U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Mobilizing High-Quality and Sustainable Conversion-Ready Feedstocks

Research and development (R&D) to transform renewable carbon and waste resources into feedstocks for conversion to biofuels, bioproducts, and biopower will sustainably expand biomass resource potential in the United States. The Department of Energy's Office of Energy Efficiency and Renewable Energy's Bioenergy Technologies Office (BETO) Feedstock Supply and Logistics Program employs an applied R&D strategy to lower the costs, improve the quality, and increase the types and quantities of feedstock intermediates available for conversion by working with partners to develop innovative technologies.

The United States has the capacity to produce up to 1 billion tons of biomass each year that could be used to produce 50 billion gallons of biofuels, 75 billion kilowatt hours of electricity, and 50 billion pounds of bioproducts.[1] Bioenergy technologies enable the use and reuse of biomass and waste streams for reduced-emission fuels for cars, trucks, jets, and ships; bioproducts; and renewable power, giving Americans more energy choices and enhancing energy affordability.

Feedstock Supply and Logistics R&D focuses on improving the efficiency and reliability of harvesting and collection, storage, handling and transportation, and preprocessing methods to convert renewable carbon and waste resources into conversion-ready feedstocks. Top left: Switchgrass harvest. Top right: Switchgrass, baled. Bottom left: Chopped and ground switchgrass. *Photos courtesy of Oak Ridge National Laboratory.*

The Feedstock Supply and Logistics (FSL) Program focuses on early-stage technology R&D to **develop and supply high-quality, energy-dense, and sustainable conversion-ready feedstocks**. This includes improving the efficiency and reliability of harvesting and collection (in collaboration with the U.S. Department of Agriculture), storage, handling and transportation, and preprocessing methods. This research portfolio provides the FSL Program the capability to identify the key quality and operational factors for enhanced conversion performance, while ensuring sustainable feedstock supplies.

Feedstock supply and resource mobilization is a key factor in bioenergy cost. The FSL Program works to understand biomass availability and characterization and develops technologies to increase available resources for multiple end uses.

The *Feedstock-Conversion Interface* evaluates how feedstock quality affects conversion process performance. R&D efforts focus on understanding the fundamental drivers of feedstock quality while developing and improving preprocessing operations, such as air classification, screening, and densification to transform renewable carbon resources into feedstocks that meet or exceed conversion quality specifications. Other R&D strategies include understanding how blending and formulation can utilize low-quality and low-cost resources and developing preprocessing technologies capable of reducing the physical and chemical variability for more reliable, predictable, and efficient performance in conversion processes.

Scalability and integration R&D by the FSL Program evaluates how newly developed technologies will scale from a pilot facility to demonstration scale, and how new technologies may integrate into existing farming, forestry, and/or waste collection and handling systems.

[1]Rogers, J.N., B. Stokes, J. Dunn, H. Cai, M. Wu, Z. Haq, and H. Baumes. 2016. "An assessment of the potential products and economic and environmental impacts resulting from a billion ton bioeconomy." Biofuels, Bioprod. Bioref. https://doi.org/10.1002/bbb.1728.

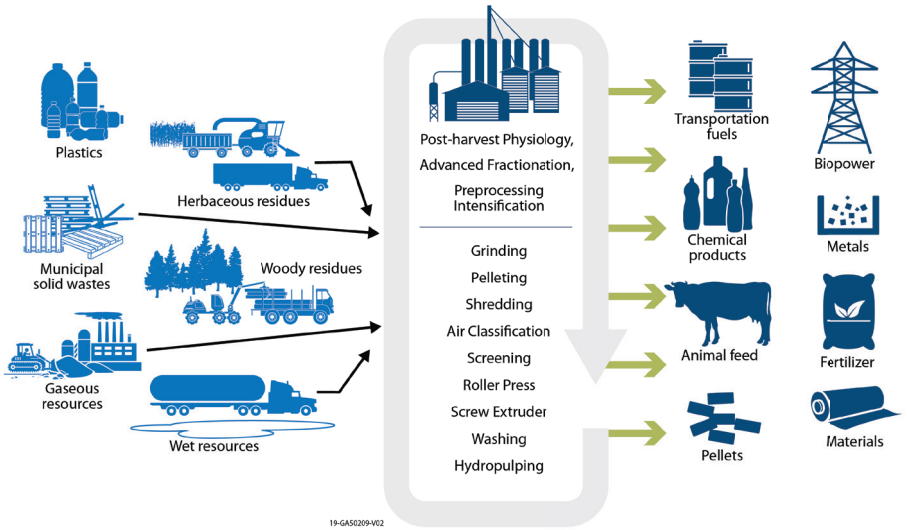
Feedstock-Conversion Interface Consortium

In collaboration with Conversion R&D and Advanced Development and Optimization programs, the Feedstock-Conversion Interface Consortium (FCIC),[2] addresses challenges related to the behavior and performance of biomass in supply, preprocessing, and conversion process operations. The FCIC focuses on identifying key feedstock quality and operation factors, and developing technologies and science-based strategies to:

- Quantify, understand, and manage variability in the targeted feedstock materials from field through preprocessing and downstream conversion to understand how biomass composition, structure, and behavior impact system performance.
- Model the behavior and performance of selected feedstocks in gravity flow and conveyance operations during preprocessing operations and introduction into the conversion processes, based on the understanding of the fundamental characteristics of those materials.
- Develop and implement mitigation strategies into the processes of feedstock supply, preprocessing, and conversion, and benchmark and verify performance in integrated operations.
- Analyze system-wide throughput to benchmark integrated system reliability, process economics, and environmental impacts, and estimate how system reliability changes with the implementation of mitigation strategies.
- Control and optimize processes with in-line sensors and feedback control logic to monitor performance at critical points in the integrated systems and adjust throughput to achieve high levels of system reliability over time.

Biomass Feedstock National User Facility

The Biomass Feedstock National User Facility's (BFNUF's) Process Demonstration Unit (PDU) is a large-scale, fully integrated feedstock preprocessing plant. Its modular construction allows industry partners to customize process flow and insert third-party equipment during process design and scale-up of bioenergy facilities. The PDU's capabilities include grinding, drying, pelletizing, cubing, torrefaction, and other mechanical and chemical separation options.



Feedstock Supply and Logistics R&D is developing technologies with a vision to expand preprocessing operations to provide multiple high- and low-value feedstock streams.
Image courtesy of Idaho National Laboratory.

The PDU also provides toll processing of a wide range of feedstock options for both BETO- and industry-funded projects. In concert with BFNUF's Bioenergy Feedstock Library—created by Idaho National Laboratory (INL)—and the Biomass Characterization Laboratory, the PDU provides customized technical support to leading U.S. bioenergy technology companies and bioenergy researchers. In short, BFNUF helps accelerate commercialization and avoid costly delays and equipment retrofits during commissioning and start-up of bioenergy facilities. INL researchers developed the Bioenergy Feedstock Library[3] to improve biomass feedstock interfaces and overall performance. The library is designed to provide researchers and industry with information about the physical, chemical, and conversion-performance characteristics of feedstock, having 35,000 physical samples, sample data for more than 50,000 biomass samples, and bioenergy characterization data for more than 7,500 samples. Outside researchers may securely manage their own biomass samples using the remote project management database. Security controls on each project can limit dissemination of raw data sets, but it does allow external visitors to view snapshots of important biomass characteristics for many projects.

Knowledge Discovery Framework

The Knowledge Discovery Framework[4] was established to serve as a hub for various data sets, publications, and mapping tools that support the bioenergy industry. This information is synchronized with the Bioenergy Feedstock Library and provides a way to contribute data, view maps, and find data at a national, regional, local, or project level. With a wide variety of datasets and analytical tools, it is a gateway to the bioenergy research community. ■

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