Non-Energy Disposal Alternatives

Vast amounts of woody biomass are not utilized. This includes woody residues remaining from timbering operations, wooden pallets used to transport goods, trees from land clearing, and trees resulting from natural disasters such as hurricanes. If this woody biomass is not used for energy production, it is disposed of in other ways.

The major categories of alternative (non-energy) disposal options for biomass residues include:
1) Open burning of agricultural and forestry residues
2) Landfill disposal of waste wood
3) Composting and land application of waste wood
4) Land spreading of wood chips and bark as mulch and cover
5) In-forest accumulation of residues as downed material

Open burning of agricultural and forestry residues

The alternative fate for agricultural residues used for fuel is open burning, although a small percentage of these materials could be put in a landfill or plowed under. Open burning of forestry and agricultural biomass residues leads to heavy emissions of smoke and air pollutants and is a major source of air pollution in many regions. Open burning produces massive amounts of visible smoke and particulate and significant quantities of emissions of nitrogen oxides (NO_x), carbon monoxide (CO), and hydrocarbons that contribute to the formation of atmospheric ozone. Use of these residues as power plant fuel vastly reduces the smoke and particulate emissions associated with their disposal, and significantly reduces the amounts of CO, NO_x, and hydrocarbons released to the atmosphere.

Landfill disposal of waste wood

Landfill disposal of recyclable biomass accelerates landfill capacity depletion and increases emissions of greenhouse gases such as methane.

Putting waste wood in a landfill is an undesirable option for a variety of reasons. Waste wood has a slower decay rate than other biomass forms, and is thus slow to stabilize in the landfill environment. It takes up 15 to 20 percent of the space in a typical county landfill, and its decay leads to emissions of methane (CH_4), a more potent greenhouse gas than carbon dioxide (CO_2).

The traditional disposal option for urban wood waste is burial in landfills. Landfill burial of the wood residues that can be recovered and converted into power plant fuel entails the same kinds of environmental impacts associated with the disposal of all kinds of organic wastes in landfills. Compared to other types of organic wastes, woody materials are slow to degrade, which means that landfill stabilization is delayed. Like all organic material in the landfill, waste wood can be a source of water-polluting leachates, and as the material degrades, it produces emissions of CH_4 and CO_2 in roughly equal quantities. CH_4 and CO_2 are both greenhouse gases, but CH_4 is much more reactive, by a factor of some 25 times per unit of carbon (IPCC 1996), so emissions of the residue-bound carbon in the form of a 50:50 mix of CH_4 and CO_2 rather than as pure CO_2 are far more damaging from the perspective of greenhouse gas buildup in the atmosphere (Morris 1992). The only effective means of eliminating CH_4 emissions from the disposal of wood residues that would otherwise be buried in a landfill is to use the material as fuel. Over time, the decaying landfill exhausts a mixture of CH_4 and CO_2 and the much greater radiative effectiveness of CH_4 rapidly leads to a greater greenhouse gas burden, which eventually becomes a major liability for the landfill option, even with the use of gas-control systems on landfills.

Composting and land application of waste wood/Land spreading of wood chips and bark as mulch and cover

Composting and spreading also lead to higher greenhouse gas emissions than does energy production, and although this use is growing rapidly, the markets for these materials are limited.

Composting of biomass residues accelerates the natural decomposition process. Decomposition occurs through aerobic and anaerobic pathways, producing a mixture of CO_2 and CH_4 emissions. In a well-managed compost operation, the emissions are primarily CO_2 because of frequent aeration of the material. The compost product, which contains approximately 50 percent of the original biomass carbon, is then spread where it continues to decompose, although no longer at an accelerated pace. The effect on the atmosphere is still a high level of contribution of methane and other volatile organic gases.

In-forest accumulation of residues as downed material

Vast areas of American forests are overstocked with biomass material, which represents an increased risk of destructive wildfires and a gradual degradation of the forest ecosystem. All forests are prone to periodic fires. Biomass overstocking has increased the amount of fuel loading and degraded forest health and productivity. Emissions associated with forest fires in overstocked forest conditions are many fold in excess of emissions from biomass power plants.

The Case for Using Woody Biomass for Energy Production

Controlled conversion of biomass fuels in fluidized bed energy systems achieves lower emission levels of all criteria pollutants for biomass power plants when compared to other technologies, including grate burners.

According to detailed studies, using conservative base-case values for all the identified impact categories, the value for the ancillary environmental benefits of biomass energy production is calculated as 11.4¢/kWh of electricity produced from biomass. Running the model with minimum values for all categories produces a benefit value of 4.7¢/kWh for biomass energy production. Using maximum values for all the categories, the benefit value is 24.7¢/kWh. A significant contributor to the computed value of these biomass energy benefits is the value of avoided greenhouse gas emissions. The expected societal return on support for biomass power production is a multiplicative factor of 7.6.

Biomass power plants make an important contribution to society in many areas, including reduction of air pollution and greenhouse gases, increased available landfill capacity, improved forest and watershed health, enhanced rural employment and economic development, and energy diversity and security.

Advantages

- There's plenty of biomass to go around, and we can keep growing more of it. Right now, roughly 39 million tons of crop residues go unused each year in the United States. If harnessed, this amount could produce about 7,500 megawatts of power -- enough for every home in New England.

- Unlike burning coal, biomass produces fewer harmful sulfur emissions and has significantly less nitrogen, which means it cuts down on acid rain and smog.

- Burning biomass can result in zero net carbon dioxide emissions: any carbon dioxide released by burning biomass can be taken right back out of the atmosphere by growing more biomass.

- Using biofuels in our cars results in less global warming pollution than using gasoline and allows us to invest our energy dollars at home instead of in foreign oil.

- Switchgrass, a promising source of biofuel, is a native, perennial prairie grass that is better for the environment than most row crops: it reduces erosion, produces very little nitrogen runoff, and increases soil carbon. It also provides good wildlife habitat.

- About half of all ethanol production plants are owned by farmer cooperatives, meaning that biofuels not only hold great promise for the environment, but are also helping to preserve the economic vitality of rural communities.

Disadvantages

While biomass has positive elements, it also has disadvantages. The most significant constraint to using agricultural field residues for electric generation is the difficulty and cost of collection and storage. The potential for electricity generation from biomass may be limited by land availability and competing uses for food and high-value chemical products. The primary concern about direct combustion is air pollution caused by particulate matter, which may contain relatively large amounts of polycyclic aromatic hydrocarbons (PAHs). Polycyclic aromatic hydrocarbons are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

References:

Energy Products of Idaho, Renewable Green Energy in Fossil Fuel Fired Power Plants Using Low-Impact Biomass Gasifier Additions for Coal and Oil Fired Facilities, http://www.energyproducts.com/Documents/Green%20Power%20Paper.PDF, Dec 2006.

California Biomass Energy Alliance, Air Quality Benefits from the Biomass Power Industry in Central California, http://www.calbiomass.org/technical8.htm, Dec 2006.

Natural Resources Defense Council, Biomass Energy, http://www.nrdc.org/air/energy/renewables/biomass.asp, Dec 2006.

Renewable Energy, Disadvantages, http://community.hei.com/altenergy/bio.dis.html, Dec 2006.

Biomass | Carbon Cycle | Biomass Plantations | Initiatives | Renewable Energy Portfolio Standards | Non-Energy Disposal Alternatives | Air Quality Impacts | Economic Benefits | Biomass Related Measures | District Energy | Biomass Combustion Systems | Product Life Cycle