V.I Hydrogen Delivery Sub-Program Overview

Introduction

Hydrogen must be transported from the point of production to the point of use. It also must be compressed, stored and dispensed at refueling stations or stationary power facilities. Due to its relatively low volumetric energy density, transportation, storage and final delivery to the point of use can be significant cost and energy inefficiencies associated with using hydrogen as an energy carrier. The Hydrogen Delivery activity is focused on developing technology to reduce the cost and increase the energy efficiency of hydrogen delivery for the transition to and long-term use of hydrogen as a major energy carrier.

There are three potential delivery pathways: gaseous hydrogen delivery, liquid hydrogen delivery, and novel solid or liquid hydrogen carriers. A carrier is a material that carries hydrogen in a form other than free H_2 molecules. Examples of potential hydrogen carriers include metal or chemical hydrides, nanostructures, and liquid hydrocarbons that can be easily and simply dehydrogenated and re-hydrogenated.

The DOE Hydrogen Delivery program element is relatively new. FY 2005 was the first year of any significant funding in this area. Seven industry-led collaborative projects and three National Laboratory projects were initiated. These research efforts are focused on delivery infrastructure analysis, lower-cost pipelines, lower-cost off-board storage at refueling stations, liquid carriers, lower-cost and more energy-efficient liquefaction, and more durable and reliable compression technology.

Goal

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

Objectives

- By 2007, define criteria for a cost-effective and energy-efficient hydrogen delivery infrastructure for the transition and long-term use of hydrogen for transportation and stationary power.
- By 2010, reduce the cost of hydrogen transport from central and semi-central production facilities to the gate of refueling stations and other end users to <$0.90/gge of hydrogen.
- By 2010, reduce the cost of compression, storage and dispensing at refueling stations and stationary power facilities to <$0.80/gge of hydrogen (independent of transport).
- By 2015, reduce the cost of hydrogen delivery from the point of production to the point of use in vehicles or stationary power units to <$1.00/gge of hydrogen in total.

FY 2005 Technology Status

Current costs for the transport of hydrogen, with the exception of that transported through the very limited amount of hydrogen pipelines, is $2-$9/gge of hydrogen. This is based on transport by gaseous tube trailers or cryogenic liquid trucks and is very dependent on amounts and distances. Pipeline transport costs are significantly lower but are also very dependent on transport distance and amounts. These transport costs do not include the delivery costs associated with compression, storage and dispensing at the point of use. These additional costs could be as high as $2-3/gge of hydrogen.

In order for hydrogen to become a major energy carrier, the total delivery cost must be substantially reduced. If hydrogen was a major energy carrier transported in large volumes and there was a pipeline infrastructure of the nature of the current natural gas infrastructure, the total cost of hydrogen delivery could be on the order of $2/gge with existing technology. The long-term goal for delivery is $1/gge of hydrogen.

In order to achieve this long-term goal for the cost of hydrogen delivery, and to have commercially viable costs during the transition period, significant technology development is needed. This includes:

- Comprehensive analysis of the options and trade-offs of hydrogen delivery approaches for the transition and long term
- Pipelines: Resolve hydrogen embrittlement concerns with steel pipelines, reduce capital costs by developing new steel compositions and/or welding and installation techniques, and develop composite pipelines with reduced capital costs
- Compression: Develop more reliable and durable hydrogen compression technology for pipeline transmission and refueling station applications
- Storage: Develop lower capital cost off-board storage vessel technology; confirm the technical feasibility and adequate availability of hydrogen geologic storage
- Liquefaction: Dramatically reduce the capital cost and increase the energy efficiency of hydrogen liquefaction
- Carriers: Leverage the Hydrogen On-board Storage program element to determine if a novel solid or liquid carrier might be suitable for hydrogen transport or off-board storage and result in the targeted delivery cost and energy efficiency

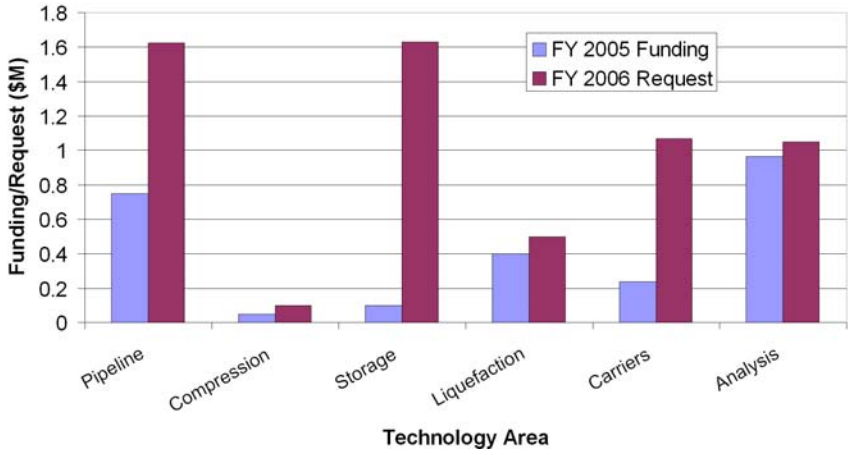
Efforts in all these areas were initiated in FY 2005.

FY 2005 Accomplishments

- Completed an initial analysis of the current costs of hydrogen delivery using pipelines, liquid trucks and gaseous trucks. This included the development of the H2A Delivery Component and Scenario modeling tools.
- Initiated research efforts on the key elements of the hydrogen delivery development plan.
- Formed a Pipeline Working Group which crosscuts all the pipeline research projects. This is enabling more efficient and effective pipeline research.
- Became a member of the EC Naturalhy Project Strategic Advisory Committee focused on the use of existing natural gas infrastructure for the co-transport of natural gas and hydrogen. This EC project is also part of the U.S. Pipeline Working Group. This is resulting in avoiding global duplication of research on this hydrogen delivery pathway.

Budget

The budget profile for the Hydrogen Delivery program element is shown to the right. Plans are to increase funding for compression through future solicitations. The FY 2005 appropriation for the Hydrogen Delivery program element was $2.7 million; the FY 2006 budget request for hydrogen delivery research and development is for $5.9 million.



2006 Plans

- Expand hydrogen delivery infrastructure analysis to include carrier technology approaches, more comprehensive regional and other geographic specific aspects, and more in-depth transition analysis.
- Make technology development progress on the newly initiated delivery research projects.
- Initiate additional research focused on compression, off-board storage, high-pressure tube trailers, and liquefaction.

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