NREL | NATIONAL BIOENERGY CENTER

NREL'S **BIOCHEMICAL CONVERSION PILOT PLANT** CAPABILITIES

A flexible pilot plant for testing a wide range of bio-based technologies for producing renewable fuels and byproducts.

The biochemical conversion pilot plant is housed in the Integrated Biorefinery Research Facility located on the National Renewable Energy Laboratory's (NREL's) main campus. The facility provides industry partners the opportunity to test and develop their own biorefining technology using NREL equipment or rental equipment that can be brought into the plant. The pilot plant can process materials up to one dry ton per day in an integrated fashion using a variety of operating modes including batch, fed-batch, and continuous processing. The plant is capable of:

- Biomass pretreatment and deconstruction to sugars or other compounds
- Enzymatic conversion of biomass-derived polymers to sugars
- Microbial conversion of sugars and other compounds to products
- Separation and recovery of intermediate and final products
- Sophisticated data acquisition, control, and storage.

Research activities are supported by extensive compositional analysis and molecular biology laboratories, and NREL's ability to perform sophisticated techno-economic analysis.

CORE CAPABILITIES AND APPLICATIONS

BIOMASS PRETREATMENT/DECONSTRUCTION

Two small 1-L and 4-L reactors and two 90-L and 170-L paddle-type reactors for batch treatment and several continuous 0.5—1.0 dry ton per day reactor (temperatures up to 200°C and residence times up to two hours) systems for aqueous phase processing and pretreatment of biomass.

ENZYMATIC HYDROLYSIS

One 1,900-L and four 4,000-L paddle reactors for high-solids enzymatic hydrolysis and multiple temperature-controlled stirred-tank vessels for low-solids enzymatic hydrolysis.

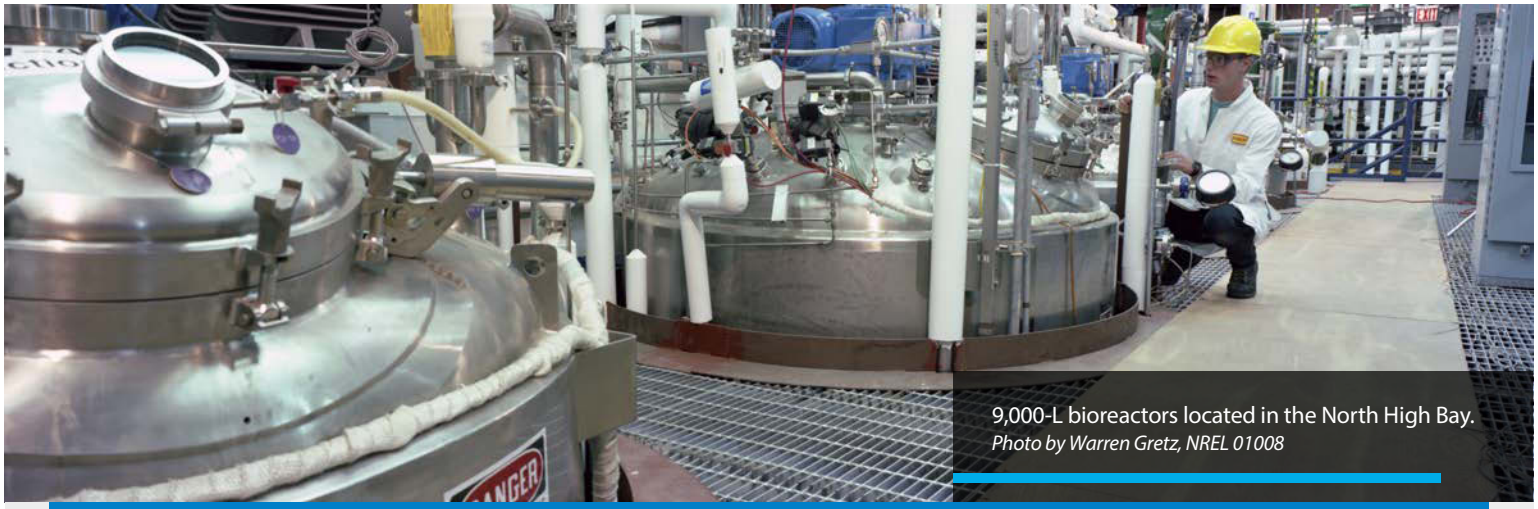
MICROBIAL CONVERSION

Fully instrumented, anaerobic- and aerobic-capable bioreactors—four 9,000-L, two 1,500-L, two 160-L, and one 30-L systems—for batch, fed-batch, or continuous microbial conversion of sugars or other compounds.

PRODUCT SEPARATION AND RECOVERY

Separation capabilities include filtration (tangential flow filter, perforated bowl centrifuges, decanter, and rotary drum vacuum filter), a continuous forced circulation vacuum evaporator, and a 10-m-tall by 0.5-m-diamater sieve tray distillation column.

Top Photo: NREL's biochemical conversion pilot plant (South High Bay).
Photo by Dennis Schroeder, NREL 20248



9,000-L bioreactors located in the North High Bay.
Photo by Warren Gretz, NREL 01008

RECENT SUCCESSES

NREL's biochemical conversion pilot plant has supported in-house technology development efforts and many industrial projects including:

- Development and demonstration of a new alternative low-temperature pretreatment process named deacetylation and mechanical refining that produces highly digestible biomass solids at low cost
- Large-scale pretreatment and bioconversion in large (> $0.5 M) cooperative research and development agreements with industrial partners such as National Advanced Biofuels Consortium, Virent, and Eco-Petrol.
- Numerous smaller industry-funded projects with partners such as Dupont, Lygos, Visolis, Novozymes, and Toyota, that use many of the pilot plant's equipment systems.

Highlighted Publications

Schell, D.J., et al. "Dilute-Sulfuric Acid Pretreatment of Corn Stover in Pilot-Scale Reactor: Investigation of Yields, Kinetics, and Enzymatic Digestibility of Solids." *Applied Biochemistry and Biotechnology.* DOI: 10.1385/ABAB:105:1-3:69.

Schell, D.J., et al. "A Bioethanol Process Development Unit: Initial Operating Experiences and Results with a Corn Fiber Feedstock." *Bioresource Technology*. DOI: 10.1016/s0960-8524(03)00167-6.

Chen, X., et al. "DMR (Deacetylation and Mechanical Refining) Processing of Corn Stover Achieves High Monomeric Sugar Concentrations (230 g L-1) during Enzymatic Hydrolysis and High Ethanol Concentrations (10% v/v) during Fermentation without Hydrolysate Purification or Concentration." *Energy and Environmental Science.* DOI: 10.1039/C5EE03718B.

Find Out More

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NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

NREL/FS-5100-75884 • September 2020

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