

VII.7 Hawaii Hydrogen Power Park

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Project Start Date: June 29, 2009 (Final Agreement
with State of Hawaii)

Project End Date: September 30, 2012

Fiscal Year (FY) 2011 Objectives

Island of Hawaii (Big Island)

- Install hydrogen dispensing infrastructure at Hawaii Volcanoes National Park (HAVO) on the Big Island of Hawaii (hydrogen provided under a separate program: “Hydrogen Energy Systems as a Grid Management Tool”).
- Support the operations of the National Park Service (NPS) hydrogen plug-in hybrid electric vehicle (PHEV) shuttle buses through September 2012.
- Conduct engineering and economic analysis of HAVO bus operations on different routes, grades, elevations and climatic conditions.
- Validate fuel cell system performance in harsh environments including high SO₂ concentrations.
- Attract new partners and applications for the Big Island hydrogen infrastructure.
- Conduct outreach to local authorities and the general public regarding hydrogen infrastructure.

Oahu

- Support operations of the General Motors (GM) Equinox Fuel Cell Vehicle (FCV) Hawaii demonstration program in partnership with the Office of Naval Research.
- Install a Powertech hydrogen production, storage, and dispensing system at Marine Corps Base Hawaii (MCB Hawaii);

- Procure and operate a lightweight hydrogen delivery trailer to support fueling requirements; and
- Conduct engineering and economic analysis of GM FCV fueling operations.

Technical Barriers

This project addresses the following technical barriers from the indicated sections of the April 2009 edition of the Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan:

Technology Validation, Section 3.6.4

- (A) Lack of Fuel Cell Vehicle Performance and Durability Data
- (C) Lack of Hydrogen Refueling Infrastructure Performance and Availability Data
- (H) Hydrogen from Renewable Resources

Hydrogen Safety, Section 3.8.4

- (H) Lack of Hydrogen Knowledge by Authorities Having Jurisdiction

Technical Targets

This project will contribute to the following DOE milestones from sections of the Multi-Year Research, Development and Demonstration Plan:

Technology Validation section 3.6.6 Milestones

- **Milestone 34:** Complete power park demonstrations and make recommendations for business case economics. (2Q, 2008) Our HAVO system will utilize electrolytic hydrogen produced at a nearby geothermal plant and delivered by tube trailer from the geothermal plant to HAVO. The geothermal hydrogen production plant is funded by a DOE/Naval Research Laboratory (NRL) project (not part of Power Park) and the Power Park is leveraging this investment. Our MCB Hawaii system will support the early deployment of a small fleet of GM Equinox FCVs. Data will be collected to evaluate cost and technical performance of the MCB Hawaii and HAVO systems.

FY 2011 Accomplishments

- Signed an implementation agreement with the State of Hawaii (DOE funds via State Energy Office) contracting HNEI as the project “Implementing Partner” on behalf of the State of Hawaii.
- Secured State of Hawaii \$1.2 million cost share funds via Kolohala Holdings LLP.

- Completed a hydrogen fueling station specification.
- Obtained Kilauea Military Camp (KMC) approval and support as the site of the fueling station.
- Completed background noise survey at the KMC site.
- Assisted HAVO to develop a noise specification for the fueling station.
- Assisted HAVO to secure bus funding from NPS (\$1 million) and from the State of Hawaii (\$600,000).
- Re-scoped the project to support the GM Hawaii Equinox FCV rollout at MCB Hawaii.
- Completed factory acceptance of the Powertech system and demonstrated compatibility with GM Equinox FCVs.
- Developing several memorandums of agreement among project partners:
 - HAVO
 - KMC
 - MCB Hawaii
- Initiated actions to relocate the Powertech integrated hydrogen production and dispensing system to MCB Hawaii on Oahu.
- National Environmental Protection Act (NEPA) approval for the HAVO site.
- NEPA approval for the MCB Hawaii site.
- Obtained funding and initiated actions to upgrade the Powertech station to 700 bar fast-fill to support GM Equinox FCVs.
- Developed the infrastructure specifications for MCB Hawaii.
- Selected the contractor to install infrastructure at MCB Hawaii.
- Secured an additional \$600,000 in state funding for the MCB Hawaii infrastructure.
- Purchased the hydrogen delivery tube trailer for use on Oahu.



Introduction

The Hawaii Hydrogen Power Park (Power Park) was established to support the DOE Technology Validation sub-program. The Power Park is funded by the DOE through the Hawaii Department of Business, Economic Development and Tourism's Strategic Industries Division, in its role as the Hawaii State Energy Office, with the University of Hawaii's Hawaii Natural Energy Institute as the implementing partner, with the objective to conduct engineering and economic validation of pre-commercial hydrogen technologies. Power Park is supporting the testing and validation of hydrogen fueling system technologies on the Big Island of Hawaii and Oahu, including production utilizing renewable energy, compression, storage, delivery, and dispensing to hydrogen vehicles. In parallel, the HAVO

is planning to acquire, initially, two battery-dominant fuel cell PHEV shuttle buses. The source of HAVO funds is from the Department of Transportation through the NPS Alternative Transportation in the Parks and Public Lands Program. It is intended to support HAVO's hydrogen fueling requirements with the infrastructure developed in the Power Park. In 2011 the scope of the project was expanded to include support for the GM Equinox FCV demonstration on Oahu. The fueling station originally planned for HAVO is being reallocated to the MCB Hawaii on Oahu. A fueling dispenser will be installed at HAVO and supplied with hydrogen produced at the Puna Geothermal Ventures (PGV) geothermal plant under a separate award and delivered by lightweight hydrogen delivery trailers to HAVO.

Approach

Due to the expanded scope of the project, activities are now being conducted on the Big Island of Hawaii and on Oahu. The approach is to install hydrogen fueling stations at each of the sites and conduct fueling operations to support small fleets of fuel cell vehicles. On the Big Island a compressor fueling dispenser will be installed at the KMC facility located at HAVO to support two PHEV battery-dominant fuel cell shuttle buses that will be used to shuttle visitors around the park. The hydrogen will be supplied via tube trailers from the PGV geothermal site. This leverages a non-related DOE/NRL project that is utilizing electrolyzers as a potential grid load management system while producing hydrogen that can be used for transportation.

On Oahu the project will install a fully integrated hydrogen production, storage, and dispensing system at MCB Hawaii. The station will be used to support the operation of a small fleet of GM Equinox FCVs. Initially dispensing hydrogen at 350 bar, the station will be upgraded to 700 bar utilizing Office of Naval Research funding.

Results

Legal and Insurance

This project relies on the installation of major hydrogen systems and infrastructure to enable the demonstration of a variety of technologies in an integrated system and a real-world environment. The installation of infrastructure in the private community requires interfacing with local authorities having jurisdiction and covers a variety of subject areas relating primarily to safety in form of permitting and related codes and standards, fire fighting and first responders training, and, as we have experienced in this project, legal issues involving risk management, liability, indemnification and insurance coverage. Multiple partners add to the complexity of developing legal agreements and we have experienced a significant educational requirement to ensure a high level of comfort with these projects among all the parties. While significant progress in working through these issues has been made, it is incremental and time-consuming,

and introduces delays to the project schedule. HNEI has identified this as a systemic issue and raised it with the DOE. Apparently many hydrogen projects have reported similar experiences. HNEI has proposed that DOE work on developing a systemic solution that includes working with the insurance industry. Initial meetings have been held and follow-on meetings have been planned. In the meantime, HNEI continues to draft appropriate agreements that address indemnification and liability concerns.

Program Development

Due to changed circumstances, it was decided that the best use of project resources would be to leverage a new separately-funded project entitled Hydrogen Energy Systems as a Grid Management Tool that will produce hydrogen at the PGV geothermal plant. The new plan will deliver hydrogen from PGV to HAVO using lightweight composite hydrogen delivery trailers towed by a light-duty truck. Fueling operations will be accomplished by a compressor-fill hydrogen dispenser connected to the hydrogen tube trailer. These changes make use of lower cost electricity and provide a clear linkage to producing hydrogen from a renewable energy source. The original Powertech fueling station will be deployed to the MCB Hawaii on Oahu to support the deployment of a fleet of GM Equinox FCVs. This 350 bar station will be upgraded to provide a 700 bar fast-fill capability using funds provided by the Office of Naval Research. This change resulted in the requirement to apply for approvals from the DOE and the State of Hawaii, amend project documentation, and submit new NEPA forms.

Technical

During this reporting period HNEI conducted a successful factory acceptance trial of a turnkey Powertech hydrogen production and dispensing system at Powertech in Vancouver. The factory acceptance trial was supported

by GM which deployed an Equinox FCV to prove compatibility of the FCV with the fueling station. Several fueling and de-fueling operations were conducted to ensure proper communications between the fueling station and the vehicle's onboard monitoring and control system. The design of the MCB Hawaii supporting site improvement infrastructure was completed, and a request for quotes was issued for the "turn-key" installation of the site improvements. Further technical progress will be accomplished after all legal agreements are in place.

Conclusions and Future Directions

Oahu

- Execute remaining memorandums of agreement with project partners.
- Complete the MCB Hawaii infrastructure site improvements.
- Install the Powertech system at MCB Hawaii.
- Upgrade the Powertech system to 700 bar fast-fill.

Island of Hawaii (Big Island)

- Install a hydrogen 350 bar dispensing system at HAVO.
- Deliver geothermal hydrogen to HAVO with tube trailer.
- Support HAVO bus operations.
- Collect and analyze fueling station and vehicle data.
- Seek opportunities for expansion of fleets and/or additional hydrogen infrastructure.

FY 2011 Publications/Presentations

1. R. Rocheleau and M. Ewan, "The Hawaii Hydrogen Power Park," US DOE Annual Merit Review, Washington, DC, May 2011.