PROJECT facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

ADVANCED CLEAN/EFFICIENT **POWER** systems

PS025.0897M

DEVELOPING THE SOLID OXIDE FUEL CELL

PRIMARY PROJECT PARTNER

Westinghouse Electric Corporation
Pittsburgh, PA

MAIN SITES

Westinghouse Science and Technology Center
Pittsburgh, PA

COST

$173,800,000

COST SHARING

DOE	**$89,300,000**
Non-DOE	**$83,700,000**

Project Description

Westinghouse Electric Corporation is developing the tubular ceramic-based solid oxide fuel cell — potentially one of the simplest, cleanest, most efficient, and most versatile technologies on the power generation horizon. Westinghouse is widely recognized as the world leader in this promising new technology.

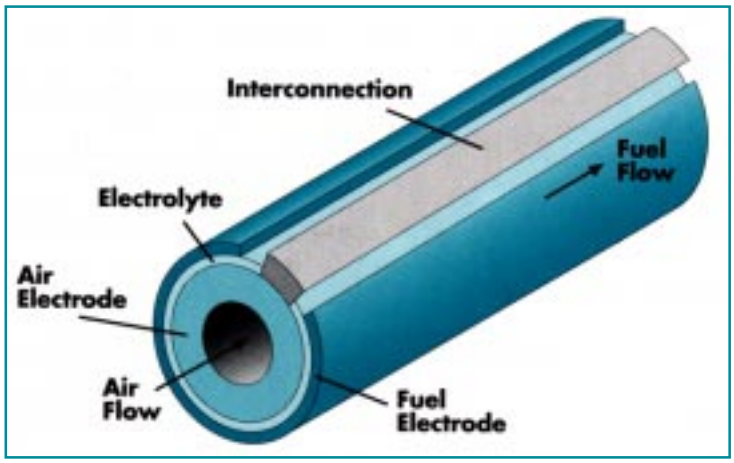
The $173-million effort — 48% of the funding is coming from the private sector — is a six-year development project aimed at moving this 21st century technology up to the threshold of commercial use.

Like a battery, the solid oxide fuel cell generates power electrochemically avoiding the air pollutants and efficiency losses associated with combustion processes. Unlike batteries fuel cells operate continuously, generating power as long as natural gas, clean-coal-derived gas, or other hydrocarbon fuels are supplied. The solid electrolyte allows for the simplest of fuel cell plant designs, and requires no external fuel reforming.

The solid oxide concept uses ceramics, which allows the cells to operate at higher temperatures than other fuel cells, producing more energy per unit of fuel and far less carbon dioxide (a greenhouse gas). The high exhaust temperature and pressurization potential of the Westinghouse design make it particularly suited for multiple combined cycles and high efficiencies.

Westinghouse's configuration is a tube made up of multiple ceramic layers bonded together. Multiple tubes link to form power modules; modules link to form generators or larger power plants.

The development effort culminated in tests of two 25-kilowatt generators, and the building of a 100-kilowatt generator. The megawatt-class plant will incorporate as many as 5,000 individual solid oxide fuel cells. The modules will be tested at utility and industrial sites.



FETC
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Developing the Solid Oxide Fuel Cell

Program Goals

The clean environmental performance of solid oxide fuel cells makes them especially well-suited for areas with strict air-quality requirements. Future units could cogenerate electricity and steam for hospitals, shopping malls, and large residential or commercial complexes. Both urban centers and remote sites (for example, those with relatively low-cost fuel sources such as coal-bed methane operations) could be candidates for solid oxide fuel cells.

Commercialization of the Westinghouse solid oxide fuel cell could offer a new approach to generating power in the United States and worldwide. It could create a new solid state manufacturing industry, employing skilled workers to design and fabricate power technologies for tomorrow's energy needs.

Project Benefits

The solid oxide fuel cell is one of the cleanest, most efficient power-generating technologies now being developed.

Capable of using either natural gas or cleaned coal gas, it emits no sulfur pollutants and as much as 60% to 65% less carbon dioxide (a greenhouse gas) than a conventional coal-burning plant.

It is also one of the most efficient means for generating electricity and usable heat. As a simple cycle power generator, it can convert more than 55% of the energy in its fuel source to electricity (conventional coal plants, for example, operate at efficiencies of only 33% to 35%). When the high-quality waste heat from the electrochemical process is used, overall efficiencies could reach 85%. When utilized with a gas turbine in a comined power system, efficiencies over 70% can be achieved.

Because they involve no liquid or moving parts, solid oxide modules are expected to operate reliably for many years. A unit that can generate 2 megawatts of electricity, enough for a small substation, can fit on less than one-tenth of an acre. Thus it can be placed close to power needs, avoiding long transmission lines.

With a simple adjustment of air and fuel flows — much as a gas pedal is used in a car — a solid oxide fuel cell can easily follow changing demands for electricity, boosting output when necessary, then cycling down when demand is low.

The all-solid-state composition of these fuel cells promises to bring to the electric power sector the mass-production processes that have reduced costs in the electronics industry.

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Project Partners

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