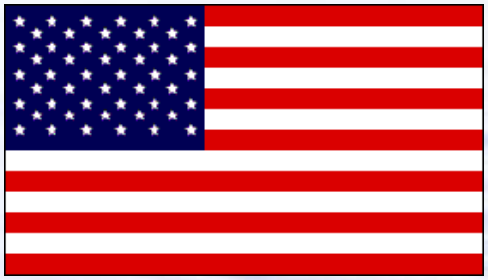
US Hydrogen Program

Country Statement for the IPHE Steering Committee

March 28, 2006

Vancouver, Canada



United States of America

Outline

- New Presidential Initiatives
- Energy Secretary Bodman Releases Manufacturing Roadmap
- Program Updates
  - Storage
  - Learning Demonstration Data
  - FutureGen Status
  - Transit Bus Program
- Potential International Collaborations

The President's American Competitiveness Initiative

"Tonight I announce an American Competitiveness Initiative, to encourage innovation throughout our economy, and to give our nation's children a firm grounding in math and science."

"I propose to double the federal commitment to the most critical basic research programs in the physical sciences over the next 10 years. This funding will support the work of America's most creative minds as they explore promising areas such as nanotechnology, supercomputing, and alternative energy sources."

President George W. Bush
State of the Union Message
January 31, 2006

American Competitiveness Initiative

Commits $5.9B in FY07 and More Than $136B Over Ten Years

- Encourages the expansion of a favorable environment for private-sector investment in innovation
- Improves the quality of education to provide children with a strong foundation in math and science
- Supports universities that provide world-class education and research opportunities
- Provides job training that affords workers and manufacturers the opportunity to improve their skills and better compete
- Attracts and retains the best and brightest to enhance entrepreneurship, competitiveness, and job creation by supporting comprehensive immigration reform
- Fosters a business environment that encourages entrepreneurship and protects intellectual property

The Advanced Energy Initiative

"So tonight, I announce the Advanced Energy Initiative -- a 22-percent increase in clean-energy research

...to change how we power our homes and offices, we will invest more in zero-emission coal-fired plants, revolutionary solar and wind technologies, and clean, safe nuclear energy.

We must also change how we power our automobiles. We will increase our research in better batteries for hybrid and electric cars, and in pollution-free cars that run on hydrogen. We'll also fund additional research in cutting-edge methods of producing ethanol, not just from corn, but from wood chips and stalks, or switch grass. Our goal is to make this new kind of ethanol practical and competitive within six years.

By applying the talent and technology of America, this country can dramatically improve our environment, move beyond a petroleum-based economy..."

President George W. Bush
State of The Union Address
January 31, 2006

President George W. Bush views a hybrid vehicle powered by Lithium-Ion batteries at Johnson Controls' Battery Technology Center in Glendale, Wisconsin, Feb. 20, 2006.

President's Initiative Creates Robust Technology Portfolio for Improving Efficiency and Developing Alternative Fuels

- Accelerate research in cutting-edge methods of producing "cellulosic ethanol" with the goal of making the use of such ethanol practical and competitive within 6 years.
- Step up research in better batteries for use in hybrid-electric vehicles (incl. "plug-in" hybrids).
- Accelerate the development of hydrogen fuel cells and affordable hydrogen-powered cars by providing **$289 million – an increase of $53 million over FY06** –Consistent with $1.2B commitment from 2003 SOTU Address.

President participates in Energy Conservation & Efficiency Panel
NREL, Golden, Colorado, February 21, 2006

Under Secretary David Garman with Ford Reflex Concept – 2006 Detroit Auto Show

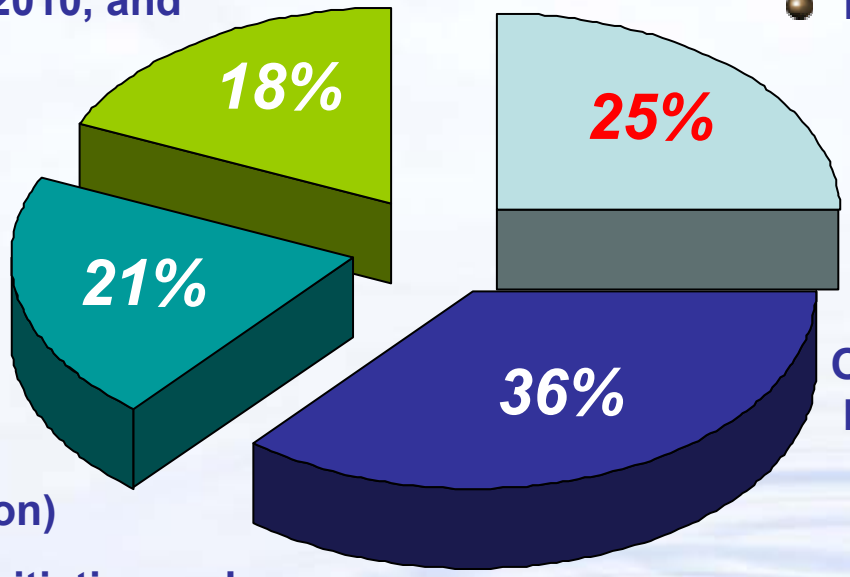
Advanced Energy Initiative To Help Break America's Dependence On Foreign Sources Of Energy

Office of Nuclear Energy, Science and Technology ($392 million)

- Global Nuclear Energy Partnership,
- Nuclear Hydrogen Initiative,
- Nuclear Power 2010, and
- Generation IV

Office of Science ($539 million)

- nuclear fusion,
- solar,
- biomass and
- hydrogen



Office of Fossil Energy ($444 million)

- Coal Research Initiative and
- other power generation/stationary fuel cell

Office of Energy Efficiency and Renewable Energy ($771 million)

- hydrogen technology,
- fuel cell technology,
- vehicle technology,
- biomass, solar, and wind

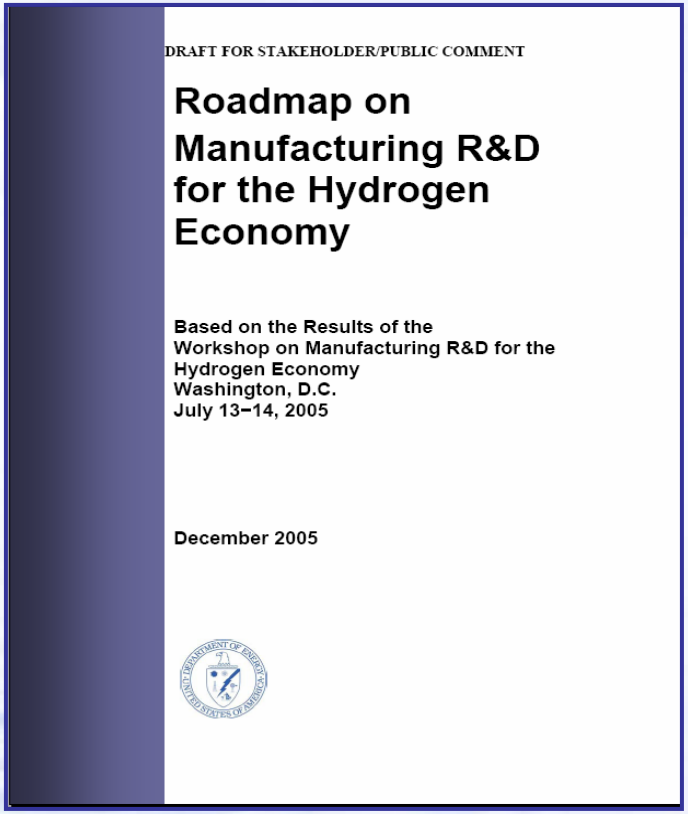
DOE FY 2007 budget requests $2.1 billion

($381 million increase over FY 2006)

Secretary Bodman Unveils *Roadmap on Manufacturing R&D for the Hydrogen Economy* for Public Comment

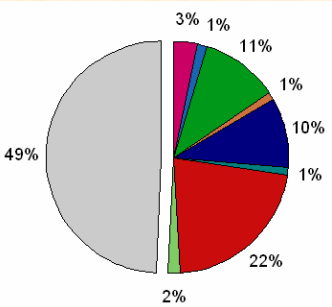
The Roadmap…

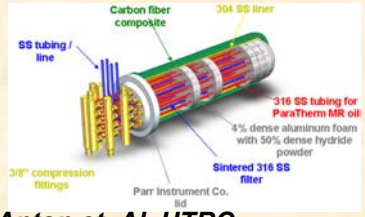
- Based on the results of a July 2005 hydrogen workshop made up of hydrogen and fuel cell experts from industry, universities, and national laboratories.
- Identifies the manufacturing research and development (R&D) challenges that must be met.
- Manufacturing research critical to developing strong supplier base.



Hydrogen Storage Update
Diverse Portfolio Starting to Show Promising Results

Prototype built (~50% is BOP)

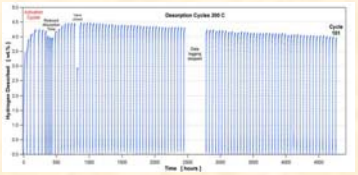




Anton et. Al, UTRC

LiMg Amides ~5 wt%, 100 cycles

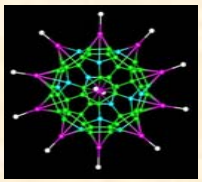
Sandia Livermore: Luo, Gross, et al

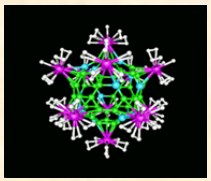


Destabilized hydrides & nanoscience

> 9 wt% shown $LiBH_4$ / MgH_2: *Vajo, et al, HRL*

Materials modeled for capacity:



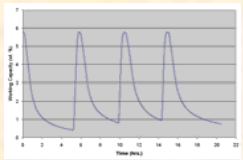


Potential for 8.8 wt%

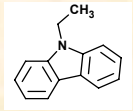
Zhao, Heben, Dillon, et al NREL

$C_{48}B_{12}[ScH]_{12} \rightleftharpoons C_{48}B_{12}[ScH(H_2)_5]_{12}$

Chemical hydrides developed, 5.5 to 7 wt% and 50-65 g/L

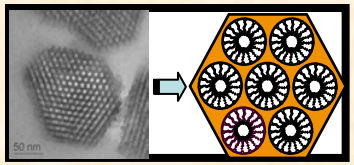


N-ethyl-carbazole



Cooper, Pez, Air Products

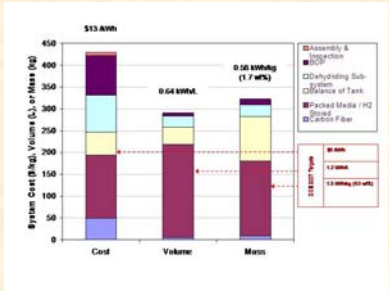
Mesoporous scaffolds with ammonia borane show >6 wt% (at < 80C & reduced byproducts)



Autrey, Gutowski, et al, PNNL

Storage Systems Analysis Working Group Established

Materials > 7 wt% needed for 4.5 wt% system (2007 target)



TIAX, ANL

Learning Demonstration Update

- Initial set of composite data results have been published
- Four auto/energy teams now operating 59 vehicles
- Five additional refueling sites stations now available including 3 in Northern California, 1 in Michigan and 1 in Florida.
- 9 of 23 sites refueling FCVs

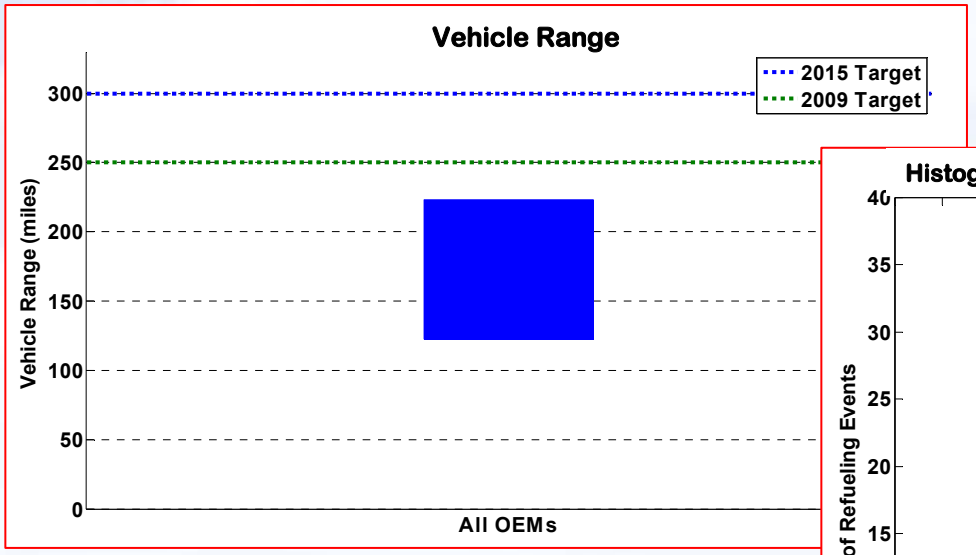
GM/Shell

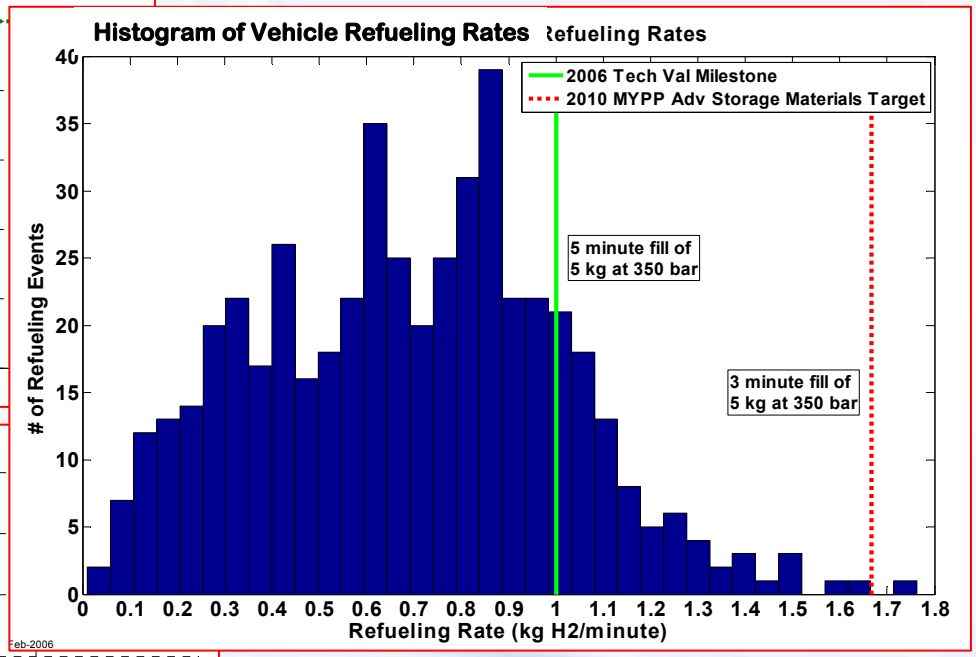

Ford/BP

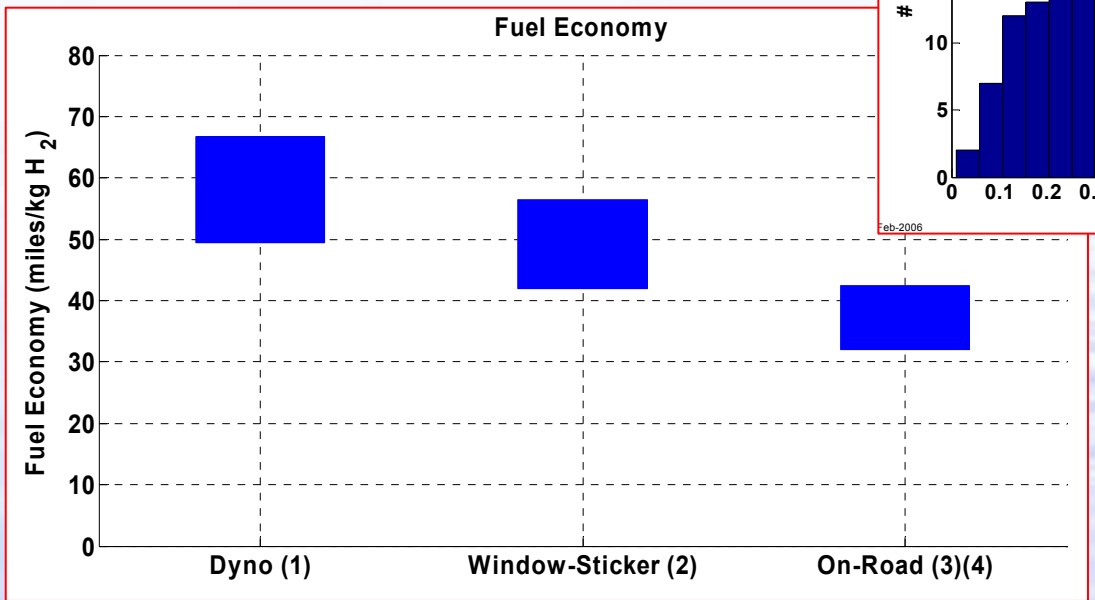
DaimlerChrysler/BP


Chevron/Hyundai-KIA

Real – World Composite Data



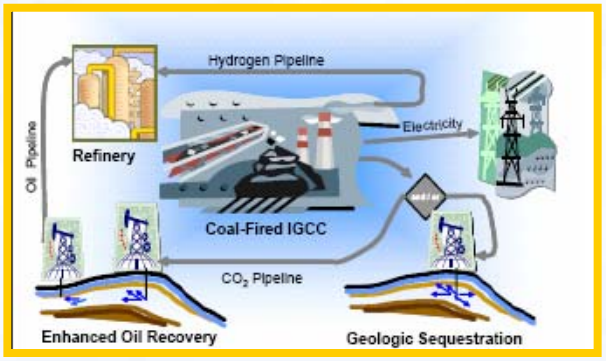




Data indicate improved H2 storage technologies that can be packaged in a vehicle are necessary to meet range targets

FutureGen Status

December 6, 2005 - Secretary of Energy announces that DOE and the FutureGen Industrial Alliance signed an agreement to build FutureGen.



- Produces both electricity & H_2 with near zero emissions (CO_2)
- Output of 275 MWe, 1 million metric tonnes of CO_2/year
- Cost: $950 million [private sector $250 M / government $700 M]
- Operations begin in 2012

FutureGen Industrial Alliance

Provides energy to tens of millions of U.S. and international residential, business, and industrial customers and has global operations serving customers in Asia, Australia, Canada, Continental Europe, the People's Republic of China, South Africa, South America, and the United States.

- Alliance officially formed and recognized
- Currently 9 members (companies)
- Open membership policy with an active recruiting effort
- Have initial capital for project
- March 8, 2006 - Final Request For Proposals released for parties interested in hosting FutureGen
- May 4, 2006 - Proposals for host site due

Update on Transit Bus Program

- FTA National Fuel Cell Bus program (NFCBP)
  - International workshop held in Vancouver
- Competitive Selection of up to 3 Regionally Diverse Non-Profit Organizations
- 50% Cost Share Required
- $49 Million Available from FY06 – FY09
  - $11,250,000 – FY 2006
  - $11,500,000 – FY 2007
  - $12,750,000 – FY 2008
  - $13,500,000 – FY 2009

Three very quiet, zero-emission Van Hool fuel cell hybrid electric buses, powered by UTC Power PureMotion™ 120 kW fuel cell systems and ISE hybrid-electric drive systems. (3/13/06)

Update on Transit Bus Program

NFCBP Objectives and Technical Targets

- Pathway to Commercialization
- Durability – 4 to 6 Years/20,000 to 30,000 hours
- Bus Cost – <5x Comparable Transit Bus
- Reliability – >90% Availability
- Fuel Efficiency – 2x Comparable Transit Bus
- Vehicle Performance – Equal or Better to Comparable Transit Bus
- Emissions – Exceed 2010 EPA Standards
- Enhance Public Acceptance

US effort involves several international participants: Potential partners include Australia, Brazil, Canada, China, Europe, Japan

Key Research Goals for FY 2006

- Independent verification of achievement of $3.00/gge of hydrogen from distributed natural gas
- Independent validation of achievement of $110/kW for PEM fuel cells at high production volume
- Independent assessment of cryo-compressed technology for on-board storage against 2010 targets
- Go/No-go decision on 6 wt.% (material) on single walled carbon nanotubes

Other New Initiatives

- Hydrogen Quality
- Advisory Panel (HTAC)

Fuel Cell Technology R&D for the Hydrogen Economy – Current Solicitation

Topic 7 Stationary Fuel Cell Demonstration requires the following:

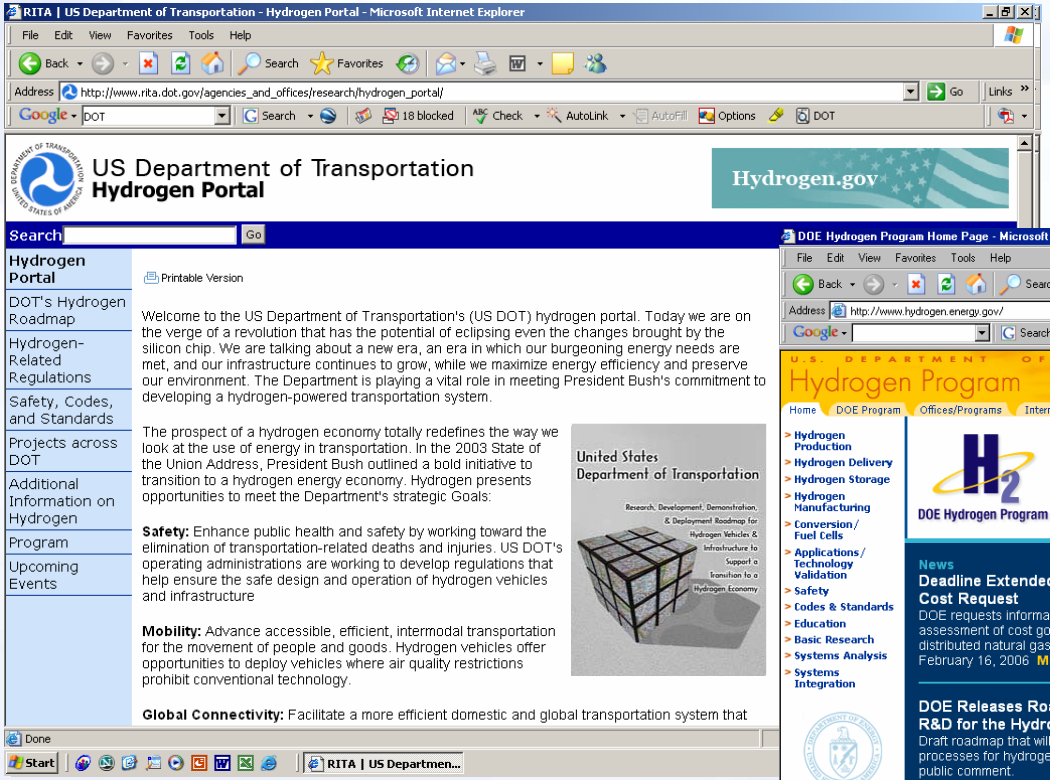
- 1 to 5 kW prototype fuel cell demonstration leading to systems capable of 40,000 hours of operation, 40% electrical efficiency and a target cost of $400/kW at production volumes.
- Proposed demonstration should last a minimum of 6 months
- **Topic 7A International Partnership for a Hydrogen Economy**
  - A written commitment of support from the other IPHE country must be included in the application.
- **Topic 7B International**
  - A written EU commitment of support must be included in the application.
- Response Due Date: 04/05/2006
- Solicitation website:

https://e-center.doe.gov/iips/faopor.nsf/UNID/F09751961314EDD585257107006FC1E7?OpenDocument

U.S. Government Hydrogen Websites

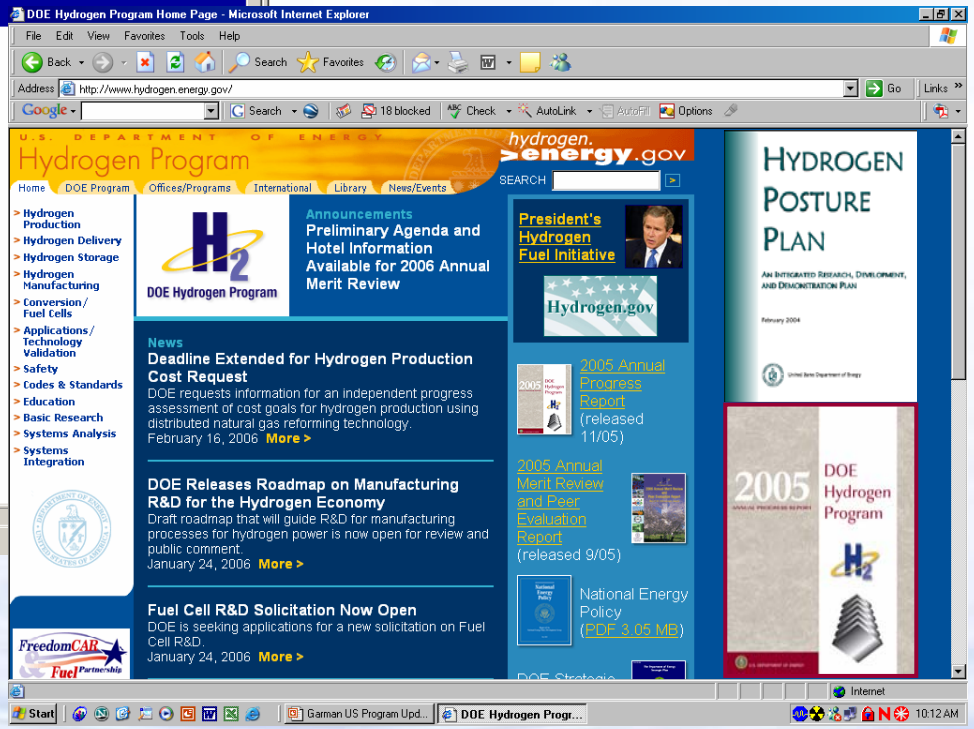
Hydrogen.gov

www.hydrogen.gov



DOT

www.rita.dot.gov/agencies_and_offices/research/hydrogen_portal/



DOE

www.hydrogen.energy.gov

U.S. Implementation-Liaison Committee Program Technology Contacts

2006 Annual DOE Hydrogen Program Merit Review and Peer Evaluation Meeting May 16-19, 2006 - Arlington, VA

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