
Reshaping American Agriculture to Meet its Biofuel and Biopolymer Roles

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NABC's twentieth annual meeting—hosted by The Ohio State University—convened in Columbus, OH, June 3–5, 2008. Delegates were welcomed by the senior author (associate vice president for agricultural administration and director of the Ohio Agricultural Research and Development Center, OSU), Bruce McPheron (NABC chair 2008–2009) and Ralph Hardy (NABC president). The conference attracted 107 delegates from twenty-seven US states, two Canadian provinces and Nigeria. Plenary sessions were held on the afternoon of June 3, the morning and afternoon of June 4, and the morning of June 5.

For the June 3 luncheon, delegates were joined by participants attending the Ohio Polymer Summit with Ohio Governor Ted Strickland as the keynote speaker. The keynote speaker for the evening's banquet was Ganesh M. Kishore (Burrill & Company, San Francisco, CA, *Agriculture: The Foundation of the Bioeconomy*). On June 4, the two luncheon keynote speakers, Christiane Deslauriers (Agriculture and Agri-Food Canada, Charlottetown, PEI, *Supporting Cross-Cutting Research: The Agricultural Bioproducts Innovation Program*) and Irwin Goldman (University of Wisconsin, Madison, WI, *Energy Transformations in a Land-Grant College: The Great Lakes Bioenergy Research Center*), shared efforts by Canada and the United States to enhance bioproduct and bioenergy research. The Ohio State University President Gordon Gee (Columbus, OH) provided the final keynote address at the June 5 luncheon.

Module I—*Megatrends Reshaping American Agriculture*—comprised presentations by John Pierce (DuPont, Wilmington, DE, *Renewable Fuels and Materials*); Steven Puepke (Michigan State University, East Lansing, MI, *Megatrends Reshaping Agriculture and Agricultural Universities*); Benson Lee (Technology Management, Inc., Cleveland, OH, *Energy Independence: On-Site Fuel Cell Systems Operating on Biofuels*); and Peter Ashcroft (Environmental Defense, Washington, DC, *What Future Role for Biofuels?*).

In Module II—*Optimizing the Value of Co-Products and Byproducts*—presentations were made by Stephen Myers (Ohio BioProducts Innovation Center, Columbus, OH,

Renewable Polymers and Advanced Materials); Robert Fireovid (USDA/ARS, Beltsville, MD, *ARS Research on Bioenergy and Co-Products*); and Joseph Bozell (University of Tennessee, Knoxville, TN, *Biomass as a Source of Carbon: The Conversion of Renewable Feedstocks into Chemicals and Materials*).

The speakers in Module III—*Enhancing Productivity of Biofeedstocks*—were Stephen Long (University of Illinois, Urbana, IL, *Opportunities for Enhancing the Productivity of Biofeedstocks and Minimizing Inputs: Theory and Practice*); Bill McCutchen (Texas A&M University, College Station, TX, *High-Tonnage Dedicated Energy Crops: The Potential of Sorghum and Energy Cane*); and David Bransby (Auburn University, Auburn, AL, *Synchronization of Biofeedstocks and Conversion Technologies: Current Status and Future Prospects*).

Presentations in Module IV—*Policy Issues Impacting Agriculture and Bioenergy*—were given by Paul Thompson (Michigan State University, East Lansing, MI, *Agricultural Biofuels: Two Ethical Issues*); Harry de Gorter (Cornell University, Ithaca, NY, *The Social Cost and Benefits of US Biofuel Policies*); and Kenneth Cassman (University of Nebraska, Lincoln, NE, *Scientific Challenges Underpinning the Food-Versus-Fuel Debate*).

The conference theme—agriculture’s biofuel and biopolymer roles—was comprehensively covered with high-quality presentations that stimulated thoughtful feedback from response panelists, lively Q&A sessions with the audience and active discussion within three breakout sessions. Points of interest made by speakers and which emerged from the Q&A sessions with audience participation included:

FOOD & FEED

- There is considerable misinformation about how food prices are impacted by ethanol production from corn; better understanding is needed of the variables that impact food pricing.
- More time needs to be committed to considering multifunctionality of systems, *e.g.* food and fuel and ecosystem services. Intensive use of land for production of both food and fuel crops needs consideration.
- Researchers need to adapt interdisciplinary approaches to solve food-availability and, thus, rising food-cost issues. A focus on genetic improvement of traits such as disease and pest resistance, adaptive changes to climate or soil-fertility differences and improvements in products for end-users is needed. Large-scale, real-world field tests will be critical for validation.
- Farmers will grow what the market demands. They have always been adaptable to changing societal needs as long as the market is sustainable.

BIOFEEDSTOCKS

- Ideal feedstocks will likely be region-specific.
- The top feedstocks today are native forests, crop residues, paper that would otherwise go into landfills, food-processing wastes, and energy crops like *Miscanthus*.

- Perennial grasses utilizing C4 photosynthesis likely come closest to meeting the concept of an ideal biomass crop. Sustainability experiments to provide actual data on greenhouse-gas balance will be important as future cropping and policy decisions are considered.
- The development of multiple crop-production systems tailored to meet local climatic, biotic and soil stresses and to economically deliver year-round supplies is essential for a successful bioprocessing industry.
- Growing crops for energy requires the same attention to production issues—rotation, soil erosion, pest management, *etc.*—as food crops.

RESEARCH & TECHNOLOGY

- Biomass is a relatively new raw material for the chemical industry with current conversion technologies limited and, thus, continued investment in research and development for bioprocesses, potential products and economic production is critical. To meet this challenge, biorefining must integrate the production of high-return feedstocks with high volumes of fuel to meet energy and economic goals.
- All aspects of bioenergy need to be synchronized, from production to processing to profitability. Converting biomass to heat energy or liquid fuel requires process technologies that maximize production and minimize environmental impacts.
- Academic and industry partnerships will be critical to solving national and international energy needs for society.
- Bioconversion technologies have significant implications for landfills and gas generation and utilization of municipal waste streams, but consideration needs to be given to the fact that agriculture and municipalities have their own cultures in terms of waste collection, separation, *etc.*
- In an era of limited resources, it is critical to prioritize goals; biotechnology will be one of the critical tools available for possible solutions.

ECONOMICS

- Economic trade-offs are overriding forces that will ultimately dictate the comparative advantages of fungible commodities in different regions and countries.
- Rural communities have an opportunity to benefit from the development of bioenergy and bioproducts industries, especially to the degree that they can develop in a decentralized environment; however, the economics of business will drive final decisions.
- We need to allow room for innovation, *e.g.* there will be entrepreneurs who will figure out the “opportunity space” for feedstocks and land utilization if given the opportunity to compete for markets.
- Intellectual property and technology licensing can be deal-breakers in part because the models are not uniform from state to state nor institution to institution,

but systems can be managed effectively either by working out the fundamental parameters upfront or by developing long-term relationships that enable partners to work through issues.

EDUCATION & WORKFORCE DEVELOPMENT

- The twenty-first-century land-grant university must evolve to incorporate changes in access to information, diversity of competition, demands of consumers, and changing faculty and student needs.
- It is critical to develop public-private forums to enhance understanding of what is happening in different sciences that may impact the feasibility of product development from energy-balance and value-chain perspectives.
- High-risk investments to propel new technology development have been an effective tool in various settings, but workforce development needs to be a core consideration in order to get and keep government engaged.

ETHICS

- As the emphasis on the development of biofuels increases, so do ethical concerns regarding perceived tradeoffs between food, fuel and the environment. However, this is a complex paradigm that cannot be easily teased apart and will require a democratic public exchange of views.
- An interesting dichotomy exists between industrial and agrarian perspectives of agriculture; only 1.4% of the population is involved in agricultural production, whereas many others have a romantic view of what agriculture should be. However, the latter agrarian perspective can have considerable policy impact and may foster different pathways to market (*e.g.* local food networks).
- Subsistence farmers produce food for their own existence without infrastructural access to broader markets. Issues beyond science are the primary barriers in these cases.

POLICY

- The net result of the current combination of tax credits and mandates negates the tax credit and subsidizes gasoline consumption. It was argued that consumption mandates alone are more efficient.
- The renewable fuel standard is critical to drive innovation and investment as it sets the goals that industry will strive to meet.
- Markets created by subsidies or other artificial means make these markets inherently risky as policy changes may eliminate them unless there is an inherent underlying demand. Renewable energy from “free” sources like the sun and wind are not limited and are, therefore, more likely to be viable over time. However, the technologies utilized to harness them are still subject to public review.

- Effective policy for developing alternative fuels must answer questions regarding integration into the existing transportation-fuel infrastructure and the implications for meeting fuel-vs.-food demands.
- The rate of technology change poses a critical catch-up problem for policymaking processes.
- Unintended consequences of policy in this nascent industry are sometimes exploited. The tax credit gained by blending in a small amount of biodiesel with normal diesel has resulted in profiteering.

Response panels followed the plenary speakers in Modules II–IV and breakout sessions were held as small-group discussions of specific questions (see pp. 11–21) with reports made back to the entire group of attendees, a process that enriched the exchange of information considered. In addition, the *Student Voice* delegates met as a group and reported on their discussions, again of specific questions (see pp. 229–232).

The discussions and interactions of all participants helped to identify significant questions and to pose relevant perspectives to an emerging land-use issue in which energy generation and food production—two critical issues for society today and for the foreseeable future—will need to be considered by all as we seek to maintain a precarious balance in a world with increasing population and the concomitant accompanying pressures.