HYDROGEN & FUEL CELL SEMINAR

Cal State LA Hydrogen Infrastructure Engineering Workforce Training Program

Hydrogen and Fuel Cell Safety, Codes, and Standards

California State University, Los Angeles:
Dr. David Blekhman, Technical Director, Professor

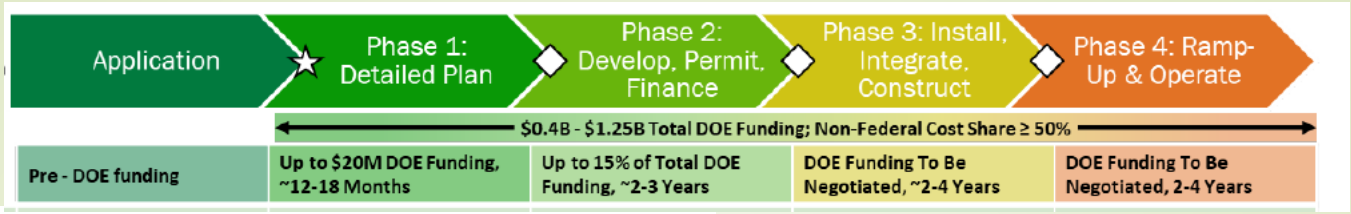
February 8, 2023

Outline for the presentation

I. Need for Workforce
II. Hydrogen Station Intro
III. CEC ZEV Workforce Program
IV. Curriculum Design
V. Partnership with Cerritos Community College
VI. Collaboration with Industry

Hydrogen is Coming Fast

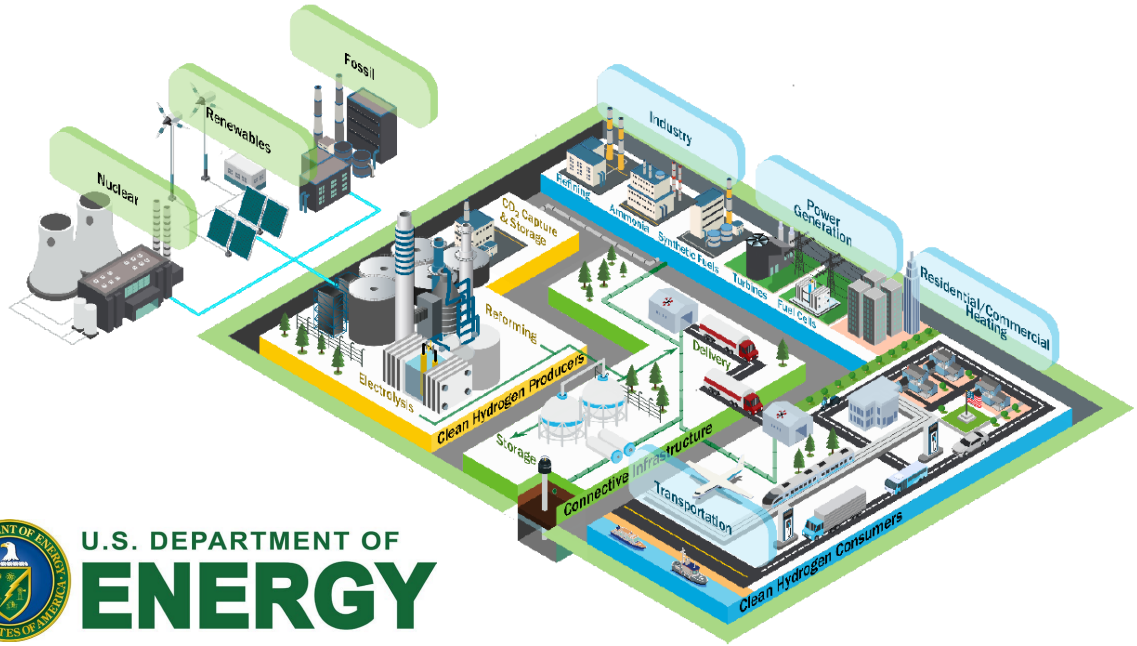
Numbers as of December 31, 2022	Total
FCEVs—Fuel cell cars sold and leased in US*	14,979
FCEBs—Fuel cell buses in operation in California	**66**
Fuel cell buses in development in California	>103
Hydrogen stations available in California**	54
Retail hydrogen stations in *construction* in California***	8
Retail hydrogen stations in *permitting* in California***	23
Retail hydrogen stations *proposed* in California***	7
Retail hydrogen stations *funded*, but not in development in California***	76
Total retail hydrogen stations in development in California***	**114**



Regional Clean Hydrogen Hubs Funding Opportunity Announcement

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002779
FOA Type: Initial
CFDA Number: 81.255

FOA Issue Date:	9/22/2022
Submission Deadline for Concept Papers:	11/7/2022 5:00pm ET
Concept Paper Encourage/Discourage Notifications:	December 2022
Submission Deadline for Full Applications:	4/7/2023 5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	5/31/2023 5:00pm ET
Pre-Selection Interviews:	Summer 2023
Expected Date for DOE Selection Notifications:	Fall 2023
Expected Timeframe for Award Negotiations:	Winter 2023-2024



U.S. DEPARTMENT OF ENERGY

The H2Hubs will form the foundation of a national clean hydrogen network that will contribute substantially to decarbonizing multiple sectors of the economy. Matching the scale-up of clean hydrogen production to a growing regional demand is a key pathway to achieving large-scale, commercially viable hydrogen ecosystems.

DOE prefers a funding range from $500 million to $1 billion for each H2Hub

Comments on Hydrogen Workforce

COMMENTARY

Skilled labor will be essential for a greener California

BY GUEST COMMENTARY, ADMINNEWSPACK AND YOUSEF BAIG
SEPTEMBER 9, 2022

By Maryam Brown

Maryam Brown is the president of Southern California Gas Company.

Jon Preciado, Special to CalMatters

Jon Preciado is the business manager of the Southern California District Council of Laborers.

For the more than 32,000 highly skilled individuals around the state who work in the gas distribution industry, hydrogen represents real and meaningful opportunities for participation in the clean economy that are hallmarks of a just transition.

CALIFORNIA HYDROGEN BUSINESS COUNCIL

Hydrogen Means Business in California!

18847 Via Sereno
Yorba Linda, CA 92886
Phone: (310) 455-6095 | Fax: (202) 223-5537
info@californiahydrogen.org | www.californiahydrogen.org

BOARD OF DIRECTORS

Officers

April 9, 2021

I am writing on behalf of the California Hydrogen Business Council (CHBC)[i] to support SB 589 (Hueso). This bill will require the commission to identify workforce development and training resources needed to meet the state's goal of putting at least 5 million zero-emission vehicles in service by 2030 and reducing greenhouse gases emissions to 40% below 1990 levels by 2030.

The CHBC supports workforce training for the zero-emission vehicle industry and the inclusion of the Community College system and Conservation Corps in these efforts. California will need a skilled workforce to bring about a smooth transition to zero-emission vehicles (ZEV), which includes both battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs).

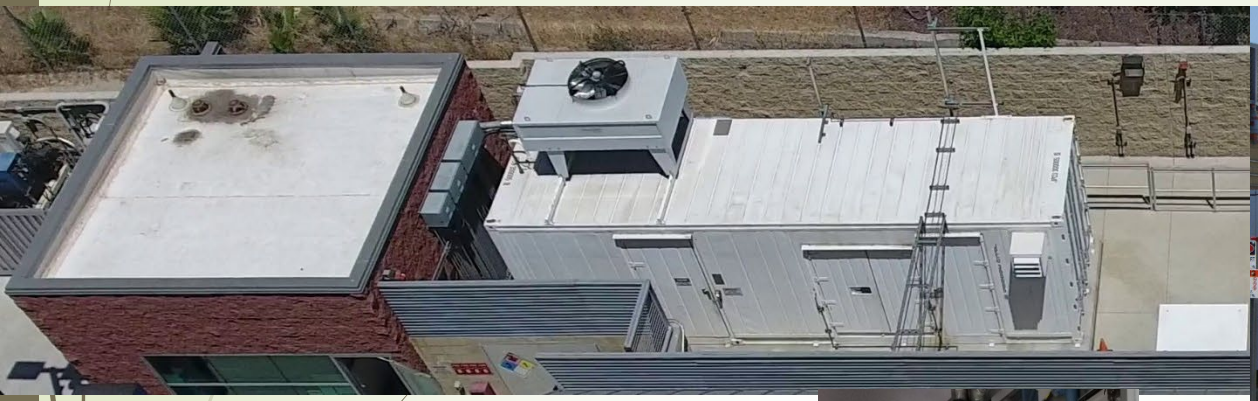
Cal State LA Hydrogen Research and Fueling Facility

CARB No. 06-618 $2,700,000
DOE Award #DE-09EE0000443 $475,750
AQMD, MSRC, Ahmanson Foundation, AAA

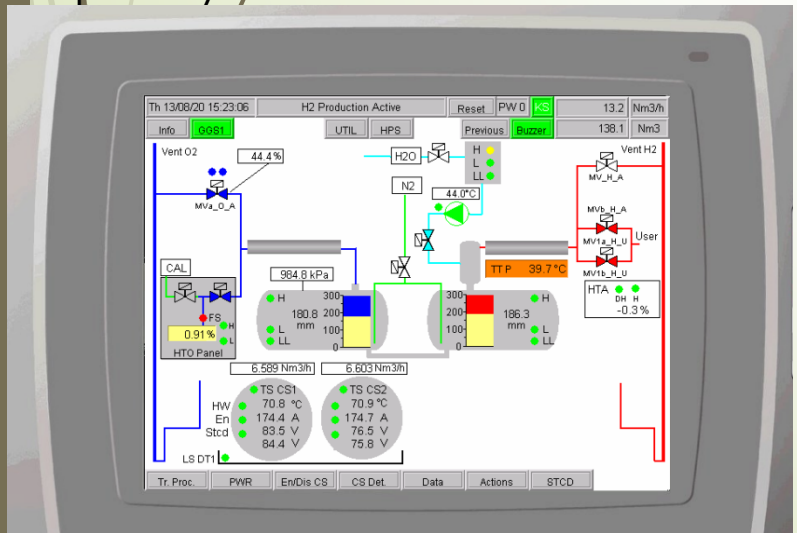
CSULA Hydrogen Station Specs

Production: 60 kg/day
Storage: 60 kg
Pressure: 5,000 and 10,000 psi
Capacity: 15-20 fuel cell vehicles per day

Cal State LA Electrolyzer, Hydrogen Production From Water



Manufacturing: Hydrogenics
Model number: HySTAT^{tm} - A 1000 D/30/10, 60 kg/day production capacity



Grand Opening: May 7, 2014

Original Goals for the Hydrogen Research and Refueling Facility

- Building a hydrogen fueling station to serve the East Los Angeles area as a focal point of commercialization, research, educational and outreach activities.
- Redesigning the curriculum to implement a Sustainable Energy and Transportation program including hydrogen economy and fuel cell applications.
- Conducting research with partner agencies.
- Preparing the Workforce in Clean Energy Transportation

Fueling All

Passenger Cars, Bus, Truck, Trailer

California ZEV Engineering Workforce Pilot by Cal State LA and Cerritos Community College

GFO-21-602: IDEAL ZEV Workforce Pilot

$500,000

$25,000

Partner

Program Objectives

Objective 1. **Assess skill sets required in the ZEV industry, with a focus on hydrogen.**

- **Action 1.** Collaborate with industry experts to develop curriculum that responds specifically to the hydrogen ZEV infrastructure and industry related skills.
- **Action 2.** Enhance the existing Sustainable Energy and Transportation Engineering Technology program with the newly developed curriculum.

Objective 2. **Accelerate and expand the internship training program to meet increasing industry demand.**

- **Action 1.** Develop formal internship curriculum that responds specifically to the processes of the hydrogen fueling infrastructure, production, and maintenance.
- **Action 2.** Develop short-term onboarding training and long-term certification, including safety, to expand intern potential, and the ability to enter the workforce upon program completion.
- **Action 3.** Expand program capability to allow for a pipeline of transferring postsecondary students to become interns, increasing training potential.

Objective 3. Prepare the program for future growth

- **Action 1.** Conduct outreach and engagement events to communities, government officials, industry, educational institutions, students, and the public.
- **Action 2.** Provide train-the-trainer workshops for incumbent workers and career technical instructors.
- **Action 3.** Design the pilot program for expansion to other institutions and CCs

Preparing Next Generation

Classes

Visiting Researchers

Interns

Train the Trainer

Public Tours

MS and PhD Visiting Researchers

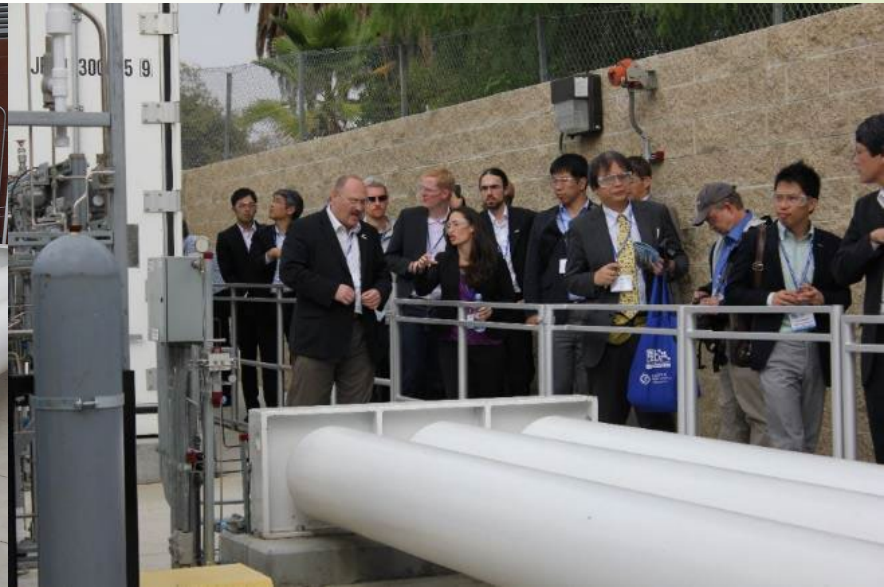
Classes: Sustainable Energy and Transportation Lecture-Lab

- **TECH 1000 Introduction to Automotive Mechanisms**
- **TECH 3700 Sustainable Energy and Transportation**
- **TECH 4700 Electric and Hybrid Vehicles**
- **TECH 4710 Engine Design and Performance**
- **TECH 4720 Photovoltaics Applications**
- **TECH 4740 Fuel Cell Applications**
- **TECH 4760 Measurement, Instrumentation and Control**
- **TECH 4880 Fluid Power**
- **TECH 5720 Autonomous Vehicles and Smart Infrastructure**

Public Tours=10,000

John Frala and students from Rio Hondo
Michael Dray conducts a tour

German Government 2022
Fuel Cell Seminar 2014



Curriculum Design

Phase I

- 2022-2023
- Concentrate on Onboarding

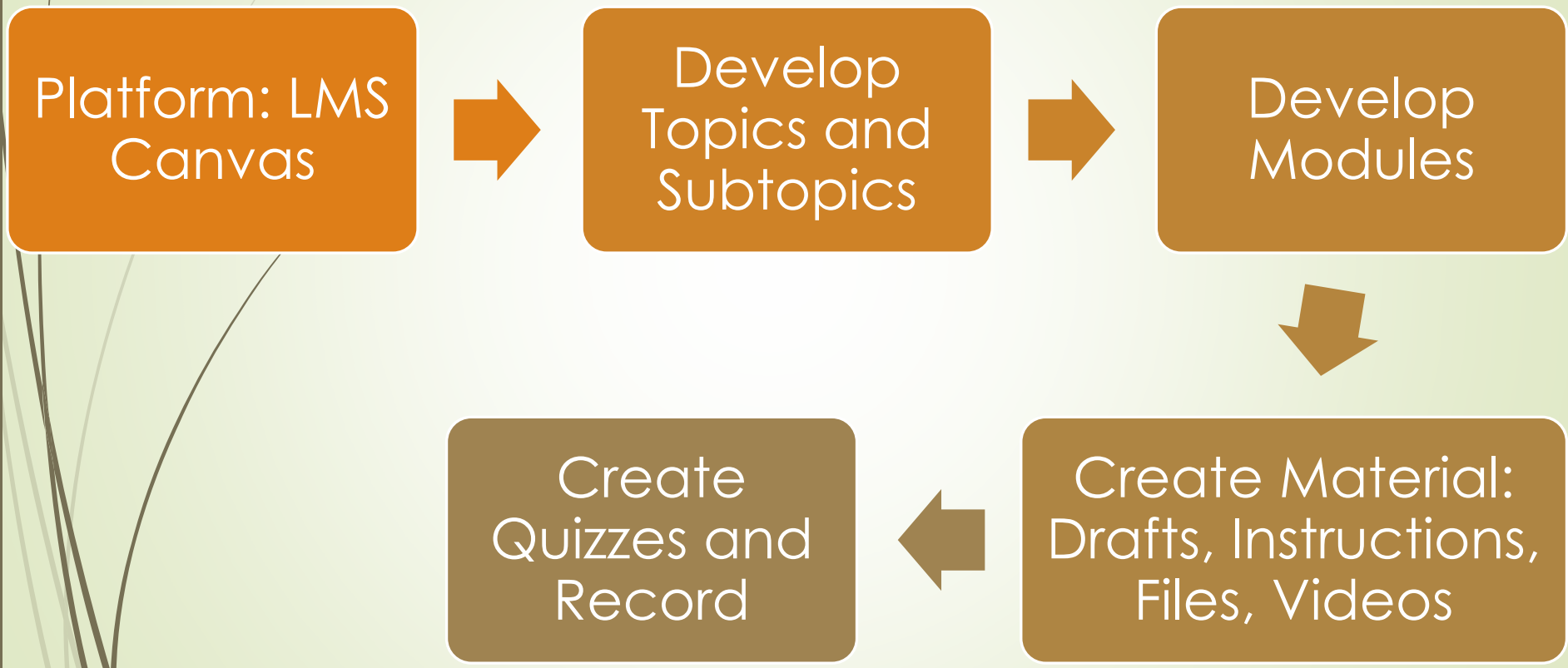
Phase II

- 2023-2024
- Concentrate on O&M

Future

- 2025-2027
- In-Depth Safety and Design Course

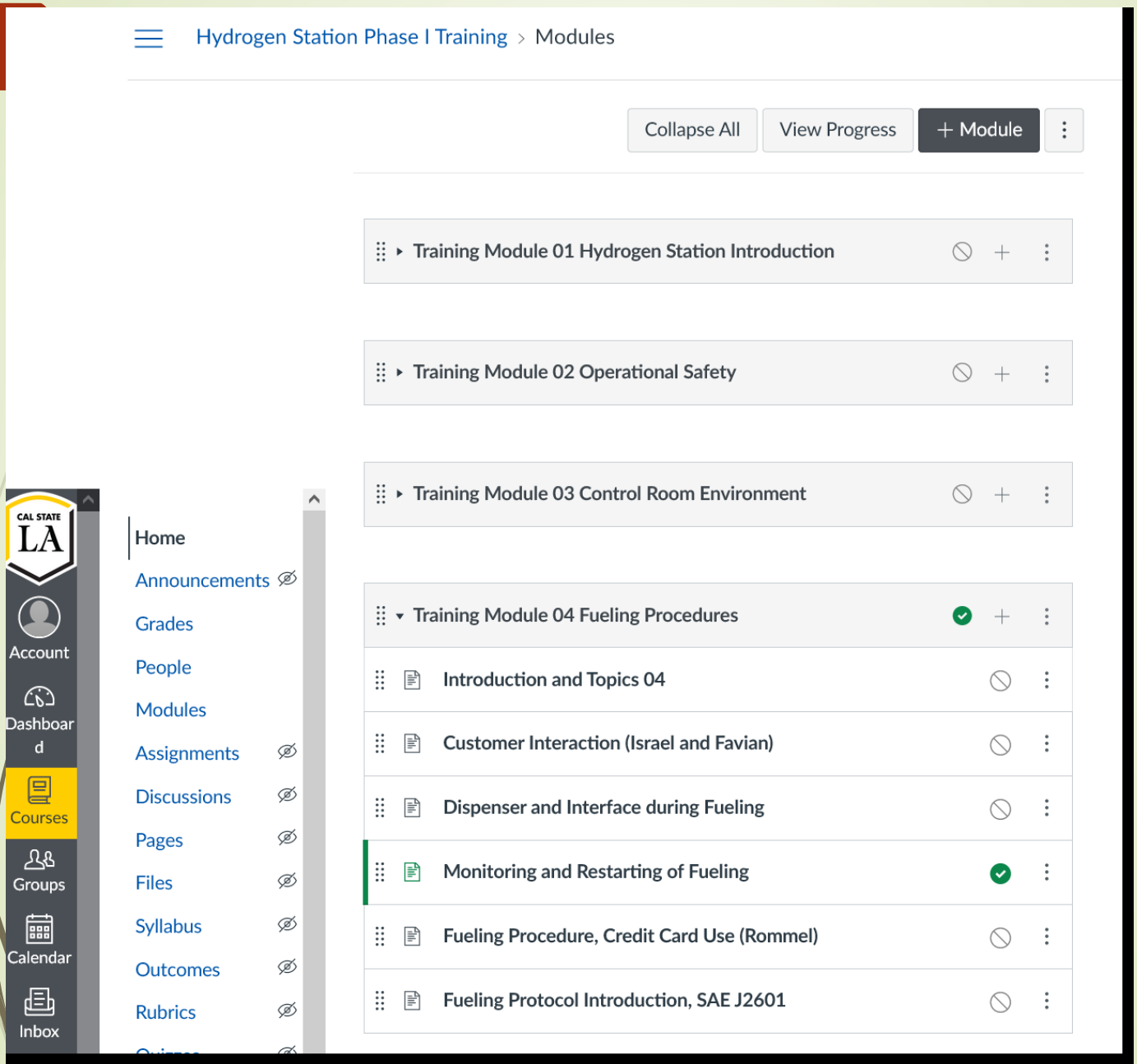
Phase I Design



Phase I Progress (Topics)

Hydrogen Station Introduction	Fueling Procedures
Walk through Hydrogen station layout and basic processes Equipment Overview Hydrogen station video and website Personnel introduction and database Training Records Cleanup and station appearance	Customer Interaction (Fabian and Israel) Dispenser and interface during fueling Fueling procedure, credit card use Monitoring of fueling and restarting Fueling protocol introduction, SAE J2601
Operational Safety	**Control Room Environment**
Introduction to hydrogen safety, organizations and standards Basic hydrogen characteristics and their relation to safety, hazardous substances/data sheets Safe work habits, protective equipment Lock out, tag out procedures review Emergency procedures and incident reporting (Gilbert) Plant inspection, specific plant inspection and tools Continuous monitoring systems and actions (fire alarm systems, hydrogen sensors, other sensors) Recommended work practices.	Software and control screens used Open/close station security Payment System Full System Reset, other resets Stop, Start procedures for the station (login) Power Control System Security Keeping records for maintenance, visitors, journal etc SOSS Common Malfunctions/Troubleshooting

Phase I Progress (CANVAS LMS)



Phase I Progress (Topic Level)

Monitoring and Restarting of Fueling

Monitoring and Restarting of Vehicle Fueling

Topics Discussed:

--Diagram components, Layout, staying in pressure and temperature corridors, scales used

--Pressure side, Fueling initiation, Pulses

--Pressure holds for integrity, leak test

--Vehicle temperature monitoring

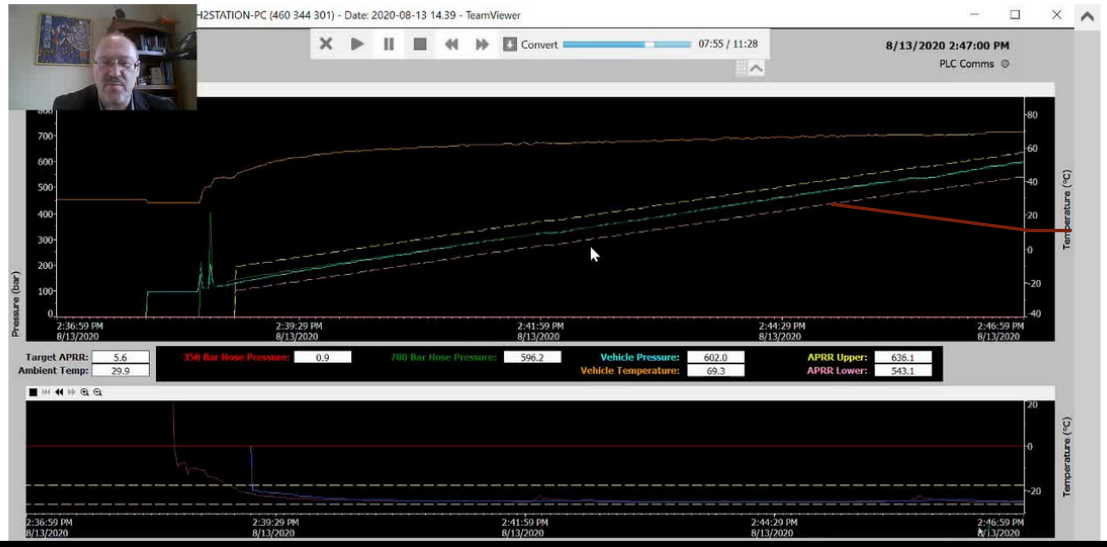
--Temperature corridors

--Common aborts and issues.

The file included here has a legend of the variables being monitored. Please review before proceeding to the instru
video below. Fueling in Progress Diagram_Legend.pdf

Watch the video (full screen is recommended) that discusses the Monitoring of Fueling through the control softwa
a light discussion of the processes that relate to SAE-J2601 fueling protocol that is discusses related topics in greate
Fueling Protocol Introduction, SAE J2601.

Sometimes fueling can be restarted after a pressure or temperature abort. This is briefly discussed in the video.



Instructions for current topic

File with reading material

Link to another module

Instructional Video

Phase II: O&M

CSULA Hydrogen Station Map

Failure by Component
2014-2017

Component	valve leak	electrolyze chiller	piping	gas management system	station computer	demineralizer	booster/ hydropac compressor	PDC compressor (low pressure)	plant chillers	fire alarm system	receipt printer	air compressor	hydrogen purity test	water treatment system	electrolyzer fault	dispenser	nitrogen supply	H2 chiller
2014	12	6	4	0	1	0	4	2	0	0	0	0	1	0	8	3	0	3
2015	0	1	0	3	2	1	2	1	5	4	2	1	1	1	11	19	2	6
2016	2	2	0	0	2	2	1	4	2	1	0	1	2	0	12	2	0	15
2017	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	3
Total	14	9	4	3	6	3	7	7	7	6	2	2	4	1	31	24	2	27

Partnership with Cerritos Community College

Train-the-Trainer

- Organize workshops

Student Transfer

- Setup Scholarships

Collaboration with Industry

Hire Student

Mechanical

Electrical

Civil

Computer Science

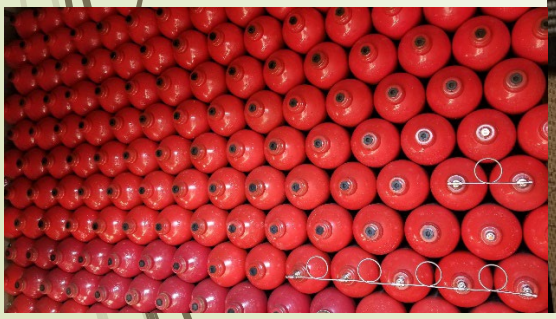
Technology

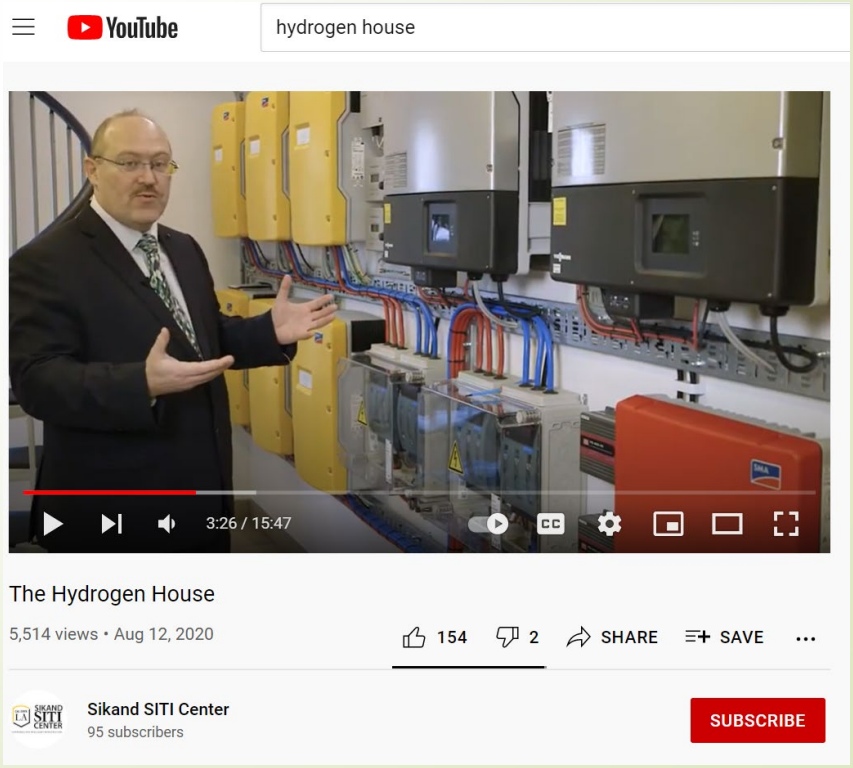
Company pays for internship

6 months or longer

Intern transfers to company

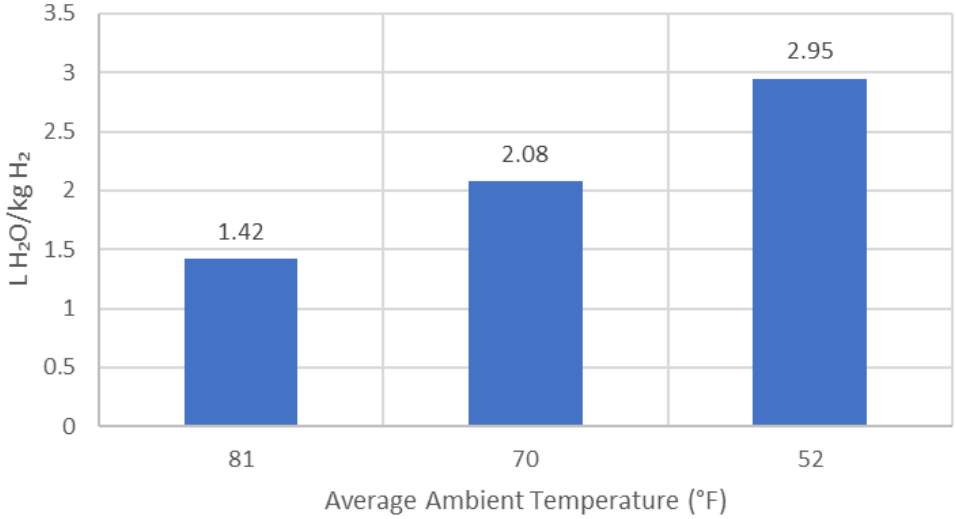
Nilsson Energy: Hydrogen House





Fuel Cell Vehicle Water Capture Capability, 2018-19

Sponsor: Metropolitan Water District of Southern California



Water capture in L as a function of ambient temperature
Ideal case is 9 kg of H2O per kg of H2.
Progress from the case of 1L box with fan.


THANK
YOU!