



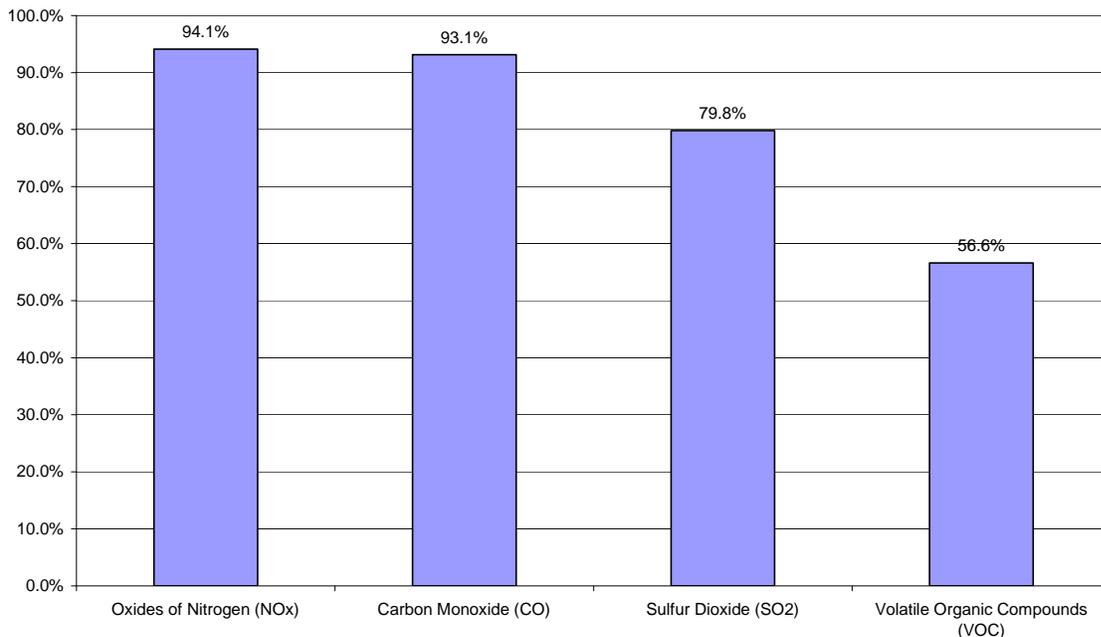
Energy use and emissions of criteria air pollutants in Missouri

"Criteria air pollutants" are defined by the U.S. Environmental Protection Agency (EPA) as indicators of air quality. Criteria pollutants include Carbon Monoxide (CO), Nitrogen Oxides (NO_x), Sulfur Dioxide (SO₂), coarse Particulate Matter (PM₁₀) and fine Particulate Matter (PM_{2.5}). For each "criteria pollutant," EPA has established a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards.

Every three years, the U.S. Environmental Protection Agency (EPA) compiles data from the Missouri Air Pollution Control Program (APCP) and other state and local air pollution control agencies into a National Emissions Inventory (NEI) of criteria pollutants. The NEI contains data on the quantity by source of CO, NO_x, SO₂, PM 10 and PM 2.5 as well as Volatile Organic Compounds. VOC emissions are not criteria pollutants but are included in the NEI because they interact with NO_x in the atmosphere to form ozone.

NEI data for 2002, released in 2006, demonstrates that energy use is the predominant source of criteria air pollutants in Missouri. As the following chart illustrates, energy use contributed 94 percent of Missouri NO_x emissions, 93 percent of Missouri CO emissions, 80 percent of Missouri SO₂ emissions and 57 percent of Missouri VOC emissions in 2002.

Percent of Missouri emissions of criteria pollutants coming from energy use
Source: EPA, 2002 National Emissions Inventory



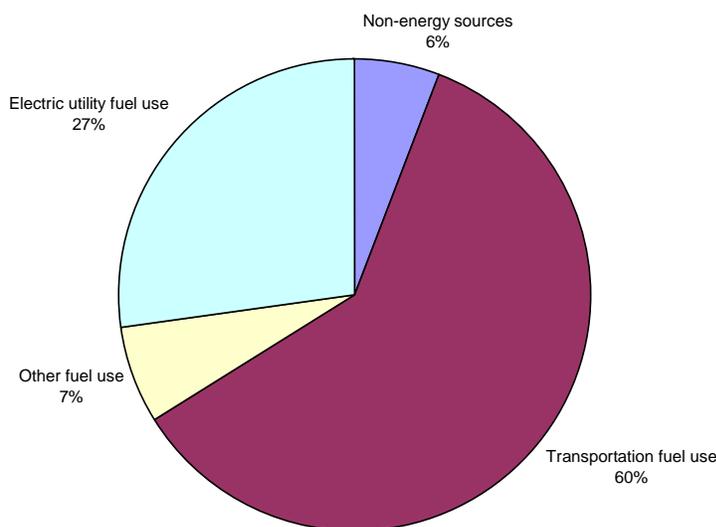
NO_x and VOC emissions endanger health primarily as precursors to the formation of ground-level ozone. Ozone is a gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone in the upper atmosphere, upward from about 6 to 30 miles, protects life on Earth from the sun's harmful ultraviolet (UV) rays. However, ground-level ozone is the principal ingredient of urban smog. According to EPA, ground-level ozone is a major health concern because it damages lung tissue, reduces lung function and sensitizes the lungs to other irritants. Scientific evidence indicates that ambient levels of ozone not only affect people with impaired respiratory systems, such as asthmatics, but healthy adults and children as

well. Exposure to ozone for several hours at relatively low concentrations has been found to significantly reduce lung function and induce respiratory inflammation in normal, healthy people during exercise. Ground-level also damages crops, trees and other vegetation.

Ozone is not emitted directly into the air. It is formed through complex chemical reactions between precursor emissions of VOC and NO_x in the presence of sunlight. Sunlight and temperature stimulate these reactions so that peak ozone levels occur in summer, which is also the peak season for transportation fuel use and electric utility fuel use.

As the following chart illustrates, transportation fuel use is the source for about 60 percent of Missouri NO_x emissions. Fuel use by electric utilities and building owners is the source for an additional third of NO_x. In the St. Louis metropolitan area, the share of NO_x from transportation energy use is even higher, about 64 percent of total NO_x. The data presented here includes emissions from both on-road and off-road transportation.

Sources of NO_x emissions in Missouri, EPA 2002 National Emissions Inventory



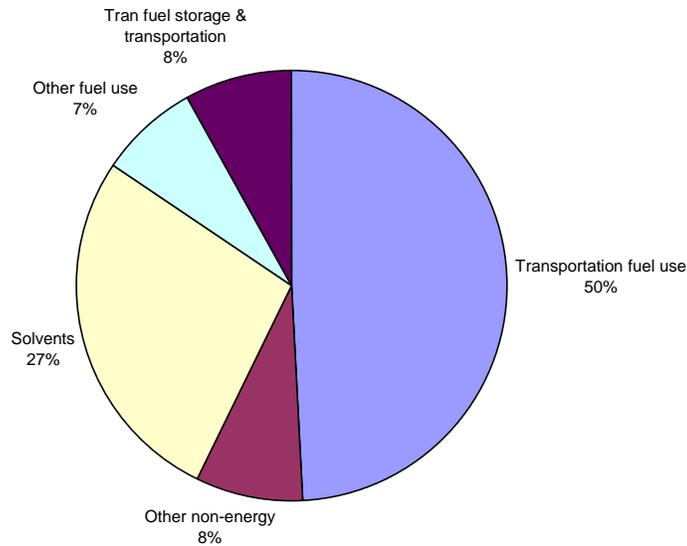
Transportation fuels are the leading source of Missouri VOC emissions. Statewide, fuel use for transportation is the source of about 50 percent of Missouri VOC emissions. Storing and transporting transportation fuels is the source of an additional 8 percent of VOC emissions.

Solvent use by industries such as printers, paint shops and dry cleaners is the other major source of VOC emissions in Missouri. Solvent use is the source of about 27 percent of the state's VOC emissions.

The storage, transportation and use of transportation fuels is the leading source of VOC emissions in Missouri's major metropolitan areas, accounting in total for about 55 percent of emissions in St. Louis and 53 percent in Kansas City. However, solvent use is a more important source in these areas than in the state generally, accounting for 31 percent of emissions in St. Louis and 35 percent in Kansas City.

Fuel use outside the transportation sector accounts for about is a relatively minor factor in VOC emissions.

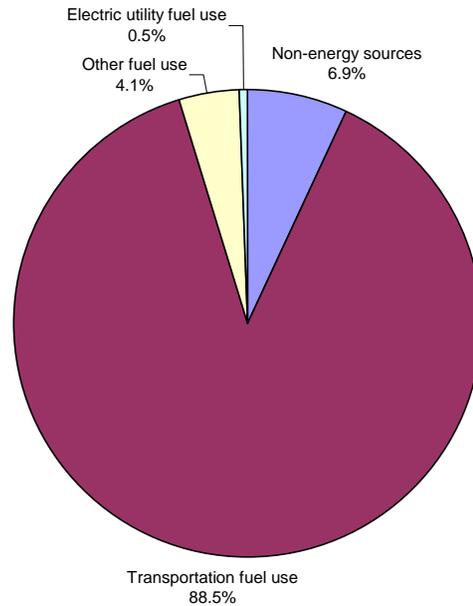
Sources of VOC emissions in Missouri, EPA 2002 National Emissions Inventory



Carbon monoxide (CO) is a colorless, odorless and poisonous gas produced by incomplete burning of carbon in fuels. According to EPA, when CO enters the bloodstream, it reduces the delivery of oxygen to the body's organs and tissues. Health threats are most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Exposure to elevated CO levels can cause impairment of visual perception, manual dexterity, learning ability and performance of complex tasks.

As the following chart illustrates, transportation fuel use is the source for nearly 90 percent of CO emissions. Remaining CO emissions are split between energy and non-energy sources.

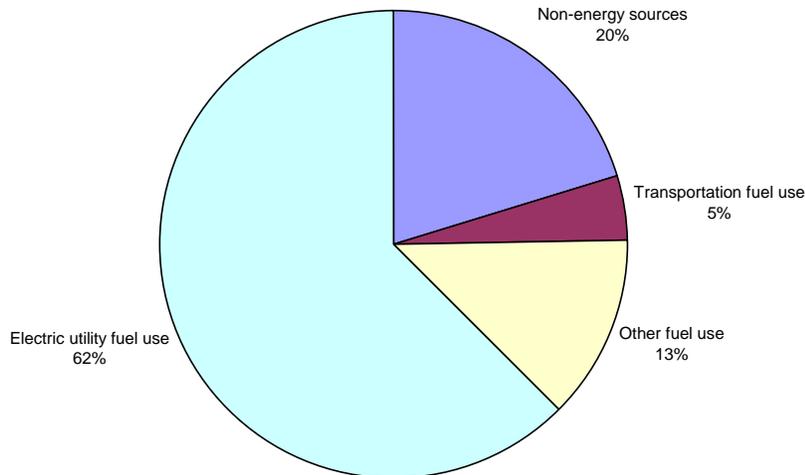
Sources of CO emissions in Missouri, EPA 2002 National Emissions Inventory



According to EPA, high concentrations of sulfur dioxide (SO₂) impede breathing and may aggravate existing cardiovascular or respiratory diseases. Asthmatics, individuals with bronchitis or emphysema, children and the elderly are particularly vulnerable to these health effects. Sulfur compounds also affect air quality by impairing visibility. Finally, SO₂ is a primary contributor to acid rain, which causes acidification of lakes and streams and can damage trees, crops, historic buildings and statues.

As the following chart illustrates, more than 60 percent of Missouri's sulfur dioxide emissions come from power plants and about 80 percent comes from energy use. Most non-energy SO₂ emissions originate with non-ferrous metal processing.

Sources of SO₂ emissions in Missouri, EPA 2002 National Emissions Inventory



"Particulate matter" refers to a mixture of solid particles and liquid droplets found in the air. PM 10 is coarse particles, larger than 2.5 micrometers, which come from a variety of sources including windblown dust and grinding operations. PM 2.5 is fine particles less than 2.5 micrometers in size. These fine particles often come from fuel combustion, power plants, and diesel buses and trucks. The fine particles can easily reach the deepest recesses of the lungs and have been linked to a variety of respiratory diseases.

The NEI ascribes 93 percent of PM₁₀ and 65 percent of PM_{2.5} to fugitive dust and other non-energy sources in the agricultural and forestry sector. However according to analysis by Missouri APCP's Air Quality Analysis Section, control emission control efforts should focus on primary PM_{2.5} whose source activities are mostly energy-related.

According to APCP, some of the largest generators of primary PM_{2.5} include electrical generation, coal, oil, and gas combustion, mineral products (cement kilns and lime processing), smelters, marine vessels, ferrous and nonferrous metals processing, followed by off-road and on-road motor vehicles.

Unfortunately, data for these sources of primary PM_{2.5} is incomplete because emission factors for these sources is still in the process of being measured.

Sources: EPA's Emissions Inventory and Analysis Group provided NEI data. Descriptions of the health impacts of criteria pollutants are taken from EPA's web site, <http://www.scorecard.org/env-releases/cap/pollutant-desc.tcl>.