Nitrogen Oxides Emissions

Q: What are the trends in outdoor air quality and their effects on human health and the environment?

The above question pertains to all 'Outdoor Air' Indicators, however, the information on these pages (overview, graphics, references and metadata) relates specifically to "Nitrogen Oxides Emissions". Use the right side drop list to view the other related indicators on this question.

Introduction

"Nitrogen oxides" (NO_X) is the term used to describe the sum of nitric oxide (NO), nitrogen dioxide (NO_2), and other oxides of nitrogen. Most airborne NO_X comes from combustion-related emissions sources of human origin, primarily fossil fuel combustion in electrical utilities, high-temperature operations at other industrial sources, and operation of motor vehicles. However, natural sources, like biological decay processes and lightning, also contribute to airborne NO_X. Fuel-burning appliances, like home heaters and gas stoves, produce substantial amounts of NO_X in indoor settings (U.S. EPA, 2003).

NO_X plays a major role in several important environmental and human health issues. Short-term and long-term exposures to elevated air concentrations of NO_2 are associated with various acute and chronic respiratory effects (U.S. EPA, 1993). NO_X and volatile organic compounds react in the presence of sunlight to form ozone, which also is associated with human health and ecological effects (the Ozone Concentrations indicator). NO_X and other pollutants react in the air to form compounds that contribute to acid deposition, which can damage forests and cause lakes and streams to acidify (the Acid Deposition indicator). Deposition of NO_X also affects nitrogen cycles and can contribute to nuisance growth of algae that can disrupt the chemical balance of nutrients in water bodies, especially in coastal estuaries (the Lake and Stream Acidity indicator; the Trophic State of Coastal Waters indicator). NO_X also plays a role in several other environmental issues, including formation of particulate matter (the PM Concentrations indicator), decreased visibility (the Regional Haze indicator), and global climate change (the U.S. Greenhouse Gas Emissions indicator; the Greenhouse Gas Concentrations indicator).

This indicator presents NO_X emissions from traditionally inventoried anthropogenic source categories: (1) "Fuel combustion: selected power generators," which includes emissions from coal-, gas-, and oil-fired power plants that are required to use continuous emissions monitors (CEMs) to report emissions as part of the Acid Rain Program (ARP); (2) "Fuel combustion: other sources," which includes industrial, commercial, and institutional sources, as well as residential heaters and boilers not required to use CEMs; (3) "Other industrial processes," which includes chemical production and petroleum refining; (4) "On-road vehicles," which includes cars, trucks, buses, and motorcycles; and (5) "Nonroad vehicles and engines," such as farm and construction equipment, lawnmowers, chainsaws, boats, ships, snowmobiles, aircraft, and others. Since a substantial portion of airborne NO_X comes from fossil fuel combustion in electric utilities, this indicator includes the separate category for "selected power generators" in addition to the fourcategories presented in the other emissions indicators. The indicator also includes estimates of biogenic NO_X emissions in 2005. Biogenic emissions were estimated using the Biogenic Emissions Inventory System Model, Version 3.12, with data from the Biogenic Landcover Database and 2001 annual meteorological data.

NO_X emissions data are tracked by the National Emissions Inventory (NEI). The NEI is a composite of data from many different sources, including industry and numerous state, tribal, and local

agencies. Different data sources use different data collection methods, and many of the emissions data are based on estimates rather than actual measurements. For major electricity generating units, most data come from CEMs that measure actual emissions. For other fuel combustion sources and industrial processes, data are estimated using emission factors. Emissions from on-road and nonroad sources were estimated using EPA-approved modeling approaches (U.S. EPA, 2008).

NEI data have been collected since 1990 and cover all 50 states and their counties, D.C., the U.S. territories of Puerto Rico and Virgin Islands, and some of the territories of federally recognized American Indian nations. Data are presented only for 1990, 1996 to 2002, and for 2005. Data are available from 1991 to 1995 and from 2003 to 2004, but these data have not been updated to be comparable to the more recent inventories from 1990, 1996 to 2002, and 2005.

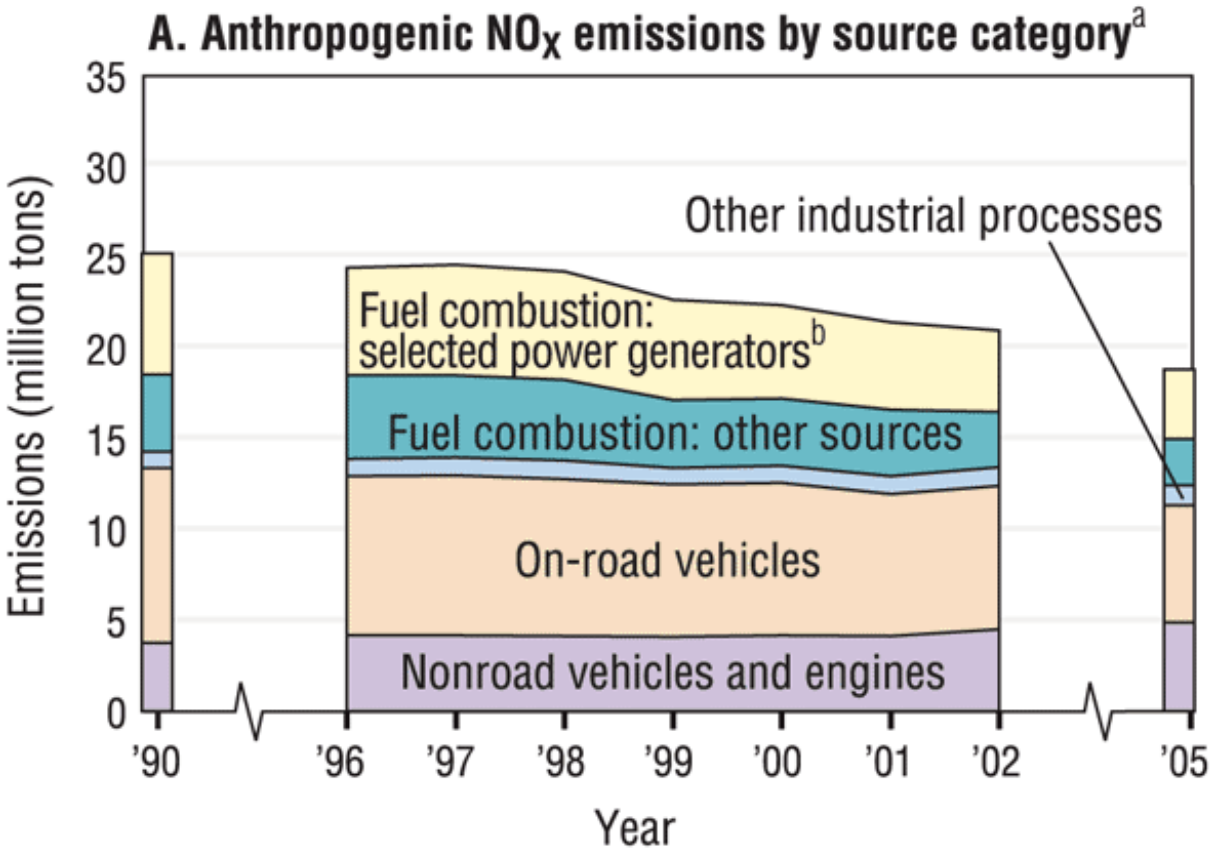
What The Data Show

This indicator focuses on trends in NO_X emissions from anthropogenic sources. However, NO_X emissions from biogenic sources were estimated for 2005 to provide a sense of the relative contributions of natural versus anthropogenic emissions. Nationally, biogenic emissions were estimated to contribute approximately 1 percent to NO_X emissions from all sources during 2005 (Exhibit 2-7, panel B).

According to the NEI data, estimated nationwide anthropogenic emissions of NO_X decreased by 25 percent between 1990 and 2005 (from 25,160,000 to 18,775,000 tons) (Exhibit 2-7, panel A). This downward trend results primarily from emissions reductions at electric utilities and among on-road mobile sources. Although total nationwide anthropogenic NO_X emissions decreased during this period, emissions from some sources (such as nonroad vehicles and engines) have increased since 1990.

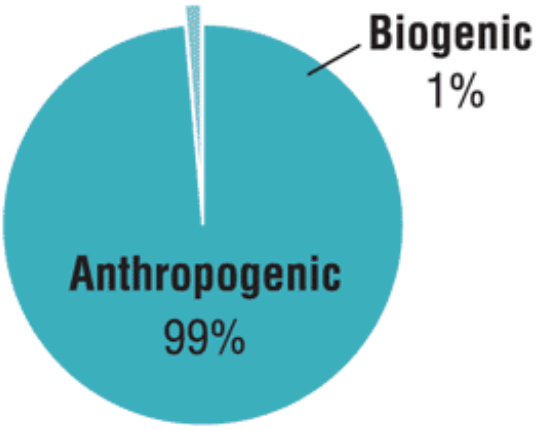
Estimated anthropogenic NO_X emissions in nine of the ten EPA Regions decreased between 1990 and 2005 (Exhibit 2-8). The percent change in emissions over this time frame ranged from a 45 percent decrease (in Region 2) to an 8 percent increase (in Region 10). The largest absolute reduction (1,502,000 tons) occurred in Region 5.

Exhibit 2-7. NO_X emissions in the U.S. by source category, 1990, 1996-2002, and 2005



[a]Data are presented for 1990, 1996-2002, and 2005, as datasets from these inventory years are all fully up-to-date. Data are available for inventory years 1991-1995 and 2003-2004, but these data have not been updated to allow comparison with data from 1990, 1996-2002, and 2005.

B. Relative amounts of NO_X emissions from anthropogenic and biogenic sources, 2005

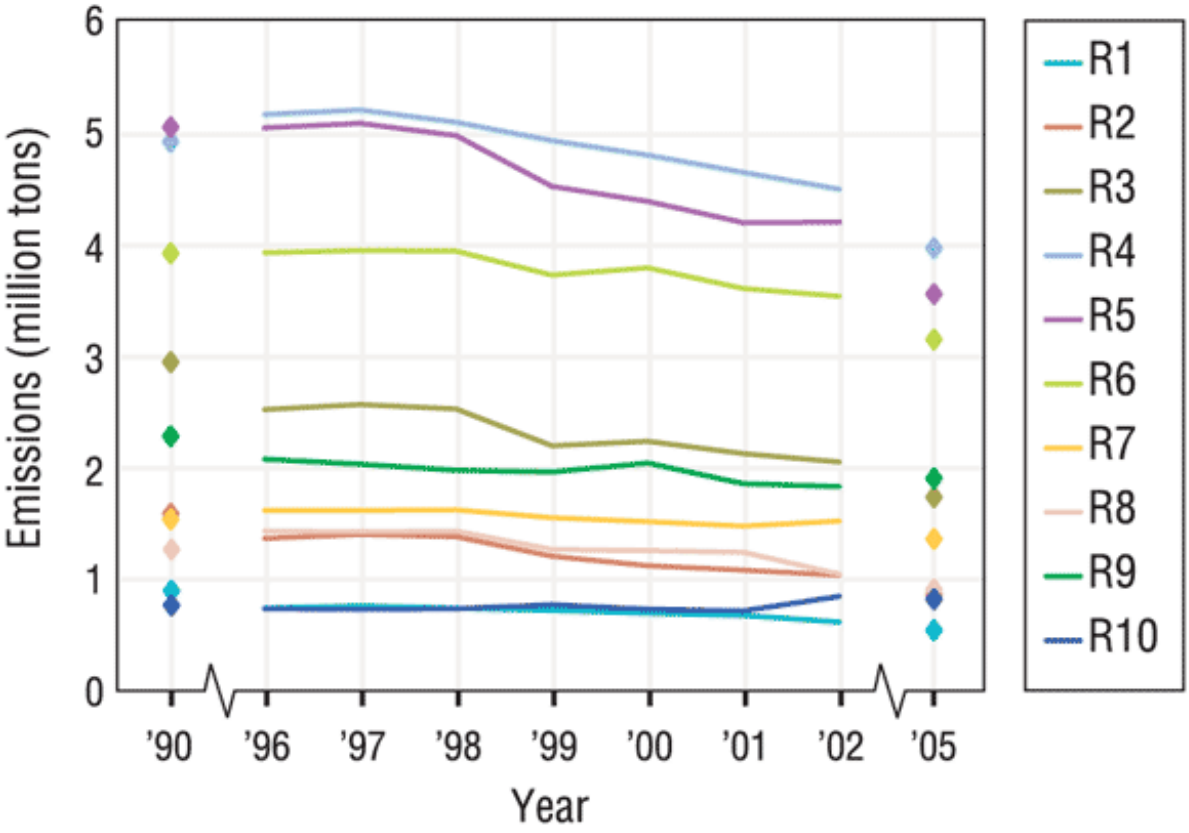


[b]This category includes emissions from only those power plants required to use continuous

emissions monitors under the Acid Rain Program.

Data source: *U.S. EPA, 2009*

Exhibit 2-8. NO_X emissions in the U.S. by EPA Region, 1990, 1996-2002, and 2005[a]



[a]Data are presented for 1990, 1996-2002, and 2005, as datasets from these inventory years are all fully up-to-date. Data are available for inventory years 1991-1995 and 2003-2004, but these data have not been updated to allow comparison with data from

EPA Regions

1990, 1996-2002, and 2005.

Data source: *U.S. EPA, 2009*

Limitations

- Comparable NO_X emissions estimates through the NEI are available only for 1990, 1996-2002, and 2005. Data for 1991-1995 and 2003-2004 are not provided due to differences in emissions estimation methodologies from other inventory years, which could lead to improper trend assessments.
- NO_X emissions from miscellaneous sources are not included in the total emissions.
- Though NO_X emissions from most electric utilities are measured directly using continuous monitoring devices, NO_X emissions data for most other source types are estimates. These estimates are generated using well-established approaches, but still have uncertainties inherent in the emission factors and emissions models used to represent sources for which emissions have not been directly measured.
- The methodology for estimating emissions is continually reviewed and is subject to revision. Trend data prior to any revisions must be considered in the context of those changes.
- Not all states and local agencies provide the same data or level of detail for a given year.

Data Sources

Summary data in this indicator were provided by EPA's Office of Air Quality Planning and Standards, based on biogenic and anthropogenic NO_X emissions data in the NEI. The most recent data are taken from Version 2.0 of the 2005 NEI (U.S. EPA, 2009). These and earlier emissions data can be accessed from EPA's emission inventory Web site (http://www.epa.gov/ttn/chief/eiinformation.html). This indicator aggregates NEI data by source type (anthropogenic or biogenic), source category, and EPA Region.

References

U.S. EPA (United States Environmental Protection Agency). 2009. Data from the National Emissions Inventory, Version 2.0. Accessed 2009. http://www.epa.gov/ttn/chief/net/2002inventory.html

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