Hydrogen

During this century, the United States is expected to undergo a transition to a sustainable energy economy. Hydrogen has long been considered the ultimate energy carrier, a versatile fuel that converts easily and efficiently to other energy forms without the release of harmful emissions. Today, most hydrogen is produced from fossil fuels via thermochemical processes. Although currently cost-effective, the production of hydrogen from fossil fuels results in the release of large quantities of carbon dioxide and will, in the future, be constrained by the availability of feedstock. Successful introduction of hydrogen into the national energy sector is dependent on the continued development of sustainable production and storage technologies as well as the development of essential infrastructure and end-use applications. The view of the U.S. Department of Energy (DOE) is that hydrogen and electricity produced from renewables will form the foundation for sustainable energy systems, displacing and eventually replacing fossil fuel resources.

The Hawaii Natural Energy Institute (HNEI) is a pioneer in the hydrogen field, with hydrogen research being conducted since 1983. From that beginning work, HNEI continues to conduct research aimed at developing technologies for renewable hydrogen production, and has made significant advancements in biological techniques, gasification of biomass, and the direct solar splitting of water into hydrogen and oxygen using photoelectrochemical devices. In 1990, HNEI hosted the World Hydrogen Energy Conference, which drew 550 specialists from 31 nations. All of these efforts were recognized by the DOE in 1996, when HNEI was designated a University Center of Excellence for Hydrogen Research and Education.

In 2000, HNEI's mandate was broadened when the Hawaii Legislature called for the Department of Business, Economic Development & Tourism to conduct a feasibility study to assess the potential for large-scale hydrogen use in Hawai?i, and HNEI was directed to conduct this study. HNEI, in collaboration with Sentech Inc., completed the final report, "Nurturing a Clean Energy Future in Hawaii: Assessing the Feasibility of the Large-Scale Utilization of Hydrogen and Fuel Cells in Hawai?i [1]," in 2001 and revised it in 2004. The study identified areas where hydrogen and fuel cells have the potential to contribute to Hawaii's energy mix and developed a roadmap to develop this potential. One of the recommendations of the study was the creation of public-private partnerships to begin installation of the necessary hydrogen infrastructure.

In later developments, HNEI has been intimately involved in developing public-private partnerships to move forward with the development of hydrogen infrastructure in Hawaii, as recommended by the earlier study. Significant progress has been made in identifying projects and partnerships for achieving this goal. When DOE selected the Hawaii State Energy Office to develop a roadmap for development of hydrogen infrastructure in the state, HNEI then became the implementing partner for development of the Hawaii Hydrogen Power Park [2]. This project involves the deployment and demonstration of an integrated hydrogen system with electrolytic hydrogen production, hydrogen storage, and use of hydrogen in a grid-connected fuel cell. HNEI is continuing its efforts to develop large-scale hydrogen and distributed energy

demonstration projects. Much of this work is focused on the Big Island of Hawai?i and on Oahu. Included are hydrogen fueling facilities for specialized vehicles and use of hydrogen for grid management ? see the various sections of our website listed below.

Separately, with funding from the Office of Naval Research (ONR) and other sources, HNEI has a significant program focused on the development and testing of fuel cells, using hydrogen as the fuel. In 2003, the facility, initially known as the Hawaii Fuel Cell Test Facility began operations. Subsequently, this facility benefited from continued funding from ONR and additional support from the US Department of Energy and other private sources. In 2012, to reflect this expanding partnership and the growing capabilities of the fuel cell test facility, it was renamed as the Hawaii Sustainable Energy Research Facility (HiSERF). For further information on activities at the HiSERF, see the section onFuel Cell Testing [3].

Specific research and project areas are the following items. Clicking on each provides activity details.

- Hawai?i Hydrogen Power Park [2] [2]
- Photoelectrochemical Hydrogen Production (overview) [4]
- Biological Hydrogen Production [5] [6]
- Hydrogen for Hawaii Volcanoes National Park Vehicles[7]
- Hydrogen for GM Equinox Vehicles [8]
- Grid Management Using Hydrogen [9]
- Hydrogen from Biomass [10]

Related Information

For other HNEI research and development activities related to the hydrogen efforts, please refer to the Fuel Cells [11], Grid Systems [12], and Transportation [13] sections of our website.

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Links:
[1] http://web41.its.hawaii.edu/www.hnei.hawaii.edu/sites/web41.its.hawaii.edu.www.hnei.hawaii.edu/files/page/2010/06/h2_fue
[2] http://www.hnei.hawaii.edu/research/hawaii-hydrogen-power-park
[3] http://www.hnei.hawaii.edu/research/fuel-cells/fuel-cell-testing
[4] http://www.hnei.hawaii.edu/node/261
[5] http://www.hnei.hawaii.edu/research/hydrogen/biological-hydrogen-production
[6] http://www.hnei.hawaii.edu/research/hydrogen/hydro-bio
[7] http://www.hnei.hawaii.edu/projects/hydrogen-hawaii-volcanoes-national-park-vehicles
[8] http://www.hnei.hawaii.edu/projects/hydrogen-gm-equinox-fuel-cell-vehicles
[9] http://www.hnei.hawaii.edu/projects/grid-management-using-hydrogen
[10] http://www.hnei.hawaii.edu/research/hydrogen/hydrogen-biomass
[11] http://www.hnei.hawaii.edu/research/fuel-cells

[12] http://www.hnei.hawaii.edu/research/grid-systems
[13] http://www.hnei.hawaii.edu/research/transportation
[14] http://www.hnei.hawaii.edu/term/biological-hydrogen-production
[15] http://www.hnei.hawaii.edu/term/hydrogen