Hydrogen Production and Delivery: Technologies, Challenges, Infrastructure Costs, and Materials Needs

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Two key goals of U.S. energy policy are energy security and reduced emissions including green house gas emissions. The use of hydrogen as an energy carrier, particularly in combination with fuel cell vehicles in the transportation sector, is an approach that can help meet these goals. In 2003, President Bush announced the Hydrogen Fuel Initiative (HFI) and pledged $1.2B over five years to hydrogen and fuel cell research and development. In 2007 he announced the Advanced Energy Initiative (AEI) supporting funding increases over a spectrum of energy technologies including; biofuels, solar, wind, nuclear, coal with carbon sequestration as well continued support for the HFI. DOE has worked with public and private organizations to develop the *National Hydrogen Energy Roadmap*[1] and has developed the *DOE Hydrogen Posture Plan*[1]. These documents describe the research, development, and demonstration steps required to enable hydrogen to become a major energy carrier. Key challenges include cost effective technology to store sufficient hydrogen on-board vehicles to provide at least 300 miles driving range, low cost and durable PEM fuel cells, and lower cost and energy efficient hydrogen production and delivery technology. Significant progress is being made in all of these areas but considerable challenges remain.

Hydrogen can be produced from a variety of domestic resources including; natural gas, coal, water, wind, solar, nuclear energy and biomass. It can also be produced using a variety of technologies that result in near-zero greenhouse gas emissions and other emissions including; coal gasification with carbon sequestration, biomass gasification, reforming of bio-derived liquids (e.g. ethanol, sugars), electrolysis, high temperature thermochemical water splitting cycles, biological production and direct photoelectrochemical production. This variety of potential production pathways from domestic resources is key to energy security. The U.S. Department of Energy (DOE) is funding research in all these hydrogen production pathways.

Hydrogen delivery is an essential component of any future hydrogen energy infrastructure. Hydrogen must be transported from the point of production to the point of use, and handled within refueling stations or stationary power facilities. There are three potential delivery pathways: gaseous hydrogen delivery, liquid hydrogen delivery, and novel solid or liquid hydrogen carriers. The DOE Hydrogen Delivery Program element is a comprehensive effort to research and develop technology to reduce the cost and improve the energy efficiency of hydrogen delivery. It includes pipeline research, improved compression technology, breakthrough liquefaction technology, lower cost off-board storage and extensive analysis of the delivery options for both the transition and longer term use of hydrogen as a major energy carrier.

This presentation will discuss the technologies, challenges, costs, and materials needs for cost effective and efficient hydrogen production and delivery infrastructure.

1. www.eere.energy.gov/hydrogenandfuelcells