Workshops Summary

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Three breakout workshops were held during NABC 19, with the following topics:

- *Sustainability: Impacts and Issues*
- *Technology: Biomass, Fuels, and Co-Products*
- *Economics and Sustainability.*

Eight groups, each with a facilitator and recorder[1], met for 1-hour sessions to discuss predetermined questions. This report provides key points that emerged from the discussions[2].

Workshop I – *Sustainability: Impacts and Issues*

Question 1: What are the chief food/feed/fuel competition concerns? What actions are recommended to minimize these concerns?

- This is an emotional issue and initial negative perceptions may become reality for some people; price increases for food crops are expected, possibly affecting people's diets; the pulp and paper industry is concerned that wood prices will increase due to competition for feedstock; in the near future, livestock prices may increase more than for other foods; there could be a negative impact on roads, especially rural roads near ethanol plants; the need to produce feedstock for the biofuels industry will add to the competition for land from urbanization, conservation programs, food production, *etc.*, and we are unsure of international implications.

[1]These duties were shared as follows: Facilitators—Tom Cheesbrough, Jeremy Freking, Wade French, Darrell Grandbois, Doug Raynie, Craig Russow, Evert VanderSluis and C.Y. Wang; Recorders—Theron Cooper, Basil Dalaly, José Gonzalez, Jim Julson, Joan Kreitlow, Tyler Remund, Lisette Tenlep and Tom West.

[2]Views expressed are not necessarily those of the authors, the Agricultural Research Service or South Dakota State University.

- The economics of growing crops in developing countries may improve, creating export opportunities.
- Factors that may minimize concerns include that food- and fuel-crop market shares will be rectified by the market; the cost of raw agricultural products such as corn and wheat are a small part of the total cost of processed foods; subsidies may be needed by the livestock industry to reduce the effect of rising feed costs; a labeling system for biofuels would reduce public confusion; good information needs to be in the hands of the general public to influence decision makers; there is a need for a massive education campaign for the general public; there is a significant need for more research; technology transfer and research on food production will be important for self-sufficiency of developing countries; the feed/fuel competition could be made into an opportunity to develop food/fuel systems in developing countries; research is needed on developing foods utilizing DDGS; and there is a need to consider some non-traditional approaches to solving this problem—for example, developing a technology for algae to harvest CO_2 from coal and convert it into a usable oil.
- A major action item is to reduce demands for conventional and biofuels through public education programs.

Question 2: What incentives and technologies are needed to induce farmers to grow cellulosic crops?

- Guaranteed stable markets will encourage farmers to invest in equipment and make changes in their farming systems; estimates of required farm-gate price for biomass varied from as low as $40 to as high as $100/ton; strong markets need to be developed for energy crops, because government subsidies should not be needed in the long term.
- Infrastructural issues related to transportation of ethanol/butanol need to be resolved; convert textile, paper and similar processing plants for energy-crop refining; research is needed on processing options such as distillation, direct combustion and pyrolysis; research is needed also to develop co-products such as fibers for clothing and oils for plastics; demonstration plants will stimulate producer interest; there is need to solve densification, transportation, and equipment issues.
- Changes in cropping systems will be more probable if technologies are developed to open up pivot corners and other unproductive lands to grow energy crops; availability of drought-tolerant energy crops for planting in marginal soils; appropriate modification in Conservation Reserve Program (CRP) rules; producers need to participate in a carbon tax credit trading system with incentives for soil and other conservation practices.

Question 3: What measures and policies should be adopted to address environmental concerns over cellulosic biofuel crops?

- As more land is planted to these crops, policies should be instituted to preserve biodiversity.
- Standards for sustainable removal rates will need to be developed to protect soils (including carbon sequestration), water quality and wildlife habitat; for example, the harvesting of switchgrass on CRP land may impact water and wildlife; policies will be needed to preclude over-stripping biomass from land to avoid negative impacts on soil, wildlife, and water quality.
- Perennial crops have more environmental benefits than negatives.
- Water-quality and environmental policies must complement the incentives given to promote cellulosic biofuel crops.
- Water-resource issues must be addressed in both crop production and processing, and national policies also need to work at the local level.
- Broader use of switchgrass as a coal-fuel blend would help address environmental concerns; lignin from switchgrass can be burned with coal; coal-firing is the most feasible method for powering these plants.
- Fly ash must be carefully used as its metal content can be detrimental to soil quality.
- The environmental impact of removing forest biomass needs to be better understood.
- Is perennial grass biomass sustainable over a long period of time?
- Education and research programs are needed to understand environmental advantages and disadvantages.
- The general public and industries need to more efficiently use energy—we should not be growing cellulosic crops to keep wasting energy from other sources.

Question 4: What is the likelihood—and potential impact—of deploying genetically modified (GM) perennial energy crops?

- It will occur and the impact will be positive as with row crops.
- Recombinant DNA technology will be necessary for rapid genetic improvement of perennial energy crops.
- It will be important to prove that GM crops will have no negative environmental effects; societal acceptance will be more likely if the GM crops are not for food use; there is a possibility of a GM crop becoming a super weed, therefore, it may be appropriate to try native plant species before turning to genetic engineering.
- The main reasons for using GM crops will be for greater yields and increased resistance to insects and diseases.
- Perennial crop traits that need genetic improvement will need to be precisely identified.

Workshop II – *Technology: Biomass, Fuels, and Co-Products*

Question 1: What technologies and agronomic practices need to be applied or developed to improve the quality and quantity of biomass crops?

- Equipment for efficiently harvesting biomass needs to be developed, *e.g.* for high-speed collection of corn and stover in a single pass.
- Logistics of transportation and storage of low-density biomass is a significant issue. In-field or localized processing may offer a solution if the economics of scale can be overcome.
- A huge ramp up will be needed to bring 50 million acres of biomass into production; seed availability will be an issue; region-specific cultivars with appropriate drought tolerance, wet tolerance and disease/insect resistance are in short supply.
- Crop-breeding programs including the use of GMOs need to be started at universities even though private companies will also have breeding programs; one important focus of a breeding program would be to increase cellulose while decreasing lignin.
- Tillage, fertilizer, and other agronomic practices for production (quantity) need to be developed to maintain/improve soil quality; mono-cultures vs. diverse stands should be evaluated for competition effects, weed control, and disease control; soil-fertility research for biomass production and the development of nitrogen-fixing energy crops is critical.

Question 2: What are the priorities for processing technology improvements and how can we encourage development of these technologies? (Or, are market forces sufficient drivers?)

- More research is needed on on-site processes such as densification and pelletization, pre-processing and distributed gasification. Processing facilities need to be developed that can be scaled down for local use without losing efficiency.
- Simple pre-treatment processes need to be developed, allowing good quality control, including use in developing countries.
- Processes also need to be robust enough to accommodate heterogeneous feedstocks.
- Metrics for indexing feedstock quality would allow more standardization of protocols and procedures.
- Developing new high-value co-products with unique uses, will help develop new markets and increase profitability.
- Consolidating processes into one enzymatic breakdown and developing enzymes for fixation in a column or bed for prolongation of activity could lower processing costs.
- Reducing water use during processing as well as in crop production will always be important.

- Venture capitalists and entrepreneurs will be major sources of funds for innovation; market forces are not always sufficient drivers to get new technology adopted—subsidies, price supports and tax credits will be needed to minimize risk until the technology is established.
- More effort is needed on the translation of technologies from the lab to the marketplace; intellectual property issues are important in the marketing of technology; the difficult task of translating new technologies from the laboratory to the market place would be facilitated if land-grant universities were more effective in public relations.

Question 3: How do we evaluate the overall sustainability of various renewable energy systems—biofuels, biopower, or hybrids of the two?

- A process that is carbon neutral and allows recycling carbon instead of releasing trapped carbon is beneficial. A process that captures CO_2 has even greater benefit.
- Sustainability will require maximizing energy output subject to constraints in terms of CO_2 balance, nutrient balance, water quantity and quality and soil quality.
- Rural community development is closely tied to the possibility of new income sources that are sustainable.
- Renewable energy may not be sustainable without government subsidies.
- The values of biofuels and biopower are linked to the demand of petroleum; sustainability is important to avoid conflict over a conceivably limited energy supply; encouraging efficient use of energy to reduce consumption will be key to achieving system sustainability.

Question 4: What issues underpin present and future production and use of co-products (such as DDGS, cellulosic ethanol byproducts, glycerol from biodiesel)? For example, conversion of corn fiber to ethanol will alter the composition and supply of DDGS.

- The phosphorus (P) content of DDGS is important; when manure is used for crop fertilization, a large area of land is needed to achieve a balance with crop uptake of P.
- The generation, handling and quality control of co-products is important to the success of the biofuels industry; variability of DDGS affects market value; DDGS quality will be affected by oil extraction or by the amount of cellulose converted to ethanol; research is needed to develop high-value uses for co-products such as building materials, antibiotics and high-value chemicals.
- Biodiesel producers in the south are having difficulty disposing of glycerol even though it can be used in cattle feed and as an energy source for algae; it can be used on gravel roads to reduce dust.
- Research is needed to make new products from the co-product CO_2.
- The amount and type of antibiotics in DDGS affect its use in organic markets.

Workshop III – *Economics and Sustainability*

Question 1: What policies will maximize investment in processing plants, distribution infrastructure and consumer adoption of biofuels?

- Consumer adoption will occur when there is economic incentive, *e.g.* lower prices for biofuels or blends at the pump.
- Consumer demand can be created by instituting blending standards; the timing of when fuel standards are phased in should be carefully coordinated with available technology—abrupt introduction of a fuel standard may get ahead of the vehicle technology or refining technology; blending standards will help corporations to stand on their own without subsidies.
- Improved communication with consumers will help to eliminate misinformation on biofuels. Issues such as fuel quality and vehicle compatibility with biofuels are concerns that impede adoption.
- Funding for biofuel-distribution infrastructure will broaden availability.
- Domestic and international policy predictability with long-term consistent goals will promote investment in biofuels infrastructure because investors will feel that they can avoid risk; policies should also reduce environmental and national security risk.
- Perfecting the carbon-credit trading system could offer economic incentives to farmers as well as biofuel consumers.
- Development of a public mentality or sense of mission similar to that of the space program in the 1960s or the Manhattan project could increase public support for biofuels—long-term off-shoots from the biofuels program may be created.
- US policies need to look beyond corn ethanol to ease the transition from corn to cellulose ethanol; minimizing "road block" policy and supporting "fast track" technology and providing incentives for co-location of plants near other industries that utilize co-products could increase biofuels production.

Question 2: What policies to stimulate renewable fuels production seem reasonable?

- Government procurement policies, government mandates such as requiring biofuels to be used by public transportation, requiring auto manufacturers to produce flex-fuel vehicles and favorable prices for electricity production.
- Policies requiring fuel blends that are most efficient and requiring blender pumps will make renewable fuels more available.
- Development of new biofuel ideas need to be completely tax free or even subsidized during startup and beyond, in particular for biofuels from feedstocks that have never been used before.
- Bioenergetic analyses of cellulosic feedstock production and long-term policy in developing cellulosic ethanol production would help to guide the industry.

- The EPA should consider relaxing standards for clean operation of older biofuel plants to help keep them economically viable.
- Government promotion of conservation policies and education programs of non-rural consumers and youth could be effective.
- Forgivable loans for farmers to plant renewable fuel feedstock such as switchgrass would help to provide stable sources for fuel processors.

Question 3: What is the role of the public sector (USDA and universities) in assisting agriculture in its response to the energy situation?

- Key research, extension and teaching areas include: plant breeding of new crops, soil science, plant diseases and insects, agronomic management of crop systems with reduced energy input, processing of co-products, economic analysis/economic policy, water problems raised in Q 4, and support for the transition from starch- to cellulose-based ethanol.
- Universities can play a key role in teaching industry employees and in workforce development; cooperative education programs that allow students to alternate semesters between industry and school can provide a well-trained source of new talent.
- Universities can make a contribution to development of rational public policy by serving as a forum to discuss controversial ideas and serving as a voice for farmers and other sectors of society.
- Research parks located in close proximity to public research centers and universities provide good places to increase industry-public sector interactions; the USDA can play an important regulatory role in the future of the biofuels industry.
- Universities can provide libraries that are useful for industries and help forge public/private partnerships by facilitating networking with commodity producers and end-users.

Question 4: How critical is it that processing facilities generate their power from renewable sources (lignin, wind-power, co-generation, *etc*.) instead of petroleum? Also, how important is net water usage in processing technology?

- The issues of usage of energy and water in processing facilities are critical for the sustainability of the industry.
- Green alternative energy must be economical for processing plants because economics will win over philosophy; there may not be a "one size fits all" solution; there must be long-term benefits for the entire system that allows industry to afford to use renewable power sources.
- Closed-loop systems with an integrated approach such as locating plants near feedlots may reduce petroleum use.
- Interdisciplinary sharing may help develop a more rational understanding of the environmental impacts of the renewable fuels industry.

- Water conservation is already a large focus in the processing industry and technology allowing economical recycling of water back into the plants could help mitigate regional water-usage issues; returning process water to groundwater creates several environmental concerns.
- Water use in the production of energy crops is a bigger issue than the water use in processing the energy crop; water use in cellulosic ethanol production may cause additional pollution concerns.