

# Ground-level ozone

## Innholdsfortegnelse

# 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.

## STATE

### Southern Norway most affected

Ground-level ozone is formed from nitrogen oxides (NO<sub>x</sub>) 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. NO<sub>x</sub> and VOC emissions are also highest in these countries.

- See up-to-date air quality maps for Europe (provisional data including O<sub>3</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>)

In Norway the main source of NO<sub>x</sub> 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/m<sup>3</sup>, 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/m<sup>3</sup>. 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/m<sup>3</sup>.

Healthy people do not feel any discomfort or effects on their health until concentrations reach 240 µg/m<sup>3</sup>. 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 (NO<sub>2</sub>) and sulphur dioxide (SO<sub>2</sub>), 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

## Transport and petroleum industry important sources

The NO<sub>x</sub> 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 NO<sub>x</sub> emissions. In addition, NO<sub>x</sub> 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 NO<sub>x</sub>, 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 NO<sub>x</sub> 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 NO<sub>x</sub> 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, NO<sub>x</sub> 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 NO<sub>x</sub> 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/m<sup>3</sup>).

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.