

PROGRAM facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Strategic Center
for Natural Gas

05/2001

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BREAKING EFFICIENCY BARRIERS WITH HYBRID FUEL CELLS

What Are Hybrid Fuel Cells?

In a hybrid fuel cell system, high-temperature fuel cells are coupled with other power generation systems, such as gas turbine, reciprocating engine, or other type of fuel cell. The hybrid arrangement allows rejected thermal energy and residual fuel from a high-temperature fuel cell to be used to drive a gas turbine, for example. Preliminary studies show that hybrid systems can maintain extremely low emissions, while achieving fuel efficiencies far beyond the reach of one technology alone.

The National Energy Technology Laboratory's Strategic Center for Natural Gas (SCNG), partnered with U.S. industry, has made great strides in fuel cell, turbine, and other natural gas end-use technologies. By carefully integrating these subsystems with future programs aimed at solving the remaining technical challenges, advanced hybrid power generation will become a reality.

Applications

Initially the SCNG is developing small systems, ranging from 250 kilowatts to 1 megawatt, for use by businesses and light industry for co-generation. These systems will have low emissions and fuel use efficiencies of at least 60 percent. Larger hybrid systems, up to 20 megawatts, with fuel efficiencies of at least 70 percent are targeted for demonstration by 2010. In the long term, production of affordable hybrid systems with efficiencies in excess of 80 percent will support central power plant operations.

Current DOE Funded Projects

FuelCell Energy Inc., with **Rolls Royce** (formerly Allison Engine Company) and **Capstone Turbine Corp.** are designing a 40-megawatt ultra-high-efficiency power plant including balance-of-plant, plant layout, cost, and trade-off studies. Key components under development include gas turbines, recuperators, and anode tail gas oxidizers for high-temperature hybrid operation, as well as fuel cell/turbine integration systems.

Honeywell International Inc. will develop and demonstrate a proof-of-concept planar Solid Oxide Fuel Cell (SOFC) hybrid system for distributed power generation applications. It will focus on pressurized operation in SOFCs, and high-temperature heat exchangers.

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Current DOE Funded Projects (continued)

Siemens-Westinghouse Power Corporation (SWPC) of Pittsburgh, PA developed and fabricated the **world's first hybrid power plant**, combining a solid oxide fuel cell and a gas turbine. The factory acceptance test was completed in April 2000. Southern California Edison will operate the new 220-kilowatt hybrid plant at the National Fuel Cell Research Center at the University of California-Irvine. A year of testing in a commercial setting is being performed at this site. This system is 55-percent efficient, with no sulfur dioxide emissions, and NO_x emissions at less than 1 part per million. A 320-kilowatt hybrid system is also in the planning stages. An initial commercial offering of a 1-megawatt fuel cell-microturbine power plant is planned for late 2002, and a larger, 60-percent efficient, 1-megawatt fuel cell-gas turbine hybrid power system is expected to be commercialized during 2003 to 2005.

Rolls Royce is developing a small gas turbine with a potential for multiple applications, both in stand-alone and combined hybrid modes.

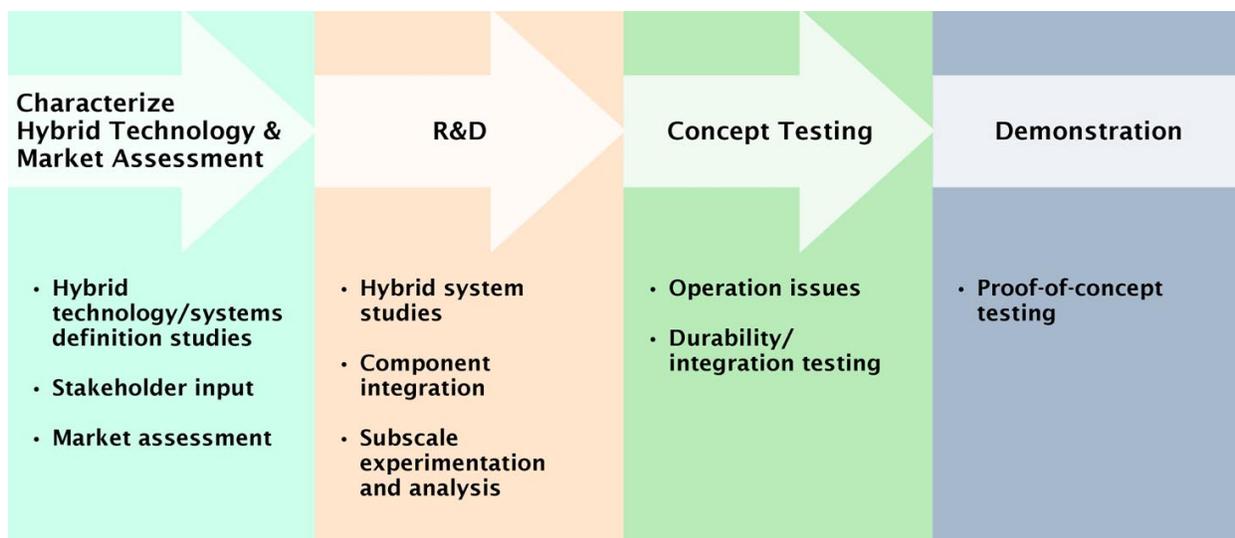
Benefits

Conventional coal-fired power plants are typically 35-percent efficient, with modern gas-fired plants at only 40 to 50 percent. Hybrid generation systems provide a tremendous opportunity to:

- Produce electricity at costs of 10 to 20 percent below conventional turbine plants.
- Achieve efficiencies greater than 70 percent.
- Lower greenhouse gas emissions.
- Reduce carbon dioxide production by nearly 30 percent.
- Reduce NO_x emissions.
- Reduce carbon monoxide emissions to less than 2 parts per million.

Vision

SCNG will champion and lead the global development and commercialization of hybrid systems for power generation applications. Hybrid power systems will be the highest efficiency power plants ever built, with a target manufacturing level of 400 MW per year by 2015.



NETL's Strategic Center for Natural Gas will spearhead the path to hybrid fuel cell commercialization.