Policy Analysis Group
Jay O'Laughlin, Director
(208) 885-5776 jayo@uidaho.edu
www.cnrhome.uidaho.edu/pag

University of Idaho
College of Natural Resources
William J. McLaughlin, Dean
(208) 885-6442 billm@uidaho.edu

Fact Sheet #5
Environmental Benefits of Using Biomass as an Energy Feedstock

Biomass, in the renewable energy context, refers to living or recently dead biological materials that can be used as fuel or for industrial production. Biomass materials are used as a source of energy in many ways. Wood and agricultural residues are burned as a fuel for cogeneration of steam and electricity in the industrial sector, or directly for power generation in the electricity sector. Biomass is used for space heating in residential and commercial buildings. For example, the University of Idaho saves $2 million per year by heating the campus with steam produced by burning wood instead of natural gas.

Environmental benefits are the most important of the many reasons for increased use of biomass to produce electricity. Substitution is the key idea. Every unit of energy produced with biomass keeps a like unit of fossil fuels in the ground. Compared with coal, for example, biomass feedstocks have lower levels of sulfur or sulfur compounds. Perhaps the most significant environmental benefit of biomass, however, is a potential reduction in carbon dioxide (CO_2) emissions. Biomass-based generation is assumed to yield no net emissions of CO_2 because plants capture and store CO_2 as part of the natural carbon cycle. Wood and other biofuels are said to contain "biogenic" carbon. Under international greenhouse gas accounting methods developed by the Intergovernmental Panel on Climate Change, biogenic carbon is part of the natural carbon balance and it will not add to atmospheric concentrations of carbon dioxide. The emission factor is zero for wood, wood waste, and other biomass fuels.[1/]

In a life-cycle sense, however, biomass burning is not precisely a net zero emission process. There are CO_2 emissions associated with harvesting, transportation, and feedstock preparation operations, such as removal of impurities and reduction of moisture and particle size. Emissions arise from fossil fuel consumption for those operations rather than from biomass combustion. Coal and other fossil fuels also produce emissions from such operations.

Dry wood is about half carbon by weight and also contains sulfur and nitrogen, which yield sulfur dioxide (SO_2) and nitrogen oxide (NOx) in the combustion process. Although there are environmental impacts of wood burning, the rate of emissions is significantly lower than that of coal-based generation.[2/] Biomass co-firing is the practice of introducing biomass and coal together into an existing coal-fired boiler for electricity generation purposes. The biomass can either be introduced via a dedicated feed system or mixed with coal in the coal pile and fed to the boiler through the coal feed system. The substitution of biomass for coal in power plants has the effect of reducing SO_2 emissions and can also lead to lower NOx emissions. Existing coal-fired plants can use 10-20% biomass for co-firing without major modifications.

Sources: "Biomass for Electricity Generation" <http://www.eia.doe.gov/oiaf/analysispaper/biomass/> and "Emission Coefficients" <http://www.eia.doe.gov/oiaf/1605/coefficients.html>, U.S. Department of Energy websites.

1/ Burning wood to produce electricity emits 195 pounds of CO_2 per million Btu; coal burning ranges from 205-227.

2/ For example, per kilowatthour generated, biomass integrated gasification combined-cycle (BIGCC) generating plants can significantly reduce particulate emissions (by a factor of 4.5) in comparison with coal-based electricity generation processes. NOx emissions can be reduced by a factor of about 6 for dedicated BIGCC plants compared with average pulverized coal-fired plants.