

What Toxic Air Pollutants Are Produced by Petroleum-Based Fuels and Combustion Engines?

Production, sales and use of petroleum-derived fuels in the United States emit thousands of tons of chemical pollutants to air each day. Hundreds of different chemical compounds are found in emissions from petroleum-burning engines. People are exposed to these compounds at home, work and school by breathing the air outdoors and indoors, traveling on busy roadways, parking vehicles in their garages, and during most daily activities. Key pollutants are listed below; the health harms linked to these pollutants are described on a companion fact sheet:

Particulate Matter: Fine particles are formed during combustion of most fuels, and can also be formed in the air by chemical reactions of other combustion emissions. Particles emitted from one type of engine or fuel (such as typical gasoline cars), differ in chemical composition and size distribution from those emitted from another engine/fuel (such as diesel buses). Particles are made up of a carbon core, and can also contain toxic acids, metals, and organic chemicals. While there are many sources of particles in the air, gasoline and diesel engines are important sources of fine particles, especially in urban areas.

Ozone: Exhaust compounds, such as nitrogen oxides, carbon monoxides, unburned hydrocarbons, and evaporative emissions from gasoline, in the presence of sunlight react to form ground-level ozone, a summertime air pollution problem.

Nitrogen Oxides (NOx): Fuel ignition forms nitrogen monoxide, which is released in exhaust. NO reacts in the atmosphere to form other oxides of nitrogen including NO₂ and nitrate ion. NO_x compounds are a critical component of ozone production and can also contribute to particle formation and production of strong acid aerosols. The majority of NO_x emissions nationwide come from diesel and gasoline powered on and off-road engines.

Sulfur Dioxide (SO₂): Sulfur dioxide is formed from incomplete combustion of sulfur-containing fuel. It can react further in the atmosphere to produce fine particles and acid rain. While most sulfur dioxide nationwide is emitted from electric power plants, diesel engines have been an important source in some areas of the U.S.

Carbon Monoxide (CO): The incomplete combustion of fuel creates CO at high levels in automobile exhaust. The great majority of CO emissions come from gasoline powered automobiles. The rate of emissions is highest for cold engines in cold temperatures.

Lead: While lead has been phased out of gasoline over the last decades, significant roadside contamination of soils from earlier leaded gasoline use persists. Lead-containing dusts become airborne and thus pose an inhalation risk.

Volatile Organic Compounds (VOC): Crude oil and the refined products made from it are complicated mixtures containing hundreds of chemicals that are made up mostly of carbon and hydrogen atoms and can evaporate into the air. Engine exhaust contains the same VOCs, because of emissions of unburned fuel, and also new VOCs created as by-products of incomplete combustion. Some of the specific chemicals described in our health harms fact sheet are acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde, naphthalene, and polycyclic aromatic hydrocarbons (a group of compounds with a similar molecular structure, often found attached to particles in soots.) Gasoline and diesel-powered vehicles are the largest source of VOCs in most urban areas.