

# UNIVERSITY OF MINNESOTA

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The University of Minnesota's Natural Resources Research Institute has made strategic investments in facilities and equipment that prepares biomass for subsequent processing for conversion into solid and liquid biofuels. This includes both pilot and demonstration scale equipment to concentrate the energy value in woody and herbaceous biomass using torrefaction and hydrothermal carbonization technologies. Both technologies enable the removal of chemical components that can complicate gasification of biomass in making high quality syngas for conversion to liquid fuels such as jet fuel and diesel. The torrefaction process effectively reduces the amount of oxygenated hydrocarbon species and this makes gasification simpler and more controllable. The Institute has partnered with high pressure gasification reactor experts in the private sector and is evaluating how to best merge its pretreatment technologies with gasification and chemical conversion technologies to demonstrate the economic viability of its planned liquid fuels approach.

Minnesota has recently supported economic development activities targeting the growth and expansion of the biofuels and biobased chemicals industry. This sector has the potential to increase demand for biomass materials, create jobs, and reduce dependence on fossil fuels through the development of Integrated Forest Bio refineries. An Integrated Bio refinery processes lignocellulosic biomass into fuels, chemicals, and materials in a balanced portfolio that collectively can add 10-100x economic value to biomass harvested from the forest. *Currently available* technologies can produce multiple types of liquid fuels, chemical precursors, bio-plastics, and food ingredients from forest biomass, thereby greatly increasing the value and diversity of products made from forest biomass. Furthermore, this industry has the potential to utilize woody biomass residues and materials from hazardous fuels treatment, creating new markets and support for the forest industry.

Currently, emerging markets for renewably sourced fuels and chemicals are expected to grow by fourteen percent annually for the foreseeable future. This positive trend is driven by business economics and consumer demand changes that encourage a market shift from dependence on fossil fuels and petroleum-based chemicals and plastics toward renewable and sustainable sources. The value proposition in this case is both economic and emotive. Once a material is determined to meet a customer's specifications and quality criteria, price will dominate the purchase decision. In addition, there is significant emotive appeal in providing a renewable/green source for chemicals historically derived from petroleum or coal.

The conversion of biomass to solid fuels has also been an area of concentration as a partial or total replacement for fossil fuels such as coal. The Institute has participated in a nationally sponsored program "Coalition for Advanced wood to energy solutions". This effort is sponsored by the US Forest Service and by the US Foundation for Forestry and Communities. Specific involvement has included evaluation of the use of solid biofuels at several major electrical producers and also development of techniques to consolidate solid fuel products using briquetting and pelleting densification methods. The use of torrefied biofuels has been found to be an acceptable coal substitute up to 100% substitution level. Continued development is underway to further improve the properties of these fuels and also to develop biofuel/coal blends that can reduce the environmental footprint associated with coal utilization.

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