



U.S. DEPARTMENT OF
ENERGY

Hydrogen Delivery

Mark Paster

**2006 DOE Hydrogen Program
Merit Review and Peer Evaluation Meeting**

May 16, 2006

Hydrogen Delivery

Goal

- Develop hydrogen delivery technologies that enable the introduction and long-term viability of hydrogen as an energy carrier for transportation and stationary power

Scope

- From the end point of central or distributed production (300 psi H₂) to and including the dispenser at a refueling station or stationary power site

< \$1/gge Overall by 2017

<\$.40/gge for Forecourt operations by 2015



Research Areas

Pathways

- Gaseous Hydrogen Delivery
- Liquid Hydrogen Delivery
- Carriers

Components

Pipelines

Compression

Liquefaction

Carriers & Transformations

Gaseous Storage Tanks

Geologic Storage

GH₂ Tube Trailers

Terminals

Separations/Purification

Dispensers

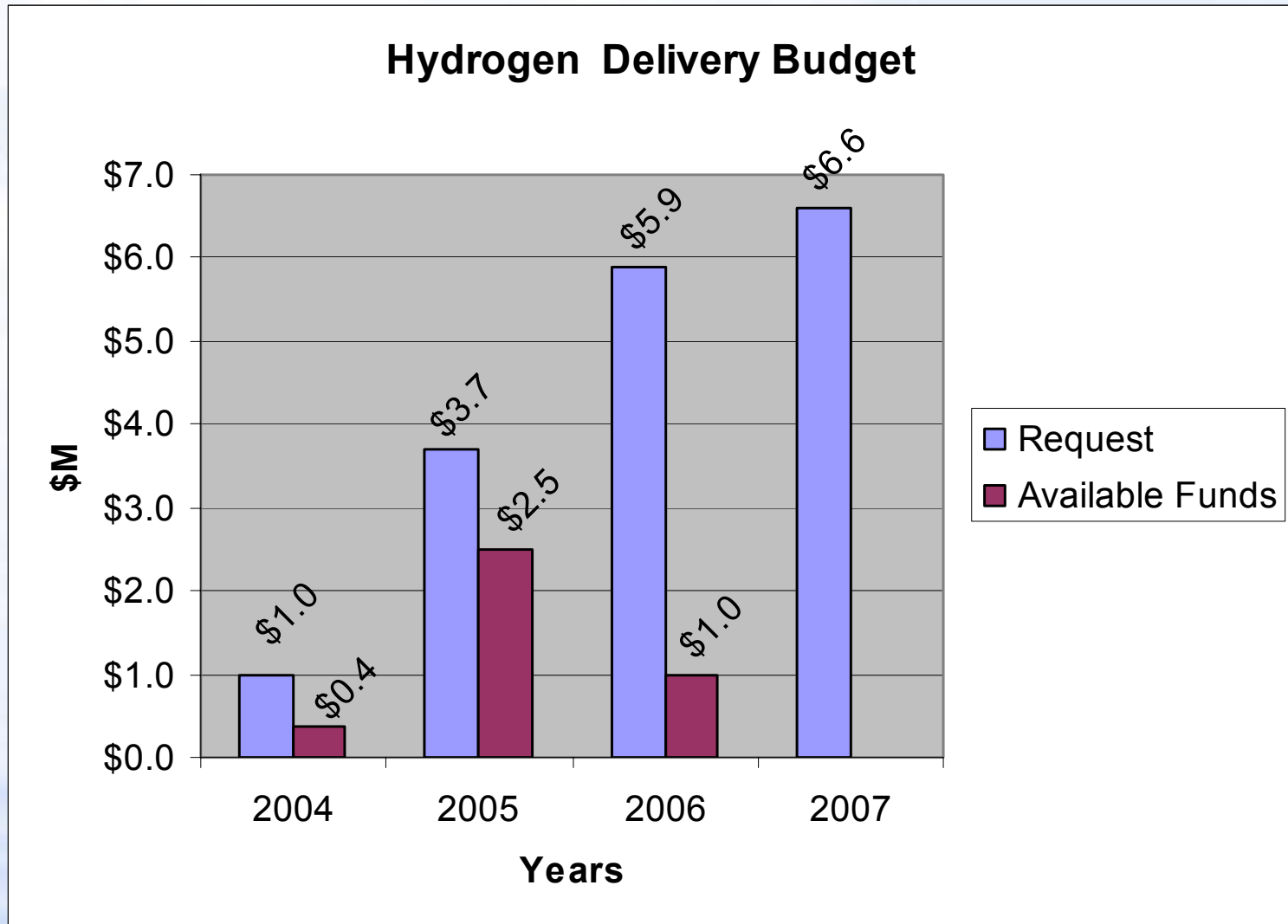
Liquid Storage Tanks

Mobile Fuelers

Liquid Trucks, Rail,

Ships

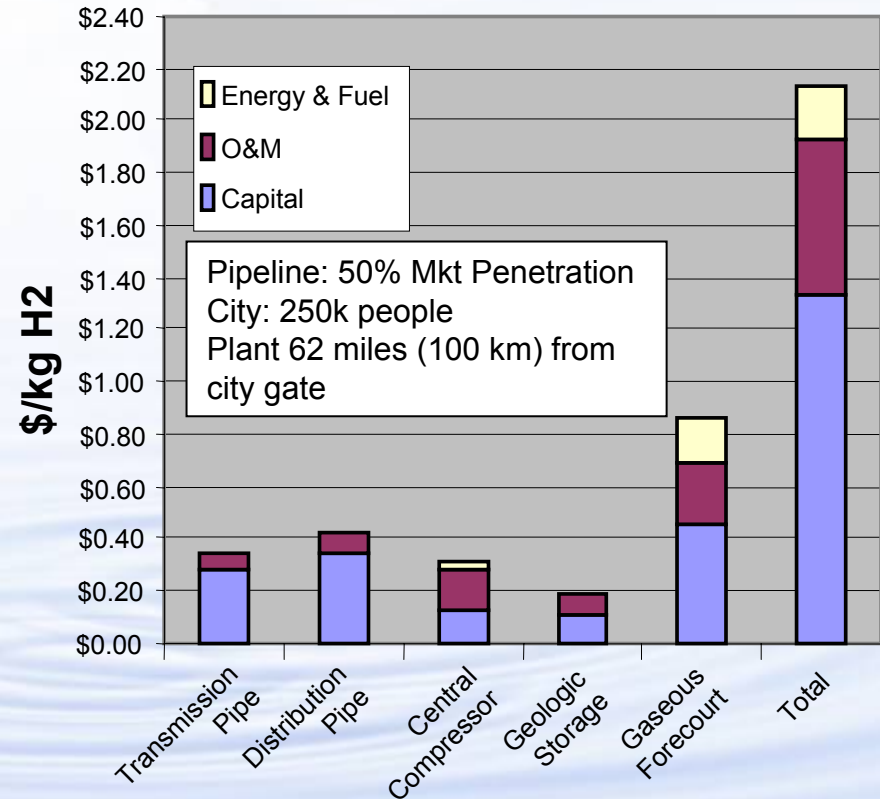
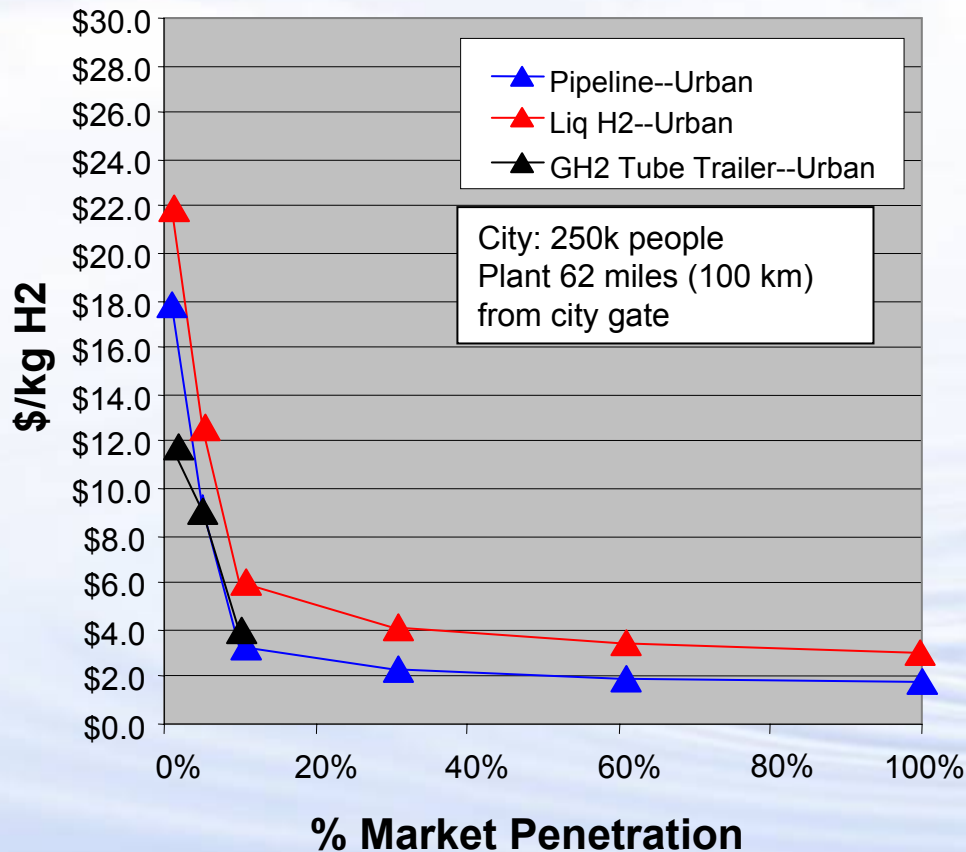
EERE Delivery R&D Budget



Accomplishments

H2A Delivery Models: Components and Scenario Model (www.hydrogen.energy.gov)

Current Hydrogen Delivery Costs



Accomplishments

- **Comprehensive Roadmap: FreedomCAR Delivery Tech Team**
- **Established a robust portfolio of research projects**
- **Established a Pipeline Working Group**
 - **Fundamental work on hydrogen embrittlement (U. of Illinois)**
 - **Strong collaboration across National Labs (ORNL, SRNL, SNL) and industry**
 - **Breakthrough composite pipe approach**
 - **Mini-Workshops including C&S community**
 - **Interaction with EC Naturalhy Project**
- **Analysis**
 - **Nexant: comprehensive collaborative analysis project**
 - **GTI: Forecourt options**

Key Learnings/Challenges

- **Forecourt costs are significant and need to be reduced**
 - **Compression reliability needs to be improved**
 - **Storage: Need a breakthrough in high pressure storage or carrier system**
 - **O&M costs are high: How can they be reduced**
- **Pipelines are the current low cost pathway for the long term, but:**
 - **How to move to pipelines (at least transmission) earlier?**
 - **H2 distribution lines in cities ? And at what pressure?**
- **Transition**
 - **Low volumes means much higher delivery costs**
 - **Need a breakthrough: liquefaction, higher H2 content tube trailers, or a carrier approach**

[\(www.eere.energy.gov/hydrogenandfuelcells/\)](http://www.eere.energy.gov/hydrogenandfuelcells/)