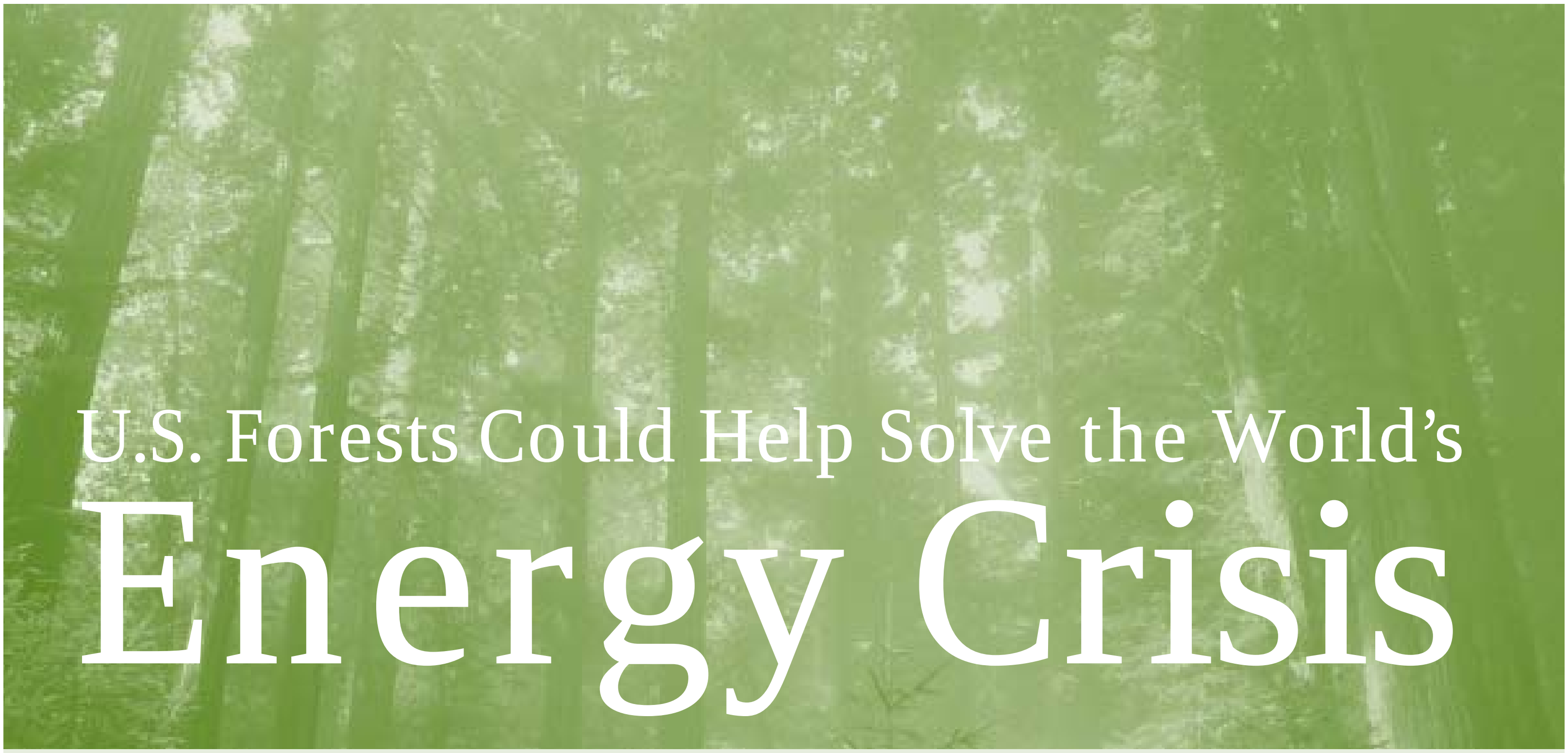


U.S. Forests Could Help Solve the World's Energy Crisis

A "perfect storm" with the potential to alter the U.S. timber industry is on the horizon. Increasingly, the world is looking to forests in the United States for solutions to economic, environmental, and social ills caused by rising oil prices, climate change associated with global warming, and homeland security. Consumer demand for sustainable and environmentally safe energy alternatives has opened the door for government and corporate spending on sustainable energy technologies. As a result, existing wood fuel markets such as wood pellets and cogeneration are expanding and new markets in cellulosic ethanol and carbon sequestration are on the rise.

By SCOTT Twillman, REUBEN Rangel, & KEUN-HAE Lee

Tree Farmers now have an opportunity to affect change in the energy market. Decisions made by forest landowners will shape the future of the wood fuel industry.

Cellulosic Ethanol

At the center of energy supply concerns in the United States is transportation fuel. In 2007, President Bush challenged lawmakers and industry to replace 35 billion gallons of petroleum-based gasoline with renewable fuels by 2017. Corn ethanol, an established gasoline additive and alternative fuel, will not be able to meet the increased demands. As a result, industry and government leaders have responded to his challenge with millions in grants and subsidies for the development of cellulosic ethanol refinement technologies and facilities. Cellulosic ethanol is derived from a wide variety of sources of plant fiber, ranging from stalks and grain straw to switch-grass and quick-growing trees (poplar and willow).

Cellulosic ethanol is of particular interest to forest landowners. The southeastern U.S. forest industry, with an estimated surplus of 20 million tons of manufacturing residue and 300 million tons of waste wood left on forest floors, already produces sufficient additional biomass to meet a large share of future alternative fuel demands.

Forest wood waste is an ideal energy crop. While agricultural harvests typically occur once a year, forest harvests can occur throughout the year to provide a consistent quantity of feedstock year-round. Legislators must provide an incentive to landowners to collect, store, and distribute what has been for years considered a waste product to spur development of this new market.

Corn ethanol has been a leader in alternative fuels because of its mass availability, an established collection and storage system, and relatively advanced conversion technology. Recently, however, public opinion has labeled corn ethanol an unsustainable fuel and blamed it for increasing world food prices, crop conversion of transitional prairie land, and increasing pollution.

The emergence of a strong cellulosic ethanol feedstock market will result in less negative collateral damage to other markets, yield greater energy conversion efficiency, and create less net pollution in comparison to corn and grain ethanol feedstock. Despite the advantage of cellulose over corn, cellulose feedstocks have lagged in popularity because of higher production costs due to an additional extraction phase during production (see Figure 1).

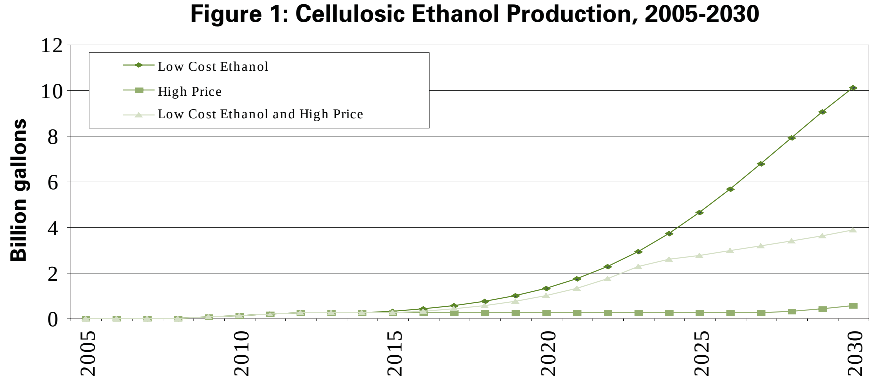
Production cost is a great challenge to the development of a viable cellulosic ethanol market. While potential breakthroughs in technology and new facility plans are announced daily, corn ethanol and traditional fuels continue to be more cost effective. A cost-competitive and energy-efficient chemical conversion process has yet to be developed. This, combined with the subsidies received by corn ethanol producers, currently makes cellulosic ethanol more expensive to produce than corn ethanol.

Current research in cellulosic ethanol production focuses on both the pretreatment phase and hydrolysis processes of cellulosic ethanol production. During pretreatment, plant fibers are broken down to their component parts: cellulose, hemicellulose, and lignin. After pretreatment, cellulose is separated and converted to glucose during hydrolysis.

The basic method for pretreatment is first to grind or crush biomass to increase its surface area and then break hydrogen bonds using sodium hydroxide or break the links that hold cellulose to the other components using acids, bases, or alcohol. Innovations in this phase make it easier to sift out the cellulose.

The challenge of converting cellulose to glucose during hydrolysis is caused in part by its structure. Cellulose is both crystalline and amorphous, unstructured. Enzymes used to convert cellulose to glucose naturally attach themselves to the easiest source, amorphous cellulose. The resulting glucose "soup" makes it difficult for the enzymes to reach the remaining crystalline cellulose. Research in hydrolysis is centered on finding a chemical or biological agent that will reduce the time and cost of converting cellulose to simple sugars.

Figure 1: Cellulosic Ethanol Production, 2005-2030



"Annual Energy Outlook 2007," Energy Information Administration

Opinions about the timetable for development of an economically viable cellulosic ethanol vary. Some politicians, researchers, and private investors believe that cellulosic ethanol will be competitive in the next three to five years, while others say the timeframe is more likely to be 10 to 15 years. Helen Chum, of the National Renewable Energy Laboratory under the U.S. Department of Energy, said costs for ethanol production should fall to $1 USD per gallon by 2012 to 2016. Still, others believe that there is a strictly government-supported ethanol "bubble," and that it will never achieve long-term, market-driven success. The real answer is that no one really knows when or if cellulosic ethanol will be commercially available at a competitive price. Regardless of the answer, the effects of the cellulosic ethanol push are sure to be felt throughout the market for years to come.

Cogeneration

Combined heat and power (CHP), commonly referred to as cogeneration, is the process in which one fuel source is used to produce both thermal and electric energy. In a cogeneration facility heat or electricity is recycled in the facility to power secondary operations. The paper, pulp, and forest products industries, accountable for more than 30 percent of overall cogenerated energy use, have been leaders in cogeneration for years. It is a century-old technology that has been revitalized due to rising energy prices and escalating interest in the use of renewable fuels.

The proliferation of cogeneration facilities for industrial, private, and public use will affect forest landowners and other members of the forest products industry due to a greater focus on biomass feedstock for energy generation. A number of political and economic factors have influenced this rise, including the EPA's CHP initiative of 1998, the "20-in-10" initiative introduced earlier this year by the Bush administration and the Healthy Forest Restoration Act. Concerns about rising prices for nonrenewable energy sources, as well as environmental interests, will also have a lasting effect on this market.

Currently, a number of state and local cogeneration programs may indicate the future of the industry. The University of South Carolina joined a growing cadre of colleges and universities that are using cogeneration to heat and power campus buildings. The Department of Energy will use woodchip and other biomass to replace coal for a steam plant at its Savannah River Site. Baycorp Holdings Ltd. and the Nacogdoches Economic Development Corp. hope to begin construction of the first biomass electricity plant in Texas with passage of state legislation to expand the state's energy portfolio. The plant could save consumers approximately $126 million during the next eight years. Georgia Pacific has installed a new steam reformer in its Big Island, Virginia, facility that will reduce process emissions by 10,000 tons and generate surplus energy that could be sold to consumers on the power grid. As fuel costs continue to climb, a growing number of businesses and institutions will turn to cogeneration technology as a part of the solution to meet their energy demands.

Wood Pellet

The burgeoning European wood pellet market will have lasting effects on U.S. Tree Farmers and wood pellet manufacturers. International interest in renewable fuels has focused attention on wood pellet fuel. Wood fuel is considered carbon-neutral, according to an independent UN study group. Burning it for energy adds no additional carbon emissions to the atmosphere than might otherwise be released naturally. Nations in the European Union (EU) have turned to wood pellet fuel to help meet carbon emissions caps specified in the Kyoto Protocol (see Figure 2).

According to the Pellet Fuel Institute (PFI), the residential and commercial pellet fuel market has the greatest potential for growth. More than 1 million homeowners use pellet stoves to heat their homes. Annual sales of pellet stoves rose from 34,000 in 1998 to almost 120,000 pellet stoves in 2005.

Figure 2: Pellet Fuel Comparative Values

	Btu/lb	Ash %	Sulfur %	Moisture%
Peanut Hull	7830	3.61	0.08	8.58
Paper	10198	3.53	0.06	4.04
Wood	8246	0.43	0.01	2.74
Grain Dust	6680	3.73	0.09	4.77

Adapted from Twin Ports Testing: Short Proximate Estimated Comparative Values, 2002-2007

Approximately 60 wood pellet manufacturers in Canada and the United States have an annual production capacity of 2 million tons. An additional 15 pellet manufacturing facilities are currently in the planning phase. The PFI estimates that growth in this market could bolster employment from its current 1,450 jobs to 820,000 within the next few years.

Growth in the European market has driven some manufacturers to harvest forest lumber specifically for pellet production and others to U.S. forests for additional wood pellet supplies. In 2005, the EU saw a sharp 16-percent upsurge in biofuel produced electricity and currently consumes an estimated 8 million tons of wood pellets annually. Expansion of the EU wood pellet market continues at a rapidly accelerating pace. Between 1992 and 2001, Swedish pellet consumption increased from 5,000 tons to 667,000 tons of pellets per year. Danish pellet use increased by approximately 600,000 tons annually after a new CHP plant began operation in 2003.

Continued expansion of the wood pellet prices may drive up profit for Tree Farmers, as current supplies of wood waste necessary for pellet production are unable to meet the new demand and more companies are forced to look at forests instead of manufacturing plants for the woody biomass they need.

Carbon Offset Market

U.S. Tree Farmers stand to gain from the growing market in carbon offset and emissions trade. Current afforestation, reforestation, and forest management practices could translate into dollars as companies in the United States and abroad seek to offset their greenhouse gas emissions. Reducing or offsetting greenhouse gas emissions through forest carbon sequestration projects is increasingly attractive to companies as their clientele have become more concerned with the possibility of climate change due to global warming.

Global trading of greenhouse gas emission credits has been encouraged by provisions outlined in the Kyoto Protocol that cap the amount of carbon emissions in participating nations and provide procedures for trade among signatories. Although the United States has yet to become a signatory of the protocol, industry leaders here have entered the carbon offset market to meet emission guidelines in other countries and in preparation for future emissions caps in the United States.

A "carbon offset" is an activity that mitigates overall greenhouse gas emissions through trade with less-polluting organizations or through specific carbon sequestration activities. Due to the prevalence of carbon dioxide, greenhouse gases and offset measurements commonly are expressed in relation to the global warming effect of carbon dioxide as tons of “carbon dioxide equivalent.”

Carbon sequestration is the process of capturing carbon dioxide and preventing its release to the atmosphere. Carbon sequestration occurs naturally in forests, oceans, and soil. Growing forests are like carbon vacuums, capturing and storing carbon dioxide from the atmosphere. Mature forests store large amounts of carbon in soil, trees, and other plants. Researchers have experimented with a variety of artificial sequestration methods, such as injecting carbon dioxide directly into the ocean and spent oil fields. Natural and artificial carbon sinks, areas that capture and store carbon dioxide, are a vital part of the global initiative to reduce the amount of carbon dioxide and other greenhouse gases released into the atmosphere.

To facilitate eventual regulations and subsequent market effects of greenhouse gas emission caps in the United States, industry, nonprofit, and state leaders have established registries that meet global standards for measuring and recording emissions. The primary function of existent registries, however, is to assemble an inventory of emissions and available carbon offsets, rather than to package them for sale on an open market. Interested parties may use the registry to help arrange individual carbon offset agreements.

According to the Department of Energy National Energy Technology Laboratory, monitoring and eligibility standards for carbon sequestration projects will continue to become more uniform as increased political and market pressures demand further regulation of carbon sequestration units (CSU) measurement processes.

Currently, a number of state and local cogeneration programs may indicate the future of the industry: the University of South Carolina is using cogeneration to heat and power campus buildings; the Department of Energy will use woodchip and other biomass to replace coal for a steam plant at its Savannah River site; and Georgia Pacific has installed a new steam reformer in its Big Island, Virginia, facility that will reduce process emissions by 10,000 tons.

Currently, the forest products industry can profit from carbon sequestration projects through federal, state, and regional programs. The Chicago Climate Exchange, the first voluntary, legally binding trading platform for carbon emissions in the United States, allows trade of CSU credits obtained through managed certified forests, long-lived wood products, and unmanaged afforestation projects (<www.chicagoclimatex.com>).

Future Course and Concerns

Growth of the biofuel industry presents forest logging companies, among other members of the forest products industry, with the potential for new revenue streams. Traditional waste materials such as logging slash could be chipped and sold on an open market to cellulosic ethanol refineries and wood pellet manufacturers. Biomass, normally collected at a logging deck and then redistributed in the woods or burned, can instead be chipped and blown into the back of a specialized hauling trailer for delivery to various destinations. Since the biomass normally collects at a logging site during harvest, no alterations would be necessary for saw and skidder operations. Harvesting precommercial materials such as understory for sale to biofuel producers would require development of new skidding technologies and is unlikely to become profitable unless demand for biofuel feedstock increases dramatically

The impact of marketing forest waste materials to forest management requires further study. Tree Farmers must consider environmental issues pertaining to the growth and maintenance of forest land. Removing traditional waste materials is beneficial for fire prevention and regeneration. It can, however, also degrade soil regeneration. Woody biomass left behind serves an ecologically productive function. Pine tops, branches, needles, and other understory slash can help protect against soil erosion, return organic matter and nutrients to the soil, improve soil moisture retention, and buffer soil temperature changes. For the Tree Farmer, these ecological concerns can translate to economic ones as the growth capacity of a forest is integral to future revenues. Maintaining some residual biomass is important to traditional row crops which are harvested on an annual basis. The complete removal of logging residue will affect future stands that grow in un-amended soil. The long-term effects of complete biomass removal will depend ultimately on the amount of material removed and how often it is removed.

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