Leading Our Nation Towards Energy Independence

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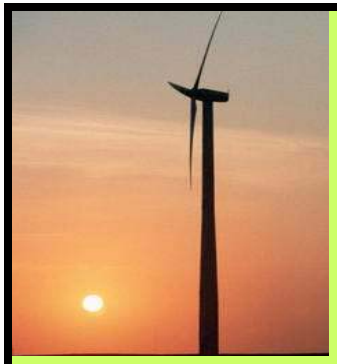
Hydrogen, Fuel Cells and Infrastructure Technologies

Presentation to
Fuel Cell Summit
May 28, 2003
College Park, MD

U.S. Department of Energy
Energy Efficiency and Renewable Energy

Why Hydrogen? It's abundant, clean, efficient, and can be derived from diverse domestic resources.



Biomass

Hydro
Wind
Solar

Nuclear

Oil

Coal

Natural Gas

With Carbon Sequestration

HIGH EFFICIENCY & RELIABILITY

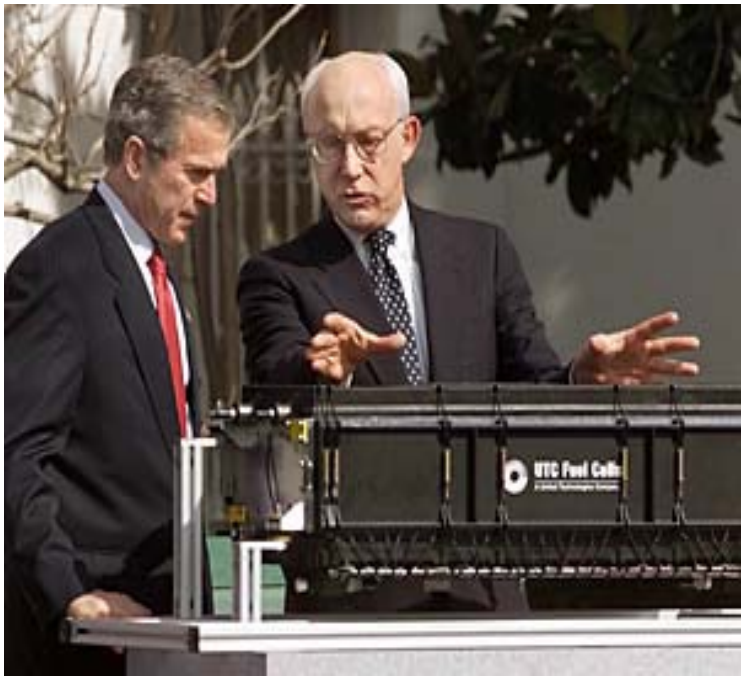
H_2

ZERO/NEAR ZERO EMISSIONS

Transportation

Distributed Generation

President's FreedomCAR and Fuel Initiatives



DOE partners with USCAR and energy companies to develop hydrogen and fuel cell technologies simultaneously:

- FreedomCAR focuses on fuel cell vehicle and hybrid component technologies
- Hydrogen Fuel Initiative focuses on hydrogen storage, production, delivery, codes, standards and safety technologies

Government leadership will help advance commercialization of hydrogen fuel cell vehicles and infrastructure by 15 years, from approximately 2030 to 2015.

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Hydrogen Infrastructure and Fuel Cell Technologies put on an Accelerated Schedule

- **President Bush commits $1.7 billion over first 5 years:**
  - ❖ $1.2 billion for hydrogen and fuel cells RD&D ($720 million in new money)
  - ❖ $0.5 billion for hybrid and vehicle technologies RD&D
- **Accelerated, parallel track enables industry commercialization decision by 2015.**

Fuel Cell Vehicles in the Showroom and Hydrogen at Fueling Stations by 2020

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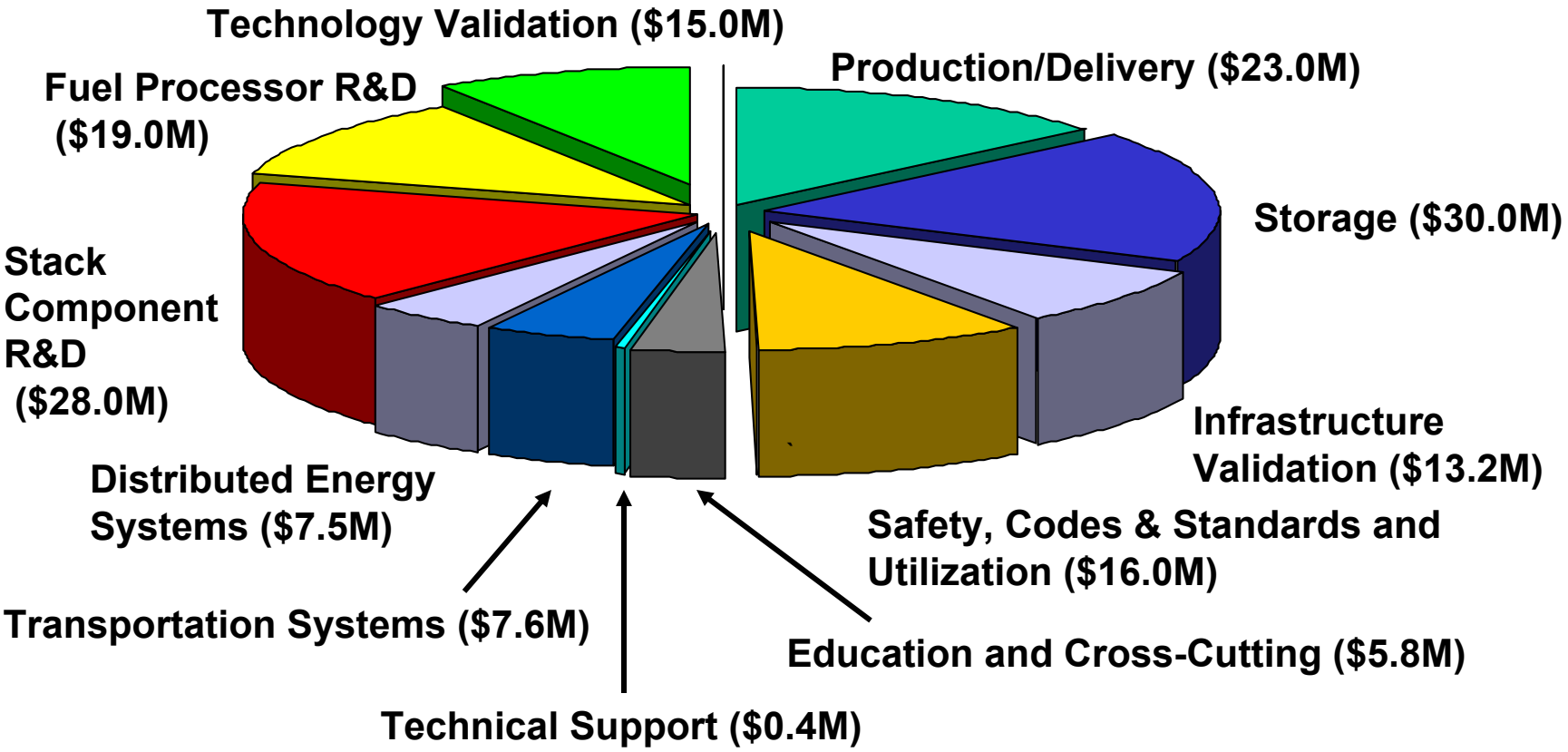
FY04 EERE Hydrogen and Fuel Cell Budget Request (Key Activities)



Total FY 04 Request $165.5M

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Hydrogen, Fuel Cells and Infrastructure Technologies Program

Program Focus: Research, develop, and validate fuel cell and hydrogen production, delivery and storage technologies for transportation and stationary applications

Major Activities	FY02 Approp.	FY03 Approp.	FY04 Request
Hydrogen Production & Delivery	$11.2M	$11.8M	$23.0M
Hydrogen Storage	$6.1M	$11.3M	$30.0M
Safety, Codes & Standards, Educatio	**$5.9M**	**$6.8M**	**$21.8M**
H2 Infrastructure/FC Vehicle Demo	$5.7M	$11.9M	$28.2M
Fuel Cell Systems & Components	$46.7M	$53.7M	$62.5M
TOTAL	**$75.6M**	**$95.5M**	**$165.5M**

Highlights

- Advanced production technologies (reforming, separation, photoelectro-chemical, photobiological, electrolysis)
- Solid-state hydrogen storage materials (carbon, hydrides, etc.)
- **Mandate: lead and accelerate codes, standards and safety development and implementation**
- Integrated fuel cell vehicle and hydrogen infrastructure technology validation
- Fuel cell stack component cost reduction (catalyst & membrane) and stationary systems development

Codes, Standards, & Safety Focus: Facilitate the development and adoption of building codes and equipment standards; international standards, and safe practices that promote insurability.

Barriers

- Historical data is limited
- Rationale for current practice cannot be verified.
- Local government, Fire Marshal and public perceptions are shaped by past history.
- Creation and adoption of new codes and standards is a slow process.
- Standards can be used as a trade barrier.

Status: August 2003

- Multi-National's Want Global Regulations
  - Unified standard for all countries
  - Processes are slow, responsibilities are not clear
  - U.S. uses "Self-Certification not Type Approval"
- Progress is being made—conflicts are assured due to scattered approaches, international trade issues
- Comprehensive plan among SDO's had not voluntarily developed
- U.S. Government moving forward on large integrated demos
- International Agreements moving forward

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Fuel Stations

ANSI/CSA NGV2[1] Fuel Containers (CNG only)

ICC Family Codes Fire,Fuel,Mechanical Electrical (Approved)

ASME Boiler & Pressure Vessel Code (Published)

NFPA Codes Fuel,Electrical,Storage (Under review for H2)

SAE J2600 Fueling Connectors (Published)

ISO TC197 WG5 H2& H2 Blends Refueling (Requested)

SAE J2601 Vehicle Communication (In Progress)

UL 2264 Gaseous H2 generation (To be developed)

ANSI/CSA NGV 4[2] Dispensing Systems (CNG only)

ISO TC197 WG8 Water Electrolysis (Requested)

CGA G-5.3 Hydrogen Commercial Specification (Published)

CGA P-6 Hydrogen Standard Density Data (Published)

SAE J1616 Recommended Practice (CNG only)

CGA G-5 Hydrogen Commercial H2 (Published)

ASME B31.3 Process Piping (Published)

CGA G-5.4 Hydrogen Piping Systems (Published)

ASME B31.1 Power Piping (Published)

ISO TC-197 WG2 Tank Containers (Requested)

Vehicles

CSA/NGV2
Fuel Tanks for Hydrogen
(Requested)

SAE J2574
Fuel Cell Vehicle
Terminology
(Published)

SAE J2600
Compressed Hydrogen
Fueling Connectors
(In Progress)

SAE J2594
Fuel Cell Recyclability
Guidelines
(In progress)

SAE J2572
Recommended Practice
Exhaust Emissions
(In Progress)

SAE J2615
Performance Test Procedures
For Fuel Cell Systems
(In progress)

SAE J2601
Compressed Hydrogen
Fueling Communication
(In progress)

SAE J2616
Performance Test Procedures
For Fuel Processor Subsystem
(In progress)

SAE J2578
Recommended Practices
For Vehicle Safety
(Published)

DOT/NHTSA
Vehicle
Regulations

ISO TC 197
Compressed Hydrogen
Fueling Connectors
(Requested)

SAE J2617
Performance Test Procedures
Of PEM FC Stack Subsystem
(In progress)

SAE J2579
Recommended Practices
For Hazardous Fluid Systems
(Published)

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Hydrogen Transport

ASME B31.4
Pipeline Transportation
(Published)

DOT 49 CFR
Transportation of
Hazardous Materials

NFPA 58
Transport of LPG
(Published)

ASME B31.8
Gas Transmission &
Distribution
(Published)

ISO TC 197 WG2
Containers & Hydrides
(In Progress)

CSA CAS No. 33
Component Acceptance
Service
(Published)

NFPA 55
Combined 50 A&B
(In progress)

Part 1910 29 CFR
OSH Standards
(Published)

ISO TC 58
Tanks & Embrittlement
(Requested)

DOT Guide
First Responders on
Emergencies
(Published)

NFPA 50B
Liquid H2 Systems
(Published)

CGA G-5.4
H2 Piping at Consumers
(Published)

ASME
Boiler & Pressure
Vessel Code
(Published)

NFPA 50A
Gaseous H2 Systems
(Published)

Issues

- Codes, standards, and regulations are being developed and proposed in advance of, or in parallel with, hydrogen systems
  - International more important than domestic
  - Codes & standards development must be coordinated with technology development – US funding most of the efforts
  - R&D to validate proposed standards (i.e., need data to support or validate proposed requirements)
- Coordination is vital
  - All Federal Agencies must be coordinated and working together.
  - Multi-National's support for domestic agenda
  - A large number of organizations are involved in generating codes & standards
  - Get smarter on International Standards

Development Needs

- Government Collaboration
  - DOE, EPA and DOT must coordinate
  - Engage in GR/GTR process
- Assist SDO's to develop training programs
- Conduct workshops and roadshows
- Provide technology data for new standards
- Coordinate SDO activities to identify gaps, form new working groups
- Provide funding to key US experts to participate in critical meetings
- Fund critical R&D to provide data for amended standards
- Collect, analyze and publish historical database

DOE Report Card

August 19,2003 Workshop

- Multiyear Program Plan with stakeholder review
- DOE should provide leadership and funding
  - National Template on domestic standards
  - Draft contracts for CSA, CGA, NGV, SAE
  - Get engaged in GRPE
  - Engage DOT in all activities
- DOE should facilitate communication
  - Quarterly newsletter continued
  - NHA safety newsletter
  - Coordinating Committee
- Annual meetings to “judge” program’s responsiveness

Safe Hydrogen Systems

- Safety issues can be handled through testing, certification, and codes & standards, just like with any other fuel
- Sustained, collaborative government-industry RD&D needed
  - Fundamental properties of hydrogen must be verified
  - Testing of hydrogen systems and components are required
  - Fuel cell and vehicle systems development must be accelerated
  - Infrastructure and codes & standards development require significant government participation (on all levels)
  - Coordination is key
  - U.S. must be as decisive as European and Asian counterparts

For more information:

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