

Outline

- Oil Gap
- Hydrogen's role in U.S. Energy Strategy
- Interest in Hydrogen - Federal & States
- DOE Budget and Program Priorities
- National Hydrogen Energy Roadmap
- Fuel Cell Path Forward --- Industry Recommendations
- Air Products Role in the Hydrogen Economy

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Hydrogen and U.S. Energy Policy

Key Drivers favoring Hydrogen

- Energy Security
 - Reduce reliance on oil imports
- Increased energy supply to meet growing demand
- Environmental quality
 - Air pollution
 - Climate change

Policy Issues

- Transition will span several decades
- Challenges to infrastructure creation
 - Early investment hurdles
 - C & S
- Public policy stimulus needed to accelerate development

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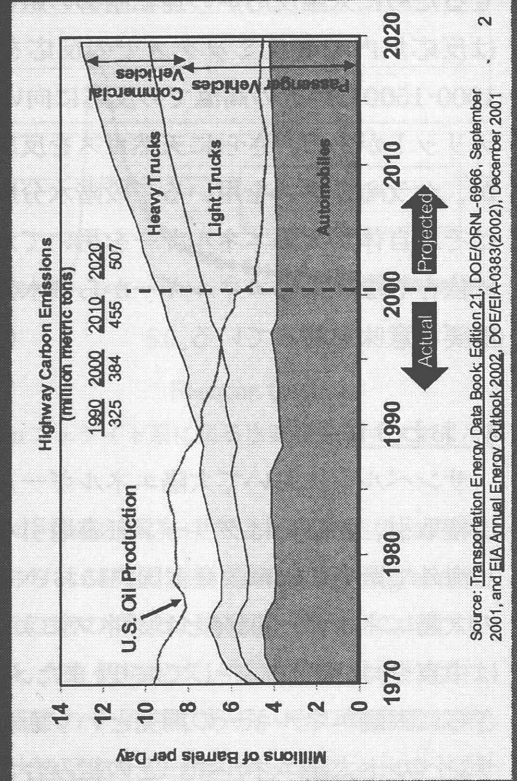
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Hydrogen Economy Strategies - a U.S. Perspective

Dr. Venki Raman
Air Products and Chemicals Inc.
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Hydrogen Energy Systems Society of Japan
Symposium
Tokyo Institute of Technology
Yokohama, Japan
December 11, 2002

The U.S. "Oil Gap" is Growing



Source: Transportation Energy Data Book, Edition 21, DOE/ORNL-6966, September 2001, and EIA Annual Energy Outlook 2002, DOE/EIA-0383(2002), December 2001

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Hydrogen is receiving the attention of the U.S. Government

"In the long run, alternative energy technologies such as hydrogen show great promise"

-- President Bush

- Major initiatives
 - National Hydrogen Energy Roadmap
 - FreedomCAR initiative.
 - Increased funding for Hydrogen R&D
 - Fuel Cell Report to Congress
- State government efforts to support Fuel Cell commercialization
 - California, New York, Ohio, Michigan etc.

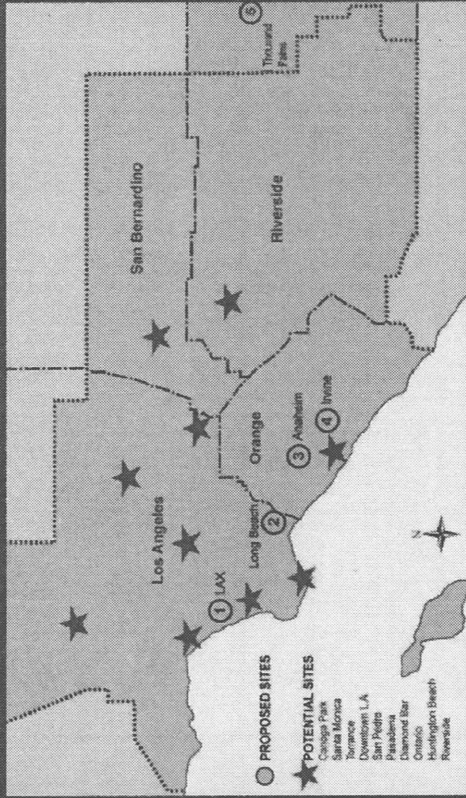


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Potential Hydrogen Fueling Stations in Los Angeles area



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DOE R&D budgets are growing...

Program	FY 2001	FY 2002	FY 2003
	\$ million	\$ million	\$ million
Transportation Fuel Cells	40.7	41.9	50.0
Stationary Fuel Cells	5.4	5.5	7.5
Hydrogen Research	26.6	29.2	39.9
Totals	72.7	76.6	97.4

Still small compared to private sector expenditures - estimated at \$2 Billion per year

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DOE Program Priorities

- 5-Year Plan to address challenges in National Hydrogen Energy Roadmap
- National program in Hydrogen Storage
- Develop Feedstock Strategy
 - Renewables
 - Fossil & Nuclear
- Fuel Cell Vehicle and H₂ Infrastructure Program
- Establish comprehensive PEM stationary fuel cell program
- National plan for Safety, Codes and Standards
- Hydrogen Education Campaign

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National Hydrogen Energy Roadmap

"This Roadmap provides a framework that can make the hydrogen economy a reality"
 Spencer Abraham, Secretary of Energy

Vision: "Hydrogen is America's clean energy choice. Hydrogen is flexible, affordable, safe, domestically produced, used in all sectors of the economy, and in all regions of the country"

- Roadmap issued - November 12
- "Challenges" and "Path Forward" to get there
- Addresses - Infrastructure, Applications, Conversion, Education and Outreach
- Available at: www.eren.doe.gov/hydrogen/

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FreedomCAR Program

- Cooperative Automotive Research
 - DOE and Big 3 US Auto Companies
- Strategic Approach
 - Technologies for mass production of H₂ powered fuel cell vehicles
 - Continue support of hybrid technologies
 - Develop technologies applicable across range of passenger vehicles
- H₂-related Goal
 - Enable transition to a hydrogen economy, ensure widespread availability of H₂

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DOE to submit a Fuel Cell Report to U.S. Congress

- Report due to Congress - November 2002
- Assessment of technical and economic barriers to the use of fuel cells
- Program to ensure commercial use of fuel cells in stationary and transportation applications by 2012.
- Preliminary findings R&D priorities
 - H₂ storage, H₂ production, and Fuel Cell cost reduction.
- Cooperative efforts needed in H₂ infrastructure.

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U.S. Industry Recommendations

- Fuel Cells and Hydrogen: The Path Forward
- Report endorsed by 28 private companies and environmental organizations
- A strategy for federal investment in fuel cell technology and fuel infrastructure
- 10-year \$ 5.5 billion cost shared program to bring fuel cells to market
 - R&D
 - Demonstrations and purchases
 - Market entry support
 - Infrastructure investments
 - Removal of barriers to commercialization
 - Education and outreach

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Congress is considering Tax Incentives for Fuel Cells

- Energy Tax Incentives Act of 2002
- Alternative Motor Vehicles Incentives
 - \$4,000 for Fuel Cell cars <8,500 lbs
 - \$40,000 for Fuel Cell vehicles > 26,000 lbs
- Credit for Refueling Facilities
 - 50% of cost of installing facilities
 - Up to \$1,000 for residential unit
 - Up to \$30,00 for retail refueling property

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Air Products Role in Hydrogen Economy Development

Air Products - World Leader in Industrial Hydrogen

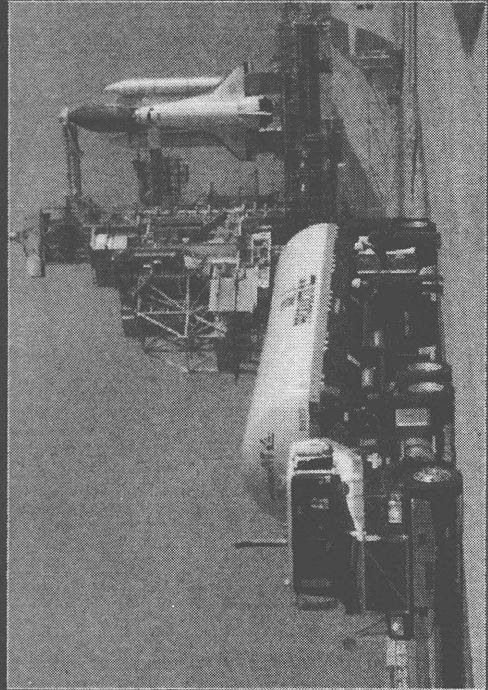
- Air Products is a \$6 billion global company
- Largest third party hydrogen producer -- over 50% Share
- Operate about 60 plants - Americas, Europe, Asia
- Produce over -- 1.25 million tonnes per year
- Increased capacity 10-fold since 1990
- 7 H₂ pipeline systems around the world (over 350 miles)
- 6 liquid H₂ facilities
- Supply H₂ purification equipment (cryogenic, PSA, membranes)

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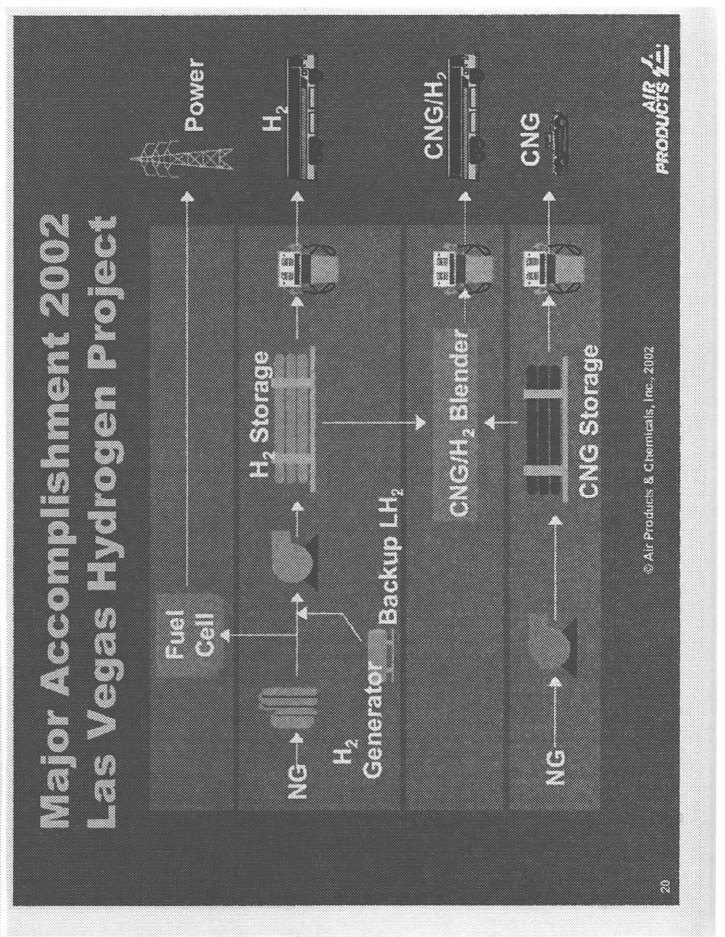
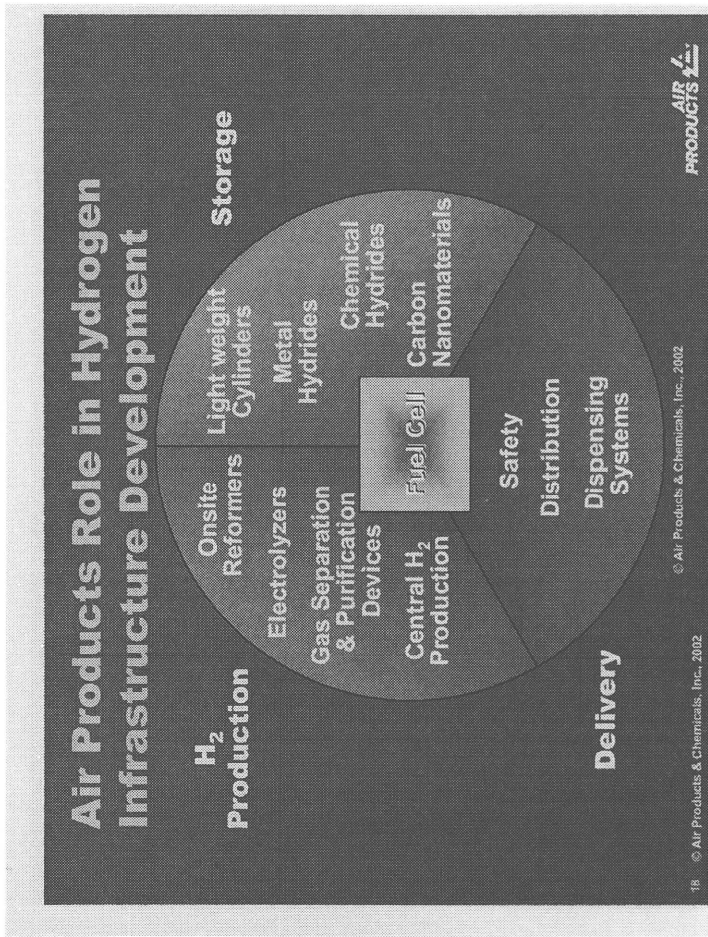
We Supply the Hydrogen for NASA Space Shuttle



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Air Products Hydrogen Energy Leadership

- Demonstration leader >15 fueling stations
- Developing solutions for the H₂ economy - sourcing, onsite generation, storage
- Global safety leader - codes & standards team - KnowH₂owSM Safety Training
- Founding member of the National H₂ Association

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Hydrogen Fuel Station Experience

- Chicago Transit Authority, IL
- City of Las Vegas, NV
- CaFCP, Sacramento, CA
- Ford (Think), Dearborn, MI

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Thank you

Conclusions

- Hydrogen is receiving a lot of attention in the U.S.
- Industry and Government are coming together to build partnerships
- Actions favor the development of Hydrogen technologies and infrastructure
- Time has never been better for advancing Hydrogen development!

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