

V.A.6 Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems (New Project)*

Richard E. Rocheleau

Hawaii Natural Energy Institute, University of Hawaii

1680 East-West Road, POST 109, Honolulu, HI 96822

Phone: (808) 956-8346; Fax: (808) 956-2336; E-mail: rochelea@hawaii.edu

DOE Technology Development Manager: Sig Gronich

Phone: (202) 586-1623; Fax: (202) 586-9811; E-mail: Sigmund.Gronich@ee.doe.gov

** Congressionally directed project*

Objectives

- Development of cost-effective renewable hydrogen production technologies.
- Assessment of hydrogen fuels purity requirements for fuel cell applications.
- Research, testing, and validation of hydrogen technologies.

Technical Barriers

This project will address the following technical barriers from the Hydrogen Production, Hydrogen Storage, Fuel Cells, Technology Validation, and Education sections of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

Hydrogen Production

- F. Feedstock Cost and Availability
- G. Efficiency of Gasification, Pyrolysis, and Reforming Technology
- M. Material Durability
- N. Materials and System Engineering
- O. Photoelectrochemical Efficiency
- T. Renewable Integration
- AB. Hydrogen Separation and Purification

Hydrogen Storage

- U. Codes and Standards
- V. Life Cycle and Efficiency Analyses

Fuel Cells

- O. Stack Material and Manufacturing Cost
- P. Durability
- Q. Electrode Performance

Technology Validation

- B. Storage
- E. Codes and Standards
- H. Hydrogen from Renewable Resources

Education

- A. Lack of Awareness
- B. Lack of Demonstrations or Examples of Real World Use
- C. Institutional Barriers and Access to Audiences

Approach

- Develop programs that take advantage of HNEI and its partners' unique expertise and technology successes, as well as unique aspects of Hawaii's energy systems.
- Leverage past and ongoing investments in the hydrogen and fuel cell research in Hawaii funded through DOE, DOD, and industry.
- Integrate these activities to bring together the technical, business, and geographic assets of the State of Hawaii and to accelerate national and international partnerships.

Accomplishments

- This project has not yet begun.

Future Directions

- Pursue research efforts aimed at achieving cost effective hydrogen production from biomass and via photoelectrochemical processes.
- Conduct studies at the Hawaii Fuel Cell Test Facility to aid in the development of fuel cells and assess hydrogen fuel purity requirements.
- Continue to develop hydrogen infrastructure at the Hawaii Hydrogen Power Park to assist in resolving issues of hydrogen production, storage, and integration.
- Educate students and the public about hydrogen technologies.

Introduction

Renewable hydrogen production activities have been conducted at the Hawaii Natural Energy Institute (HNEI) under DOE funding since 1986 and have included biological and photoelectrochemical hydrogen production and hydrogen from biomass. Under this project, HNEI will continue to develop these technologies for cost effective renewable hydrogen production. With funding from Office of Naval Research (ONR), HNEI has developed a state-of-the-art fuel cell test facility. Under this project, HNEI will use this facility to determine the effect of trace contaminants on the performance and durability of fuel cells. In 2003, with funding through the Hawaii Energy Office under the State Energy Partnership Program, HNEI developed the Hawaii Hydrogen Power Park. Under this project, HNEI proposes to develop additional infrastructure to provide larger quantities of high purity hydrogen in support of fuel cell testing and other mobile and

stationary hydrogen energy applications. In addition, the Power Park will conduct community outreach programs.

Approach

HNEI's renewable hydrogen production activities will include hydrogen production from photoelectrochemical devices and from biomass. In addition, HNEI proposes to conduct engineering assessments of these and other potential renewable hydrogen technologies to identify promising technologies for low-cost production. The Thin Films Laboratory at HNEI is continuing to develop hybrid photoelectrodes using modified multijunction amorphous silicon devices. Under this project, HNEI proposes to explore four novel terminal devices combining amorphous silicon and copper-indium-gallium-diselenide devices to offer the potential for significantly higher efficiencies. These new structures have the potential for solar-to-

hydrogen efficiencies of greater than 15%. With regard to biomass, HNEI will be a partner in a proposed project aimed at cost effective production of alcohol and hydrogen from bagasse using a combined gasification/synthesis route. HNEI will conduct research in critical areas including developing technologies for removing contaminants from the biomass, optimizing reformer design and operation, and developing technologies for gas cleanup. HNEI will also evaluate the feasibility of using fuel cells for electricity generation using the various product streams.

Under this project, HNEI proposed to conduct comprehensive studies of the effects of trace contaminants on PEM fuel cell performance and durability. Working with DOE, SAE, and the U.S. Fuel Cell Council (USFCC), HNEI intends to provide experimental data which will help identify fuel purity requirements.

HNEI's Hawaii Hydrogen Power Park will be expanded as part of this proposed project. HNEI will explore the transport and cleanup of hydrogen from a

local refinery as a way to provide larger quantities of high purity hydrogen to the Power Park. HNEI also expects to provide hydrogen to an internal combustion engine (ICE) powered combined heat and power (CHP) system proposed by Hawaiian Electric Company and the City and County of Honolulu. HNEI will study the engineering and environmental impact of using the hydrogen blended fuel in the ICE engine. Codes and standards for the transport and use of hydrogen will be addressed.

FY 2004 Publications/Presentations

1. Richard E. Rocheleau, "Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems," Poster Presentation at 2004 DOE Hydrogen, Fuel Cells & Infrastructure Technologies Program Review, Philadelphia, PA (2004).
2. Richard E. Rocheleau, "Hydrogen Programs in Hawaii," Presentation at 2004 NHA Meeting, Los Angeles, CA (2004).