



2011 DOE Hydrogen Program and Vehicle Technologies Program AMR

SUSTAINABLE HYDROGEN FUELING STATION, CALIFORNIA STATE UNIVERSITY, LOS ANGELES

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California State University, Los Angeles

prepared March, 2011

Project ID
TV014



Overview



Timeline

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

~90 % 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 10,000psi (700bar), 60kg 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

- 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 station electrolyzer: HySTAT-A 1000D-30-10.
- Quoted delivery time 32-36 weeks.
- **Subtask 1.2 350 Bar Compressor**
- Order, receive and install station 350 bar compressor: PDC-4-1000-6500.
- Quoted delivery time 20-24 weeks.
- **Subtask 1.3 700 Bar Compressors**
- Order, receive and install station two (2) 700 bar compressors: Hydro-Pac C12-60-10500LX.
- Quoted delivery time 16-18 weeks.
- **Subtask 1.4 Hydrogen Storage Tanks**
- Order, receive and install station three (3) 350 bar storage tanks: .
- Quoted delivery time 18-20 weeks.

MILESTONES

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.



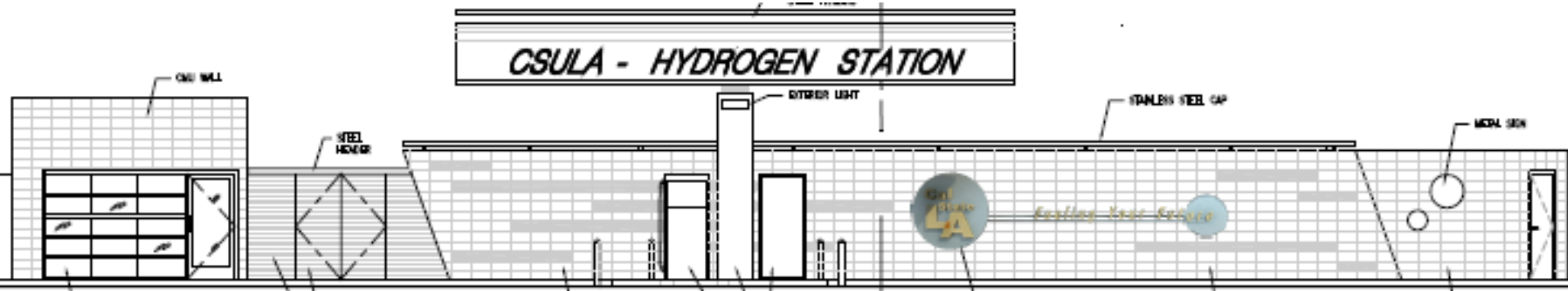
Hydrogen Fueling Facility

- 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





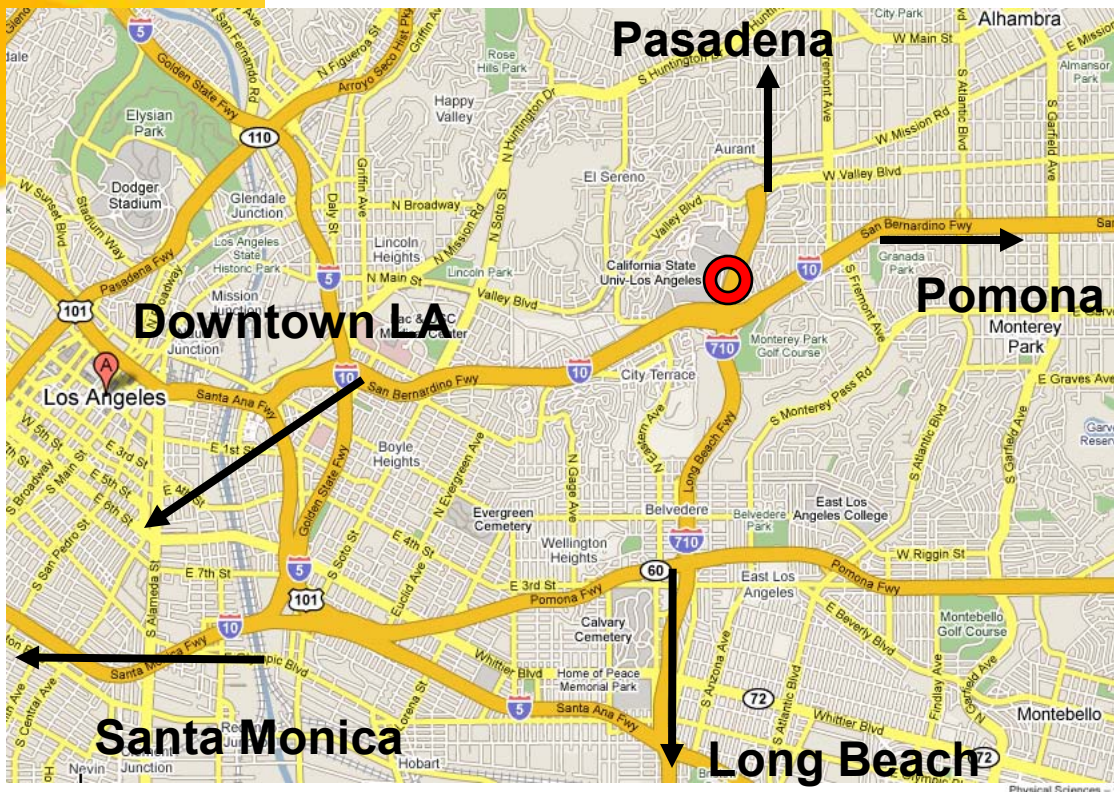
Design Options



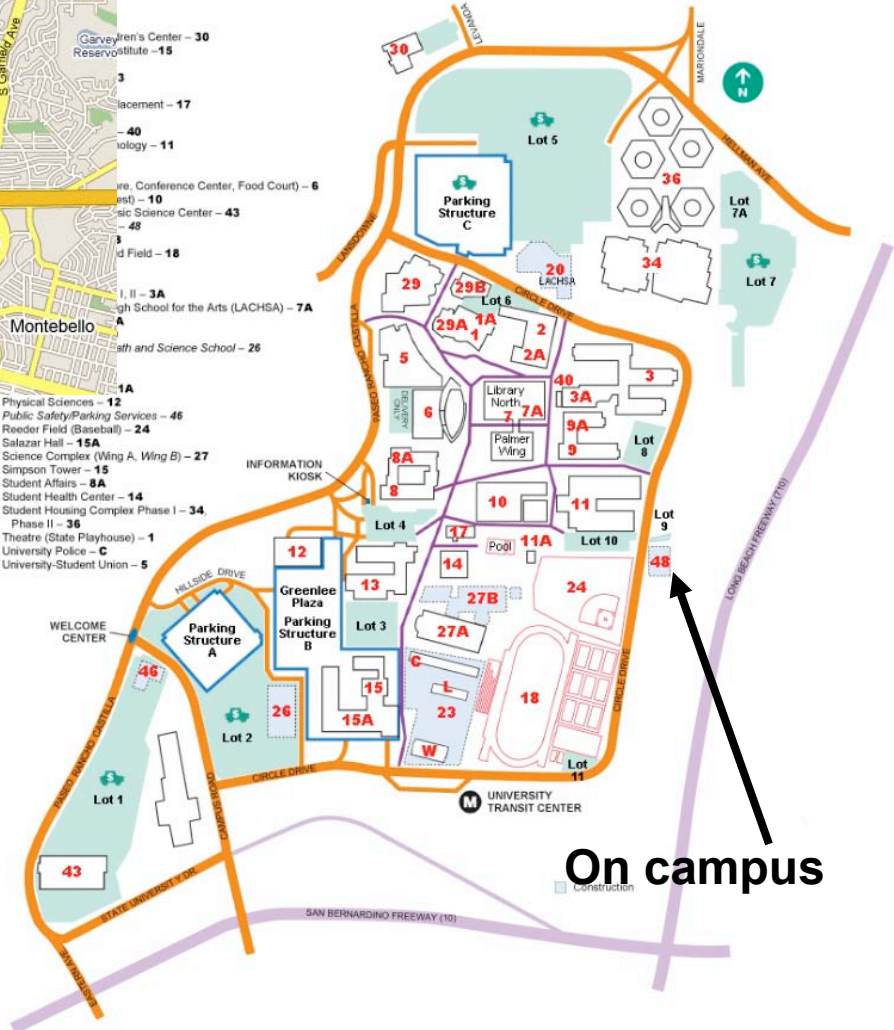
Images are courtesy **Leo A Daly**



Great Location



- Carver's Center - 30
- Reservisttute - 15
- placement - 17
- 40
- ology - 11
- re, Conference Center, Food Court) - 6
- est) - 10
- asic Science Center - 43
- 48
- id Field - 18
- , II - 3A
- gh School for the Arts (LACHSA) - 7A
- A
- ath and Science School - 26
- 1A
- Physical Sciences - 12
- Public Safety/Parking Services - 46
- Reader Field (Baseball) - 24
- Salazar Hall - 15A
- Science Complex (Wing A, Wing B) - 27
- Simpson Tower - 15
- Student Affairs - 8A
- Student Health Center - 14
- Student Housing Complex Phase I - 34
- Phase II - 36
- Theatre (State Playhouse) - 1
- University Police - C
- University-Student Union - 5



2009

On campus



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

12 November, 2010



January 26, 2011



350 bar compressor, 2 x 700 bar
compressors and storage vessels

Electrolyzer Arrived



Hydrogenics electrolyzer

January 27-28, 2011



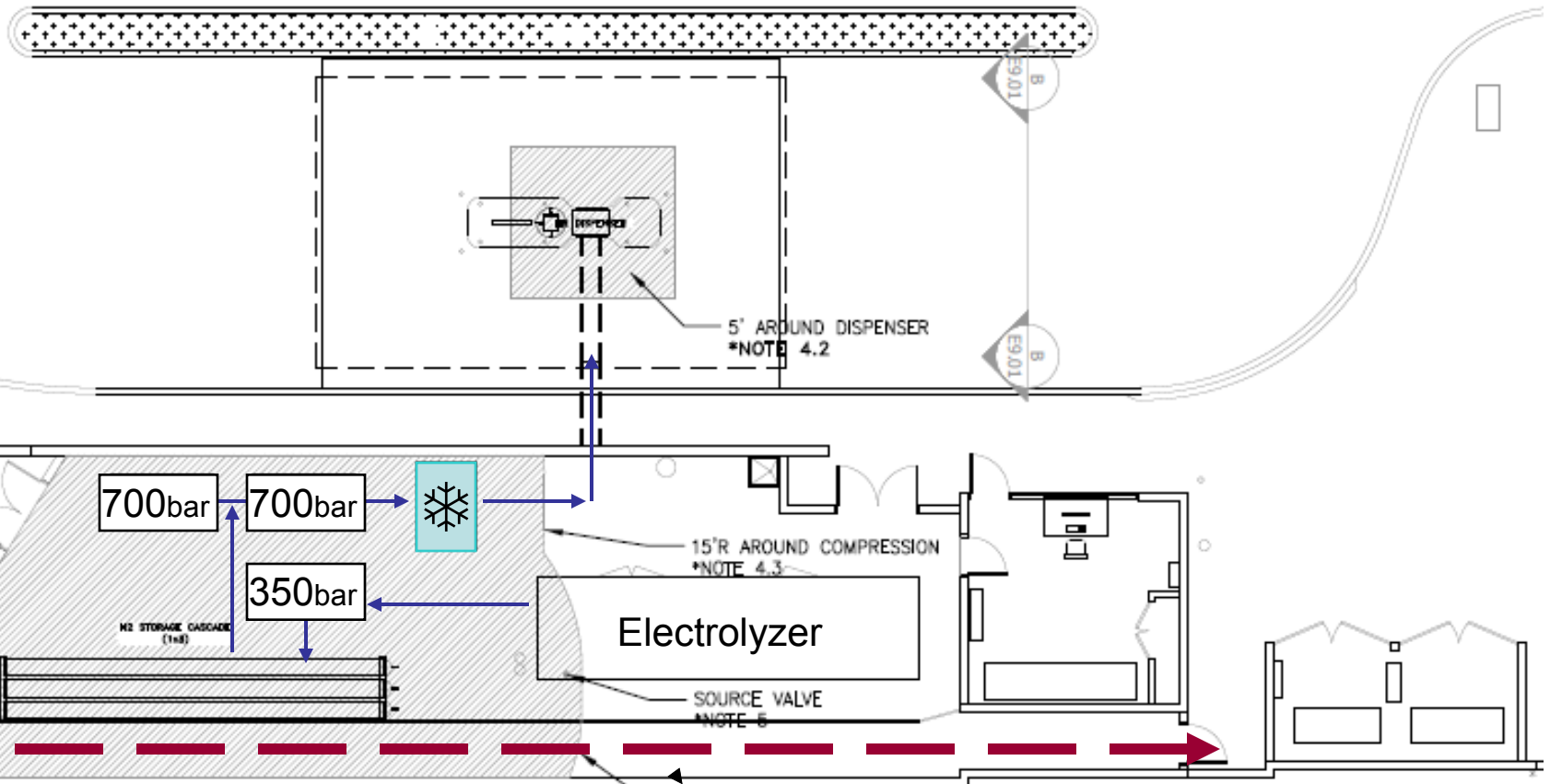
Construction and Equipment

http://www.calstatela.edu/faculty/vseaman/Hydrogen_Station.php





Equipment Layout and Hydrogen Flow

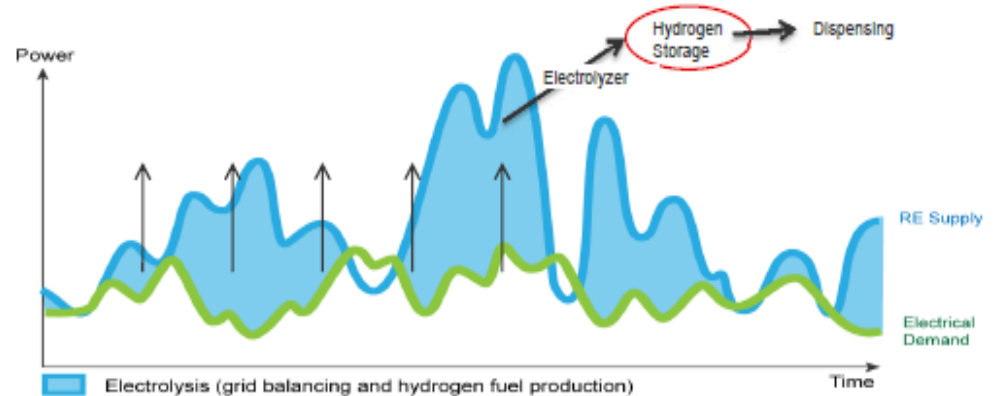


Walking tours

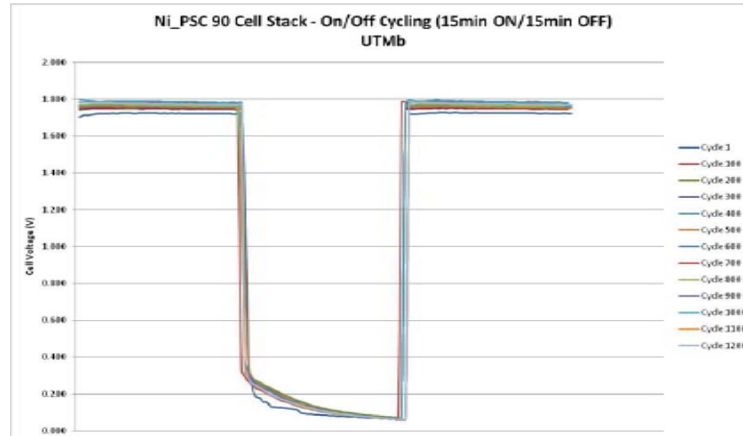


Future Work: Research Opportunities

- 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

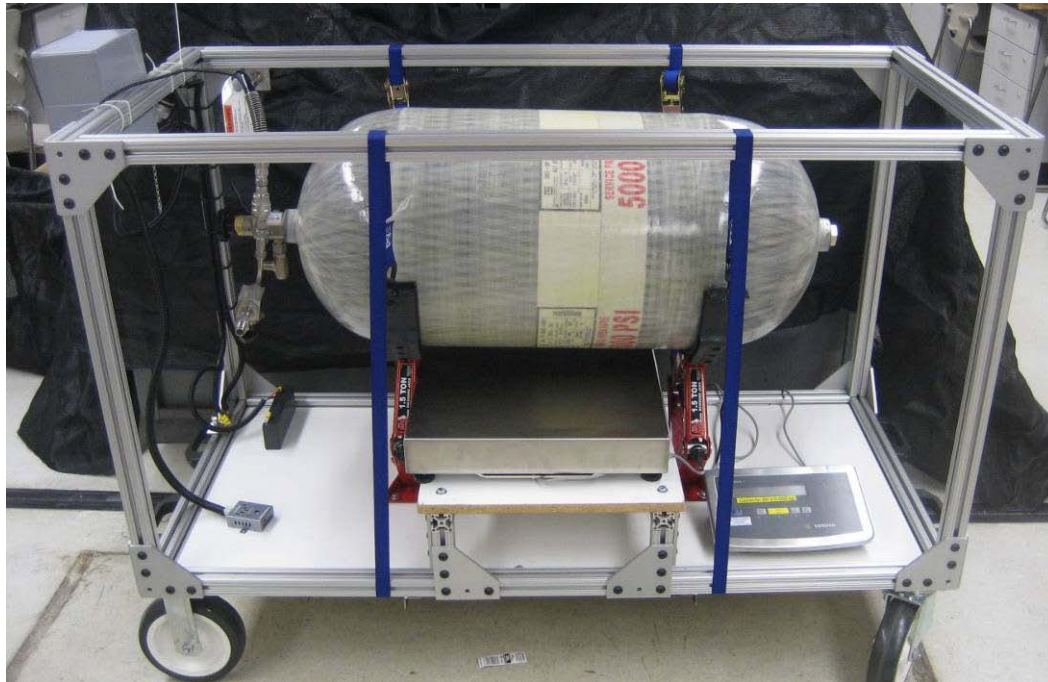


Power, Energy and Transportation Emphasis Department of Technology

- TECH 100 Introduction to Automotive Mechanisms
- TECH 370 Power, Energy and Transportation
- TECH 405 Advanced Engine Design
- TECH 470 Electric, Hybrid and Alternatively Fueled Vehicles
- TECH 474 Power Generation, Distribution and Utilization (+Smart Grid)
- TECH 476 Electronic and Computer Control Systems
- TECH 478 Fuel Cells, Emerging Technologies
- TECH 478 Photovoltaics, Emerging Technologies
- TECH 488 Fluid Power

Sempra Senior Project

MOBILE DISPENSED HYDROGEN CALIBRATION

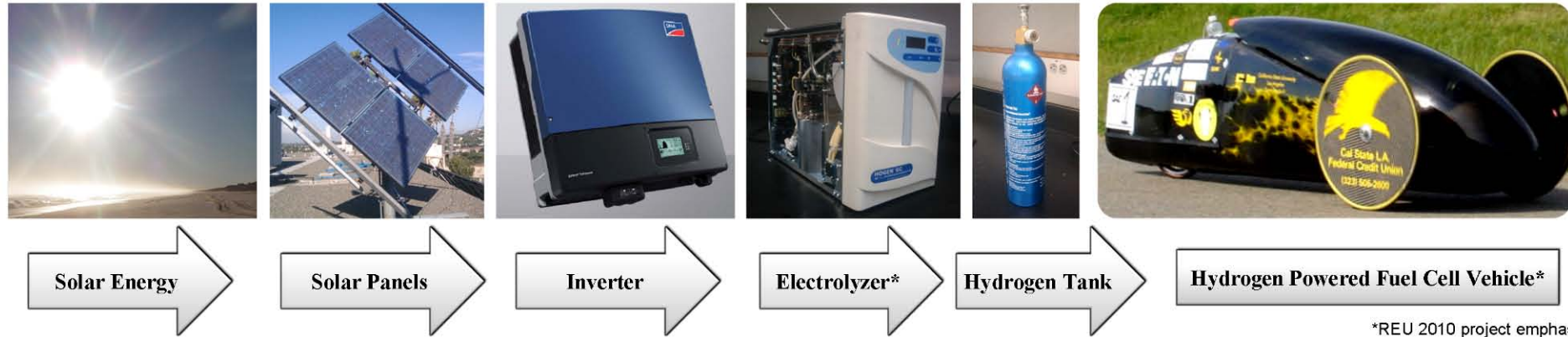


- ECST senior project: 3 ME and 1EE student.
- To create a calibration device for measuring the amount of H₂ dispensed by a hydrogen station to an accuracy of +/- 2% per mass and serve as the official verification standard approved by the CA Dept. of Food and Agriculture, Measurement Standards Division.
- Needs a method analogues to conventional gasoline standards.



FCV: Hydrogen Super Eagle

System Energy Flow Diagram for a Zero Emission System

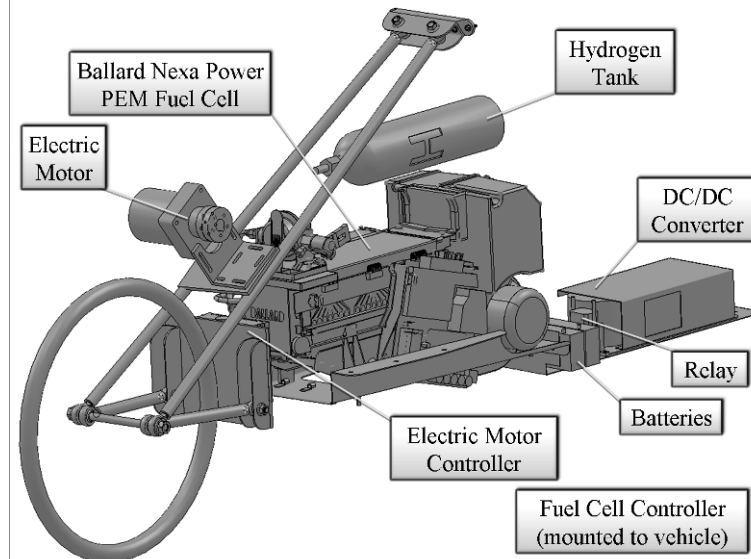


*REU 2010 project emphasis

Summer REU program with support by CSULA Center for Energy and Sustainability (4 students)



Vehicle Setup



Student Design



Home Hydrogen Refueling

Number of teams: **54**

Number of Countries: **19**

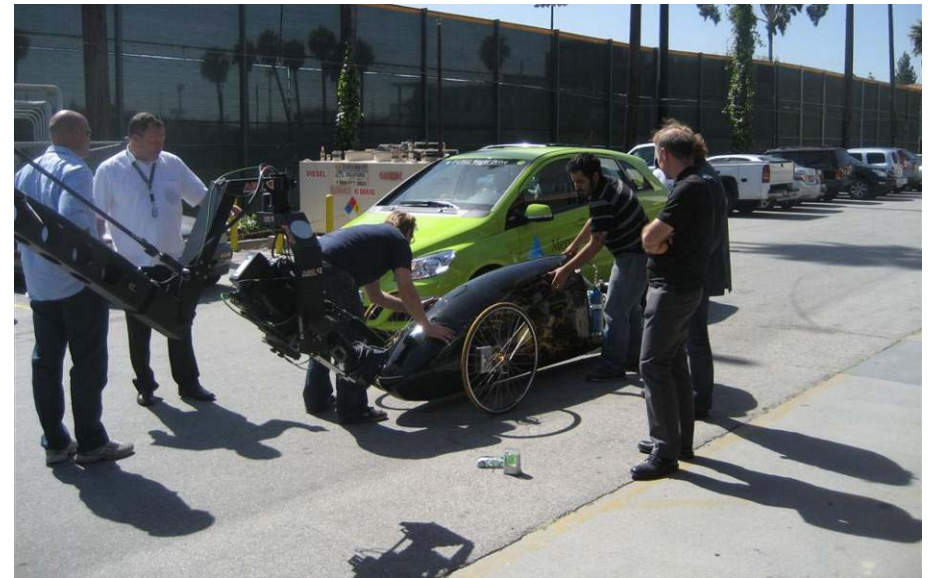
Number of Submissions **17**

Placed **7**

**Collaboration: 2 students from
East Los Angeles College**

Hector Nava
Jose Padilla
Dennis Chinn
Mark Anthony Aguilar
Pamela Green
Fakhru Shawaludin
Keith Bacosa
Annette Barrasza
Mike Strada
Julio Cesar Cardenas
Christino Castro
Advisor : Dr David Blekhman

Mercedes Benz F-Cell World Drive



CSULA hosted Mercedes Benz F-Cell World Drive with Cristian Maier, March 8, 2011



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.
- 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.
- Project is a coherent effort among many collaborators and is a congruent element in the college's Alternative and Renewable Energy initiatives.