Delivery of Hydrogen Produced from Natural Gas

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Key Near-Term Hydrogen Delivery Milestones

- **2005:** Identify and evaluate the most promising approaches and options for economic storage, handling and delivery of hydrogen.

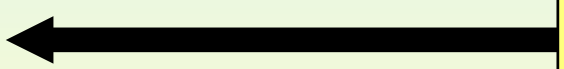
Office of Fossil Energy Milestone

- **2006:** Define a cost-effective hydrogen fuel delivery infrastructure for the introduction and long-term use of hydrogen for transportation and stationary power.

DOE Milestone

Hydrogen Delivery Options

- **Gaseous hydrogen**
  - Pipelines
  - Trucks
  - On-site reforming
- **Liquid hydrogen**
- **Liquid carriers**
- **Solid carriers (e.g., hydrides)**
- **Other novel carriers (e.g. carbon nanotubes)**



The focus of this presentation will be on natural gas-derived gaseous hydrogen delivery.

Existing Natural Gas Delivery Program R&D Areas

- **Inspection technologies**
  - Sensors, pigs, robotic platforms, automation
- **Remote Sensing**
  - 3rd party damage, underground imaging, leak detection
- **Materials Development**
  - Repair, smart pipe, liners
- **Operational Technologies**
  - Compressors, modeling, corrosion

Gaseous hydrogen pipeline delivery program would share similar technology R&D areas with this program.

Gaseous Hydrogen Delivery – Potential Research Areas

- **Inspection technologies**
  - Develop novel pigs to test gaseous H_2 pipelines
- **Remote sensing**
  - Evaluate and develop leak detection technologies
- **Materials development**
  - Research hydrogen embrittlement of metals and requirements for low carbon steels or special alloys
  - Develop novel seal materials and standards required for hydrogen's more demanding tolerances
  - Research and develop novel liners to enable use of existing pipelines
  - Evaluate and demonstrate if, and under what conditions, existing natural gas and liquid pipelines are suitable for conversion to hydrogen service
- **Operational technologies**
  - Codes and standards for hydrogen delivery
  - Novel compressor technologies
  - Safety issues

Gaseous Hydrogen Delivery – Additional Issues

- **Research is needed on the effects of adding hydrogen to natural gas**
  - Feasibility of injecting hydrogen into natural gas and impact on pipeline operation and efficiency of compressors and gas equipment
  - Technologies to separate hydrogen at distributed site

- **Hydrogen metering technology**
  - Analyzing the effect that the presence of hydrogen may have on gas volume metering and measurement technology
  - New metering technologies may be needed

Office of Natural Gas & Petroleum Technology Delivery Activity

To achieve the FE milestone:

- 2005: Identify and evaluate the most promising approaches and options for economic storage, handling and delivery of hydrogen

ONGPT will:

- Evaluate various methods of delivery of hydrogen produced from natural gas
- Work with industry, national laboratories and academia to identify most promising approaches and the means to overcome technical and market barriers
- Provide findings in a “white paper” to be issued in 2005