Alternate Feedstock and Architectures for Fuels and Co-products

Current R&D for converting agricultural biomass to biofuels uses biomass feedstock.
Research includes improving and/or modifying feedstocks to improve conversion potential, separation, and conversion.
The Western Regional Research Center and the Plant Gene Expression Center

Feedstock

Crop residues such as rice straw, wheat and barley straw and Guayule bagasse, are here-and-now resources in the West for which new pretreatments (enzymatic, high pressure steam) promise improved conversion to biofuels. New energy crops such as switchgrass use marginal lands and have high biomass yields.

Future energy crops and residues will arise from model plants such as Brachypodium. The use of this plant model for all grasses will establish how the plant cell wall is constructed and provide the tools and understanding for improved disassembly. An ARS-DOE collaboration is defining the genomic sequence of both Brachypodium and switchgrass.

Switchgrass

Guayule

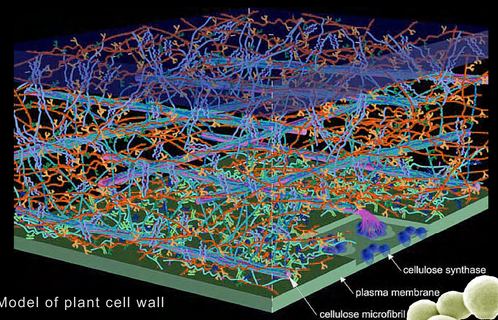
Brachypodium

Rice straw in California

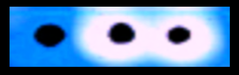
Biorefining Options

The plant cell wall a complex of carbohydrates, lignin, protein, and micro-fibers is the bulk of biomass. However, the plant cell wall resists breakdown for energy. This can be overcome by

1. simplifying the chemical and physical architecture of the plant cell wall by breeding and molecular biology,
2. developing new suites of highly active enzymes to convert the complex biomass to fuels and intermediates, and
3. applying physical, chemical, and enzymatic treatments to separate the components and gain access for component breakdown.



Model of plant cell wall



High-throughput screening of enzymes

Yeast for enzyme delivery & conversion

Steam pretreatment of biomass

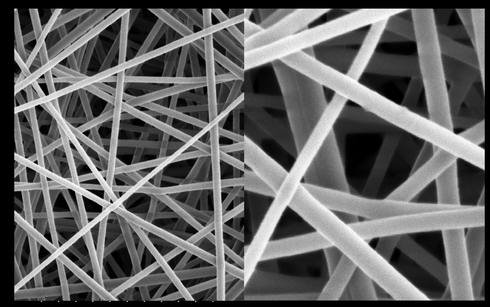
Separation of wheat starch and protein

Co-products

Value-added co-products pulled from the fuel refining stream will ensure economic viability of fuel biorefining. Extracting latex from the desert shrub, guayule, yields valuable rubber articles and precedes conversion of the bulk of the plant residue (bagasse) to biofuel. Nanocomposites and molded packaging materials from native cellulose complements conversion of plant residue to biofuel. The biorefinery of the future can make multiple uses of the parts of the plant yielding food, feed, fibers, and valuable intermediates--along with biofuels and bioenergy.

Guayule products

Crop-residue-based packaging.



Native nanostructures

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