AIR POLLUTION

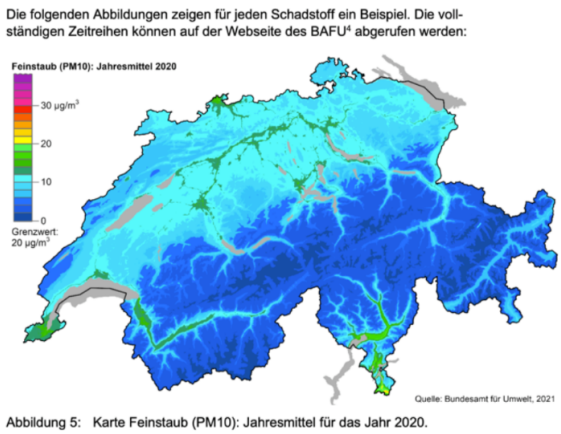
Air pollution occurs when any chemical, physical, or biological factor contaminates the indoor or outdoor environment, altering the natural characteristics of the atmosphere.

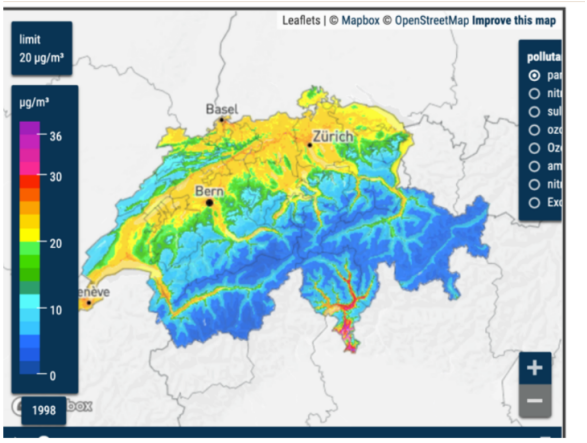
Air pollution caused by Particulate matter and gas is a public health concern. Air pollution, both outdoor and indoor, causes respiratory and other illnesses and is a significant cause of morbidity and mortality, especially in developing countries. Each year, air pollution is predicted to kill seven million people worldwide (4.3 million deaths/year from exposure to the household (indoor) air pollution and 3.7 million deaths/year are attributable to ambient (outdoor) air pollution).

Air Pollution in Switzerland

Since the mid-1980s, Switzerland's air quality has progressively improved. Even so, ozone (O3) concentrations exceed the ambient limit values over a large area, particulate matter PM10 and PM2.5 concentrations exceed the ambient limit values at several locations, and nitrogen dioxide (NO2) concentrations exceed the ambient limit values at several locations near traffic. Ammonia (NH3) pollution is also significantly greater than the crucial limit amount.

The figure below illustrates the reduction of PM10 contamination in Switzerland between 1998 and 2020.





Source: Federal office for the environment FOEN

CAUSES OF AIR POLLUTION

Air pollution is caused by:

- Fine particles: Microscopic dust particles (PM10 and PM2.5)

These particles occur in a variety of sizes and forms and can be composed of a wide variety of substances. Certain types of pollutants are emitted directly from sources such as construction sites, unpaved roads, fields, smokestacks, or fires.

- Ozone O3

Ozone is produced as a byproduct of pollutants generated by automobiles, power plants, industrial boilers, refineries, and chemical facilities, as well as paints, cleaners, solvents, and motorized lawn equipment.

- Nitrogen compounds

NO2 is predominantly released into the air as a result of fuel combustion, automobile, truck, and bus emissions, power plants, and off-road equipment.

Agriculture is the primary source of NH3 emissions, including animal husbandry and NH3-based fertilizer applications. Additionally, industrial operations, vehicular emissions, and volatilization from soils and oceans are all sources of NH3.

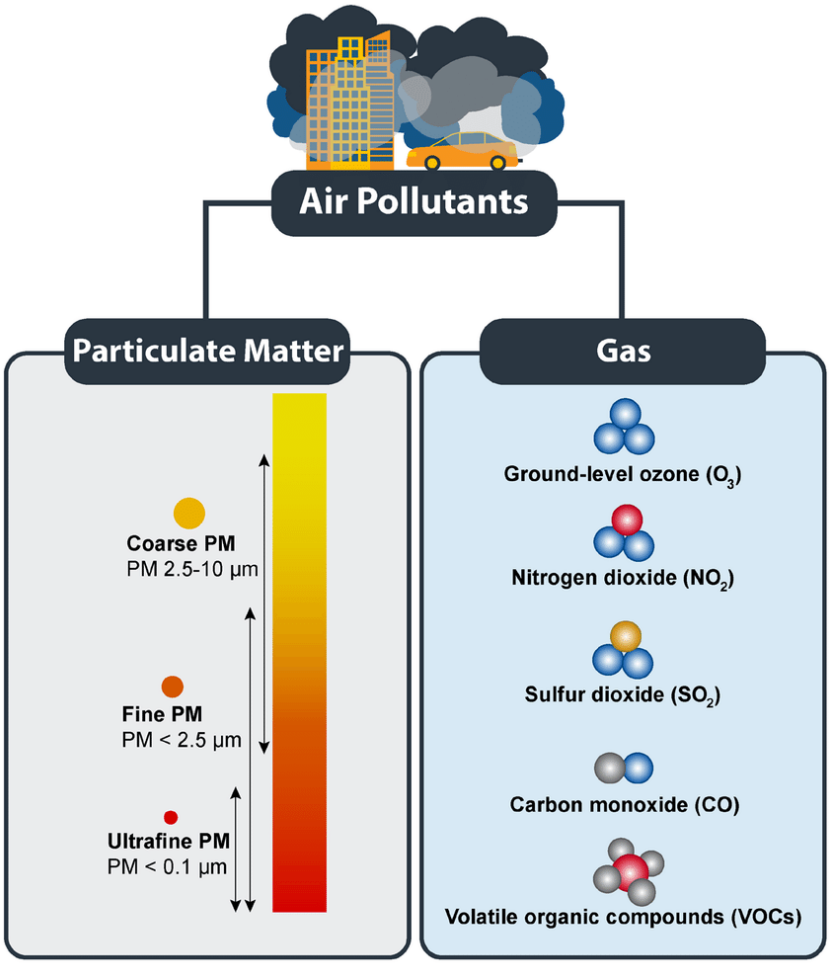
- Carbon monoxide

The primary sources of CO in outdoor air are automobiles, trucks, and other fossil-fuel-powered vehicles and machinery. Devices used in homes, including unvented kerosene and gas space heaters, leaking chimneys and furnaces, and gas stoves, all emit CO.

- Sulfur dioxide

The primary source of SO2 in the atmosphere is the combustion of fossil fuels by power plants, other industrial facilities, industrial processes such as metal extraction from ore; natural sources such as volcanoes; and locomotives, ships, and other vehicles and heavy equipment that run on sulfur-containing fuel.

Below is a graphic illustrating the various forms of air pollution found around the world.

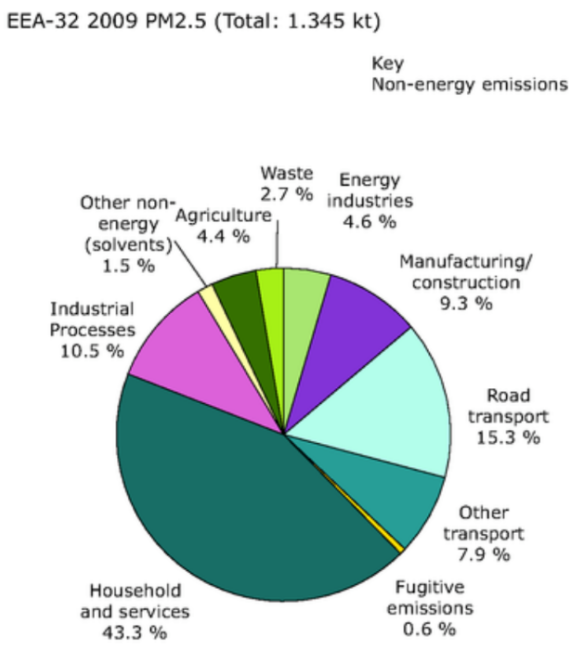


Source: Sompornrattanaphan, Mongkhon & Thongngarm, Torpong & Ratanawatkul, Pailin & Wongsa, Chamard & Swigris, Jeff. (2020). The contribution of particulate matter to respiratory allergy: A review of current evidence. Asian Pacific journal of allergy and immunology. 38. 10.12932/AP-100619-0579.

CONSEQUENCES OF AIR POLLUTION

Air pollution caused by microscopic dust particles (PM10 and PM2.5) **(fine particles)** has a significant impact on human health and is a source of contention for Swiss air pollution management policies. High quantities of particulate matter, particularly in the winter, can occur in weather conditions with a limited exchange.

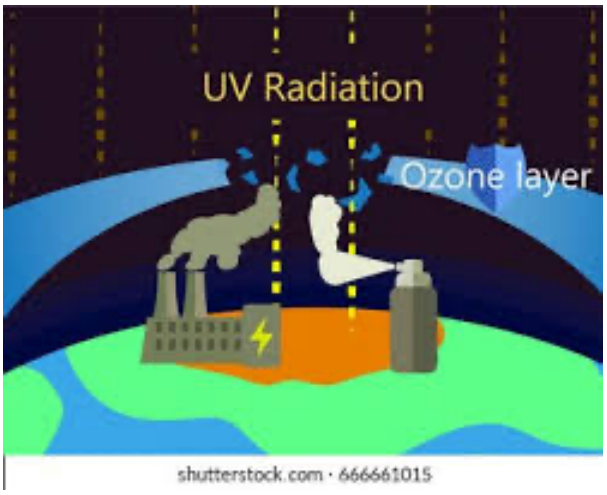
This gràfic shows the percentatge of non-energy atmosphere types emissions of PM2.5.



Source: European environment agency

Summer days without a breeze result in an increase in **ozone** concentrations. This pollution has a detrimental influence on human health, the environment,

buildings, materials, and the climate. The confederation's policy aims to permanently reduce precursor chemicals (nitrogen oxides and volatile organic compounds). Air pollution containing nitrogen has an effect on biodiversity.



Source: Google immages

This illustration depicts what occurs when the Ozone layer deteriorates as a result of gas emissions and UV radiation entering the atmosphere.

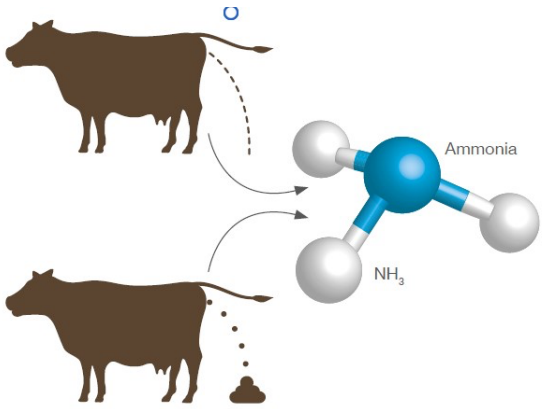
Increased **nitrogen** inputs have a damaging effect on nitrogen-sensitive ecosystems because they result in over-fertilization. Ammonia emissions from agriculture contribute to around two-thirds of total nitrogen inputs, whereas nitrogen oxide emissions from combustion processes account for approximately one-third. Specifically, air pollutants can travel long distances to end up in sensitive aquatic and terrestrial ecosystems due to dry and wet deposition. Nitrogen and sulfur deposition cause acidification and over-fertilization of sensitive ecosystems. For example, in alpine lakes and streams, acidification affects also higher altitudes and forest soils. Overfertilization also adversely affects many nitrogen-sensitive ecosystems such as forests, species-rich natural pastures and dry grassland, alpine heathland, raised bogs, and fens.

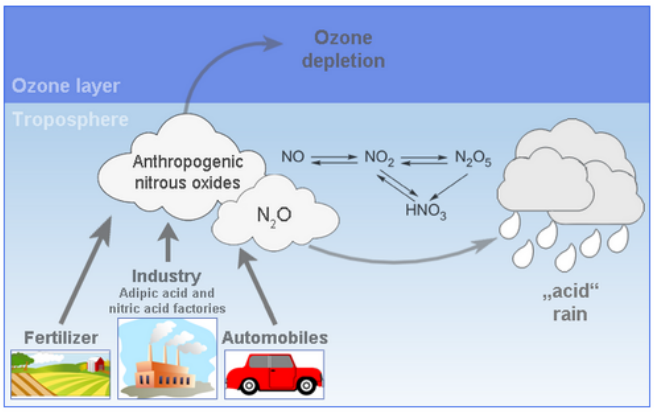
Consequences of the nitrogen overload in the forest are nitrogen leaching from the forest floor into the groundwater and changes in biodiversity.

To preserve human health and the environment, the Swiss Federal Council plans to reduce ammonia emissions by around 40% and nitrogen oxide emissions by approximately 50% from 2005 levels.

Air pollution's human health effects are principally on the body's respiratory system and the cardiovascular system, ophthalmologic, dermatologic, neuropsychiatric, hematologic, immunologic, and reproductive systems. However, the molecular and cell toxicity may also induce a variety of cancers in the long term.

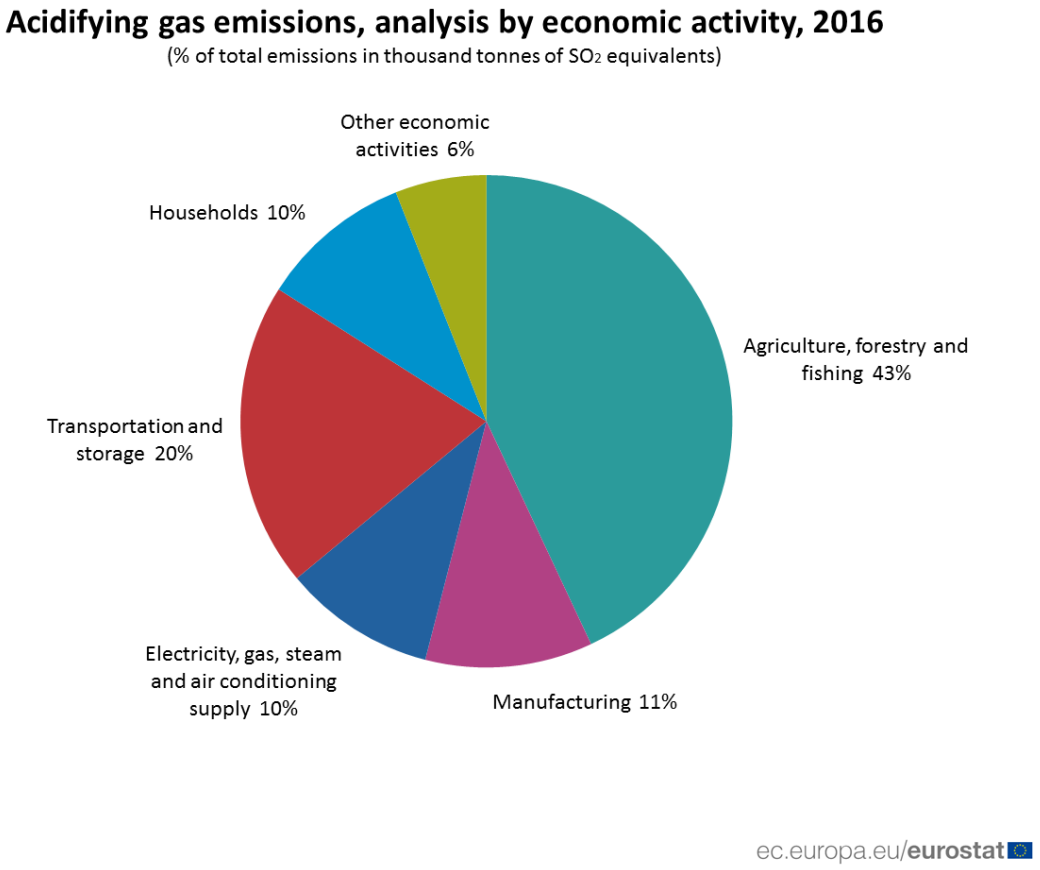
The pictures below show the effect of ruminant animals' dejections, agriculture, industry, and automobile emissions on the atmosphere leading to cause acid rain.





Source: Google immages

Air pollution comes from different industries, specifically, SO4 gas emissions mainly come from Agriculture, forestry and fishing (43%), and transportation and storage (20%) as it shown in the graphics below.



Source: ec.europa.eu/eurostat

MEASURES FOR AIR PROTECTION

Energy: ensuring affordable, sustainable energy alternatives for cooking, heating, and lighting in the household.

Transport: transition to cleaner energy sources; prioritizing rapid urban transit, walking and cycling networks in cities, as well as intercity rail freight and passenger travel; shifting to cleaner heavy-duty diesel vehicles and low-emission vehicles and fuels, including those with reduced sulfur content.

Urban planning: enhancing building energy efficiency and making cities more green and compact, hence increasing their energy efficiency.

Power generation: Increased use of low-emission fuels and combustion-free renewable energy sources (such as solar, wind, and hydropower); cogeneration of heat and electricity; and distributed energy generation (e.g. mini-grids and rooftop solar power generation).

Municipal and agricultural waste management: Such as waste reduction, waste separation, recycling, and reuse, or waste reprocessing, as well as improved biological waste management techniques such as anaerobic waste digestion to generate biogas, are viable, low-cost alternatives to open incineration of solid waste. Where incineration is necessary, it is vital to use combustion systems that have rigorous emission controls.

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