

Bioenergy research and development cuts across disciplinary and technology boundaries, encompassing feedstock cultivation and harvest, pretreatment and conversion technologies, product separation and purification, process integration, and economic and life cycle analysis. It requires insights and advances provided by molecular biotechnology, mathematical modeling, process analytical technology, thermodynamics, quorum sensing, fermentation, and a host of other disciplines and knowledge bases. Recognizing that all biomass is local, and that all treatment and conversion technologies must be adapted to the biomass at hand, North Carolina State University is currently pursuing research and development activities in a variety of areas using a variety of feedstocks, including but not limited to,

- industrial sweet potatoes, sweet sorghum, genetically-modified grasses and trees,
- chemical, enzymatic and thermal pretreatment technologies,
- aerobic and anaerobic fermentation technologies,
- process separation technologies (protein and small molecules), and
- economic and life-cycle analysis of biomass to biofuels technologies.

To affect this breadth and depth of research and development activities, NCSU has developed,

- a biodiesel pilot facility that demonstrated various process technologies,
- a screening pilot facility for conversion of cellulose to ethanol and other products,
- a thermochemical pilot facility for wood torrefaction,
- a state-of-the-art biofuels analytical facility, and
- an NSF-sponsored industry-university consortium involving approximately 30 companies and 5 universities focused on bioenergy production.

NCSU researchers have been particularly successful in attracting support for bioenergy research. Currently, roughly 60 faculty and professional staff are engaged in 55 separately funded projects totaling over \$20 million in currently active external funding. Taken over the last 5 years, funding at NCSU in the bioenergy arena has exceeded \$40 million.

NCSU is also one of the partners on an EFRC: **Center for Lignocellulose Structure and Function** led by Pennsylvania State University and including Virginia Polytechnic Institute and State University, DOE, 5 yrs-\$21 million. The objective is to dramatically increase our fundamental knowledge of the physical structure of bio-polymers in plant cell walls to provide a basis for improved methods for converting biomass into fuels.

NCSU recently was awarded a new Engineering Research Center entitled: **Future Renewable Electric Energy Delivery and Management Systems Center**, where total funding over five years will be about \$35m. (See: <http://www.freedm.ncsu.edu/>). Partners include Florida State University, Florida A&M, Arizona State and the University of Missouri. The proposed FREEDM System is a green energy grid infrastructure that will (1) allow plug and play of any energy resource or storage device, anywhere and anytime; (2) manage distributed energy resources and storage devices through Distributed Intelligence; (3) pioneer a scalable and secure communication backbone; (4) be capable of being totally isolated from the central grid, if necessary, continuing to operate based on 100% renewable energy; (5) provide perfect power quality and guaranteed system stability; (6) and have improved efficiency, operating the alternating current system with a unity power factor.

NCSU is a partner in an EFRC on Solar Fuels entitled: **Solar Fuels and Next Generation Photovoltaics**. Its objective is the synthesis of new molecular catalysts and light absorbers and the integration into nanoscale architectures for improved generation of fuels and electricity from sunlight. The UNC-Chapel led EFRC will involve over 20 faculty and include collaborations with scientists at Duke University, University of Florida, North Carolina Central University, and North Carolina State University.

Nuclear Energy Research: This is a major activity for NCSU. Faculty in its Nuclear Engineering program have recently received grants through awarded the DOE Battelle Alliance Program. Strengths of the department are in modeling and simulations in commercial nuclear reactors, light water reactors, and next generation reactions. NCSU is a leader Nuclear Energy University Program and the Idaho national Lab with Battelle.