

SURA Energy Research Workshop
Atlanta, Georgia
August 11-12, 2009
Report of the Working Group on Biomass/Biofuels

Participants: Dr. Martin Hjortso, LSU
Dr. Rakesh Bajpai, ULL
Dr. Joy Doran Peterson, UGA
Dr. Curt Peterson, WVU
Dr. Babu Joseph, USF

Reporter: Dr. Babu Joseph

Facilitator: Mr. Marc Oettinger, SURA

Summary

The objective of this session was to identify strengths at SURA universities for research related to Biomass/Biofuels research and to recommend a future course of action that could lead to joint research ventures. The group identified research into the production of high energy density liquid fuels from biomass as a potential area of unique strength and interest among SURA universities. It is recommended that a follow up workshop/seminar on **High Energy Density Liquid Fuels from Biomass** be held to bring together the various researchers in SURA universities to build interdisciplinary research team(s) to tackle the key scientific, technical and ecological challenges that need to be addressed in this area.

1. Introduction and Background

The Southeastern region of the United States possesses some unique geophysical characteristics that make it rich in biomass production that will not conflict directly with food production. At the same time, for obvious strategic and security reasons, it is imperative for the US to seek renewable sources of liquid fuels to meet global socio-economic, political and environmental threats. While nuclear, wind and solar energy sources provide alternatives to fossil fuels, biomass conversion is a realistic near term and long term alternative to meet the need for liquid transportation fuels such as those required by the military (air force) and transportation sector. Therefore, there is a strong strategic interest in overcoming the challenges faced in developing a biomass to liquid fuels industry in the southeastern United States. Biomass as used here refers to a variety of materials produced from living organisms including agricultural residues, forestry products, and algae. Biofuels as used here to refer to fuels produced from any biomass source.

2. Existing strengths at selected SURA universities

Discussion gathered from participants at the meeting identified a number of areas of research activity at member universities related to biomass/biofuels. The list here is limited by the participants present and therefore is by no means comprehensive.

There is ongoing research on plant genetics, growth of algae and plant biomass, and efficient collection procedures and processing of the biomass material. In addition to algae, pine, switch grass, energy cane, and sweet gum were identified as potential crops for the Southeastern region. A number of universities are also engaged in various types of conversion methods to synthesize liquid fuels from biomass. The underlying science includes genetics, physiology, genomics, proteomics, thermodynamics, catalysis, life cycle analysis, and sustainability. There is a considerable amount of on-going work in these underlying sciences at member universities that we believe could be coordinated into a regional effort that could be competitive for funding external to the participating universities, and hopefully could engage one or more national labs and representative industries interested in the technology that could develop from this coordinated program.

Based on the brief discussion we had and the interest expressed by the participants, we narrowed down the intersection of research interests to two narrowly focused areas for exploring cooperation among participating universities. These two are the production of algal biomass and the thermochemical conversion of biomass to liquid fuels.

Some of the test beds necessary for the evaluation of systems, processes and materials related to the above areas are already in place at participant universities. These include the Nanomaterials and Nanotechnology Center at USF, the catalyst characterization and testing facilities at USF and UF, the pilot scale gasifier unit at ULL, the pilot plant pyrolysis unit at UGA, etc. Also there are unique analytical instrumentation facilities available such as the synchrotron at LSU, and the NMR, LC MSMS, and other equipment available at UGA at the Complex Carbohydrate Research Center.

3. Some key challenges facing the production of high density liquid fuels from biomass

Key challenges in algal production include: the advantages/disadvantages of using of native species or GMO; the growth/culture systems, such as pond vs. container growth; delivery of photons and carbon dioxide to algal cells; effect of impurities in the nutrient on algal strains; recovery of algal cells; the nature of the cellular products, e.g., lipids, resulting from varied culture conditions; coupling the algal growth with industrial wastes (ex. CO₂ from fermentations or power generation, liquid waste streams from food processing, etc.); processing of algal lipids into green fuels; using the entire algal biomass for production of lipids and higher value-added co-products; efficiently disrupting the algal cell walls for recovery of the lipids and co-products; using the cellulose-rich algal cell walls for further conversion to fuels or energy adequately assessing the environmental impacts and life cycle analysis.

Key challenges in thermochemical conversion of biomass to liquid fuels include: biomass gasification process development, gas cleanup processes, catalyst development for liquefaction (both biological and non-biological catalysts for conversion of synthesis gases to products), environmental impact analysis, biomass variability, and, the distributed nature of the raw material which would require innovations in small scale processing techniques.

4. Future course of action

The next course of action is to bring together the faculty from various universities that are interested in forming a research team(s) to pursue coordinated, interdisciplinary thrusts to identify and tackle the various research issues. Once the issues have been clearly identified, a research strategy can be developed to ensure a longer term (~10 years) sustained effort at establishing the knowledge base, achieving the necessary scientific breakthroughs and overcoming the technological, ecological and economic barriers to create an industry to produce high energy density liquid fuels from biomass. It is important to include industry and government labs (NREL and/or ORNL in particular) in these discussions in order to ensure a long term industry-government-university partnership that can support the research and development needed.

The Center for Energy Systems at LSU is a possible organization and venue for holding such a workshop. The participants should include faculty currently engaged in related research and who have a strong interest in forming a joint alliance to tackle the issues identified above along with representatives from potential funding agencies.