



## Energy Co2 : Energy Profiles

### Bioenergy: Plugging into Nature

**While burning wood to heat or cook is one of the least efficient ways to use bioenergy, it remains the most important energy source for some three billion people. But there are better ways to use biomass.**



#### Picture Gallery (click on the picture to start)

A closer look at the primitive and modern ways to produce bioenergy (Photo: Reuters)

Legend has it that fire was given to man by a half-god who pitied their vulnerability. Fire has been the most important form of bioenergy for thousands of years, but there are many other ways to extract energy from dead or harvested biological matter like generating gas from waste or producing liquid biofuels from crops.

#### Worldwide Importance and Future Trends

Biomass currently supplies a little over ten percent of primary global energy supply making it the most important renewable energy source. According to the World Energy Council, around half of this is produced from burning wood fuels - mostly fuelwood, charcoal, and black liquor - which an estimated three billion people worldwide still rely on for heating and cooking.

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Developed countries have found more efficient ways to use biomass - mainly burning it to generate electricity. Global electricity production from biomass in 2005 was around 180 Terawatt hours - equivalent to about 0.01 percent of annual electricity consumption. Around 2.4 percent of electricity in the European Union comes from biomass, but climate-friendly policies could drive growth in this sector, particularly biogas. Some experts say that biogas alone could supply up to 10 percent of Germany's electricity needs by 2020.

Liquid biofuels made from rapeseed, corn, sugar cane, palm oil, and a

number of other sources are poised for future growth if oil prices stay high. Although fossil fuels still account for over 95 percent of the global transportation fuel market, climate and energy security concerns are pushing annual biofuel production growth rates to about 15 percent, mostly in ethanol and biodiesel. Global ethanol production has doubled since the year 2000.

### **Global Resources and Producers**

The estimated energy supplied by world's terrestrial biomass each year would be equivalent to three Zettajoules - which is several times global annual energy consumption. Only around two percent of this is currently used for energy, which theoretically leaves a big potential for growth. Not all of what remains, however, can be used for energy needs in a sustainable way.



#### **Biogas**

Cows produce massive amounts of methane, a potent greenhouse gas. Using manure to produce biogas neutralizes some the gas and turns it into a renewable energy source (Photo: Reuters)

In terms of Terawatt hours produced each year, the world's leading bioenergy electricity producers are the United States (30 percent of world's total), Germany (13 percent), Brazil (13 percent), Japan (9 percent), and Finland (9 percent).

Brazil and the United States are far and away the world's two largest biofuel producing countries; both produce well over 4 million gallons of ethanol each year. Germany is the global leader in biodiesel production, producing over 2.6 million tons a year, mostly from rapeseed.

### **Energy Output**

Biomass is mainly used to produce electricity in three ways: direct-firing, co-firing, and gasification. Direct-fired systems burn biomass to produce steam. Co-firing systems simply replace parts of the coal burnt in existing power plant furnaces with biomass, which emits less toxic and greenhouse emissions than coal. The most efficient way of using biomass is gasification. Most biogas plants produce 500 kilowatts of power or less, though one planned plant in Germany will have a capacity of 4 Megawatts (MW).

Biofuels for transportation vary significantly in their net energy output; it depends on the crops from which they are made and if they have to be shipped a long way from producers to consumers. Corn, which is the biggest ethanol crop in the United States, is not considered very efficient, because the energy gain from producing corn-based ethanol is relatively low. By comparison, crops like sugar cane, jatropha, and palm oil are considered more efficient in terms of net energy gain.

## Environmental Impact and Drawbacks

There has been some debate over the environmental and social benefits of biomass as an energy source. Growing corn to produce ethanol is one of the most controversial because it is not yet energy efficient, represents only a marginal reduction in net greenhouse gas emissions from petroleum, and competes with food and livestock production. The massive increase of corn production for fuel purposes has driven the price of corn beyond what many poorer consumers can afford.

The development of cellulosic ethanol production in the future - which makes better use of crop residues and byproducts - may help make corn-based ethanol more sustainable. The expansion of other biofuel crops, however, has also drawn scrutiny. Booming global demand for biofuels has led to rapid growth of sugar cane and palm oil production in Brazil and southeast Asia, respectively, which has led to alarming levels of deforestation, soil erosion, and pollution.

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