

2.3.7 BIOMASS RESIDUES

Technology Description

Biomass residues are the organic byproducts of green plants used for food, fiber, and forest production and processing. Major sources of residues include grain crops such as corn, wheat, and rice; animal waste; forest harvest; fuel-reduction treatments, and processing. These residues can be used as an alternative fuel source and for other purposes. This profile addresses the issues of harvesting, storing, and transporting biomass residues.

System Concepts

- The sustainable use of biomass residues for energy requires understanding when and where residues can be removed from agricultural and forest soils without reducing long-term productivity.
- Under certain circumstances, residues may have greater economic and ecological value when left on the land to restore nutrients, reduce erosion, and stabilize soil structure than if harvested for fuel. Biomass residue energy production may be most effective in locations where crop yields and soil organic levels are high, and erosion is not a major concern.

Representative Technologies

- Agricultural residues (corn stover, straws from wheat, rice, and other grain crops).
- Wood residues resulting from lumber, furniture, and fiber production.
- Forest residues (tops and limbs from harvest for wood products, material from fuel reduction treatments).
- Black liquors from pulp production.
- Animal wastes from confined production of chickens, pigs, and cows.
- Clean wood from urban yard trimmings and construction/demolition.

Technology Status/Applications

- Sustainable and recoverable amounts of corn stover, wheat straw, rice straw, and cotton stalks are estimated at about 150 MdT/year (less than 50% of the amount actually produced). Some corn stover is being removed presently for production of chemicals and animal bedding. Straws are being used in Europe as a bioenergy resource.
- More than 2.1 quadrillion Btu of primary biomass energy is consumed by industry, and it generates 56 million MWh of electricity plus heat. Nearly two-thirds of this electricity is derived from wood and wood wastes (including spent pulping liquors, wood residues, byproducts from mill processing, and forest residues). About one-third of the electricity and heat is derived from municipal solid waste and landfill gas.
- Some technologies are available to combust or gasify animal wastes. The most widely known option is to capture methane gas, a byproduct of anaerobic digestion.

Current Research, Development, and Demonstration

RD&D Goals

- By 2006, establish measurable cost reductions in corn-stover supply systems with modifications of current technology.
- By 2007, develop whole-crop harvest systems for supplying biorefineries of multiple products.
- By 2010, develop enhancements to the whole-crop harvest systems that include fractionation for maximum economic return, including returns to soil for maximum productivity and conservation practices.
- By 2015, develop an integrated system for pretreatment of residues near harvest locations and a means of collecting and transporting partially treated substrates to a central processing operation.
- By 2020, develop fully integrated crop and residue harvesting, storage, and transportation systems for food, feed, energy, and industrial applications.

RD&D Challenges

- Develop environmental data to make decisions on residue removal from agricultural and forest lands.
- Assemble better information on the characteristics of residue feedstock to assist in cost-effective harvest/handling and storage systems, and to assist potential users in optimizing their systems to handle residue feedstock.
- Develop cost-effective drying, densification, and transportation techniques to create more “standard” feedstock from residues.

- Develop efficient and environmentally sound infrastructure for residue supply systems (collection, handling, storage, transport).
- Gain public acceptance for the removal of agricultural and forest residues where shown to be sustainable.
- Develop methods for estimating residue availability based on published or easily accessible information sources.
- Develop effective and publicly acceptable ways of using animal wastes.

RD&D Activities

- Reduce feedstock costs and enhance feedstock quality through improving and adapting the existing collection, densification, storage, transportation, and information technologies (precision agriculture and forestry) to bioenergy supply systems.
- Enhance the sustainability of feedstock supply enterprises (production and handling) by developing and servicing robust machines for multiple applications and extended use.
- Research the engineering properties of novel aqueous and nonaqueous multiphase bioenergy feedstocks.

Recent Progress

- Critical operations contributing to the cost of residue harvest have been identified. It is now clear that a reduction in the number of operations is the key to reduction in feedstock costs.
- Farm-equipment manufacturers in the United States are becoming increasingly aware of opportunities in biomass harvesting and handling systems. Large and small companies are building alliances with research institutions to develop equipment for handling large quantities of biomass.
- Green power producers are making greater use of landfill gas as a resource for electricity production.

Commercialization and Deployment Activities

- Use of biomass residues for bioenergy and bioproducts is already commercial where those materials are captured internally by an industry or where disposal fees are high enough to encourage delivery of these materials to an energy end user for little to no cost.