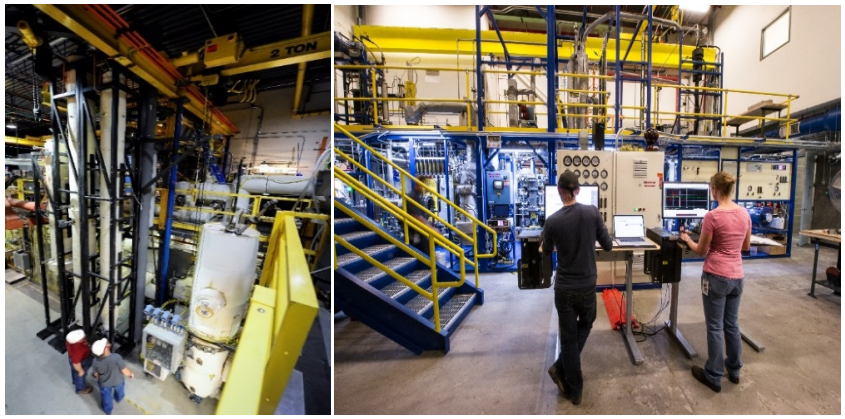
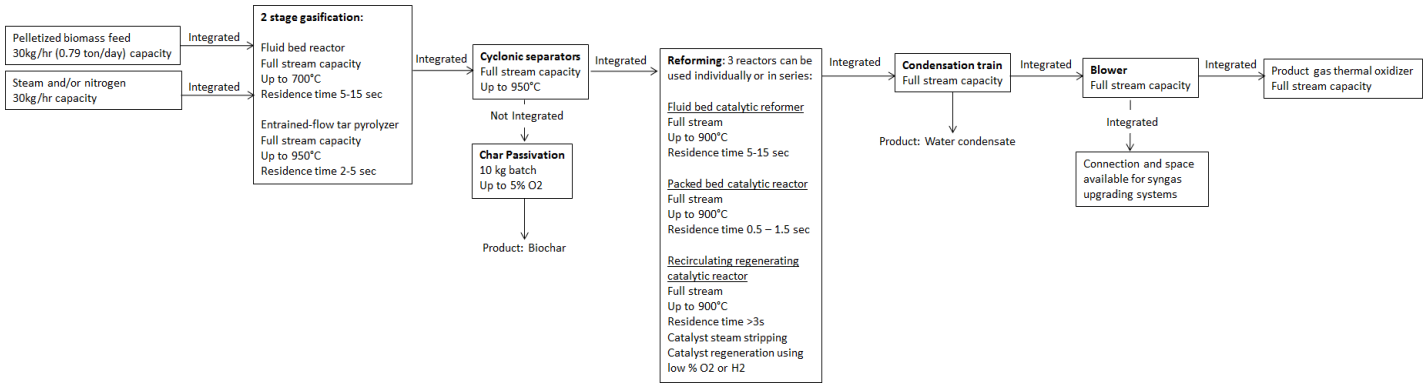
National Renewable Energy Laboratory

Thermochemical Process Development Unit Facility



TCPDU and Davison Circulating Riser Pilot Plant

The Thermochemical Process Development Unit (TCPDU) is available for R&D on gasification and pyrolysis processes for thermochemical conversion of biomass (and other organics such as polymers) to biofuels and bio-based products. Both syngas and bio-oil can be produced directly or can be upgraded and converted to clean fuels and other valuable chemicals. NREL's thermochemical program includes both bench-scale (500 g/h) and pilot-scale facilities for research on biomass gasification and pyrolysis, including the 0.5 metric tonne/day TCPDU. Components of the TCPDU (http://www.nrel.gov/biomass/thermochemical_users_facility.html) include capabilities for thermal and catalytic gasification and pyrolysis in both fluid bed and entrained flow reactor configurations, tar reforming (gasification only) and product collection, separation, and upgrading to fuels and chemicals. Both bench-scale and full-stream pilot-scale catalytic fuels synthesis reactor labs are integrated into the TCPDU for testing catalysts using authentic biomass-derived syngas. Additional pilot-scale capabilities include a Davison Recirculating Reactor system (5 kg/h biomass feedrate) for investigation of ex situ upgrading of biomass pyrolysis vapors. The TCP DU can be configured in three operational modes: 1) gasification (depicted in the flow diagram, below, 2) pyrolysis, and 3) ex-situ catalytic fast pyrolysis.



TCPDU, Flow Diagram, Gasification Mode

Thermochemical Process Development Unit Facility NREL, Equipment List

Gasification Configuration

- Feed System (loss-in-weight feeder, rotary valves, feed transfer screw)
- Gas Feed System
- Two-stage Gasification Reactor (Fluidized Bed Reactor FBR, coupled to Entrained-Flow Reactor EFR)
- Dual-cyclone char & ash removal system
- Fluidized Bed Reformer
- (Optional)
- Polishing Packed Bed Reformer (Optional)
- Circulating Riser Reactor System
- Scrubber System: steam condensation and collection
- Online Analytical (GC, NDIR, TCD)
- Online MBMS

Pyrolysis Configuration

- Feed System (loss-in-weight feeder, rotary valves, eductor)
- Gas Feed System
- Pyrolysis Reactor (Entrained flow reactor)
- Dual-cyclone char & ash removal system
- Scrubber System: bio-oil condensation and collection
- Online Analytical (GC, NDIR, TCD)
- Online MBMS

Ex-situ Pyrolysis Configuration

- Feed System (loss-in-weight feeder, rotary valves, feed transfer screw)
- Gas Feed System
- Pyrolysis Reactor (Entrained flow reactor)
- Dual-cyclone char & ash removal system
- Circulating Riser Reactor System
- Scrubber System: pyroil condensation and collection
- Online Analytical (GC, NDIR, TCD)
- Online Molecular Beam Mass Spectrometer