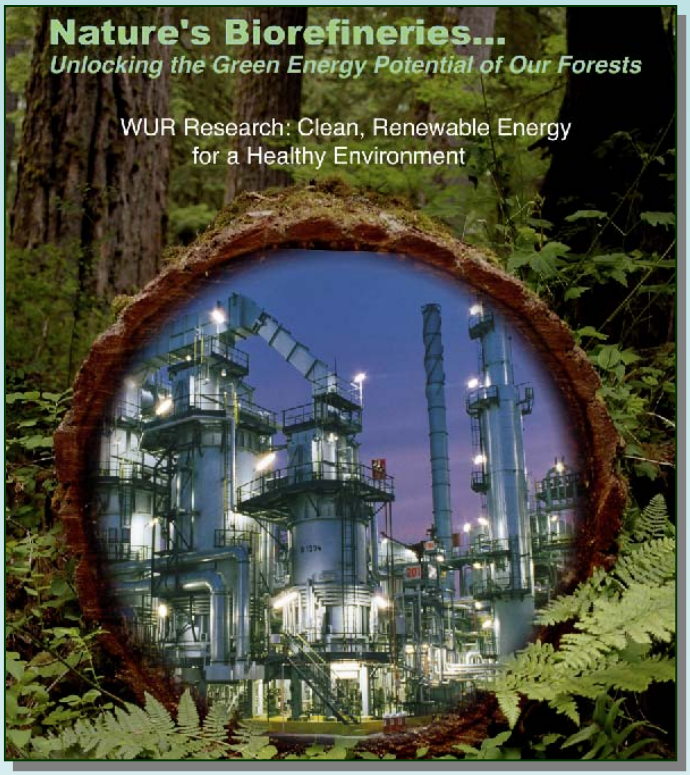
Biofuels and Bioenergy

Wood Utilization Research (WUR) National Centers

1.3 billion tons! A recent USDA/DOE study concluded that 1.3 billion tons of lignocellulosic biomass is available in the United States to reduce our dependence on foreign oil. This resource translates to almost 3.5 billion gallons of oil, an amount that is nearly double our current domestic oil production. In short, there is enough biomass available to have a real impact on our nation's energy independence in a sustainable, and sustained, manner. The forest sector has a vital role to contribute to ensure that the goals advanced by the vision of renewable, alternative fuels and chemicals are met; and, that they are met in a sustainable manner. Several approaches to advance the concept of the forest biorefinery are being explored by the universities that comprise the Wood Utilization Research program.

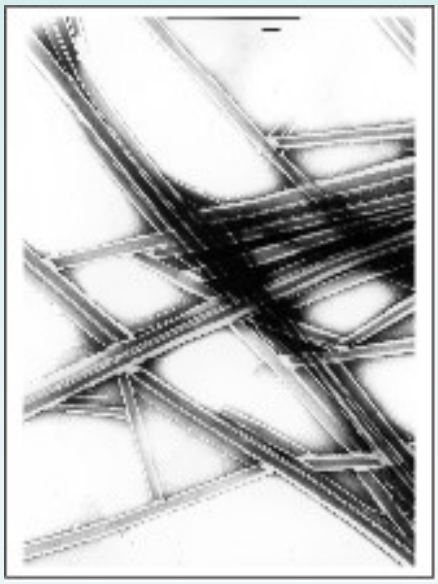


Cellulosic Ethanol - The conversion of cellulose from wood to biofuels like ethanol is a technology that has been with us for decades. Reliant on biochemical processes, it is a technology that is not yet economically viable but WUR researchers are developing new "pretreatment" technologies to allow it be so. While opportunities to improve the systems economics can be found in technical challenges like harvesting and transportation, the prospect of improving accessibility of the cellulose sugars to the enzymes promises improved product yields and rates of conversion. Recent progress has been made toward a clean methodology for this important task, including the use of enzymes such as laccases or dioxygenases, as well as oxygen-based reagents. Also, innovative solvent fractionation technology is being studied that generates pure sugar streams for fermentation to ethanol. The studies directly target pretreatment cost reductions while minimizing the environmental footprint of this critical step.

Integrated Systems - Process integration is considered important for the efficient use of renewable resources as biofuels and chemicals. A significant research effort underway at several of the WUR partner institutions seeks to exploit the fact that biomass is already available at existing wood conversion operations. One element of the program involves extracting a portion of the carbohydrates from the wood prior to primary product manufacture. This concept has been demonstrated for certain pulp and paper processes, and is now being extended to structural wood composites like oriented strandboard. Although results are mixed, preliminary work suggests that composite properties can be improved through extraction, which creates a new value stream for biofuels and value-added products. This could ultimately improve the competitive position of the existing industry, as well.

Integration of chemical conversion technologies is also a necessary approach to efficient utilization of the resource. To that end, pyrolysis (a thermochemical method) is being used to produce bio-oils from forest residue. The bio-oils are complex mixtures of a number of chemical compounds, and provide a route to additional market applications from low-value material from harvesting and processing. Wood Utilization Research members have identified several promising applications, that include a natural biocide to extend the lifetime of structural wood products like lumber, and new adhesive systems for bonding wood.

Value-Added Chemicals - Reducing our nation's dependence on petroleum extends beyond use of woody biomass for biofuels and bioenergy. Biomass is the only source available for production of liquid chemicals and materials that are important to our quality of life. The WUR universities are actively conducting research on new plastics and materials derived from cellulose. Furthermore, studies are underway to develop novel platform chemicals that can be used to produce a family of commercially important compounds. These chemicals will also be used to create new, green materials with unique and valuable characteristics. Research is currently considering novel, biobased nanostructured systems. Known as "bola" molecules, these sugar-derived chemicals can be manipulated to form various nano-scale structures, including the rods shown at left.



Additional information on these topics and more can be found at: http://www.UTbioenergy.org, http://www.msstate.edu, and http://chemistry.umeche.maine.edu/Fort/Cole-Fort.html

WUR National Centers, http://www.woodutilization.org

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