



# WOOD <sup>to</sup> ENERGY

## Fact Sheet

### Impacts on Air Quality

*Richard Schroeder & Martha C. Monroe*

Most of the energy produced in the United States and the world from renewable resources is from biomass. In the South, the majority of this biomass comes from wood, and much of the wood is used to make heat, steam, or electricity in sawmills and pulp mills. As fossil fuel prices rise and more emphasis is placed on renewable energy sources, using wood to produce energy is becoming more prevalent. People are concerned, however, about how using wood for energy will impact air quality.

#### Stoves and Fireplaces

Many people relate wood energy to their own experiences with fireplaces or wood stoves (Figure 1). In these cases, the wood varies in moisture and size, the amount of combustion air may vary and generally is not sufficient for complete combustion, and the temperature may change during combustion. The result is that some of the wood burns very quickly, some doesn't burn at all, and some of the wood will burn very slowly or smolder. This irregular and inefficient combustion emits smoke, ash, and odors that can be carried by the wind over the landscape. Wood stoves and fireplaces, if not properly managed, can create problems for local air quality. In fact, smoke from fireplaces can be an issue in some mountainous regions where it settles in valleys, which can cause limited visibility and respiratory illnesses.

Burning wood in a power plant, however, allows operators to monitor combustion temperatures, manage fuel moisture, effectively mix air with fuel, and dictate the particle size of

the fuel. These controls, coupled with air emissions controls, can significantly reduce the amount of air pollution. And unlike fireplaces, emissions from wood-fueled power plants must meet standards set by the U.S. Environmental Protection Agency (EPA).

#### Industrial Uses of Wood Energy

Industries such as power plants and pulp mills are by far the largest users of wood energy. Wood is used as a fuel source to replace coal, oil, or natural gas. This is how most



**Figure 1.** Wood stoves provide heat in homes and other facilities.

PHOTO COURTESY OF [EPORIA.COM](http://EPORIA.COM).

of the increase in wood energy is expected to take place in the coming years. These facilities treat wood as a valuable resource, with the objective of extracting the maximum amount of energy while minimizing pollution.

### Clean Air Standards

All industries must comply with clean air standards and regulations regardless of the type of fuel used. Industrial combustion facilities are regulated by the EPA as well as state and local regulatory agencies. These agencies are responsible for managing the nation’s air quality by using strict rules, permits, and enforcement actions to ensure that new or existing facilities minimize their impact on air quality. These regulations apply to all major combustion facilities, including those using wood for fuel.

### Major Pollutants of Combustion

There are several main air pollutants of concern to any industrial facility regardless of the fuel type used. Although many pollutants are regulated, the most commonly regulated pollutants of oil, gas, coal, and wood are nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO is a product of incomplete combustion), sulfur dioxide (SO<sub>2</sub>), mercury (Hg), and particulate matter (very small airborne particles). Largely due to discussions in recent years about global climate change, greenhouse gases such as carbon dioxide, nitrous oxide, methane, and water vapor are also a significant concern. In this section, we will discuss several fuel sources in the context of each of these pollutants. This information is summarized in Table 1, which compares uncontrolled emissions; however, in practice, emission control devices are used. These devices prevent much of the pollution from reaching the atmosphere. Particulates, which can be high for wood fuels, are relatively easy to control.

Natural gas is considered the cleanest fossil fuel because it can be burned in a manner that generates medium to low

levels of NO<sub>x</sub> and negligible levels of SO<sub>2</sub>, Hg, and particulate matter. However, natural gas still emits greenhouse gases.

Oil is no longer frequently used as industrial fuel in the U.S. because of its high cost compared to other fuels, though we include it here for the sake of comparison. Oil is available in different grades, and while the NO<sub>x</sub> and CO emissions are usually lower than coal, sulfur levels in oil can be high, requiring methods to control SO<sub>2</sub>.

Because coal and wood are solid fuels, not liquids or gases, they can vary in quality, energy value, moisture, and ash production. This variation makes managing the fuel, or preparing the fuel for combustion, and its emissions more difficult. NO<sub>x</sub> emissions from combusting wood are generally less than from burning coal, with studies reporting that mixing wood with coal reduces overall NO<sub>x</sub> emitted from the facility. SO<sub>2</sub> emissions are much lower from wood than those from coal. Depending upon where the coal comes from, it can contain seventy-five times more sulfur than wood on a heat value basis. Therefore, while sulfur is a major emission to control in a coal-fueled facility, a wood-fueled facility generally requires little effort to meet SO<sub>2</sub> emissions standards. Technology and equipment are available to effectively control the NO<sub>x</sub> and SO<sub>2</sub> from both coal and wood energy plants.

### Particulate Matter

Particulate matter is a by-product of burning solid fuels, and ash is a common form of particulate matter. While the particles may not contain toxic chemicals, breathing fine particulate matter has been shown to have negative health effects. Effective methods of particulate control have been developed to remove most of the particles from the exhaust air of both coal and wood combustion facilities. The particulate matter emitted from both coal-fired and wood-fired plants is higher than that emitted from a natural gas-fired plant, but particulates from

Table 1. Comparing Uncontrolled Emissions from Different Fuel Sources U.S. EPA 2006

Fuel Type	NO <sub>x</sub>	SO <sub>2</sub>	Hg	Particulate Matter	Greenhouse Gases
Natural Gas	Medium	Negligible	Negligible	Low	High
Oil	Medium	Medium to High	Medium	Low	High
Coal	High	High	High	Medium	High
Wood	Low	Low	Negligible	Medium	Low

coal-fired and wood-fired plants can be rather effectively controlled using existing technology to minimize negative effects on air quality.

## Greenhouse Gases

Of all of the greenhouse gases, scientists agree that the increasing level of carbon dioxide in our atmosphere is the largest contributing factor in global climate change. Wood presents an advantage over fossil fuels because it is the only traditional industrial fuel that does not increase the amount of atmospheric carbon dioxide and therefore does not contribute to climate change. The carbon emitted from combustion of fossil fuels—oil, natural gas, and coal—comes from deposits that have been buried in the earth for millions of years. The combustion of wood also emits carbon dioxide; however, this carbon was derived from recently living plant matter. Carbon is taken in as new trees grow, and as long as trees are replanted at least as fast as wood is used, wood-fueled facilities will not increase atmospheric carbon dioxide concentrations. Fossil fuels cannot be managed the same way since there is not enough land to continually plant the number of trees necessary to absorb the additional carbon dioxide the fossil fuels emit every day. For more information, see the *Climate Change and Carbon* fact sheet, found at <http://www.interfacesouth.org/woodybiomass>.

## Summary

Many communities are considering using renewable sources of fuel for energy generation. The effect that different fuel sources will have on air quality is an important consideration. Extracting energy by combustion will generate some types of air pollution. Modern technology makes it feasible to effectively remove some pollutants from the emissions produced during this process. Some fuels, such as wood, represent a fuel source that initially creates fewer pollutants.

For more information about using wood to produce energy, visit <http://www.interfacesouth.org/woodybiomass> and read other fact sheets, community economic profiles, and case studies from this program, or <http://www.forestbioenergy.net/> to access a number of other resources.

## References

- U.S. EPA 2006. U.S. EPA Web site, Clean Energy, Air Emissions. [www.epa.gov/solar/emissions.htm](http://www.epa.gov/solar/emissions.htm)  
Last updated July 19, 2006 (accessed June 14, 2007).

### Authors

Richard Schroeder, President, BioResource Management, Gainesville, FL and  
Martha C. Monroe, Associate Professor, School of Forest Resources and Conservation, University of Florida, Gainesville, FL



