Biomass Research & Development Program
Technical Advisory Committee
2012 Recommendations

The Technical Advisory Committee (Committee) for the Biomass Research and Development Act was authorized through section 9008(d) of the Food, Conservation, and Energy Act of 2008 (FCEA). The Committee has specific reporting obligations to the Biomass Research and Development Board (Board), including:

In §(d)(3)(B) – evaluate and make recommendations in writing to the Board regarding whether - -

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 [§(e)(2)];
ii. solicitations are open and competitive with awards made annually;
iii. objectives and evaluation criteria of the solicitations are clearly stated and minimally prescriptive with no areas of special interest;
iv. the points of contact [§(c)(2)(A)] 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; and
v. activities under this title are carried out in accordance with the title.

Annual reporting obligations for the Committee are stated in §(g). In adherence to these obligations, the Committee shall issue a report on the status of funds appropriated for the Initiative, indicating that all funds are distributed and used in a manner that is consistent with the objectives and requirements of section 9008.

The Committee charter provides for forming subcommittees that can address particular matters for the Committee as a whole. The Committee currently operates with three subcommittees; Feedstocks, Conversion, and Infrastructure/Logistics.

SPECIFIC COMMITTEE REPORTING OBLIGATIONS

- Were funds distributed and used consistent with the Initiative's objectives, purposes, and considerations?

  While BRDI has met the overall objectives of the Biomass Act (Section 9008 of

FCEA of 2008), and projects address the objectives and the defined technical areas, the Committee identified areas that could be improved and provided the following recommendations.

1. Problem Statement**:** The portfolio of awards does not show clear technology progression, nor is there a link from one year to the next, or to the larger goals of the USDA or DOE programs.

   1.1 Recommendation: BRDI awards should be in support of wider USDA/DOE Biomass goals and portfolio. Therefore, the Committee believes that the value of BRDI can be significantly enhanced by implementing a five-year technology roadmap with goals, objectives, and metrics, which follows existing USDA and DOE roadmaps.

- Were the solicitations open and competitive with awards made annually?

The solicitations were made available through Grants.gov and were announced through social media and other routine means. The joint agencies shared in the workload, with DOE's Office of the Biomass Program (OBP) leading the review process for pre-applications. This process pre-screened applications and was used to identify the most promising projects that would be invited to submit full proposals. Evaluation and selection of full proposals was led by USDA's National Institute of Food and Agriculture (NIFA).

The BRDI merit review process appears to be in line with other federal research and development (R&D) programs, as well as effective and efficient. We commend the pre-proposal process, which can avoid placing unnecessary burden on the applicant community. The following are recommendations to improve the process:

2. Problem Statement: The separation of responsibilities, with DOE-OBP handling pre-application process and USDA-NIFA handling evaluation and selection, may eliminate excellent projects based on inadequate coordination between the agencies, particularly in the pre-application process.

   2.1 Recommendation: Both pre-application and full application processes should have integrated agency oversight to support improved coordination regarding the grant review process.

- Were the objectives and evaluation criteria for each solicitation clearly stated, minimally prescriptive, and aimed toward no special interests?

The Initiative objectives were clearly presented in each solicitation and were consistent with §(e)(2). The solicitations also presented the Initiative technical areas that were consistent with §(e)(3).

The pre-application criteria in fiscal year (FY) 2009 and FY 2010 included a statement that implied a preference toward industry-academia collaborations. In FY 2011, however, consortia were specifically allowed and encouraged. Such collaborations are no longer limited to industrial and academic participants; we commend this expansion. The following are recommendations to continue improvement.

3. Problem Statement**:** BRDI solicitations are prescriptive, in terms of requiring a full systems approach including feedstock, conversion, and systems analysis components. The integrated systems approach may not address specific gaps in knowledge that we know exist. Research is warranted in specific technical areas, as defined in the technical recommendations, in addition to an integrated approach.

   3.1 Recommendation: For the next solicitation, include more specific R&D efforts. A portion of the available funds should be reserved for grants to address gaps. Consider a two-tiered approach—one at a systems level and one at a systems-component level.

4. Problem Statement**:** The time from releasing the BRDI solicitation to the deadline for proposal submission has sometimes been too short, and BRDI draft solicitations have never been made available for public comment prior to releasing the final draft, as is done by some other federal grant programs.

   4.1 Recommendation: In order to ensure high-quality proposals, adequate time should be allowed between the pre-proposal and full proposal submission deadlines. BRDI Programs should make a draft FOA available to the public to allow for comments and revisions.

   4.2 Recommendation: The application process should focus on the objectives, approach, timeline, and budget, as well as the work force, equipment, and materials available. Require only the necessary documentation for the merit review. Review regulatory paperwork after projects have been recommended by the merit review. This will make better use of the time available for both those preparing and those reviewing the grants.

- Were proposals evaluated and selected on merit by use of independent panels predominantly composed of experts outside of USDA and DOE?

  Evaluation criteria and procedures were clearly presented in each solicitation and adhered to established merit review guidelines and procedures for both agencies. The Initiative conducts grant reviews through a two-phase submission process, with pre-applications serving as a screening process prior to invitations for full applications' final merit review.

  Review panels were gathered for both processes. During 2010 and 2011, a total of 107 panelists were involved, with most members having expertise in engineering, cropping systems, agronomy, and business. For the pre-application process, the percentage of reviewers coming from industry and academia was 38% and 42% in 2010 and 48% and 39% in 2011, respectively. The following are the Committee's recommendations:

  5. Problem Statement**:** BRDI review and site visit panels seem to have a limited number of representatives from the private sector.

     5.1 Recommendation: Develop a larger network of reviewers and inform them of the scope/areas for review. Consider drawing reviewers from previous or current applicants or through the use of a finalist peer review system. Qualifications of reviewers should be previously demonstrated. Reviewers should be drawn from industry, academia, government, and other groups to create a diverse pool of expertise.

  6. Problem Statement**:** Ensuring merit review panels include expertise to adequately review proposed programs is essential to the success of BRDI. Abbreviated timeframes between pre-proposal submittal and review and full proposal submittal and review decreases the amount of time program managers have to invite an appropriate merit review panel.

     6.1 Recommendation: Utilize a checklist (e.g., National Science Foundation) with pre-proposals to allow BRDI managers to secure review teams with expertise matched to the program ideas being developed for full proposals.

  7. Problem Statement**:** Proposal submitters should reasonably expect that rejected BRDI proposals will be improved by responding to the reviewers' comments in a later submission. While responding to comments can never guarantee approval in a later submission, it is only fair for the submitters to

expect that their efforts to respond were duly noted and taken into account. Many federal funding programs make explicit provision to consider the response to reviewers' comments in a resubmitted proposal, but the BRDI does not. The credibility and value of the BRDI program, and its institutional memory, will be strengthened if this deficiency is corrected.

7.1 Recommendation: We recommend that when a revised proposal is submitted to the BRDI, that the new reviewers be provided with a copy of the past review(s) and a two-page response prepared by the submitters, to be submitted with the proposal. This action will help the current set of reviewers be better informed and render a more useful and accurate review than if the past review and the submitters' response to that review are excluded from the decision.

INFORMATION REQUESTS

While discussing and formulating their 2012 recommendations, the Committee felt that key information was not available and would therefore like to make the following information requests:

8. Problem Statement**:** The Committee wishes to have a better understanding of the scope of projects funded by other significant federal research programs being conducted, particularly in agencies that are represented in the multi-agencies BRDI Board [§(c)].

   8.1 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. This will enable the Committee to identify both trends and gaps in funding.

9. Problem Statement**:** BRDI does not seem to have a method of evaluating the success of awards, or the results, as past awards have not been shared with the Committee.

   9.1 Recommendation: Measureable outputs of awards should be established; success of the funded technologies should be shared and reviewed by the Committee. At least some funded projects should be presented at Committee quarterly meetings, focusing on substantive challenges and milestones.

10. Problem Statement**:** The Committee needs a better understanding on how the awarded projects are meeting expectations toward commercialization of technologies and creation of new industries.

    10.1 Recommendation: Implement analysis of commercialization and technology transfer resulting from federally funded research programs. Identify what factors contributed to a project's success and allowed the technology to be replicated. Metrics should be stage-specific. In other words, which funded technologies reach development, advanced development, or commercialization? And if commercialized, at what scale?

11. Problem Statement**:** The Committee does not have a complete picture of the types of proposals submitted in the pre-application and proposal submission.

    11.1 Recommendation: Develop a check list 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.

FEEDSTOCKS RECOMMENDATIONS

The Committee did not have an opportunity to review the DOE and USDA responses to the 2011 recommendations, but the Committee believes that the substance of those recommendations are still relevant and still supported by the Committee. The following are the Committee's 2012 Feedstocks recommendations:

- Feedstock Sustainability

12. Problem Statement**:** Currently, greenhouse gas (GHG) exchange data for life-cycle assessment is provided by models. Actual measurements on GHG exchange are needed for more accurate life-cycle assessments.

    12.1 Recommendation: The DOE Great Lakes Regional Center is making actual GHG exchange measurements. Building on their success, solicitations should be issued to develop more actual GHG exchange measurements.

- Cropping Systems Optimization

13. Problem Statement**:** Although sugarcane is used extensively in Brazil for fuel ethanol production, the high value of sucrose makes this approach uneconomical in the United States. Alternative sweet crops are available (sorghum, sweet potato, sugar beets, etc.), which could be used to produce renewable fuels with modest modifications of the mature industrial corn-ethanol process.

    Ethanol from corn uses inexpensive enzymes to convert starch into glucose for fermentation by conventional yeasts. The corn ethanol industry also provides co-products that are used for food animal production such as beef, dairy, pork, and poultry. This mature process coupled with the efficiencies of corn production and public policy has allowed corn starch to serve as the low-cost feedstock for ethanol in the United States.

    Lignocellulosic biomass residues and energy crops/trees are relatively inexpensive, based on competing values for steam production or pulping. From 60% to 70% of the dry weight of these materials is carbohydrate that could be converted into sugars using enzymes and chemical treatments; a non-food non-feed material.

    Unlike starch, lignocellulose was designed by nature to resist deconstruction. Harsh chemical treatments and/or high levels of enzymes are required. Resulting processing costs have served as a barrier to offset the advantages of these inexpensive feedstocks.

    Considerable progress has been made in these cellulosic processes and several biorefineries with a cellulosic-fuel component are under construction or planned for the near future. Forestry residues, short-rotation trees, and energy fiber crops could be used to rapidly deploy such biorefineries as industrial experience matures. Additional research is needed to define regional feedstocks, best practices, harvesting, and storage.

    The fermentative conversion of sugars into fuels and commodity chemicals that compete with petroleum products can be distilled into a single focus, the production of low-cost sugars.

    13.1 Recommendation: The United States should invest in sugar-platform programs for the development of cost-effective processes and crops for the

near-term expansion of fuel ethanol production (starch and sugars) and for intermediate-term expansion (lignocellulose).

i. Sugar crops for fuel and chemical production

ii. Starch crops, in addition to corn for fuel and chemical production

iii. Lignocellulosic feedstocks for fuel and chemical production.

Each sugar-platform program should have a low-cost, fermentable sugar yield as a key milestone and goal. Additional considerations should include identification of single or multiple feedstocks that can be produced locally or regionally and allow operation for at least 9 months per year.

Research should identify the best near-term crops and processes for each class of substrate, recognizing that these will often be regional.

14. Problem Statement**:** A cropping systems approach is lacking to maximize efficiency or yield of bioenergy crops.

14.1 Recommendation: Research is needed to identify the best integrated cropping system approach maximizing land use and other inputs such as modifying growing seasons to maximize use of land, water, and other inputs throughout the entire year.

15. Problem Statement: Throughout the last 3 years, BRDI has addressed more than 15 types of feedstocks. However, limited waste feedstocks are utilized.

15.1 Recommendation: Future BRDI solicitations should expressly recognize the eligibility of waste feedstocks such as animal waste, crop residues, municipal solid waste (MSW), and food waste.

15.2 Recommendation: Specialty crop biomass residues should be recognized as important to overall BRDI goals, even though the availability of these residues may be relatively low. Examples include almond and walnut shells and hulls, rice hulls, cotton gin wastes, grape pomace, citrus juicing wastes, orchard prunings, etc. BRDI solicitations should encourage proposals involving specialty crop biomass residues as feedstocks, along with the higher profile residues such as sugarcane bagasse, corn stover, etc.

15.3 Recommendation: Guidance should be provided in future solicitations on volumetric requirements for minimal feedstock availability to ensure projects economic sustainability and scalability if this is a scoring criteria for reviewers.

CONVERSION RECOMMENDATIONS

The following are the Committee's 2012 Conversion recommendations:

16. Problem Statement**:** Conversion—pre-treatment through fuel production—is a major barrier to bringing down costs.

    16.1 Recommendation: Give priority to research for pre-treatment as part of a conversion process.

17. Problem Statement**:** There is a critical gap in the existing solicitations portfolio on separations technology. Improved separations technology can significantly reduce capital and operating requirements, as well as life-cycle emissions.

    17.1 Recommendation: Conduct a review of the status of chemical and physical separations R&D for biofuel precursors with the goal of identifying gaps and opportunities in product purification (e.g., alcohol and water). R&D should focus on reducing capital expenses, operating expenses, energy intensity, etc., for separations technology.

18. Problem Statement**:** Some bioenergy grants outside BRDI programs (for example, the Defense Production Act) restrict eligibility to 'commercial-scale' projects, defined as those that use at least 700 tons per day of biomass or produce 10 million gallons per year of biofuel. This restriction could result in eliminating extremely promising and valuable technologies.

    18.1 Recommendation: The criteria designating a project as 'commercial scale' should be based on profitability and commercial impact, rather than size or production capacity. Small-scale systems can be commercially viable and still generate profits. The rationale for any minimum size requirements should be explained in the funding opportunity announcement. Biomass conversion scale-up requirements are different than those for petroleum refineries and need to be better understood.

LOGISTICS, STORAGE, HANDLING, AND INFRASTRUCTURE RECOMMENDATIONS

In support of GHG emissions reductions, the unique issues related to bioenergy and bioproducts, creating new jobs, reducing fossil fuel use, and improving rural economies, the Committee recommends:

- Research to densify and preprocess biomass to improve logistics, storage, handling, processing, and conversion performance.

19. Problem Statement**:** Biomass—the raw material for production of biofuels and bioproducts—has many serious logistical disadvantages as an industrial feedstock. Compared to fossil feedstocks, biomass is much less dense per unit of energy; is more heterogeneous; more spatially dispersed; less stable; more difficult to handle, store, and transport; more variable in year-to-year yields and chemical properties; and presents some additional safety challenges (e.g., dust explosions and spontaneous combustion). Most forms of biomass pose cost, logistical, and processing challenges. It seems very unlikely that large-scale commodity industries can be built up around biomass feedstocks until these disadvantages are overcome.

19.1 Recommendations: To overcome these serious disadvantages with biomass, we recommend research in the following areas:

i. Development of relatively low capital/operating cost, distributed processes that can increase the energy or physical density of biomass near where the biomass is produced. Emphasis is also needed on overcoming heterogeneity, and the removal of moisture and other problematic substances
ii. Development of integrated land use, harvesting, handling, transport, processing, and blending methods that can improve logistics and storage stability of biomass feedstocks plus manage availability uncertainties
iii. Development of strategies on how more distributed biomass production and processing can promote rural communities and accelerate industry emergence.

- Research to mitigate seasonality concerns and associated problems.

20. Problem Statement**:** Typically, biomass has seasonal growth and harvest patterns that impact supply, storage, and use. Bioenergy production generally requires year-round feedstock supplies—sometimes with peak demands at times very different from peak feedstock supply seasons. Storage often leads to feedstock losses, along with moisture and combustion issues. Matching seasonal supplies with year-round or seasonal demands requires the development of extensive storage, multiple feedstocks, altered harvesting practices, and various forms of preprocessing and/or densification. This can be both expensive and challenging in terms of implementation.

    20.1 Recommendation: Field–to-user systems need to be developed to accommodate seasonality.

    i. Research projects need to develop low-cost preprocessing or multi-feedstock provisions, logistics, and storage systems designed to accommodate seasonality.

    ii. Develop mobile feedstock processing operations to accommodate seasonality issues, as well as unexpected changes in weather, beetle kill, etc.