2005 DOE Hydrogen Program California Hydrogen Infrastructure Project

Mark Pedersen
Air Products and Chemicals, Inc
Future Energy Solutions Group
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This presentation does not contain any proprietary or confidential information

Overview

Timeline

- December 8, 2004 pre-award initiation
- Program Kickoff June 2005

Budget

- Total project funding
  - $5MM DOE
  - $5MM APCI and Collaborators

Barriers

- Delivered Hydrogen Cost

Partners

- Air Products – Lead
- Honda, Toyota, Nissan, BMW, GM, DaimlerChrysler, Fuel Cell Energy, SCAQMD, ConocoPhillips, Shell Hydrogen, UC Irvine

Objectives for this Program

- Focus on the supply of hydrogen to demonstrate a cost effective infrastructure model in the state of California for nationwide implementation.

- Implement a variety of flexible infrastructure concepts within selected regions to demonstrate “real world” infrastructure including potential pathways to a fully developed hydrogen economy.

Objectives - Longer Term

Longer term we plan to demonstrate several delivered hydrogen modes, hydrogen production from waste energy sources, renewable sources, and on-site generation modes. We will gather infrastructure and fueling experience data as input to an infrastructure recommendation.

Approach

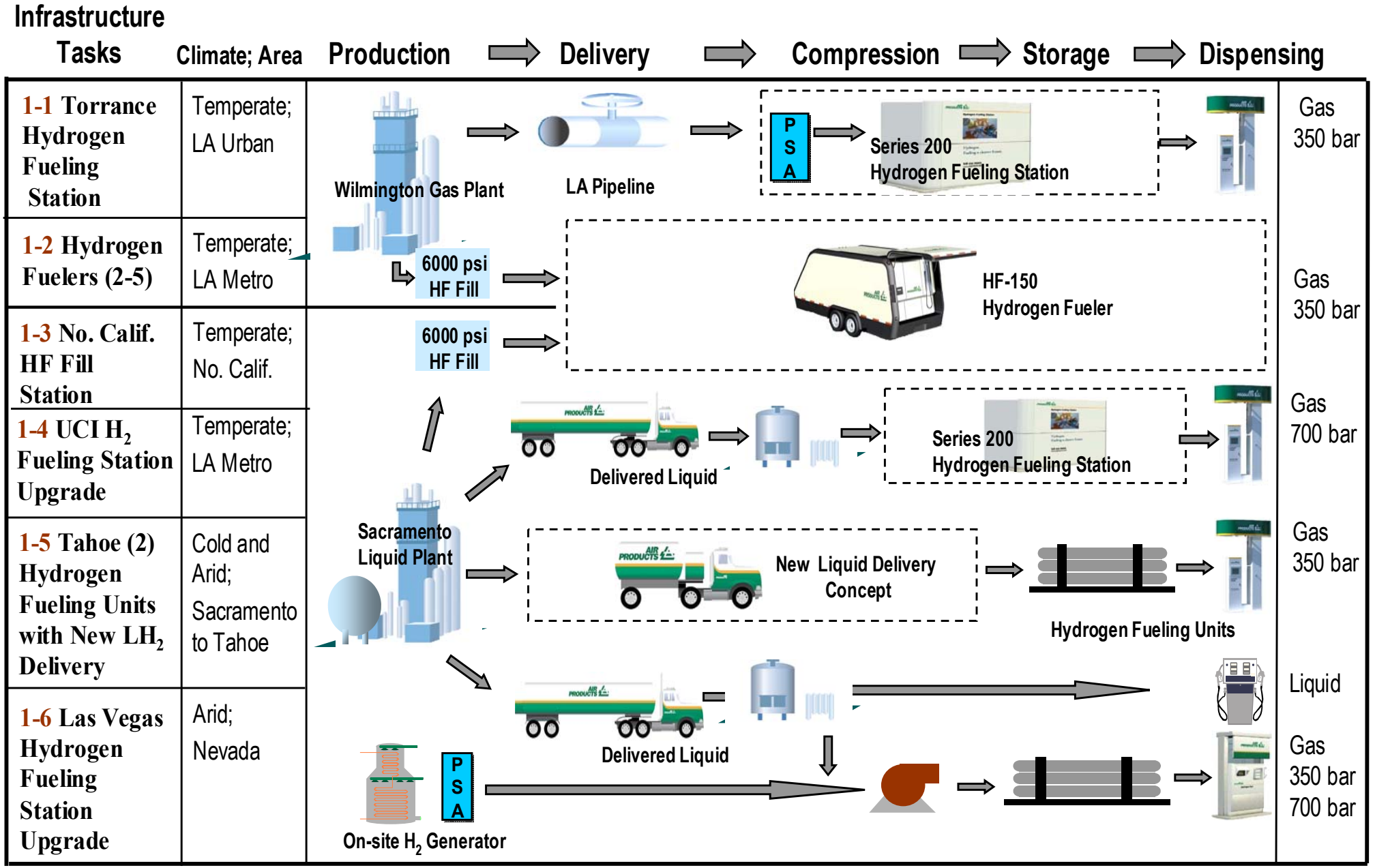
- Deploy and demonstrate multi-purpose, multi-functional assets capable of relocation, while advancing the state-of-the art in fueling.

- Infrastructure stations:
  - Pipeline Station
  - Mobile Hydrogen Fuelers
  - Hydrogen Fueling Units with Novel delivery Concept
  - 700 bar Station Dispensing Upgrades
  - Liquid Hydrogen Dispensing Upgrade
  - Enhance high pressure distribution capabilities
  - **E**lectronic **R**emote **A**ccess **M**onitoring System

Approach

- Stations will be located in a variety climates
  - Warm Weather
  - Arid
  - Cold Climate / Higher Elevation
- Establish total delivered hydrogen cost economics. Infrastructure roll-out study by the NFCRC at UC Irvine.

Figure 1- California H_2 Infrastructure Program Overview



Program Tasks

Task 1: Torrance Hydrogen Pipeline Fueling Station

Task 2: Hydrogen Fuelers in S. CA & Hydrogen Fueler Refill Capability in N. CA

- ConocoPhilips (1)
- Shell (2)
- TBD (1)
- Hydrogen Fueler Fill Station – N. California

Task 3: Upgrades to Two Existing Hydrogen Fueling Stations

- UC Irvine - Fueling Station Upgrade and 700 Bar Dispenser
- Las Vegas Station – LHy Dispenser and 700 Bar Dispenser

Take 4: Tahoe Hydrogen Fueling Units (HFU) with Novel Liquid-Gas Delivery System

- New Hydrogen Delivery Concept Vehicle (HDCV)
- Hydrogen Fueling Units - HFU's (2)

Task 5: Hydrogen Infrastructure Study (UC Irvine)

Task 6: Infrastructure Data Acquisition, Analysis and Delivery (eRAM)

Task 7: Reporting and Management

Program Duration

- Multi-year Year Program
- Financial support from DOE for the 1st yr
- Stations and data reporting will continue
- Partners will provide funding for continuing operations to cover H2 and O&M costs

Technical Progress

- Project Kick-off to occur in June 2005

- Key Milestones for FY'05
  - Initiate Torrance Pipeline station
  - Upgrade UC Irvine Station
  - Determine mobile fueler locations
  - Initiate Infrastructure study with the NFCRC
  - Develop and implement eRAM

Proposed Program Schedule

Phase I (May to Oct '05)

- Torrance Pipeline Project (begin project)
- UC Irvine Station Upgrade
- HF-150 Station in S. CA, #1
- HF-150 Station in S. CA, #2
- New High Pressure Delivery Trailer - (design process)
- eRAM developed and in use by the end of Phase I

Proposed Program Schedule cont.

Phase II (Nov to April '06)

- Torrance Pipeline Project (onstream)
- N. CA Filling Station
- HF-150 Station in S. CA, #3
- HF-150 Station in S. CA, #4
- New High Pressure Delivery Trailer (testing and in service)
- HBU #1 - Lake Tahoe Area (begin project)
- HBU #2 - Midpoint on Hwy 50 b/w Sacramento and Lake Tahoe (begin project)

Proposed Program Schedule cont.

Phase III (May to Oct '06)

- HBU #1 - Lake Tahoe Area (onstream early in Phase III)
- HBU #2 - Midpoint on Hwy 50 b/w Sacramento and Lake Tahoe (onstream early in Phase III)
- LHy Fueling at Las Vegas Station
- 700 Bar Dispensing at Las Vegas Station
- 700 bar Dispensing at UC Irvine
- HF-150 Trailer in S. CA, #5 (TBD)

Future Work

Beyond current funding efforts

- Include existing industrial gas infrastructure into CA efforts
- Inclusion of Power Park into CA
- Development of renewable applications
- Development of off-gas clean-up applications

Supplemental Slides

Hydrogen Safety

This program involves projects that are focused on the operation and demonstration of hydrogen refueling stations. As such, several potentially hazardous situations are possible and are covered in Air Products' safety and design reviews. The detailed HAZOP identifies the hazards and the safety measures taken to mitigate them. It is imperative that safety be the number concern and objective through out the entire program.

Hydrogen Safety

The engineering, design, installation and operation of these stations will be achieved through the application of a modern layered approach to safety. This includes a systematic application to work practices to execute and audit the implementation of that approach for assuredness of results. The Air Products approach to safety relies on four major elements to ensure satisfactory safety results;

- *Designed to be inherently safe where possible.*
- *Protective systems employed as a safeguard for any operating deviation that cannot reasonably be made inherently safe.*
- *Operating procedures and training, combined with safety performance monitoring and management.*
- *Personnel have the correct personal protective equipment required for the work.*