The Solid State Energy Conversion Alliance

2nd Annual SECA Workshop
March 29th & 30th, 2001

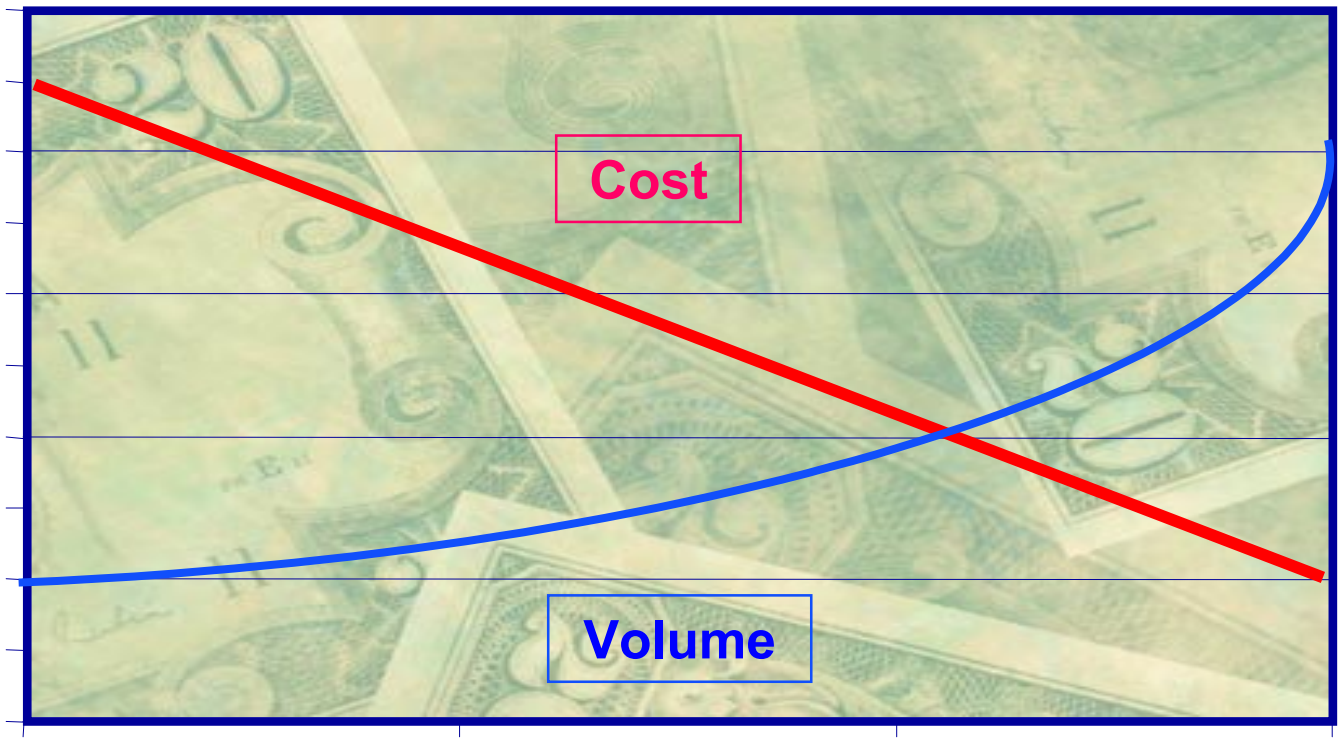
Joseph P. Strakey

National Energy Technology Laboratory

Public Benefits

- Negligible emissions of SO_2, NOx, particulates, VOC using fossil fuels
- Double the efficiency of producing power from fossil fuels
  - Reduced CO_2 emissions
  - Reduced dependence on imported fuels
- Reliability of power supply
- Multiple fuel capability

The Vision: *Fuel Cells in 2010*



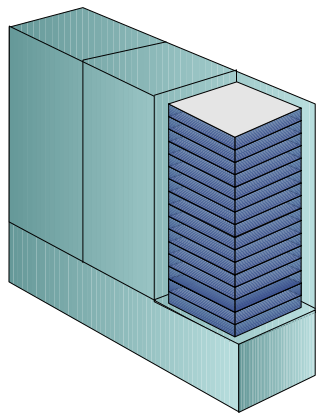
Low Cost/High Volume
$400/kW/ > 50,000 units/yr

A High Power Density, Low Cost Core Module for Multiple Applications

SECA

Stationary

Transportation



Core Module

Key to Cost Reduction:
Mass Customization of Common Modules

Military

NETL

SECA Development: Progressive Applications

2005

- $800/kW
- Prototype ($-Unit)
  3 - 10 kW

2010

- $400/kW
- Commercial

2015

- Vision 21 Power Plants
  70-80% efficient plants
- Propulsion <$200?/kW

Program Structure

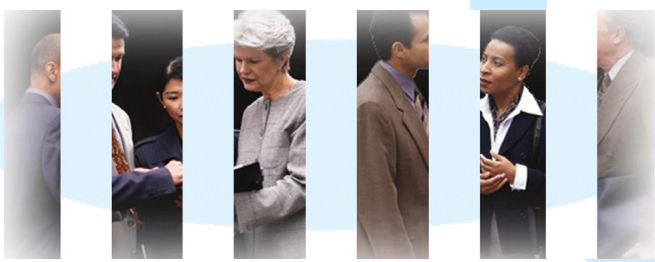
Industry Input

Program Management

Project Management

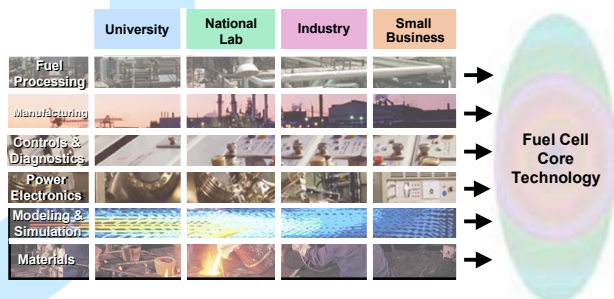
Needs

Research Topics



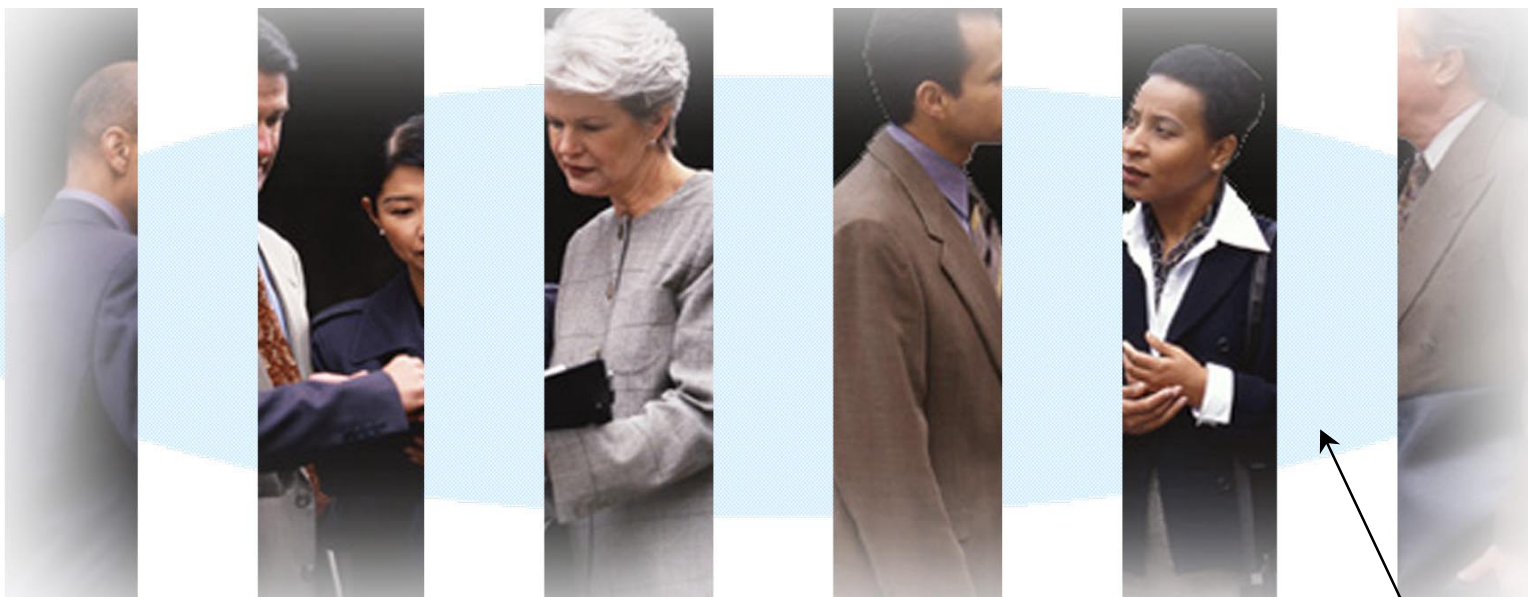
Industry Integration Teams

Technology Transfer



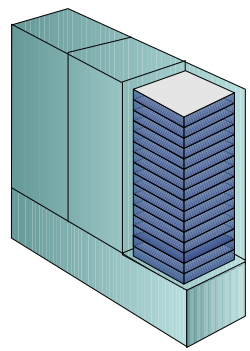
Core Technology Program

Industry Integration Teams
The Manufacturing Base



Industry Integration Teams

- Three to six competitively selected DOE/DOD teams
- Prototype within four years of award.
- 20% cost share in Phase I 50% in Phase II and III.



Industrial Team Solicitation Components

Technical Approach

Statement of Work, Milestones, and Test Plan

Cost Estimate

Capabilities, Facilities, Team Structure and Personnel

Market Evaluation and Applicants Existing Experience

Industrial Team Minimum Requirements

PHASE III

Power Rating Net	3-10 kW
Cost	$400 / kW
Efficiency (AC or DC/LHV)	30 - 50% [APU] 40 - 60% [Stationary]
Testing (Steady State) :	>1500 hours - 95% availability - Power ≤0.1% degradation/500 hours at a constant stack voltage
(Transient):	>100 cycles defined by application - Power ≤ 1% degradation after 100 cycles at a constant stack voltage

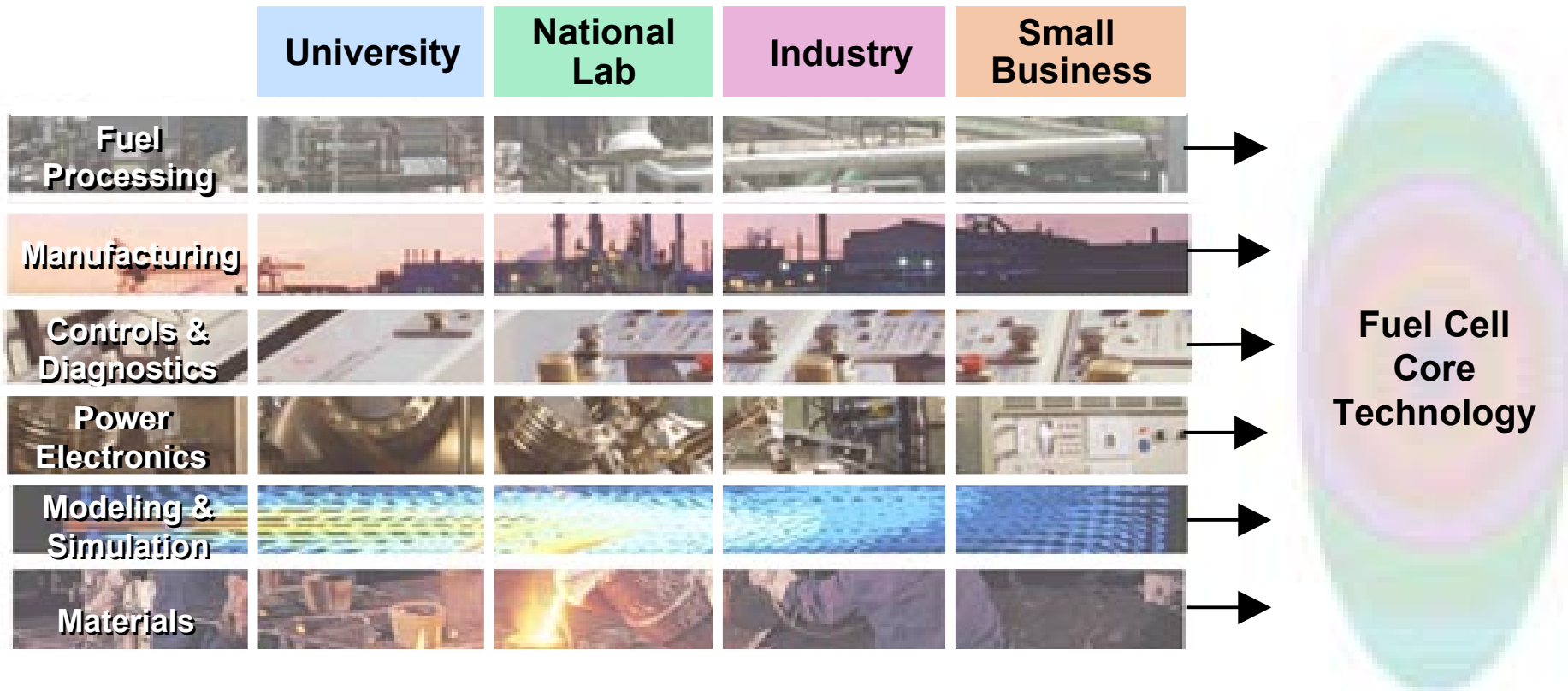
Industrial Team Minimum Requirements

PHASE III

Design Lifetime	**5,000 Hours [APU]** **40,000 Hours [Stationary]**
Maintenance Interval	**> 1,000 Hours**
Fuels (Current infrastructure)	**Natural Gas** **Gasoline** **Diesel**

Core Technology Program

The Technology Base



Core Technology Program (CTP)

Raising the Technology Baseline.

- CTP developments can benefit all SECA Industrial Teams
- A mix of short (1-2 year) projects that address the needs of multiple Industrial Teams and a few longer term projects that add significant value to all projects.
- Biannual meeting of CTP participants, Industrial Teams, Project Management Team
- Limited Lab Call in FY01
- Solicitation in FY01 for universities and small businesses

Intellectual Property

Cornerstone of the Alliance

- **Non-Exclusive License** **CTP ➡ Industry Teams**
  - **Ready market of potential licensees**
  - **Best designs vs. highest bidder**
- **Promotes Collaboration - Limits Redundancy**

Exceptional Circumstance Provisions

- Each Industrial Team will be offered a non-exclusive license for the IP generated by the Core Technology Program in the SOFC field of use
- Offers must be open for 1 year after issue of a U.S. patent
- Pilot program; reevaluate after 2 years

SECA Players/Efforts

Universities, National Labs, Industry

McDERMOTT

NEXTECH MATERIALS

Honeywell

ARGONNE NATIONAL LABORATORY

Pacific Northwest National Laboratory

THE UNIVERSITY OF UTAH

NETL

SIEMENS Westinghouse

Arthur D Little

OAK RIDGE NATIONAL LABORATORY

UNIVERSITY OF FLORIDA

BERKELEY LAB

TMI SYSTEMS

UNIVERSITY of MISSOURI-ROLLA

NORTHWESTERN UNIVERSITY

DELPHI

Automotive Systems

Active SECA Projects

- Multi-layered, co-fired, planar, SOFC stack
- Manufacturing technology utilizes high-volume production methods currently employed in the manufacture of multi-layer ceramic packages

Honeywell

- Manufacturing process based on tape calendering for multi-layer planar SOFC using a new Honeywell design concept
- Demonstrate cell performance

Active SECA Projects

Pacific Northwest National Laboratory

- SOFC component development
- SOFC modeling & experimental support
- Prototype small stack testing of developed components and concepts
- Supporting Delphi through CRDA

ARGONNE NATIONAL LABORATORY

- Development of low-temperature cathode materials
- Sulfur - tolerant anode materials
- Metallic bi-polar plates and stack
- Systems modeling

Active SECA Projects

THE UNIVERSITY OF UTAH

- Theoretical studies and materials work on cathode microstructures while maintaining high-power density performance with standard solid oxide fuel cell materials at reduced temperatures

NORTHWESTERN UNIVERSITY

- Revisit the segmented-in-series SOFC design using modern multi-layer manufacturing techniques

Active SECA Projects

OAK RIDGE NATIONAL LABORATORY

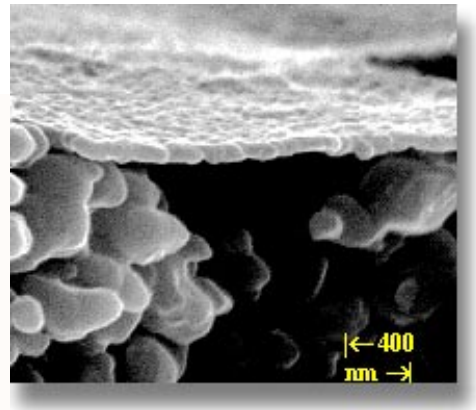
- Anode supported thin film fuel cell development
- Tape casting, screen printing

NETL

- Fuel cell reformer R&D
- Fuel cell modeling and simulation
- Testing of all fuel cell types
- Dynamic hybrid system studies
- Sensors

Active SECA Projects

- Identify, characterize, test new electrolyte materials that have ionic conductivity suitable for use in the 550 - 800ºC range, and are chemically stable at SOFC operating conditions



UNIVERSITY OF FLORIDA

- Develop a stable bi-layer electrolyte for low-T SOFC's
- Develop a detailed kinetic/ thermodynamic/transport model for use in evaluating bi-layer electrolytes and for SOFC cell evaluation

Active SECA Projects

SIEMENS Westinghouse

- Evaluate and test the suitability of electrolyte materials for low temperature SOFC operation in combination with cathode materials

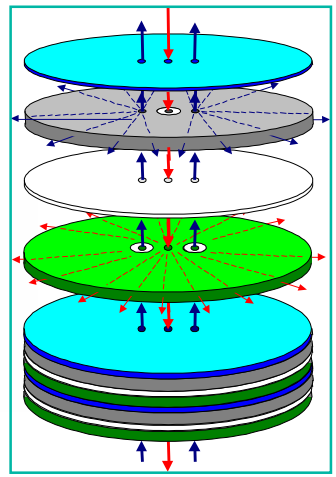
NEXTECH MATERIALS

- Research co-sintered electrode supported planar fuel cells, spin coated ultra-thin electrolytes, and co-extrusion of monolithic shapes

Active SECA Projects

TMI SYSTEMS

- Implement a screen-print manufacturing technique for production of complete cells at lower cost



DELPHI

Automotive Systems

- New project selected in FY 2000 (In negotiation)
- PNNL providing technology support through CRDA

SECA Timeline

• 1st Annual SECA Workshop	June 1-2, 2000
• Industry Team Solicitation Issued	November 3, 2000
• Proposals Due	January 24, 2001
	January 4, 2002
	January 3, 2003
• SECA Core Technology Program Workshop	February 14 & 15, 2000
• 2nd Annual SECA Workshop	March 29-30,2001
• 2001 Industrial Teams Selected	*May 2001*
• Core Technology Program Solicitation Issued	*May 2001*
• Core Technology Program Review Meeting	*November 2001*

SECA FY01 Funding (millions)

- **FY 2001 Funding - $18.9**
- **Industrial Funding - $ 11.8**
  - FY 2001 Industrial Team Funding - $7.4
  - Multi-Layer Ceramic - $3.7
  - Systems - $0.5
  - Materials - $0.24
- **Core Technology Program - $ 6.7**
  - National Laboratories - $5.4
  - Universities - $0.57
  - FY 2001 - $ 0.68
- **Studies, Workshops, and Support - $0.43**

DOD Interests/Activities

- Core Technology
  - Accelerate development
  - Logistic fuels
- Militarization
  - Survivability, shock & vibration, etc.
- Integration
  - Balance of plant packaging
- Testing
  - Laboratory to field environment

Some SECA-Related Solicitations

- ✓ California Energy Commission PIER Solicitation
- ✓ DOE Office of Transportation Technology CARAT Solicitation
- ✓ NIST Advanced Technology Program
- ✓ EC FRAMEWORK V and VI
- ✓ DOD DARPA Palm Power

EU - US Cooperation

- Transatlantic network supporting research and stimulating co-operation on fuel cells for transportation and stationary applications, including several SECA-related areas:
  - Auxiliary power units
  - Codes and standards,
  - SOFC and high temperature fuel cell hybrid systems
  - Assessment of availability of critical materials for high temperature fuel cells

Responding to the Needs of the Nation

President Bush and I are deeply committed to developing an energy policy that includes . . . developing new technologies that conserve fossil fuels and reduce energy-related pollution.

Spencer Abraham, Secretary of Energy