Source: Biomass Research and Development Technical Advisory Committee

Advisory To: Biomass Research and Development Board

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Issue: ***Feedstock Supply Chain Costs and Efficiencies: Opportunities in the Nearer Term***

Opportunities:

- ☐ Develop uniform, on-specification industrial biomass feedstocks
- ☐ Improve the understanding of the impacts that feedstock characteristics and compositions have on handling, processing, and conversion steps
- ☐ Exploit currently available specialized, stranded, and opportunistic resources
- ☐ Conduct research on low-acreage but scalable crops that can produce high-value biofuels and bioproducts in the near term
- ☐ Improve the use and reuse of all the components of biomass to increase value

Context

Development efforts have resulted in commercial production of a range of bioproducts and biofuels at a variety of scales. However, *essentially all* of these facilities have encountered feedstock issues related not only to the cost, quality, and availability of those feedstocks, but also to the ability to successfully handle them. These issues create ongoing challenges not only to specific projects, but also to the entire industry that is striving to achieve ≥90% on-stream performance goals. While biomass has been used for centuries, the reality of handling it in advanced biomass conversion systems is more difficult than was initially assumed.

Biomass generally requires preparation and processing before it can be used as an industrial feedstock. Examples of preprocessing include size reduction, moisture content adjustment, chemical treatment, and others. Because each processing step adds incremental costs, it is critical that the feedstock supply chain is efficient in changing initial biomass into an industrial feedstock fed directly to a process reactor. Funding from both the Biomass Research and Development Initiative (BRDI) and the individual agencies participating in the Initiative has advanced knowledge in this area. Programs of the U.S. Departments of Agriculture and Energy, such as the Coordinated Agricultural Projects (CAP) and the Regional Feedstock Partnership (RFP) field trials, have improved the understanding of regionally-based biomass and related industrial feedstocks. Commercial partners' involvement in the CAP and RFP projects has provided increased industrial relevance. The agencies participating in the BRDI have also funded core research to reduce the cost of biomass, to address the interface between biomass and conversion, and to otherwise improve the feedstock supply chain.

Additional efforts are needed in the relatively near term (approximately 5 years) to assist with biomass and industrial feedstock issues. These efforts are crucial to reducing the recurring problems experienced in commercial biorefineries.

Key Challenges of Effective Feedstock Supply Chains

- *A lack of uniformity of industrial feedstocks exists.* The variable, non-uniform nature of current feedstocks creates difficulties in processing and increases conversion costs. The characteristics of feedstocks vary significantly by biomass type, but they also vary due to factors such as localized agricultural practices, availability of moisture during growth, temperature and length of time in storage, and others.
- *Insufficient information is available to correlate feedstock properties with conversion behavior.* Prior analytical work has provided information about the basic characteristics of biomass and some industrial feedstocks, but there is little data correlating that with conversion behavior. No easy-to-access public database is available to support industry efforts.
- *Utilization of specialized, stranded, and opportunistic biomass is difficult*. Currently available, specialty biomass provides a potential economic entry point to help establish the bioeconomy infrastructure, but matching those resources with appropriate, cost-effective conversion technologies is difficult.
- *The cost of biomass and industrial feedstocks continues to be challenging*. Biomass must be used efficiently for biorefineries to be successful, and continued improvements in the use of all components of the biomass are needed to help defray the cost of the biomass.

Opportunity 1

Fund additional research to identify a cost-effective method to produce more stable, dense, uniform feedstocks for easier handling and transport.

- ⇒ ***Create on-specification industrial feedstock streams that allow for reliable (≥90%) continuous processing at the fully commercial biorefinery.***
- ⇒ ***Consider on-stream processing availability as a target in BRDI projects.***

Opportunity 2

Develop improved technical information that correlates feedstock chemical and physical characteristics to handling, processing, and conversion yield behavior. Provide the information in a publicly available database that is readily accessible to biorefinery operators.

- ⇒ ***Develop improved correlations between the "as delivered" feedstock characteristics and subsequent conversion performance. Better understand the chemistry and physics involved.***
- ⇒ ***Develop "quick and easy" compositional measurement tools (e.g., advanced nano-based sensors, near-infrared, or others) that can be used in the field or at the feedstock preparation facility.***
- ⇒ ***Develop a public database of feedstock composition and correlations to conversion behavior that can ultimately link to commodity feedstock specifications.***

Opportunity 3

Fund research to better utilize currently available specialized, opportunistic, and stranded biomass resources that provide a potential economic entry point to expand the bioeconomy.

- ⇒ ***Develop a comprehensive listing and database of specialized biomass sources with quantities and locations of currently available resources (e.g., wastewater treatment sludges, municipal solid waste, beetle-killed pine, etc.).***
- ⇒ ***Match feedstock to appropriate-scale conversion technologies, particularly those with more profitable products and co-products.***

Opportunity 4

Fund research on current low-acreage crops that are readily scalable and that can yield high-value, high-impact bioproducts/biofuels in the near term.

- ⇒ ***Focus on additional oil seed crops that have ability to produce higher oil content than current oil seed crops.***
- ⇒ ***In addition, examine crops with near-term commercial potential for products, such as rubbers, plastics, or fillers, that will enhance performance.***

Opportunity 5

Fund research that will improve the use and reuse of all components of biomass or the industrial feedstock to increase its value.

- ⇒ ***Examine processes to increase the value and use of lignin. Characterize and evaluate market applications for processes to produce different types of lignin that result in up to 100% feedstock valorization. The emphasis should be on near-term processes with potential to yield a better type of lignin***.
- ⇒ ***Examine the efficient use and reuse of bio-crops and their biomass in sequential applications to increase the value of the biomass.***