What is Nitrogen Dioxide (NO₂) and How Does It Get in the Air?

Nitrogen Dioxide (NO₂) is one of a group of highly reactive gases known as oxides of nitrogen or nitrogen oxides (NO_x). Other nitrogen oxides include nitrous acid and nitrogen monoxide (also called nitric acid). NO₂ is used as an indicator for the larger group of nitrogen oxides.

Man-made sources in the U.S. emitted 14 million metric tons of nitrogen oxides, mainly from burning fuels, in 2011.

NO₂ is produced primarily from the burning of fuel, such as when fossil fuels such as coal, oil, gasoline, or diesel fuel are burned. NO₂ forms from emissions from cars, trucks, buses, power plants, off-road equipment, industrial boilers, airplanes, ships, other industrial combustion sources, generators, and many other smaller combustion sources such as furnaces and water heaters.

Effects of NO₂

Health effects

Breathing air with a high concentration of NO₂ can irritate airways in the human respiratory system and can causes a range of harmful effects on the lungs, including:

- Increased inflammation of the airways;
- Worsened cough and wheezing;
- Reduced lung function;
- Increased asthma attacks; and
- Greater likelihood of emergency department and hospital admissions (U.S. EPA, 2016).

Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions, and visits to emergency rooms. Longer exposures to elevated concentrations of NO₂ may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk for the health effects of NO₂.

 NO_2 along with other NO_x reacts with other chemicals in the air to form both particulate matter ($PM_{2.5}$ primarily in the form of particulate ammonium nitrate) and contributes to ozone formation. $PM_{2.5}$ and ozone are also harmful when inhaled due to effects on the respiratory system.

New research warns that NO₂ is likely to be a cause of asthma in children (U.S. EPA, 2016).

A large new study found evidence that people with lung cancer faced greater risk from NO₂, ozone, and other outdoor air pollutants. The 2016 study tracked the air pollution levels from

1988 to 2011 experienced by more than 350,000 cancer patients in California. The researchers found that exposure to these air pollutants shortened their survival (Eckel et al. 2016).

In addition to health effects on the lungs, newer research has linked NO₂ to cardiovascular harm, lower birth weight in newborns and increased risk of premature death (U.S. EPA, 2016).

Environmental effects of NO₂

 NO_2 and other NO_x interact with water, oxygen, and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests. The particulate ammonium nitrate particles that result from NO_x oxidation in the atmosphere make the air hazy and difficult to see though. This affects visibility in general and also at the many national parks that are often visited for the view. NO_x in the atmosphere contributes to nutrient pollution in coastal waters.

Where Do High NO₂ Concentrations Occur?

Monitors show the highest concentrations of outdoor NO₂ in large urban regions such as the Northeast corridor, Chicago and Los Angeles. Levels are higher on or near heavily traveled roadways in many areas.

What is being done to reduce NO₂ pollution?

US EPA's national and regional rules to reduce emissions of NO_2 and NO_x will help state and local governments meet the National Ambient Air Quality Standard (NAAQS). The US EPA identifies areas where the air quality does not meet national NO_2 standards. For these areas, state, local, and tribal governments develop plans to reduce the amount of NO_2 in the air.

What are NO₂ standards?

National Ambient Air Quality Standards (NAAQS) for NO₂ specify maximum amounts of NO₂ allowed to be present in outdoor air. Limiting NO₂ in the air protects human health and the environment.

The current NO₂ health-based standards set by US EPA are considered protective of public health, including the at-risk populations of older adults, children and people with asthma, with an adequate margin of safety. The NAAQS for nitrogen oxides specify long-term levels are not to exceed 53 ppb (as an annual average) and short term levels are not to exceed 100 ppb (based on the highest 1-hour concentration each day).

US EPA also sets secondary NAAQS to protect the environment.

How are the air quality standards developed and reviewed?

The Clean Air Act requires EPA to set national ambient air quality standards for nitrogen oxides as one of the six criteria pollutants. The NAAQS for nitrogen oxides are currently set using NO₂ as the indicator of the larger group of nitrogen oxides. The law also requires EPA to periodically review the standards and revise them if appropriate to ensure that they provide the requisite amount of health and environmental protection and to update those standards as necessary.