WOOD to ENERGY

Fact Sheet

Sustainable Forest Management

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Woody biomass for energy production comes from both urban environments and rural forests. Urban sources include materials from land clearing for development, yard waste from tree trimming, and storm damage debris. These woody materials represent an excellent fuel source for energy production, which might otherwise be wasted and lost when sent to landfills or piled and burned. If the amount of urban woody biomass will not be sufficient for a proposed wood-to-energy project, the remaining feedstock requirement must come from agriculture or rural forestry sources. The three sources of woody biomass from a forest are (1) thinning to reduce the number of small, competing trees (for forest health, wildfire risk reduction, ecological restoration, and timber stand improvement); (2) short-rotation plantations grown specifically for fuel production; and (3) residues left after harvesting for other wood-based products. (See the fact sheet, *Sources and Supply*, for more information. All of our materials are available at http://interfacesouth.org/woodybiomass.) Many people are concerned that the forests could be overharvested and the ecosystems impaired by the constant demand of a wood-to-energy system. This fact sheet addresses the sustainability of forests when extracting woody biomass for energy production. More detailed information about forest sustainability is summarized in the online forestry encyclopedia, at http://www.forestryencyclopedia.net/Encyclopedia/bioenergy.

Sustainability is evaluated from several perspectives, one of which is the ability of the soil to continually support tree growth, which is a function of soil structure and nutrient levels. A second perspective is the ability to sustain forests across the landscape; this is particularly important in areas such as the southeastern U.S. which is rapidly urbanizing. Nearly 75 percent of the South's forestland is in nonindustrial private ownership and a majority of those landowners are interested in forest sustainability. In many areas of the southeastern U.S. the value of the land is higher if it is sold and developed rather than if it is maintained as a functioning forest. Therefore, if landowners can generate income by selling forest residues after regular harvesting operations while maintaining the forest's productivity, they may be more willing to hold onto their forests rather than sell the land. Therefore, woody biomass for the production of energy provides an additional market for products and services from their land, and another reason to sustain the forests.

Forest Biomass Sources

Forestry residues are usually the non-merchantable portion of a tree (branches, leaves or needles, and small or broken stems) left after a harvesting operation. These residues are normally piled to get them out of the way of subsequent tree planting activities or they are spread across the site and either burned or left to gradually decompose. Since the leaves and small twigs typically account for 25 to 50 percent of the nutrients in a tree (close to 50 percent in young trees) (Gresham 2002), nutrient loss can be a concern if these residues are taken off-site to be used for energy. One way to assure that the nutrients from leaves or needles go back into the soil is to allow the residues to dry out and drop the leaves or needles before the woody stems are removed from the harvest site. Leaves and needles can also be removed from woody stems by various machines which use chains or other mechanisms to physically separate foliage and branches before the larger woody pieces are chipped and removed. Either of these practices can help retain nutrients for replenishing forest soils.

Currently, few forest plantations are grown specifically for woody biomass production in the southeastern U.S. Where they do exist they are typically grown on old agricultural fields or land reclamation projects (e.g., reclaimed mine sites) and they are harvested on very short rotations (5 to 10 years vs. 15 plus years) compared to plantations grown for wood fiber. In both cases these woody biomass plantations represent an addition of forested land in the landscape.

As with utilizing woody residues, harvesting of trees in biomass plantations may extract only the wood or it

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_x), carbon monoxide (CO is a product of incomplete combustion), sulfur dioxide (SO_2), 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 fossi fuel because it can be burned in a manner that generates medium to low levels of NO_x and negligible levels of SO_2, 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_x and CO emissions are usually lower than coal, sulfur levels in oil can be high, requiring methods to control SO_2.

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_x emissions from combusting wood are generally less than from burning coal, with studies reporting that mixing wood with coal reduces overall NO_x emitted from the facility. SO_2 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_2 emissions standards. Technology and equipment are available to effectively control the NO_x and SO_2 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_x	SO_2	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 Last updated July 19, 2006 (accessed June 14, 2007).

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