NABC news

Fall 2008 # 37

Providing an open forum for exploring issues in agricultural biotechnology

NABC'S PRINCIPAL OBJECTIVES ARE TO:

- **provide an open forum for persons with different interests and concerns to come together to speak, to listen, to learn, and to participate in meaningful dialogue and evaluation of the potential impacts of agricultural biotechnology**
- **define issues and public policy options related to biotechnology in the food, agricultural, biobased industrial product, and environmental areas**
- **promote increased understanding of the scientific, economic, legislative, and social issues associated with agricultural biotechnology by compiling and disseminating information to interested people**
- **facilitate active communication among researchers, administrators, policymakers, practitioners, and other concerned people to ensure that all viewpoints contribute to the safe, efficacious and equitable development of biotechnology for the benefit of society**
- **sponsor meetings and workshops and publish and distribute reports that provide a foundation for addressing issues.**

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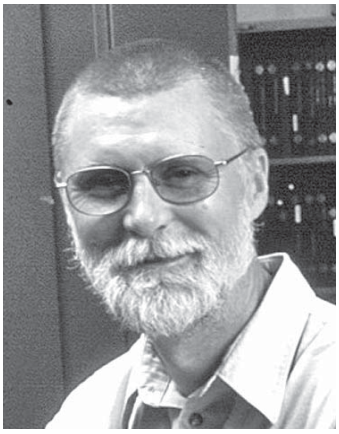
Letter from the Chair....



BRUCE MCPHERON
THE PENNSYLVANIA STATE UNIVERSITY
NABC CHAIR 2008–2009

Just over a year ago, the Norwegian Nobel Committee recognized the efforts of an international group of scientists in making the case for global climate change and for beginning the Herculean task of identifying and implementing steps we must take to respond to this change. The debate continues, and the National Agricultural Biotechnology Council will use the 2009 annual conference to examine this issue and add the collective wisdom of its membership to the discussion of what impacts climate change will have on agriculture and what science might bring to bear toward solutions. At stake is our ability to feed, clothe, house, and fuel the world.

On October 27, The National Academies released a new booklet, *New Horizons in Plant Sciences for Human Health and the Environment* (available at their plant genome sciences website—http://dels.nas.edu/plant_genome/report.shtml), that highlights exactly the questions we must address. While genetic modification of plants under human selection stretches back millennia, the past decade has seen extraordinary advances in plant genome science, with the commercialization of genetically modified selections of several key commodities, attracting much attention. While these varieties, developed using biotechnology, have gained widespread acceptance by crop producers (in 2008, in the United States, USDA reported that 80% of corn, 86% of cotton, and 92% of soybean acres were planted to genetically modified varieties), they remain controversial in some areas of the world and among some segments of society.

If we are to move ahead to solve the dilemma of producing sufficient plant-derived resources for the future in the face of changing conditions in our primary production regions, we will need to take full advantage of advances in plant genomics. One key issue will be the adaptation of plants to less favorable growing conditions. Identification of traits to withstand temperature stress, drought, and a variety of other abiotic challenges will be required. Biotic pressures are also likely to change—shifts in temperature and precipitation regimes could permit range expansion in important pest species, leading to disruption of current pest-management strategies. Traits that can be used to manage these new pests will be invaluable in defining sustainable production practices. Such traits to address abiotic and biotic stressors will be needed in key crop species in order to use existing land, but we will also need to deal with the great variety of plant species used for food and fiber in developing economies around the world.

The environmental footprint of food production will also remain in the spotlight in the face of climate change. Given the importance of human activity on climate, producing plants in ways that have less environmental impact is a desirable goal. Increased nutrient-uptake efficiency could result in the need for less fertilizer input (with a concomitant reduction in the energy required to produce and apply fertilizer) and in a reduction in the loss of applied nutrients into the environment. Fuel consumption is at the very heart of the issue of climate change. The environmental and economic sustainability of using corn

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Overview of NABC 20

Reshaping American Agriculture to Meet Its Biofuel and Biopolymer Roles

STEVEN A. SLACK

NABC's twentieth annual meeting—hosted by The Ohio State University—convened in Columbus, OH, June 3–5, 2008. Delegates were welcomed by the 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 108 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, *Agriculture: The Foundation of the Bioeconomy*). On June 4, the two luncheon keynote speakers, Christiane Deslauriers (Agriculture and Agri-Food Canada, *Supporting Cross-cutting Research: The Agricultural Bioproducts Innovation Program*) and Irwin Goldman (University of Wisconsin-Madison, *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. OSU President Gordon Gee provided the final keynote address at the June 5 luncheon.

Session #1—*Megatrends Reshaping American Agriculture*—comprised presentations by John Pierce (DuPont, *Renewable Fuels and Materials*); Steven Pueppke (Michigan State University, *Megatrends Reshaping Agriculture and Agricultural Universities*); Benson Lee (Technology Management, Inc., *Energy Independence: On-site Fuel Cell Systems Operating on Biofuels)*; and Peter Ashcroft (Environmental Defense, *What Role for Biofuels in our Energy Future?*).

In Session #2—*Optimizing the Value of Co-products/By-products*—presentations were made by Stephen Myers (Ohio BioProducts Innovation Center, *Renewable Polymers and Advanced Materials*); Robert Fireovid (USDA/ARS, *ARS Research in Bioenergy Co-products*); and Joseph Bozell (University of Tennessee, *Biomass as a Source of Carbon: The Conversion of Renewable Feedstocks into Chemicals and Materials*).

The speakers in Session #3—*Enhancing Productivity of Biofeedstocks*—were Stephen Long (University of Illinois at Urbana-Champaign, *Opportunities for Enhancing the Productivity of Biofeedstocks and Minimizing Inputs: Theory and Practice*); Bill McCutchen (Texas A&M University, *High-Tonnage Dedicated Energy Crops: The Potential of Sorghum and Energy Cane*); and David Bransby (Auburn University, *Synchronization of Biofeedstocks and Conversion Technologies: Current Status and Future Prospects*).

Presentations in Session #4—*Policy Issues Impacting Agriculture and Bioenergy*—were given by Paul Thompson (Michigan State University, *Biofuels: Two Key Ethical Issues*); Harry de Gorter (Cornell University, *The Social Costs and Benefits of U.S. Biofuel Policies*); and Kenneth Cassman (University of Nebraska, *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 include:

- The twenty-first century land-grant university must evolve to respond to changes in access to information, diversity of competition, demands of consumers, and different faculty and student needs.
- The global marketplace requires adaptive strategies for learning and knowledge exchange as well as identifying and developing talent, including interdisciplinary approaches that incorporate non-traditional expertise and stakeholders.
- Effective policy for developing alternative fuels must answer questions regarding integration into the existing transportation-fuel infrastructure and the implications for meeting both fuel and feed demands.
- 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.
- The development of multiple crop-production systems tailored to meet local climatic, biotic and soil stresses and to economically deliver a year-round supply is essential for a successful bioprocessing industry.
- 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 energy production and minimize environmental impacts.
- As the emphasis on the development of biofuels increases, so do ethical concerns regarding perceived tradeoffs between food, fuel and the environment.

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The University of Saskatchewan will host NABC 21

June 24–26, 2009

Adapting Agriculture to Climate Change

GRAHAM J. SCOLES

Agriculture on the Canadian prairies occurs in an area of climatic extremes with limited rainfall, a growing season of just over 100 days and temperatures that range from –40°C to +40°C. As such, it is the ideal location at which to host a meeting on agriculture and climate change. The province of Saskatchewan possesses almost 50% of the cultivated land in Canada, and although wheat (bread and durum) has been the major crop for many years, recent decades have seen canola emerge as the second most valuable crop, over 80% of which is genetically engineered. The province is now a major producer of pulses (lentil, pea, chickpea and bean), barley, oat and flax.

The University of Saskatchewan is home to Canada's only synchrotron, which is being used in numerous areas of agricultural research, and Innovation Place, a successful research park with incubator facilities accommodating 150 clients and 2,700 employees in nineteen buildings. Three federal institutions, Agriculture and Agri-Food Canada, the National Hydrology Research Centre and the Plant Biotechnology Institute are also located on campus.

NABC 21—*Adapting Agriculture to Climate Change*—will consist of four plenary sessions, focused on Canadian and US research efforts in this critical area, each with three or four speakers. Session 1 (Wednesday PM) will set the stage by providing an overview of the latest information on climate change and projections for the next decade and half-century with reviews of agriculture's contributions and responses to climate change. Session 2 (Thursday AM) will deal with genetic approaches to adapting crops to climate change. Many genetic engineering projects in this area are underway and products should be in the field over the next several years. This session will provide an update on our ability to manipulate resistance to abiotic and biotic stresses, to improve nitrogen-use efficiency and to modify photosynthesis. Session 3 (Thursday PM) will focus on approaches other than genetics to deal with climate change, including land use and carbon sequestration, livestock adaptation and mitigation, and water-related issues. And Session 4 (Friday AM) will cover the areas of policy, technology transfer and ethics. Following the formal presentations, there will be opportunities for audience discussion of the issues in Q&A sessions followed by breakout workshops. The *Student Voice at NABC* will again be a part of the meeting (see page 4)

Information on registration, travel and lodging will be online shortly, linked to the NABC website (http://nabc.cals.cornell.edu/). Further details will also be provided in the spring issue of *NABC News.*

June is a wonderful month in Saskatoon, with extended, warm evenings that provide opportunities to stroll along the banks of the South Saskatchewan River. For jazz enthusiasts, the Saskatchewan Jazz Festival begins on June 26; a link will be provided from the meeting website.

Please direct questions, comments and suggestions to

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However, this is a complex paradigm that cannot be easily teased apart and will require an open public exchange of views.

• 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.

• Researchers need to adapt interdisciplinary approaches to solve food availability and, thus, rising food-cost issues. A focus on genetic improvements 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.

• Academic, government and industry partnerships will be critical to solving national and international energy needs for society.

• Perennial grasses utilizing C4 photosynthesis likely come closest to meeting the concept of the ideal biomass crop. Sustainability experiments to provide actual data on greenhouse gas balance will be important as future cropping and policy decisions are considered.

Response panels followed the plenary speakers in each session, preceding breakout workshops, which were held as small group discussions with reports made back to the assembled attendees, a process that enriched the exchange of information considered. In addition, the *Student Voice* delegates (see page 4) met as a group and reported on their discussions regarding food and fuel markets, systems to optimize biofuel impact on greenhouse gases, modification of crop management systems for biomass crops, and the NABC white paper, *"Agriculture and Forestry for Energy, Chemicals and Materials: The Road Forward."*

More detail will be available in the proceedings volume, *NABC Report 20*, which will include speaker manuscripts. ■

The Student Voice at NABC 20

To increase graduate-student participation at NABC conferences, the *Student Voice at NABC* initiative was launched ahead of NABC 19. Feedback from those involved was positive, therefore the program was continued for NABC 20. Grants of up to $750 were offered to graduate students at NABC-member institutions (one student per institution) to assist with travel and lodging expenses. Registration fees were waived for the grant winners.

Registration fees were waived also for some graduate students from NABC-member institutions who agreed to act as recorders for the breakout sessions; they were invited to participate in the *Student Voice* discussions.

Student Voice delegates attend the plenary sessions and the breakout workshops then meet as a group to identify current and emerging issues relevant to the conference subject matter; for the NABC-20 *Student Voice*, the students were provided with four questions to help focus the discussions.

Sixteen graduate students participated:

Karunanithy Chinnaduari *South Dakota State*	Fang Cong * *Penn State*	Mary Carol Frier *Penn State*	Darby Harris *U. Kentucky*
Sarah Kiger *Ohio State*	Srilakshmi Makkena * *Ohio State*	Lisa Meihls *U. Missouri-Columbia*	Mitch Minarick *U. Illinois*
John Schumm *Purdue*	Sachin Teotia * *Ohio State*	Thu Vuong *Cornell*	Lee-Ann Walter *U. Saskatchewan*
Ellen Wan *Ohio State*	Xiaomin Yu * *Ohio State*	Yajuan Zeng *U. Georgia*	Qiujio Zheng *Washington State*

Some of the points that emerged from the discussion are provided here, drawn from a report written by Ms. Frier and Ms. Kiger. Full coverage will be provide in *NABC Report 20*:

How does agriculture serve both food and fuel markets?

- 130 years ago, biomass was the most common fuel in the United States. It could become common once again. How will we sustain the economic and population progress we have made in the "age of petroleum" as we return to biomass as an energy source?
- Is the public ready for large-scale use of biomass again? Biomass is less energy dense than oil and currently less convenient to use. Will public sentiment allow more biomass to be packaged as fuel?
- Biomass is only one aspect of our emerging total energy portfolio, which includes other renewables such as wind and solar.
- Biotechnology will play key roles in maximizing extraction of food, feed and fuel from biomass.

What systems are needed to optimize the impact of biofuels on greenhouse gases?

- Our society generates huge amounts of waste products, which could be used to produce biofuels. Landfills could be thus minimized.
- We need more knowledge about crop residues in the field, particularly corn stover. Residues from alternative crops may or may not support soil fertility more effectively than corn stover.
- Crop residue should be considered a crop, with its own harvest problems/opportunities and profitability.
- Optimize current cropping systems to increase carbon sequestration.

Much research as been done to improve agricultural systems for the production of major crops (such as no-till planting). Should similar research be done for biomass crops?

- Yes. It could reduce the production cost and/or increase the harvestable yield of biomass crops. It could also upgrade these lands to higher-valued agricultural uses. This research could include: optimizing irrigation, harvesting techniques, pesticide usage, fertilizer usage.
- Land used to grow dedicated biomass crops should not compete with land used to produce food, feed and fiber.
- Our society generates huge amounts of waste products, which could be used to produce biofuels. Landfills could be thus minimized.
- We need more knowledge about crop residues in the field, particularly corn stover. Residues from alternative crops may or may not support soil fertility more effectively than corn stover.
- Crop residue should be considered a crop, with its own harvest problems/opportunities and profitability.
- Optimize current cropping systems to increase carbon sequestration.
- Use of seed-delivered pesticides could reduce production costs and improve quality of biomass crop yield. They could favorably affect water-use efficiency of these crops.

* *Funding provided by institutions other than NABC.*

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NABC-20 Workshops Summary

Three breakout workshops were held at NABC 20, under the following general topics:

- *Optimizing the Value of Co-Products/By-Products*
- *Enhancing Productivity of Biofeedstock*
- *Policy Issues Impacting Agriculture and Bioenergy*

Four groups, each with a facilitator and recorder[1], met for 1-hour sessions to discuss predetermined questions. This article provides some of the issues that emerged from the discussions; fuller coverage will be provided in *NABC Report 20.*

Workshop I

Optimizing the Value of Co-Products/By-Products

Question 1: What economic and social issues need to be considered as industrial products are made from bioresources instead of from petroleum?

- There is much media coverage of direct adverse effects on food prices of using corn as a feedstock for biofuels. This subject requires more study and the degree to which perception prevails over reality needs to be conveyed to the public.
- Accurate life-cycle analyses are needed to understand energy gains/losses and waste generation associated with biofuel production.
- Although recultivation of marginal land to produce biofeedstocks would be to farmers' benefit, if productivity is relatively poor, increasing transportation costs may make this strategy unfeasible. Also, the cultivation of more land has implications for wildlife habitat and environmental quality.

Accurate life-cycle analyses are needed to understand energy gains/losses and waste generation associated with biofuel production.

- Land on which corn is productive should not be planted to switchgrass. Illinois, for example, should stay in corn, whereas switchgrass might be usefully grown in parts of Tennessee. It might be most useful to grow cellulosic feedstocks on land no longer used for agriculture. Also, pasture land may be well suited for switchgrass production.
- In the long term, agriculture will be unable to keep pace with growing demands for food, fiber and fuel without impingement on the ecosystem services—clean air and water, fertile soil and biodiversity—that human survival depends upon. The increasing global population dictates the need for long-term alternatives to cellulosic biofuels.

Question 2: What elements are necessary to develop a systems approach (value chain) to predict best end uses of biobased industrial products (*e.g.* biofuels and co-products)?

- The type and cost of feedstock, its transportation and processing all affect the value chain.
- Means are needed to encourage university faculty members of varied disciplines to work together—*e.g.* plant breeding and molecular biology—and to collaborate with industry and government.
- At the high-school and undergraduate levels greater emphasis should be placed on cellulose-based chemistry as well as petro-based chemistry. Greater emphasis should also be placed on plant biology across the educational system. For example, chemical engineers should have at least a grounding in plant biology.

...encourage university faculty in varied disciplines to work together—e.g. plant breeding and molecular biology—and to collaborate with industry and government.

- A policy group should evaluate and define what bioproducts are, to facilitate uniform legislation among states. "Biobased" certification would give bioproducts a preferred status for government purchase. This would assist achievement of production at the scale necessary for companies to provide bioproducts commercially.
- Regulatory aspects require reconsideration, with emphasis on deregulation coupled with selective incentives.

Question 3: How can life-cycle greenhouse-gas impacts (footprint) be minimized for the biobased economy?

- A sound scientific basis is needed on which to make life-cycle analyses of biofuels and fossil fuels. These analyses can be used by technology developers to improve sustainability and minimize waste. Renewable fuels should not be held to stricter standards than non-renewables.
- CO_2 produced during yeast fermentation could be captured by microalgae, for use in turn as a feedstock for biofuel production.
- There is need for a comprehensive approach to reducing the carbon footprint; the focus should not be wholly on energy consumption *per se*. Economic incentives, laws and policies, moral imperatives, education, introduction of new social norms, and technological/mechanistic changes could be aimed at reducing the carbon footprint.

Economic incentives, laws and policies, moral imperatives, education, introduction of new social norms, and technological/mechanistic changes could be aimed at reducing the carbon footprint.

- A carbon tax would raise revenue and make people realize how much carbon they use. The effect of rising fuel prices on driving habits shows that consumer behavior can change.
- Broader study of carbon sequestration by plants is needed; plants for carbon sequestration should be chosen on a regional/climate basis.
- Encourage use of mass transportation.

[1] These duties were shared as follows:
Facilitators—David Benfield, Colin Kaltenbach, Kinnamon, John Kirby and Bruce McPheron.
Recorders—Karunanithy Chinnaduari, Sarah Kiger, Srilakshmi Makkena, Lisa Meihls, Sachin Teotia and Thu Vuong.

Workshop II

Enhancing Productivity of Biofeedstocks

Question 1: What are the economic, environmental and social issues that should be considered in the selection of biofeedstocks?

- Profit and risk factors including susceptibility to disease, insect predation and drought.
- Government should provide a financial safety net for farmers growing new crops.
- Papermill waste and wood chips may be good candidates as biofeedstocks for ethanol.

Land conversion can have long-term effects on the ecological footprint.

- The area available for planting biofeedstock crops will depend on the processing-plant location; "capture zone" size will depend on many factors including the energy content of feedstock on a per unit weight basis.
- Land conversion can have long-term effects on the ecological footprint. Perennial systems should not be converted to annual systems. Systems that store large amounts of carbon should not be converted to those that store minimal amounts of carbon.
- Couched in appropriate terms, animal-waste conversion to energy could be an important factor in the acceptance of the livestock industry.

Question 2: Where are the greatest opportunities for genetic and agronomic productivity enhancement of biofeedstocks to provide sufficient supply to meet demand?

- Water is an important resource for crop production and access to irrigation will be an increasing challenge. Breeding for increased drought resistance will be important as will high efficiency in water use from production through processing.
- Perennial crops are preferable to annual crops.

New emphasis on plant breeding is needed, with incorporation of biotechnological innovations.

- New emphasis on plant breeding is needed, with incorporation of biotechnological innovations. Because the germplasm base of biofeedstocks like switchgrass is narrow, genetic engineering will play a key role in achieving genetic improvements.
- Genome sequencing should be a component of the appraisal of new crops to maximize understanding of their biology.
- The negative public perception of private companies holding ownership of varieties and genes should be addressed. It is important that the public understands that, without the profit motive, much of the expensive research that will be needed to improve food production will not be done.
- Over-seeding biomass crops with nitrogen-fixing cover crops should explored.
- The ultimate measure for a biofeedstock might be that the production system has to be carbon neutral.

Question 3:. What are the primary systems obstacles/ opportunities for utilization of new biofeedstocks?

- More than feedstock development, vertical integration is needed, involving harvesting, in-field processing, transportation, storage, in-factory processing, co-product catchment and utilization, *etc.*
- The major issue is technology availability. Familiarity with current technologies may constrain adoption of new ones. The cornstarch process is so well known that there will be inertia to change to more complex processes. Furthermore, large financial investments in corn ethanol will take years to pay off and may delay the transition to cellulosic ethanol. Farmers have the potential to steer the momentum towards cellulosic biofuels; they have to lead the change.
- There is need to capitalize on previously unused components. Before considering new biofeedstocks we should examine the possibility of using corn and soybean more efficiently, including straw, stover and cobs as sources of carbon.

The major issue is technology availability...

- More research is needed on how much straw and stover can be removed from the field without compromising soil organic matter replenishment.
- Risk-management incentives should be available to farmers growing new biofeedstock crops.
- Support is needed from environmental groups. Industries are investing profits in ecological restoration.

Workshop III

Policy Issues Impacting Agriculture and Bioenergy

Question 1: What primary economic, environmental and social perspectives should be considered in making effective public policy to encourage adoption of bioproducts?

- Because several technical issues remain unresolved, conversion of cellulosic biomass to ethanol is not economically viable. Furthermore, biomass transportation and storage systems are not ready to deal with large-scale production of cellulosic biofuels.
- Public understanding of the food-versus-bioproducts issues is needed. Outreach programs could be aimed at high-school students and consumers in general.

Public understanding of the food-versus-bioproducts issues is needed.

- Regional and local factors will influence choice of biomass feedstocks. In the Northeast there is emphasis on woody biomass. Pennsylvania has about 750,000 private forest landowners with an average woodlot area of less than 19 acres. Whether these will be available becomes a sociological issue.

• The government should implement a land-use policy that dictates return of organic matter to the soil to maintain its organic matter content.
• Opportunities exist to reposition agriculture to address human health as well as energy-security issues. Human-interest stories of past significant contributions resulting from agricultural research should be propagated for public consumption.
• Feedstock-resource owners will need education on economic and sociological issues. A bridge will be needed between industrial and agrarian considerations as they relate to advanced biofuels.

Question 2: What key issues must be resolved for the discussion to move beyond the "food versus fuel" debate to encourage consumer acceptance of "food and fuel"?

• Cellulosic technology must be improved to make ethanol production economical.

As alternative fuel scenarios are developed and tested, we must not compromise the natural resource base necessary for increased food production.

• Do we have a sufficient natural resource base to produce the food needed to support an increasing global population and demands for higher living standards? As alternative fuel scenarios are developed and tested, we must not compromise the natural resource base necessary for increased food production.

• Farmland continues to be used for building. If we are to achieve a biobased/renewable economy, policies should be instituted to keep land in agricultural production. One approach would be to subsidize land rather than crops.
• Population movement from town to country has caused much of our energy needs. Population repositioning could result in energy conservation, but necessary lifestyle and behavioral changes would need to be orchestrated by economic forces, possibly with or without policy changes.
• Algal ponds could be placed adjacent to coal-burning power plants, to utilize CO_2 and provide biofeedstock, on otherwise unproductive land.

Question 3: What unresolved technical issues are impeding progress toward sound biofuel policies?

• Many technical issues are unresolved, but not all have policy implications.
• These technologies are disruptive and may be difficult to regulate.
• There is a disconnect between policies at the city, state and national levels. City and state policymakers are, in general, more aware of opportunities.
• With adoption of the Canadian model—with federal funding encouraging the uniting of efforts from academia, industry, and government—more rapid progress would be possible in terms of advancing agriculture and its contributions to energy security, the biobased economy, and human health.

There is a disconnect between policies at the city, state and national levels.

• Regulations should facilitate the implementation of novel developments. Unfortunately, the current federal regulatory framework is inhibitory to the adoption of new policies. ■

continued from page 4 "Student Voice...."

Please comment on the NABC white paper, *Agriculture and Forestry for Energy, Chemicals and Materials: The Road Forward*

• It outlines how traditional and new biomass crops can provide chemicals, materials, fuels and polymers that will provide a sustainable way to improve homeland security and economic growth.

• Technological, social, and economic issues resulting from transitioning to new biomass crops still need to be addressed.

• The short-term focus should be on replacing petroleum as a source of fuels and chemicals. The longer term should focus on biobased chemicals and biomaterials, as well as new crops that provide health benefits.

• New feedstock development, more efficient conversion technologies, and efficient transportation infrastructure must be encouraged.■

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grain for ethanol production is a debated and researchable topic, and biofuels derived from cellulose rather than starch are widely seen as a key component of the future of renewable fuels. However, this transition—and development of other technologies not yet identified—will not occur without attention to the genetic improvement of the plant sources of biomass. Again, the information that plant genomics has unlocked will be exploited to literally fuel our future.

These crop as well as animal issues will confront us in Saskatoon next June and beyond that as we facilitate the successes of plant and animal researchers at our institutions. We must encourage the creativity of our faculty and staff, but we must also work to resolve a variety of issues that complement their research. The issues of intellectual property and "ownership" of key genetic resources will continue to be contentious, especially as we talk about the genetic advances needed beyond those few centrally important commodity species. Whether we continue to use transgenic recombinant DNA technologies to develop our commercial crop varieties or whether we rely more on identification of target genes through comparative genomics and insert them into crop species through cisgenic recombinant methods or conventional breeding facilitated by marker-assisted selection, we must continue the dialogue with the consuming public about the methods we use and the benefits of our work. The products of our work must be sustainable; while we encourage progress on plant genomics, we must also encourage other expertise at our institutions—economists, engineers, ecologists—to address other components of the complex system that is food, feed, fiber, and fuel production. Finally, we must focus on future human resources as well. Much of plant improvement has moved to the private sector in the past decade, but academia remains at the center of training the next generation of scientists who will solve emerging problems. I look forward to our dialogue in Saskatchewan as we wrestle with solutions to these questions. ■

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