

# Search for Solutions

*Keeping our energy reliable and affordable*



## Growth Potential

*Nation's biomass resources could limit use of fossil fuels*

Biopower is electricity generated from organic matter. It is a small part of the overall energy picture today, but likely will become much more important in the future as efforts increase to find alternatives to coal-fired generation.

Organic matter available for power generation is called biomass. It comes from many sources, but generally refers to agricultural and forestry residues, animal and municipal solid waste, and crops grown specifically for energy use.

National research and development of biomass feedstocks seek to establish "a viable, sustainable domestic biomass industry that produces renewable biofuels, bioproducts and biopower, enhances U.S. energy security, reduces our dependence on oil, provides environmental benefits—including reduced greenhouse gas emissions—and creates economic opportunities across the nation," according to the U.S. Department of Energy (DOE).

One goal is to transform biomass resources into cost-competitive alternatives to coal for the power industry and gasoline for the transportation industry.

Most biopower plants use direct-fired systems, burning bioenergy feedstocks directly to produce steam, according to the DOE's National Renewable Energy Laboratory. The steam drives a turbine, which turns a generator that converts the power into electricity.

Another common means of producing biopower is to burn biomass with coal or gas. This method is called co-firing. It refers to replacing a certain percentage of fossil fuels with biomass—typically a wood product—to fire turbines.

Indirect co-firing requires gasification

of biomass to create a biofuel. Products of gasification include electricity through gas-combustion turbines and ethanol.

Direct co-firing is the easiest and cheapest method because biomass is simply mixed with coal and burned inside the same turbine. As the percentage of coal decreases, the environmental benefits increase.

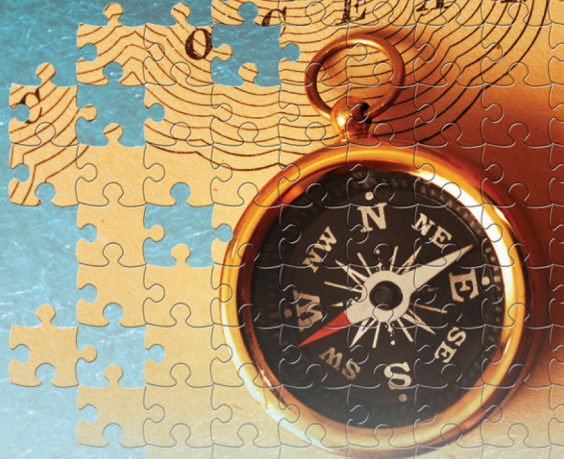
This use of biomass could be important to the power industry as it tries to reduce emissions from coal, which accounts for about 50 percent of the electricity generated in the United States.

Biomass is considered carbon neutral because it absorbs from the atmosphere as much carbon dioxide as it creates during combustion. A closed-loop process—power generation using energy feedstocks such as switchgrass or hybrid poplar—will produce a small amount of carbon dioxide. These emissions, however, are caused by harvest and transportation rather than electricity generation, according to the U.S. Energy Information Administration (EIA).

Studies show biomass produces significantly lower emissions of sulfur dioxide and oxides of nitrogen than coal, according to EIA.

How biomass is produced, however, is a topic of debate yet to be resolved. Growing corn for fuel, for example, takes cropland out of service for food production. Extensive use of woody biomass could lead to deforestation.

While creating the infrastructure necessary for sustainable biomass production will be expensive, EIA estimates there is enough biomass available today for 3,000 megawatts of capacity at production costs equal to coal. ■



### Bioelectricity Shows Its Road Worthiness

A study published last year in the scientific journal *Science* suggests bioelectricity could be more efficient than ethanol to power vehicles.

Researchers at the University of California-Merced, Stanford University and the Carnegie Institution found that "bioelectricity produces an average of 80 percent more transportation kilometers and 129 percent more emissions offsets per unit area (of) cropland than cellulosic ethanol."

Cellulosic ethanol is derived from biomass found in nonedible plant fiber rather than food crops, such as corn. However, corn stalks will produce cellulose.

The U.S. Department of Energy supports cellulosic ethanol research as a sustainable means of biomass production.

"Biomass could power either internal combustion or electric vehicles," the study says. "We show that bioelectricity outperforms ethanol across a range of feedstocks, conversion technologies and vehicle classes."

One of the feedstocks tested was switchgrass, a native North American plant that is a potential perennial crop for the nation's biomass production. As an energy source, switchgrass outperformed corn for efficiency both as a source of ethanol and electricity.

**ENERGY TIP:** Learn more about the federal government's research and development of biomass resources in the United States at [www1.eere.energy.gov/biomass](http://www1.eere.energy.gov/biomass).