why fuel cells?

A solid oxide fuel cell is an electrochemical device that converts the chemical energy of a fuel (hydrogen, coal, natural gas, gasoline or diesel) into electrical energy without combustion. The absence of the combustion process in fuel cells minimizes the formation of pollutants, including nitrogen oxides, sulfur oxide, hydrocarbons and particulate matters, and significantly improves electrical power generation efficiency.

SECA solid oxide fuel cell technology offers the following benefits:

Efficiency and fuel extension

- Extends the use of fossil fuels, including vast domestic coal reserves, as fuel cells are 40 to 60 percent efficient in small electric systems, over 75 percent efficient in larger hybrid systems, and up to 85 percent efficient with co-generation
- Generates electricity nearly twice as efficiently as conventional means.

Domestic security

- Supports the development of central power generation using clean coal technology
- Supports the development of distributed power generation. These technologies provide energy security by reducing our dependence on imported fuels and enabling the grid to be less vulnerable to the threat of terrorism.

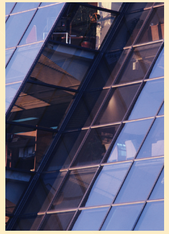
Fuel flexibility

- Enables a broad base of applications for stationary, mobile and military uses. These broad-based applications are necessary for reducing costs, thus meeting SECA cost targets.

taking flight

success through collaboration

SECA relies on a unique program of cooperation between industry and research organizations. SECA's success in bringing together industry and research to accelerate fuel cell development has resulted in impressive gains during the program's first stage and has made it a model for other government programs.



The program involves six industry teams using varied approaches to design a fuel cell that will meet DOE cost and performance goals while also meeting their own specific needs. In addition, leading researchers in industry, academia and at national laboratories support the industry teams with cutting-edge research and development through the Core Technology Program. As the industry teams identify research issues, they bring these challenges to the Core Technology Program for innovative solutions that are shared with all the teams.

Industry Teams Exceed Expectations

As SECA approaches the completion of its first phase—technology maturation—the six industrial teams report substantial gains in developing innovative SOFC systems to achieve breakthrough performance and to reduce fuel cell production costs by a factor of ten. The teams are

- Acumentrics
- Cummins/SOFCo
- Delphi/Battelle
- FuelCell Energy
- General Electric
- Siemens Westinghouse

SECA industry teams have made significant technical progress, exceeding many of their first-phase targets in performance, cost and degradation. They have

- increased fuel cell performance by designing and engineering a fuel cell system that will achieve higher fuel utilization
- integrated low-cost manufacturing processes into fuel cell design and successfully fabricated and tested fuel cells using these processes to meet initial cost requirements
- achieved performance degradation results significantly better than targets for the first phase, demonstrating intelligent selection of materials and fabrication processes.

Core Technology Program Delivers Solutions

Composed of universities, national laboratories and other research organizations, the Core Technology Program develops innovative solutions to scientific and engineering problems identified by the industrial teams. Core Technology research also provides the fundamental understanding required for the technology advances needed to make fuel cells reliable and affordable for broad-based applications.

During SECA's first phase, lasting five years, researchers in the Core Technology Program have enabled industrial teams to overcome identified technical barriers as well as advance fuel cell technology more rapidly toward the marketplace by developing

- commercial SOFC-multiphysics modeling software that has accelerated the design, development and optimization of solid oxide fuel cells and stacks

- advanced architecture for power electronics in modular SOFC systems that reduces the number of components, thus reducing the cost and improving long-term reliability
- protective coatings for improved, long-term corrosion protection of the interconnects between repeating cells
- a fundamental database of physical and mechanical properties for key SOFC component materials. SECA partners can use this database to assist in the design and optimization of their power systems.

Coordination and technical resources for the Core Technology Program are provided by NETL and PNNL, which possess decades of experience in forming and managing collaborative research teams for national programs.

national player

SECA's goal is to efficiently generate electrical power using solid oxide fuel cells with near-zero emissions. In pursuit of this goal, it supports several national programs that address resolving climate change, generating clean power from coal, improving energy security and advancing the use of hydrogen as an energy source.

SECA also supports various Department of Defense and National Aeronautics and Space Administration programs that aim to maintain national security.

SECA's contributions to national energy programs will have a wide-ranging impact on the nation's economy and its ability to be energy self-sufficient. In economic terms alone, DOE projects that SECA technology will save the nation more than $50 billion by 2025 through increased efficiency and lower fuel costs. SECA technology is critical to three U.S. government programs:

FutureGen

This program will create the power plant of the future, a near-zero emissions facility that produces electricity and supplies hydrogen to help meet the nation's energy needs. SECA will play a pivotal role in achieving FutureGen's success by creating the highly efficient and fuel-flexible fuel cell modules used in these advanced plants. FutureGen is a cooperative program between the federal government and industry.

21st Century Truck Program

The focus of this program is developing and implementing cost-effective fuel cells for heavy-duty vehicles that will help significantly improve fuel efficiency, reduce emissions, enhance safety and performance, and lower operating costs. The SECA fuel cell, with its high efficiency, fuel flexibility and ability to operate over a range of temperatures, will produce electricity for the truck's auxiliary and essential power systems, significantly increasing overall efficiency and reducing emissions caused by idling engines.

Remote-Based Power

The Department of Defense is now developing a prototype, based on SECA fuel cell technology, that could provide power to remote military bases. In addition to providing electricity, solid oxide fuel cells could provide heat, and because SOFCs produce water as a byproduct, they also may provide a clean, inexpensive water supply. Fuel cells are efficient energy producers that can use logistic fuels, are quieter than generators and hold up in harsh environments—all benefits for military applications.

For the Benefit of U.S. Citizens

SECA's mission is to develop technologies that will provide affordable and clean energy. To keep costs down, the SECA program is working on a modular fuel cell design that can be customized for specific applications and then mass-produced for uses as diverse as stationary power, commercial and residential power and auxiliary power for military applications. Developing a base technology that has broad applications intelligently leverages DOE and taxpayer investments.

Stepping into the Future

As technology development matures, SECA industry teams are moving forward with engineering and design for the fuel cell system and demonstrating its ability to meet longevity and performance objectives. In the next stage, SECA will focus on increasing reliability and longevity, reducing costs and testing prototypes.

As SECA transitions from the technology maturation stage to the systems engineering, development and testing stages, cost-sharing will shift. The U.S. government has funded the majority of the technology development stage, but as the technology is readied for commercialization and potential profits, industry will increase its funding support of SECA to better reflect this shift in focus.

On Target

SOFCs are highly efficient and generate electricity from a variety of fuels on demand and on location. They will reduce harmful emissions and provide clean and efficient power with the carbon fuels of today and the hydrogen of tomorrow.

SECA has completed the first phase in its goal of developing affordable SOFC technology for broad-based applications. As the program moves forward from technology development to systems engineering and assembly, SECA will continue refining its technology base for modular fuel cell design to make it more easily customized for diverse applications, more affordable and more reliable.

transitioning

into the marketplace

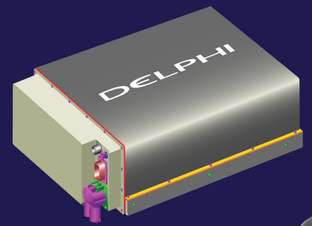
Bringing low-cost solid oxide fuel cells to the marketplace is the ultimate goal of the Solid State Energy Conversion Alliance. SOFCs will reduce our nation's dependence on imported oil and mitigate environmental concerns associated with burning fossil fuels to generate electricity by providing clean, efficient power using both hydrogen and fossil fuels. SECA is accelerating the development of advanced technologies that will make SOFCs for diverse applications a reality.

SECA is a collaborative alliance between U.S. industry, universities and other research organizations. It is led by two U.S. Department of Energy national laboratories—the National Energy Technology Laboratory (NETL) and the Pacific Northwest National Laboratory (PNNL) and funded through the DOE Office of Fossil Energy.

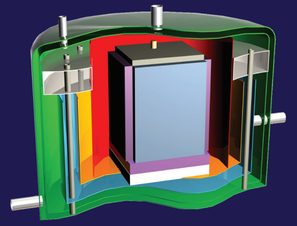
fuel cells

Acumentrics

Cummins • SOFCo

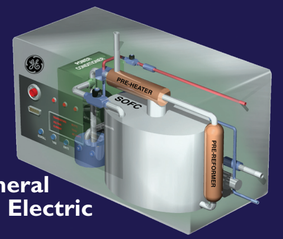


Delphi • Battelle



FuelCell Energy

Siemens Westinghouse



General Electric

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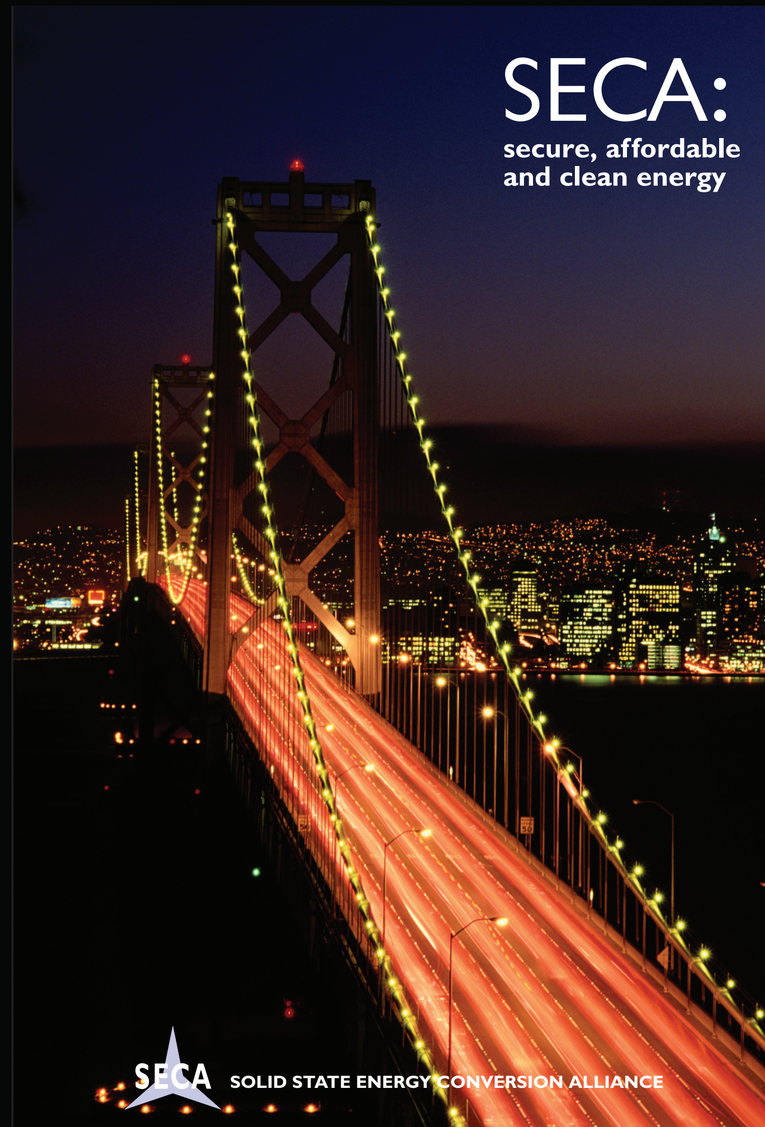
Operated by Battelle for the U.S. Department of Energy

U.S. Department of Energy
National Energy Technology Laboratory • Pacific Northwest National Laboratory



SECA:

secure, affordable and clean energy

SECA **SOLID STATE ENERGY CONVERSION ALLIANCE**