



Clean Energy

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Air Emissions

Electricity generation is the dominant industrial source of air emissions in the United States today. Fossil fuel-fired power plants are responsible for 67 percent of the nation's sulfur dioxide emissions, 23 percent of nitrogen oxide emissions, and 40 percent of man-made carbon dioxide emissions. These emissions can lead to smog, acid rain, and haze. In addition, these power plant emissions increase the risk of climate change. Congress is currently considering proposals to require further reductions of emissions from power plants, including the President's [Clear Skies Initiative](#). However, renewable energy is receiving increased attention by environmental policymakers because renewable energy technologies have significantly lower emissions than traditional power generation technologies. To find out more about the air emissions generated by U.S. power plants, you can use EPA's [Emissions and Generated Resource Integrated Database](#), or eGRID. eGRID provides emissions data on virtually every power plant and company that generates electricity in the United States.



Various Energy Resources

- Air Emissions
- Water Resource Use
- Water Discharges
- Solid Waste Generation
- Land Resource Use

The air emissions impacts of electricity generation vary from technology to technology, as described below.

Natural Gas

At the power plant, the burning of natural gas produces [nitrogen oxides](#) and [carbon dioxide](#), but in lower quantities than burning [coal](#) or [oil](#). [Methane](#), a primary component of natural gas and a greenhouse gas, can also be emitted into the air when natural gas is not burned completely. Similarly, methane can be emitted as the result of leaks and losses during transportation. Emissions of [sulfur dioxide](#) and [mercury compounds](#) from burning natural gas are negligible.

The average emissions rates in the United States from natural gas-fired generation are: 1135 lbs/MWh of carbon dioxide, 0.1 lbs/MWh of sulfur dioxide, and 1.7 lbs/MWh of nitrogen oxides.¹ Compared to the average air emissions from coal-fired generation, natural gas produces half as much carbon dioxide, less than a third as much nitrogen oxides, and one percent as much sulfur oxides at the power plant. In addition, the process of extraction, treatment, and transport of the natural gas to the power plant generates additional emissions.²

Coal

When coal is burned, carbon dioxide, sulfur dioxide, nitrogen oxides, and mercury compounds are released. For that reason, coal-fired boilers are required to have control devices to reduce the amount of emissions that are released.

The average emission rates in the United States from coal-fired generation are: 2,249 lbs/MWh of carbon dioxide, 13 lbs/MWh of sulfur dioxide, and 6 lbs/MWh of nitrogen oxides.³

Mining, cleaning, and transporting coal to the power plant generate additional emissions. For example, methane, a potent greenhouse gas that is trapped in the coal, is often vented during these processes to increase safety.

Oil

Burning oil at power plants produces nitrogen oxides, sulfur dioxide, carbon dioxide, methane, and mercury compounds. The amount of sulfur dioxide and mercury compounds can vary greatly depending on the sulfur and mercury content of the oil that is burned.

The average emissions rates in the United States from oil-fired generation are: 1672 lbs/MWh of carbon dioxide, 12 lbs/MWh of sulfur dioxide, and 4 lbs/MWh of nitrogen oxides.⁴

In addition, oil wells and oil collection equipment are a source of emissions of methane, a potent greenhouse gas. The large engines that are used in the oil drilling, production, and transportation processes burn natural gas or diesel that also produce emissions.

Nuclear Energy

Nuclear power plants do not emit carbon dioxide, sulfur dioxide, or nitrogen oxides. However, fossil fuel emissions are associated with the uranium mining and uranium enrichment process as well as the transport of the uranium fuel to the nuclear plant.

Municipal Solid Waste

Although municipal solid waste (MSW) includes renewable resources, its use as a source of energy has been met with controversy. Despite recent toughening of emission standards for MSW combustion, the process creates significant emissions, including trace amounts of hazardous air pollutants.

Burning MSW produces nitrogen oxides and sulfur dioxide as well as trace amounts of toxic pollutants, such as mercury compounds and dioxins. Although MSW power plants do emit carbon dioxide, the primary greenhouse gas, the biomass-derived portion is considered to be part of the Earth's natural carbon cycle. The plants and trees that make up the paper, food, and other biogenic waste remove carbon dioxide from the air while they are growing, which is returned to the air when this material is burned. In contrast, when fossil fuels are burned, they release carbon dioxide that has not been part of the Earth's atmosphere for a very long time (i.e., within a human time scale).

The average air emission rates in the United States from municipal solid waste-fired generation are: 2988 lbs/MWh of carbon dioxide, (it is estimated that the fossil fuel-derived portion of carbon dioxide emissions represent approximately one-third of the total carbon dioxide emissions) 0.8 lbs/MWh of sulfur dioxide, and 5.4 lbs/MWh of nitrogen oxides.⁵

The variation in the composition of MSW raises concerns. For example, if MSW containing batteries and tires are burned, toxic materials are released into the air. A variety of air pollution control technologies are used to reduce most toxic air pollutants from MSW power plants.

If MSW were to be incinerated anyway, little or no environmental impact would be attributable to using the resulting heat to generate electricity. However, there are alternatives to incineration, such as recycling waste, storing waste in landfills, and source reduction.

Hydroelectricity

Hydropower's air emissions are negligible because no fuels are burned. However, if a large amount of vegetation is growing along the riverbed when a dam is built, it can decay in the lake that is created, causing the buildup and release of methane, a potent greenhouse gas.

Non-Hydroelectric Renewable Energy

Solar

Emissions associated with generating electricity from solar technologies are negligible because no fuels are combusted.

Geothermal

Emissions associated with generating electricity from geothermal technologies are negligible because no fuels are combusted.

Biomass

Biomass power plants emit nitrogen oxides and a small amount of sulfur dioxide. The amounts emitted depend on the type of biomass that is burned and the type of generator used. Although the burning of biomass also produces carbon dioxide, the primary greenhouse gas, it is considered to be part of the natural carbon cycle of the earth. The plants take up carbon dioxide from the air while they are growing and then return it to the air when they are burned, thereby causing no net increase. Biomass contains much less sulfur and nitrogen than coal;⁶ therefore, when biomass is co-fired with coal, sulfur dioxide and nitrogen oxides emissions are lower than when coal is burned alone.⁷ When the role of renewable biomass in the carbon cycle is considered, the carbon dioxide emissions that result from co-firing biomass with coal are lower than those from burning coal alone.⁸

Landfill Gas

Burning landfill gas produces nitrogen oxides emissions as well as trace amounts of toxic materials. The amount of these emissions can vary widely, depending on the waste from which the landfill gas was created. The carbon dioxide released from burning landfill gas is considered to be a part of the natural carbon cycle of the earth. Producing electricity from landfill gas avoids the need to use non-renewable resources to produce the same amount of electricity. In addition, burning landfill gas prevents the release of methane, a potent greenhouse gas, into the atmosphere.

Wind

Emissions associated with generating electricity from wind technology are negligible because no fuels are combusted.

1. U.S. EPA, eGRID 2000.
2. Ibid.
3. Ibid.
4. Ibid.
5. U.S. EPA, Compilation of Air Pollutant Emission Factors (AP-42).
6. U.S. Department of Energy, Energy Efficiency and Renewable Energy Clearinghouse, Biomass Cofiring: A Renewable Alternative for Utilities. June 2000. DOE/GO-102000-1055.
7. Ibid.
8. Ibid.