Hydrogen and Fuel Cell Update

Shannon Baxter-Clemmons, PhD
Catherine Dunwoody
Ron Friesen

The California Hydrogen Highway Network (CA H2 Net)

Shannon Baxter-Clemmons, PhD
California EPA

CA H2 Net Overview

- The Vision
- The Implementation Strategy
- Present Status

State of the State

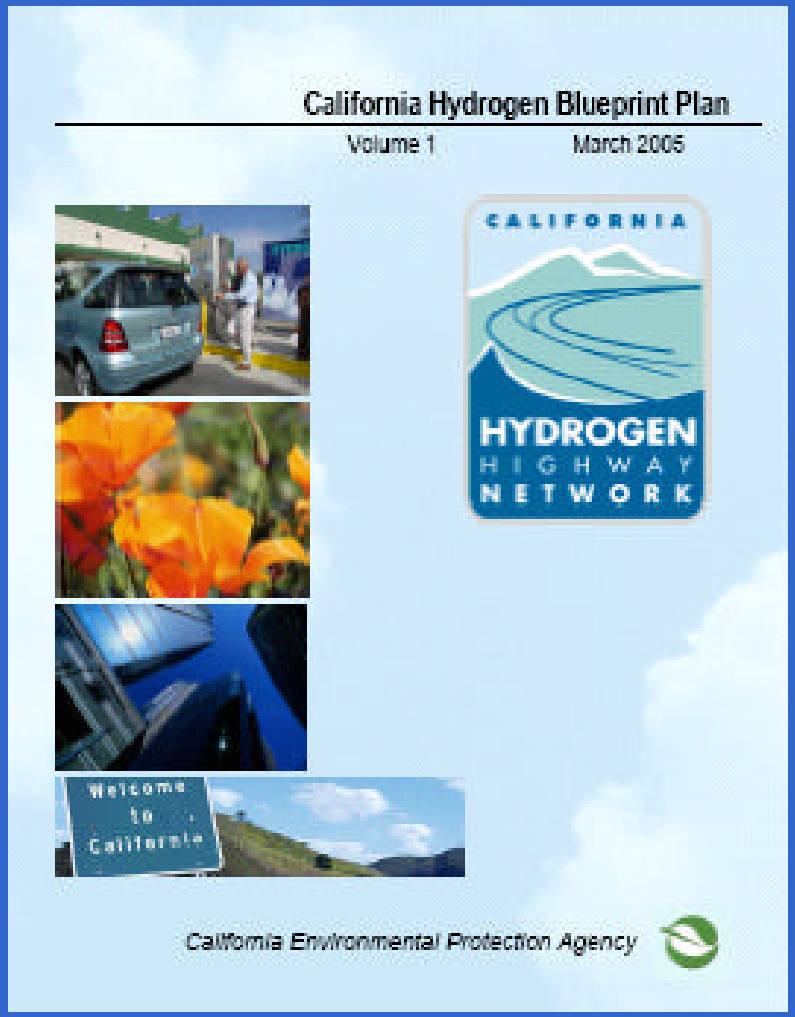
I am going to encourage the building of a hydrogen highway to take us to the environmental future...I intend to show the world that economic growth and the environment can coexist.

And if you want to see it, then come to California.

Governor Arnold Schwarzenegger

January 6, 2004

The California Hydrogen Blueprint Plan



- Suggests a pathway to implement the Governor's vison
- Over 200 stakeholders contributed
- 2 Volumes and 5 Team reports
- Adopted by the Administration

www.HydrogenHighway.ca.gov

CA H2 Net Overview

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An Action Plan

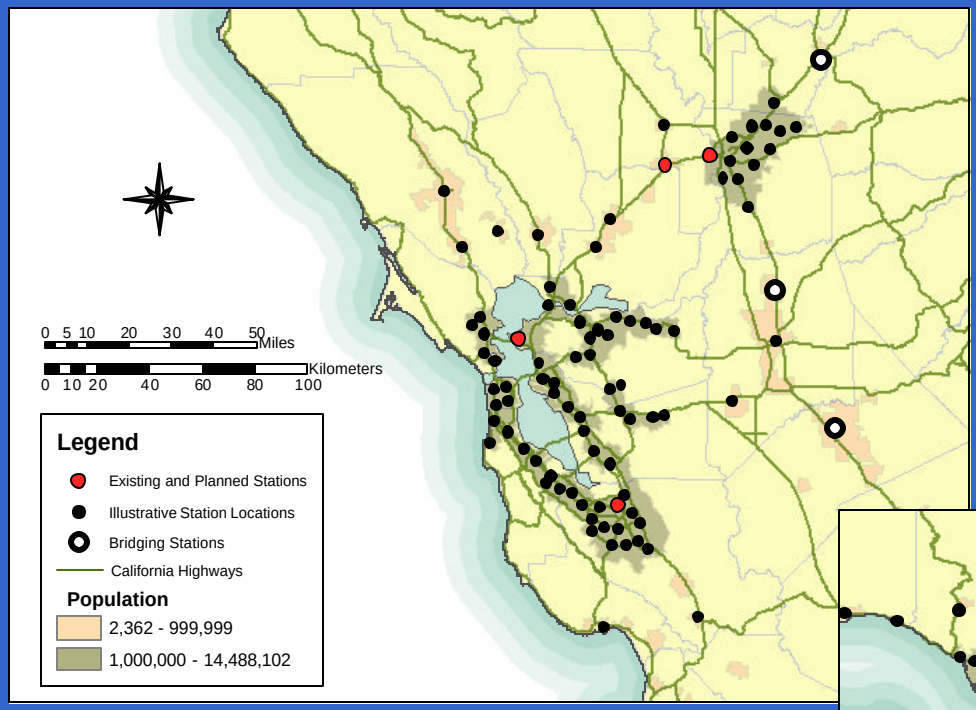
- Funding
- A public/private partnership
- Environmental goals
- Policies
- An outreach plan

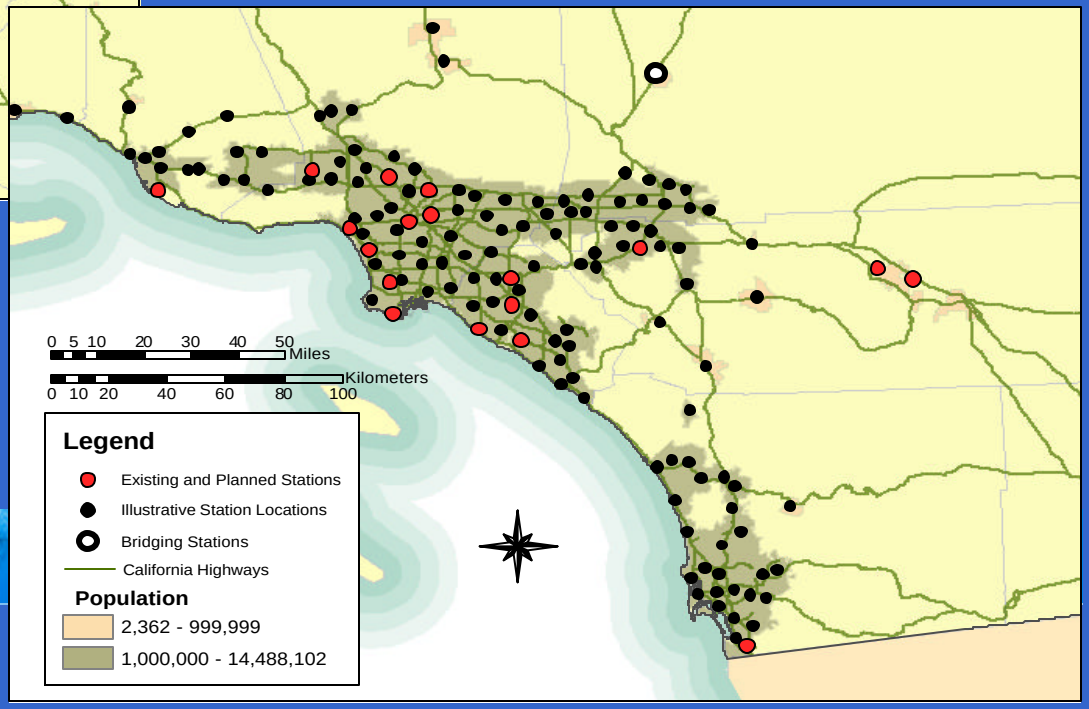
Phase Approach

Type of Hydrogen-Fueled Vehicle or Product	Number of Units Targeted / Estimated for Deployment (by Phase)		
	Phase 1: 50 to 100 Stations	**Phase 2: 250 Stations**	**Phase 3: 250 Stations**
Light-duty FCVs and ICEVs	2,000	10,000	20,000
Heavy-duty FCVs or ICEVs.	10	100	300
Stationary and off-road vehicle applications.	5	60	400

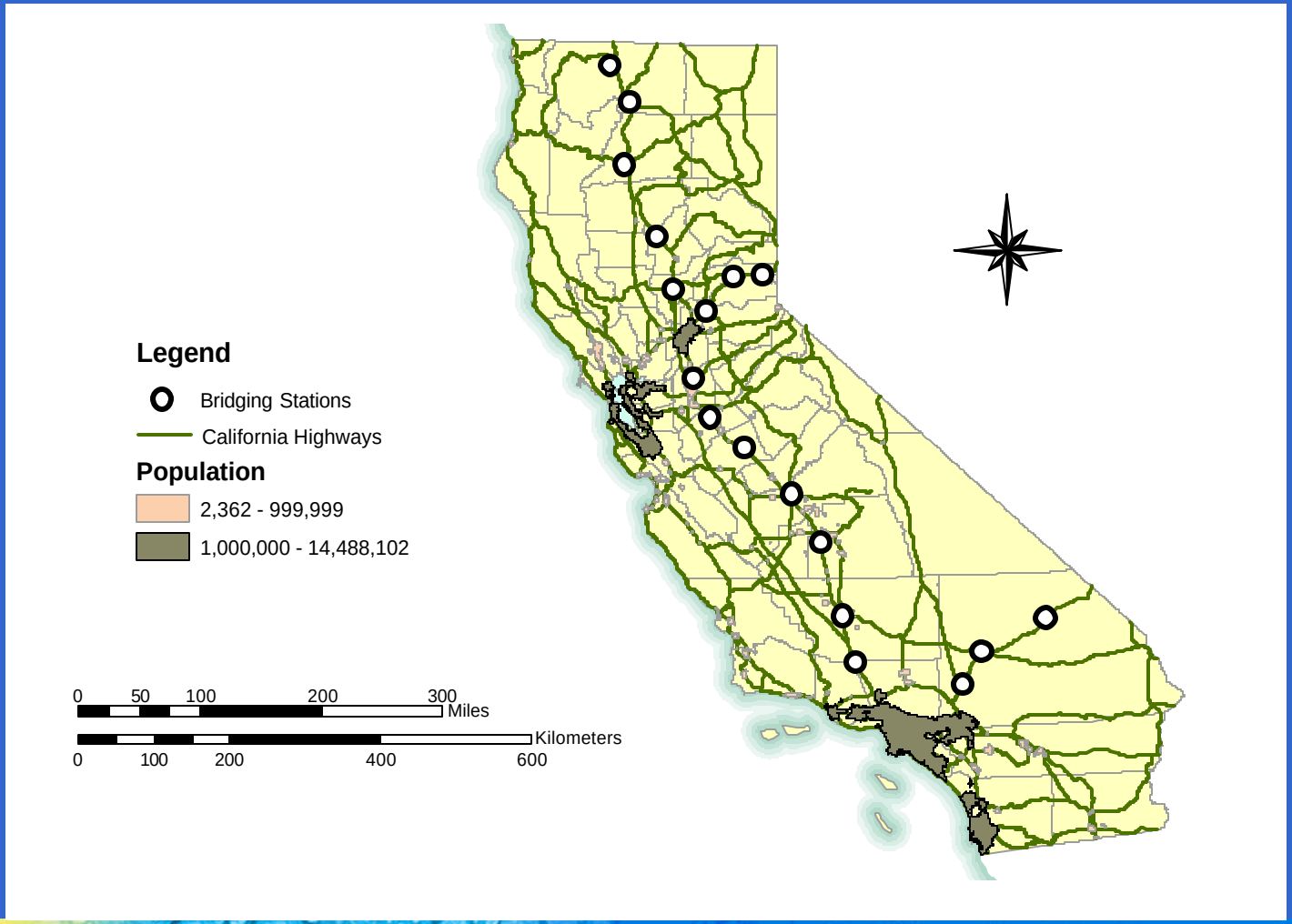
FCV = Fuel Cell Vehicle ICEV = Internal Combustion Engine Vehicle

Station Build Up Philosophy





Bridging Stations



Environmental Goals

30 percent reduction in greenhouse gas emissions relative to a comparable number of today's fuels and vehicles

20 percent new renewable resources used in the production of hydrogen for use in vehicles by 2010 and increase annually thereafter

California's Investment

- Incentives for hydrogen stations
- Incentives for hydrogen fuel cell vehicles
- Incentives for hydrogen internal combustion engine vehicles

The Blueprint outlines a 5 year plan that requests a total of $53.5 million cost share from the state.

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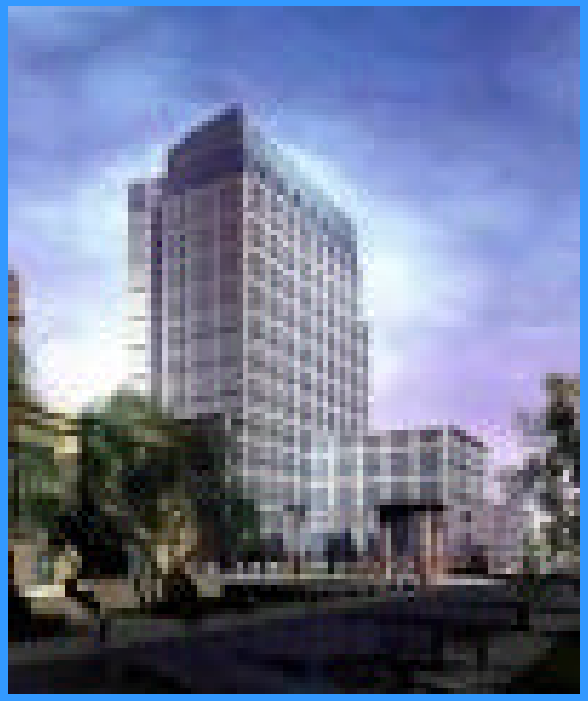
Spring Finance Letter



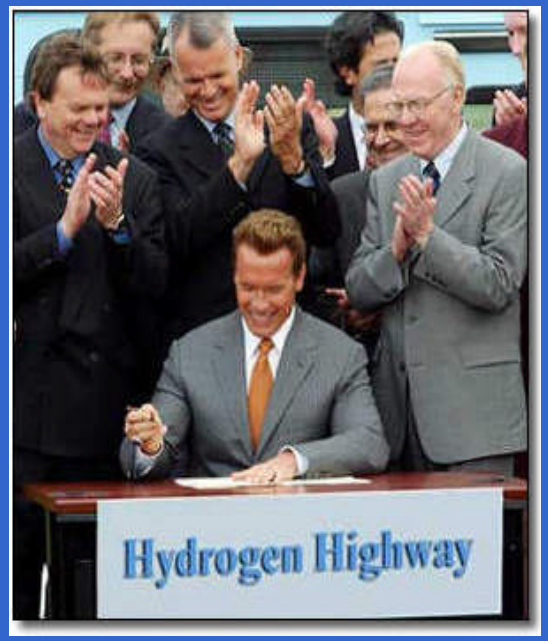
- Staff
- Contracts
- Incentives

California Senate Bill 250

Classify hydrogen as a transportation fuel

Direct the Department of Food and Agriculture's Division of Measurement Standards to develop specifications for hydrogen transportation fuel.

The Implementation Advisory Panel



Fuel Cell Vehicles on the Road in California

Catherine Dunwoody
Executive Director

May 26, 2005

The CaFCP is…

Full Members

AUTOMOTIVE
DaimlerChrysler
General Motors
Ford
Honda
Hyundai
Nissan
Toyota
Volkswagen

ENERGY
BP
ChevronTexaco
ExxonMobil
Shell Hydrogen

TECHNOLOGY
Ballard
UTC Fuel Cells

GOVERNMENT
CA Energy Commission
CA Air Resources Board
National Automotive Center
South Coast AQMD
US EPA
US DOE
US DOT

Associate Members

AC Transit
Santa Clara VTA
SunLine Transit
Air Products
Stuart Energy
ISE Corporation
Praxair
PG&E
Proton Energy Systems
Ztek
ITS – UC Davis

The CaFCP is…

… a public/private collaborative

… consensus-driven

… diverse members

… competitors collaborating on a common goal

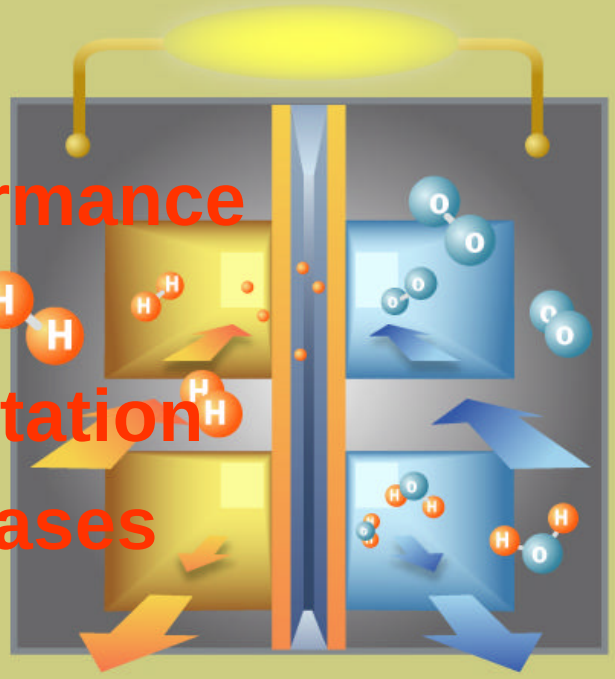
Our Mission

The CaFCP is committed to promoting fuel cell vehicle commercialization as a means of moving towards a sustainable energy future, increasing energy efficiency and reducing or eliminating air pollution and greenhouse gas emissions

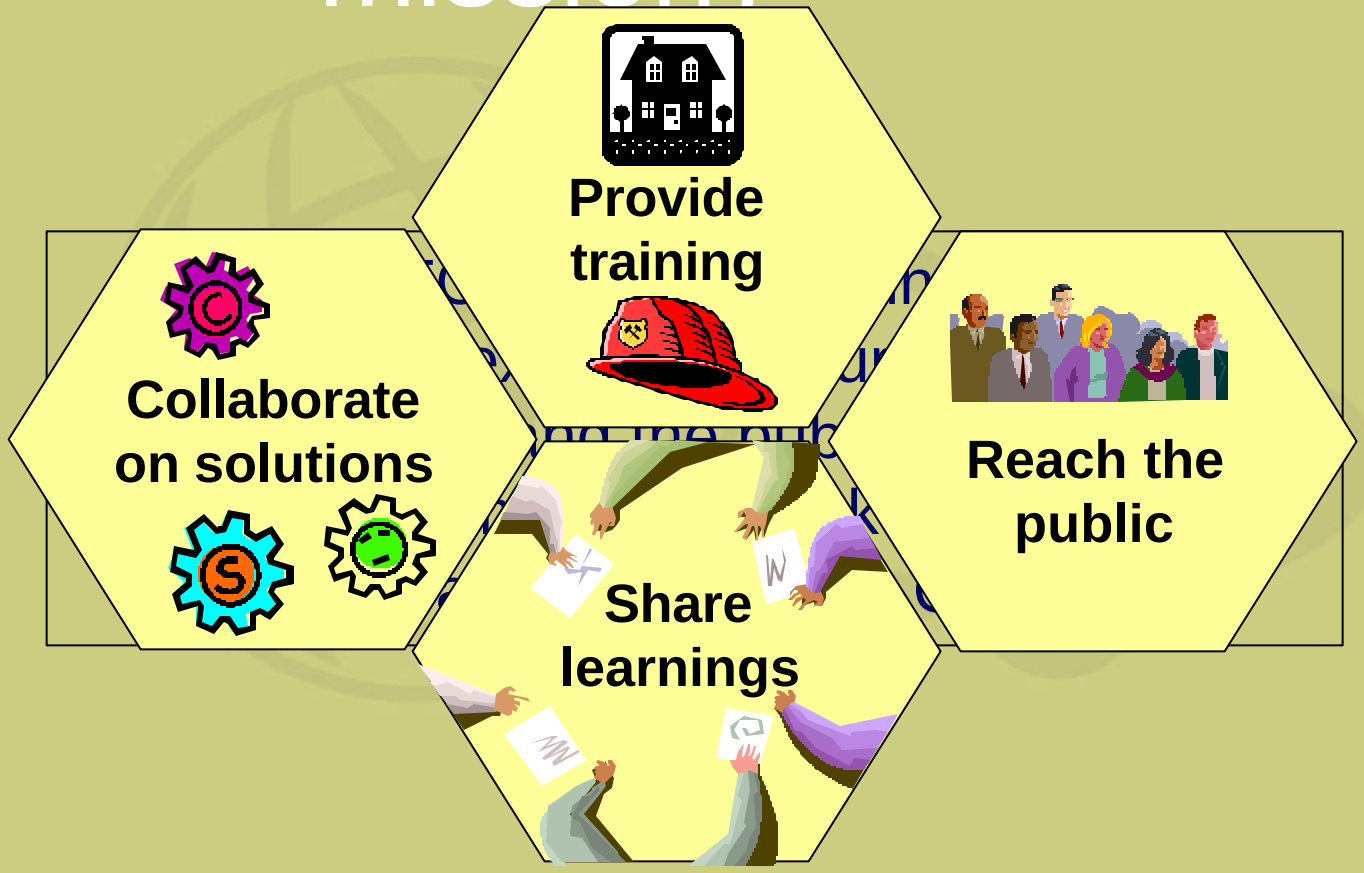
From the CaFCP Statement of Intent, 1999

One of the solutions

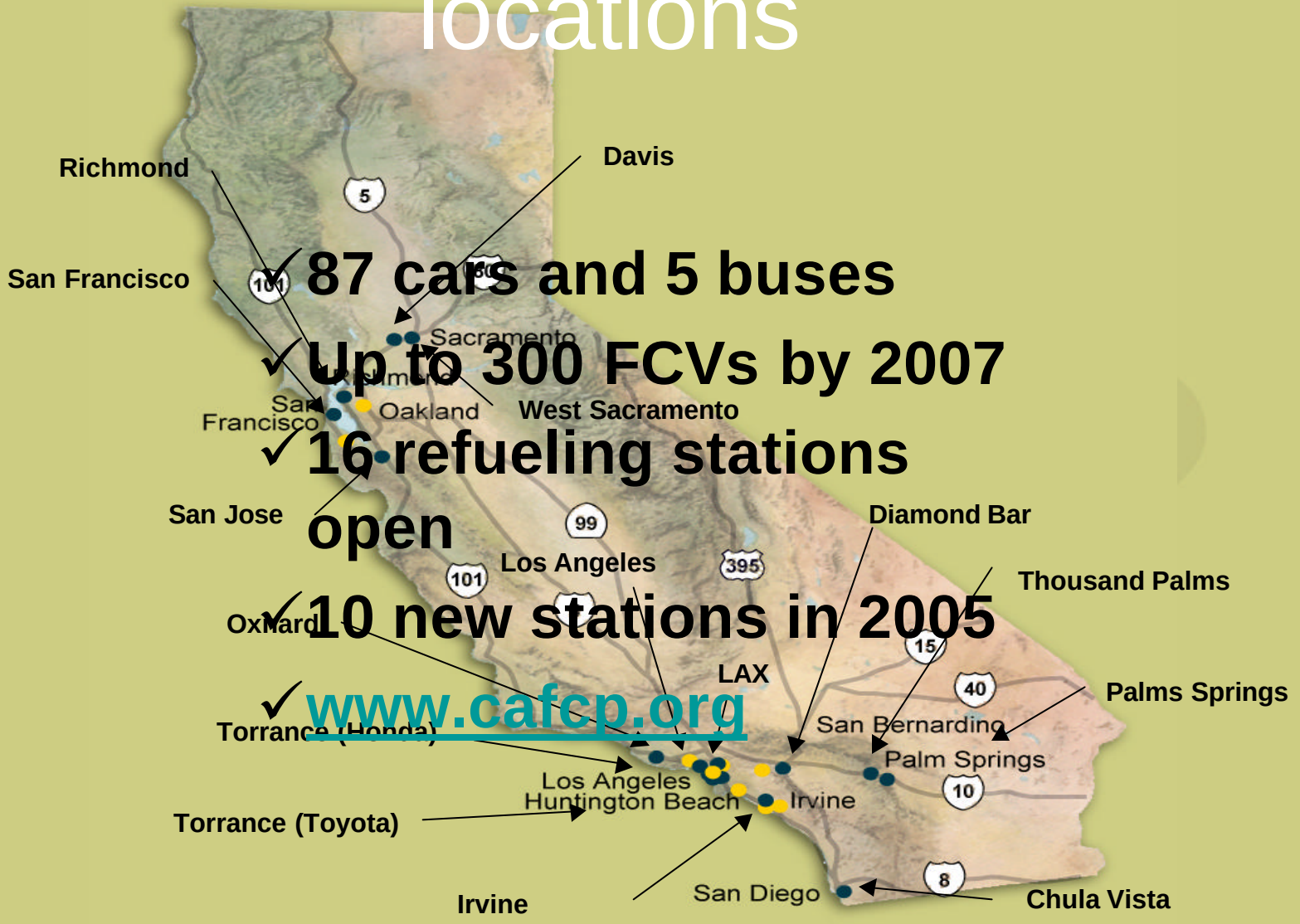
- ✓Improved vehicle performance
- ✓Energy independence
- ✓Zero-emission transportation
- ✓Reduced greenhouse gases



How do we achieve this mission?



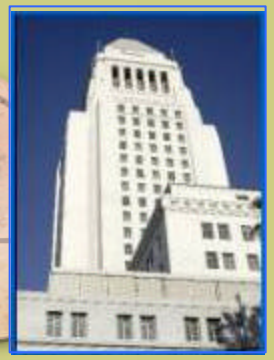
Current fleet and station locations



- ✓ 87 cars and 5 buses
- ✓ Up to 300 FCVs by 2007
- ✓ 16 refueling stations open
- ✓ 10 new stations in 2005
- ✓ www.cafcp.org

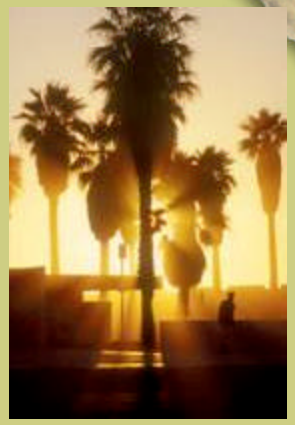
California FUEL CELL PARTNERSHIP

Honda FCX Fleet Program



AIR PRODUCTS

DaimlerChrysler Fleet Program

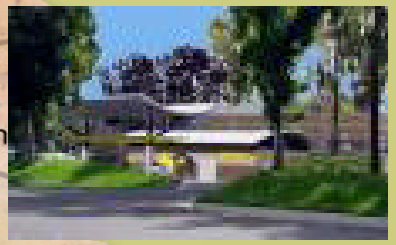


Toyota FCHV Fleet Program

GM FC Fleet Program

Shell Hydrogen

Hyundai FCV Fleet Program



ChevronTexaco

Ford Fleet Program

AC Transit and SunLine Programs

ChevronTexaco

Santa Clara VTA Program

Complementary Programs

TODAY

FUTURE

Demos → Commercialization

+

Practical Experience

- Technical Info
- Collaborative solutions
- Outreach

Public Policy

- Energy and Env. Goals
- Program criteria
- Co-funding support

Station Accessibility

- physical access
- technology interface
- training
- payment

✓ Suggested guidelines for defining “open” fueling stations

CaFCP Demo Net

- A CaFCP member forum for sharing learnings from the demonstration projects and developing collaborative solutions to common challenges

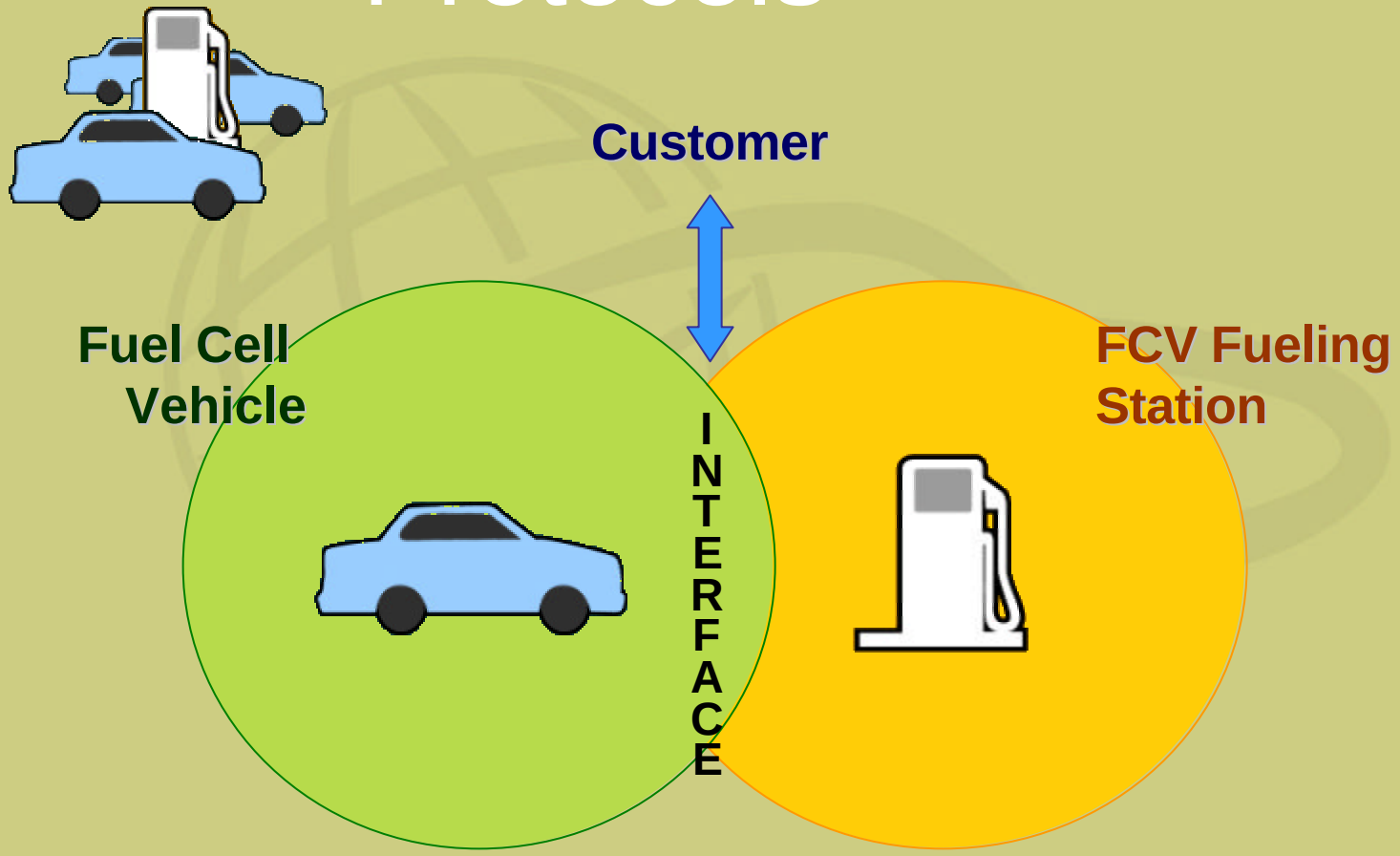
- ✓ Annual learnings reports (e.g. case studies, operating procedures, safety practices, etc.)

Interactive fleet and H_2 station map

- ✓ CaFCP will work with CA H2 Net to share and sustain this tool

www.cafcp.org

Promote Common-fit Protocols



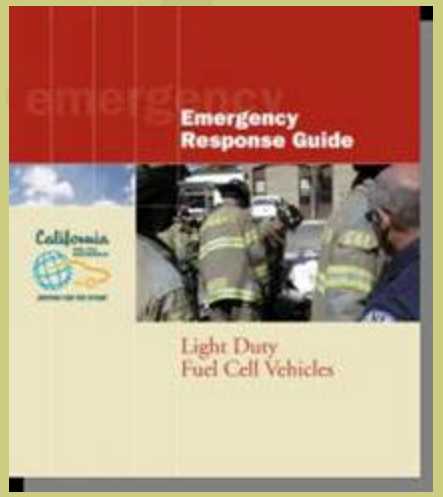
- ✓ Recommend consensus-based interoperability protocols

Station Test Apparatus

- ✓ Station Test Apparatus available for State or station-owner use

Train first responders

- **Working with national and state efforts**
- **Over 300 first responders trained**
- **ER guides and video**



✓ Provide training, technical input to new programs, coordination with OSFM and national efforts

Community Outreach Creates Advocates

- City/county officials
- Emergency responders
- Employees at a demo sites
- General public

- ✓ Coordinate communications activities for demonstration communities

California FUEL CELL PARTNERSHIP

Working Together for a Better Future

California
FUEL CELL
PARTNERSHIP
DRIVING FOR THE FUTURE

Thank you

Please visit us on the web at

www.cafcp.org

“Update on California Stationary Fuel Cell Collaborative”

California Stationary Fuel Cell Collaborative

May 26, 2005

California Stationary Fuel Cell Collaborative

Chairs

Alan Lloyd, Ph.D.
Agency Secretary, CalEPA

Scott Samuelsen, Ph.D

Industry Advisory Panel

- Director Members
- Associate Director Members

General Members

- Affiliate Members

Core Group

- CA Air Resources Board
- CA Department of General Services
- CA Energy Commission
- CA Environmental Protection Agency
- CA Public Utilities Commission
- CA Department of Transportation
- CA Business, Transportation & Housing
- CA Resources Agency
- South Coast AQMD
- US Department of Energy
- US Department of Defense
- US Environmental Protection Agency
- US Fuel Cell Council
- LA Department of Water and Power
- Sacramento Municipal Utility District
- National Fuel Cell Research Center

CaSFCC Mission

To promote stationary fuel cell development and commercialization as a means towards:

- **Reducing or eliminating air pollutants and greenhouse gas emissions,**
- **Increasing energy efficiency,**
- **Promoting energy reliability and security,**
- **Promoting energy diversity,**
- **Promoting energy independence, and**
- **Realizing a sustainable energy future.**

The Collaborative envisions fuel cell installations pursued by State, local, and public organizations as well as private entities. We believe that California represents a critical market for the fuel cell industry. Therefore, it is anticipated that California will capture 5 to 25 percent of the global sales volume capacity over the next several years.

Fuel Cell Types

FUEL CELL TYPE	*ELECTROLYTE*	*OPERATING TEMPERATURE*	*CHARGE CARRIER*	*APPLICATION & FUEL COMMENTS*

Fuel Cell Applications

STATIONARY / DISTRIBUTED POWER

- Residential/Commercial/Industrial Appl.
- Backup Power
- Remote Power
- Premium Power

TRANSPORTATION: HEAVY / LIGHT DUTY VEHICLES

- Buses / Trucks
- Passenger Vehicles
- Locomotives / Shipping

PORTABLE POWER BATTERY REPLACEMENT

Consumer Electronics	Small Motors
Laptop Computers	Boating
Cellular Phones	Lawn Mower
Camcorders, etc.	Tools, etc.

Fuel Cell End-Uses

Plug Power

Hydrogenics

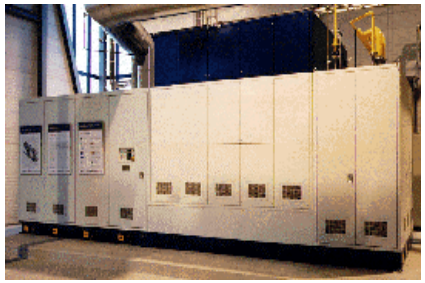
FuelCell Energy

UTC Fuel Cells

GM / Hydrogenics

Idatech

Nuvera



Siemens Westinghouse

Ballard-Ebara

Fuel Cell End-Uses

Altergy Systems

Casio

Toshiba

Smart Fuel Cells

Fraunhofer ISE

Ballard Power Systems

Manhattan Scientifics

Ballard Power Systems

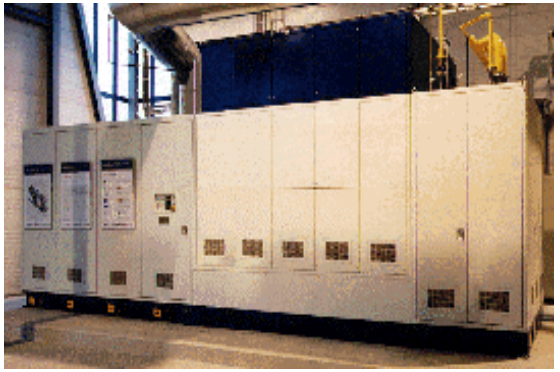
SOME RECENT DEVELOPMENTS

Plug Power

UTC Fuel Cells

SOME RECENT DEVELOPMENTS

FuelCell Energy



Siemens Westinghouse

CaSFCC Next Steps

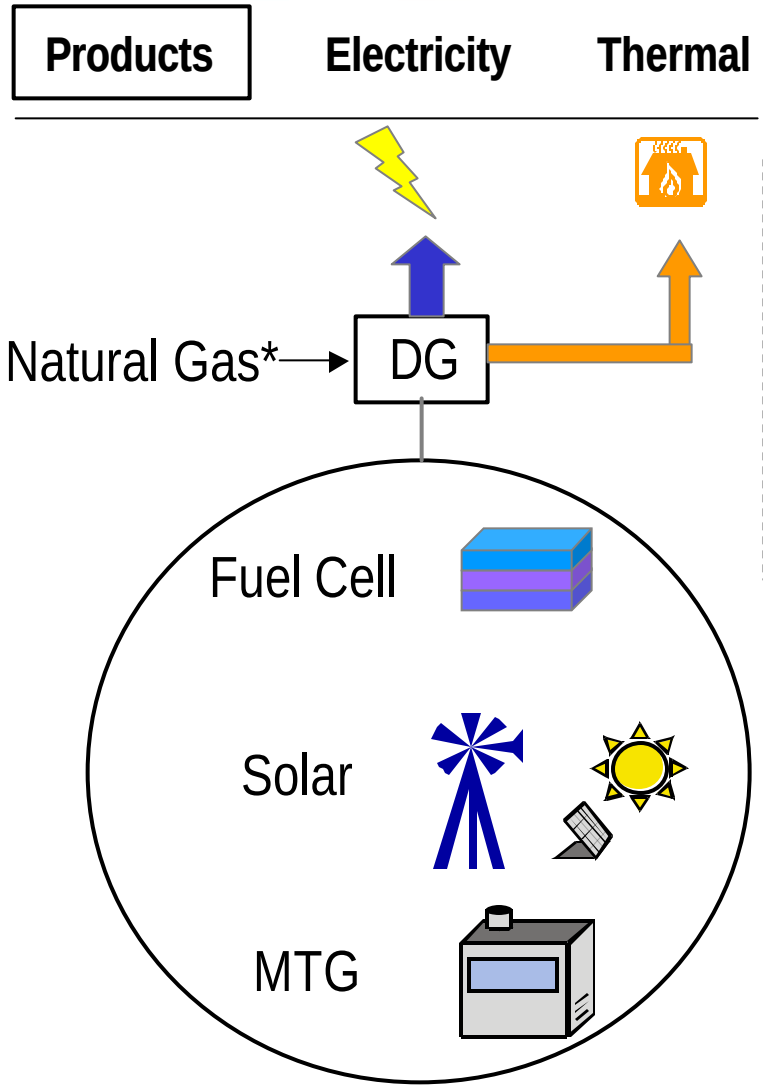
Roadmap Tasks

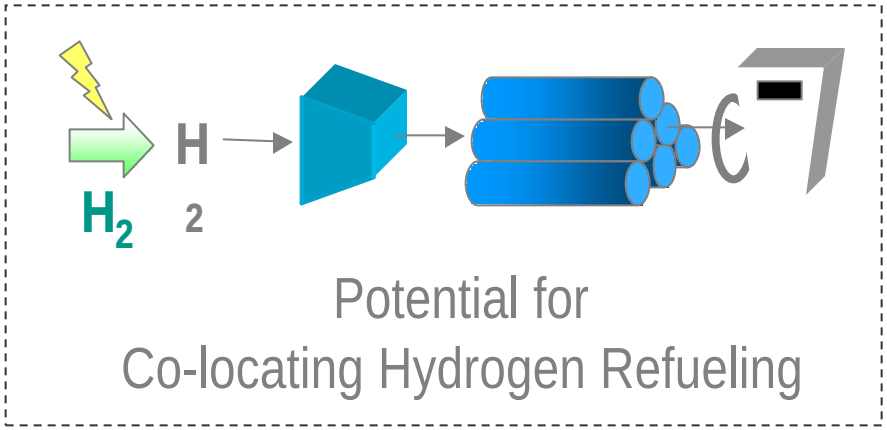
1. Formalize Collaborative Structure
2. Identify and Address Technology Hurdles
3. Establish and Implement Demonstration Plan
4. Establish and Implement Large Scale Deployment Projects
5. Support H2 Highway Network Implementation
6. Identify, Address, and Implement Policy, Regulations, Legislation, and Incentives
7. Conduct Key DG Economic and LCA Studies
8. Develop and Implement an Outreach/Marketing Program

California H2 Highway Network

- **CaSFCC Position Statement**
- **Identification of Distributed Generation Features**
- **Alternative Configurations for Energy Stations that Include Distributed Generation Technologies**
- **Projected number of energy stations to be included in Hydrogen Highway**
- **Reported on High Temperature Fuel Cell Electricity and Hydrogen Co- Production (Brouwer-NFCRC)**

ENERGY STATION



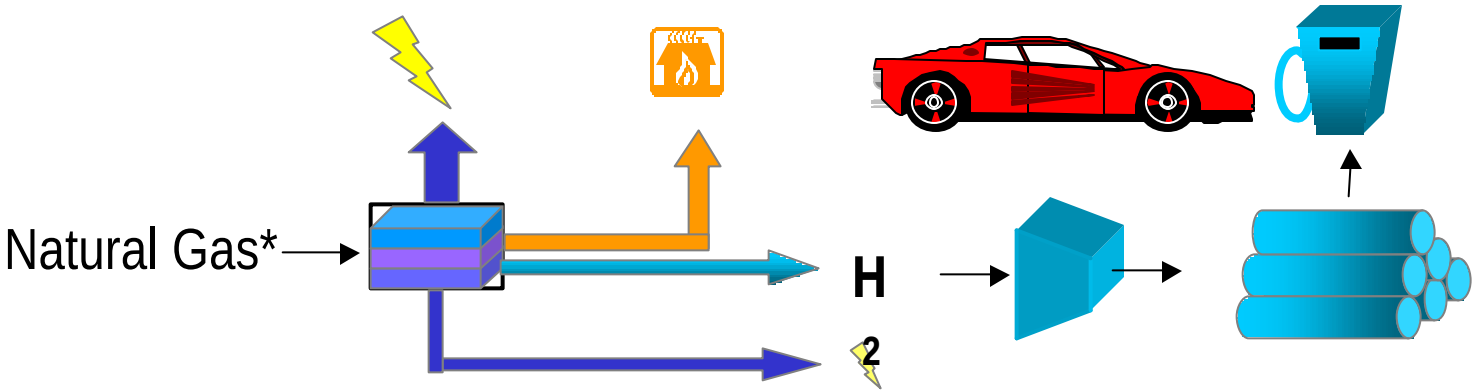


* Fuel gas may be from renewable sources (e.g., bio mass, digester, land fill) and blends with NG

ENERGY STATION

Co-Located Hydrogen Refueling

Products: Electricity, Thermal, Hydrogen



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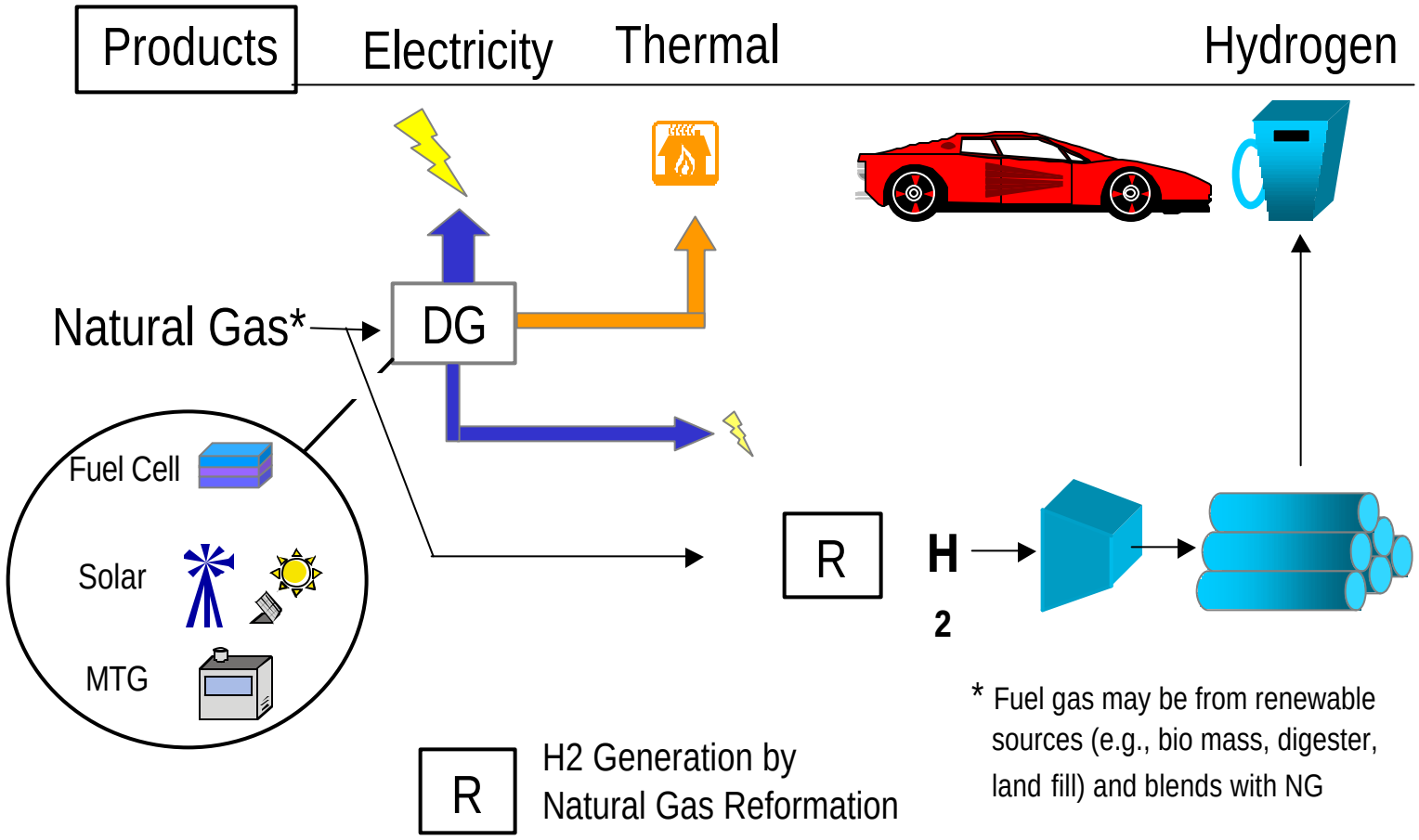
High Temperature Fuel Cell with H2 Co-Generation

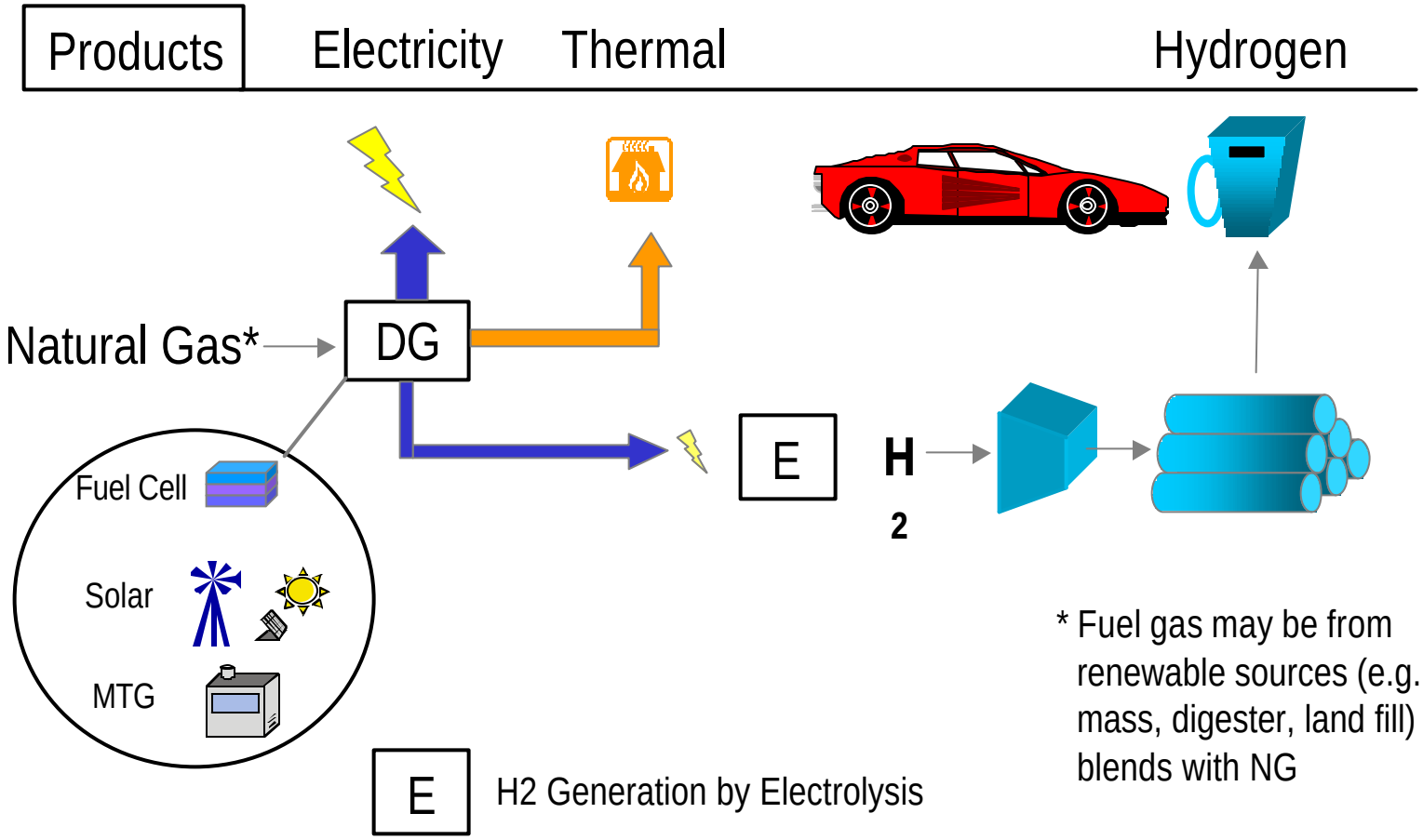
ENERGY STATION

Co-Located Hydrogen Refueling



ENERGY STATION

Co-Located Hydrogen Refueling



Next Steps

Continued Support of H2 Highway Network Initiative

this task will focus on supporting the Initiative's implementation...

- **Identify and Develop Demonstration Projects that will Compliment Hydrogen Highway Blueprint Plan**
- **Continue to Define the Role and Technical Aspects of Stationary Fuel Cells and Distributed Generation in the Hydrogen Future**
- **Address the Manner by Which DG and Stationary Fuel Cells Can Both Promote and Anchor the Evolution of a Hydrogen Economy**
- **Develop Economic Case for Energy Stations and Hydrogen Refueling Stations**
- **Identify Sites for Development**