DOE Hydrogen Program

New Fuel Cell Projects
Kickoff Meeting

Patrick Davis
Acting Program Manager

February 13, 2007
Washington, DC
The Program's overarching goal is to reduce or eliminate dependence on foreign oil.

Mission:
To research, develop, and validate fuel cell and hydrogen production, delivery, and storage technologies.

Hydrogen from diverse domestic resources will then be used in a clean, safe, reliable, and affordable manner in fuel cell vehicles and stationary power applications.
DOE Hydrogen Program

*Encompasses research, development and demonstration activities being conducted by the following DOE program offices:*

- *Energy Efficiency & Renewable Energy (EERE),*
- *Fossil Energy (FE),*
- *Nuclear Energy (NE), and the*
- *Office of Science (SC)*

**To ensure that:**

1) these efforts are fully integrated and coordinated,
2) the Department speaks with *one voice*, and
3) there is a clear line of management responsibility and accountability, the DOE Under Secretary issued a memorandum on March 15, 2004, requiring that all of the DOE Hydrogen Program efforts conducted by these DOE offices be reviewed by the DOE Hydrogen Program Manager (*designated to be the Program Manager for EERE’s HFCIT Program*).
EERE is working to provide a prosperous future where energy is clean, abundant, reliable, and affordable. FE's primary mission is to ensuring that we can continue to rely on clean, affordable energy from our traditional fuel resources. NE's mission is to support the nation's diverse nuclear energy programs. SC is the single largest supporter of basic research in the physical sciences in the United States (>40%).
DOE Hydrogen Program Organization

Secretary
- Under Secretary

Program Secretarial Officers
- Energy Efficiency and Renewable Energy – EERE
- Fossil Energy – FE
- Nuclear Energy – NE
- Science - SC

DOE Hydrogen Program Manager
- Chief Engineer
- Technology Analyst

Systems Integrator

CFO PI

Hydrogen Program Coordination Group
- EERE H₂ Activities
- FE H₂ Activities
- NE H₂ Activities
- SC H₂ Activities
- DOT H₂ Activities

Interagency Task Force

Hydrogen Technical Advisory Council (HTAC)

Program Management (Headquarters)

Golden Field Office
- NETL
- Idaho Operations Office
- Chicago Operations Office

Project Management (Field)

National Laboratories
- Industry
- Universities
- State & Local Government

Project Implementation
Current EERE Hydrogen Program Staff

Hydrogen Technologies Program
Patrick Davis, Acting DOE Hydrogen Program Manager
JoAnn Milliken – Chief Engineer
Fred Joseck – Technology Analyst
Sid Anderson – Office Manager

Sigmund Gronich - Technology Validation
Christy Cooper - Education
Pete Devlin – Market Transformation
Patrick Davis - Safety, Codes/Standards
Antonio Ruiz - Safety Engineer

Hydrogen Production Team
Roxanne Garland
Acting Team Leader
Arlene Anderson
Mark Paster
One new hire

Hydrogen Storage Team
Sunita Satyapal,
Team Leader
Carole Read
Grace Ordaz
Two new hires

Fuel Cell Team
Nancy Garland
Acting Team Leader
John Garbak
Kathi Epping
Amy Manheim
Jason Marcinkoski
**Program Goal/Challenges**

**Goal:** Technology readiness to enable industry to commercialize fuel cell vehicles and hydrogen infrastructure in the 2020 timeframe

**Challenges:**

### Critical Path Technology
- Hydrogen Storage (target: >300-mile range; status 103-190 miles)
- Fuel Cell Cost and Durability (targets: $30 per kW, 5000 hours; status: $110/Kw, 2000 hours)
- Hydrogen Cost (target: $2.00 - 3.00 per gallon gasoline equivalent*; status: $3.00/gge for natural gas)

### Economic/Institutional
- Codes and Standards (Safety, and Global Competitiveness)
- Hydrogen Delivery (Investment for new Distribution Infrastructure)
- Education (safety and code officials, local communities, state and local governments, students)

*One kilogram of hydrogen contains nearly the same energy as a gallon of gasoline.*
Program Elements

Program Management

Systems Integration and Analysis

Applied Research & Technology Development

- Delivery
- Production
- Conversion
- Storage

Basic Research

Safety, Codes and Standards

Education

Program planning, organization, implementation, evaluation, and linkages

Technical advances and validation of hydrogen and fuel cell technologies

Fundamental understanding and scientific breakthroughs

R&D to ensure safety and enable development of codes & standards for technology implementation

Communication and training for increased understanding and awareness
Hydrogen Program R&D Progress

**Fuel Cells**

*Lowered high-volume cost to 4X that of ICEs*

<table>
<thead>
<tr>
<th>Fuel Cell Stack (only) Durability</th>
<th>Fuel Cell System (80kW) Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2003 Status</strong></td>
<td><strong>2002 Baseline (50 kW)</strong></td>
</tr>
<tr>
<td>1000</td>
<td>275</td>
</tr>
<tr>
<td><strong>2005 Status</strong></td>
<td><strong>2005 Status</strong></td>
</tr>
<tr>
<td>2000</td>
<td>110</td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td><strong>Target</strong></td>
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<tr>
<td>5000</td>
<td>30</td>
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</tbody>
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**Hydrogen Storage Technology**

*Identified new materials with potential for high storage capacity*

**Hydrogen Production**

*Lowered cost of distributed H₂ production*

- **Renewable Liquids**
- **Electrolysis**
- **Natural Gas**

**Technology Validation**

*Obtained valuable data on FCVs and H₂ stations*

- **69 vehicles, 10 stations in operation**
  - **Fuel cell durability:** Maximum: 950 hours
  - **Range:** 103 to 190 mi (equivalent to EPA vehicle sticker rating)
  - **Cost of hydrogen production:** $3.00/gge
Hydrogen Fuel Initiative Budget

Key Activities focus on:

Technology Challenges

- Hydrogen Cost (target: $2.00 - 3.00/kg) independent of production pathway
- Hydrogen Storage (target: >300-mile range)
- Fuel Cell Cost and Durability (targets: $30 per kW, 5000 hours)

Economic/Institutional Challenges

- Safety, Codes and Standards
- Hydrogen Infrastructure
- Market Transformation
- Education (safety and code officials, local communities, state and local governments, students)
Program Evaluation

Annual Program Merit Review & Peer Evaluation

- Projects are rated by peers. Reviewers come from National Labs, Industry, and universities.
- Rating Criteria: relevance, approach, progress & tech transfer

FreedomCAR & Fuel Partnership

- Includes automobile and energy companies
- Technical Teams provide input on technical milestones & system needs, and review/evaluate projects:
  - Hydrogen Production
  - Hydrogen Delivery
  - Hydrogen Storage
  - Fuel Cells
  - Hydrogen Codes & Standards
  - Fuel Pathway Integration

National Academy of Sciences

- NAS reviews the program priorities & technical milestones, and evaluates progress toward achieving them.

2007 Annual DOE Hydrogen Program Merit Review and Peer Evaluation Meeting
May 14-18, 2007 - Arlington, VA
FreedomCAR and Fuel Partnership
Extensive External Coordination

Hydrogen R&D Task Force (Interagency - OSTP lead)
- Key mechanism for collaboration among 8 Federal agencies
- Provides guidance for agency research directions
- Identifies key areas for interagency collaboration

Federal/State/local (Example)
- California Fuel Cell Partnership
- California Hydrogen Highway Network

International Partnership for the Hydrogen Economy
- Accelerates the development of hydrogen and fuel cell technologies to improve their energy, environmental and economic security.
- Provides a mechanism to organize, coordinate and implement effective, efficient, and focused international RD&D and commercial utilization activities
- Provides forum for advancing policies and common codes & standards
- Educates/informs stakeholders and the general public on H₂
For More Information

hydrogen.energy.gov

Introductory fact sheets available in the web site library

All hard copy documents, fact sheets, CDs, etc. can be ordered free-of-charge