Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

SECA FAQs

q: What is a fuel cell?

a: A fuel cell is an electrochemical energy conversion device that uses a carbon and/or hydrogen fuel source and air to produce electrical power.

q: What fuels can fuel cells use?

a: Solid oxide fuel cells can use virtually any fuel: coal gas, hydrogen, bio-fuel, gasoline, diesel, JP8, or propane.

q: How do fuel cells improve the environment?

a: Fuel cells are virtually emissions free and quiet. Features significantly improved efficiency in comparison to conventional natural gas- or coal-combustion based power generation, greenhouse gas emissions are reduced.

SECA R&D: *Where Competition Meets Collaboration*

From New York to California, SECA's Core Technology Program is working on dozens of fuel cell projects, led by the brightest minds from leading universities, national laboratories and businesses across the country. These competitively selected projects work together to provide vital R&D and testing support to the six Industry Teams.

In the same spirit of healthy competition, the Industry Teams leverage the collective ingenuity of the Core Technology Program to independently pursue innovations in fuel cell design that can be mass produced at lower costs. Whether focused upon Cost Reduction or Coal-Based Systems, the Industry Teams are working to solve the challenges of fuel cell technology, each using different approaches and techniques. As a result, the SECA program is rich in innovation, allowing it to reach its goals that much faster.

SECA Cost Reduction: *The Power of a Goal*

The SECA program's Industry Teams are hard at work on the design and manufacture of a variety of low-cost fuel cell prototypes. Recent testing of these prototypes has demonstrated giant leaps made toward fuel cell commercialization.

Manufactured with a scalable mass-production technique, these SOFC prototypes exceed all of SECA's Phase I targets for availability, efficiency, endurance, and production cost. The system's operational availability was 90 percent, over and above the SECA Phase I target of 80 percent. An efficiency of 41 percent was achieved in the 3.6 kilowatt (kW) system, surpassing the target of 35 percent.

This superior efficiency at a small size demonstrates the achievability of much higher efficiencies for larger systems. And, most significant of all, system cost was a low $746/kW.

	SECA Phase I	SECA Phase II
Cost	—	$746/kW
Efficiency	35–55%	41% LHV-DC
Degradation	4%/1000 hours	3.6%/1000 hours
Availability	80%	90%

These accomplishments represent a major breakthrough toward achieving SECA's goal of mass-producing a $400/kW SOFC power generation system by 2010. The prototype's cost approaches that of conventional stationary power, furthering the vision of an economy driven by pollution-free, low-cost fuel cells.

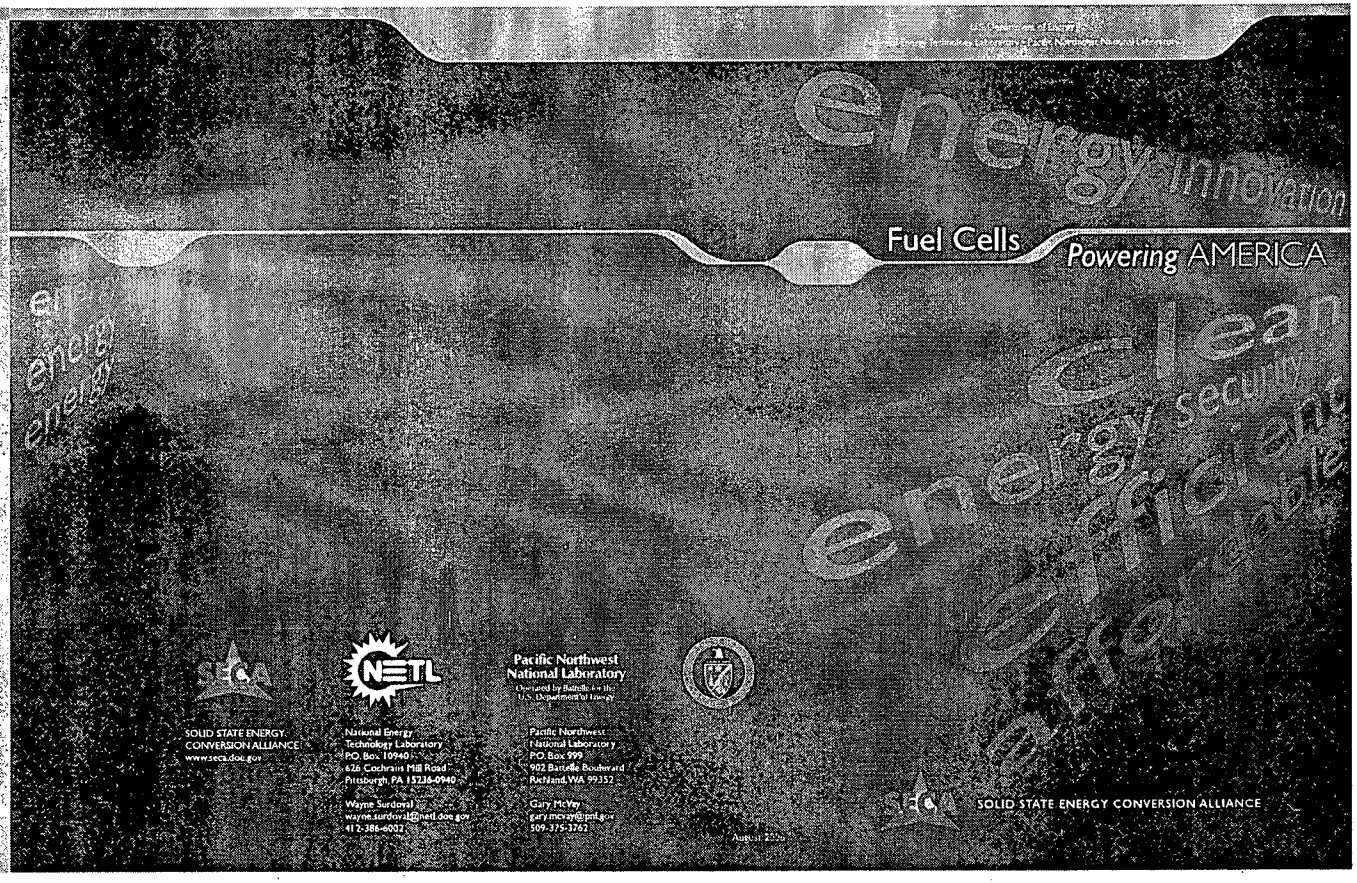
SECA Manufacturing: *Building the Future*

Technical challenges remain to be overcome. Fuel cell technology has traditionally been too costly for broad penetration into commercial markets. SECA is focused on driving costs down to achieve widespread use in the public marketplace. SECA is blending established manufacturing processes with state-of-the-art fuel cell technology advancements in order to leverage the advantages of economies of production (high-volume mass production) and scale.

The cost-reduction goal is to make the cost of fuel cell technology comparable to that of current stationary power systems—$400/kW—by 2010.

To achieve this, the SECA program has set aggressive targets for its private sector Industry Teams. Dividing the research and development into three phases, SECA has set escalating benchmarks for achieving breakthroughs in cost and efficiency—the keys to commercial viability.

The Department of Energy projects that SECA technologies will save the United States more than $100 billion by 2025 through increased efficiency, lowering fuel cost, and meeting emission and carbon sequestration requirements without expensive control equipment.



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SECA: *Demanding Progress*

The race is on. Momentum is building. Research teams all across America are making innovations that will change the future of electricity generation. With the successful completion of its first phase, the Solid State Energy Conversion Alliance (SECA) is one step closer to realizing its vision of cost effective, near-zero-emission fuel cell technology for commercial applications.

Launched in 2000, SECA is a collaboration between government, the private sector, and the scientific community to develop modular, low-cost fuel-flexible solid oxide fuel cell (SOFC) systems that can operate on coal gas, natural gas, bio-fuels, diesel and hydrogen. SECA's ultimate mission is to have its fuel-cell systems ready for FutureGen, the world's cleanest coal-fueled power plant.

SECA's fuel cell development will provide America with a virtually emission-free, efficient, and affordable power generation technology that will improve our environment and reduce our dependence on foreign oil.

SECA has already surpassed its Phase I targets. By developing fuel cells to operate cost effectively on coal gas as well as natural gas, bio-fuels, diesel and hydrogen, it is building a bridge to the hydrogen economy while solving today's environmental, climate change and fuel availability issues. The once distant vision of using clean, low-cost fuel cell technology for everyday applications is now within reach.

SECA Targets: *Fuel Cell Performance and Cost*

	Cost Reduction Targets		2010
Power Rating	3 to 10 kW	3 to 10 kW	3 to 10 kW
Cost*	—	—	$400/kW
Efficiency (LHV)	35 to 55%	40 to 60%	40 to 60%
	Coal-Based Fuel Cell System Targets		
	2001	2005	2010
Power Rating*	500 kW	2 MW	50 MW
Cost	—	$400/kW	$400/kW
Efficiency (HHV)**	45%	50%	50%

* Estimated manufacturing capacity for three Industry Teams
** Coal plant efficiency

Fuel cells convert the chemical energy of a fuel (hydrogen, coal gas, natural gas, diesel and bio-fuels) into electrical energy without combustion.

SECA Cost Reduction
Phase I | Phase II | Phase III

SECA Coal-Based Systems
Phase I | Phase II | Phase III

FutureGen
Construction | Operation

2000 SECA is formed

2001 First SECA awards

2005 Phase II cost goal achieved

2010 SECA commercial prototypes of 3-10kW

2012 FutureGen operation begins

2015 SECA fuel cells (10 MW) operated 25,000 hours demonstrating ability to achieve 50% efficiency, overcoming durability and electric power

SECA Coal-Based Systems: *Meeting Our Nation's Energy Needs*

Coal is a critical resource for our future. There's plenty of it—the United States has 25 percent of the world's coal reserves, offering a substantial opportunity to reduce our dependence on foreign oil and natural gas markets. Coal currently provides more than half of the Nation's electricity supply. Coal provides a safe, secure domestic source of affordable energy. The biggest question mark about coal—how to reduce its carbon dioxide emissions through higher efficiency and ease of capture—is being addressed by Fossil Energy R&D.

To address this challenge, SECA is developing large fuel cell systems to capitalize on the benefits of coal through clean and affordable central power station applications. SECA is ahead of schedule in developing fuel cell systems for FutureGen, the world's cleanest coal-based power plant, envisioned to render our most abundant and under-utilized resource virtually pollution-free.

Competitive Innovation: *Accelerating Technology Development*

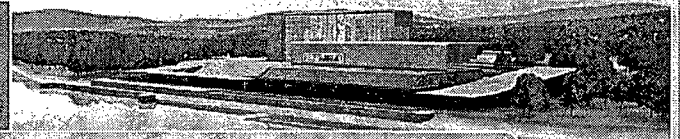
The Administration's Office of Management and Budget recently cited the SECA program as leading the way in Government-industry partnerships.

"The SECA program leverages private-sector ingenuity by providing Government funding to industry teams developing fuel cells for large. The teams continue to exceed a series of stringent technical performance hurdles. This novel incentive structure has generated a high level of competition between the teams and an impressive array of technical approaches. The SECA program also develops certain core technologies that can be used by all the industry teams to avoid duplication of effort. The program exceeded its 2005 performance targets and is on track to meet its goal for an economically competitive technology by 2010."

FutureGen: *The Power Plant of Tomorrow*

"Today I am pleased to announce that the United States will sponsor a $1 billion, 10-year demonstration project to build the world's first coal-based, zero-emission electricity and hydrogen power plant."

President George W. Bush
February 27, 2003

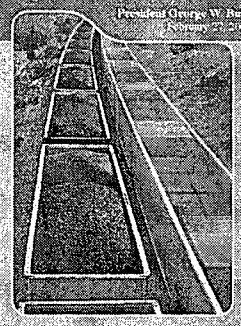


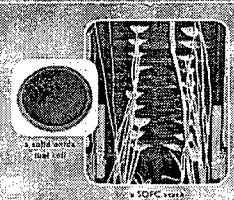
SECA's coal-based fuel cell systems will play a significant role in the overall efficiency and environmental performance of the FutureGen project.

The culmination of a collaboration between government, the scientific community, and private industry, the $1 billion showcase FutureGen project is the first big step toward the President's goal of providing America with a secure energy future. FutureGen will demonstrate the efficient, clean and greenhouse gas free production of electricity and/or hydrogen from coal, and its viable commercial use in providing power to homes and businesses. When operational, it will be the cleanest fossil fuel-fired power plant in the world.

The project will employ coal-based integrated gasification combined cycle (IGCC) power generation technology. The plant will gasify the coal through a process that produces hydrogen. The hydrogen can then be used as a clean fuel for electricity generation in turbines or fuel cells, or a combination of the two. The process will capture and store 90 percent of carbon dioxide emissions preventing release as a greenhouse gas.

Large scale commercial SOFC systems are 25% more efficient compared to conventional power generation.





A solid oxide fuel cell

A SOFC stack

What's Next

With Phase I cost reduction targets achieved, SECA will go full steam ahead into Phases II and III. It will reach the cost and coal-based systems performance targets by 2010 and deliver SECA fuel cells to the FutureGen project in 2011.

SECA FAQs

q: Where are solid oxide fuel cells used?

a: Fuel cells can be used anywhere electric power is needed. Applications include providing power for homes and businesses from central- and distributed-power plants, as well as providing auxiliary power for buses, heavy duty trucks, military transports, RVs and more.

q: How efficient are fuel cells?

a: Fuel cells are much more efficient than today's conventional power generation technologies. For example, efficiency gains of 25% can be realized for central power plants that incorporate fuel cells within an integrated gasification combined cycle (IGCC) system.

q: How much do fuel cells cost?

a: The SECA fuel cell program will reduce the cost of fuel cells tenfold so that they can penetrate the power generation and transportation markets. SECA fuel cell technology will achieve its $400/kW target by 2010.