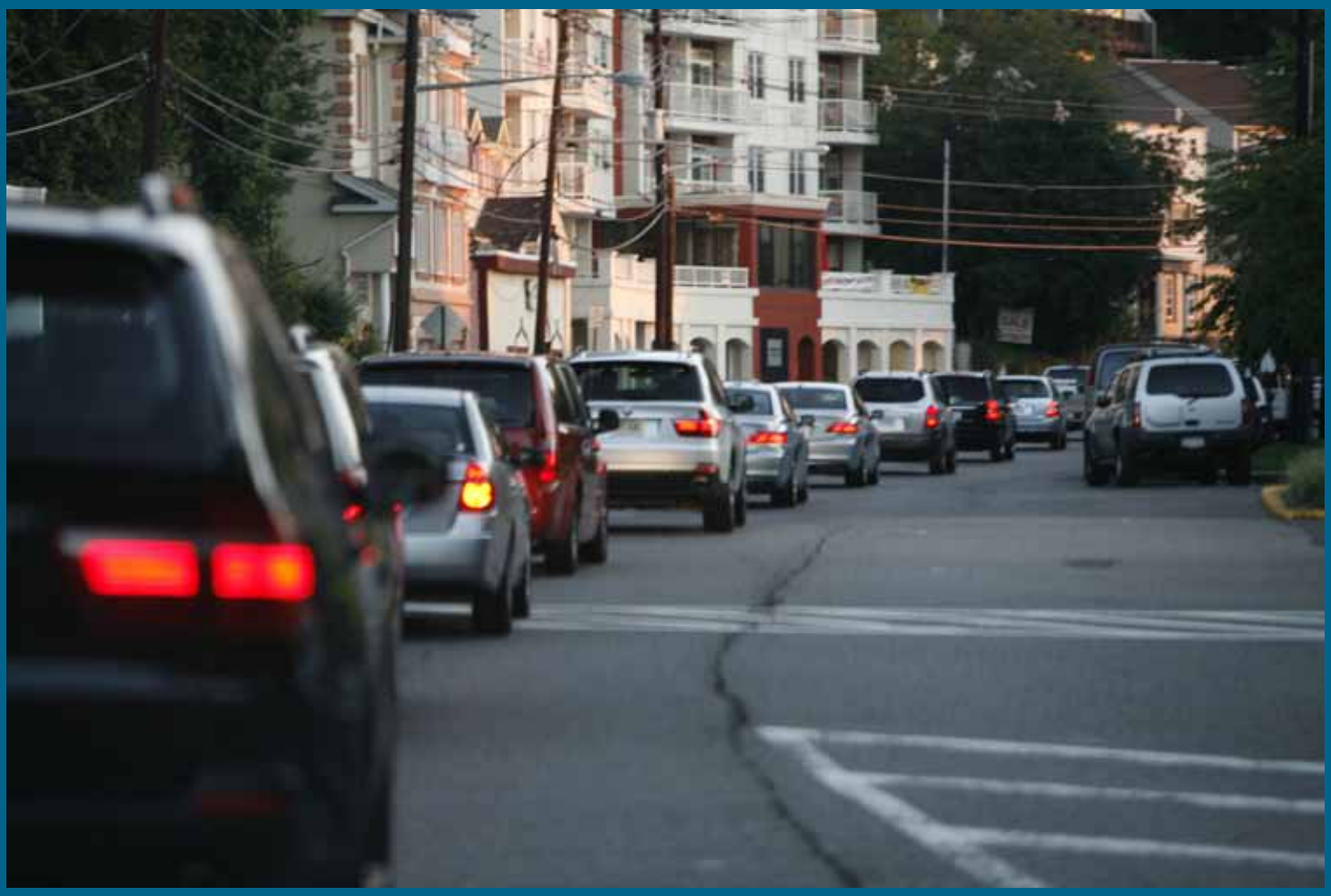
H_2 Readiness

Best practices for hydrogen stations in early-adopter communities



Part of the ZEV Action Plan
A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025

April 2014

FUEL CELL

Fuel cell electric vehicles are powered by electricity generated in a fuel cell from hydrogen and oxygen. Hydrogen, stored on board the vehicle as a compressed gas, is safe and currently available for industrial uses. FCEVs take 5 to 7 minutes to fill at a hydrogen station and have a range similar to gasoline vehicles (250-400 miles).

Hydrogen is nontoxic, noncorrosive and environmentally benign, and can be produced locally from a variety of sources including natural gas, water and biogas. In a FCEV, hydrogen is 2 to 3 times more efficient than gasoline in a conventional vehicle.

Hydrogen stations are usually located at existing gas stations and dispense hydrogen as a compressed gas, similar to compressed natural gas. Hydrogen dispensers are similar in appearance to retail fuel dispensers. Hydrogen is delivered at 35 MPa or 70 MPa (5,000 psi or 10,000 psi) to a vehicle's tank.

HYDROGEN

Benefits of Being an Early Market Community

In March 2012, Governor Brown issued an executive order directing state government to help accelerate the market for zero-emission vehicles (ZEVs) in California. The Executive Order established several milestones on a path toward 1.5 million ZEVs in California by the year 2025.

ZEVs include hydrogen fuel cell electric vehicles (FCEVs) and plug-in electric vehicles (PEVs). Accelerating the market for ZEVs is a cornerstone of California's long-term transportation strategy to reduce localized pollution and greenhouse gas emissions, save consumers money and enable continued economic growth.

Automakers are bringing FCEVs to market in California beginning in 2015. Once hydrogen fueling opportunities are available to the first FCEV customers, hydrogen fuel demand should then closely follow vehicle sales growth. Communities that are among the first to have hydrogen stations will see specific benefits including:

- Promoting the community's commitment to sustainability
- Assisting local businesses including gas station owners, most of whom have deep roots in their communities
- Supporting California's economic and workforce development goals by deploying innovative new technologies

This document provides people involved with planning or permitting a hydrogen station with guides, resources and best practices learned from constructing hydrogen stations in California. You will learn:

- Characteristics of hydrogen as a fuel
- Layout and design of hydrogen stations
- Recommended actions to prepare for hydrogen stations and fuel cell electric vehicles
- Building and fire codes that apply to hydrogen stations
- An example permitting process for a hydrogen station

Did you know?

- FCEVs are zero-emission, electric vehicles that help achieve sustainable community and SB 375 goals.
- Hydrogen is a domestic fuel produced from natural gas, water and biogas. About one-third of Air Products' hydrogen is produced in California adding about $1 billion to the state's economy.
- By adding hydrogen dispensers to an existing gas station, owners have a new, clean fuel to sell and an opportunity to attract new business to the community.
- Building stations generates jobs. Air Products estimates that building 100 hydrogen stations could add 2,000+ jobs.
- Advance knowledge of stations and vehicles can lead to new technologies, including job training programs, new businesses and new university programs. UC Irvine's National Fuel Cell Resource Center is an excellent example of a first mover benefit.

Fuel Cell Electric Vehicles
A Snapshot

Zero-emission vehicles, including those powered by fuel cells, will play an important role in improving California's air quality, reducing greenhouse gases that contribute to climate change, and increasing energy security while promoting a green economy. To reduce GHGs to 1990 levels and below, we need to invest in infrastructure, including an early network of hydrogen stations that will provide convenient and reliable fueling for the first customers that purchase fuel cell electric vehicles.

Fuel cell electric vehicles (FCEVs) are poised to enter the commercial market, helping California reach its goals for reducing greenhouse gas emissions, improving air quality and diversifying our transportation fuel to improve the quality of life and wellbeing of Golden State residents. FCEVs will provide customers with a no-compromise electric-drive vehicle with the range, refill time, performance and comfort, along with zero emission and a low-carbon and potentially renewable fuel. Hydrogen will adhere to a quality standard, just as gasoline and diesel do today.

Automakers are preparing to bring fuel cell electric vehicles to market in California in 2015 as an integral part of their electric-drive portfolio. Transit agencies are considering fuel cell buses for their fleets, and medium- and heavy-duty vehicles with fuel cells are in demonstration programs. Building hydrogen stations is crucial for the success of vehicle introduction. The first FCEV purchasers will need to have confidence that sufficient fueling is available wherever they may be, whether it's their home, work or favorite destination. As the number of vehicles increases, the station network must grow in number and capacity to keep up with the fuel demand.

Hundreds of zero-emission fuel cell electric vehicles are on the road today and tens of thousands are coming beginning in 2015. With about 100 stations statewide, customers will have sufficient access to hydrogen fuel to replace a conventional vehicle with an FCEV.

Community Benefits of ZEVs
Hydrogen in your community

ZEVs reduce pollution: Increased numbers of ZEVs on the road reduce tailpipe pollution and its harmful effects on local residents. The ZEVs' quieter motors also reduce localized noise pollution.	Transportation sources such as cars, trucks, buses, ships and trains account for 90% of the cancer risk associated with air pollution. (NRDC)
ZEVs reduce greenhouse gas emissions: With zero tailpipe emissions, the carbon footprint of a ZEV is significantly less than a conventionally powered vehicle. While climate change is a global issue, its impact is often felt in local communities.	In California, nearly 75% of human-made GHGs are tied to fuel: producing, distributing and using it in a vehicle. (US EPA)
People are attracted to ZEV-ready communities: Installing hydrogen stations ensures that local communities are attractive for people who drive fuel cell electic vehicles to live, shop and do business.	California represents 30-40% of the national market for ZEVs, and will be the first state to have commercially available FCEVs beginning in late-2014. (Office of Planning and Research)
Enabling ZEVs improves constituent service for residents: Providing infrastructure and other local support (such as efficient permitting) and by publicly promoting such services, communities expand consumer choice and encourage residents that want to make the transition to FCEVs.	California has about 11,000 gas stations. With about 100 optimally located hydrogen stations statewide, drivers will have fuel to comfortable drive anywhere in the state, and to neighboring states that also have stations. (California Fuel Cell Partnership)
ZEVs enhance energy reliability and independence: Hydrogen is produced from a variety of domestic sources of energy. In addition, as "vehicle-to-grid" technologies develop, hydrogen stations could provide electricity back to the grid, allowing stations to become an important source of distributed energy storage in communities, especially during emergencies.	The world produces hydrogen equivalent to 56 billion gallons of gasoline, enough to fuel 180 million FCEVs. About half is used in refining gasoline and 1/3 in manufacturing. (Energy Information Agency and California Fuel Cell Partnership)
ZEVs provide access to new and convenient fuels: Becoming H2 ready offers a clean and economical fuel choice to local residents and businesses.	One California hydrogen station produces hydrogen from biogas at a wastewater treatment plant. (Califorina Fuel Cell Partnership)

I Hydrogen Stations

II Community Engagement

III Planning and Permitting

IV Templates & Guides

I HYDROGEN STATIONS

Key points

- Hydrogen is a safe fuel that has been used for 75 years
- Hydrogen is dispensed as a compressed gas, similar to fueling with CNG
- Hydrogen stations can have several different designs

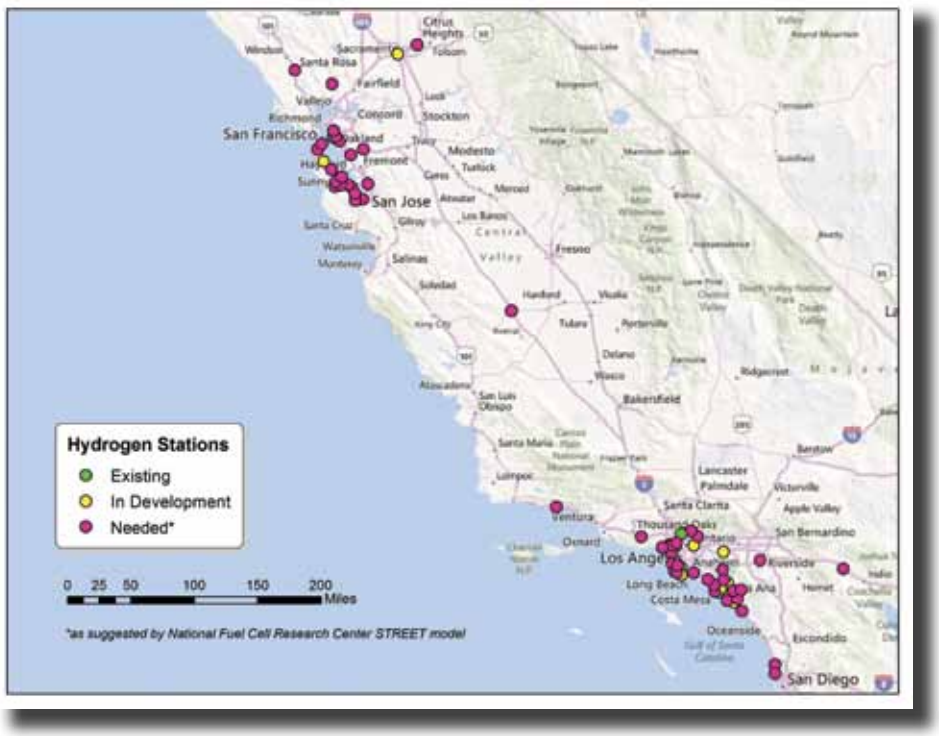
A Hydrogen Station Network
68 stations in California

Through a collaborative process substantiated by research, data and modeling, stakeholders determined that a network of 68 stations operating statewide will enable the launch of the early commercial market for passenger FCEVs. Initial station deployments will focus on geographic clusters in key markets with additional stations connecting these clusters into a regional network. The first clusters communities are:

- Santa Monica/West Los Angeles, including Beverly Hills and West Hollywood
- Torrance and nearby coastal cities
- Irvine and southern coastal Orange County
- Berkeley
- San Francisco South Bay Area

Providing fuel for long-distance trips is essential to meet customer expectations. With a broad fueling network, FCEVs provide the same utility as gasoline vehicles. The stations maximize full use of the vehicles throughout the state and help FCEVs appeal to a broader audience by providing redundancy and consumer confidence. At the same time, these stations will seed the next clusters.
The following cities are emerging markets and stations in these areas will support the hydrogen station network.

- Anaheim
- Pleasanton
- Central Valley
- Riverside
- Diamond Bar
- Sacramento
- Hayward
- San Diego
- Lake Tahoe
- San Fernando Valley
- Long Beach
- San Francisco
- Napa
- Santa Barbara
- Palm Springs
- Sonoma
- Pasadena



Additional stations in other important markets, including the Central Valley, San Bernardino/Riverside Counties and San Joaquin Valley will support deploying passenger vehicles, transit buses, trucks and off-road vehicles for ports and material handling in regions that have severe air quality impacts from freight.

Please see "A California Road Map" at
www.cafcp.org/carsandbuses/caroadmap

Hydrogen as a Fuel
A Snapshot

Hydrogen is widely recognized as a suitable fuel for transportation and has been classified as such by the State of California.[1] Industry has used hydrogen in vast quantities in the petroleum refinery process, as an industrial chemical and as fuel for space exploration. This developed an infrastructure to produce, store, transport and use hydrogen safely. Hydrogen is no more or less dangerous than other flammable fuels, including gasoline and natural gas. In fact, some of hydrogen's differences actually provide safety benefits compared to gasoline or other fuels. However, all flammable fuels must be handled responsibly. Like gasoline and natural gas, hydrogen is flammable and can behave dangerously under specific conditions, but can be handled safely by understanding its behavior.

Hydrogen is a low-carbon, non-toxic fuel that is domestically produced from local resources. Most hydrogen is made from natural gas, but increasingly it is made from water, biogas and biomass. For more than 75 years, hydrogen has been safely handled, distributed and dispensed. Building codes and technical standards are created around hydrogen's unique properties: small molecule, lighter-than-air, quick diffusion and gaseous state.

Hydrogen is lighter and smaller than other fuels: Hydrogen is the lightest and smallest element in the universe and diffuses rapidly. The small molecular size increases the likelihood of a leak, but its low weight results in very high buoyancy and diffusivity. Industry takes into account the buoyancy and diffusivity of hydrogen when designing structures to confine hydrogen safely.

Hydrogen is odorless, colorless and tasteless: Industry often uses hydrogen sensors to detect hydrogen leaks and has maintained a high safety record using them for decades. By comparison, natural gas is also odorless, colorless and tasteless, but industry adds a sulfur-containing odorant, called mercaptan, to make it detectable by smell.

Hydrogen flames have low radiant heat: When hydrogen does ignite, it burns with an invisible or near-invisible flame and produces heat and water. A hydrogen fire radiates significantly less heat compared to a hydrocarbon fire and, therefore, the flame is more easily contained and the risk of secondary fires is usually lower.

Hydrogen has a wide flammability range: The energy required to ignite hydrogen (0.02 megajoule) is low compared to gasoline and natural gas. However, it is more difficult to reach a combustable mix of hydrogen and oxygen in the air than with other fuels.

Hydrogen is non-toxic and nonpoisionous: It will not contaminate groundwater, because it is a gas under normal atmospheric conditions, nor will a release of hydrogen contribute to atmospheric pollution. Hydrogen does not create harmful fumes, and doesn't have drips and spills associated with liquid fuels.

Hydrogen has a low risk of asphyxiation: Any gas can cause asphyxiation. In most scenarios, hydrogen's buoyancy and diffusivity make hydrogen unlikely to be confined where asphyxiation might occur.

1 Senate Bill 76 – Committee on Budget and Fiscal Review, Chapter 91, Statutes of 2005. leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200520060SB76

A "hydrogen station" includes, at minimum, above-ground fuel storage tank(s), a compressor and a dispenser typically integrated into an existing gasoline or CNG station. As with natural gas, all the equipment is above ground and may likely have a significant footprint. Unlike CNG, equipment can be distributed on the property to maximize space. In addition, hydrogen stations have multiple designs that include the option of making hydrogen on site.

Most hydrogen is made by steam-reforming natural gas at a central production plant—often at or near an oil refinery. At atmospheric temperature, hydrogen is a gas and can be distributed by a pipeline or in pressurized tubes. Some plants can also liquefy hydrogen by cooling it to a cryogenic temperature (-423ºF/-253ºC). Stations can also make hydrogen on site by reforming natural gas or electrolyzing water. Compressed gaseous hydrogen is stored above ground in ASME-standard steel pressure vessels. (Composite pressure vessels require individual approval by OSHA.)

Hydrogen is a gaseous fuel that can be dispensed at two different pressures: H35, (5,000 psi), and H70 (10,000 psi). A hydrogen dispenser looks similar to a retail fuel dispenser and usually has one hose and nozzle for each pressure. Customers cannot attach the high-pressure nozzle to a lower pressure receptacle, similar to a diesel nozzle not fitting into a gasoline port.

When a customer activates the dispenser, hydrogen flows from the storage tanks to the dispenser and through the nozzle into the vehicle in a closed-loop system. If filling with H70, the hydrogen passes through a booster compressor and chiller before entering the dispenser. If the nozzle is not correctly attached, fuel will not flow.

Filling with hydrogen is fast, easy and safe. A full tank of hydrogen—4-6 kilograms—provides range similar to a conventional vehicle on about one-third the amount of energy as gasoline.

Is hydrogen dangerous?

Hydrogen is as safe as other fuels; just different. It is a lighter-than-air gas that diffuses quickly. It is difficult to concentrate hydrogen enough to make it catch fire, let alone explode. The vehicles and tanks pass all safety tests.

What are the safety systems?

A hydrogen station has several different safety systems that work together. If flame detectors or gas sensors detect a fire or leak, safety measures turn on automatically, such as sealing the storage tanks, stopping hydrogen flow or—in the case of an extreme fire—safely venting the hydrogen. Strategically placed emergency stops will manually shut down hydrogen equipment. Retaining walls, equipment setbacks and bolsters are designed into the site plan to maximize safety.

Can the hydrogen storage tanks be placed underground?

Current hydrogen fueling equipment technology allows for above ground fuel storage only. Codes and standards organizations are looking at below-ground storage, but that will be some time in the future.

How are the dispensers the same or different from gasoline dispensers?

Like a gasoline dispenser, a hydrogen dispenser typically has two sides, each with a similar interface. The dispensers are designed to accept credit cards and display sales information in accordance with state weights and measures requirements. Volume is displayed in kilograms (kg).

How is fuel distributed?

If you are having fuel delivered (as opposed to making it on site), you will have one hydrogen provider that negotiates an annual contract and arranges a delivery schedule. The cost of hydrogen is quite stable and doesn't have the same fluctuations as gasoline and diesel.

- Gaseous hydrogen is delivered by swapping storage trailers. Storage tubes are permanently mounted on the trailer. The driver opens the gate around the storage area, backs in a full trailer and connects it to the dispensing system. The driver then disconnects the empty tube trailer, hooks it to the tractor and drives away. Swapping trailers can take between 10 and 30 minutes.
- Liquid hydrogen is delivered by a tanker truck that looks quite similar to a gasoline tanker. The driver connects the hose from the truck to a valve on the storage tank and offloads liquid hydrogen. Because liquid hydrogen is at a cryogenic temperature, a vapor cloud often forms around the transfer point. Filling the storage tank typically takes around 30 minutes, depending on the size of the tank.

Can the equipment go under the canopy?

It can physically go under the canopy, but some station brands do not allow other fuels to be under the brand canopy. Some of the current hydrogen stations have hydrogen dispensers on the same island as other dispensers. At other stations the hydrogen dispenser is on its own island either under the canopy, just outside of canopy or on a separate section of property.

What training is needed to operate a dispenser?

Hydrogen dispensers are designed for unattended operation. Customers often receive fueling training one time and are then ready to fill at every hydrogen station. Your station developer will provide your employees with training and the California Fuel Cell Partnership has additional resources available. Visit www.cafcp.org.

Who are the equipment providers?

Industrial gas companies. including Air Liquide, Air Products and Linde, provide equipment, design and construction of stations. Proton OnSite makes electrolyzers and SunHydro stations. Hydrogenics and Powertech also provide equipment. Two new start-up companies, First Element and Hydrogen Frontier, are also designing stations and providing equipment.

Hydrogen Station Funding

The California Energy Commission provides cofunding for hydrogen stations through its Alternative and Renewable Fuel and Vehicle Technology Program. AB 8 authorizes CEC to co-fund at least 100 hydrogen stations with a commitment of up to $20 million a year through a competitive grant process. To date, grant recipients have been hydrogen station builders partnered with gas station owners.

Please see the resources page for a list of hydrogen and equipment providers.

Where does hydrogen come from?

There is not a "right" way to make hydrogen, but ways that are right for every region of the world. Most hydrogen comes from natural gas, but you can also make hydrogen from solar or wind energy and water. One station makes hydrogen, electricity and heat from wastewater. Researchers are experimenting with making hydrogen from other forms of biomass, such as almond shells, rice straw, and algae.

Some hydrogen stations have fuel delivered as a gas or a liquid, others make their fuel onsite by electrolysis or steam reforming. The chart below outlines the equipment needs and advantages of each method of hydrogen delivery.

Delivery Method	Equipment at Station	Advantages	Disadvantages
Liquid Delivery (see example on page 14)	Liquid storage tank Heat exchanger Compressor Gaseous storage Booster compressor (optional) Chiller Dispenser	• Can store more fuel (greater capacity)	• Much larger footprint • Potential for fuel to boil off • Expense of two types of storage tanks (liquid & gaseous)
Gaseous Delivery (see example on page 15)	Gaseous storage Compressor Chiller Dispenser	• Smaller footprint than liquid • Equipment can be in various locations	• Least amount of storage capacity without multiple trailers/ storage tubes
On-site Electrolysis (see example on page 16)	PV or wind system (optional) Water purifier Electrolyzer Compressor Gaseous storage Booster compressor Chiller Dispenser	• Make fuel on site • Potential to sell carbon credits	• More equipment • Larger footprint • Can be more expensive
H2 from Pipeline (see example on page 17)	Scrubber Gaseous storage Booster compressor (optional) Chiller Dispenser	• Larger capacity • Can require less storage	• Station must be near pipeline • More equipment • Larger footprint
On-site Reforming (see example on page 18)	Natural gas or biogas supply Scrubber Water purifier Reformer Compressor Gaseous storage Booster compressor Chiller Dispenser	• Make fuel on site • Potential to sell carbon credits	• More equipment • Larger footprint • Can be more expensive

The following pages provide profiles of different types of hydrogen stations operating in California. To learn more about these stations, view profiles of additional stations or learn more about the functions of the equipment, please visit www.cafcp.org/toolkits/stations.

Hydrogen Fueling Station | Irvine - UC Irvine

As of September 2013

Station Information

Address: 19172 Jamboree Road
Irvine, CA 92697

Station Status: Open to public

Hours of Operation: 24/7

PIN Required: Yes

Fuel Pressures: 5,000/10,000 psi

Designed Capacity: 25 kg/day
Actual Demand ~ 50 kg/day

Fuels: 5-10 cars/day

Fuel Price: Contract

Operations Contact: National Fuel Cell Research Center
University of California, Irvine
Irvine, CA 92697

Market: Cluster – Coastal/ Southern Orange County

Open to Public: February 2007
(3rd Generation)

Hydrogen Supply/Equipment

- **Hydrogen Source/Storage:**
  - Liquid hydrogen supply delivered by truck 3-4 times/month
  - 1,500 gallon horizontal liquid hydrogen tank
  - Storage for 50 kg of gaseous hydrogen
- **Dispenser:** Air Products
- **Nozzle:** WEH

Design/Construction/O&M Service Contractors

- **Designed by:** Air Products
- **Constructed by:** Air Products
- **Installed by:** Air Products
- **Maintained by:** Air Products

Station Contact

Jean Grigg
Manager of Operations, Sustainable Transportation, Sustainable Energy
National Fuel Cell Research Center
University of California, Irvine
Irvine, CA 92697
949-824-4286 x11340
jmg@nfcrc.uci.edu

Funding/Financing

Total: $1.5 million
- Original funding (2002) provided by Toyota

Update in 2007:

Govt: US DOE; SCAQMD ($573,666)

Private cost share: APCI, Toyota, Honda, Nissan and BMW

Public funding period: Six years (DOE CHIP)

Note: Upgrade funding awarded to APCI by CEC in 2010 NOPA (11/16/10) (CEC PON-09-608) to upgrade to expand capacity to 100 kg/day

Hydrogen Fueling Station | Harbor City - Mebtahi

As of September 2013

Station Information

Address: 25800 S. Western Ave.
Harbor City, CA 90710

Station Status: PUBLIC

Hours of Operation: 24/7

PIN Required: Yes

Fuel Pressures: 5,000/10,000 psi

Supply Capacity: 100 kg/day

Fuels: Up to 25 cars/day

Fuel Price: Contract

Operations Contact: Mebtahi Station Services
25800 S. Western Ave, Harbor City,
CA 90710

Market: Cluster – Torrance/Coastal Cities

Open to Public: April 2013

Hydrogen Supply/Equipment

- **Hydrogen Source/Storage:**
  - Gaseous high-pressure hydrogen delivered by truck
  - 64 kg H2 storage at 14,000 psi (permanent)
  - 230 kg H2 storage at 7,500 psi (trailer)
- **Dispenser:** Air Products
- **Nozzle:** WEH

Design/Construction/O&M Service Contractors

- **Designed by:** Air Products/GP Strategies
- **Constructed by:** Air Products/ GP Strategies
- **Installed by:** Air Products/GP Strategies
- **Maintained by:** Air Products

Station Contact

David Shamtoub
Mebtahi Station Services
25800 Western Ave.
Harbor City, CA 90710
310-325-8245
dshamtoub@verizon.net

Funding/Financing

Total: $2.5 million

Govt: ARB – $1.7 million (4/6/09)

Private/Cost share: Capitol Investments Group

Public funding period: April 1, 2013—March 30, 2016

Hydrogen Fueling Station | Emeryville - AC Transit

As of September 2013

Station Information

Address: 1172 45th St.
Emeryville, CA 94608

Station Status: Open to public

Hours of Operation: 24/7

PIN Required: Yes

Fuel Pressures: 5,000/10,000 psi

Supply Capacity: 65 kg/day (electrolyzer)

Fuels: Up to 20 cars/day

Fuel Price: Contract

Operations Contact: AC Transit
1600 Franklin Street, Oakland, CA 94612

Market: Cluster – Berkeley

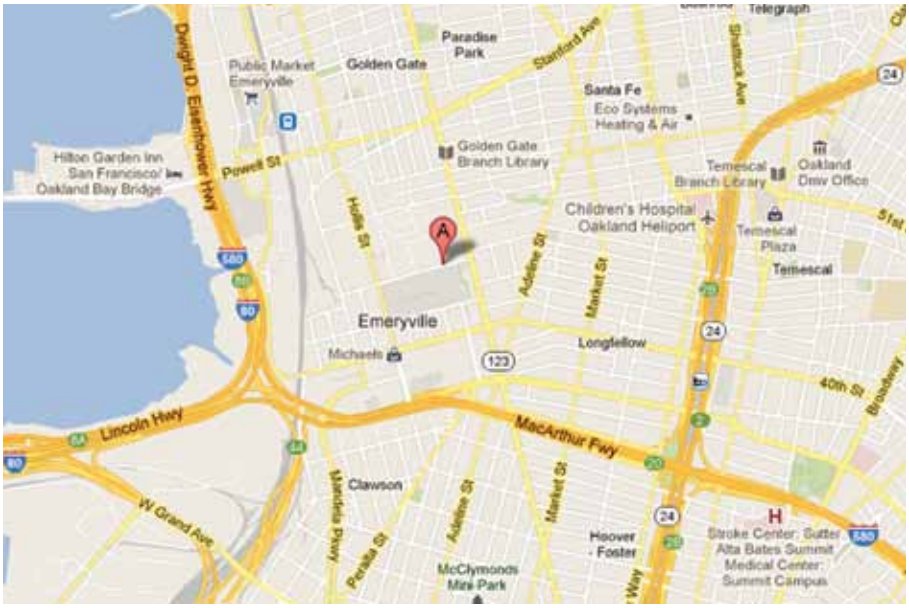
Open to Public: April 2012

Hydrogen Supply/Equipment

- **Hydrogen Source/Storage:** Proton OnSite electrolyzer using 100% renewable solar-powered electricity produces 65 kg/day of hydrogen for passenger vehicles
- Liquid hydrogen storage is provided as a backup to the electrolyzer
- **Dispenser:** Linde
- **Nozzle:** WEH

Design/Construction/O&M Service Contractors

- **Designed by:** Linde North America, Jacobs and EPC
- **Constructed by:** W.L. Butler Construction
- **Installed by:** 510 kW DC solar photovoltaic system installed by engineering and construction firm Cupertino Electric, Inc.
- **Maintained by:** Linde



Station Contact

Douglas Byrne
Project Manager, ZEB Demonstration Program
AC Transit
10626 International Blvd.
Oakland, CA 94603
510-577-8821
dbyrne@actransit.org

Funding/Financing

Total: $9.4 million for transit and public fueling

Govt: Total grants: $6.7 million (7/12 Staff Report – ARB and FTA)
ARB – $2.7 million grant (public FCEV fueling)

Public funding period: Three years

Hydrogen Fueling Station | Torrance - Shell

As of September 2013

Station Information

Address: 2051 W. 190th Street
Torrance, CA 90501

Station Status: Open to public

Hours of Operation: 24/7

PIN Required: Yes

Fuel Pressures: 5,000/10,000 psi

Supply Capacity: 50 kg/day

Fuels: 10-12 cars/day

Fuel Price: Contract

Operations Contact: Shell Oil Products, US
910 Louisiana Street OSP 4114 B
Houston, Texas 77002

Market: Cluster – Torrance/Coastal Cities

Open to Public: May 2011

Hydrogen Supply/Equipment

- **Hydrogen Source/Storage:** Pipeline-fed hydrogen connected to Air Products' Wilmington and Carson hydrogen production facilities
- **Dispenser:** Air Products
- **Nozzle:** WEH

Design/Construction/O&M Service Contractors

- **Designed by:** Air Products
- **Constructed by:** Air Products
- **Installed by:** Air Products
- **Maintained by:** Air Products

Station Contact

Rick Scott
Operations & Safety Coordinator, Hydrogen Stations
Shell Oil Products, US
910 Louisiana Street OSP 4114 B
Houston, Texas 77002
rick.scott@shell.com

Funding/Financing

Total: $944,221

Govt: SCAQMD – $489,000

Private/Cost share: Air Products
Toyota – land owner

Public funding period: Three years

Hydrogen Fueling Station | Fountain Valley - OCSD

As of September 2013

Station Information

Address: 10844 Ellis Ave
Fountain Valley, CA 92708

Station Status: Open to public

Hours of Operation: 24/7

PIN Required: Yes

Fuel Pressures: 5,000/10,000 psi

Supply Capacity: 100 kg/day

Fuels: 25-30 cars/day

Fuel Price: Contract

Operations Contact: National Fuel Cell Research Center
University of California, Irvine
Irvine, CA 92697

Market: Cluster - Coastal/Southern Orange County

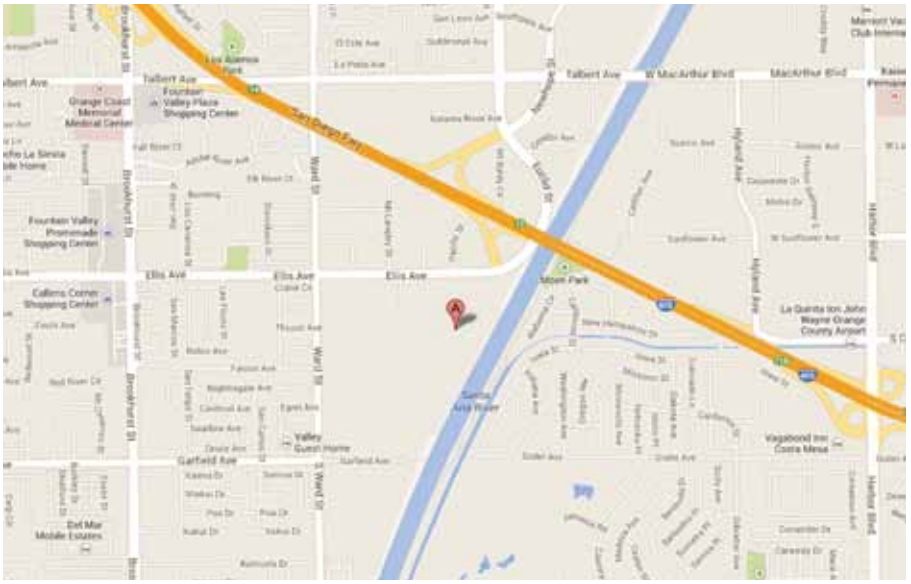
Open to Public: August 2011

Hydrogen Supply/Equipment

- **Hydrogen Source/Storage:** Renewable hydrogen produced on site from methane gas generated from wastewater at OCSD treatment plant
- **Dispenser:** Air Products
- **Nozzle:** WEH

Design/Construction/O&M Service Contractors

- **Designed by:** FuelCell Energy, Inc.(power plant) and Air Products
- **Constructed by:** Air Products
- **Maintained by:** Air Products



Station Contact

Jean Grigg
Manager of Operations, Sustainable Transportation, Sustainable Energy
National Fuel Cell Research Center
University of California, Irvine
Irvine, CA 92697
949-824-4286 x11340
jmg@nfcrc.uci.edu

Funding/Financing

Demonstration: Tri-Generation of Bio-Hydrogen from Wastewater Biogas using Stationary Fuel Cell

Total: $8.7 million

Govt: ARB – $2.7 million (2006 CARB Solicitation 06-618)
SCAQMD – $750,000
US DOE - $2,077,283 (CHIP program)

Cost share: APCI, FuelCell Energy, National Fuel Cell Research Center, Southern California Gas Company

Public funding period: Three years

II COMMUNITY ENGAGEMENT

Key Points

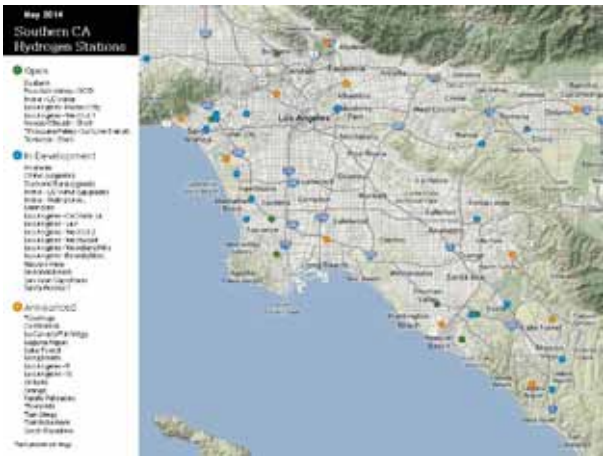
- Identify fuel cell electric vehicle infrastructure needs in the community
- Ensure local policies for battery vehicles extend to FCEVs
- Extend existing EV readiness plans and partnerships to include FCEVs and hydrogen

FCEVs are coming in 2015 to California consumers and communities can help industry take appropriate actions to build demand and maximize the "electric miles" that these vehicles generate.

Fuel cell electric vehicles have a driving range and refill time that is similar to combustion vehicles. "Hydrogen stations" are usually storage and dispensing equipment added to existing fuel stations. Over the next few years, the goal is to increase the geographic coverage and the number of hydrogen stations to ensure a sufficient number of early adopters will consider purchasing an FCEV. The number of hydrogen stations in early market communities will need to increase and additional stations will be required to expand the market.

A station's location, and its ability to encourage customer adoption of FCEVs, represents one-half of the equation. The other half is whether anticipated vehicle volumes will prove adequate to allow station operators to create a retail hydrogen fuel market.

The approach to station placement during early commercialization provides an important foundation toward balancing the coverage with capacity utilization principles. This focuses the earliest vehicle deployments on a few target areas in key California regions. The underlying strategy for fuel cell electric vehicle readiness is to create a network that meets the needs of the earliest adopters, while making sure that station operators are able to build a business case for selling hydrogen.



Hydrogen Station Planning

Through a collaborative process, substantiated by data and modeling conducted at UC Irvine and UC Davis, the California Fuel Cell Partnership determined that an initial network of 68 stations operating statewide by 2016 would enable the launch of the early commercial market.

Before FCEVs are sold or leased on a larger scale, drivers must have confidence that they can fill up near their homes, jobs and key destinations throughout California. At the same time, hydrogen stations must have an adequate supply on a daily basis and during peak hours to supply the growing number of vehicles. Automakers anticipate that fleet customers will use these stations instead of building private stations. Station coverage (as opposed to capacity) is essential so that early adopters can confidently travel throughout the state and take full advantage of FCEVs' long range.

Geographic distribution for the hydrogen stations falls into areas defined as clusters, connectors or destinations; broad geographic descriptions of early market communities for fuel cell passenger vehicles. Stations for fuel cell buses, material handling and heavy-duty vehicles will likely expand into other regions, including the Central Valley, San Joaquin Valley and San Bernardino/Riverside Counties.

Is Your Community Hydrogen Ready?

- ❒ Is your city in or near one of the clusters, a connector or a destination area?
- ❒ Does your city have an existing gasoline or natural gas station with a vacant area of about 20x40 feet?
- ❒ Does your city offer incentives, such as free parking, for electric vehicles, fuel cell and hydrogen?
- ❒ Does your city's zoning requirement specify that service stations dispense gasoline, or does the requirement refer to avoid needing a conditional use permit?
- ❒ Has your fire department and/or permitting department attended hydrogen and fuel cell training?
- ❒ Is your air quality management district involved with local transportation planning?
- ❒ Does your city have an air quality blueprint?
- ❒ Does your city already have an EV Readiness plan and partnerships?
- ❒ Are you aware of the existing funding and incentive opportunities?

Creating partnerships with local associations and community stakeholders, such as business or environmental groups, provides an opportunity to leverage existing private and nonprofit expertise and experience in government planning and outreach for zero-emission vehicle readiness.

Local associations and community stakeholders are key allies in ZEV adoption because of the information and expertise they can provide. For example, they can educate businesses and consumers about ZEV benefits, act as a common voice for the ZEV industry in the community or facilitate dialogue and plans among the various community stakeholders.

Local planning for H2 readiness can tie into existing EV readiness activities. One example of an effective partnership available to all California regions is the California Fuel Cell Partnership, which provides permitting workshops, emergency responder training, speakers for community groups and participates in outreach events. For more information, contact info@cafcp.org.

Several organizations throughout the state may be helpful during the FCEV planning process. Following is a partial list of organizations to consider involving in community planning or training:

Organization	Interest	Website
CALSTART	Buses, medium and heavy duty vehicles, hydrogen stations	www.calstart.org
Center for Transportation and the Environment	Buses, medium and heavy duty vehicles, hydrogen stations	www.cte.tv
Rio Hondo College	Workforce development	www.riohondo.edu
California Hydrogen Business Council	Business connections and education	www.californiahydrogen.org
Los Angeles Economic Development Corporation e-Mobility task force	Business assistance and eduction	laedc.org/event-page/laedc-e-mobility-task-force/
California Center for Sustainable Energy	Education and information	www.ccse.org
Southern California Association of Governments	Local resources and planning	www.scag.org
California Fuel Cell Partnership	Education, information, training	www.cafcp.org
Clean Cities Coordinators	Information, training, resources	www1.eere.energy.gov/cleancities/coalitions.html

Incentives for FCEVs and H2 Stations

Incentive Program	Description	Amount	Eligibility
FEDERAL			
Fuel Cell Vehicle Tax Credit	A tax credit for the purchase of a new light-duty FCEV; credits are based on vehicle weight	$4,000 – $40,000	Individuals
Alternative Fuel Vehicle Refueling Property Credit	A 30% tax credit is allowed for any qualified alternative fuel vehicle refueling property	$1,000 – $30,000	Individuals/ Property Owners
STATE of CALIFORNIA			
Clean Vehicle Rebate Project	Available rebate for leased and sold FCEVs	$900 – $2,500	Individuals/ Private Fleets/ Public Fleets/ Nonprofit Fleets
California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project	Vouchers to help fleets reduce the initial costs of converting fleets to PHEVs and ZEVs	$8,000 – $45,000	Public/Private Fleets

In addition to state and federal incentives, several local government incentives encourage residents and businesses to adopt ZEVs. For example, some cities offer free parking for battery electric vehicles, an incentive that could be extended to fuel cell electric vehicles. Many local incentives do not involve significant costs to the municipality.

Some employers offer corporate incentives for fuel-efficient or alternative fuel vehicles, such as a cash rebate for buying or leasing a fuel-efficient vehicle, provide pre-paid gas cards for their employees who carpool or offer free charging at work for employees with plug-in vehicles. Incentives can also include preferred parking.

Communicating about Hydrogen Stations

Businesses will need to know where hydrogen stations are available and the availability of vehicles. Businesses and residents alike are also curious about how hydrogen is produced and hydrogen's safety record. Gas stations and service repair businesses in the community will need information on what to consider when deciding whether to install hydrogen fueling infrastructure. Businesses near the station are often curious about the increase of traffic from customers and delivery trucks.

Recommended Actions for Cities

Partnerships

Create partnerships with local associations and stakeholders to further H2 readiness in local communities. Successful partnerships include city departments (planning, inspection, public works, fire and sustainability), local business associations, the station owner, the hydrogen station builder and one or more automotive company.

Attend or establish training programs for local officials and service technicians. Contact the California Fuel Cell Partnership at www.cafcp.org to get started with training.

Work with the regional readiness plans that have been or are being developed with funding from the Department of Energy or California Energy Commission.

Contact the local Metropolitan Planning Organization and Air Quality Management District to learn more about the ZEV deployment happening in local regions and any potential resources that may be available.

- Air districts are county or regional governing authorities that have primary responsibility for controlling air pollution from stationary sources. Get regional contact info and a statewide overview. www.arb.ca.gov/drdb/dismap.htm
- Metropolitan planning organizations are responsible for regional transportation planning. Find the appropriate regional contact at www.dot.ca.gov/hq/tpp/offices/orip

Permitting

Document existing municipal permitting and inspection processes for gasoline or compressed natural gas stations and for completing the inspection process, including contact information for main staff.

Create an expedited permitting process for hydrogen stations, which could include pre-permit meetings and negative CEQA declarations.

Create instruction sheets to guide installers and inspectors through the key requirements of hydrogen stations.

Test the permitting and inspection process with inspectors and contractors to identify areas in need of improvement.

(Please see section 3 of this book for detailed permitting information)

General Plan

Include language about ZEV readiness in general plans. Including high-level policy objectives can be sufficient, for example, one sentence in the circulation element that states the community wants to work toward ZEV readiness.

Stay up-to-date on the status of the state's Office of Planning and Research General Plan Guidelines Update, which will include more information about incorporating ZEVs into general plans. opr.ca.gov/s_generalplanguidelines.php

Zoning

Examine land use mix and determine in which zoning classifications, if any, to prioritize for explicit permission in the zoning ordinance for hydrogen stations.

Consider including hydrogen fueling as an option for obtaining a density bonus when negotiating with developers who want to build more densely on a site than the zoning code normally allows.

III PLANNING AND PERMITTING

Key Points

- Review local zoning codes
- Understand technology certifications
- Become familiar with codes and standards that apply to H2
- Understand CEQA and Cal-ARP applicability
- Know standard vehicle signage

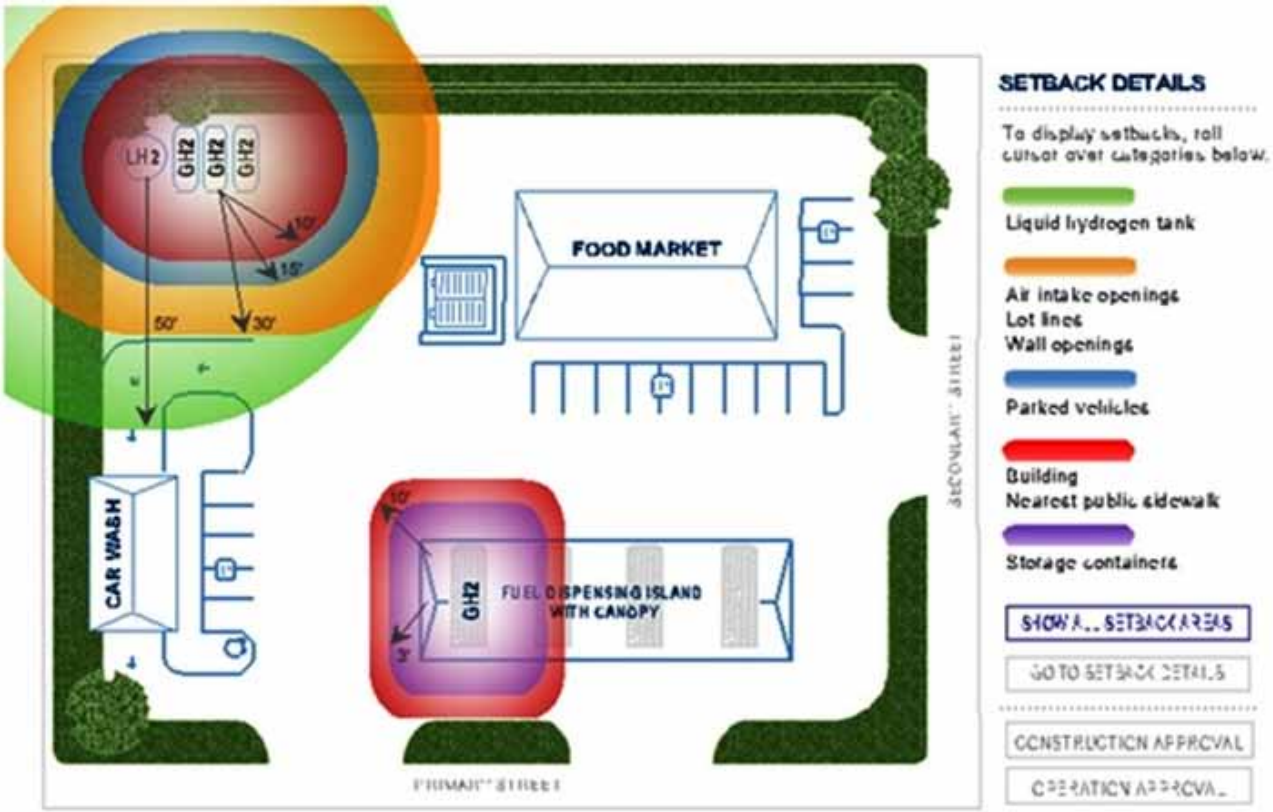
Hydrogen has been produced and employed for industrial, power-generation, energy storage and transportation purposes for decades. Hydrogen is developing into one of several major fuel types for advanced clean vehicles.

Safety codes and standards are in place to ensure the safe production, storage, handling and use of hydrogen in the U.S. Some local governments have had experience with codes (e.g., NFPA 1, NFPA 2, NFPA 52, NFPA 55, NFPA 70, ICC codes adopted by the state) and standards (e.g., ASME, CGA, CSA, SAE and UL) as they relate to industrial, commercial and fueling infrastructure projects that incorporate hydrogen.

Most jurisdictions, however, have limited experience with hydrogen and authorities having jurisdiction need to become more knowledgeable of hydrogen codes, standards and fueling equipment as well as the FCEVs themselves.

Construction and Setbacks

Among many considerations for code officials, the layout of a hydrogen fueling station must meet specific requirements for construction setbacks. This figure provides an example of a hydrogen fueling station layout, along with some of the required codes and standards.



Zoning: Hydrogen stations are being installed in retail settings alongside gasoline and natural gas dispensers. In California, jurisdictions are responsible for writing or adopting their own zoning codes. As such, the rules that govern the construction of hydrogen stations may differ, sometimes substantially from one jurisdiction to another.

Technology Certification: The codes and standards specific to hydrogen distribution, storage and dispensing have been developed by standard development organizations, the National Fire Protection Association (www.nfpa.org), the International Code Council (www.iccsafe.org) and with support from the Department of Energy and other entities. Nationally recognized testing laboratories are publishing test and design standards for hydrogen station components and continue to move toward greater standardization of hydrogen station components. Local officials may find few listed components and assemblies at hydrogen stations in the early commercialization stage. Key stakeholders are working to establish consistent processes for equipment review.

Codes & Standards Table

Regulations, Codes and Standards Template for California Hydrogen Dispensing Stations developed by the National Renewable Energy Laboratory provides information about codes and standards that could help the design and construction, and regulatory approval of hydrogen dispensing stations. The following table presents the codes as of April 2014. Please visit www.nrel.gov for updated tables.

California codes and ICC codes adopted by the State of California and enforced as law in California	
California Building Code 333	
	406.5.2.1 Canopies used to support gaseous hydrogen systems. Canopies that are used to shelter dispensing operations where flammable compressed gases are located on the roof of the canopy shall be in accordance with the following: 1. The canopy shall meet or exceed Type I construction requirements. 2. Operations located under canopies shall be limited to refueling only. 3. The canopy shall be constructed in a manner that prevents the accumulation of hydrogen gas
California Fire Code	Please see fire code table starting on page 44
ICC Documents	
	International Mechanical Code (IMC)
	International Fuel Gas Code (IFGC)
	International Fire Code (IFC)
	International Building Code (IBC)

Key reference documents that are not directly adopted as law in the State of California

NFPA 2 and Related Documents

NFPA 2 is a comprehensive hydrogen technologies code. It covers vehicle fueling and infrastructure as well as hydrogen storage. It will likely be referenced in the 2015 IFC and eventually referenced in the CFC.

NFPA 1 Uniform Fire Code (UFC)	The NFPA 1 UFC is used in roughly 25% of the states- primarily in the Northeastern portion of the US.
NFPA 2 Hydrogen Technologies Code	NFPA 2 covers almost all aspects of hydrogen technologies infrastructure including hydrogen dispensing and vehicle maintenance. The first edition was promulgated in 2011 and included extract materials from NFPA 55, NFPA 853, and NFPA 52.
NFPA 70 National Electric Code (NEC)	The NEC sets requirements for the classified areas in the dispensing requirements.

Standards Documents

CSA Standards

CSA America HGV 4.1 -2012 Final standard for Hydrogen Dispensing Systems	This document covers the complete dispensing system.
CSA America HGV 4.2 -2012 Final standard for hoses for compressed hydrogen fuel stations, dispensers, and vehicle fuel systems	Standard for listing hoses for high pressure hydrogen dispensing.
CSA America HGV 4.3 -20012 Final standard Fueling Station Parameter Safety	Standard for evaluating station performance as defined in SAE J2601.
CSA America HGV 4.5 -20012 Final standard for priority and sequencing equipment for hydrogen vehicle fueling	
CSA America HGV 4.6 -2009 TIR for manually operated valves for use in gaseous hydrogen vehicle fueling stations	
CSA America HGV 4.4 -20012 Final standard for breakaway devices for compressed hydrogen dispensing hoses and systems	Standard for evaluating devices to be used in conjunction with CSA 4.2.
CSA America HGV 4.7 -2009 TIR for automatic valves for use in gaseous hydrogen vehicle fueling stations	
CSA America HGV 4.10 -2008 TIR for performance of fittings for compressed hydrogen gas and hydrogen rich gas mixtures	
CSA Standards HPRD-1-2009 TIR for pressure relief devices for compressed hydrogen vehicle fuel containers	

SAE Standards

SAE J2579 Vehicle Fuel Systems	Covers the vehicle fuel storage system. Many of the requirements of this standard form the basis of the Global Technical Regulation (GTR) for fuel cell vehicles.
SAE J2601 Fueling Protocol	Sets station performance requirements for hydrogen dispensing over a range of temperatures and pressures.

Standards Documents

UL Standards

UL 2075 Standard for Safety Gas and Vapor Detectors and Sensors	These requirements cover toxic and combustible gas and vapor detectors and sensors intended to be portable or employed in indoor or outdoor locations in accordance with the National Electrical Code, NFPA 70. A gas detector and/or sensor and/or vapor detector, as covered by these requirements, consists of an assembly of electrical components coupled with a sensing means inside a chamber, or by separate components to detect toxic and/or combustible gases or vapors. The detector includes provision for the connection to a source of power and signaling circuits

CGA Standards

H-1 Service Conditions for Portable, Reversible Metal Hydride Systems	www.cganet.com/customer/publication_detail.aspx?id=H-1
H-2 Guidelines for the Classification and Labeling of Hydrogen Storage Systems with Hydrogen	www.cganet.com/customer/publication_detail.aspx?id=H-2
H-3 Cryogenic Hydrogen Storage	www.cganet.com/customer/publication_detail.aspx?id=H-3
H-4 Terminology Associated with Hydrogen Fuel Technologies	www.cganet.com/customer/publication_detail.aspx?id=H-4
H-5 Installation Standards for Bulk Hydrogen Supply Systems	
CGA S-1.1 Pressure Relief Device Standards-Part 1-Cylinders for Compressed Gases, Fourteenth Edition	Edition: 14th Compressed Gas Association / 01-Nov-2011 / 49 pages
CGA S-1.2 Pressure Relief Device Standards - Part 2 - Cargo and Portable Tanks for Compressed Gases	Edition: 9th Compressed Gas Association / 18-Mar-2009 / 35 pages
CGA S-1.3-2008 Pressure Relief Device Standards-Part 3 Stationary Storage Containers for Compressed Gases	Complements requirements of various regulations, codes, standards, or specifications applicable to storage containers for compressed gases. In case of conflict, the requirements of the regulations, codes, standards, or specifications of the authorities having jurisdiction over such containers shall apply. It is recommended that containers fabricated after December 31, 1995, use PRDs that meet the requirements of this edition of CGA S-1.3

ASME Standards

ASME B31.12 Hydrogen Piping and Pipelines	Code for the design of hydrogen piping systems that was developed from ASME B31.3- the code used extensively for industrial piping systems.
ASME Boiler and Pressure Vessel Code (BPV)	Sets requirements for storage vessels including vessels used on vehicles- although its primary application is for fixed storage vessels.

California Environmental Quality Act (CEQA)

Background: The CEQA Statute (Res. Code §21000 et seq) was promulgated in 1970 to protect the environment from the potential adverse impacts of projects. The act was implemented through the CEQA Guidelines which are regulations that explain and interpret the law. They are found in CCR Title 14 Chapter 3. Projects are generally construction projects but also include programs, such as a change in zoning requirements that would allow different types of construction that could result in an environmental impact. Figure 1 describes the process flow for compliance with the CEQA regulations.

Applicability: CEQA applies to projects undertaken by state and local agencies or a private entity for which they must receive some discretionary approval. For example, adding a piece of equipment that requires a permit from an Air Quality Management District would be considered discretionary approval.

Installing a hydrogen station generally fits the definition of a project under CEQA. Local governments have taken a range of actions under CEQA to install hydrogen fueling stations, including filing categorical exemption or preparing a negative declaration. Most of the recently built hydrogen stations have used categorical exemptions. Commonly filed exemptions for hydrogen stations are:

- 15301 (Class 1) for Existing Facilities
- 15303 (Class 3) for Small Structures

It is recommended that agencies enforcing the CEQA statue refer to exemptions granted by other enforcing agencies.

California Accidental Release Program (Cal-ARP)

Background: The CAL–ARP program is the Federal Risk Management Plan regulation that reduces public risk by providing information to first responders about dangerous materials used in commercial activities.

Applicability: Hydrogen dispensing stations are exempt from Cal-ARP if less than 10,000 pounds of hydrogen is stored or processed on site. Please see www.caloes.ca.gov/HazardousMaterials/Pages/Cal-ARP-Proposed-Regulations-2013.aspx.

If a station stores more than 10,000 pounds of hydrogen, the facility owner must prepare a document that includes at least the following elements:

- Regulated substances held onsite at the stationary source
- Offsite consequences of an accidental release of a regulated substance
- The accident history at the stationary source
- The emergency response program for the stationary source
- Coordination with local emergency responders
- Hazard review or process hazard analysis
- Operating procedures at the stationary source
- Training of the stationary source's personnel
- Maintenance and mechanical integrity of the stationary source's physical plant
- Incident investigation

Existing and planned hydrogen stations store less than 10,000 pounds of hydrogen and will be exempt from Cal-ARP.

Vehicle Signs

Signs and pavement markings are important elements of zero-emission vehicle infrastructure, serving to inform FCEV drivers of available hydrogen fueling and to help enforce ZEV-related rules and laws. Signs also help increase ZEV market visibility, which can help to grow adoption in local communities. Throughout the state, ZEV signs and markings must be uniform and consistent in their appearance and placement, allowing them to be clearly recognizable to motorists.

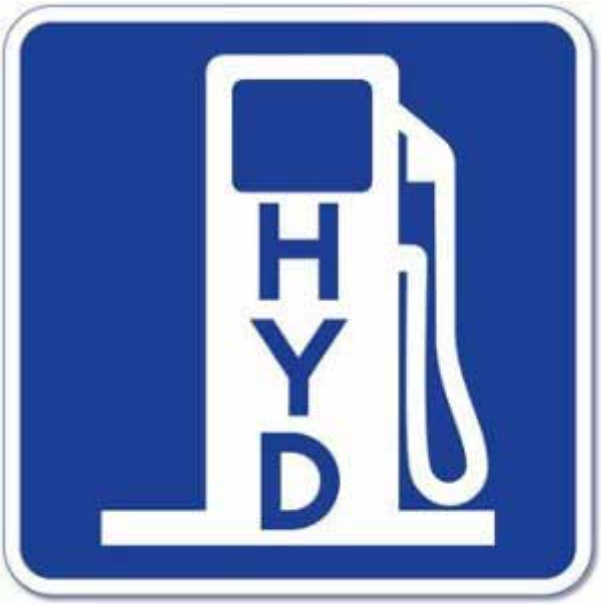
Well-placed, visible signs can safely direct a driver to a station better than a mobile device, keeping the driver's eyes on the road, reducing distractions and potentially collisions, while increasing the visibility of the ZEV industry. Proper signage also raises awareness and confidence in the availability of hydrogen stations.

Caltrans has issued comprehensive standards for ZEV signage in its Traffic Operations Policy Directive 13-01, (Please see www.dot.ca.gov/hq/traffops/signtech/signdel/policy/13-01.pdf) released in March 2013. The directive incorporates new ZEV-related signs and pavement markings into the California Manual on Uniform Traffic Control Devices (MUTCD), which ensures uniformity and consistency in signs, markings and signals. The California MUTCD provides standards (mandatory or specifically prohibited practices), guidance (recommended practices) and options (permissive practices) that may modify standards or guidance. State law and federal regulations require signs, markings and signals placed on California's public roadways to comply with the requirements of the MUTCD. Devices or signs installed on private roadways and parking also should be consistent with the MUTCD to be enforceable. While the California MUTCD exists to ensure signage consistency throughout the state, it allows for some local flexibility in the placement and usage of signs.

Section 2I.03 Section 2I.03 General Service Signs for Freeways and Expressways
Electric Vehicle Charging Station Signs (G66-21(CA), G66-21A(CA), G66-21B(CA), G66-21C(CA))

Guidance:
34 To avoid misleading the road user, those services that are more than 0.5 mile from the access point on the major route to the service, should have a Distance with Arrow (G66-21A(CA)) plaque installed below the service sign.

Option: (in Paragraph 41, subpart #13)
13. Where hydrogen (HYD) fuel is available, the Hydrogen (G66-22G(CA)) symbol sign and HYDROGEN (G66-22H(CA)) supplemental plaque may be used within 3 miles of a State highway and be available to the public at least 16 hours a day, in addition to the other appropriate signs.



High Occupancy Vehicles (HOV) Signs: Federal and state laws allow drivers of qualified ZEVs to use HOV-designated lanes that are typically limited to vehicles with multiple passengers. This benefit is provided, in part, because like carpooling, driving a ZEV reduces transportation-related criteria pollutants and greenhouse gas emissions. California's DMV issues white vehicle decals to FCEVs to administer this benefit. Vehicles displaying this "clean air decal" may travel in any HOV lane, regardless of vehicle occupancy. Although a regulatory sign exists to inform ZEV drivers of this permission, the presence of the sign is not required for a decaled vehicle to drive in the HOV lane. Caltrans is the responsible agency for the designation, signage and maintenance of HOV lanes on state highways. However, local authorities have responsibility with regard to county highways and should ensure that HOV lanes display signs indicating ZEVs are authorized to use these lanes.

Education and Training

Following is a list of education and training resources for permitting officials and first responders:

Name	Description	Website
The Introduction to Hydrogen for Code Officials	The Department of Energy offers an online training course for code officials that provides an overview of hydrogen and fuel cell technologies, how they are used in real-word applications and references for related codes and standards.	www.hydrogen.energy.gov/code_official_training.html
H2BestPractices.org	Online best practices manual providing suggestions and recommendations pertaining to the safe handling and use of hydrogen	www.h2bestpractices.org
Hydrogen Fueling Station Case Studies	Examples of operational hydrogen fueling stations throughout the nation	www.hydrogen.energy.gov/permitting/stations_studies.cfm
California Fuel Cell Partnership	Educational materials and training for authorities having jurisdiction and first responders. CaFCP also conducts workshops for AHJs and first responders in California communities.	www.cafcp.org/toolkits/safety
Introduction to Hydrogen Safety for First Responders	DOE's online materials acquaint first responders with hydrogen use in fuel cells for transportation and stationary power.	hydrogen.pnl.gov/FirstResponders
Hydrogen Safety Bibliographic Database	Provides references to reports, articles, books and other resources for information on hydrogen safety.	nrelpubs.nrel.gov/Webtop/ws/hsdb/www/hydrogen/SearchForm
H2Incidents.org	Database-driven website intended to facilitate the sharing of lessons learned and other relevant information gained from actual experiences using and working with hydrogen.	www.h2incidents.org
Emergency Response Guidebook	Pipeline and Hazardous Materials Safety Administration provides first responders with 2012 a free go-to manual to help deal with hazmat accidents during the critical first 30 minutes.	www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2012.pdf
Hydrogen Highway Listserve	A forum for asking questions, discussing or sharing information related to hydrogen, fuel cell vehicles, fueling stations, codes and standards, permitting, etc.	www.cafcp.org/node/1593

Recommended Actions

Presubmittal Review: Prospective permit applicants are recommended to meet with permitting officials before submitting an application. Permitting officials are encouraged to offer a presubmittal review, which provides an opportunity to avert potential issues that may delay the permitting process or lead to the denial of an application, such as:

- Problems at the proposed site that the applicant is not aware of
- Requirements the project must meet that the applicant had not evaluated in the draft application
- Issues with similar projects in the jurisdiction

Authorities Having Jurisdiction are encouraged to make the applicant aware of:

- Any special concerns relating to the proposed hydrogen station site
- Local zoning codes and amendments that may have not been considered in the draft application
- History of issues with similar projects in the jurisdiction and other key insights for a successful project plan during the presubmittal review

Project applicants are encouraged to provide AHJs with information about
Hydrogen station technology

- Any codes, standards and regulations related to hydrogen station development used for other projects
- How certain codes have been interpreted or amended in other jurisdictions

Open communication between local AHJs and hydrogen station developers is especially vital when local codes have not been adopted for certain aspects of the project.

Community Support: Hydrogen station developers and automakers should prepare high-level presentations and/or educational materials about hydrogen as a fuel, commercialization plans for fuel cell electric vehicles, emergency response and other appropriate topics for the public. Extensive and ongoing outreach to the general public—especially local elected officials, businesses and residents—in the local area has proven to be advantageous for projects in California.

Periodically Communicating Safety Plan: As with any project that could impact the health and safety of a community, a hydrogen station operator should develop a project safety plan that addresses potential risks and impacts to personnel, equipment and the environment. The plan should describe how project safety is communicated and made available to the operating staff, neighboring occupancies and local emergency response officials. A communication plan that employs regular dissemination of safety procedures and practices is critical to avoiding potential safety incidents and assure proper incident response.

IV TEMPLATES AND GUIDES

Key Points

- A general awareness of local planning and permitting
- A hydrogen safety checklist
- A permitting template
- An example permit

Every California jurisdiction has its own building codes. Codes usually reference national or international codes, such as the International Building Code or Uniform Fire Code, and then include variations for the jurisdiction, which then adopts the codes through administrative law. Authorities Having Jurisdiction (AHJ), such as building inspectors and fire departments, are legally required to follow the code requirements to protect public safety. Few California cities have experience with hydrogen stations.

Office of the State Fire Marshal (OSFM) acknowledges and supports the development of codes and standards for hydrogen and hydrogen fueling installations. The OSFM involvement in the development of hydrogen codes and standards is also a strategy in the Governor's Zero-Emission Vehicle Action Plan.

OSFM is working to educate and train AHJs and to adopt the most recently approved International Fire and Building Code proposals into the 2013 California Fire Code supplement, and ultimately into the next edition of the California Fire Code.

Establishing a single comprehensive hydrogen code will help project developers and code officials achieve a consistency of safety requirements that can make permit development and approval process more smooth and efficient.

The decision by the International Fire Code Committee to reference the National Fire Protection Association 2 Hydrogen Technologies Standard in the 2015 edition of the IFC is one example of a significant code advancement to provide consistent code application in the deployment of hydrogen technologies. NFPA 2 is a comprehensive hydrogen standard that addresses hydrogen safety including the installation and operation of hydrogen fueling stations and the associated hydrogen storage and repair facilities.

The checklists and templates in this section are intended to assist AHJs, people designing stations and others involved with risk assessment of hydrogen stations. While these considerations are fairly inclusive, it is not possible to include all variables that need to be considered. The hazard analysis process should, therefore, include personnel who are familiar with applicable codes and standards in addition to team members with expertise in the technical aspects of the specific project.

The permitting processes can be broken down into seven stages that help define the overall process and timeline for completing all required components.

1. Preliminary project scoping
2. Station design
3. Approval process
4. Station/dispenser construction
5. Station/dispenser startup (Commissioning)
6. Station/dispenser operation
7. Station/dispenser maintenance

The required permits address all of these phases, but the permitting structure does not correlate on a one-to-one basis with the chronological steps required to build and operate a station. The tables below list elements of the permitting and approval processes.

Hydrogen Dispensing Station Permitting/Potential Permits Required

Permit	Agency	Permit/Permit Scope
Construction	Building Department	Permit to Construct General/ Address safety construction issues
Drainage	Engineering Department	Permit to Construct Drainage/ Modification to sewer drainage
Site grading	Engineering Department	Permit to Construct Grading/ Modification to site elevation
Electrical	Building/Electrical Department	Electrical Permit/Modification to electrical service
Demolition	Building Department	Construction Permit/Demolish structures required for dispenser construction
Food services	Health Department	Food sales
Air emission impacts	Air Quality Management District (AQMD)	Air Quality Permit or No impact declaration
Fire safety	Fire Department Plans Review Office	Fire Safety Permit/General fire code compliance

Please visit www.nrel.gov for updated tables.

Hydrogen Dispensing Station Approvals

Approval	Agency	Approval Scope
California Environmental Quality Act (CEQA)	Self enforcing although local AHJ has first opportunity to enforce	CEQA approval or finding of no significant impact/ environmental agency having jurisdiction
Zoning	Local zoning board	Zoning approval/allows construction and operation at defined location
California Accidental Release Prevention Program (CAL –ARP)	Local administering agency (for example county health or fire department) and U.S. EPA	Approved submission or finding of non-applicability/ requires an evaluation of the impact of the release of a regulated materials from the site and a plan in the event of a release

The Permit Applicant

The administrative process for reviewing and approving projects may vary from jurisdiction but there are common elements. These basic elements are as follows:

- Presubmittal review and feedback (optional but highly recommended)
- Review and feedback to applicant
- Formal submission of application
- Public meeting (on an as needed basis determined by both administrative law and the jurisdiction's determination as to whether public input should be solicited)
- Make adjustments in the permit application (as needed) based on public input
- Review of modified application and feedback to application
- Resubmittal of modified application
- Issuance of permit
- Project construction
- Site inspection to determine that project built as shown in final design plans
- Periodic inspections to determine ongoing compliance

The presubmittal review provides an opportunity to avert potential issues that may delay the permitting process or lead to the denial of an application, such as:

- Problems at the proposed site, such as parking or right-of-way
- Requirements the project must meet that the applicant had not evaluated in the draft application
- Issues with similar projects in the jurisdiction

Hydrogen Safety Checklist

This checklist is intended to assist people developing designs for hydrogen systems as well as those involved with the risk assessment of hydrogen systems. While these considerations are fairly inclusive, it is not possible to include all variables that need to be considered. The hazard analysis process should therefore include personnel who are familiar with applicable codes and standards in addition to team members with expertise in the technical aspects of the specific project.

Plan the Work

Approach		Examples of Actions
Recognize hazards and define mitigation measures	❒	Identify risks such as flammability, toxicity, asphyxiates, reactive materials, etc.
	❒	Identify potential hazards from adjacent facilities and nearby activities
	❒	Address common failures of components such as fitting leaks, valve failure positions (open, closed or last), valves leakage (through seat or external), instrumentation drifts or failures, control hardware and software failures and power outages
	❒	Consider uncommon failures such as a check valve that does not check, relief valve stuck open, block valve stuck open or closed and piping or equipment rupture
	❒	Consider excess flow valves/chokes to size of hydrogen leaks
	❒	Define countermeasures to protect people and property
	❒	Follow applicable codes and standards
Isolate hazards	❒	Store hydrogen outdoors as the preferred approach; store only small quantities indoors in well-ventilated areas
	❒	Provide horizontal separation to prevent spreading hazards to/from other systems (especially safety systems that may be disabled), structures and combustible materials
	❒	Avoid hazards caused be overhead trees, piping, power and control wiring, etc.
Provide adequate access and lighting for activities including	❒	Operation, including deliveries
	❒	Maintenance
	❒	Emergency exit and response

Keep Hydrogen in the System

Approach		Examples of Actions
Design systems to withstand worst-case conditions	❒	Determine maximum credible pressure considering abnormal operation, mistakes made by operators, etc., then design the system to contain or relieve the pressure
	❒	Contain: Design or select equipment, piping and instrumentation that are capable of maximum credible pressure using materials compatible with hydrogen service
	❒	Relieve: Provide relief devices that safely vent the hydrogen to prevent damaging overpressure conditions
	❒	Perform system pressure tests to verify integrity after initial construction, after maintenance, after bottle replacements and before deliveries through transfer connections
Protect systems	❒	Design systems to safely contain maximum expected pressure or provide pressure relief devices to protect against burst
	❒	Mount vessels and bottled gas cylinders securely
	❒	Consider that systems must operate and be maintained in severe weather and may experience earthquakes and floodwater exposures
	❒	Demobilize vehicles and carts before delivery transfers or operation
	❒	Protect against vehicle or accidental impact and vandalism
	❒	Post warning signs
Size the storage appropriately for the service	❒	Avoid excess number of deliveries
	❒	Avoid unnecessary risk of large release from an oversized system
Provide hydrogen shutoff(s) for isolation	❒	Locate automatic fail-closed shutoff valves at critical points in the system (such as storage exit, entry to buildings, inlets to test cells, etc.) to put the system in a safe state when a failure occurs
	❒	Consider redundant or backup controls
	❒	Install manual valves for maintenance and emergencies
Prevent cross-contamination	❒	Prevent backflow to other gas systems with check valves, pressure differential, etc.

Manage Discharges

Approach		Examples of Actions
Safely discharge all process exhausts, relief valves, purges, and vents	❒	Discharge hydrogen outdoors or into a laboratory ventilation system that assures proper dilution
	❒	Direct discharges away from personnel and other hazards
	❒	Secure/restrain discharge piping
Prevent build-up of combustible mixtures in enclosed spaces	❒	Do not locate equipment or piping joints/fittings in poorly ventilated rooms or enclosed spaces; use only solid or welded tubing or piping in such areas
	❒	Provide sufficient ventilation and/or space for dilution
	❒	Avoid buildup of hydrogen under ceilings/roofs and other partly enclosed spaces
Size the storage appropriately for the service	❒	Avoid excess number of deliveries
	❒	Avoid unnecessary risk of large release from an oversized system
Remove potential ignition sources from flammable spaces/zones	❒	Proper bonding and grounding of equipment
	❒	No open flames
	❒	No arcing/sparking devices, e.g., properly classified electrical equipment

References and Resources

Hydrogen Fueling Station Locations, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Alternative Fuels Data Center
www.afdc.energy.gov/fuels/hydrogen_locations.html

California Fire Code text
osfm.fire.ca.gov/

California Environmental Quality Act text
ceres.ca.gov/ceqa/stat/

Regulation text of California Risk Management Plan Regulations
calarp.com/CalARP%20Regs.pdf

Detect and Mitigate

Approach		Examples of Actions
Leak detection and mitigation	❒	Provide detection and automatic shutdown/isolation if flammable mixtures present, particularly in enclosed spaces
	❒	Consider methods for manual or automatic in-process leak detection such as ability for isolated systems to hold pressure
	❒	Periodically check for leaks in the operating system
Loss of forced ventilation indoors	❒	Automatically shut off supply of hydrogen when ventilation is not working
Monitor the process and protect against faults	❒	Provide alarms for actions required by people, e.g., evacuation
	❒	Provide capability to automatically detect and mitigate safety-critical situations
	❒	Consider redundancy to detect and mitigate sensor or process control faults
	❒	Provide ability for the system to advance to a "safe state" if power failures or controller faults are experiences
Fire detection and mitigation	❒	Appropriate fire protection (extinguishers, sprinklers, etc.)
	❒	Automatic shutdown and isolation if fire detected

Manage Operations

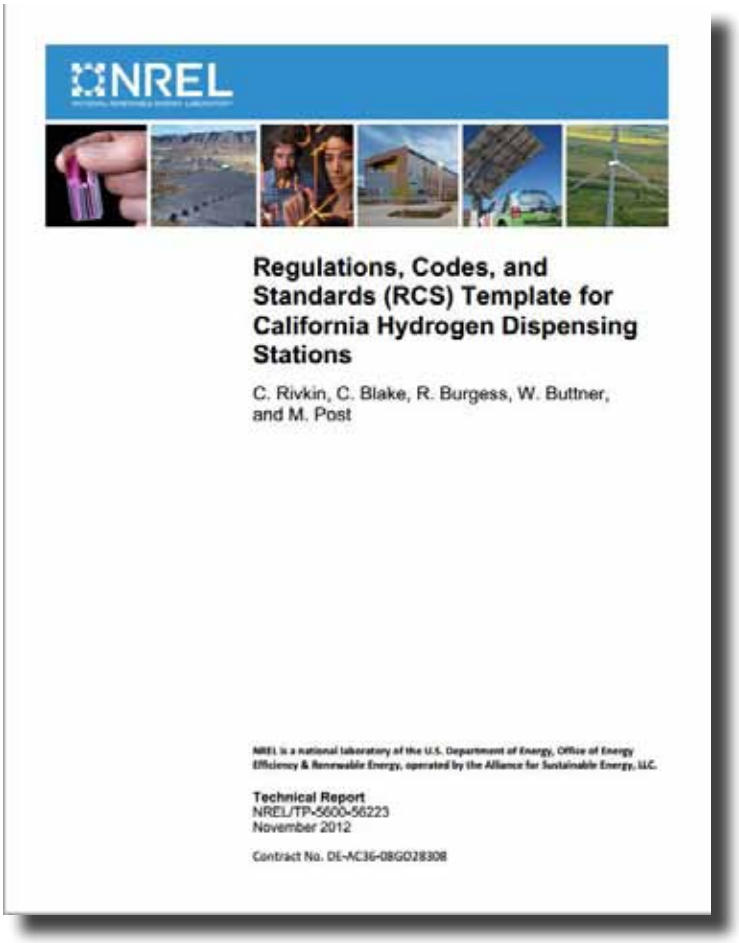
Approach		Examples of Actions
Establish and document procedures	❒	Responsibilities for each of the parties involved
	❒	Operating procedures
	❒	Emergency procedures
	❒	Preventive maintenance schedules for equipment services, sensor calibrations, leak checks, etc.
	❒	Safe work practices such as lock-out/tag-out, hot work permits and hydrogen line purging
Train personnel	❒	MSDS awareness for hydrogen and other hazardous materials
	❒	Applicable procedures and work instructions for bottle change-out, deliveries, operation, maintenance, emergencies and safety work practices
Monitor	❒	Track incidents and near misses and establish corrective actions
	❒	Monitor compliance to all procedures and work instructions

Permit Template

For this template a single dispenser is added to an existing fueling station. In all California jurisdictions, the California Fire Code is the enforced fire code. The addition of a single dispenser still will trigger construction requirements. The dispenser will require at least the following elements:

- A dispensing platform
- Vehicle crash protection
- Electrical service
- Hydrogen storage or generation equipment or both for dispenser that has hydrogen generating and storage capability
- Lighting
- Compressors to compress the hydrogen to vehicle storage pressure
- Dispenser with fueling hose and nozzle
- Piping from the gaseous hydrogen storage system to the dispenser
- Fire protection system
- Maintenance system
- Unique construction requirements such as handicapped parking requirements

Additional templates are available at www.nrel.gov/docs/fy13osti/56223.pdf



California Fire Code 2012 edition

Item	Code Citations	Compliance Issues
General requirements	2309.3.1.1 Outdoors. Generation, compression, or storage equipment shall be allowed outdoors in accordance with Chapter 58.	Requiring the equipment be located outdoors will allow any releases to disperse and dilute rapidly
Dispensing platform	2309.4.1 Dispensing systems. Dispensing systems shall be equipped with an overpressure protection device set at 140 percent of the service pressure of the fueling nozzle it supplies.	This section gives a few general requirements for the dispenser-primarily gives the overpressure limit
Vehicle crash protection and fueling area	2309.5.1 Protection from vehicles. Guard posts or other approved means shall be provided to protect hydrogen storage systems and use areas subject to vehicular damage in accordance with Section 312.	
	2309.5.1.1 Vehicle fueling pad. The vehicle shall be fueled on noncoated concrete or other approved paving material having a resistance not exceeding 1 megohm as determined by the methodology specified in EN 1081.	
Electrical service	2309.2.3 Electrical equipment. Electrical installations shall be in accordance with NFPA 70.	NFPA 2 will set electrical classification zones around dispensers
Lighting	Must meet NEC requirements	
Hydrogen storage or generation equipment or both for dispenser that has hydrogen generating and storage capability	2309.2 Equipment. Equipment used for the generation, compression, storage or dispensing of hydrogen shall be designed for the specific application in accordance with Sections 2309.2.1 through 2309.2.3.	The components most directly in contact with the individual performing the fueling operation are of particular concern. These components would include the dispenser nozzle and hose. A hose or nozzle failure could result in an injury to the individual performing the fueling operation. At a retail fueling facility, this individual could be any member of the public purchasing fuel or proximate to the fueling operation.

Citations associated with the code requirements are the International Fire Code's numbering system.

Item	Code Citations	Compliance Issues
Hydrogen storage or generation equipment or both for dispenser that has hydrogen generating and storage capability	2309.2.1 Approved equipment. Cylinders, containers and tanks; pressure relief devices, including pressure valves; hydrogen vaporizers; pressure regulators; and piping used for gaseous hydrogen systems shall be designed and constructed in accordance with Chapters 53, 55 and 58.	Currently there are very few listed components for hydrogen dispensing systems. As a result of the absence of listed equipment, the system would have to go through the approval process by the AHJ. The AHJ may seek the assistance of a third party hydrogen safety expert to perform the review of the system and components.
	2309.2.2 Listed or approved equipment. Hoses, hose connections, compressors, hydrogen generators, dispensers, detection systems and electrical equipment used for hydrogen shall be listed or approved for use with hydrogen. Hydrogen motor-fueling connections shall be listed and labeled or approved for use with hydrogen.	
	2309.3.1.3 Gaseous hydrogen storage. Storage of gaseous hydrogen shall be in accordance with Chapters 53 and 58.	
	2309.3.1.4 Liquefied hydrogen storage. Storage of liquefied hydrogen shall be in accordance with Chapters 55 and 58.	
Compressors to compress the hydrogen to vehicle storage pressure	2309.2 Equipment. Equipment used for the generation, compression, storage or dispensing of hydrogen shall be designed for the specific application in accordance with Sections 2309.2.1 through 2309.2.3.	The chapters referred to in this section specify requirements as follows: Chapter 53 Compressed Gases; Chapter 55 Cryogenic Fluids, Chapter 58 Flammable Gases and Flammable Cryogenic Fluids
	2309.2.1 Approved equipment. Cylinders, containers and tanks; pressure relief devices, including pressure valves; hydrogen vaporizers; pressure regulators; and piping used for gaseous hydrogen systems shall be designed and constructed in accordance with Chapters 53, 55 and 58.	
	2309.2.2 Listed or approved equipment. Hoses, hose connections, compressors, hydrogen generators, dispensers, detection systems and electrical equipment used for hydrogen shall be listed or approved for use with hydrogen. Hydrogen motor-fueling connections shall be listed	
Dispenser with fueling hose and nozzle	2309.2 Equipment. Equipment used for the generation, compression, storage or dispensing of hydrogen shall be designed for the specific application in accordance with Sections 2309.2.1 through 2309.2.3.	

Item	Code Citations	Compliance Issues
	2309.2.1 Approved equipment. Cylinders, containers and tanks; pressure relief devices, including pressure valves; hydrogen vaporizers; pressure regulators; and piping used for gaseous hydrogen systems shall be designed and constructed in accordance with Chapters 53, 55 and 58.	
	2309.2.2 Listed or approved equipment. Hoses, hose connections, compressors, hydrogen generators, dispensers, detection systems and electrical equipment used for hydrogen shall be listed or approved for use with hydrogen. Hydrogen motor-fueling connections shall be listed and labeled or approved for use with hydrogen.	
Piping from the gaseous hydrogen storage system to the dispenser	Piping shall be in accordance with ASME B31.12 hydrogen Pipelines and Piping	Cast iron pipe is particularly susceptible to hydrogen embrittlement and failure.
	704.1.2 Piping systems. Piping, tubing, valves and fittings conveying gaseous hydrogen shall be designed and installed in accordance with Sections 704.1.2.1 through 704.1.2.5.1, Chapter 27 of the International Fire Code, and ASME B31.3. Cast-iron pipe, valves and fittings shall not be used.	
Fire protection system	2309.3.1.5.2 Fire-extinguishing systems. Fuel-dispensing areas under canopies shall be equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1. The design of the sprinkler system shall not be less than that required for Extra Hazard Group 2 occupancies. Operation of the sprinkler system shall activate the emergency functions of Sections 2309.3.1.5.3 and 2309.3.1.5.4.	Note that fuel dispensing that is not conducted under a canopy does not require the use of an approved automatic sprinkler system. However, there still may be a safety basis for install a sprinkler system. The AHJ may require manual release of the stored hydrogen. Also, the AHJ may allow for the use of manual release instead of the use of an automatic sprinkler system.
	2309.3.1.5.3 Emergency discharge. Operation of the automatic sprinkler system shall activate an automatic emergency discharge system, which will discharge the hydrogen gas from the equipment on the canopy top through the vent pipe system.	
	2309.3.1.5.4 Emergency shutdown control. Operation of the automatic sprinkler system shall activate the emergency shutdown control required by Section 2309.5.3	

Item	Code Citations	Compliance Issues
Maintenance system	2309.3.1.2.1 Maintenance. Gaseous hydrogen systems and detection devices shall be maintained in accordance with the manufacturer's instructions.	Maintenance is vital particularly for high pressure gas dispensing systems that detect a system disturbance before it develops into a more serious problem.
Ignition control	2309.3.1.2.2 Smoking. Smoking shall be prohibited in hydrogen cutoff rooms. "No Smoking" signs shall be provided at all entrances to hydrogen cutoff rooms.	Hydrogen can be easily ignited.
	2309.3.1.2.3 Ignition source control. Open flames, flame-producing devices and other sources of ignition shall be controlled in accordance with Chapter 58.	
	2309.3.1.2.4 Housekeeping. Hydrogen cutoff room shall be kept free from combustible debris and storage.	
Emergency shutoff	2309.5 Safety precautions. Safety precautions at hydrogen motor fuel-dispensing and generation facilities shall be in accordance with Sections 2309.5.1 through 2309.5.3.1.	It is crucial to shut down the gas flow in the event of an upset condition. Until the gas flow is shut down fuel is being fed to a potential release point. The 75-foot distance will allow activation of the emergency shutdown valve without unduly exposing the individual performing the shut down to hazards associated with a hydrogen release
	2309.5.2 Emergency shutoff valves. A manual emergency shutoff valve shall be provided to shut down the flow of gas from the hydrogen supply to the piping system.	
	2309.5.2.1 Identification. Manual emergency shutoff valves shall be identified and the location shall be clearly visible, accessible and indicated by means of a sign.	
	2309.5.3 Emergency shutdown controls. In addition to the manual emergency shutoff valve required by Section 2309.5.2, a remotely located, manually activated emergency shutdown control shall be provided. An emergency shutdown control shall be located within 75 feet (22 860 mm) of, but not less than 25 feet (7620 mm) from, dispensers and hydrogen generators.	
	2309.5.3.1 System requirements. Activation of the emergency shutdown control shall automatically shut off the power supply to all hydrogen storage, compression and dispensing equipment; shut off natural gas or other fuel supply to the hydrogen generator; and close valves between the main supply and the compressor and between the storage containers and dispensing equipment.	

Item	Code Citations	Compliance Issues
Unique construction requirements	2309.3.1.5 Canopy tops. Gaseous hydrogen compression and storage equipment located on top of motor fuel-dispensing facility canopies shall be in accordance with Sections 2309.3.1.5.1 through 2309.3.1.5.5, Chapters 53 and 58 and the International Fuel Gas Code.	Allows for canopy mounted equipment. Early installations employing canopy mounted equipment have proven be very expensive in part because of construction and material cost associated with supporting heavy equipment.
	2309.3.1.5.1 Construction. Canopies shall be constructed in accordance with the motor fuel-dispensing facility canopy requirements of Section 406.7 of the International Building Code.	
	2309.3.1.5.5 Signage. Approved signage having 2-inch (51 mm) block letters shall be affixed at approved locations on the exterior of the canopy structure stating: CANOPY TOP HYDROGEN STORAGE.	
	2309.3.2 Canopies. Dispensing equipment need not be separated from canopies of Type I or II construction that are constructed in a manner that prevents the accumulation of hydrogen gas and in accordance with Section 406.7 of the International Building Code.	

Section 1: Basic Indentifying Information

Example

Jurisdiction of _____, _____(state)
Building/ Fire Permit For Hydrogen Dispensing Installation

Compliance with the following permit will allow the construction and operation of a hydrogen dispensing installation in the _____ jurisdiction. This permit addresses the following situations:

1. The addition of a hydrogen dispensing and storage system to an existing fueling station
2. TBD

This permit contains a general reference to the California fire and Building Codes or equivalent codes used in the jurisdiction. All work and installed equipment will comply with the requirements of XXXX code used in the jurisdiction. The jurisdiction maintains the authority/responsibility to conduct any inspections deemed necessary to protect public safety.

Section 2: Code Requirements

Identifies code requirements and addresses specific elements of station safety:

1. Approval/listing and labeling requirements
2. Piping code compliance
3. Storage vessel stamps/approval

Example

Topic	Premit Requirements
Siting	Do storage and dispenser systems meet separation distance requirements?
Mechanical	Is equipment listed or approved? Valves, Pressure Relief Devices (PRDs), Piping, Containers, Hoses, Nozzles
Electrical	Is equipment proximate to dispenser classified?
Maintenance	Have maintenance requirements been defined in permit application? Is documentation required?
Emergency response	Are E-stops accessible? Do they have a plan? Are personnel trained? Is communication with the fire department and other emergency responders clearly defined?
Sensors	Do sensors detect releases or upset conditions? Is the information from sensors conveyed to the process equipment, operators, and fire department?

Section 3: Standard Certification Statement
By signing the certification statement the applicant agrees to comply with the standard permit conditions and other applicable requirements. This consent would give the jurisdiction the option of allowing the applicant to proceed with installation and operation of the dispensing equipment.

Example

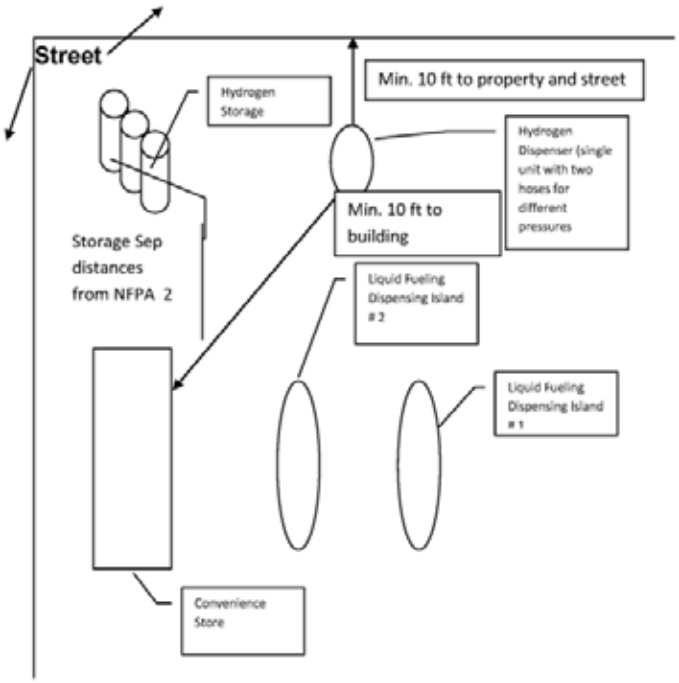
I hereby certify that the electrical work described on this permit application shall be/ has been installed in compliance with the conditions in this permit, NFPA 70, National Electric Code, and the Fire Code currently adopted and enforced within the jurisdiction of installation. By agreeing to the above requirements, the licensee or owner shall be permitted to construct and operate the hydrogen station.

Signature of Owner *Date*

Section 4: Jurisdiction Checklist
A checklist the jurisdiction could develop to track key information on the application. A few items of the many that the jurisdiction might wish to track are:

1. Unique requirements in the jurisdiction such as seismic requirements
2. Summary of California Risk Management Plan (RMP) analysis if subject to RMP
3. Summary of California Environmental Quality Act Compliance (CEQA) analysis

Section 5: Schematic (optional)
A schematic drawing that shows the arrangement of the equipment. The example is to show how the station equipment could be arranged and is not intended to convey any permit requirements.



Conclusion

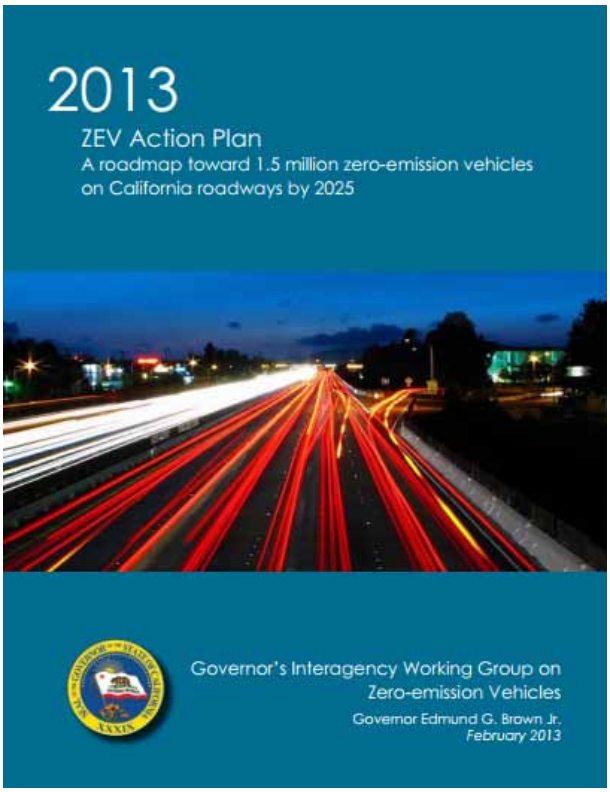
Launching fuel cell electric vehicles and an associated hydrogen infrastructure is a significant undertaking and requires considerable planning and coordination to ensure success. Automakers are testing and leasing FCEVs in real-world environments. For FCEVs to become commercially available in California, automakers, equipment providers and hydrogen station operators will assume major business risk until sufficient scale is achieved in the market.

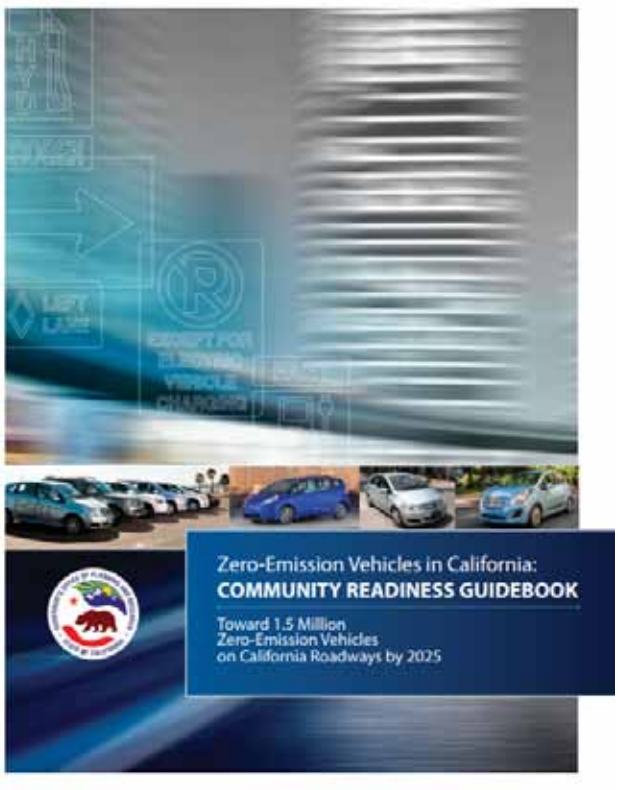
Through the Governor's Office of Planning and Research, and the California Fuel Cell Partnership, cities and counties have access to resources that can help you become hydrogen ready.

Governor's ZEV Executive Order
gov.ca.gov/news.php?id=17472

ZEV Action Plan
www.opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_(02-13).pdf

ZEV Guidebook
www.opr.ca.gov/docs/ZEV_Guidebook.pdf





APPENDIX

Laws and Programs Incentivizing ZEVs that apply to FCEVs

Policy Name	Description	Bill Number
Clean Vehicle Rebate Project energycenter.org/clean-vehicle-rebate-project	Provides direct rebates to consumers for the purchase of qualifying FCEVs.	AB 118 AB 8
Carpool access leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100SB535 http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB2405	FCEVs are eligible for white-colored carpool stickers until 2019, or until federal authorization expires.	AB 535 AB 2045

Federal Laws and Programs that Apply to FCEVs

Policy Name	Description	Notes
National Greenhouse Gas and Corporate Average Fuel Economy Standards for Vehicles www.afdc.energy.gov/laws/law/US/385	Requires that passenger cars, light-duty trucks and medium-duty passenger vehicles sold in the U.S. meet certain fuel economy and greenhouse gas emission standards. FCEVs are one way auto companies can lower greenhouse gas emissions and meet the requirement.	CAFE Standards
Energy Policy Act www1.eere.energy.gov/vehiclesandfuels/epact/	Sets goals and mandates to increase clean energy use and improve energy efficiency in the nation. It also requires certain public-sector fleets to acquire alternative fuel vehicles and establishes incentives for the private sector.	
Renewable Fuel Standard www.epa.gov/otaq/fuels/renewablefuels	Requires that 36 billion gallons of total renewable fuel be used as transportation fuel by 2022 in the U.S. This requirement promotes the use of alternative fuels.	
H2USA h2usa.org	The Department of Energy recently launched H2USA, a new public-private partnership focused on advancing hydrogen infrastructure nationwide.	

California State Regulations

Policy Name	Description	Bill Number
California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB118	Provides $1.4 billion through the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) for clean vehicles and their associated infrastructure from 2008 to 2015. Revenue for this program is collected through vehicle license and smog abatement fees. Annual funding from ARFVTP enables the state's vehicle rebates for ZEVs, infrastructure and grants for ZEV-technology companies. Funding for the ARFVTP was extended to 2024 by Assembly Bill 8 (Perea, Statutes of 2013)	AB 118 AB 8
Low Carbon Fuel Standard (LCFS) leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32 http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf	Requires fuel providers in California to reduce the carbon content of the fuels they sell in California by 10% by 2020. Growing the ZEV market can be a key way to achieve requirements of low carbon fuel standards	AB 32 Executive Order S-01-07
Vehicle License Fees www.arb.ca.gov/capcoa/roster.htm	A number of legislative bills provided the authority for the state's local air districts to increase vehicle license fees in their jurisdictions to provide funding for air pollution reduction, including clean vehicle programs. The programs vary by district.	
California Alternative Energy and Advanced Transportation Financing Authority Act leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100SB71	Authorizes certain sale and use tax exemptions on manufacturing equipment for ZEVs and other advanced or alternative transportation or energy technologies. This law, which enables these tax exemptions through 2020, provides an incentive to locate ZEV manufacturing within California.	SB 71
ZEV Regulation www.arb.ca.gov/msprog/zevprog/zevregs/1962.1_Clean.pdf	Requires car manufacturers to produce ZEVs and advanced technology vehicles proportional to total sales volumes in California. In December 2009, ARB staff worked on incorporating the state's goal of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050 in the ZEV regulatory revisions.	
Advanced Clean Cars Program www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm	Increases the requirements for ZEVs between 2018 and 2025. ARB anticipates that ZEVs will reach over 15% of new cars sold in California in 2025.	

ADDITIONAL RESOURCES

California Air Resources Board Advanced Clean Cars Program
www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm

California Fuel Cell Partnership
www.cafcp.org

Californinia Center for Sustainable Energy
www.energycenter.org

National Renewable Energy Lab (NREL)
www.nrel.gov

US DOE Codes & Standards
www1.eere.energy.gov/hydrogenandfuelcells/codes/

PNNL Hydrogen and Fuel Cells Permitting Guide
www.pnl.gov/fuelcells/permit_guide.stm

AFDC Hydrogen Fueling Infrastructure Development
www.afdc.energy.gov/fuels/hydrogen_infrastructure.html

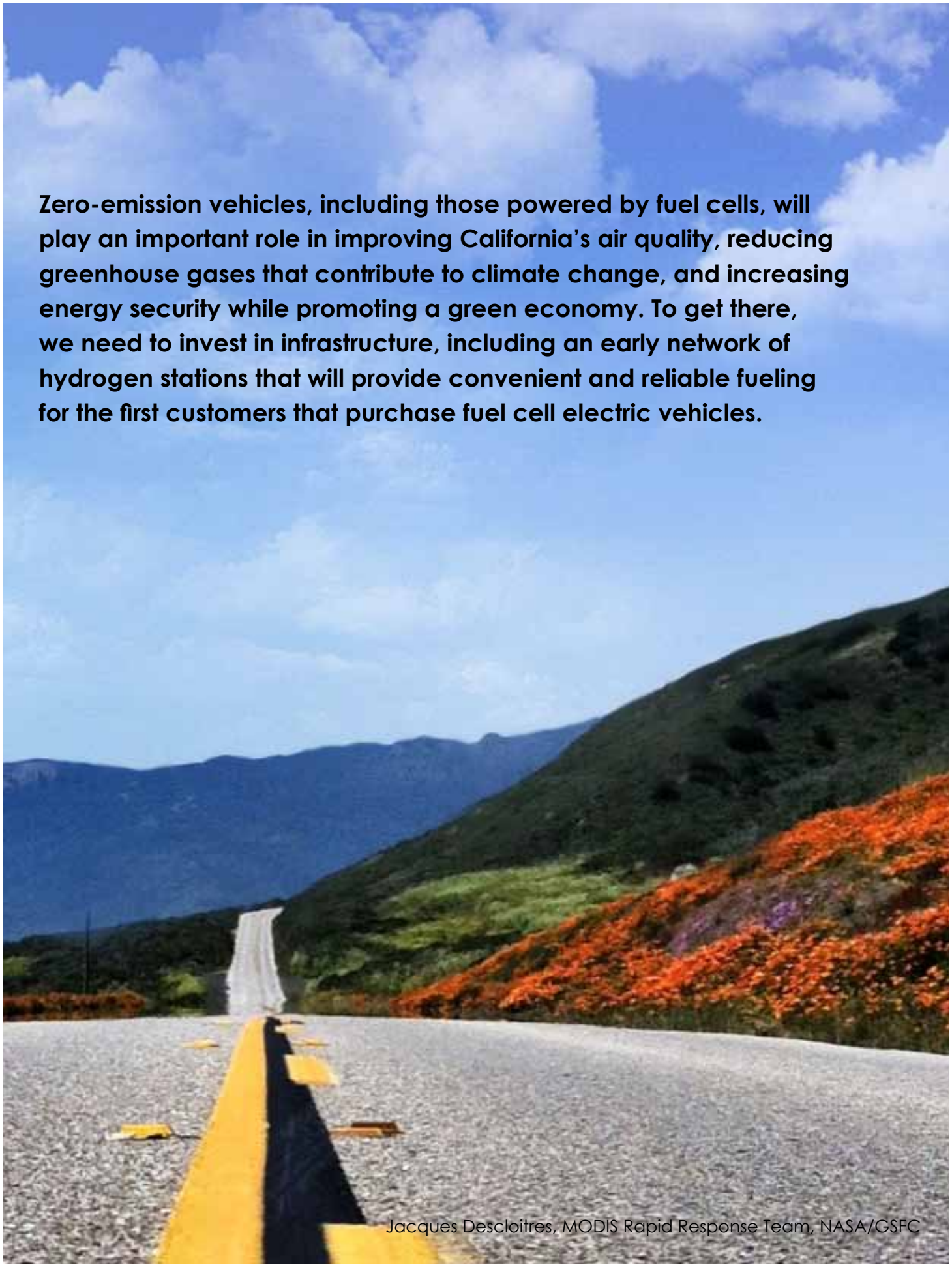
CA Energy Commission Alternative and Renewable Fuel and Vehicle Technology Program
www.energy.ca.gov/altfuels/index.html

Energy Independence Now Hydrogen Network Investment Plan
www.einow.org/images/stories/factsheets/h2nip_full_paper_final.pdf

H2 Readiness: a mobile and web-based version of this document and all templates
www.h2readiness.org

Hydrogen Tools— app available for iPhone and iPad that includes:

- A hydrogen safety best practices module with references
- A hydrogen safety events module that characterizes incidents and near-misses
- A hydrogen properties module with links to the source information
- A conversion calculator for doing simple conversions between four popular phase points of hydrogen
- A separation distances calculator (based on NFPA 2 and NFPA 55) to determine the minimum separation distance from an outdoor bulk hydrogen compressed gas system (>5,000 scf) to a specified enclosure
- A safety checklist for an outdoor hydrogen supply system for an indoor use
- A project safety planning guidance document
- Technical references on hydrogen compatibility and embrittlement



Zero-emission vehicles, including those powered by fuel cells, will play an important role in improving California's air quality, reducing greenhouse gases that contribute to climate change, and increasing energy security while promoting a green economy. To get there, we need to invest in infrastructure, including an early network of hydrogen stations that will provide convenient and reliable fueling for the first customers that purchase fuel cell electric vehicles.

Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC

H_2 Readiness

Best practices for hydrogen stations in early-adopter communities

www.h2readiness.org