Carbon Monoxide Emissions

Carbon monoxide (CO) gas forms primarily when carbon fuels are not burned completely. Mobile sources account for the majority of CO emissions. These sources include both on-road vehicles (e.g., cars, trucks, motorcycles) and nonroad vehicles and engines (e.g., farm equipment, construction equipment, aircraft, marine vessels). Consequently, high concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all CO emissions may come from motor vehicle exhaust (U.S. EPA, 2008). Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources, such as wildfires. The CO Concentrations indicator describes health hazards associated with inhaling CO.

This indicator presents CO emissions from traditionally inventoried anthropogenic source categories: (1) "Fuel combustion," which includes emissions from coal-, gas-, and oil-fired power plants and industrial, commercial, and institutional sources, as well as residential heaters (e.g., wood-burning stoves) and boilers; (2) "Other industrial processes," which includes chemical production, petroleum refining, metals production, and industrial processes other than fuel combustion; (3) "On-road vehicles," which includes cars, trucks, buses, and motorcycles; and (4) "Nonroad vehicles and engines," such as farm and construction equipment, lawnmowers, chainsaws, boats, ships, snowmobiles, and aircraft. The indicator also includes estimates of biogenic CO emissions in 2008. Biogenic emissions were estimated using the Biogenic Emissions Inventory System Model, Version 3.14, with data from the Biogenic Emissions Landcover Database, Version 3, and 2008 annual meteorological data. This indicator excludes CO estimates of prescribed burning and other miscellaneous sources except in the calculation of the biogenic fraction, because those data were either not readily available in the 1990 inventory or are small contributors to the total inventory.

CO emissions data are tracked by the National Emissions Inventory (NEI). The NEI is a composite of data from many different sources, with CO data coming primarily from EPA models as well as from state, tribal, and local air quality management agencies. Different data sources use different data collection methods, and many of the emissions data are based on estimates rather than actual measurements. For mobile sources, the data are based on mobile source models for on-road and nonroad vehicles, often using state-supplied model inputs (U.S. EPA, 2013a). Emissions from wildfires in 2008 come primarily from an estimation process that bases fire activity and location on satellite detection (U.S. EPA, 2013a). For most fuel combustion sources and industrial sources, emissions are from the state, local, and tribal air quality management agencies and are estimated primarily using emission factors.

NEI data have been compiled 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 for 1990, 1996, 1999, 2002, 2005, and 2008. With the exception of 1993, the NEI data are published on a triennial cycle, thus an annual trend is not readily available.

What the Data Show

Nationwide estimated anthropogenic CO emissions have decreased 59 percent between 1990 and 2008, the most recent year for which aggregate NEI emissions estimates are available (Exhibit 1).

Almost the entire emissions reduction is attributed to decreased emissions from on-road mobile sources. In 2008, mobile sources (both on-road and nonroad sources combined) accounted for 87 percent of the nation's total anthropogenic CO emissions. The CO emissions reductions are reflected in corresponding reductions in ambient concentrations (the CO Concentrations indicator).

This indicator focuses on trends in CO emissions from anthropogenic sources. However, CO emissions from biogenic sources were estimated for 2008 to provide a sense of the relative contributions of natural versus anthropogenic emissions (Exhibit 2). Biogenic emissions for this exhibit include emissions from wildfires and soils. Nationally, biogenic emissions were estimated to contribute approximately 22 percent to the CO emissions from all sources during 2008.

Net estimated anthropogenic CO emissions declined in all EPA Regions between 1990 and 2008 (Exhibit 3). The largest net decrease (15.7 million tons) occurred in Region 5, and the smallest decrease (3.2 million tons) occurred in Region 8.

Limitations

- CO emissions estimates through the NEI are provided only for the triennial years starting with 1990 and continuing through 2008, with the exception of 1993.
- CO emissions from “miscellaneous sources,” including wildfires and prescribed burning, are not included in the total anthropogenic emissions. Yearly fluctuations in wildfire emissions have the potential to mask trends in anthropogenic emissions and therefore have been excluded from the trends graphics. Details on emissions from miscellaneous sources can be found on EPA’s emission inventory website (http://www.epa.gov/ttn/chief/eiinformation.html).
- The emissions data for CO are largely based on estimates that employ emission factors generated from empirical and engineering studies, rather than on actual measurements of CO emissions. Although these estimates are generated using well-established approaches, including extensively reviewed mobile source models, the estimates 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.
- NEI emissions from on-road mobile sources prior to 2002 were estimated using the Mobile Source Emissions Factor Model (MOBILE), and 2002, 2005, and 2008 emissions for this source category were estimated using the MOtor Vehicle Emissions Simulator (MOVES) model. Thus, the change in model is reflected as part of the trend shown.

Data Sources

Summary data in this indicator were provided by EPA’s Office of Air Quality Planning and Standards, based on biogenic and anthropogenic CO emissions data in the NEI. The most recent data are taken from Version 3.0 of the 2008 NEI (U.S. EPA, 2013b). These and earlier emissions data can be accessed from EPA’s emission inventory website (http://www.epa.gov/ttn/chief/eiinformation.html). The MOVES data used for 2002 and 2005 are not available through the 2002 and 2005 NEI website. This indicator aggregates NEI data by source type (anthropogenic or biogenic), source category, and EPA Region.

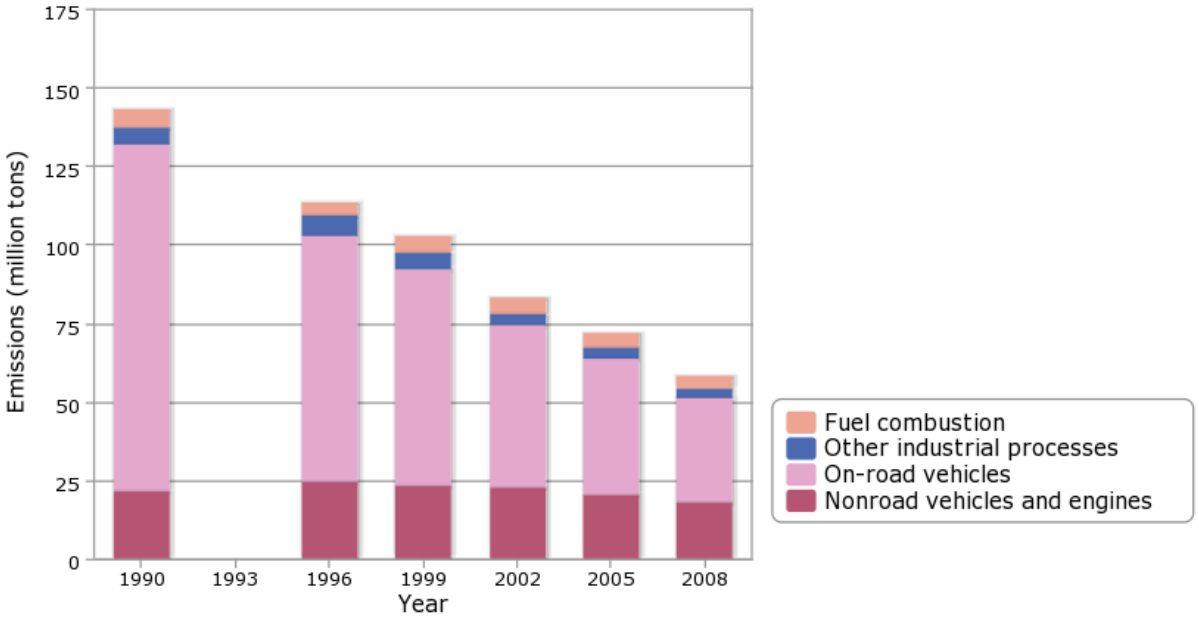
References

U.S. EPA (United States Environmental Protection Agency). 2013a. 2008 National Emissions Inventory, Version 3, technical support document. Draft report, in press.

U.S. EPA. 2013b. Data from the National Emissions Inventory, Version 3.0. Accessed 2013. http://www.epa.gov/ttn/chief/eiinformation.html.

U.S. EPA. 2008. Latest findings on national air quality: Status and trends through 2006. EPA-454/R-07-007. Research Triangle Park, NC. http://www.epa.gov/airtrends/2007/.

Exhibit 1. Anthropogenic CO emissions in the U.S. by source category, 1990-2008



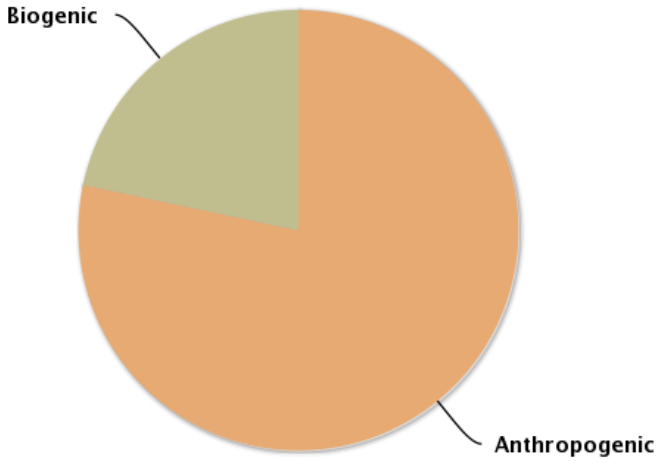
During some parts of the period of record, inventories were only developed every three years, hence the three-year intervals shown here. Data are available for inventory year 1993, but these data have not been updated to allow comparison with data from the other years shown.

Changes shown from 1990–2008 include both emissions changes and methods changes. While trends shown are generally representative, actual changes from year to year could have been larger or smaller than those shown.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2013b

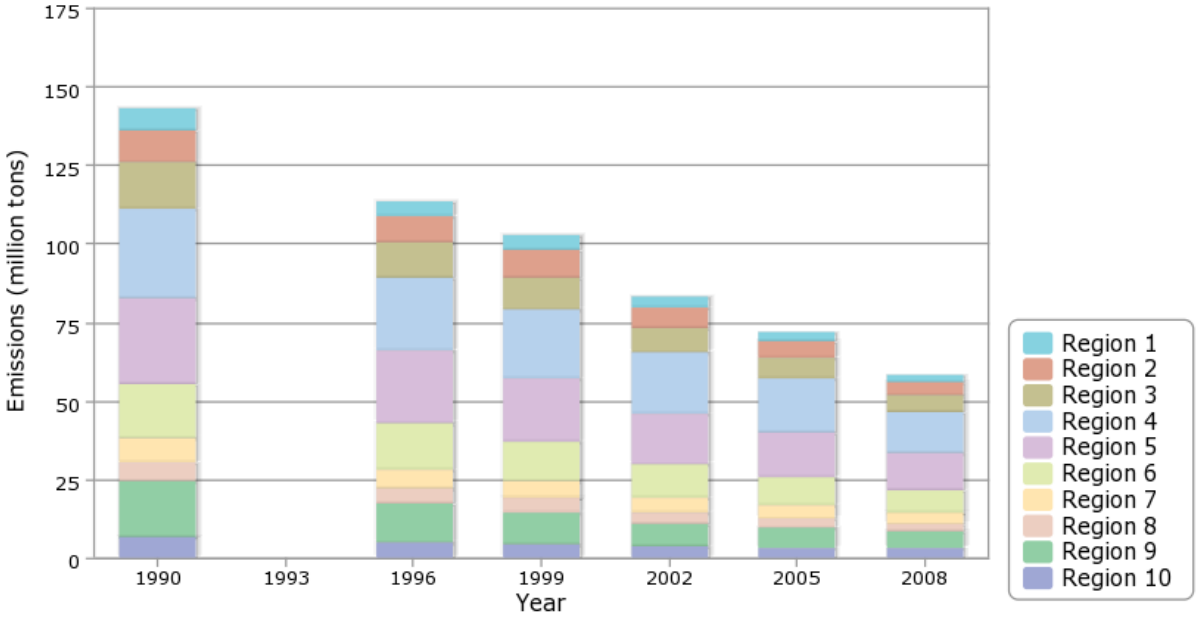
Exhibit 2. Relative amounts of U.S. CO emissions from anthropogenic and biogenic sources, 2008



Trend analysis has not been conducted because these data represent a single snapshot in time. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2013b

Exhibit 3. Anthropogenic CO emissions in the U.S. by EPA Region, 1990-2008



During some parts of the period of record, inventories were only developed every three years, hence the three-year intervals shown here. Data are available for inventory year 1993, but these data have not been updated to allow comparison with data from the other years shown.

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