

# Project Update: The Vermont Gasifier

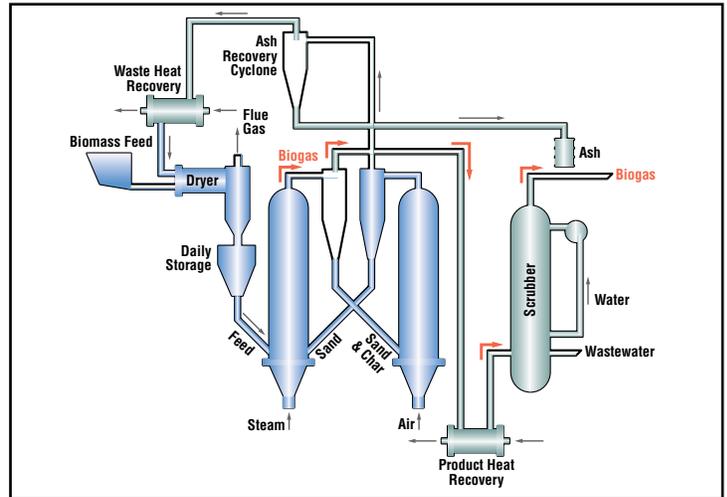


A new demonstration biomass gasifier in Burlington, Vermont, takes a major step toward biopower systems of the 21st century. The project's purpose is to verify design and operating characteristics of this intermediate size gasifier. Designers rate the Vermont gasifier capacity at 200 tons of biomass per day. Previously, the inventor, Battelle, successfully operated a pilot unit rated at 20 tons per day. The Vermont operation will provide the information necessary to scale up the process for a first-of-its-kind commercial-size gasifier that will be demonstrated at an industrial or utility site.

## Project Description

### Who Are the Players?

The Burlington Electric Department, a city utility, hosts the gasifier demonstration at its Joseph C. McNeil wood-powered electric generating facility. The demonstration project was put together by a unique partnership that includes the host, the U.S. Department of Energy, Battelle, the National Renewable Energy Laboratory (NREL), and Future Energy Resources Corporation (FERCO), a private firm committed to developing and commercializing the gasifier.



Vermont gasifier schematic

### How Does the Gasifier Work?

The Vermont project demonstrates a process called low-pressure, indirect gasification of biomass. The process mixes wood chips with very hot sand at a temperature of about 830°C, or 1500°F, in a steel tank called a gasifier. The hot sand breaks down the wood and, helped by added steam, causes the resulting carbon, hydrogen, and oxygen to form into combustible gases. The gases and sand leave the gasifier and the gas is cleaned for use as fuel. (See diagram above.) This fuel burns cleanly with a heat content of about 500 Btu per cubic foot (about half the heat content of natural gas), which qualifies it as a medium-heat content gas. This gas can be used directly in unmodified gas turbines. However, McNeil burned the gas in its wood-fired boiler during the startup and evaluation periods.

The Battelle gasifier differs from others producing medium-heat content gas because it does not use pure oxygen; therefore, it costs much less to build and operate. Steam replaces oxygen in this modern process. The Vermont gasifier processes biomass much more quickly than other gasifiers, which means that smaller, less costly equipment is needed for a given amount of biomass. This, in combination with low-pressure operation, further reduces its construction cost.

Using biomass to fuel gas turbine combined-cycle systems will nearly double the electricity-generating efficiency typical of today's biopower industry. Such systems have garnered the interest of the pulp and paper industry, which will soon need to replace many of its power boilers and can benefit from higher efficiencies.



Dove Parsons/PIX04735

This country's first demonstration of a biomass gasifier—which supplies clean, renewable fuel from biomass to a utility power plant—is set to go on-line.

## What's Been Done?

The project consists of three phases:

- Phase 1: Design and construction, which was completed in 1998.
- Phase 2: Gasifier startup and shakedown testing, which began in 1998 and will continue through 2000. The following activities were completed by the end of 1999:
  - Tested and calibrated components and subsystems.
  - Operated the gasifier integrated with the power plant.
  - Installed instrumentation to obtain performance data.
- Phase 3: Sustained operation and testing with a gas turbine, which will begin late in 2001 following design and installation that will start early in 2001.

NREL supplied technical support for gasifier design and engineering, and provides technical and analytical support during operation. To date, the gasifier has supplied fuel for generating 150,000 kilowatt-hours of electricity.

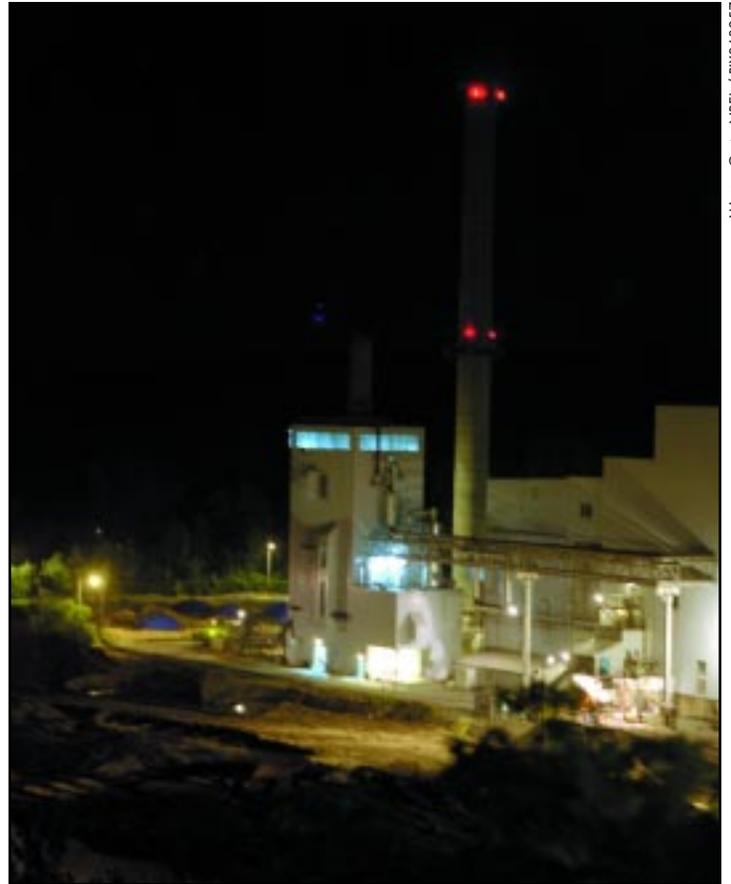
## What's Next?

Remaining Phase 2 activities are to complete operations testing to measure and define the gasifier's baseline performance, its operating limits, and specifications for particle size and moisture content of the fuel. Operating limits include maximum turn-up and turn-down ratios for bringing the plant on- and off-line, and dynamic response of the system to transient events such as sudden increases in demand or sudden loss of load. Year 2000 activities emphasize gas conditioning and cleanup.

Plans are to install the turbine late in 2001. Long-term trials of the entire system will then identify the most important factors for system reliability. System operation and performance will be thoroughly measured. Tests during sustained operation will also yield information about using other biomass fuels with different compositions and physical characteristics.

### Project Partners

- Battelle
- Burlington Electric Department, Burlington, Vermont
- Future Energy Resources Co., Atlanta, Georgia
- National Renewable Energy Laboratory, Golden, Colorado
- U.S. Department of Energy, Washington, D.C.



Warren Greitz, NREL / PIX063257

The Battelle gasifier in Burlington, Vermont, provides a clean gas fuel for modern power systems that can achieve efficiencies double those of today's biopower industry.

## For More Information

Visit the Biopower Web Site:

<http://www.eren.doe.gov/biopower>

For copies of print documents on renewable energy, call DOE's Energy Efficiency and Renewable Energy Clearinghouse (EREC) 1-800-DOE-EREC (1-800-363-3732)

