HAVO Fuel Cell Buses

Hawai'i Natural Energy Institute

The Hawai'i Natural Energy Institute (HNEI) is conducting research to develop and validate fuel cell air filtration systems in support of operating Fuel Cell electric buses in a variety of road grades, elevations, and air quality conditions at Hawai'i Volcanoes National Park (HAVO). HNEI is also evaluating the logistics requirements of supplying hydrogen to HAVO from a central production site located in Kona.

Figure 1: Supply of Hydrogen to HAVO

Challenges & Significance

A major challenge being investigated by HNEI researchers is the operation of fuel cell electric vehicles in areas of high levels of air contamination. Air contaminantion, in particular those with high levels of sulfur content, such as SO_2, can lead to the rapid deterioration of the platinum catalyst in fuel cells. This in turn can result in the premature requirement to replace them at considerable expense. HNEI researchers have developed a novel air contaminant sensor monitoring system that informs the bus driver in real time of the requirement to change air filters, thus protecting the fuel cells from damage. The HAVO high air contaminant environment is similar to potential battlefield conditions that may be experienced by the Marine Corps and Army. Fuel Cell performance data will be collected, analyzed and reported jointly to the Office of Naval Research and US Department of Energy. In support of the air filtration test program, HNEI is supplying the buses with hydrogen.

Status & Accomplishments

- An air filtration system has been integrated with an air contaminant environmental sensor system.
- Two fuel cell electric shuttle buses have been completed and shipped to O'ahu for testing and installation of the air filtration monitoring systems.
- Three lightweight hydrogen transport trailers have been purchased to deliver hydrogen from NELHA to HAVO.
- A hydrogen dispenser is being installed at HAVO to fuel the two buses.
- A hydrogen production system has been purchased and is being installed at NELHA.

Project Detail

Transportation applications, initially utilizing fleet vehicles such as buses, is the most likely scenario for developing a hydrogen economy in Hawai'i. In 2008 the Hawai'i Volcanoes National Park (HAVO) was awarded funding in the amount of $989,000 under the Alternative Transportation in the Parks and Public Lands (ATTPL) financial assistance program to fund

Contact(s):
Mitch Ewan
808-956-2337
ewan@hawaii.edu

Richard Rocheleau
808-956-8346
rochelea@hawaii.edu

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- US Hybrid

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the purchase of two plug-in hybrid electric vehicle hydrogen shuttle buses to be used for transport of Park visitors. Fuel cell buses can significantly mitigate many of the negative impacts associated with private and commercial vehicles visiting the Park while also fulfilling the role of providing greater access to the park's natural and cultural resources. The project supports the NPS Climate Friendly Parks program. HNEI is installing hydrogen fueling infrastructure at HAVO as a component of its Hawai'i Hydrogen Power Park project. The hydrogen storage and dispensing system (a hydrogen "gas station") will be located at the Kilauea Military Camp (KMC), a Department of Defense (DoD) recreational facility located inside HAVO park boundaries. KMC's part-time bus drivers will be employed to drive the HAVO shuttles. The hydrogen will be produced at NELHA and transported in 450 bar hydrogen transport trailers to HAVO (Figure 1). The trailers will be used in a "drag and drop" scenario where an empty trailer is replaced by a full trailer. The trailer provides onsite hydrogen storage and cascade fills the bus. This eliminates the need for an onsite compression system. This will be the first hydrogen fueling station on the Island of Hawai'i.

Working in consultation with the Hawai'i Center for Advanced Transportation Technologies (HCATT), a state R&D entity attached to the Department of Business, Economic Development and Tourism (DBEDT), HAVO developed a specification for the HAVO shuttle buses that meets the Park's needs. Because there are no off-the-shelf hydrogen shuttle buses available on the commercial market at this time, HAVO purchased two buses powered by an internal combustion engine drive train utilizing ATTPL funds. The buses were converted to a PHEV hydrogen drive train system by US Hybrid under contract to HCATT. HCATT is well-qualified by virtue of its robust hydrogen program with the US Air Force at Hickam AFB to implement the conversion of the buses. The HAVO buses leveraged the considerable non-recurring engineering investment by the US Air Force. This project establishes a complete hydrogen transportation system on the Big Island that will be used to collect operational data as well as provide outreach and education experiences to the general public. The buses will be operated on several routes in the Park to test performance under a variety of operational conditions including elevations from sea level to 7,000 ft elevation. This will provide valuable data on the performance of the buses on steep grades. Some areas of the Park experience very high levels of sulfur dioxide that will provide a good opportunity to evaluate the performance and reliability of hydrogen drive trains operating in high levels of air pollution.

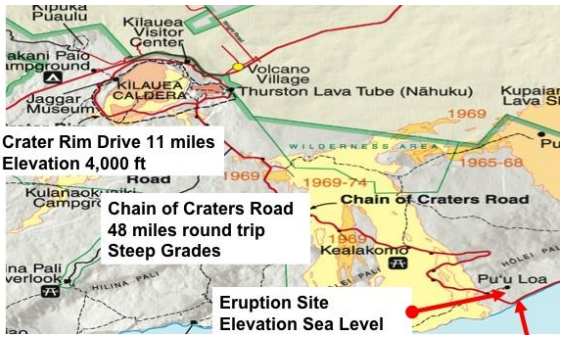

Figure 2: HAVO Routes

HNEI has developed an environmental sensor system that monitors the air quality of inlet air to the fuel cell before and after it passes through the filter element. It provides real time information to the bus driver on the condition of the inlet air and identifies when the filter element needs to be changed to prevent contamination of the fuel cell platinum catalyst by sulfur compounds in the air such as SO2. This is of interest to the Marine Corps and Army because it emulates potential air contaminants in a battlefield environment.

Hawai'i Natural Energy Institute | School of Ocean & Earth Science & Technology
University of Hawai'i, 1680 East West Road, POST 109 • Honolulu, HI 96822
www.hnei.hawaii.edu • Ph: (808) 956-8890 • Fax: (808) 956-2336
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