Biomass Research & Development Technical Advisory Committee

Presentation to the Biomass Board
By Kevin Kephart, Committee Co-chair

Vice President for Research and Economic Development
South Dakota State University

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The Grand Challenge (2013)

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Replace fossil carbon with renewable transportation fuels and related products:

- Rapidly expand the emerging biofuels and bioproducts industries achieving 30% penetration of biomass carbon into the U.S. transportation market by 2030 in a sustainable and cost-effective manner to create jobs, reduce greenhouse gas impacts, and enhance national security.

Additional Outcomes:

- Enhanced economic development by increasing direct and indirect jobs from 152,000 in 2012 (Bio-ERA Report) to more than 1 million by 2022. By 2030, with 45 billion gallons of fuel made with renewable carbon introduced into the biofuel industry, the direct and indirect economic impact should exceed 5 million jobs. Incentives need to guide such developments to provide opportunities for disadvantaged and minority populations.
- A cost-effective energy supply that is synergistic with existing fossil-based markets.
- Enhanced economic, environment, and social sustainability.
- Improved national energy security and decreased dependence of national defense on foreign energy supplies.

Challenges (2013)

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Barriers to Rapid Adoption of Bio-Based Fuels and Products

1. Biomass as the source of low-cost renewable carbon feedstock for conversion to fuels adds significant complexity for the agricultural industry.
2. Conversion technologies for production of fuel from cellulosic feedstocks suffer from high energy requirements and low productivity (yield and rate of production); as well as high capital expenditures per gallon, which results in conversion technologies that are unable to achieve reinvestment economics.
3. Lack of an updated distribution infrastructure and other market incentives directly impacts the adoption of the new fuel products by consumers.

Challenge #1: *Reduce Feedstock Costs*

Widespread, sustainable, affordable, commercial-scale biomass feedstocks is our first key enabler to achieving significant bioenergy and bioproducts production for the U.S. "all-of-the-above" energy strategy and supports the "National Bioeconomy Blueprint."

Barriers:

- Concerns around sustainable (environmental, social, and economic) development.
- Matching supply and demand of both feedstock and bio-based products in a nascent industry requires robust and cost effective conversion technologies.
- Adoption in the farming community and response to economic opportunities.

Potential Solutions:

- During the next 5 years, access 200 million tons of aggregated low-cost feedstocks; Next 5 to 10 years, access 600 million tons of feedstocks; Beyond 10 years, access 1 billion tons of feedstocks annually.
- Early use of non-conventional feedstocks (waste streams).
- Add productivity to existing production acreage.
- Link feedstock resources to the correct conversion process.
- Implement algae-based production systems.

Challenge #2: *Develop Highly Productive Conversion Technologies that Demonstrate Investment Economics*

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Focus should be on technologies investments that can significantly reduce the capital and operating costs of advanced biofuels and biochemicals.

Barriers:

- Feedstock transportation costs often render *pro-forma* estimates as non-feasible
- High capital costs increase perceived project risk and reduce the likelihood of obtaining investment funding.

Potential Solutions:

- Ensure that current IBR are completed and begin production and lessons from terminated IBRs should be objectively captured.
- More demonstrations and pilot projects through science-based competitive processes.
- Establish policy to provide a “floor” for biofuels prices compared to petroleum.
- Support research on specialty and high value co-products derived from biomass to enable the production of fuels.
- Support research on novel separations technology to help lower capital costs.

Challenge #3: *Improve Distribution Infrastructure, Consumer Adoption, and Market Incentives*

Fuel prices are based on the market price of petroleum; however, petroleum production costs are relatively low. The result is a volatile market dynamic for biofuels that renders the new industry uncompetitive.

Barriers:

- Absence of a reliable and sufficient market price for the fuel products.
- Integrating unit operations is a challenge especially since the scaling factor of one unit is substantial different.
- Create value for both the upstream feedstock elements and the downstream conversion sector.

Potential Solutions:

- Conduct feasibility analyses between large centralized biorefineries and distributed pre-treatment facilities.
- Solicit proposals to establish multiple examples of functioning supply chains, which represent real-world examples of collecting, preprocessing, and shipping biomass to the various end users that facilitate the nation meeting the grand challenge.
- Demonstrate improved distribution logistics of conversion products and co-products, including distribution of drop-in fuels that consist of molecules similar to petroleum derived fuels as well as products that do not have petroleum counterparts.

Policy Action Items (2013)

- Establish a national policy creating a floor price for bio-fuels whereby if market prices remain above the floor, no support will be implemented. If prices drop below a “reasonable” floor price, support will be provided.

- RFS goals must encourage use of renewable materials for the production of both biofuels and biochemicals

Committee Scope (2014)

The Biomass Research and Development Act requires the Committee to evaluate and make recommendations to the Board on the following:	
(i) Funds authorized for the Initiative are distributed and used in a manner that is consistent with the objectives, purposes, and considerations of the Biomass Research and Development Initiative (BRDI)	Funds were not distributed in calendar year 2014
(ii) Solicitations are open and competitive with awards made annually	N/A
(iii) Objectives and evaluation criteria of the solicitations are clearly stated and minimally prescriptive with no areas of special interest	N/A
(iv) The points of contact are funding proposals under this title that are selected on the basis of merit, as determined by an independent panel of scientific and technical peers predominantly from outside the Departments of Agriculture and Energy	N/A

BRDI Recommendations (2014)

- The Committee commends the two lead agencies for their respective preparatory work for the next solicitation and for leveraging additional funds.
- Developing a secure biobased economy will require BRDI appropriations to be similar to what was previously provided prior to funding cuts implemented in the most recent Farm Bill. BRDI has a critical role in the science value chain, serving as an important translational link for accelerating potential early-stage technologies toward application and commercialization.
- The Committee wishes to have a strong and ongoing working relationship with the Board.

BRDI Recommendations (2014)

- **Problem Statement**: Budget cuts and focused program R&D solicitations have hindered the progression and actualization of potential benefits from BRDI.
- **Recommendations**:
  - BRDI should explore collaborations with other federal agencies (beyond DOE and USDA), foundations, corporations, and other funding sources to better leverage its resources.
  - BRDI should solicit proposals for work and increase public outreach efforts to demonstrate the current and potential societal benefits of the bioeconomy (job creation, reduced oil imports, greenhouse gas reductions, and positive regional impacts).
  - BRDI should ensure that information is shared and that there are efforts made to include underrepresented and disadvantaged communities.
  - BRDI should develop and track new performance metrics that provide insights on outcomes and accomplishments, such as return on investment, job creation, and commercial activity.

BRDI Recommendations (2014)

- **Problem Statement**: The Committee wishes to better understand the scope of biomass-related projects funded by other federal research programs being conducted, particularly in agencies that are represented in the multi-agencies BRDI Board.
- **Recommendation**:
  - Obtain focus areas and program summaries for significant federal biomass-to-energy programs and present them in a manner similar to the BRDI program update that was provided by USDA-NIFA.
- **Problem Statement**: The Committee does not have a complete picture of the types of proposals submitted in the pre-application and final proposal submission stages.
- **Recommendation**:
  - Develop a checklist for proposers to complete that will provide data that can be tracked. The Committee recommends that BRDI implements a tracking process similar to the one used by the National Science Foundation.

BRDI Recommendations (2014)

- **Problem Statement**: The dialog between the Board and Committee in response to the Committee's annual report is slow and unsatisfactory. Committee members understand that reviewing recommendations and approving the annual report takes time; however, the lack of timely feedback and turnover in Committee members each year prevents the Committee from receiving formal responses on annual recommendations. The amount of feedback the Committee receives could be enhanced through greater interaction between the Committee and the BRDI Operations Committee.

- **Recommendation**:
  - Members of the BRDI Operations Committee should be encouraged to attend Committee meetings to become more aware of Committee concerns on an ongoing basis.

Conversion Recommendations (2014)

- **Problem Statement**: Biomass conversion plants require substantially higher capital expenditure per gallon capacity than first-generation ethanol or biodiesel plants because biomass processing is more complex and entails a greater number of unit operations.

- **Recommendations**:
  - To establish a successful biofuels industry, there needs to be major policies driving it forward (e.g., maintaining cellulosic RFS2 as originally enacted) and a major increase in R&D funding dedicated to crossing major technical barriers.
  - Emphasize development of technologies that have viable economics for early-stage plants that attract capital investment for subsequent expansion of similarly designed facilities. Priority should go to the following:
    - Disruptive technology investments that can significantly reduce the capital and operating costs of advanced biofuels and biochemicals.
    - Basic, targeted research on specific elements of processes and programs that address operational issues of current pilot and/or commercial demonstration facilities.
    - Support technologies that can displace fossil fuels on a cost-competitive basis, including a reasonable return on capital.

Conversion Recommendations – Cont'd (2014)

- Continue to support novel research in the following conversion areas will help to address barriers for commercialization:
  - Densification, Storage, and Transport
  - Pretreatment
  - Fermentation
  - Thermochemical Conversion and Catalysis
  - Separations
  - Modeling and Simulation.
- "Nth" plant economics are not realistic for driving early investment because they don't accurately reflect risks, capital requirements, or contingencies required for the first several plants. There is a need for a dynamic model that accurately reflects commercially relevant risks, capital requirements, and return on investment/hurdle rate adjustments over time.

Products, Markets, and Systems Recommendations (2014)

- **Problem Statement**: The creation of fuels that are not true drop-in biofuels can drive significant distribution, retail, and end-user infrastructure costs. The use of true drop-in biofuels minimizes issues with products, markets, and systems, as is the case with the development of aviation turbine fuels.

- **Recommendation**:
  - Analysis is needed to address how to accelerate installation of E85 dispensers. The research should identify policy differences, success factors, and effects potential policies have on increasing adoption/penetration of alternative fuel use and infrastructure.

Products, Markets, and Systems Recommendations – Cont'd (2014)

- **Problem Statement**: Bioproducts are underexploited and could enhance overall biofuel production if bioproducts were further developed and marketed.

- **Recommendations**:
  - Support research on specialty and high-value products derived from biomass to build bio-derived product platforms that will facilitate low-cost production of fuels.
  - Examine how to calculate the total carbon impact of products for the purposes of federal procurement and consumer outreach.
  - Create, maintain, and widely share databases of federally and privately developed bioproducts to inform federal and private initiatives.
  - Encourage more educational outreach on bioproducts with "show and tell" events in Washington, D.C., and elsewhere.

Feedstocks and Logistics Recommendations (2014)

- **Problem Statement**: Sufficient volumes of advanced biomass feedstocks are not delivered continuously to the processor at low enough unit costs. Land owners/ operators must achieve sufficient economic return to adopt bioenergy feedstocks and new production systems. Regional differences require unique approaches to addressing the general logistic issues (harvest, transportation, storage).
- **Recommendations**:
  - Increase yield and decrease unit cost.
    - Better utilize and maximize use of existing but underutilized feedstock resources.
    - Prioritize feedstocks that require minimal inputs of water, nutrients, and energy.
    - Develop and utilize farming systems that maximize productivity throughout the year.
    - Do not exclude any feedstock, as long as it can show that it meets volumetric needs and economic viability.
  - Ensure feedstocks are continuously available to processors.
    - Develop and demonstrate improved logistics for feedstock procurement and distribution by aggregating, processing, blending, and storing feedstocks.
    - Establish processes to efficiently deconstruct, increase energy density, remove oxygen, improve handling, and stabilize during storage.

Feedstocks and Logistics Recommendations – Cont'd (2014)

- **Problem Statement**: Diversity of feedstocks gives rise to different bioproduct yields and compositions.
- **Recommendations**:
  - Better characterize and standardize analysis of the chemical and physical properties of feedstocks.
    - Conduct coordinated R&D to understand how variations in plant nutrition, climatic, soils, and stress affect chemical composition, and how impacts of variation might be minimized.
    - Analyze the stability and composition in different environments for different feedstocks and define how we can control/tailor it.
    - Prioritize productive feedstocks that can be grown economically with minimal water, energy, and fertilizer inputs.

2015 Committee Planning

RECOMMENDATIONS for 2015 (under consideration)

- More emphasis on bioproducts, waste-to-energy, and sustainability are likely.
- Co-chair considering refocusing Subcommittees and recommendations around selected topics.

Committee/Board Interaction

- TAC welcomes a close working relationship between TAC and the Board.
- TAC is open to receiving Board-derived topics requiring TAC assistance, but appreciates it if informed at the Q1 meeting to maximize effectiveness.

2015 Approach

- Enhance input from both TAC members and federal program managers to Identify specific topics for the TAC to focus on during 2015. Topics will emanate from TAC subcommittees and members as well as other sources such as the Board working groups and others
  - Sub-committees narrow in on topic areas and possible gaps to address for the full committee.

2015 Schedule

- Q1 Meeting
  - Have initial discussions and interactions between the Biomass Board, Operation Committees, Interagency Working Groups, DOE and USDA biomass budget and new activities and goals.
- Q2 Meeting
  - TAC along with the attending Operation Committees and Interagency Working Group guests develop a list of focused topics.
  - Determine areas which the TAC should emphasize by down-selecting from the potential TAC 2015 topics suggested.
  - Adjust the TAC sub-committee structures if necessary to best address one or more topics per future meeting.
- Q3 and Q4 Meetings
  - Work in Subcommittees to develop recommendations on agreed upon topic areas.
- Q4
  - Finalize 2015 recommendations by achieving consensus and vote.

Examples of Possible 2015 Topics

Recommendations remaining from 2014: More emphasis on bioproducts, waste-to-energy, and sustainability

Possible 2015 Topics

- How would modifications to the RFS policy positively affect innovation in biofuels commercialization?
- How should technology breakthroughs and scientific facts be effectively communicated to the American public to convey the positive impacts of biomass, bioenergy and bioproducts?
- Which Bioproduct platform(s) contain a positive business case worth pursuing?
- Are existing sustainability models adequate or are additional studies and approaches needed?
- How can techno-economic analyses be improved and made more useful?
- How can USA efforts be better coordinated with and benefit from international experiences?
- How to improve production of value-added products from sugars by biological methods?
- How to improve crop production to obtain higher yields and better GHG balance for sugar and starch crops and for lignocellulosic crops?
- How to improve chemistry & engineering technology / scale-up for thermo/catalytic conversion of whole biomass to bio-products?
- How can the Federal agencies better coordinate their activities to optimize and leverage biofuels R&D and infrastructure across Government?
- What are the commercial opportunities related to biogas?
- Should renewable diesel (*ex*. F-76) for marine applications be considered an early biofuels adoption area and subsequently a new focus area?
- Address how volatile oil prices impact different technologies under consideration.
- How effective are public/academic to private technology transfers and is the biomass industry getting all the research information that they need? Where are research shortfalls that industry sees?
- What approaches have been used to foster successful alternative fuel markets around the world? Special attention should be paid to identification of factors that facilitated adoption in successful markets such as Brazil, Sweden and Thailand. The research must identify policy differences and allocate success factors.

Thank You!

Are there any questions?