2012 DOE Hydrogen Program and Vehicle Technologies Program AMR

SUSTAINABLE HYDROGEN FUELING STATION, CALIFORNIA STATE UNIVERSITY, LOS ANGELES

Dr. David Blekhman

California State University, Los Angeles

prepared March, 2012

Project ID
TV014

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Overview

Timeline

- Start: 01/01/2010
- End: 12/31/2012

100 % complete

Budget

- Total project funding
  - DOE $475,750
  - Contractor $475,750
- Funding received in full.

Partners

- California State University, Los Angeles— Project lead
- Funding Agencies
- California Fuel Cell Partnership
- GM Corp, Honda, Daimler, Hyundai, Toyota

Barriers

Hydrogen Production and Delivery

– Reduce the cost of compression, storage, and dispensing at refueling stations

– Research and develop low-cost, highly efficient hydrogen production technologies

Technology Validation

– Validate complete systems of integrated hydrogen and fuel cell technologies for transportation, infrastructure and electricity generation applications under real-world operating conditions.

Education

– Educate key audiences to facilitate near-term demonstration, commercialization, and long-term market acceptance.

Project Objectives Relevance

A. PROJECT OBJECTIVES

- The College of Engineering, Computer Science, & Technology at California State University, Los Angeles as part of its energy curriculum is building a sustainable hydrogen station to teach and demonstrate the production and application of hydrogen as the next generation of fully renewable fuel for transportation.
- The requested funding will provide for the acquisition of the core hydrogen station equipment: electrolyzer, compressors and hydrogen storage.

B. PROJECT SCOPE

- The CSULA hydrogen station will deploy the latest technologies with the capacity to produce 60 kg/day. The station will be utilizing a Hydrogenics electrolyzer, first and second stage compressors capable of fast filling at 10,000 psi (700bar), 60 kg of hydrogen storage, water purification and equipment cooling system. The station will be grid-tied and powered by 100% renewables.
- The station will also be used as an applied research facility for equipment testing and verification, testing of fuel purity and dispensing accuracy. Another primary function of the station is to introduce hydrogen as a safe transportation fuel through public education and partnerships.

Approach: Tasks Under This Funding

Task 1.0 Hydrogen Station Equipment Acquisition--Completed

- The current funding provides for a single task of acquisition of the core hydrogen station equipment: electrolyzer, compressors and hydrogen storage.
- **Subtask 1.1 Electrolyzer**
  - Order, receive and install electrolyzer: HySTAT-A 1000D-30-10.
- **Subtask 1.2 350 Bar Compressor**
  - Order, receive and install 350 bar compressor: PDC-4-1000-6500.
- **Subtask 1.3 700 Bar Compressors**
  - Order, receive and install two (2) 700 bar compressors: Hydro-Pac C12-60-10500LX.
- **Subtask 1.4 Hydrogen Storage Tanks**
  - Order, receive and install three (3) 350 bar storage tanks: .

MILESTONES--Passed

Milestone 1.1 Ordering

- Complete ordering equipment listed in Task 1 in Quarter 1 after receiving funds.

Milestone 1.2 Receiving and Installation

- Complete receiving and installing the equipment listed in Task 1 in Quarter 4 after receiving funds.

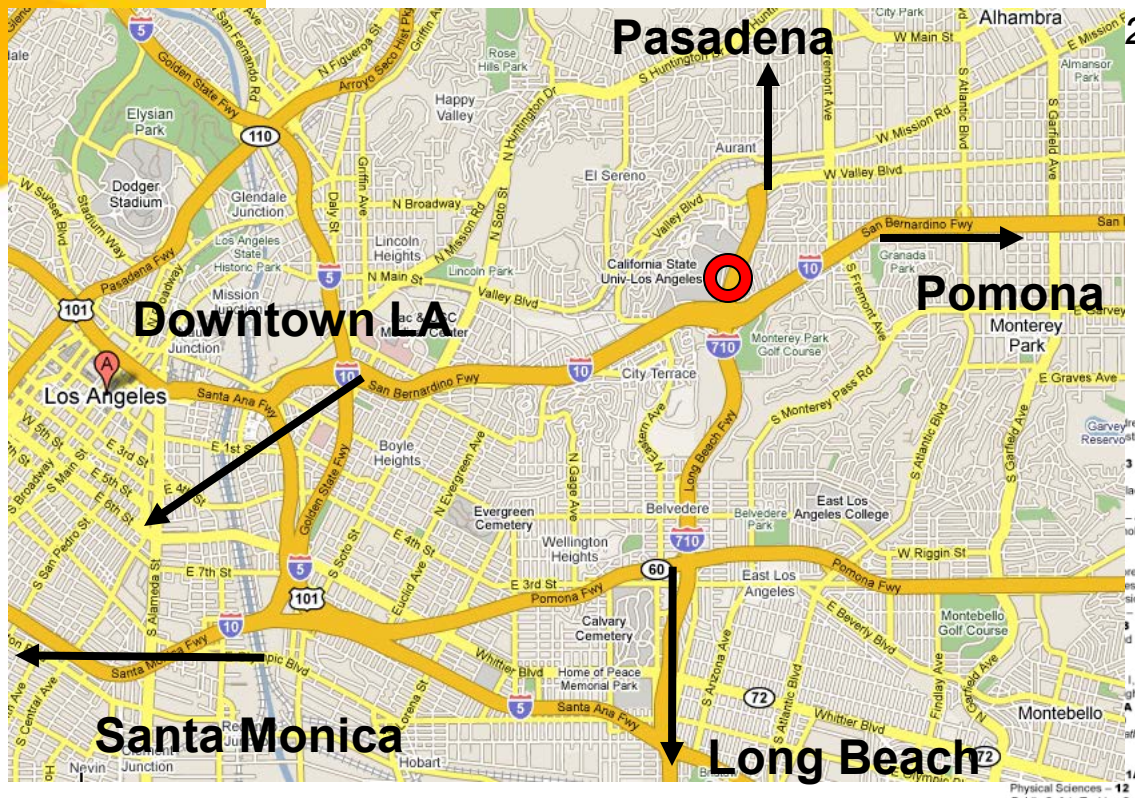
College Initiatives Relevance

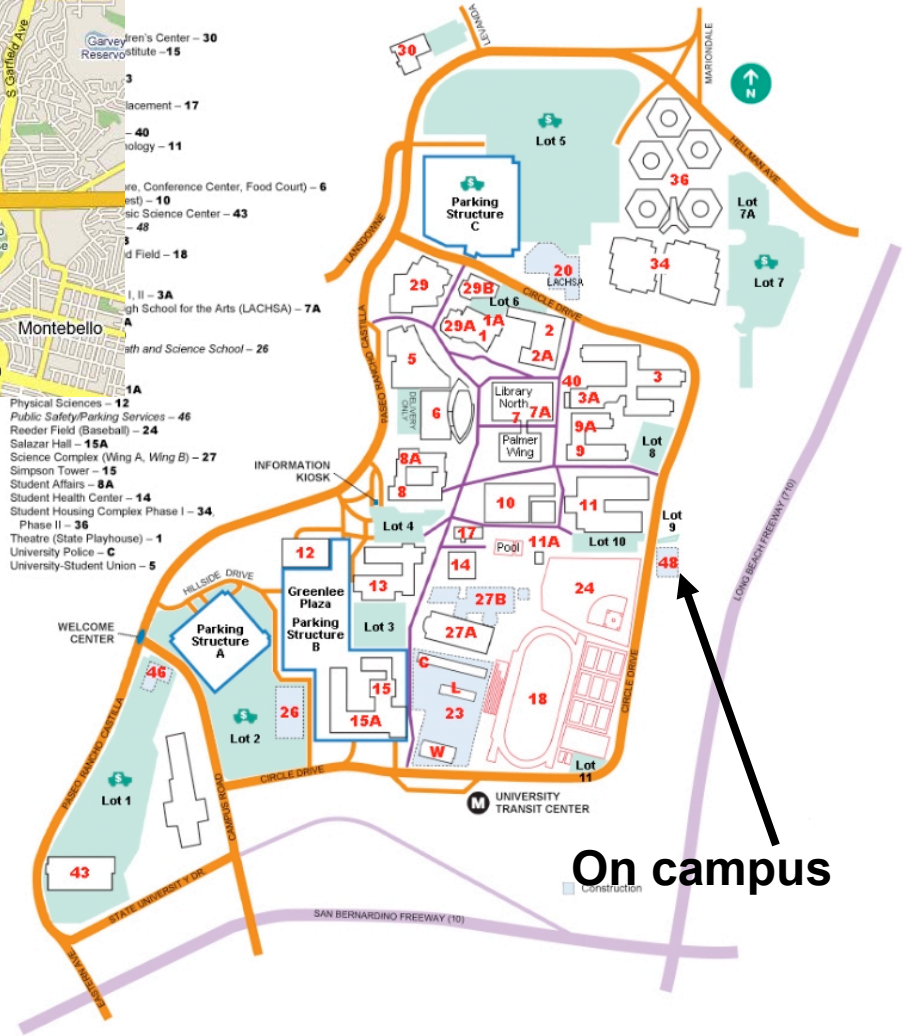
- Building a hydrogen fueling station to serve the central Los Angeles area and become a focal point of research, educational and outreach activities.
- Redesigning the curriculum to implement an effective Alternative and Renewable Energy Technologies program including hydrogen economy and fuel cell applications.
- Conducting research in collaboration with the Center for Alternative and Renewable Energy and Sustainability. Funded by NSF programs and local partners.

Hydrogen Fueling Facility

- Establish a Sustainable Hydrogen Fueling Facility at Cal State L.A
  - CARB No. 06-618 $2,700,000
  - DOE Award #DE-09EE0000443 $475,750
  - AQMD, MSRC, Ahmanson Foundation, AAA

Great Location



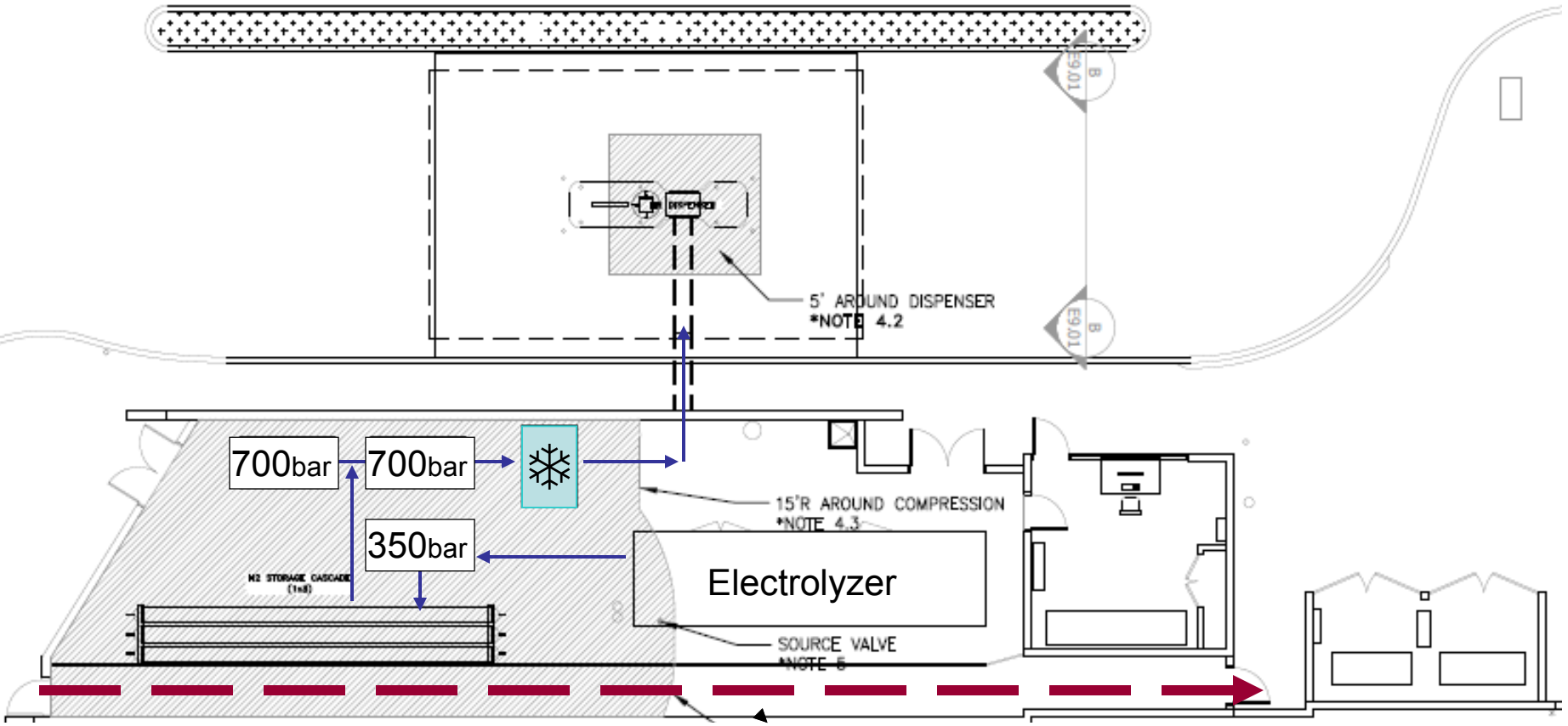


The Team and Equipment

- Cal State LA
  - Project management
- General Physics
  - Major equipment
- Weaver
  - **Leo-A-Daly**-architect
  - **EPC4H2**-engineering
  - **Quantum Technologies**-hydrogen dispensing
  - **Others**

- Major Equipment
  - Electrolyzer **Hydrogenics** HYSTAT 30—60 kg/day
  - 350 bar compressor **PDC**-4-1000/7500—0.044 kg/min
  - 700 bar compressor **Hydro PAC** C12-60-10500XL (2) –0.5 kg/min each
  - Storage tanks (3) **CPI** 8x16247—20kg/350 bar each

Equipment Layout and Hydrogen Flow



Walking tours

Station Look From Inside

Hydro-Pac 700 bar compressor
0.5 kg/min
2 units installed

Hydrogenics Electrolyzer

-25 °C Chiller

PDC 350 bar compressor

60 kg Storage

Walkway

Station from Outside

Purity Testing Passed

Cal State University, Los Angeles

Quality of Hydrogen Fuel from 350 bar Nozzle of CSA Hydrogen Station

Sampling Date: 2/21/2012

Smart Chemistry No: 12CSU005

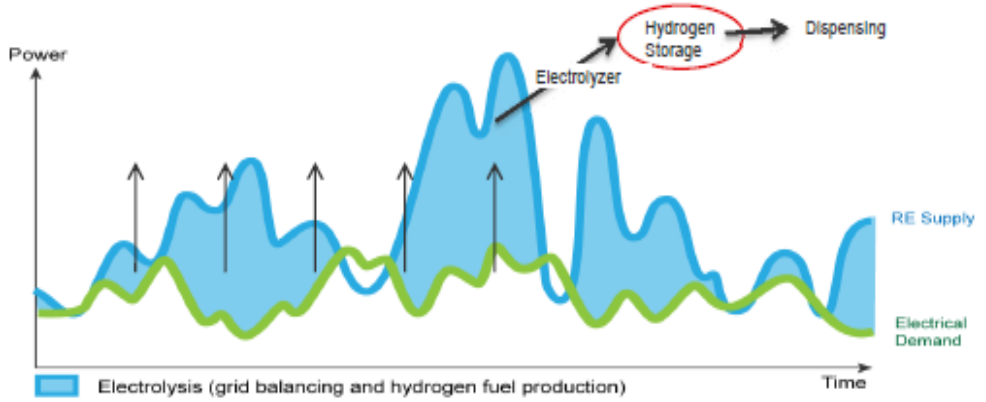
Constituent	SAE Limits (µmol/mol)	Smart Chemistry Detection Limits (µmol/mol)	Concentration (µmol/mol)	Analytical Method
Water	5	1	< 1	ASTM D7649-10
Total Hydrocarbons (C_1 Basis)	2	1	0.035	
Methane		0.001	0.0029	ASTM WK34574
Ethane, Ethene, Ethyne		0.06	< 0.06	ASTM D1946
Acetone		0.001	0.008	ASTM WK34574
Ethanol			0.004	ASTM WK34574
Oxygen	5	2	< 2	ASTM D7649-10
Helium	300	10	< 10	ASTM D1946
Nitrogen, Argon	100			
Nitrogen		5	14	ASTM D7649-10
Argon		0.3	0.45	ASTM D7649-10
Carbon Dioxide	2	0.5	< 0.5	ASTM D7649-10
Carbon Monoxide	0.2	0.001	< 0.001	ASTM WK34574
Total Sulfur	0.004	0.0001	< 0.0001	ASTM D7652-11

Test Fills at 350 and 700 Bar

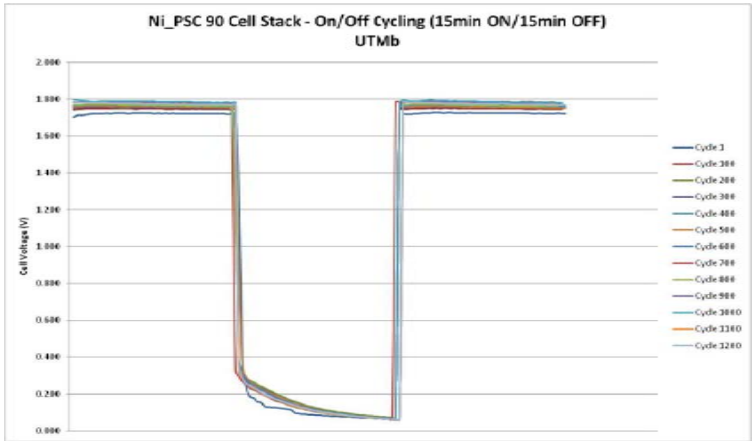
Dispenser and Chiller by Quantum Technologies

Future Work: Research Opportunities

- Performance Optimization, Hydrogen Fleet and Infrastructure Analysis
- Smart Grid: Load Following with Renewable Power Generation
  - Off-peak load
  - Load shedding
- Workforce, Public and Professional Education



Intermittent wind exceeds load



Electrolyzers demonstrate quick start-stop without degradation

Summary

- Program demonstrates high relevance to DOE Hydrogen and Fuel Cell program.
- Tasks proposed by the grant have been completed : equipment is purchased and transferred to the site.
- Station is completed and is in commissioning.
- Future directions and plan for program growth beyond current funding is being developed.
- Public outreach, education and building partnerships opportunities are actively pursued.
- Students are learning about hydrogen infrastructure and fuel cell vehicle technologies.