

PROJECT facts

Vision 21

10/2002

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY



HYBRID POWER SYSTEMS TO ACHIEVE HIGH EFFICIENCY

Description

FuelCell Energy Inc. (FCE) is developing ultra high efficiency Direct FuelCell/ Turbine® (DFC/T) hybrid power plants which meet or exceed stringent Vision 21 goals. The DFC/T power system is based on an innovative power cycle utilizing an indirectly heated gas turbine to supplement fuel cell generated power. FuelCell Energy will be working with Montana State University investigating effective heat recovery and internet-based load monitoring systems and CTA Architects Engineers who will assist with the site selection and installation of a sub-MW unit in Montana.

The FCE project focuses on these major activities:

1. Proof-of-concept tests of DFC/T system in a sub-MW class power plant configuration based on a 250 kW Direct FuelCell integrated with a microturbine.
2. Development of key system components including gas turbine, recuperators and high temperature catalytic oxidizer suitable for DFC/T systems.
3. Experimental investigation of approaches for achieving very high efficiency from the fuel cells by evaluating alternative designs for anode gas delivery to the fuel cells.
4. Development of conceptual design of a 40 MW DFC/T forming the basis for 10-50 MW DFC/T hybrid power plant products for wholesale electric power market.
5. Design and fabrication of two DFC/T systems in order to assess the efficiency potential of the sub-megawatt power plants.
6. Tests of the first sub-MW unit at FCE's facilities in Danbury, CT followed by demonstration of the second DFC/T power plant in Montana to provide data on integration and operation of DFC/T power plants under laboratory and field operating conditions.

PRIMARY PARTNER

FuelCell Energy, Incorporated
Danbury, CT

TOTAL ESTIMATED COST

\$19,355,679

COST SHARING

DOE \$11,836,373
Non-DOE \$7,519,306

WEBSITE

www.netl.doe.gov



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PROJECT PARTICIPANTS

Capstone Turbine Corporation

Chatsworth, CA

Montana State University

Bozeman, Montana

CTA Architects Engineers

Billings, Montana

Goals

An objective of DOE's Vision 21 hybrid power system is to develop larger, multi-megawatt power plants that would generate electricity with net efficiencies targeting 75 percent (with natural gas), while producing sulfur and nitrogen oxide emissions of less than 0.01 lb/million BTU. These goals are significant improvements over conventional power plants, which are only 35-60 percent efficient and produce emissions of 0.07 to 0.3 lb/million BTU of sulfur and nitrogen oxides.

Benefits

DFC/T system concept uses a novel approach in which heat energy from the fuel cell is transferred indirectly to the turbine air with heat exchangers. At the core of this power plant design is the Company's DFC fuel cell technology. The system extends the potential fuel savings and positive environmental attributes of the DFC by combining a non-fired gas turbine and a network of heat exchangers, resulting in extra electricity and adding significantly to the already high efficiency of the DFC. Features of the DFC/T system include: high efficiency, minimal emissions, simplicity in design, direct reforming internal to the fuel cell, no pressurization of the fuel cell, independent operating pressure of the fuel cell and turbine, and potential cost competitiveness with existing combined cycle power plants at much smaller sizes. The combined system does not require any combustion in the turbine resulting in ultra high efficiencies with minimal environmental impact. The reliability and operability enhancements possible with this system may open up markets for high-efficiency fuel cell technology that would otherwise not be available.



Sub-MW DFC/T Proof-of-Concept Power Plant