

US power plant emissions down, study finds

January 9 2014



In 2013, Xcel Energy decommissioned this coal-fired power unit in Denver's Arapahoe Station. Shifts in the US energy industry, including less electricity from coal, have meant fewer emissions of greenhouse gases and other pollutants from power plant, according to a new CIRES-led analysis. Credit: Photo by Will von Dauster of National Oceanic and Atmospheric Administration

Power plants that use natural gas and a new technology to squeeze more energy from the fuel release far less of the greenhouse gas carbon

dioxide than coal-fired power plants do, according to a new analysis accepted for publication Jan. 8 in *Earth's Future*, a journal of the American Geophysical Union. The so-called "combined cycle" natural gas power plants also release significantly less nitrogen oxides and sulfur dioxide, which can worsen air quality.

"Since more and more of our electricity is coming from these cleaner [power plants](#), emissions from the power sector are lower by 20, 30 even 40 percent for some gases since 1997," said lead author Joost de Gouw, an atmospheric scientist with NOAA's Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado Boulder. NOAA is the National Oceanic and Atmospheric Administration.

De Gouw, who works at NOAA's Earth System Research Laboratory (ESRL), and his NOAA and CIRES colleagues analyzed data from systems that continuously monitor emissions at power plant stacks around the country. Previous aircraft-based studies have shown these stack measurements are accurate for [carbon dioxide](#) (CO₂) and for nitrogen oxides and sulfur dioxide. Nitrogen oxides and sulfur dioxide can react in the atmosphere to form tiny particles and ozone, which can cause respiratory disease.

To compare pollutant emissions from different types of power plants, the scientists calculated emissions per unit of energy produced, for all data available between 1997 and 2012. During that period of time, on average:

- Coal-based power plants emitted 915 grams (32 ounces) of CO₂ per kilowatt hour of energy produced;
- Natural [gas power plants](#) emitted 549 grams (19 ounces) CO₂ per kilowatt hour; and
- Combined cycle [natural gas](#) plants emitted 436 grams (15

ounces) CO₂ per kilowatt hour.

In combined cycle [natural gas plants](#), operators use two heat engines in tandem to convert a higher fraction of heat into electrical energy. For context, U.S. households consumed 11,280 kilowatt hours of energy, on average, in 2011, according to the U.S. Energy Information Agency. This amounts to 11.4 metric tons per year of CO₂ per household, if all of that electricity were generated by a coal power plant, or 5.4 metric tons if it all came from a natural gas power plant with combined cycle technology.

The researchers reported that between 1997 and 2012, the fraction of electric energy in the United States produced from coal gradually decreased from 83 percent to 59, and the fraction of energy from combined cycle natural gas plants rose from none to 34 percent.

That shift in the energy industry meant that power plants, overall, sent 23 percent less CO₂ into the atmosphere last year than they would have, had coal been providing about the same fraction of electric power as in 1997, de Gouw said. The switch led to even greater reductions in the power sector's emissions of [nitrogen oxides](#) and [sulfur dioxide](#), which dropped by 40 percent and 44 percent, respectively.

The new findings are consistent with recent reports from the Energy Information Agency that substituting natural gas for coal in power generation helped lower power-related [carbon dioxide emissions](#) in 2012.

The authors noted that the new analysis is limited to pollutants emitted during energy production and measured at stacks. The paper did not address levels of greenhouse gases and other pollutants that leak into the atmosphere during fuel extraction, for example. To investigate the total atmospheric consequences of shifting energy use, scientists need to

continue collecting data from all aspects of [energy](#) exploration, production and use, the authors concluded.

More information: "Reduced Emissions of CO₂, NO_x and SO₂ from U.S. Power Plants Due to the Switch from Coal to Natural Gas with Combined Cycle Technology," *Earth's Future*, 2014.

Provided by University of Colorado at Boulder

Citation: US power plant emissions down, study finds (2014, January 9) retrieved 25 April 2024 from <https://phys.org/news/2014-01-power-emissions.html>

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