Report of the Michigan Forest-Based Bioeconomy Summit
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MSU-MICHIGAN TECH RENEWABLE FUELS WORKING GROUP

Co-Chairs:

Raymond O. Miller (MSU Upper Peninsula Tree Improvement Center) rmiller@msu.edu
David Shonnard (Michigan Tech Department of Chemical Engineering) drshonna@mtu.edu

Committee Members:

Margaret Gale (Michigan Tech School of Forest Resources and Environmental Science)
Kyung-Hwan Han (MSU Department of Forestry)
Daniel E. Keathley (MSU Department of Forestry)
Jeffrey Naber (Michigan Tech Department of Mechanical Engineering – Engineering Mechanics)
Chris Saffron (MSU Department of Biosystems and Agricultural Engineering)
Barry D. Solomon (Michigan Tech Department of Social Sciences)

INTRODUCTION

Michigan State University (MSU) and Michigan Technological University (Michigan Tech) are research intensive institutes of higher education with complimentary expertise and a shared commitment to improve the economic well-being of Michigan and the nation. Over the last two years, members of these universities have been engaged with the Michigan Economic Development Corporation (MEDC), a Michigan state agency, in promoting economic development in agricultural and forest-based bioeconomy areas. An Agreement to Collaborate was signed in November of 2007 that established a forest-based Renewable Fuels Working Group composed of 4 faculty members from each institution with the overall goal to support development of the forest-based renewable fuels industry within the State of Michigan. In February of 2008, this group organized a summit where more than 50 individuals (representing industry, local governments, state agencies, and other organizations) identified priority research and outreach activities that our universities could conduct to advance the forest-based bioeconomy in Michigan. This report was prepared to summarize the comments made by the various working groups at that summit and to propose a course of action for our two cooperating universities.

Participants at the summit identified critical needs facing three broad segments of the forest-based bioeconomy: 1) feedstock production, 2) feedstock supply chains, and 3) feedstock conversion systems. These needs were then discussed and ranked by the participants to identify the most important research and outreach issues to be addressed by our two universities.

During this process, consensus built rapidly that definitions were needed to identify precisely what was meant by "renewable biomass" and "sustainable forest management." Additionally, the summit group strongly encouraged the Michigan state legislature to quickly join more than 20 other states and adopt some form of renewable portfolio standards for electricity and renewable fuels standards for transportation fuels. Both universities were asked to develop statements of support on behalf of the summit group. These basic definitions, the statement of support for renewable standards, the critical research and outreach needs, specific research questions and outreach programs, and recommended actions for our two universities follow.

DEFINITIONS

Renewable biomass: Ligno-cellulosic plant material whose supply becomes available for use at different time intervals and in which present use does not diminish future supply. (adapted from the International Union of Forest Research Organizations [IUFRO]).

Sustainable forest management: Stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their

potential to fulfill now and in the future, relevant ecological, economic, and social functions at local, national, and global levels, and that does not cause damage to other ecosystems (the Ministerial Conference on the protection of Forests in Europe, Helsinki, 1993).

STATEMENT IN SUPPORT OF RENEWABLE ENERGY STANDARDS

The "Forest-Based Renewable Fuels Working Group", a joint faculty committee from Michigan State University and Michigan Technological University, strongly supports the enactment of a mandatory Renewable Portfolio Standard (RPS) and Renewable Fuel Standard (RFS) for the State. The RPS and RFS are critical policy instruments that will help to ensure the expeditious development of robust markets for electric power, heat, fuels, and chemicals based on sustainable use of the forest resources of the State. They will help to stem the loss of our existing forest products infrastructure by expanding markets and help create a Bioeconomy in Michigan as called for by Governor Granholm.

CRITICAL RESEARCH AND OUTREACH NEEDS

1. Complete a comprehensive **inventory** of forest-associated woody biomass feedstocks in Michigan at a detailed level.
2. Establish **sustainability guidelines** for the management and use of forest-associated woody biomass based on sound scientific results.
3. Aggressively expand **technology and information transfer** in an accurate, unbiased, and user-friendly way to forest landowners, bioeconomy industries, and the general public.
4. Develop a **supply chain model** to be used to understand the effects of technological innovation on economics, biological, and ecological factors throughout the system.
5. Continue **technological innovation** in woody feedstock production, harvesting, transportation, and conversion within the context of the supply chain model.

1. Inventory

The urgent need for a geospatial inventory of all woody biomass feedstocks was expressed. This inventory should reflect current and future availability, productivity, ownership, and environmental and social limitations. It should be made user-friendly, geospatially presented, and widely available for use by policy makers, investors, entrepreneurs, planners, as well as researchers. Everyone agreed that a tool like this is long overdue and urgently needed to expand our wood-based bioeconomy. A database containing a comprehensive inventory of Michigan's harvesting and transportation resources or infrastructure is also desirable. MSU and Michigan Tech have begun working on the first version of this inventory but more work remains to be done.

2. Sustainability Guidelines

Michigan is revising their 1998 Guidebook for "Best Management Practices for Michigan Watersheds." The need to expand this new version to include guidelines for harvesting of biofuels from our forests and plantations is clear. While the Michigan Department of Natural Resources (MDNR) is already working on the first draft of these guidelines, research will be needed to supply the sound scientific underpinnings to these harvesting guidelines. This is where our universities can contribute most significantly.

3. Technology and Information Transfer

Strong consensus emerged from all groups that significant effort must be placed on bioeconomy technology transfer and education programs aimed at landowners, bioeconomy industries, and the general public. Particular emphasis should be placed on providing assistance and knowledge to small landowners, who own the majority of our feedstocks, and small entrepreneurs trying to enter Michigan's bioeconomy. Although Michigan has made only limited efforts in this area to date, MSU Extension and United States Forest Service Institute of Applied Carbon Science at Michigan Tech provide the potential to greatly expand outreach.

4. Supply Chain Model

A comprehensive supply chain model was identified as a keystone tool for integrating results from all of the other work that could be done by the two universities in this area. This model will provide a framework around which many research projects can be organized. Building the model will provide a mechanism to find, study, and improve critical technology and cost points in the feedstock supply chain. The model will allow study of energy budgets and cost factors throughout the supply chain. Furthermore, the model will assist developing bioindustries to understand the market dynamics and business opportunities available in Michigan. It will provide policy makers with a tool to explore the effects of proposed legislation, regulations, mandates, subsidies, taxes, and land use options.

Filling in the blanks within the model will require experts from the fields of silviculture, forest genetics, soil science, plant nutrition, biometry, geographic information system analysis, forest economics, social science, systems modeling, biosystems engineering, mechanical engineering, chemical engineering, forest engineering, and forest ecology. The model will be used as a framework to coordinate the resources at both universities and efficiently focus them to address critical issues facing the industry.

5. Technological Innovation

Several high priority research needs emerged from the summit on the effects of technological innovation on improving the economics of producing fuels and energy from Michigan's forest resources. High priority research needs were identified in the areas of transportation, biomass densification, improved mechanization, conversion process improvements, energy efficiency, and systems integration. Advances in these technologies of the biofuels supply chain will

require expertise in many fields of science and engineering. The knowledge gained from research will improve the confidence of predictions made by the supply chain model mentioned in paragraph 4 above. Technological innovations resulting from this research may lead to new discoveries and manufacturing opportunities in Michigan leading to economic growth.

SPECIFIC RESEARCH QUESTIONS AND OUTREACH NEEDS

1. **Woody feedstock production**
   a. What are the effects of quantity, distribution, ownership on feedstock availability and cost, and what can be done to increase supply and/or reduce cost?
   b. At what level can feedstocks be extracted sustainably from both natural forests and energy plantations?
   c. How can productivity be increased through alternate silvicultural systems, nutrient management regimes, species selection, and genetic improvement?
   d. What are the possibilities for improving mechanization in feedstock acquisition as a means of reducing cost?
   e. What are the environmental and energy impacts and harvesting costs of specific feedstock production equipment?
   f. How well would Swedish technologies work in Michigan?
   g. What are the most effective policy instruments (carbon taxes or credits, real estate taxes, subsidies, wood certification programs, public land management decisions, landowner outreach programs, etc) to increase feedstock availability and reduce cost?
   h. What are the effects of competition from domestic and international markets?
   i. What are the effects of competing social needs and landowner desires?

2. **Woody feedstock supply chain**
   a. What is the effect of product extraction integration on harvesting efficiency and cost?
   b. How can harvesting, transportation, densification, and storage systems be improved to be more efficient and less costly?
   c. Are there alternative merchandizing and marketing systems that can be employed to streamline the supply chain?
   d. What are the effects of land parcelization and public land use on the supply chain?
   e. What are the effects of policy instruments like Renewable Portfolio Standards, Renewable Fuel Standards, wood certification programs, public land use policy, roadway and railroad policy, taxation or credit programs, etc. on the feedstock supply chain?
   f. What is the optimal mix of small and large scale conversion facilities that will minimize transportation and reduce costs?
   g. What options exist for pre-treating feedstocks to reduce transportation costs and/or produce specialty value-added feedstocks?

3. **Woody feedstock conversion systems**
    a. How does local and world market stability or volatility change the profitability of various conversion operations?
    b. How can the type, cost, and condition of delivered raw materials be best matched to conversion technologies?
    c. What is the appropriate scale for various conversion technologies?
    d. Can new processes be integrated with existing and future wood products or bioenergy markets to improve efficiency and profitability and what industrial systems lend themselves to co-location and improving heat integration?
    e. What are the effects of policy instruments like RPS, RFS, carbon taxes or credits, real estate taxes and abatements, development zones, etc. on conversion activities?
    f. How do we overcome technical barriers in conversion processes?
    g. What conversion technologies would yield the "best" bioproducts for different sectors (residential, industrial, municipalities)?
    h. What conversion processes would allow the most rapid expansion of the forest-based bioeconomy in Michigan?
    i. How can the Michigan "Centers of Excellence" be organized to best support the MI bioeconomy?
    j. What are the usable fluids in heat conversion recovery?
    k. What are the technical issues for utilizing co-products and by-products from biomass conversion to the maximum extent?

RECOMMENDED ACTIONS FOR OUR TWO UNIVERSITIES

The forest-based Renewable Fuels Working Group of Michigan Tech and MSU have considered the input we received from the participants in February's summit, as described above, and make the following recommendations to address the critical issues identified. We see the need for *steering* committees; one for each of the critical areas. These committees should be composed of one member from each interested organization and serve as a forum where activities and resource needs can be communicated and coordinated among the various participants. Their role will be to ensure the needs of the industry are being met, that duplication of efforts is avoided, and information is released rapidly as it becomes available.

A woody **feedstock inventory steering committee** is needed to coordinate the efforts of MSU, Michigan Tech, the MDNR, the MEDC, the United States Department of Agriculture (USDA) Forest Service Forest Inventory and Analysis unit in Houghton, and the Governor's Energy Office. Each of these organizations has resources to bring to the ongoing effort to produce this comprehensive inventory. At a minimum, this group should be composed of one representative from MSU, Michigan Tech, and the MDNR. They should meet at least quarterly over the next

two years, alternating between the campus of Michigan Tech and MSU as they follow and advance the work that is now underway at both institutions.

A **feedstock sustainability steering committee** is needed to coordinate the process of developing "Best Woody Biomass Feedstock Management Guides" for Michigan. Since this effort has begun at the DNR, this agency may wish to play a leading role in guiding the efforts of our two universities and should certainly have a seat on the committee. This group may also expand the scope of investigations to include carbon cycling, since this subject will inevitably engender intense political debate. This committee should also meet quarterly over the next two years to ensure that ongoing work is directed correctly and that information gaps are quickly filled.

A **technology and information transfer steering committee** is needed to see that this critical need is adequately addressed by our two institutions. Membership in this group should include Michigan Tech, MSU Extension, MDNR, the Governor's Energy Office, the MEDC (and perhaps local Economic Development Alliances), USDA, Natural Resource Conservation Service, the United States Forest Service (USFS) Rural Development Program, the USFS Northern Institute of Applied Carbon Science, trade associations, landowner associations, Society of American Foresters, and industry representatives. They should meet frequently at first to establish program priorities, and then on a regular basis to ensure that resources are applied wisely and progress is maintained. Michigan is far behind some of its neighbors in this area so this group should proceed with a sense of urgency.

A **forest-based bioeconomy development steering committee** is needed to coordinate the resources of our two universities and of other governmental and corporate partners to focus on providing answers to the important questions identified above. This group should organize the construction of the supply chain model that was identified at the summit as a critical need. This model, as previously described, will produce the framework around which the scientific and engineering work at both universities can be coordinated to benefit the bioeconomy. In this way, the whole enterprise will become greater than the sum of its parts.

Many of the biological and engineering questions raised at the summit can only be answered by conducting and evaluating field trials or pilot programs. Much of this work can be most efficiently done at a centrally located, jointly operated facility at which all phases of the woody feedstock supply chain (as described by the model) can be examined. This committee should coordinate the design, construction, and operation of such a center to serve as a site for field research, outreach programs, demonstration projects, and a proving ground for new materials, technologies, and processes. It should be a place that is open to the research and business communities as well as the general public.

This proposed research and outreach center should be designed to compliment and support MEDC “Centers of Excellence” that are contemplated to provide research and development support for companies seeking to produce chemicals, fuels, or energy from woody biomass feedstocks using either thermochemical or biochemical processes.

The forest-based bioeconomy development steering committee should be a standing committee and composed of several members from both universities. It should continually solicit input (like that received at this summit) and broaden their membership to include other organizations and industries as they move forward. The committee will need financial resources to coordinate the completion of the forest-based bioeconomy model that is formulated by engineers and scientists at both universities.

POSTSCRIPT

All four of these recommendations represent a new way to approach research and outreach at our two universities. Success will be determined by the level of personal and financial commitment placed behind this effort. Collaboration and coordination must be recognized and valued for it to succeed over the long run. The objective, as stated by the presidents of our two universities and the Governor of Michigan, is to promote the bioeconomy of Michigan. To that end we should first focus our efforts on studies with *direct application* to the concerns of Michigan industries as stated here. Basic science is often more glamorous and more generously funded than applied science. Recently it has been assumed that industry was responsible for applied studies while the universities should concentrate on basic science. That assumption has been challenged by this summit and we must rise to meet the challenge.