

# California Hydrogen Infrastructure Project

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Air Products and Chemicals, Inc.  
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Project ID #TV7

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# Overview

## Timeline

- Start – Aug. 2005
- End – Sept. 2008
- 85% Complete

## Budget

- Total project funding
  - DOE \$5.5 million share
  - Contractor \$5.4 million share
- Funding received through FY07
  - Total \$4.4 million
- Funding for FY08
  - Total \$0.7 million (2/29/08)

## Barriers

- Cost of delivered hydrogen

## Partners

- Various collaborators and funding groups including:
  - SCAQMD
  - OEM's
  - UC Irvine
  - Energy Companies

# Objectives

- **Demonstrate a cost effective infrastructure model in California for possible nationwide implementation**
  - Design, construct and operate seven hydrogen fueling stations
  - Collect and Report Infrastructure Data
  - Document permitting requirements and experiences
  - Validate expected performance, cost, reliability, maintenance, and environmental impacts
- **Implement a variety of new technologies with the objective of lowering costs of delivered hydrogen**
  - New Delivery Concept (NDC)
  - Hydrogen Based Unit (HBU)

# Approach

- **Work with OEM's to determine vehicle usage needs and general station equipment requirements**
- **Work with OEM's and others to determine preferred locations/areas for fueling station deployment**
- **Select potential Station Operators and work to locate suitable sites**
- **Initiate and complete required agreements, determine and address specific site issues including liability, billing, etc.**
- **Complete detailed Station Design, permits, installation, operation, and maintenance of stations**
- **Collect and report Infrastructure Data to the DOE once stations put online**
- **Monitor and collect feedback which can be incorporated to improve station user's fueling experience**

# Project Tasks

- **Station Installation**
  - UCI Fueling Station
  - Torrance Pipeline Fueling Station
  - Hydrogen Fuelers (HF-150)
  - New Delivery Concept (NDC)
  - Hydrogen Based Unit (HBU)
- **Novel Compressor Development**
- **Hydrogen Infrastructure Study (UC Irvine)**
- Infrastructure Data Acquisition, Analysis and Delivery (includes eRAM)

# Operating Stations

## UCI 350/700 Bar Station

- Excellent operating performance, increasing station utilization
- Liquid hydrogen station project cancelled



## Long Beach Mobile Fueler

- Station installed in June 2007
- Continuing to negotiate vehicle access agreements



# New Delivery Concept (NDC) Trailer

Liquid H<sub>2</sub> trailer modified to deliver both liquid and low/medium/high pressure gaseous products.  
Efficiency of liquid distribution for bulk H<sub>2</sub> stations.



## Status:

- NDC#1 fabricated and deployed to CA
- HBU#1 built, station operator to be identified



LH<sub>2</sub> Tank



Bulk H<sub>2</sub>



HF-150



Hydrogen Based Unit (HBU)

# **Status of Other Station Development Activities**

## **Torrance Pipeline Hydrogen Fueling Station**

- **Agreements could not be reached with landowners at original site for fueling station equipment**
- **Station Operator is negotiating lease for a new location along Air Products' hydrogen pipeline**
- **Equipment lease and station funding agreements to be finalized**

## **South Lake Tahoe Mobile Fueler**

- **Conditional approval by City Council of agreement to site station**
- **Negotiating vehicle access and station funding agreements**

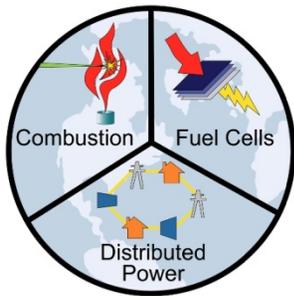
# Novel Compressor System

New equipment design which can compress hydrogen from 100 psi to 14,000 psi in one stage.

- System leak-checked to 14,000 psi
- Function test performed at 4,000 psi
- Functional test completed on all major components
- System ready for next phase of operation



# Assessing the Impacts of Hydrogen Infrastructure Deployment in Southern California



**Advanced Power and Energy Program  
University of California, Irvine**

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U.S. Department of Energy  
6/10/08

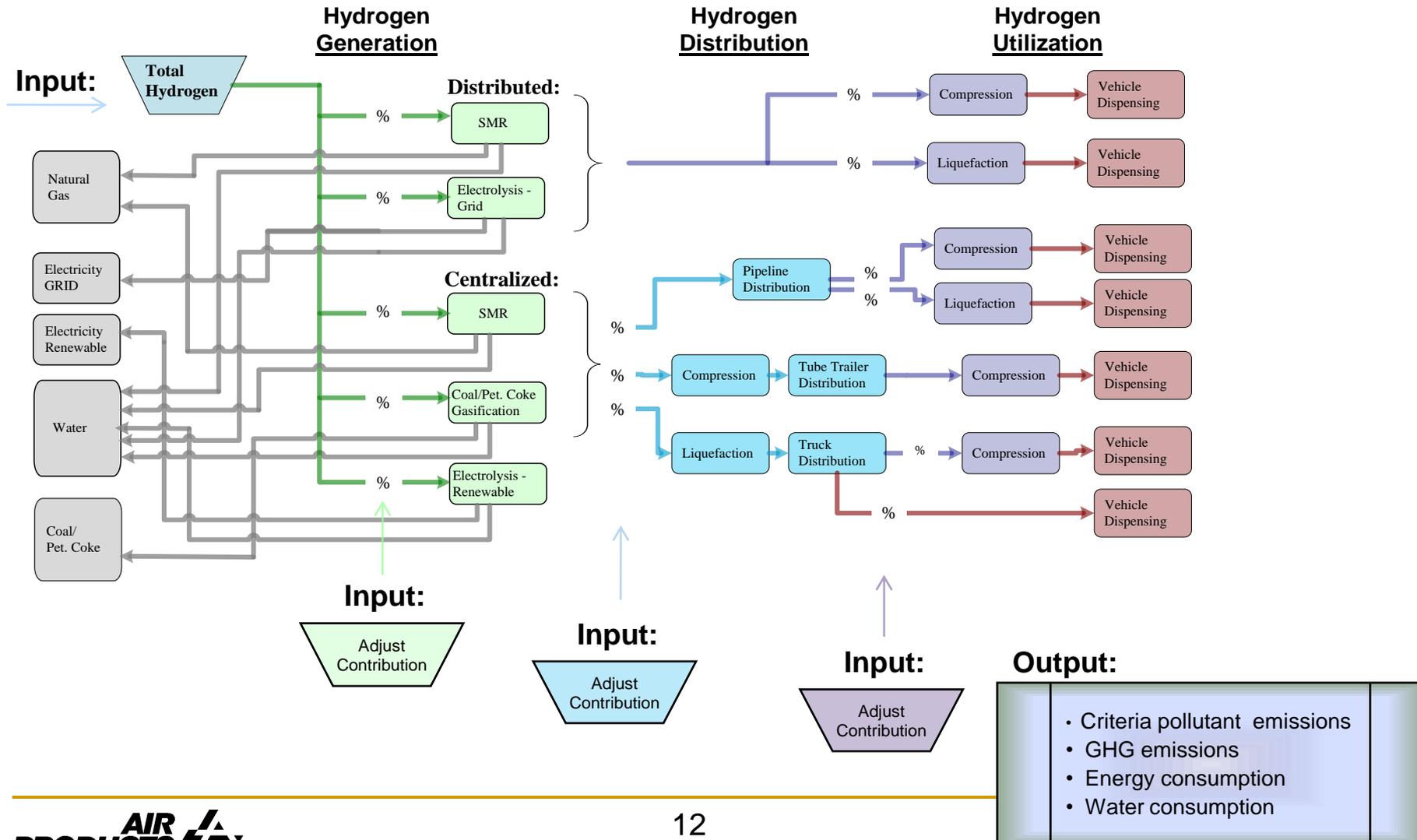
# Overview of H2 Infrastructure Assessment

Goal -

Assess the impacts associated with the deployment of hydrogen infrastructure in Southern California by designing and modeling a variety of scenarios for deployment.

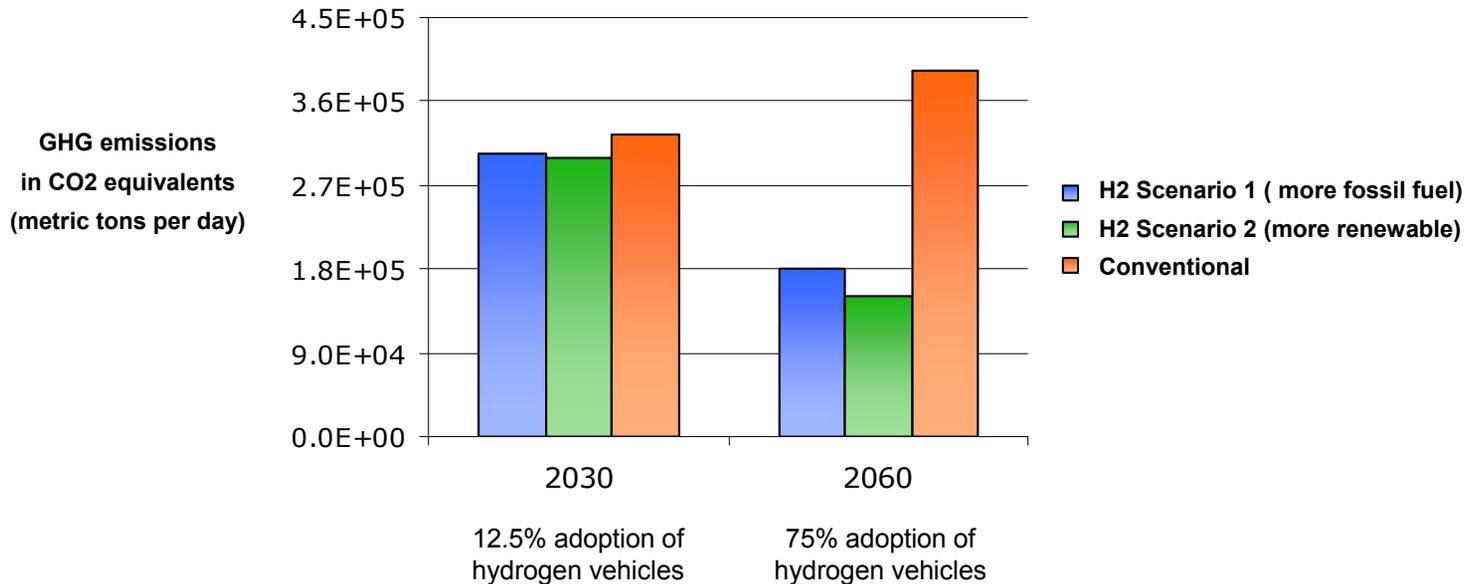
1. Develop a methodology to analyze the integration of technologies in a hydrogen infrastructure with respect to criteria pollutant emissions, GHG emissions, energy consumption, and water consumption.
2. Develop hydrogen infrastructure scenarios with a high level of geographic detail and utilize the capabilities of the *Computational Environmental Sciences Laboratory* at the University of California, Irvine to simulate the air quality impacts.

# 1. Analysis of Integrated H2 Infrastructure



# 1. Analysis of Integrated H2 Infrastructure

## GHG emissions with the adoption of hydrogen infrastructure in Southern California



## 2. Simulating Air Quality Impacts



Southern California  
Year: 2060

- Interstates & Freeways
- H2 fueling stations
- Central SMR facilities
- Petroleum coke
- Coal
- Renewable (Solar, Wind, Geo)
- H2 Pipelines

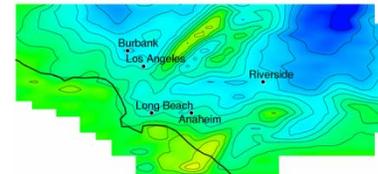
## 2. Simulating Air Quality Impacts

### Output:

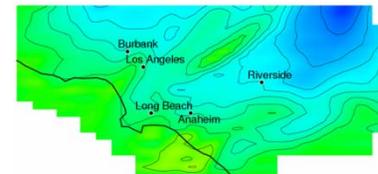
- Criteria pollutant emissions
- GHG emissions
- Energy consumption
- Water consumption

Air Quality  
Simulation

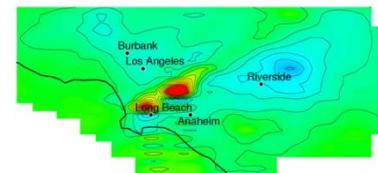
Ozone: peak



Ozone: 8-hour average

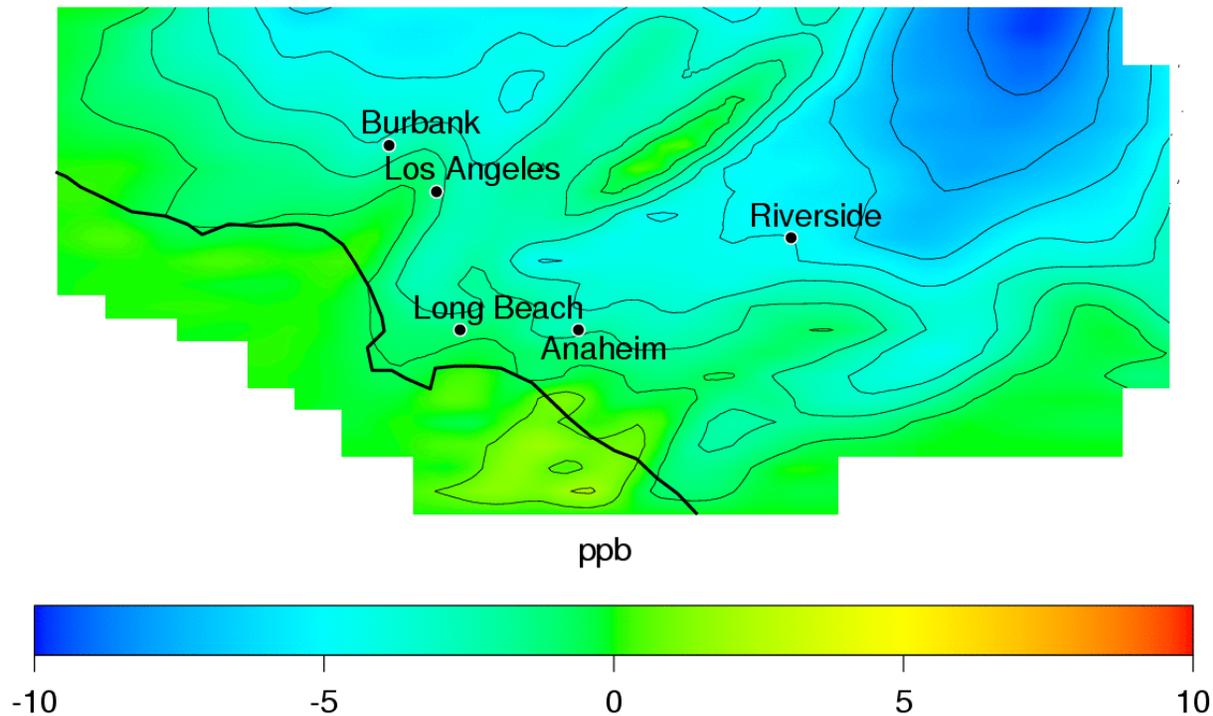


Particulate Matter



## 2. Simulating Air Quality Impacts

Ozone: 8-hour average  
[ $\Delta$  H2 vs. conventional]



Southern California  
Year: 2060

# Future Work

- **UCI Fueling Station – Finalize LHy Dispensing System**
- **Torrance Pipeline Fueling Station – Complete Agreement with Station Operator; Install and Commission both 350 and 700 bar Systems**
- **Hydrogen Fuelers (HF-150) – Begin Operation at Long Beach; Identify Other Locations and Station Operators**
- **New Delivery Concept (NDC) – Complete Fabrication of NDC #1 and Deploy; Fabricate NDC #2 and Deploy**
- **Hydrogen Based Unit (HBU) – Fabricate HBU #2; Identify Locations and Station Operators**
- **Infrastructure Data Acquisition, Analysis and Delivery – Report Data to DOE**
- **Novel Compressor Development – Complete Operating Program**
- **Hydrogen Infrastructure Study by UCI – Perform Scope of Work**

# Summary

- **Demonstrate a variety of options for delivery of low-cost hydrogen in the deployment of Hydrogen Infrastructure**
  - **First permanent CHIP station (350 and 700 bar gaseous hydrogen) opened at UCI**
  - **First mobile CHIP station (HF-150) opened in Long Beach**
  - **Commissioning of Novel Compression System**
  - **Infrastructure Data Reporting at each station**
- **Near Term Activities**
  - **First pipeline supplied hydrogen station in permit phase**
  - **Equipment fabrication nearly complete in most cases**
- **Continuing to develop site locations and Station Operators for other stations**
- **Initiating Hydrogen Infrastructure Study at UCI**

**Thank you**

**tell me more**  
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