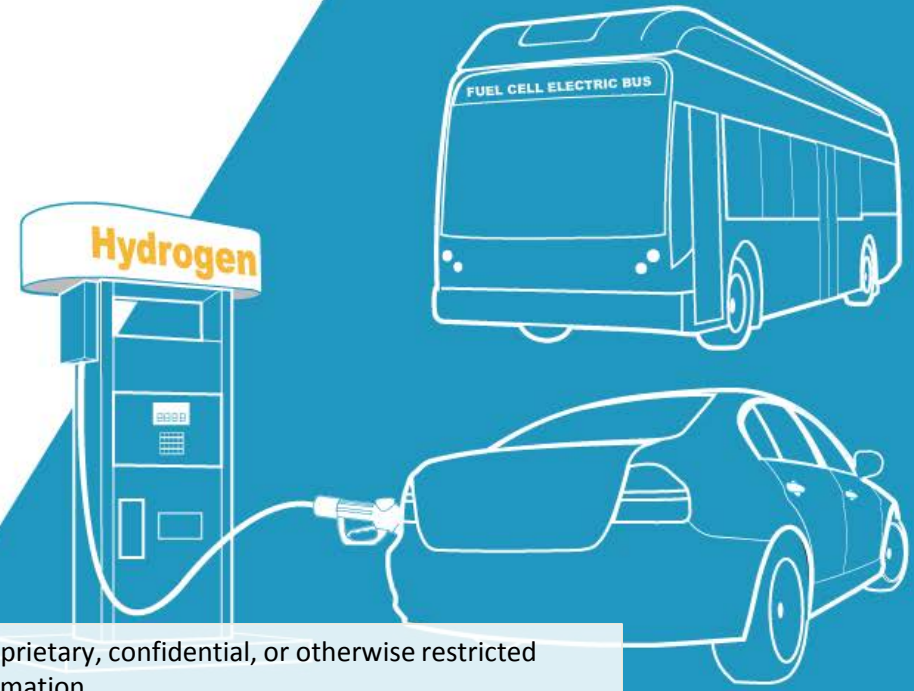


Station Operational Status System (SOSS) 3.0 Implementation, SOSS 3.1 Upgrade, and Station Map Upgrade Project

2016 DOE Hydrogen and Fuel Cells Program Review

June 9, 2016

PI: Ben Xiong, California Fuel Cell Partnership
Operated by BKi



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

Overview

TIMELINE

- Start: October 1, 2015
- End: September 30, 2016*
- 75% complete

BUDGET

- Total project funding: \$200,000
- DOE share: \$155,000
- Contractor share: \$45,000
- Funding received in FY15: \$155,000

* Funded project end date

BARRIERS (D)

- Integration of complex systems
- Lack of Hydrogen Refueling Infrastructure Performance and Availability Data

PARTNERS

- Funders
 - See CaFCP members slide
- Collaborators
 - See Collaborations slide
- Developers
 - ImageX Media



Relevance

OBJECTIVE:

Consistently and reliably report hydrogen station operational status information to FCEV customers to increase customer satisfaction and station demand.

Provide the most recent, realistic and accurate hydrogen station information to FCEV customers, station implementers and AHJs to address stakeholder station information needs.

IMPACT:

Automated station information improves user experience and satisfaction. People considering FCEV purchases have more confidence in availability and reliability of fueling network.



Approach - SOSS Steps/Phases

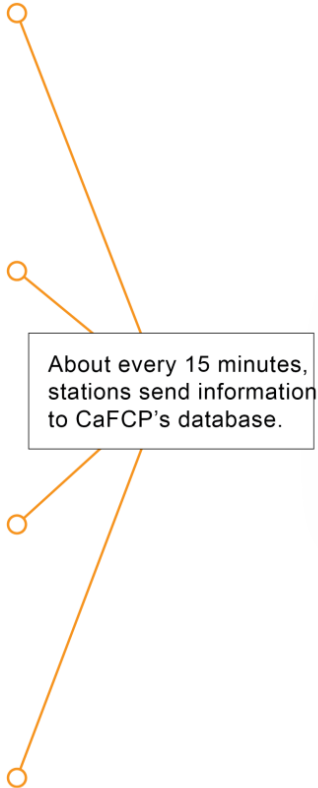
PROJECT PHASES

- **Phase 1 (2010-2014): SOSS 1.0 and SOSS 2.0 (completed)**
 - Manual and automatic reporting of station status
 - Small number of station participation
- **Phase 2 (2014-2015): SOSS 3.0 (completed)**
 - All automatic reporting of station status
 - Consistent and defined criteria
 - 15 minutes or less reporting intervals
- **Phase 3 (2015-2016): SOSS 3.1 (current)**
 - Implement SOSS at newly built stations
 - Improve SOSS usability features
 - Drupal content management system update
 - Develop Disaster Recovery Plan
- **Phase 4 (2017-beyond): SOSS 4.0 (future)**
 - Real-time reporting
 - Hardware upgrades

Approach - Overview

Station Operational Status System (SOSS)

HOW IT WORKS

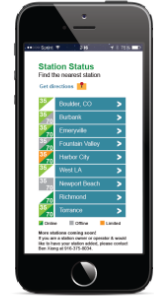


About every 15 minutes, stations send information to CaFCP's database.



CaFCP's secure server and station database

Authorized applications receive data from CaFCP to provide drivers with real-time station information.





Approach - Overview (2)

Station Status Criteria

ONLINE

- Station can deliver SOC > 95%
- Boost compressor online
- High pressure storage online
- Chiller online
- H2 source online
- POS online

LIMITED

- Station can still deliver fuel but SOC ≤ 95%
- Boost compressor offline
- High pressure storage offline
- Chiller online
- H2 source offline
- POS online

OFFLINE








- Station cannot deliver fuel
- Boost compressor offline
- High pressure storage offline
- Chiller offline
- H2 source offline
- POS offline

Acronyms

SOC: State of charge

POS: Point of sale

H2: Hydrogen

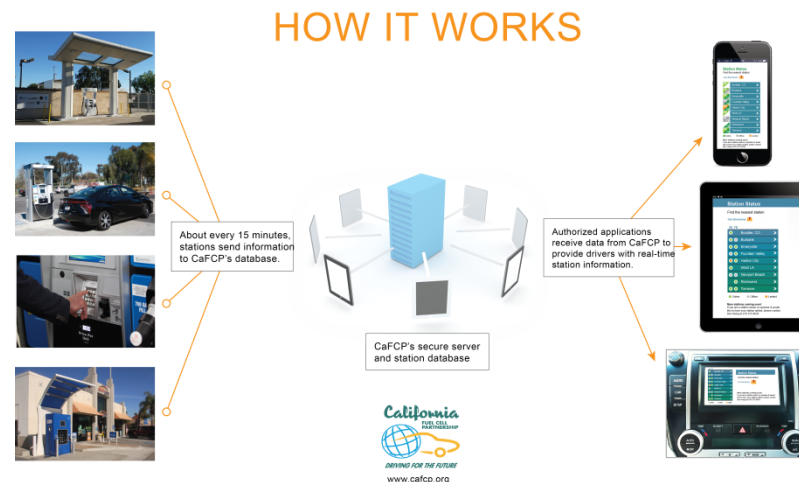
Newport Beach		
Torrance		
	 Online	 Offline
		 Limited



Approach - Components

- Web server based on Linux OS, Apache HTML Server, MySQL database management system, and PHP server-side scripting language.
- User interface
 - Google map interface
 - Mobile online interface
 - SMS/Email notification
- System at each station to transmit operational status

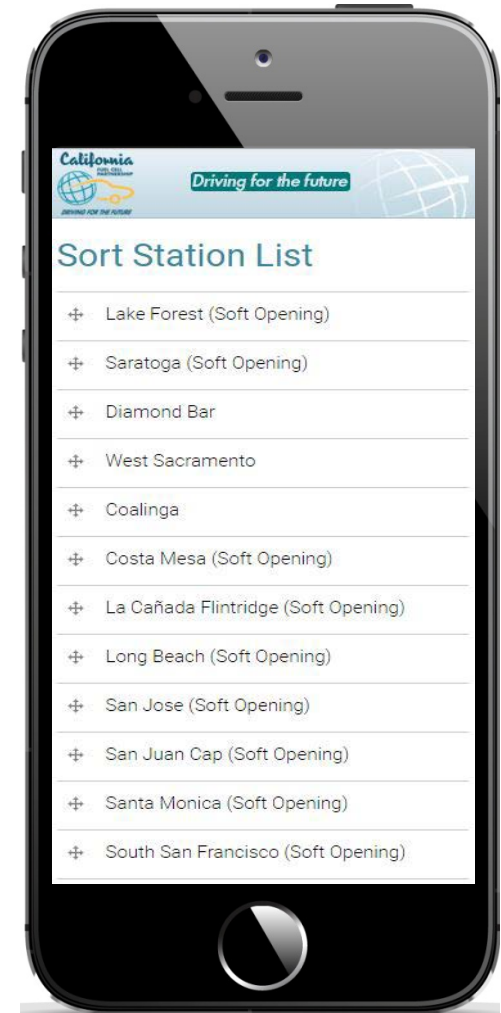
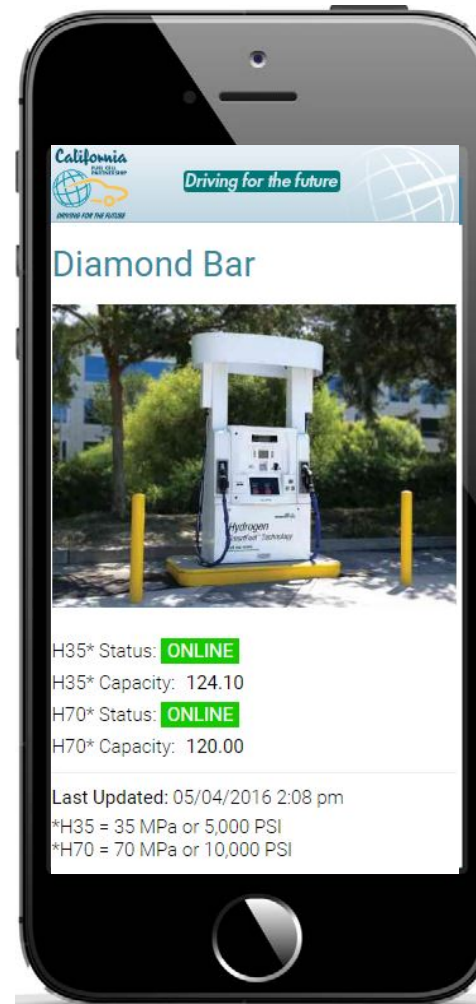
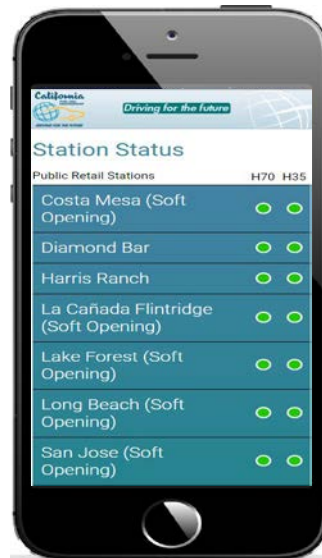
Station Operational Status System (SOSS)





Accomplishments (1)

- Improved user interface
 - Station list sorting
 - Public Retail/Other Non-retail stations
 - User preference
 - “Unknown” status
 - Show current available capacity



<http://m.caafcp.org>



Accomplishments (2)

- Implement SOSS at newly built hydrogen stations (**by September 30, 2016**)
 - 17 new retail stations added to SOSS
 - 3 retail stations in progress
 - All stations under construction will have SOSS
 - California Energy Commission requires SOSS on future state-funded stations
- Maintain SOSS operational status at hydrogen stations
 - 7 existing non-retail stations on SOSS

Station (Station Developer/Owner)	Status
<i>Burbank</i> *(H2 Frontier), <i>Emeryville</i> * (Linde), <i>Fountain Valley</i> * (APCI), <i>Harbor City</i> * (APCI), <i>Newport Beach</i> * (Shell/Powertech), <i>Richmond</i> * (UCB/Powertech), <i>Torrance</i> * (Shell/APCI),	Complete
Costa Mesa (First Element Fuel), Diamond Bar (APCI), Fairfax – LA (APCI), Harris Ranch (FEF), Hayward (FEF), La Canada Flintridge (FEF), Lake Forest (FEF), Long Beach (FEF), San Jose (FEF), San Juan Capistrano (Linde), Santa Barbara (FEF), Santa Monica (APCI), Saratoga (FEF), South San Francisco (FEF), UC Irvine (APCI), West LA (APCI), West Sacramento (Linde)	
CSULA, Riverside (ITM Power), Campbell (FEF)	In progress

*Non-retail stations



Accomplishments (3)

- **Disaster Recovery Plan**
 - Components completed and implemented
 - Identify and train primary disaster recovery staff
 - Identify disaster classification (hardware and software)
 - Identify direction control and administration procedures
 - Identify procedures for internal and external communications
 - Components in progress
 - Identify procedures for resuming and recovering operations (hardware and software)
 - Identify procedures for restoring facilities and normalizing operations (hardware)



Accomplishments (4)

Implement Station Map Upgrade

- Completed transition from Drupal 6 to Drupal 7 content management system
- Transition to a standalone site in progress
 - Start upgrade: May 1, 2016
 - Upgrade completion: August 31, 2016

The screenshot displays the California Fuel Cell Partnership website's station map interface. The header includes the logo and navigation links: HOME, CARS, STATIONS, BENEFITS, BUSES & TRUCKS, and RESOURCES. A search bar is present with a 'GO' button and a 'Filter By' button. The main content area features a map of California with several station markers. A sidebar on the right provides details for two stations:

- Harris Ranch** (RETAIL: OPEN): Commissioning Complete, 24505 West Dorris Avenue, 93210 Coalinga, CA. Details >
- Santa Barbara (Soft Opening)** (RETAIL: IN DEVELOPMENT): Commissioning, 150 South La Cumbre Road, 93105 Santa Barbara, CA. Details >

The footer contains the following information: © CALIFORNIA FUEL CELL PARTNERSHIP, 3300 Industrial Blvd, Suite 1000 West Sacramento, CA 95691, SOSS | 916.371.2870.



Response to Reviewers' Comments (3.0 Upgrade)

- **Reviewer comment:** It seems that the potential impact of this initiative may be competing to some extent with activities being undertaken in parallel by other organizations (e.g., individual original equipment manufacturers [OEMs]) that have similar and/or related objectives.
- **Response:** Automakers, station operators and station developers have agreed to provide CaFCP with station status data and make it the central clearinghouse of station status information for H2 stations in California. While other organizations may introduce similar products, the guarantee and likelihood that they will provide data from all H2 stations in CA is what sets this system apart from the others. The data the OEMs display will be a direct result of data from SOSS. The car companies may develop a front end system geared specifically for their customers but the backend (the data from the stations) will be coming from CaFCP's SOSS and then pushed to the automakers.
- **Reviewer comment:** To fully reflect the hydrogen coverage available in the area, all public stations should be included. The team needs to do everything possible to gain access to all stations.
- **Response:** Our goal is to have 100% of retail stations on SOSS. Not all stations are public retail stations accessible by all customers which can make getting access to SOSS data from those stations impossible and not necessary.



Collaborations

- **CaFCP member partners**

- Car manufacturers (Customer interface and definition dev't)
 - Daimler, Toyota, GM, Honda, Hyundai, Nissan, VW
- Station operators/Developers (SOSS integration & definition dev't)
 - Air Liquide, H2 Frontier, Hydrogenics, ITM Power, Linde, First Element Fuel

- **Other partners**

- Powertech, Shell, Stratos Fuel, Air Products, HyGen



Remaining Barriers and Challenges

- Delayed station implementation/rollout
- Hardware standardization
- Security protocol at station
- Knowledge of station operator
- Point of Sale
- Funding for labor & equipment
- Number of stations expected to come online



Proposed future work

Implementation at new stations (*by Dec 2017*)

Fremont

Thousand Oaks

Newport Beach (Upgrade)

Rancho Palos Verdes

Encinitas

Santa Clarita

Oakland (Emeryville)

North Hollywood



Proposed future work (2)

- Solicit new hydrogen stations to participate on SOSS
- Include stations outside California
- FCEV user interaction and feedback system
- Mobile native app capabilities
- Real-time reporting
- Include additional data fields
 - Price, user comments, etc.
 - Update to SOSS will be needed to have capability to include additional fields
- Analysis reporting capabilities



Summary

- SOSS implemented at 17 new hydrogen stations
- 100% station participation in California
- Multiple partners committed
- Station implementation/rollout delays create barriers
- Station Map upgrade in progress
- Disaster Recovery Plan in progress
- CaFCP to continue including additional stations
- Next: additional data collection opportunities



Station Operational Status System (SOSS) 3.0 Implementation, SOSS 3.1 Upgrade, and Station Map Upgrade

Questions & comments?

Ben Xiong

California Fuel Cell Partnership (CaFCP)

(916) 375-8034

bxiong@cafcp.org



Back-up Slides



CaFCP Members

Air Liquide

Alameda-Contra Costa Transit District (*AC Transit*)

Automotive Fuel Cell Cooperation

BAE Systems

Ballard Power Systems

Bay Area Air Quality Management District

California Air Resources Board

California Department of Food and Agriculture

California Energy Commission

California State University - Los Angeles

CALSTART

The Center for Energy Efficiency and Renewable
Technologies (*CEERT*)

Center for Transportation and the Environment (*CTE*)

Daimler

Energy Independence Now

FirstElement Fuel, Inc.

General Motors

H2 Logic

Honda

Hydrogenics

HydrogeNXT

Hyundai

ITM Power

Institute of Transportation Studies, UC Davis

Linde North America, Inc.

National Fuel Cell Research Center, UC Irvine

National Renewable Energy Laboratory (*NREL*)

Nissan

Office of Governor Edmund G. Brown Jr.

Sandia National Laboratories

South Coast Air Quality Management District

Southern California Gas Company

SunLine Transit Agency

Toyota

U.S. Department of Energy

U.S. Environmental Protection Agency

University of California, Berkeley

Volkswagen



SOSS Implementation (1)

Station Name	SOSS Status	Station Developer	Expected Open Date	Development Status
West Sacramento - S. River Rd.	Completed	Linde	2015 June	1. Open - Retail
Diamond Bar - SCAQMD	Completed	Air Products	2015 August	1. Open - Retail
West LA	Completed	Air Products	2015 October	1. Open - Retail
UC Irvine	Completed	Air Products	2015 November	1. Open - Retail
San Juan Capistrano	Completed	Linde	2015 December	1. Open - Retail
Harris Ranch	Completed	FirstElement Fuel	2015 December	1. Open - Retail
Long Beach	Completed	FirstElement Fuel	2016 February	1. Open - Retail
South San Francisco	Completed	FirstElement Fuel	2016 February	1. Open - Retail
Santa Monica - Cloverfield Blvd.	Completed	Air Products	2016 February	1. Open - Retail
San Jose	Completed	FirstElement Fuel	2016 January	1. Open - Retail
Costa Mesa	Completed	FirstElement Fuel	2016 January	1. Open - Retail
La Canada Flintridge	Completed	FirstElement Fuel	2016 January	1. Open - Retail
Lake Forest	Completed	FirstElement Fuel	2016 May	1. Open - Retail
Saratoga	Completed	FirstElement Fuel	2016 April	1. Open - Retail
Hayward	Completed	FirstElement Fuel	2016 April	1. Open - Retail
Santa Barbara	Completed	FirstElement Fuel	2016 April	1. Open - Retail
Fairfax - LA	Completed	Air Products	2016 May	1. Open - Retail
Emeryville	Completed	AC Transit / Linde	2012	1.1 Open - Non-Retail
Burbank	Completed	H2 Frontier	2010	1.1 Open - Non-Retail
Torrance	No upgrade	Shell / Air Products	2011	1.1 Open - Non-Retail
Newport Beach	Completed	Shell / Powertech	2012	1.1 Open - Non-Retail
Harbor City	Completed	Air Products	2013	1.1 Open - Non-Retail
Fountain Valley	Completed	Air Products	2015 July	1.1 Open - Non-Retail



SOSS Implementation (2)

Station Name	SOSS Status	Station Developer	Expected Open Date	Development Status
Cal State LA	In progress	CSULA / EPC	2016	2. Commissioning
Campbell	In progress	FirstElement Fuel	2016 June	2. Commissioning
Riverside	In progress	ITM Power	2016 June	2. Commissioning
Truckee	Planned	FirstElement Fuel	2016 June	2. Commissioning
Woodland Hills	Planned	Air Products	2016 May	2. Commissioning
Mill Valley	Planned	FirstElement Fuel	2016 June	2. Commissioning
Hollywood	Planned	FirstElement Fuel	2016 July	2. Commissioning
Ontario	Planned	Ontario CNG Station	2016 June	3. Under Construction
Anaheim	Planned	Air Liquide	2016 July	3. Under Construction
Playa Del Rey	Planned	FirstElement Fuel	2016 Q3	3. Under Construction
Chino - East End Ave.	Planned	H2 Frontier	-	4.1. Approval to Build
Woodside	Planned	HTEC	2016 Q4	4.1. Approval to Build
Lawndale	Planned	Air Products	2016 Q3	4.2 Planning Approval
Rohnert Park	Planned	HyGen Industries	2016 Q4	4.2 Planning Approval
Del Mar	Planned	FirstElement Fuel	2016 Q3	4.2 Planning Approval
San Ramon	Planned	Linde	2016 Q3	4.2 Planning Approval
South Pasadena	Planned	FirstElement Fuel	2016 Q4	4.2 Planning Approval
Orange	Planned	HyGen Industries	2016 Q4	4.3. Permit In-Process
Mountain View	Planned	Linde	2016 Q4	4.3. Permit In-Process
Palo Alto	Planned	Air Liquide	2016	4.3. Permit In-Process
Los Angeles - LAX	Planned	Air Liquide	2016 January	4.4. Pre-Permitting
Los Altos	Planned	Linde	2016	4.4. Pre-Permitting
Fremont	Planned	FirstElement Fuel	2017	4.4. Pre-Permitting
Thousand Oaks	Planned	FirstElement Fuel	2017	4.4. Pre-Permitting
Newport Beach (Upgrade)	Planned	Shell / Linde	2017	4.5. Site Acquisition
Rancho Palos Verdes	Planned	Air Products	2017	4.5. Site Acquisition
Encinitas	Planned	Air Products	2017	4.5. Site Acquisition
Santa Clarita	Planned	Air Products	2017	4.5. Site Acquisition
Oakland	Planned	Linde	2017	4.5. Site Acquisition
North Hollywood	Planned	HyGen Industries	2017	4.5. Site Acquisition