

# Air pollution

## Introduction

By air pollution we mean the presence, in the air, of one or more substances that alter the composition and equilibrium of the atmosphere, causing harmful effects for humans, animals, plants and for the environment.

In order to protect our Planet and its inhabitants we should not pollute the air. By adopting small daily actions, like switching off the lights when they are no longer required, using the car only if it is necessary, recycling waste, and by not exaggerating when heating or cooling environments where we live, we can avoid releasing into the atmosphere those gases that are responsible for pollution, that provoke acid rain, ozone depletion, and the greenhouse effect. How important a small gesture can be!

## What it is

### Air pollution sources

The air is polluted when one or more substances modify its characteristics making it harmful both for men and the environment. There are several pollution sources:

- burners (heating systems and thermoelectric plants)
- transports (spark-ignition engine)
- industrial waste

The most dangerous pollutants are:

- carbon oxide (CO), that is very harmful for health
- sulphur dioxide (SO<sub>2</sub>), that provokes acid rain
- nitrogen oxides (NO), that are harmful for health
- ozone (O<sub>3</sub>), that is very harmful if inhaled
- benzene (C<sub>6</sub>H<sub>6</sub>), that is highly toxic
- fine dusts (PM10), that transport very poisonous substances to the lungs

### Consequences of air pollution

Some pollutants, if they are present in excessive quantities, can produce chemical and physical alterations of the air, hampering its capacity to “work” correctly and guarantee our survival functions. Men’s activity usually originates pollutants (anthropogenic origin), although in some cases natural sources contribute significantly. Most of human-origin air pollution derives either from fossil fuels (their combustion is necessary to produce energy) or from industrial chemical processes. The environmental impact of air pollutants is variable: some compounds mainly act at local level, where they are produced and distributed, while others affect entire regions.

Some others have an impact on the whole planet. In fact, some atmospheric agents have a short life (a few hours or a few days) and after that they fall on the ground, while other pollutants keep active for long periods and can spread on a wider area. This type of pollutants can have an influence on environmental conditions at a continental, sometimes even planetary level, with a negative impact on human health, even in places that are far away from the source of pollution. In most cases, the type and quantity of pollutants emitted into the atmosphere depend on the nature of the energy sources that are used (see the corresponding section on natural resources) and on the raw materials that men use during production processes.

## Suggestions to reduce pollution

### Travel respecting the air

If you use public transport more than private cars, you will reduce air pollution in your city. Public means of transport (buses, trams, trains), bicycles or your own legs are the best way to help the environment.

The cooler you are, the cooler the Earth

In winter, if we only reduce the average temperature in schoolrooms by one centigrade, we will reduce CO<sub>2</sub> emissions inside the school by 7%.

### Save electricity!

Remember to switch off the light if you do not need artificial light. If you keep a 60 W bulb off for 5 hours a day, in one year you will save around 80 kg of CO<sub>2</sub>. In fact, in order to produce 1 kWh approximately 0.72 kg of CO<sub>2</sub> are released into the atmosphere

### Paper is always young!

Also by recycling paper we can reduce the emission of dangerous gases. In order to produce paper we need energy, we have to cut down trees and use chemical products like binders, whitening substances and solvents, that provoke air pollution.

### Password: choosing, differentiating and recycling

Waste disposal releases a large quantity of dangerous gases into the atmosphere. For instance, for each kg of organic waste 0.31 kg of methane (a very dangerous greenhouse gas) is produced. Let us choose products with a recyclable package. Differentiating and recycling waste means producing fewer gases that damage the environment.

## Pollutants and their effects

### Acid deposits

The atmosphere contains acid-reaction substances that deposit on the Earth's surface and contaminate it: they are the so-called "acid deposits". The substances that make these deposits acid are generally nitric acid and sulphuric acid, that form by the reaction of water and nitrogen oxides and sulphur oxides (SO<sub>x</sub>) contained in polluted air. Nitrogen oxides are produced by the combustion of fossil energy sources rich in sulphur – especially coal and lignite – and by volcanic eruptions. Instead sulphur oxides can have a natural origin (lightning, fires, bacterial decomposition of organic materials, biological processes of the oceans), or an anthropogenic origin, deriving from the combustion of fossil energy sources.

Acid deposits alter the acidity of lake and river waters (making it impossible for fish and other water organisms to live there) and that of soils (by altering the availability of nutritional elements, resulting in the reduction of fertility and productivity). Acid deposits can also directly damage the vegetation (for instance by melting the wax that protects the leaves and making them more vulnerable to parasitic attacks), buildings, monuments and, if particularly intense, man and animals as well.

### The stratospheric ozone layer

Ozone has been much talked about over the last few years, becoming an increasingly important problem, either because there is too little or too much of it. If there is too much ozone in the troposphere (that is in the part of the atmosphere that is closest to the ground, the one where we live and that we breathe), it represents one of the most harmful substances of photochemical smog ("bad ozone"). In the stratosphere, instead, (i.e. in the part of the atmosphere that is highest and most distant from us), ozone is extremely useful and there must be plenty of it, since it works as a natural screen (good ozone) that filters out the harmful ultraviolet rays emitted by the sun (UV). In the last few years, though, the amount of ozone contained in the stratosphere seems to have decreased due to some substances of anthropogenic origin (the notorious "ozone hole"). The emissions for industrial, agricultural and private uses of some substances, such as chlorofluorocarbons (CFC), methyl bromide, halons and methyl chloroform, contribute, either directly or indirectly, to destroy the precious molecules of the stratospheric ozone. Even if it affects the whole atmosphere, the stratospheric ozone layer seems to be more depleted at the poles. The most direct consequence of the hole in the ozone layer is an increase in the amount of ultraviolet rays (UV-B) that reach the Earth's surface. These rays cause: a higher risk of

tumours and eye diseases a decrease in men and animals' immune defences a reduction in the photosynthesis and damages to the DNA of plants, with a significant impact on farming a reduction in the production of phytoplankton in the sea, with significant damages in the food chain of water ecosystems.

## Radioactive pollution

The sudden explosion that occurred in April 1986 in the Chernobyl plant, in the former Soviet Union, brought the whole world face to face with the tragic consequences of the nuclear pollution of the air, related in particular to the international dimension of this risk of pollution. The radioactive cloud that followed the explosion had released into the atmosphere several radio-nuclides (Barium 140, Iodine 131, etc.) that were carried far away by the winds before falling back to the ground through meteoric precipitations. It was observed, therefore, that the damage caused by nuclear pollution is not limited to a specific area, but it can affect large regions, even very far from its source. When aground, the radio-nuclides, that contaminate the vegetal species and get into the food chain, are taken in by man and concentrate in some specific organs. In man, exposure to rays emitted by radio-nuclides increases the number of cases of tumours and leukaemia.

## Photochemical pollution

The "photochemical smog" is a typical form of pollution of all the main urban and industrial areas of the world. It occurs in or near areas with a high traffic density, in the presence of specific climatic conditions (no wind or weak winds, high temperatures, etc.), that cause the concentration of polluting gases to increase and prevent them from dispersing. In these areas, the concentrations of some gases (tropospheric ozone, carbon monoxide, particulate, VOC, nitrogen oxides, etc.) very often exceed the threshold values, above which there are risks for human health, farming and natural vegetation.