



UNIVERSITY OF CALIFORNIA *Berkeley*  
**Transportation Sustainability**  
RESEARCH CENTER

April 22, 2010

Commissioners James D. Boyd and Anthony Eggert  
California Energy Commission  
Dockets Office, MS-4  
Re: Docket No. 09-ALT-1  
1516 Ninth Street  
Sacramento, CA 95814-5512

**DOCKET**

**09-ALT-1**

DATE APR 22 2010

RECD. APR 22 2010

Dear Commissioners Boyd and Eggert:

We are writing to provide input to the draft 2010-2011 Investment Plan for implementing AB 118, the Alternative and Renewable Fuel and Vehicle Technology Program. We are providing this information as a partnership between the Schatz Energy Research Center (SERC) at Humboldt State University (HSU) and the Transportation Sustainability Research Center (TSRC) at the University of California, Berkeley (UCB).

### **Background**

The draft 2010-11 Investment Plan calls for focusing funding for hydrogen infrastructure in designated southern California clusters. This is a cost-effective and sensible policy. However we feel it is important to draw attention to the fact that we operate hydrogen vehicles and infrastructure outside those clusters in northern California, and that support is needed for these efforts as well. This is an area of the state where significant hydrogen vehicle technology development is occurring and where public support for alternative transportation is high. We feel there are compelling reasons why our locations are important and should be included in a statewide effort to realize the goals of AB 118.

Currently there are only three operating hydrogen fueling stations in northern California. They are located at HSU in Arcata, the California Fuel Cell Partnership (CAFCP) in West Sacramento, and AC Transit in Oakland. The station at HSU was designed and built by SERC engineers. SERC has 20 years of experience with hydrogen and fuel cell technology, built the first hydrogen station in the U.S. at SunLine Transit in Thousand Palms, has two fuel cell patents, and license agreements with three U.S. corporations to commercialize fuel cell technology. SERC operates and maintains the station, which has run well for almost two years.

The new standard for hydrogen tanks on vehicles is 700 bar, double the original 350 bar standard. None of the operating stations above are capable of a 700 bar fill. However, several new Bay Area stations are nearing construction; they are located at the TSRC in the UCB Richmond Field Station, at AC Transit in Emeryville, and at San Francisco International Airport. Once they are open later in 2010, these new stations will be 700 bar capable. The CAFCP is also planning to upgrade their station to 700 bar.

SERC and TSRC are presently collaborating on two related projects. The first, headed by the TSRC, involves testing, gathering operational data, and gauging consumer reaction to state-of-the-art hydrogen fuel cell vehicles and fueling infrastructure. Vehicle OEMs Toyota and Daimler are providing vehicles for this project. TSRC recently furnished SERC with a Toyota Highlander FCHV-adv “advanced” fuel cell vehicle for testing (see below). The Highlander is 700 bar capable and has a 400 mile range when its tanks are full. At SERC, drivers are only able to utilize half of the vehicle's range because the station dispenses at 350 bar.



*The Toyota Highlander FCHV-adv “advanced” fuel cell vehicle and the HSU hydrogen fueling station*

The second project, an education project entitled Hydrogen Energy in Engineering Education (H2E3), is headed by SERC and funded by the U.S. Department of Energy (total funding is \$524K). It involves developing laboratory hardware and curricula to introduce hydrogen and fuel cell topics to thousands of engineering students in the University of California (UC) and California State University (CSU) systems. During the first year of a three-year project, SERC has delivered fuel cell/electrolyzer laboratory kits and a fuel cell test station to TSRC and the HSU Environmental Resources Engineering Department. We have also begun introducing curricular material in HSU and UC Berkeley engineering courses (see below).



*HSU engineering students using the lab kits*

*The test station is delivered to UC Berkeley.*



Beginning this summer, the H2E3 project also aims to place engineering students who have experienced the hydrogen and fuel cell curriculum in internships at U.S. fuel cell companies. Companies involved include UTC Fuel Cells, IdaTech, and Protonex.

## **Proposal**

SERC and TSRC propose to respond to the 2010-2011 Investment Plan with the following activities:

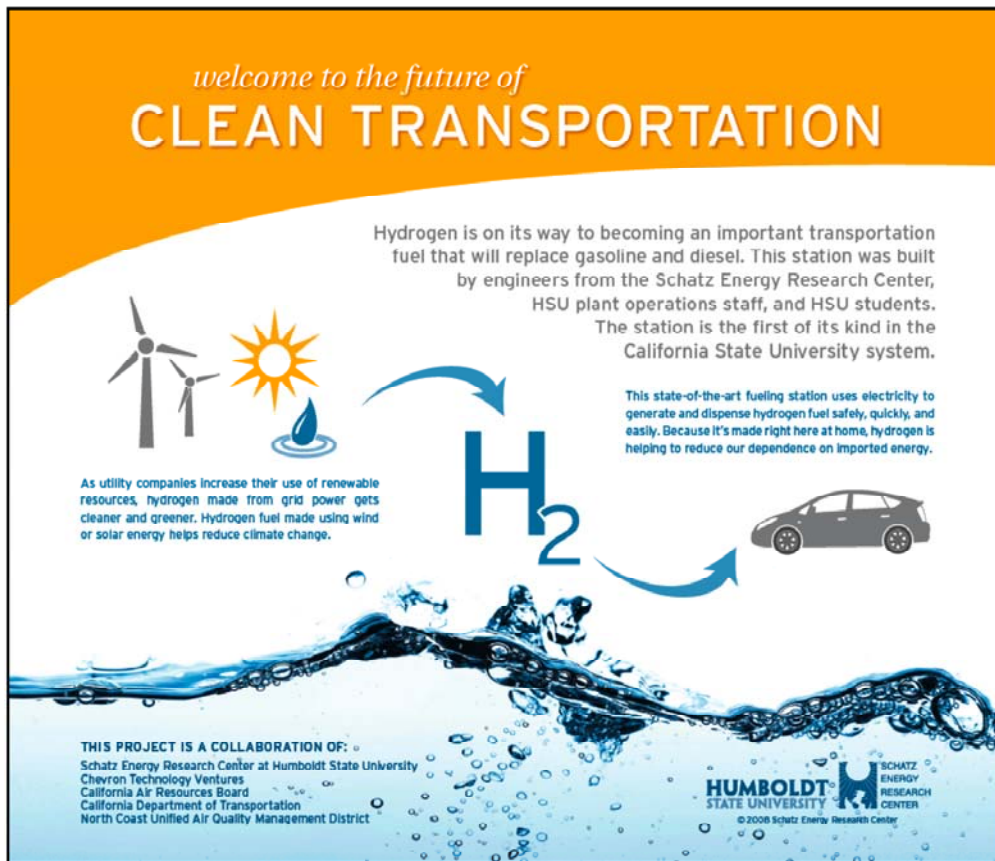
1. Upgrade the HSU Hydrogen Fueling Station to 700 bar capability. We will accomplish this by adding a 700 bar compressor and associated fuel dispensing hardware and compress hydrogen directly into the vehicle. This will enable full fueling of the Highlander, providing sufficient range to allow it to be driven from HSU back and forth to the Bay Area and Sacramento, trips of 300 miles made fairly frequently by SERC personnel. This will connect the HSU station to the existing northern California hydrogen infrastructure and add important information on the long distance performance of fuel cell vehicles (FCVs), information not here-to-fore available since FCVs are being tested in urban areas. It is also likely that, with 700 bar capability, Toyota and Daimler will add additional FCVs to the SERC/TSRC fleet for field testing.

2. Instrument the fueling stations and vehicles to provide important data for use in energy modeling and for classroom use. The TSRC and SERC stations will be instrumented with electrical power and hydrogen flow transducers. This will enable measurement of the energy required for hydrogen compression; there are no published data for 700 bar compression.

These data will also be used in classrooms on the two campuses and in educational materials developed for wider use. One of the tasks in the H2E3 education project is to “monitor and analyze hydrogen fueling stations and vehicles as class projects.” This activity is a natural follow-on to the student labs. In the lab, students measure electrolyzer and fuel cell efficiencies. They will then visit a fueling station (many UC and CSU campuses are in close proximity of a hydrogen station) and drive (or get rides in) the vehicles. With station and vehicle data, they can compare their lab measurements with real world technology. This is an excellent way to get engineering students excited about clean transportation technology.

3. Expand the H2E3 project. We will expand the H2E3 project to other campuses in the UC and CSU by assembling additional lab kits and fuel cell test stations. These will be accompanied by the curricula and delivered along with training in their use. We will also expand the internship program to include fuel cell and hydrogen technology companies (i.e., Alteryg, Air Products, Linde, etc.) in California. This will serve to develop the workforce of future design professionals that will be needed to implement hydrogen energy and fuel cell technology in our state.

4. Extend education and outreach to students and the general public. SERC and TSRC will produce educational outreach materials and placards to carry the clean transportation message to many (not just engineering) UC and CSU students and the general public. An example of these materials is the interpretive sign at the HSU fueling station (see below).



*This interpretive sign informs visitors to the HSU fueling station of the promise of hydrogen to reduce our dependence on imported oil and mitigate climate change.*

TSRC and SERC will work to produce up-to-date signage and brochures for use at TSRC's station and other stations in California. We will participate in outreach events to the general public and student populations.

As noted above, we support the Energy Commission's plan to focus efforts to develop a hydrogen infrastructure in southern California. However, we do not feel *all* the funding should go to that area. The projects we describe have advantages unique to northern California and would benefit the entire state, at a small fraction of the total budget. We urge you to support them.

Sincerely yours,

Peter Lehman, Director  
Schatz Energy Research Center

Timothy E. Lipman, Co-Director  
Transportation Sustainability Research Center