the current EU directive on air pollution by ozone, which states that the authorities must issue information when concentrations reach a specified threshold (over 180 µg/m3).

It is unlikely that population warnings will be necessary in the future, given the emission reductions that have been agreed, but unfortunately the most sensitive groups of the Norwegian population, those with respiratory complaints, will probably have to take precautions at times for many years to come.