

# *Overview of U.S. DOE EERE Fuel Cell Program*



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Argonne National Laboratory

FACA Meeting  
Oct. 16  
Detroit, MI



# ***Presentation Outline***

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- ***New EERE Organization: The Hydrogen, Fuel Cells, and Infrastructure Program***
- ***FreedomCAR***
- ***Fuel Cell and Hydrogen R&D Activities***
- ***Hydrogen Vision/Roadmap***
- ***Fuel Cell Report to Congress***



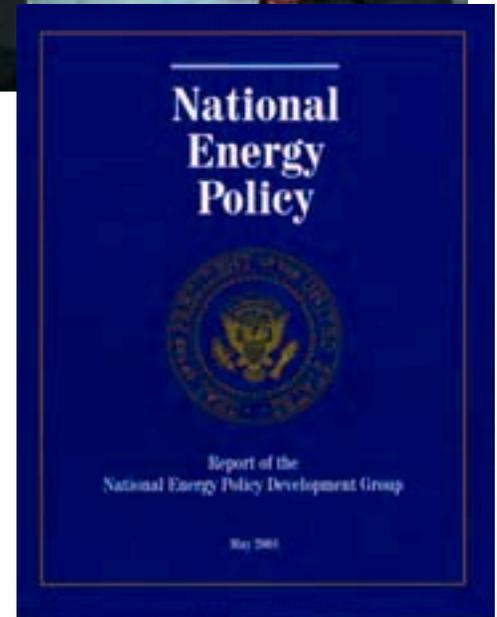
# *Hydrogen and Fuel Cells are a High Priority within EERE*

## National Energy Policy:

**Directs the Secretary Of Energy “to develop next generation technology including hydrogen...**

**“Focus research and development efforts on integrating current programs regarding hydrogen, fuel cells, and distribution...**

*“The President’s Plan directs us to explore the possibility  
of a hydrogen economy....”  
Spencer Abraham, Secretary of Energy*





# ***Hydrogen and Fuel Cells Program R&D Priorities***

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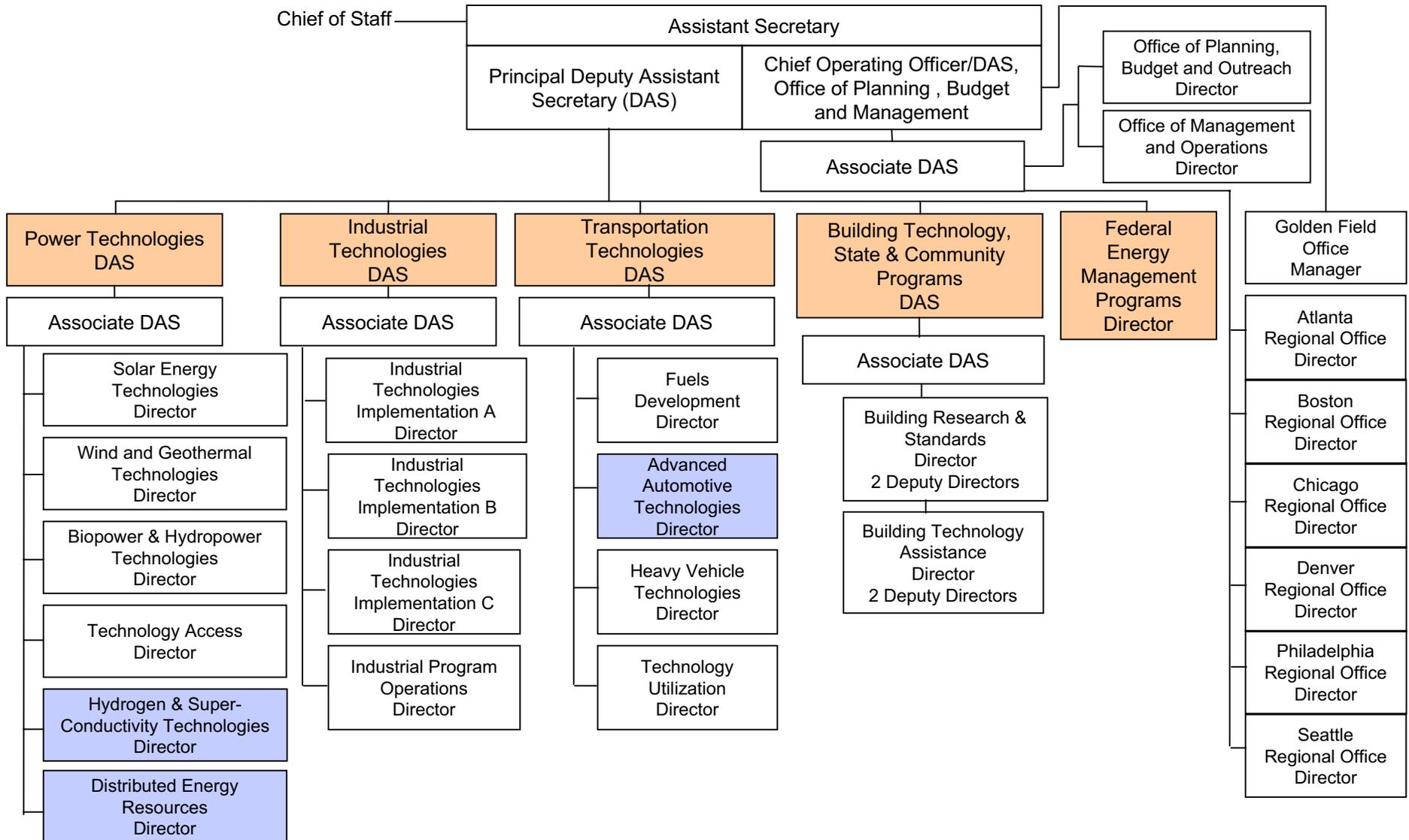
- ***Hydrogen Storage***
- ***Hydrogen Production***
- ***Fuel Cell Cost Reduction***

*Safety & Codes/Standards, Education, and  
Vehicle/Infrastructure Testing and Validation will  
be areas which receive much greater attention*



# EERE Reorganization

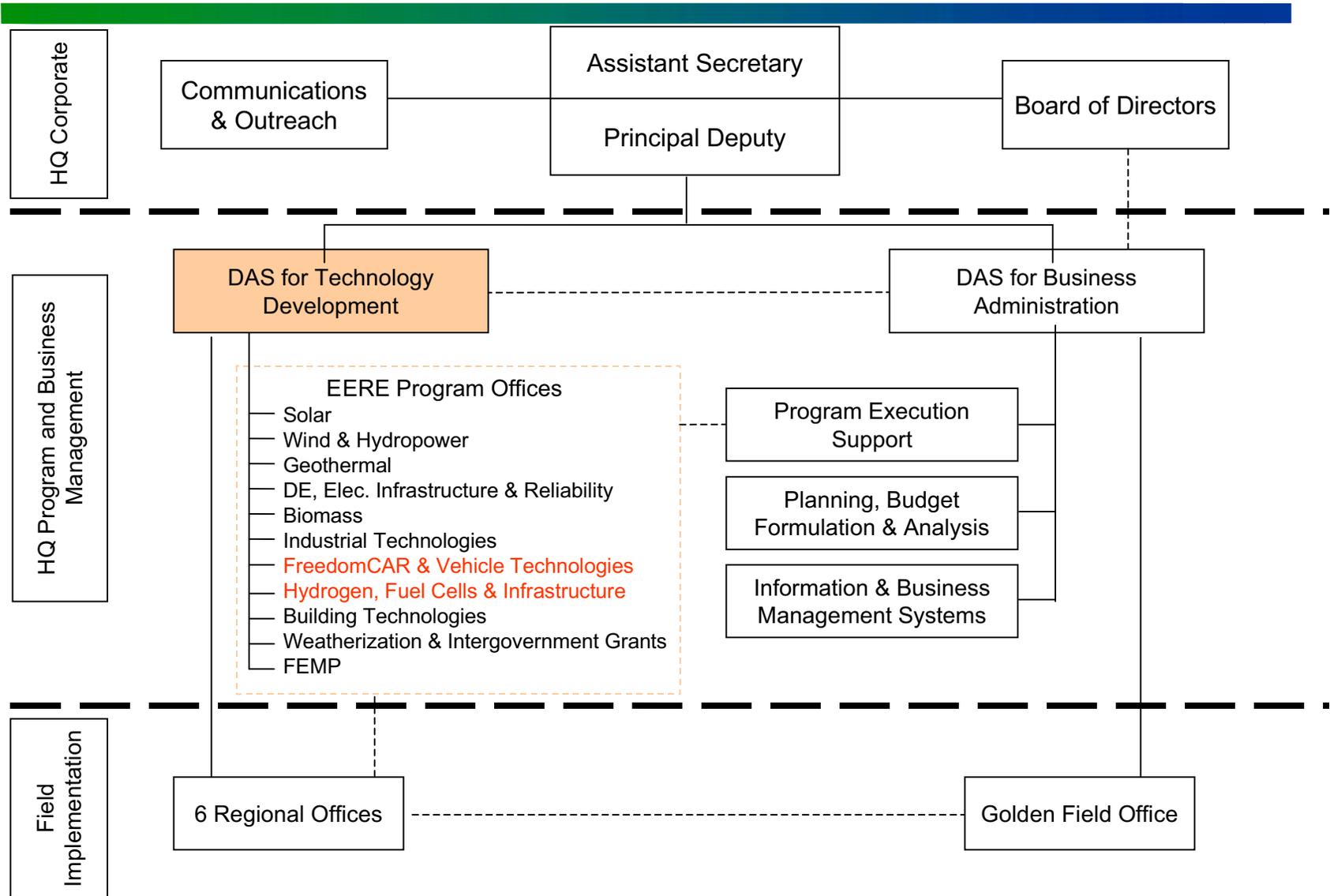
## The Previous "Market Sector" Model





# EERE Reorganization

## A New Integrated and Focused Model



# Hydrogen, Fuel Cells and Infrastructure Technologies Program

**Steve Chalk, Program Manager**  
**Tia Alexander, Administrative Support**

*Technology Validation Manager* - **Sigmund Gronich**  
*Education and Outreach* - \***Christy Cooper**  
*Safety and Codes/Standards* - **Neil Rossmeissl**

## ***Hydrogen Production***

**Chris Bordeaux**  
**Roxanne Danz**  
**Peter Devlin**  
**Matt Kauffman**  
**\*Arlene Anderson**  
**\*Mark Paster**

## ***Hydrogen Storage***

**Lucito Cataquiz**  
**JoAnn Milliken**  
***1-2 Potential***  
***Vacancies***

## ***Fuel Cells***

**Patrick Davis**  
**Donna Ho**  
**\*Valri Lightner**  
**\*John Garbak**  
**\*Kathi Epping**  
**\*Nancy Garland**

\*Detail or other Federal employees

Draft 9-18-02



# White House Vehicle Technology Event

February 25, 2002



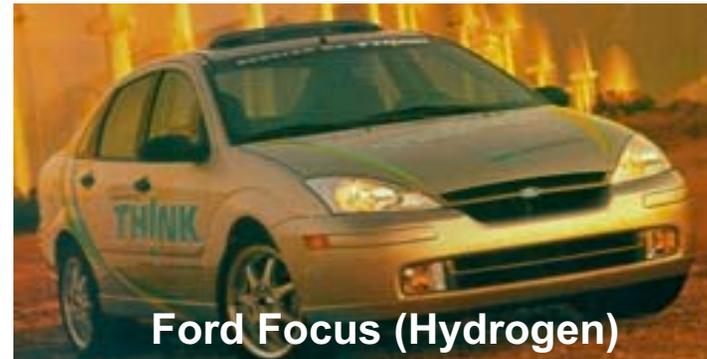
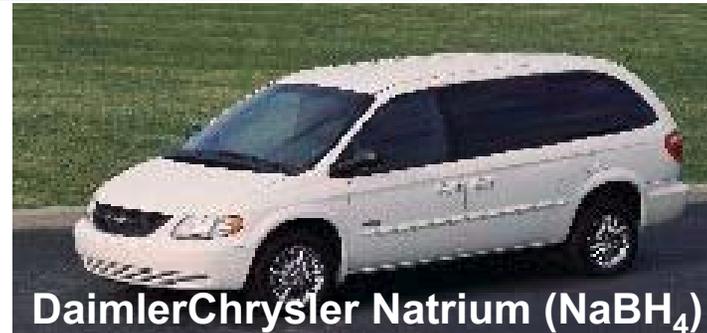
“We happen to believe that fuel cells ... offer incredible opportunity. Now, there's a lot of obstacles that must be overcome in order to make fuel cells economically viable. And, therefore, we're promoting more research and development. In January, Secretary Abraham announced a \$150 million FreedomCAR plan, focused on development of fuel cell technologies that run on hydrogen, whose only emission is water vapor.”

*President Bush*



# *Fuel Cells for Transportation*

Our goal is to develop highly efficient, low- or zero-emission cost-competitive automotive fuel cell power system technologies that operate on conventional and alternative fuels





# *The FreedomCAR Partnership*



**January 9, 2002  
Secretary Abraham  
Announces the  
FreedomCAR Partnership**

**The CAR in FreedomCAR is **C**ooperative  
**A**utomotive **R**esearch**

**The Partners are:**

- U.S. Department of Energy**
- U.S. Council for Automotive Research**



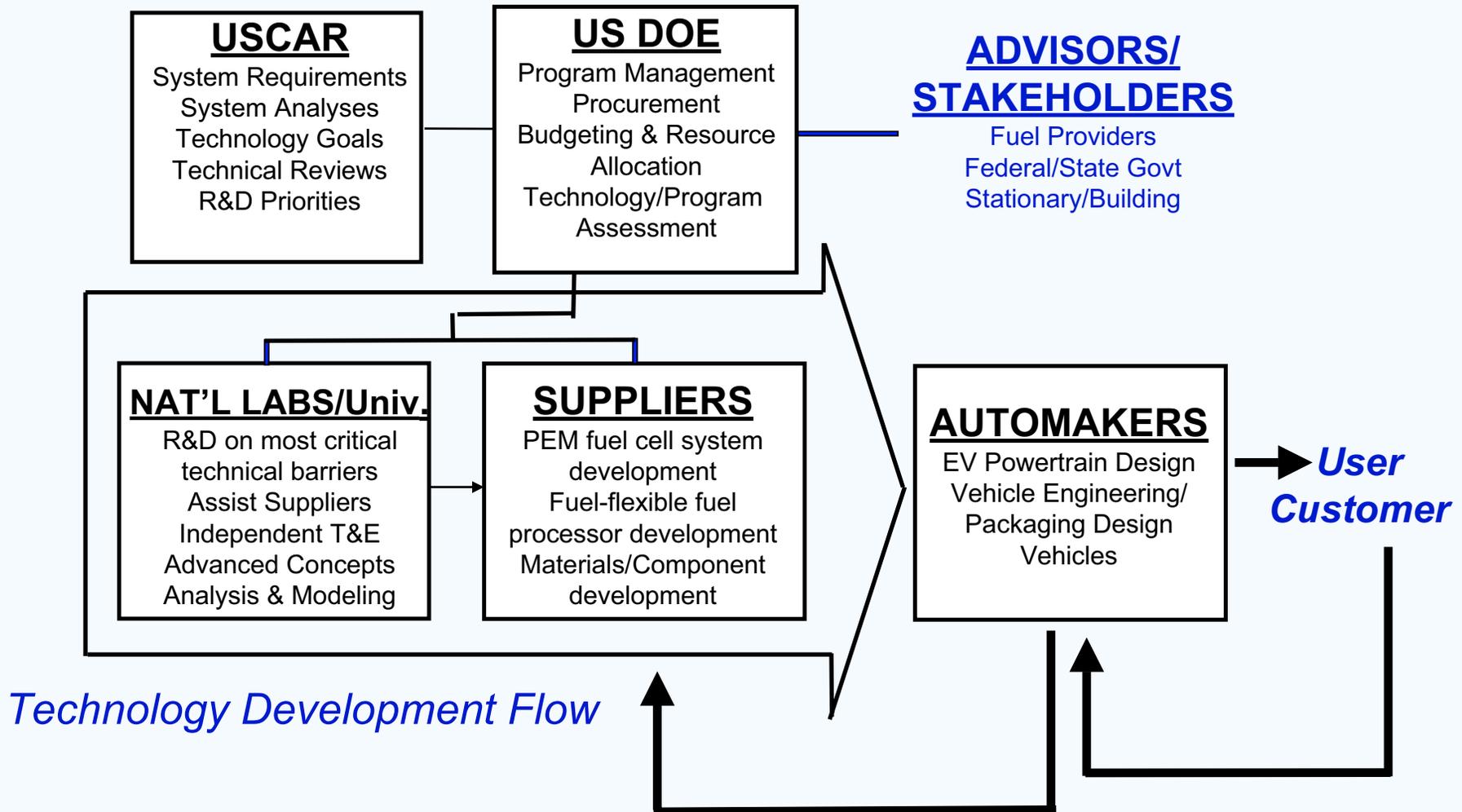
## ***FreedomCAR Strategic Approach***

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- **Develop technologies to enable mass production of affordable hydrogen-powered fuel cell vehicles and assure the hydrogen infrastructure to support them.**
- **Continue support for hybrid technologies and advanced materials that can dramatically reduce oil consumption and environmental impacts in the nearer term.**
- **Develop technologies applicable across a wide range of passenger vehicles.**



# Program Implementation (FreedomCAR Partnership)





# ***Fuel Cells and Hydrogen – The Critical Challenges***



## **Fuel Cells:**

- Cost
- Durability
- Fuel Processing
- Air/Thermal/Water Management
- Codes & Standards



## **Hydrogen:**

- Storage
- Fuel Infrastructure
- Hydrogen Fuel Cost
- Codes & Standards





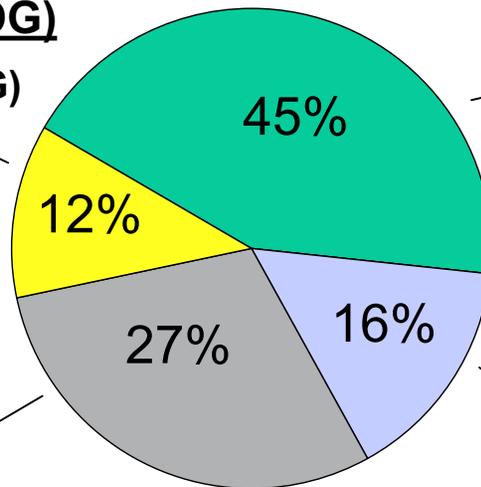
# ***FY02 EERE Fuel Cell Activities***

(Activities Focus on Removing High Risk Technical Barriers)

**FY 2002 Budget = \$47.425M**

## **Distributed Generation (DG)**

- Reforming Technology (NG)
- Critical Components
- Systems Development
- Codes and Standards



## **Transportation Fuel Processing/Storage Subsystem**

- On-Board Fuel Processor R&D  
- gasoline, diesel, methanol
- Hydrogen On-board Storage

## **Transportation Fuel Cell Stack Subsystem**

- Catalyst Loading Reduction
- MEA/Bipolar Plate Manufacturing
- Durability Studies

## **Transportation System**

- Modeling/Validation
- Cost Analyses
- Ancillary Components  
(Compressors, Sensors)

***R&D is carried out by industry suppliers, national labs and universities.***



# ***Fossil Energy Fuel Cell Budget 2002***

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- SECA - \$27.1 MM
- Vision 21 Hybrids - \$13.5 MM
- Fuel Cell Systems - \$13.5 MM
- Advanced Research - \$4.0 MM
- DOD Climate Change - \$3.5 MM

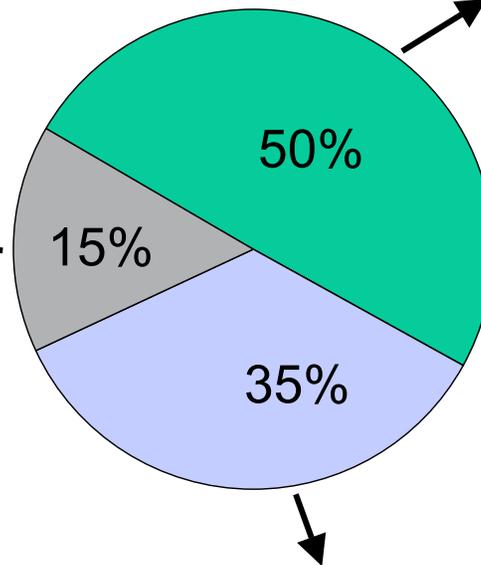


# FY 2002 EERE Hydrogen Activities

FY 2002 Budget = \$29.2M

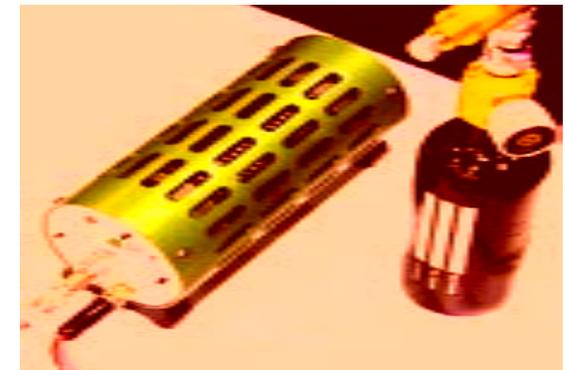
## Analysis and Outreach

- Codes and Standards
- Educational Training
- Tank Standards



## Core R&D

- Storage technology
- Hydrogen generation



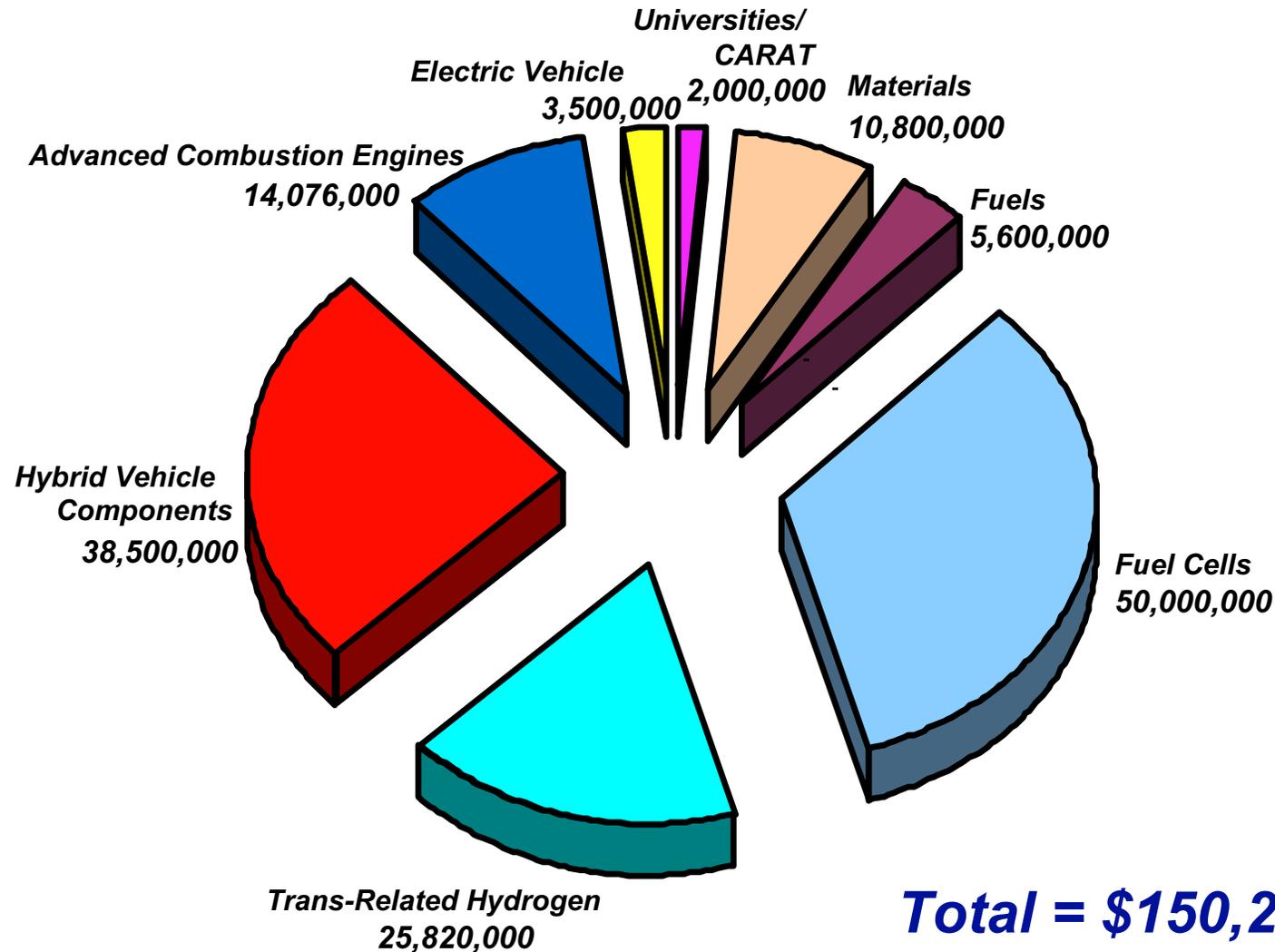
## Technology Validation

- Hydrogen refueling station demonstration
- Development of Power Parks concept



# FreedomCAR FY 2003 Budget

(Request Reflects Fuel Cell and Hydrogen Priorities)





# *EERE Fuel Cell and Hydrogen Funding (\$K)*

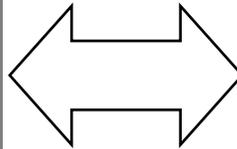
<b>Interior Appropriations</b>					
TRANSPORTATION FUEL CELL R&D	FY 2001	FY 2002	FY 2003 Req.	Increase	
Systems (8)	7,405	7,600	7,600	0	(0%)
Components (28)	12,052	12,825	14,900	2,075	(+16%)
Fuel Processing & Storage (26)	20,806	21,300	24,100	2,800	(+13%)
Field Evaluations	0	0	3,000	3,000	(New)
Technical Support Services (5)	400	200	400	200	(+100%)
<b>TOTAL</b>	<b>40,663</b>	<b>41,925</b>	<b>50,000</b>	<b>8,075</b>	<b>(+19%)</b>
DISTRIBUTED GENERATION TECH.					
<b>TOTAL, Stationary Fuel Cells</b>	<b>5,440</b>	<b>5,500</b>	<b>7,500</b>	<b>2,000</b>	<b>(+36%)</b>
<b>Energy &amp; Water Appropriations</b>					
HYDROGEN RESEARCH					
Core Research and Development	14,438	14,426	19,331	4,905	(+34%)
Technology Validation	9,009	10,320	15,000	4,680	(+45%)
Analysis and Outreach	3,147	4,437	5,550	1,113	(+25%)
<b>TOTAL</b>	<b>26,594</b>	<b>29,183</b>	<b>39,881</b>	<b>10,698</b>	<b>(+37%)</b>

(#) = ~No. of Projects in FY 2002



# ***DOE Fuel Cell Related Programs***

**Office of  
Energy Efficiency  
and Renewable Energy  
(EERE)**



**Office of  
Fossil Energy  
(FE)**

## ***Emphasis on low temperature fuel cells***

- Transportation Applications
- Distributed Generation (Building Applications)
- Hydrogen Technologies

## ***Emphasis on high temperature fuel cells***

- Large Stationary Applications
- Distributed Generation (Grid)



# ***FY 2003 Planned Programmatic Highlights***

## Transportation:

**Continuation of R&D through 30 new cost-shared industry contracts and national laboratories to address key barriers**

**Field Evaluations - Initiate activity to perform field evaluations of fuel cell vehicles in fleets**

## Distributed Generation:

**Major Procurement to be released in late FY02, awards mid-FY03**

**Program will continue to focus on critical component and systems development**

## Hydrogen Program:

**Increased efforts in hydrogen storage and infrastructure in support of the FreedomCAR program**

**Support for Power Parks and Uninterruptible Power Sources**

## '04 Transportation:

**Fuel processing Go/No Go decision**



## ***Financial Assistance Solicitation for R&D for Fuel Cells***

- Covers both Stationary & Transportation Applications
- Federal Register / Vol. 67, No. 184 / Monday 09/23/02
- Solicitation will be available ~mid-October at:  
<http://e-center.doe.gov>
- Applicants must register in DOE's "IIPS" prior to submitting an application
- Applications will be due no later than November 27, 2002 (or ~60 days after solicitation posted)



## ***Financial Assistance Solicitation for R&D for Fuel Cells***

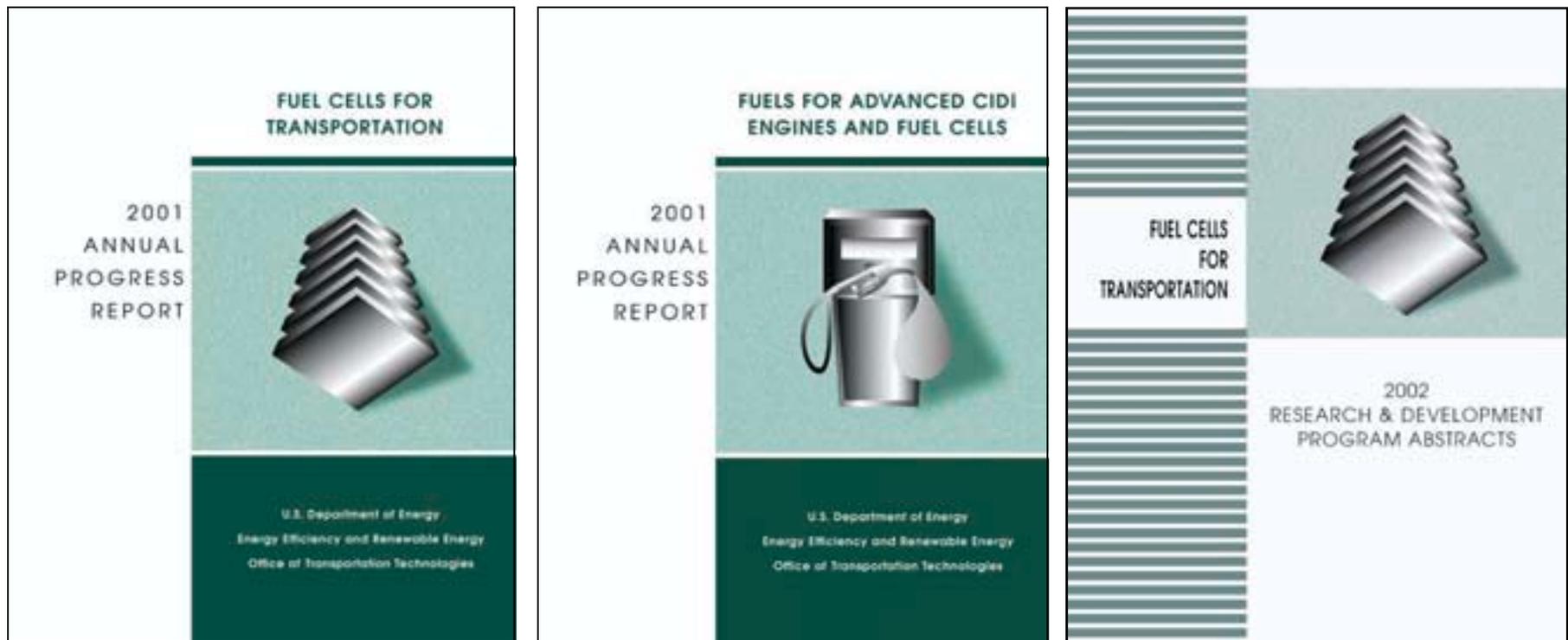
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- Topic areas include, but are not be limited to:
  - development of a stationary PEM fuel cell system for buildings
  - development of a back-up fuel cell system
  - PEM stack durability
  - high-temperature membrane
  - fuel processing
  - fuel cell demonstration
  - platinum recycling
  - development of non-precious metal catalysts
  - fuel cell economic analysis



# ***2001 Annual Progress Reports & Program Abstracts***

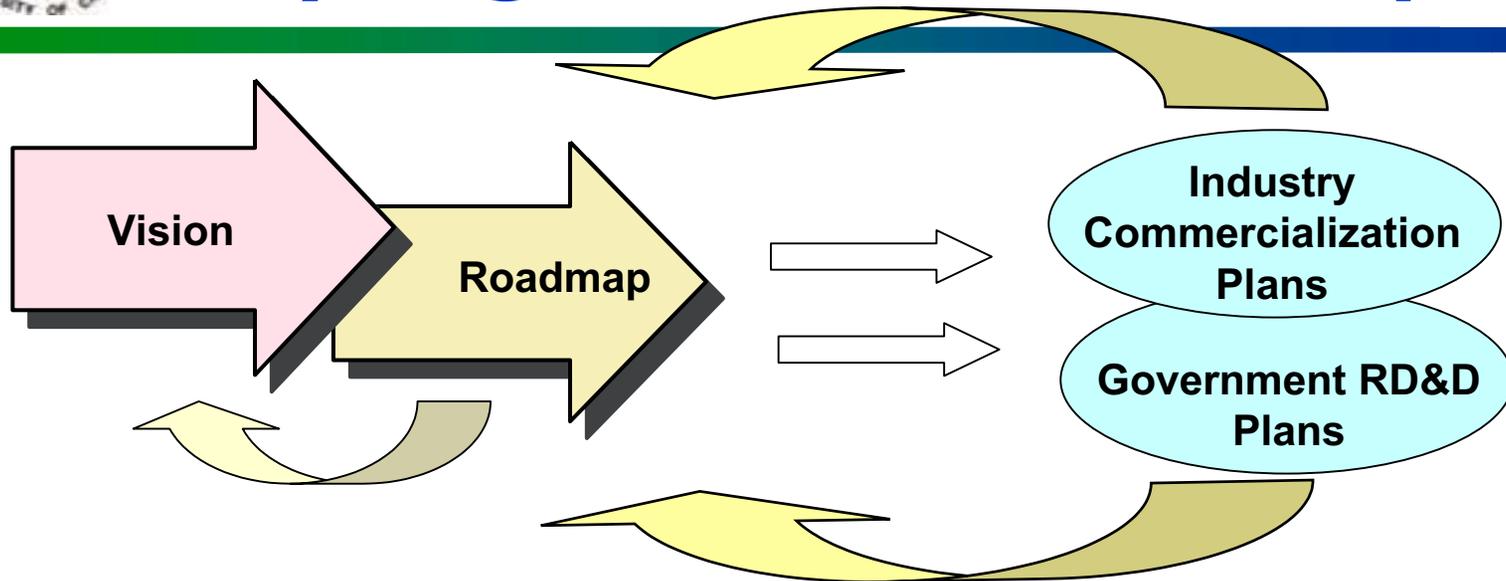
Available at [www.cartech.doe.gov](http://www.carttech.doe.gov)



The 2002 Lab Review Presentations of both the Hydrogen Program and the Transportation Fuel Cell Program: [www.eren.doe.gov/hydrogen](http://www.eren.doe.gov/hydrogen)



# Complementary DOE Activity: Hydrogen Vision & Roadmap



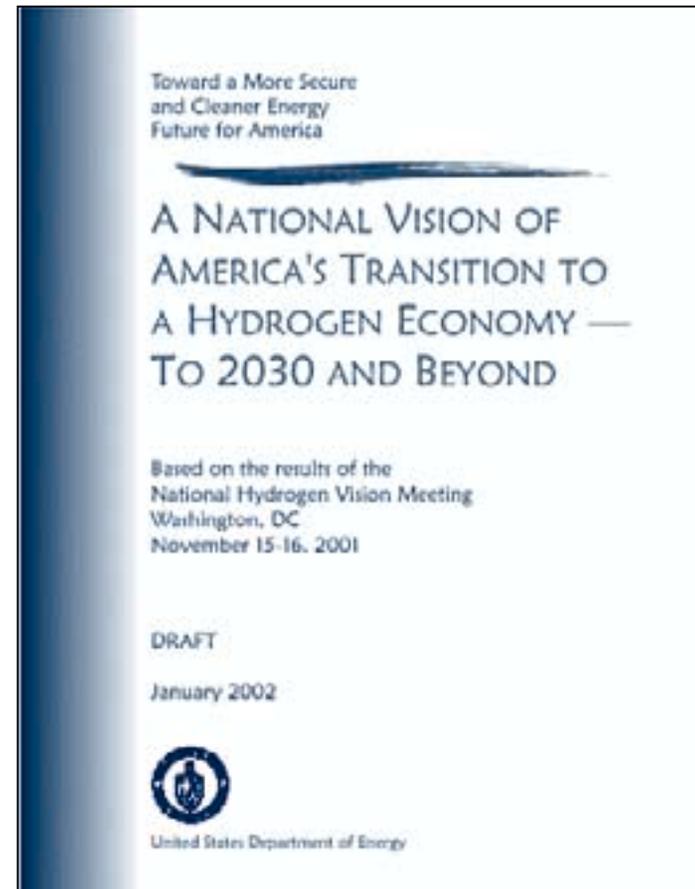
H <sub>2</sub> Vision Meeting	▲▲	November 2001
Roadmap Strategy	▲▲	December 2001
Circulate Draft H <sub>2</sub> Vision for Review	▲▲	January 2002
Publish Final H <sub>2</sub> Vision	▲▲	February 2002
H <sub>2</sub> Roadmap Meeting	▲▲	April 2002
Circulate Draft H <sub>2</sub> Roadmap for Review		May 2002
Publish National H <sub>2</sub> Roadmap		June 2002



# ***Vision for the Hydrogen Economy***

**“Hydrogen is America’s clean energy choice.**

**Hydrogen is flexible, affordable, safe, domestically produced, used in all sectors of the economy, and in all regions of the country.”**



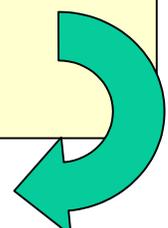
Available at: [www.eren.doe.gov/hydrogen/](http://www.eren.doe.gov/hydrogen/)



# ***Fuel Cell Report to Congress*** ***(FY 2002 Interior Appropriations Bill)***

***Full Report:*** “Report... within twelve months... on the technical and economic barriers to the use of fuel cells...recommendations on program adjustments...needed for the commercial use of fuel cells ... by 2012.”

***Interim Report:*** “Within six months...an interim assessment that describes the need for public and private cooperative programs to demonstrate the use of fuel cells.”



## ***PUBLIC/PRIVATE PARTNERSHIPS ARE NEEDED DUE TO THE MAGNITUDE OF THE TECHNOLOGY CHALLENGES:***

- Fundamental R&D hurdles remain, government needs to share risks in realizing the substantial public benefits.
- Test & demonstration of technology is important to validate technology progress and “readiness” for commercialization.
- The government can coordinate transition to a hydrogen infrastructure.
- Government inherently plays an important role in the education and regulatory aspects of fuel cells and hydrogen.



# Potential Vehicle & Infrastructure Partnership Demonstration Timeline

2000

2004

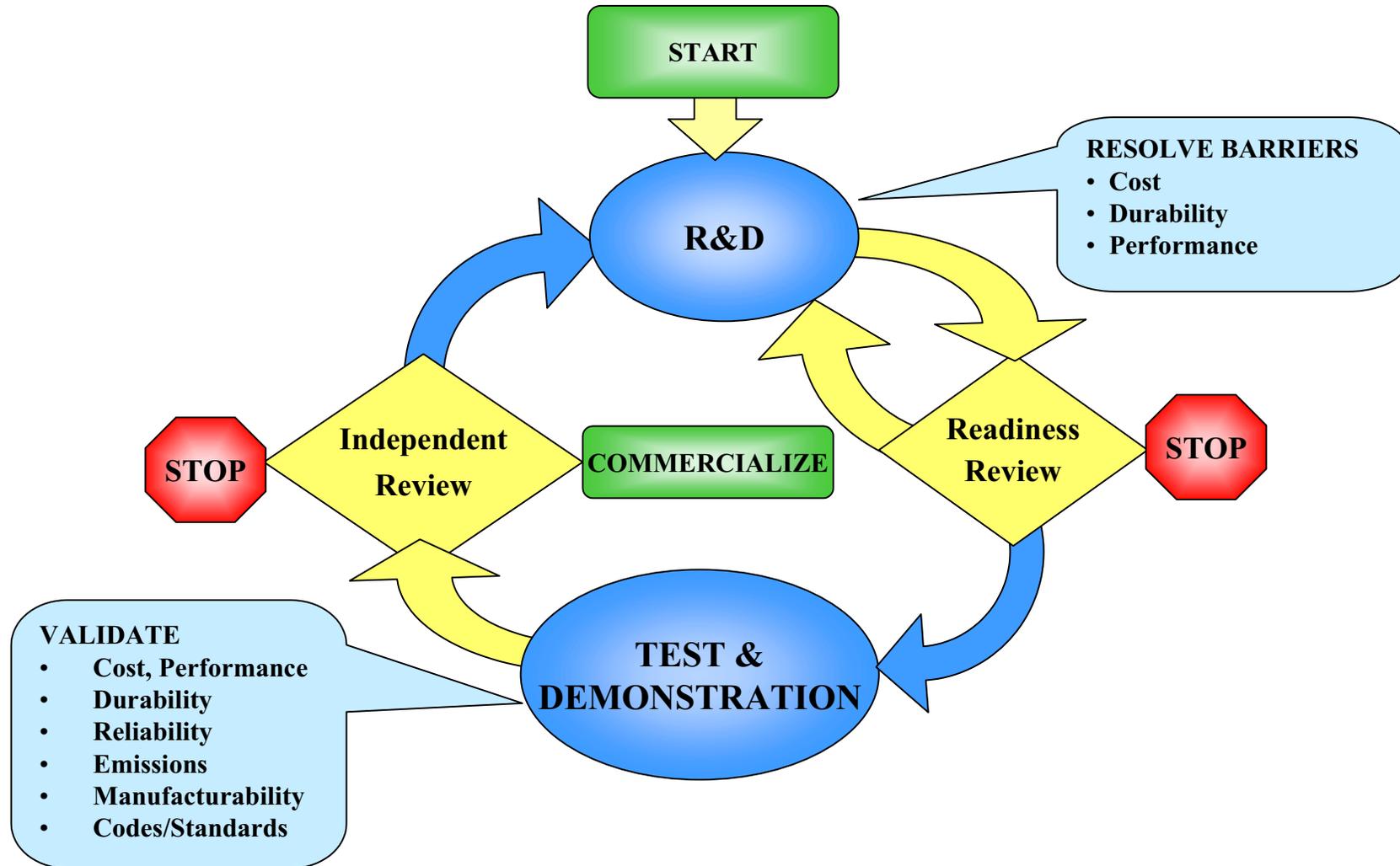
2008

2012

	Phase 1 Technical Feasibility Demonstration	Phase 2 Controlled Fleet Demonstrations	Phase 3 Commercial Readiness Demonstrations	Commercialization Phase
<b>Vehicles Objective</b>	Test FC vehicle performance and feasibility 1(CaFCP)	Demonstrate use of FC vehicles under real-world conditions 1-3 sites (varying climates) ~ 500	Demonstrate commercial viability of FC Fleet vehicles 2-3 states (networked sites) ~ 5000	Investment to establish manufacturing plants and sales/service
Sites				
Number of Vehicles	< 50			
<b>Infrastructure Objective</b>	Demonstrate H <sub>2</sub> fueling station Analyze fuel options Primarily trucked in liquid	Onsite generation from multiple feedstocks  Renewables and fossil fuels	Sufficient stations to provide consumer convenience  Most Cost Effective sources by region	Investment for 25-50% of all stations H <sub>2</sub> capable
Hydrogen Source				
Number of Stations	~3	5-10	20-30	
<b>Go/No Go Decision Points</b>		◇	◇	◇
<b>2001 Laboratory Status</b> Fuel Cell Cost = \$325/kW at high volume (on-board reformer), \$200/kW at high volume (hydrogen system), Durability = 1000 hrs, Hydrogen Cost = \$4.50/gallon gasoline equivalent (untaxed)		<b>Decision Criteria:</b> Phase 1 vehicles achieve 1000 hrs durability, \$200/kW cost (projection based on 500,000 units production). R&D results project 2500 hrs durability, \$125/kW, \$3.00/gallon gasoline equivalent (untaxed), and 145 g/mi greenhouse gases	<b>Decision Criteria:</b> Phase 2 vehicles achieve 2500 hrs durability, \$125/kW cost (projection based on 500,000 units production) and hydrogen at \$3.00/gallon. R&D results project 5000 hrs durability, \$45/kW, \$1.50-\$2.10/gallon gasoline equivalent (untaxed), and 120 g/mi greenhouse gases	<b>Decision Criteria:</b> Based on capability to achieve 5000 hrs durability, \$45/kW cost, \$1.50/gallon gasoline equivalent (untaxed), And 120 g/mi greenhouse gases and other market factors, the decision to enter a commercialization phase will be made by industry.
<b>R&amp;D Continues Concurrently to Address Key Cost and Performance barriers</b>				



# The R&D – Demonstration Cycle

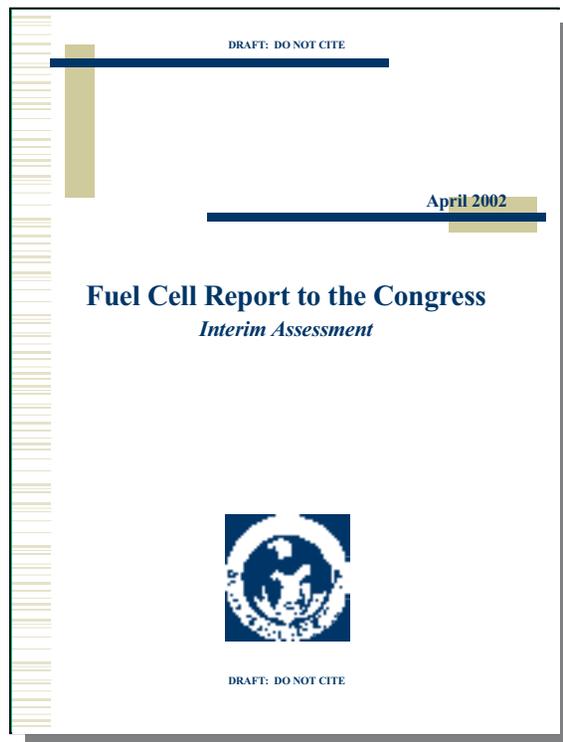




# ***Fuel Cell Report to Congress***

## ***Interim Report Highlights***

Draft *Interim Report* available at:  
[www.sentech.org](http://www.sentech.org)  
under “2002 Fuel Cell Workshop”



- Fuel cell technology offers dramatic reduction in energy use and emissions in transportation and stationary applications.
- Hydrogen opens a clear path to increase use of renewable energy sources.
- Additional R&D is required for fuel cell cost reduction and durability.
- For transportation applications, a new hydrogen infrastructure is required. Hydrogen storage and production are high R&D priorities.
- A cooperative approach is required for addressing regulatory, codes & standards issues.



## ***For Further Information***

### **DOE Hydrogen, Fuel Cells & Infrastructure Program:**

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**Nancy Garland: 202-586-5673, Nancy.Garland@ee.doe.gov**

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### **Argonne National Laboratory Fuel Cells Technical Support:**

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