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NATIONAL RENEWABLE ENERGY LABORATORY

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R&D WITH NREL'S **2" FLUIDIZED BED REACTOR (2FBR) SYSTEM**

SYSTEM CAPABILITIES

The 2FBR is a versatile lab-scale thermal processing and catalytic upgrading system to evaluate the conversion of renewable and waste feedstocks into fuels and chemicals.

NREL researchers are using the 2FBR to evaluate critical process integration parameters, such as yield, product distribution, and carbon efficiency, for a variety of feedstocks and thermal conversion routes, including:

- Fast pyrolysis
- Catalytic fast pyrolysis (fixed or fluidized bed upgrading)
- Gasification
- Steam reforming
- Solid, liquid, and reactive gas feeds.

FEEDSTOCK & PROCESS FLEXIBILITY

NREL has processed multiple feedstocks and catalysts to simulate a variety of processes, including *in situ* or *ex situ* upgrading of pyrolysis vapors from woody and herbaceous biomass, carbon recovery from aqueous waste streams, and hydrogen generation from pyrolysis oil streams.

FULL PRODUCT STREAM ANALYSIS

Comprehensive solid, liquid, and gas product analyses are available for accurate material and elemental balances, including starting feedstock, char, whole or fractionated liquid products, and online (μGC, NDIR, TCD) and offline (GC-MS) gas analysis.

Hydrotreated bio-oil and fuel fractions

Highlighted Publications

K. Iisa, et al. "*In Situ and Ex Situ* Catalytic Pyrolysis of Pine in a Bench-Scale Fluidized Bed Reactor System." *Energy & Fuels*. DOI: 10.1021/acs.energyfuels.5b02165.

M. Griffin, et al. "Driving Towards Cost-Competitive Biofuels through Catalytic Fast Pyrolysis by Rethinking Catalyst Selection and Reactor Configuration." *Energy & Environmental Science*. DOI: 10.1039/C8EE01872C.

Find Out More

For more information and collaboration opportunities, contact:

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NREL's catalytic carbon transformation research is supported by the U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy (EERE), Bioenergy Technologies Office (BETO).

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R&D WITH THE **NREL RESEARCH GASIFIER (NRG)**

CORE CAPABILITIES

FEEDSTOCK FLEXIBILITY

NREL has utilized multiple biomass feedstocks, including pine, poplar, miscanthus, switchgrass, and forest residues, with excellent operational performance.

EFFICIENT TAR REMOVAL AND TUNABLE CO_2 CONTENT

Using industrially relevant syngas cleanup methods, NREL researchers have demonstrated tar removal greater than 99% and have developed a method to tune CO_2 content in the final syngas from 1% to 15%.

DOWNSTREAM CONVERSION TO FUELS AND CHEMICALS

The NRG systems couple gasification and cleanup with the ability to store high-pressure syngas for downstream use in fuels and chemicals production, either on-site for use in NREL reactors or in U.S. Department of Transportation-compliant gas cylinders that can be shipped to research partners.

The NRG is a lab-scale gasification system, perfectly suited to study the conversion of biomass and waste streams to purified syngas.

NREL researchers evaluate the critical syngas production and cleanup challenges for a variety of feedstocks. Complete gas analysis at multiple sampling points in the system enables comparisons of:

- Syngas yield and gas efficiency
- Tar removal/conversion using commercial reforming technology
- Carbon dioxide (CO_2) content with tunable removal using an amine-based scrubber.

Find Out More

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Highlighted Publication

D. Dupuis, et al. "High-Octane Gasoline from Biomass: Experimental, Economic, and Environmental Assessment." *Applied Energy.* DOI: 10.1016/j.apenergy.2019.02.064.

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Top Photo: NREL researchers work with a research gasifier pyrolyzer. *Photo by Dennis Schroeder, NREL 49301*

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