

Nuclear Energy and the Environment

September 2009

Key Facts

■ Nuclear power plants generate about 20 percent of U.S. electricity. They do not burn hydrocarbons when producing electricity, so they do not produce any greenhouse gases or combustion byproducts. By substituting for fossil fuels in the electricity sector, nuclear energy has significantly reduced U.S. emissions of air pollutants and greenhouse gases.

■ About one-quarter of America's electricity comes from clean-air sources, including nuclear power plants, hydroelectric plants, and wind and solar energy facilities.

■ Nuclear energy is the only large-scale, clean-air electricity source that can be expanded widely to produce large amounts of energy. Nuclear energy makes up more than 70 percent of all the nation's clean-air electricity generation.

U.S. nuclear power plants also prevented the emission of 1 million short tons of nitrogen oxides and 2.7 million short tons of sulfur dioxide—pollutants controlled under the Clean Air Act.

The amount of nitrogen oxide emissions that nuclear plants prevent annually is the equivalent of taking more than 47 million passenger cars off the road.

■ In 2008, U.S. nuclear plants prevented the emissions of almost 689 million metric tons of carbon dioxide. This is nearly as much carbon dioxide as is released from all U.S. passenger cars.

■ Environmental responsibility is an important part of nuclear power plant management. The companies that operate nuclear power plants voluntarily work to protect nearby wildlife and their habitats.

Nuclear: Clean-Air Energy

America's 104 nuclear power reactors provide nearly 20 percent of its electricity. Among clean-air electricity sources, nuclear energy plays an even greater role. Only 27 percent of our nation's electricity comes from clean-air sources, and nuclear power plants generate almost three-fourths of it.

The other major sources of clean-air electricity are hydroelectric plants, which provide 5.9 percent of our nation's electricity; wind energy, 1.3 per-

cent; and solar energy, less than 0.01 percent.

Reducing Carbon Dioxide Emissions

Carbon dioxide is the major focus of global policy discussions and U.S. legislative action to reduce greenhouse gas emissions.

Most scientists believe that carbon dioxide emissions increase Earth's temperature, bringing about changes in climate. According to the U.S. Environmental Protection Agency, 85 percent of U.S. greenhouse gas emissions are carbon dioxide.

Nuclear energy's vital role in greenhouse gas mitigation has been clearly established in a variety of studies by the Intergovernmental Panel on Climate Change, Columbia University's Earth Institute, the National Academies of Science from 13 leading industrial and developing nations, and the International Energy Agency.

The U.S. Department of Energy managed a voluntary greenhouse gas reduction program. Increased electric generation by nuclear power plants accounted for 36 percent of total carbon dioxide reductions in this pro-



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Nuclear Energy and the Environment

Page 2 of 4—September 2009

gram in 2005, the most of any sector.¹

To compare the greenhouse gas impacts of electricity generation from various fuel sources, generating 1 million kilowatt-hours of electricity produces:

- 996 metric tons of carbon dioxide from a coal-fired plant
- 809 metric tons of carbon dioxide from an oil-fired plant
- 476 metric tons of carbon dioxide from a natural gas-fired plant
- none from a nuclear power plant.²

In 2008, the use of nuclear power to generate electricity avoided the emissions of nearly as much carbon dioxide as is released from all U.S. passenger cars combined. If nuclear power were

not used, about 133 million of the nation's 136 million passenger cars would have to be eliminated to keep U.S. carbon dioxide emissions from increasing. More than 400 nuclear power plants worldwide produce 14 percent of the world's electricity, while reducing carbon dioxide emissions by more than 2.5 billion metric tons per year. Renewables have a small but growing role to play in electricity generation. Renowned environmentalist James Lovelock said, "By all means, let us use the small input from renewables sensibly, but only one immediately available source does not cause global warming, and that is nuclear energy."

Clean Air Act Targets Two Major Pollutants

Nuclear power plants do not burn hydrocarbons when producing electricity, so they do not produce combustion byproducts, such as nitrogen oxides, sulfur dioxide and carbon dioxide. The first two types of emissions are regulated under the 1990 Clean Air Act Amendments.

According to the U.S. Environmental Protection Agency, the largest source of carbon dioxide emissions globally is the combustion of fossil fuels such as coal, oil and gas in power plants, automobiles, industrial facilities and other sources. Generating electricity is the single largest source of carbon dioxide emissions in the United States, representing 41 percent of all emissions.

By substituting for other types of electric generating facilities, nuclear power plants prevent substantial emissions of these materials and are essential to meeting clean-air goals in the 31 states where they are located.

Nitrogen Oxides. Nitrogen oxides play a major role in the formation of ozone, which is detrimental to human health. Nitrogen oxides also are a significant contributor to acid rain. Producing electricity with nuclear energy improves human health and the environment by avoiding the emission of nitrogen oxides.

In 2008, U.S. nuclear power plants avoided the emissions of nearly 1 million short tons of nitrogen oxides—the same amount emitted by more than 47 million passenger cars in a year. This means that without nuclear energy, more than 47 million cars would have to come off the road to keep the emissions of nitrogen oxides where they are today.

Sulfur Dioxide. Sulfur dioxide also contributes to acid rain. A main objective of the Clean Air Act is to reduce the amount of sulfur dioxide emitted into the atmosphere.

In 2008, nuclear plants avoided the emission of 2.7 million short tons of this pollutant—almost three times that avoided by all other non-emitting energy sources combined.

¹ Most recent data available.

² Nuclear energy, like all non-emitting technologies such as wind turbines and hydroelectric generation, does not emit criteria pollutants or greenhouse gases during the production of electricity. All of these technologies may produce some emissions during maintenance, while testing backup generators or from other segments of the life cycle. These emissions, in all cases, have been found to be insignificant when compared with air emissions from fossil fuel-based generation.

Nuclear Energy and the Environment

Page 3 of 4—September 2009

Policymakers Recognize Nuclear Power's Clean Air Benefits

In 2006, seven Northeastern states established the first mandatory regional U.S. cap-and-trade program for carbon dioxide. The Regional Greenhouse Gas Initiative (RGGI) program treats all emission-free sources of electricity, such as nuclear power and renewables, equally in its framework for greenhouse gas reduction. RGGI includes 10 Northeastern and mid-Atlantic states. In addition, six Western U.S. states have formed a similar initiative.

A cap-and-trade system limits the total allowable amount of emissions and creates tradable certificates called “allowances” that permit the bearer to emit a certain quantity of the regulated gas.

Policymakers are debating various approaches to address climate change and carbon emissions on a federal level.

The Obama administration has made energy legislation a priority, and the U.S. Congress continues to debate climate change legislation. In June, the House of Representatives approved the Clean Energy and Security Act (H.R. 2454). The bill, with a primary goal of reducing carbon emissions, contained several provisions favoring nuclear energy.

The Senate Energy and Natural Resources Committee approved the American Clean Energy Leadership Act of 2009, which designates nuclear energy as essential in a low-carbon energy mix.

Both acts—which have yet to become law—recognize the importance of clean-energy projects and provide financing mechanisms for the development of nuclear and other clean energy sources. The Senate will continue debate on energy and climate legislation later this year.

The Nuclear Energy Institute in 2007 released a position paper detailing the industry's standpoint on climate change policy. The industry believes that an effective climate change policy depends on a portfolio of energy sources, including nuclear energy and renewables, that help prevent greenhouse gases. The nuclear industry supports federal action or legislation to reduce greenhouse gas emissions. The position paper also states that significant U.S. expansion of nuclear power requires sustained federal and state government policies relating to energy infrastructure and the environment. These climate change policy principles are available at www.nei.org/keyissues/protectingtheenvironment/policybriefs/nuclearenergyclimatechangeinitiatives.

Protecting Resources for Future Generations

Nuclear energy has the smallest environmental impact of any clean-air electricity source. As a result, nuclear energy is well suited to meet the growing energy demands of the world's urban centers. A 1,000-megawatt power plant can meet the needs of a city the size of Boston or Seattle.

Life-cycle analysis is a mechanism for measuring the total environmental impact of various energy sources. Environmental researchers have evaluated total emissions from various energy sources. This includes emissions resulting from all aspects of each energy source—construction, operation, dismantling and disposal. According to a University of Wisconsin study, the life-cycle impact of nuclear energy is among the lowest of any form of electricity generation, comparable with renewable technologies such as wind and geothermal power.

Clean Water and Safe Haven for Wildlife

Protecting the environment extends to safely managing used fuel, protecting water quality, and preserving and improving habitat for plants and wildlife, including endangered species such as the American crocodile and pallid sturgeon. Nuclear plants also provide safe havens for nesting sea turtles and manatees.

Nuclear Energy and the Environment

Page 4 of 4—September 2009

The companies that operate nuclear power plants honor and protect the environment in all these ways, under strict regulations and through many voluntary programs. Cooling water discharged from a nuclear plant contains no harmful pollutants, and it meets federal Clean Water Act requirements and state standards for temperature and mineral content.

All companies that operate nuclear power plants have extensive environmental programs. Many augment these programs with voluntary initiatives to enhance natural habitats at nuclear reactor sites. For example, some companies have developed environmentally rich wetlands, providing better nesting areas for waterfowl and other birds, new habitats for fish, and sanctuaries for other wildlife, flowers and grasses.

The environmental activities conducted by companies that operate nuclear power plants have been recognized by the nation's best-known environmental organizations, including the Audubon Society, Ducks Unlimited, the National Wildlife Federation, the Nature Conservancy, Trout Unlimited, the U.S. Fish and Wildlife Service and the Wildlife Habitat Council.

This fact sheet also is available at www.nei.org/keyissues/protectingtheenvironment/factsheets/nuclearenergyandtheenvironment.