

Hydrogen Production and Delivery

Energy from diverse, domestic sources: \$103 Million Total (\$77 Million Federal Share)

Distributed Reforming Using Natural Gas and Renewable Liquids

- Develop intensified, lower capital cost, more efficient NG reformer technology
- Develop improved catalysts and technology for renewable liquids reforming (e.g. ethanol, sugar alcohols, Bio-oil)
- Lead Partners: GE, APCi, H2Gen, Virent, Ohio State Research

Electrolysis

- Develop low cost and high efficiency materials and system designs
- Integrated compression
- Integrated wind power/electrolysis systems
- Lead partners: Teledyne, Giner, Materials and Systems Research

Biomass Gasification

- Developed integrated gasification, reforming, shift and separations technology to reduce capital and improve efficiency.
- Lead Partners: GTI, UTRC, SRI, Ceramatec, Arizona State U.

Solar/Photolytic

- Develop durable materials for direct photo-electrochemical solid state water splitting using sunlight
 - Lead Partners: Univ. of California, MV Systems, U, of Hawaii, Midwest Optoelectronics
- Research microorganisms that split water using sunlight
 - Lead Partners: Univ. of California, Craig Venter Inst.
- Research thermochemical cycles that split water using heat (600 – 2100 C) from solar concentrators
- Lead Partners: UNLV, U. of Colorado, SAIC

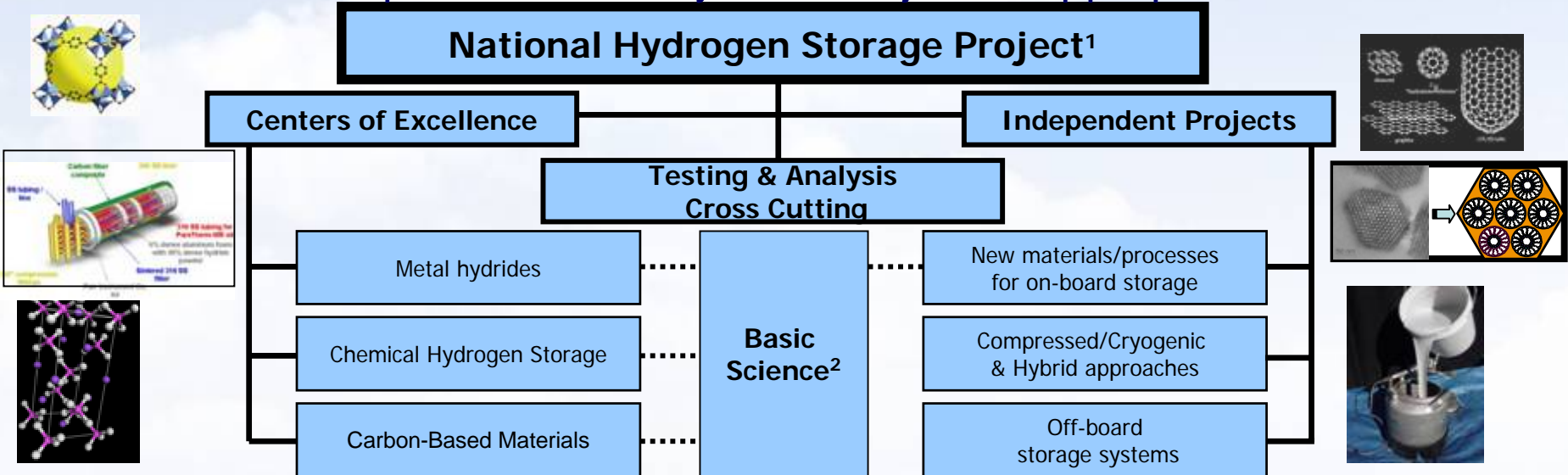


Delivery

- Infrastructure options and trade-offs analysis
- Develop lower cost and robust technology for pipelines, compression, off-board storage, carriers, and liquefaction
- Lead Partners: Nexant, GEECO, NCRC, APCI, SECAT, U. of Illinois

Hydrogen Storage

Focused on *materials-based* technologies for >300-mile range
 \$150M planned over 5 years, subject to appropriations



Materials reversible on-board

- Can “refill” H₂ at the fueling station, directly onto the vehicle
- Advanced metal hydrides (alanates, borohydrides, Li-Mg amides)
- Carbon-based materials, high surface-area adsorbents
- Focus on capacity and thermal management

Materials regenerable off-board

- Take depleted material off vehicle & regenerate off-board
- Liquid or solid materials, high binding energy of hydrogen, high capacity
- Organic liquids, boron-based materials, polymeric systems
- Focus on capacity and regen efficiency

New Materials and Concepts: Nanoporous materials, clathrates, MOFs, perhydrides, other

1. Coordinated by DOE Energy Efficiency and Renewable Energy, Office of Hydrogen, Fuel Cells and Infrastructure Technologies

2. Basic science for hydrogen storage conducted through DOE Office of Science, Basic Energy Sciences



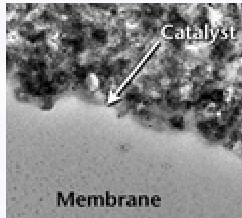
PEM Fuel Cell Activities

Focused on Removing Technical Barriers: Cost & Durability

Stack Component R&D

UTC Fuel Cells, 3M, DeNora, Cabot Superior Micropowders, Englehard, Arkema (previously Atofina) Chemicals, DuPont, Plug Power, Ion Power, Ballard, U. of South Carolina, Porvair, LANL, NIST, NRL, NASA, ANL, LBNL, ORNL, PNNL, NREL, SNL and BNL

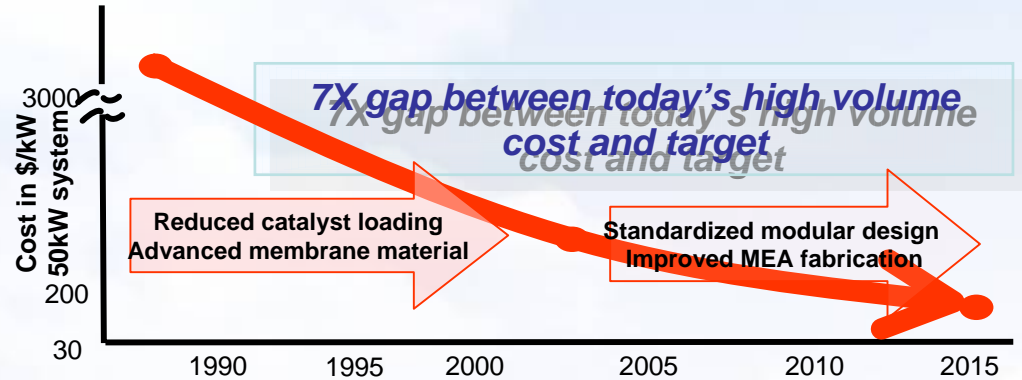
- polymers, proton conducting membranes
- MEAs in high volume manufacturing
- electrocatalysts, platinum recycling
- bipolar plates



Transportation Systems

UTC Fuel Cells, Honeywell, Delphi Automotive Systems, Cummins Power Generation, PolyFuel, MTI MicroFuel Cells, IdaTech, NREL, LLNL, PNNL, ANL, and LANL

- system modeling & analyses
- physical and chemical sensors
- turbo compressor / expander
- compact humidifiers / heat exchangers
- auxiliary power in trucks
- portable power applications



Distributed Energy Systems

IdaTech, UTC Fuel Cells, Plug Power, ANL, NREL, and Battelle

- demonstrations of integrated stationary systems
- modeling and analysis



Fuel Processor R&D

Nuvera, Texaco Energy Systems, ANL, LANL NETL, PNNL

- fuel processor catalysts & systems for stationary applications
- diesel or propane fuel processing for APUs

FY 05 Budget: \$57.2M FY 06 Request: \$59.6M

New Solicitation: Fall 2005

Technology Validation Strategy

- Conduct learning demonstrations of hydrogen infrastructure in parallel with hydrogen fuel cell-powered vehicles to enable and assess technology readiness for a 2015 commercialization decision.
 - Not a “Commercialization” demonstration to prepare the market

Major Objectives

- Obtain detailed component data under real-world conditions (climatic, geographic etc.) to re-focus the Department’s hydrogen and fuel cell component and materials research
- Validate the technology against time-phased performance-based targets

