ENVIRONMENTAL ASPECTS OF BIOENERGY

Proper production and use of biomass resources can have positive impacts on air and water quality, reduce greenhouse gas emissions, and have other environmental benefits.

Global Climate Change and Greenhouse Gas Emissions. Greenhouses work by using transparent covers that allow light, a form of radiant energy, to pass through them. This radiant energy is converted to heat when it is absorbed by material inside the greenhouse. Certain gases in the earth's atmosphere act like the transparent covers of a greenhouse. Two of the primary greenhouse gases are carbon dioxide and methane, both of which are usually given off when biomass materials and fossil fuels decompose in nature or are broken down by humankind by various processes. Methane is roughly 21 times more effective at trapping the sun's radiation than carbon dioxide. Fortunately, methane, which is a primary component of biogas and natural gas, is an excellent fuel or chemical feedstock. Capturing and using methane for energy can convert it into carbon dioxide.

Green plants need carbon dioxide to grow. Thus the continuous use for bioenergy and replacement does not add carbon dioxide to the air. Fossil fuels such as coal, petroleum, and natural gas are also derived from plants. However, since these plants lived millions of years ago, the use of fossil fuels adds carbon dioxide to the atmosphere. Concentrations of greenhouse gases have increased significantly during the time period that fossil fuels have been widely used and the temperature of the earth's atmosphere has correspondingly increased during this time period.

Animal wastes can be utilized using a variety of digestion, combustion and gasification technologies—all of which result in lowered methane emissions and improved air and water quality. Landfill sites can similarly be "mined" for methane (biogas) because these sites contain large amounts of organic materials.

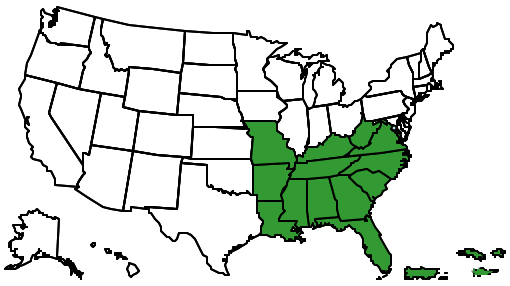
Water Quality. The use of organic wastes for energy or biomass-related products can keep these materials out of landfills and help protect water quality. Combustion, gasification, and pyrolysis processes use heat to decompose animal wastes and reduce the volume of wastes. Concentration and recovery of the phosphorus and potassium nutrients in the ash from these processes reduces their transportation costs and allows them to be cost effectively shipped to areas that need these nutrients.

Methyl tertiary butyl ether—or MTBE—is a fuel oxygenate derived from petroleum and historically has been added to gasoline as an oxygenate. MTBE has been listed as a possible carcinogen for humans and has been found in groundwater at high levels in several states. As of January 2005, 20 states had banned MTBE from gasoline sold in their state. Ethanol, which is non-toxic and water-soluble, has been used to replace MTBE.[1]

Air Quality. Regions of a state may be classified by the U.S. EPA as non-attainment areas that do not meet EPA regulations for ozone. States must respond to non-attainment classification by formulating a state implementation plan (SIP). Biomass and biofuels could play an important part in meeting a state's SIP by implementing and accounting for air quality improvement due to both trapping of methane gases in biomass-to-energy applications, as well as the use of biofuels that have better emissions profiles than conventional fossil fuels. Major biofuels and their emissions impact are described below.

[1] National Corn Growers Association, www.ncga.com/ethanol/main/environment.htm

Air Emissions—Biodiesel. In 2000, biodiesel became the only alternative fuel in the country to have successfully completed the EPA-required Tier I and Tier II health effects testing under the Clean Air Act. That study found that B20 (20% biodiesel blended with 80% fossil diesel) reduced total hydrocarbon emissions by up to 30%, carbon monoxide by up to 20%, and total particulate by up to 15%. Biodiesel contains no sulfur or aromatics. A U.S. Department of Energy study showed that the production and use of biodiesel, compared to petroleum diesel, resulted in a 78.5% reduction in carbon dioxide emissions. Although biodiesel is more expensive than diesel fuel, blending 20% biodiesel with fossil diesel (called B20) increases the cost only slightly but provides almost the complete range of benefits of using biodiesel only (B100)[2].



Southeast Biomass State and Regional Partnership

Air Emissions—Ethanol. Ethanol contains 35% oxygen which results in more complete fuel combustion and reduced tailpipe emissions. Studies have shown that ethanol:

- Reduces tailpipe carbon monoxide emissions by as much as 30%
- Reduces exhaust VOC (volatile organic compounds) emissions by 12%
- Reduces toxic emissions by 30%
- Reduces particulate matter (PM) emissions by more than 25% (Particulate matter has been found to penetrate deeply into human lungs.)

The American Lung Association of Metropolitan Chicago credits ethanol-blended reformulated gasoline with reducing smog-forming emissions by 25% since 1990[3].

. According to the U.S. Environmental Protection Agency[4], typical *uncontrolled* NOx and SO_2 emissions from industrial boilers are less for wood fuels in comparison to coal and heavy oil and slightly more in comparison to light oil and natural gas. Wood has the highest level of particulate matter emissions over all fuels. However, particulates are the easiest and least expensive emissions to control. Gasification and pyrolysis systems operate at lower temperatures than combustion systems and have lower emissions than combustion systems.

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This series of fact sheets was prepared by the Southeast Biomass State and Regional Partnership (formerly the Southeastern Regional Biomass Energy Program). The Partnership is one of five regional administrations of the U.S. Department of Energy's (DOE) National Biomass State and Regional Partnership. The Partnership was established in 2003, and is managed for DOE by the Southern States Energy Board. The goal of this Partnership is to work cooperatively with the DOE Office of Biomass Programs (OBP) to facilitate the increased use of bioenergy and biobased products through coordinated federal, regional, and state outreach, education and technical assistance programs.

Partnership Project Staff

Kathy Baskin, Project Manager
Southern States Energy Board
6325 Amherst Court
Norcross, GA 30092
(770) 242-7712
(770) 242-9956 fax
baskin@sseb.org

Phillip Badger, Technical Mgr
General Bioenergy, Inc.
3115 Northington Court
Florence, AL 35630
(256) 740-5634
(256) 740-5635
pbadger@bioenergyupdate.com

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[2] National Biodiesel Board, *Environmental Benefits*, www.nbb.org
[3] National Corn Growers Association, www.ncga.com/ethanol/main/environment.htm
[4] Federal Register, June 19, 1984, Vol. 49, No. 119, Page 25106