Air Pollution

Health and Environmental Impacts

Air pollution can affect our health in many ways. Numerous scientific studies have linked air pollution to a variety of health problems including: (1) aggravation of respiratory and cardiovascular disease; (2) decreased lung function; (3) increased frequency and severity of respiratory symptoms such as difficulty breathing and coughing; (4) increased susceptibility to respiratory infections; (5) effects on the nervous system, including the brain, such as IQ loss and impacts on learning, memory, and behavior; (6) cancer; and (7) premature death. Some sensitive individuals appear to be at greater risk for air pollution-related health effects, for example, those with pre-existing heart and lung diseases (e.g., heart failure/ischemic heart disease, asthma, emphysema, and chronic bronchitis), diabetics, older adults, and children.

Air pollution also damages our environment. For example, ozone can damage vegetation, adversely impacting the growth of plants and trees. These impacts can reduce the ability of plants to uptake carbon dioxide (CO_2) from the atmosphere and indirectly affect entire ecosystems.

Sources and Health Effects of Air Pollution

Pollutant	Sources	Health Effects
Ozone (O_3)	Secondary pollutant typically formed by chemical reaction of volatile organic compounds (VOCs) and NO_x in the presence of sunlight.	Decreases lung function and causes respiratory symptoms, such as coughing and shortness of breath; aggravates asthma and other lung diseases leading to increased medication use, hospital admissions, emergency department (ED) visits, and premature mortality.
Particulate Matter (PM)	Emitted or formed through chemical reactions; fuel combustion (e.g., burning coal, wood, diesel); industrial processes; agriculture (plowing, field burning); and unpaved roads.	Short-term exposures can aggravate heart or lung diseases leading to respiratory symptoms, increased medication use, hospital admissions, ED visits, and premature mortality; long-term exposures can lead to the development of heart or lung disease and premature mortality.
Lead	Smelters (metal refineries) and other metal industries; combustion of leaded gasoline in piston engine aircraft; waste incinerators; and battery manufacturing.	Damages the developing nervous system, resulting in IQ loss and impacts on learning, memory, and behavior in children. Cardiovascular and renal effects in adults and early effects related to anemia.
Oxides of Nitrogen (NO_x)	Fuel combustion (e.g., electric utilities, industrial boilers, and vehicles) and wood burning.	Aggravate lung diseases leading to respiratory symptoms, hospital admissions, and ED visits; increased susceptibility to respiratory infection.
Carbon Monoxide (CO)	Fuel combustion (especially vehicles).	Reduces the amount of oxygen reaching the body's organs and tissues; aggravates heart disease, resulting in chest pain and other symptoms leading to hospital admissions and ED visits.
Sulfur Dioxide (SO_2)	Fuel combustion (especially high-sulfur coal); electric utilities and industrial processes; and natural sources such as volcanoes.	Aggravates asthma and increased respiratory symptoms. Contributes to particle formation with associated health effects.

Sources of Air Pollution

Air pollution consists of gas and particle contaminants that are present in the atmosphere. Gaseous pollutants include SO_2, NO_x, ozone, CO, volatile organic compounds (VOCs), certain toxic air pollutants, and some gaseous forms of metals. Particle pollution ($PM_{2.5}$ and PM_{10}) includes a mixture of compounds. The majority of these compounds can be grouped into five categories: sulfate, nitrate, elemental (black) carbon, organic carbon, and crustal material.

Some pollutants are released directly into the atmosphere. Other pollutants are formed in the air. Ground-level ozone forms when emissions of NO_x and VOCs react in the presence of sunlight. Similarly, some particles are formed from other directly emitted pollutants. For example, sulfate particles are formed from complex reactions in the atmosphere of SO_2 emissions from power plants and industrial facilities. Weather plays an important role in the formation of secondarily formed air pollutants, as discussed later in the Ozone and Particle Pollution sections.

EPA and states track direct emissions of air pollutants and emissions that contribute to the formation of key pollutants, also known as precursor emissions. Emissions data are compiled from many different organizations, including industry and state, tribal, and local agencies. Some emissions data are based on actual measurements while others are estimates.

Generally, emissions come from large stationary fuel combustion sources (such as electric utilities and industrial boilers), industrial and other processes (such as metal smelters, petroleum refineries, cement kilns, manufacturing facilities, and solvent utilization), and mobile sources including highway vehicles and non-road sources (such as recreational and construction equipment, marine vessels, aircraft, and locomotives). Sources emit different combinations of pollutants. For example, electric utilities release SO_2, NO_x, and particles.

Figure 2 shows the distribution of national total emissions estimates by source category for specific pollutants in 2010. Electric utilities contribute over 60 percent of national SO_2 emissions. Agricultural operations (included in the "other processes" category) contribute over 80 percent of national NH_3 emissions. Almost 50 percent of the national VOC emissions originate from solvent use (included in the "other processes" category). Highway vehicles and non-road mobile sources together contribute approximately 60 percent of national CO emissions. Pollutant levels differ across regions of the country and within local areas, depending on the size and type of sources present.

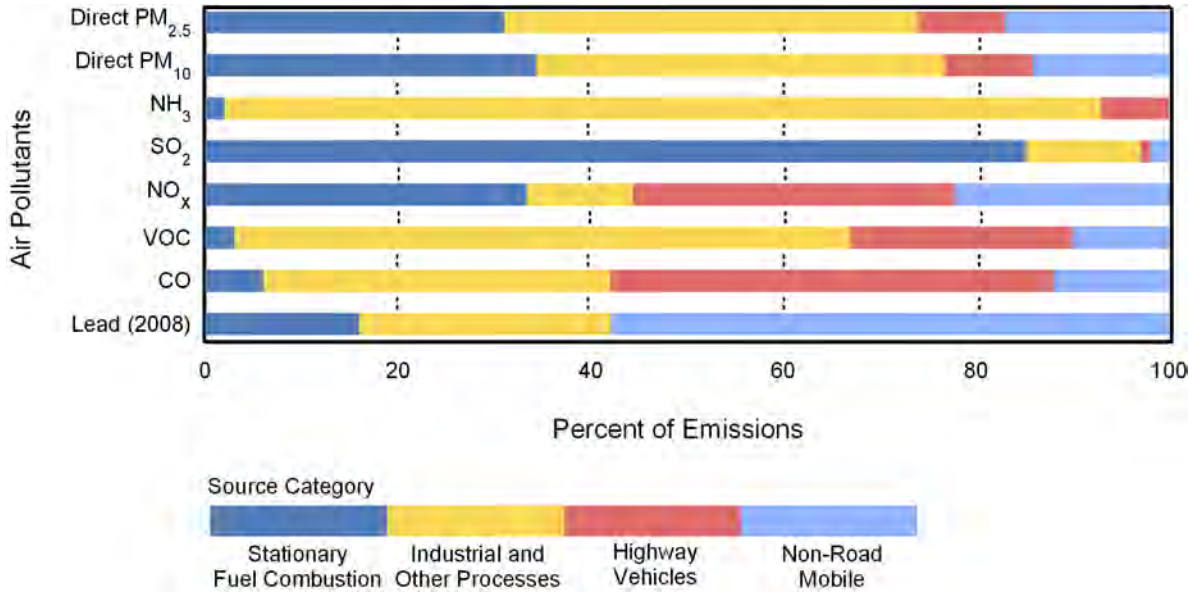

Figure 2. Distribution of national total emissions estimates by source category for specific pollutants, 2010.

Note: Lead emissions estimates are for 2008.

Tracking Pollutant Emissions

Since 1990, national annual air pollutant emissions have declined, with the greatest percentage drop in lead emissions. Direct $PM_{2.5}$ emissions have declined by more than half; PM_{10} and SO_2 emissions have declined by more than 60 percent, and NOx and VOC emissions have declined by more than 40 percent. The combined emissions of the six common pollutants and their precursors ($PM_{2.5}$ and PM_{10}, SO_2, NO_x, VOCs, CO, and lead) dropped 59 percent on average since 1990, as shown in Figure 3. This progress has occurred while the U.S. economy continued to grow, Americans drove more miles, and population and energy use increased. These emissions reductions were achieved through regulations, voluntary measures taken by industry, partnerships between federal, state, local, and tribal governments; academia; industrial groups; and environmental organizations. This environmental progress has occurred while overall, the U.S. economy grew 65 percent, Americans drove 40 percent more miles, and population and energy use increased by 24 and 15 percent respectively. There was a noticeable decline in Gross Domestic Product between 2008 and 2009. There was also a notable reduction in vehicle miles traveled and energy consumed from 2007 to 2009. Factors likely contributing to these reductions include the nationwide spike in gasoline prices during 2008 and the economic recession that began in 2008. These indicators showed an increase in 2010. Figure 3 also shows total CO_2 emissions increasing by about 8 percent from 1990 to 2009 (http://epa.gov/climatechange/emissions/usinventoryreport.html).

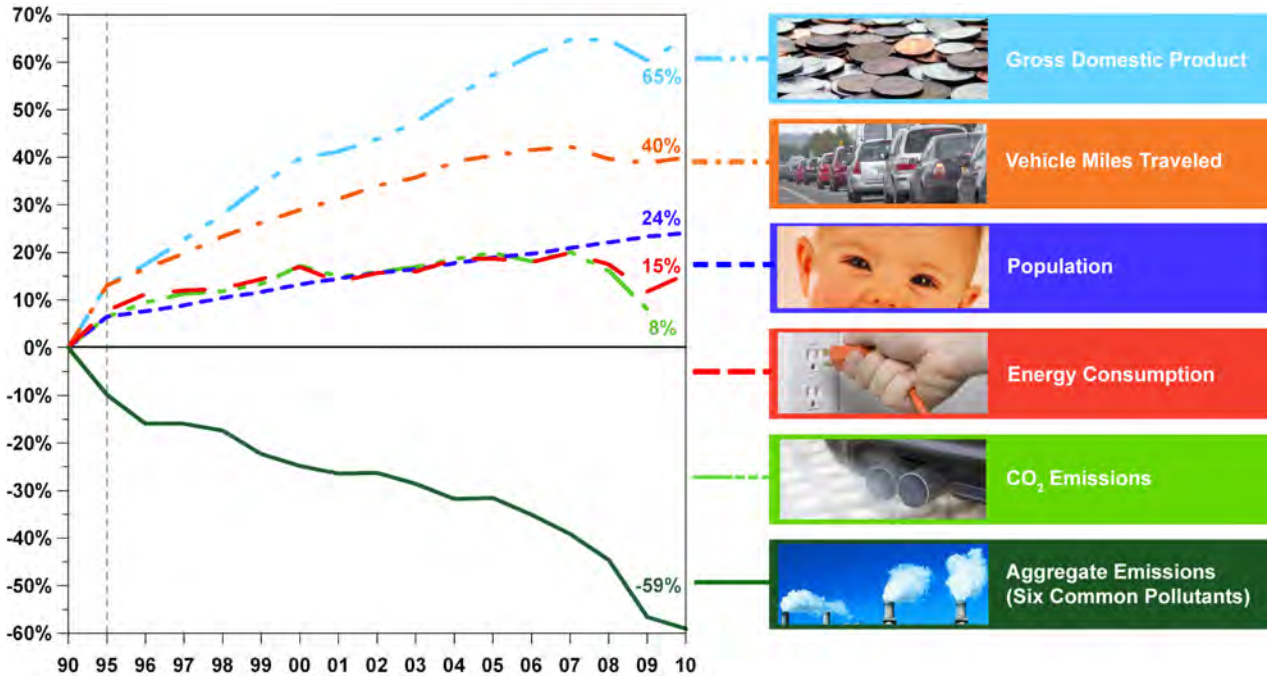

Figure 3. Comparison of growth measures and emissions, 1990-2010.

Note: CO_2 emissions estimates are from 1990 to 2009.