

# California Regulations on Renewable Hydrogen and Low Carbon Technologies

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*Delivering Renewable Hydrogen*  
*A focus on near term applications*  
*November 16, 2009*

California Environmental Protection Agency



**Air Resources Board**

# Overview

- Background
- ZEV / ZEB Regulation
- H2 Network
- SB 1505
- Clean Fuels Outlet
- Low Carbon Fuel Standard

# CaH2Net Background

- January 6, 2004 Governor's State of the Union Address
  - *"I am going to encourage the building of a hydrogen highway to take us to the environmental Future...I intend to show the world that economic growth and the environment can coexist"*.
  - April 20, 2004 signed Executive Order, S-7-04 – development of a California Hydrogen Blueprint Plan – Core Values:
    - Diversified more secure sources of transportation energy
    - GHG, & criteria pollutant reductions, renewables, no increase in toxics
    - Economic growth and job opportunities for California
  - Recommendations
    - Stations built in phases, major urban areas first
    - State funding for stations and vehicle incentives
    - Establish policies that help create hydrogen infrastructure



# Southern California (2009-2012)



## High Priority Areas

- Santa Monica
- Torrance
- Irvine
- Newport Beach
- San Francisco Bay Area
- Sacramento Area



State Funded Station



Existing Station



**ZEV Requirement:** Expected Number of Vehicles for the purpose of meeting the requirements

Type	2009-2011*	2012-2014	2015-2017
Required Vehicles	2,500	25,000	50,000
Gold Fuel Cell Vehicles	<b>250</b>	<b>5,357</b>	<b>25,000</b>

**ZBus Requirement:** Expected Number of Vehicles for the purpose of meeting the requirements

	2011	2014
Number of FCBs	15	20-60

\*Includes probable credit use

# Regulation of Hydrogen

## Senate Bill 1505

### Emissions requirement (relative to gasoline)

- 50% reduction of NO<sub>x</sub> plus ROG (WTT),
- 30% reduction of greenhouse gas (GHG) (WTW)\*
- No increase in toxic air contaminants (WTT)

### Energy source requirement

- 33.3% of H<sub>2</sub> produced made from renewable resources\*

### Threshold & who must comply

- Applies to state co-funded hydrogen stations NOW
- To all hydrogen stations once 3,500 metric tons/year (3,500,000 kg/yr) state-wide throughput is reached (~10K cars)
- Limited exemptions with Board approval

*\*Can be met statewide*

# Regulation of Hydrogen

## Senate Bill 1505

### Energy source requirement

- 33.3% of H<sub>2</sub> produced must be made from renewable resources\*
- Based on energy content
- Can be averaged over multiple stations within the state

*\*Can be met statewide*

# Eligible Renewable Resource

- *biomass,*
- *solar thermal,*
- *photovoltaic,*
- *wind,*
- *geothermal,*
- *fuel cells using renewable fuels,*
- *electricity generated from a small hydroelectric facility of 30 megawatts or less, (provided certain conditions are met)*
- *digester gas,*
- *municipal solid waste conversion, (provided certain conditions are met)*
- *landfill gas,*
- *ocean wave,*
- *ocean thermal, and*
- *tidal current.*



# Renewable definitions

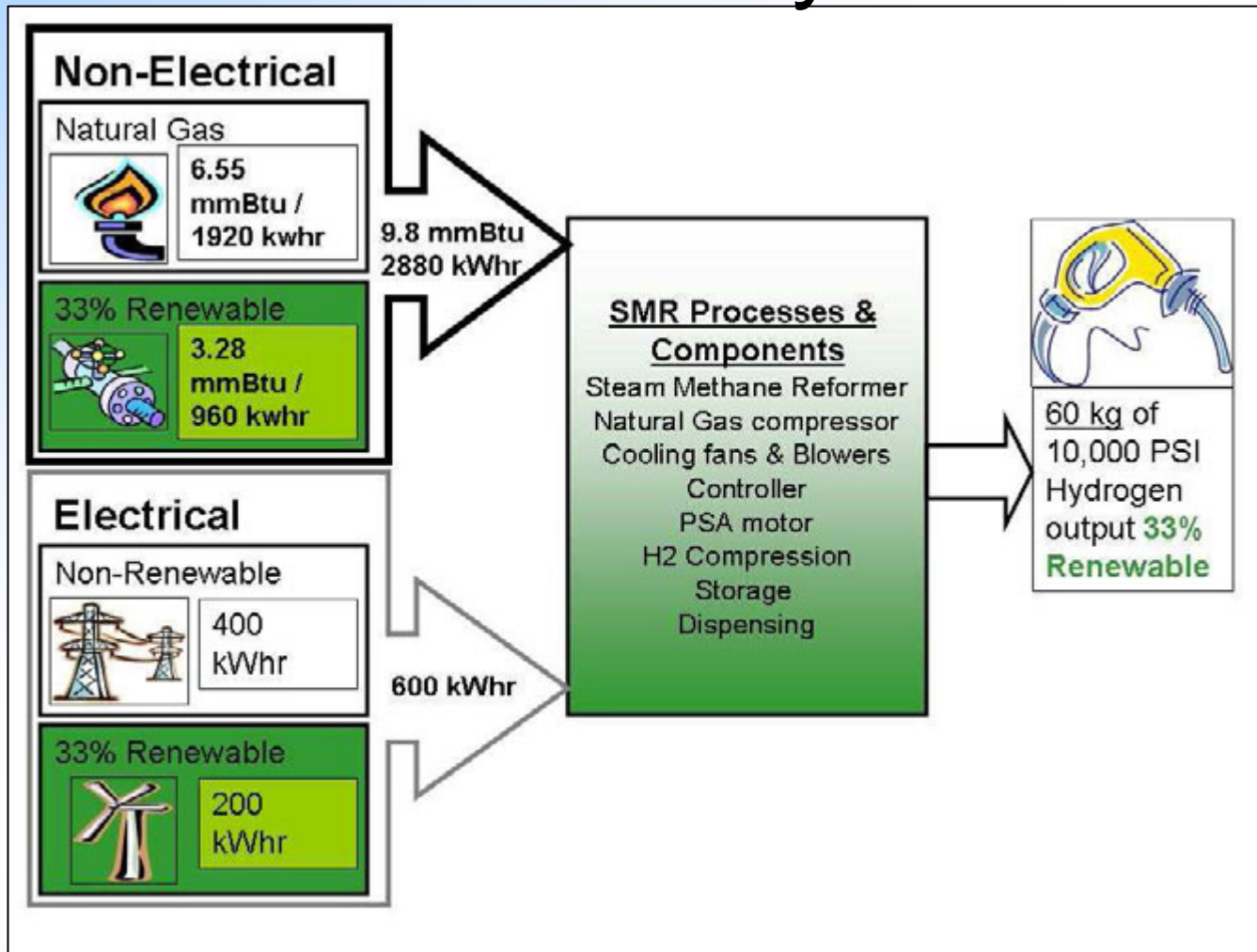
- Fuel cells using renewable fuels – electricity produced from the creation and breakdown of hydrogen. If the hydrogen source is a renewable fuel, this technology is RPS eligible.
- Biomass - any organic material not derived from fossil fuels, including agricultural crops, agricultural wastes and residues, waste pallets, crates, dunnage, manufacturing, and construction wood wastes, landscape and right-of-way tree trimmings, mill residues that result from milling lumber, rangeland maintenance residues, sludge derived from organic matter, and wood and wood waste from timbering operations.  
Digester gas - gas from the anaerobic digestion of organic wastes.
- Geothermal - natural heat from within the earth, captured for production of electric power, space heating, or industrial steam.
- Landfill gas - gas produced by the breakdown of organic matter in a landfill (composed primarily of methane and carbon dioxide), or the technology that uses this gas to produce power.
- Municipal solid waste - solid waste as defined in [Public Resources Code Section 40191](#).
- Ocean wave - an experimental technology that uses ocean waves to produce electricity.
- Ocean thermal – an experimental technology that uses the temperature differences between deep and surface ocean water to produce electricity.
- Tidal current - energy obtained by using the motion of the tides to run water turbines that drive electric generators.
- Solar Photovoltaic - a technology that uses a semiconductor to convert sunlight directly into electricity.
- Small hydroelectric (30 megawatts or less) - a facility employing one or more hydroelectric turbine generators, the sum capacity of which does not exceed 30 megawatts.
- Solar thermal – Use of concentrated sunlight to produce heat that powers an electric generator.
- Wind - energy from wind converted into mechanical energy and then electricity.

For more detailed information, please see the Energy Commission's [Overall Program Guidebook](#) and [Renewables Portfolio Standard Eligibility Guidebook](#).

# Renewable H2 Biogas

- Biogas sources
  - Must be Renewable Portfolio Standard (RPS) eligible
- Direct use
  - Onsite/Offsite conversion
- Indirect use (Credit purchase)
  - Must not be used for RPS credits or counted twice
  - Must have the ability to be transferred to California pipeline network & must meet California pipeline quality standards

# Renewable H2 from Biogas and Electricity



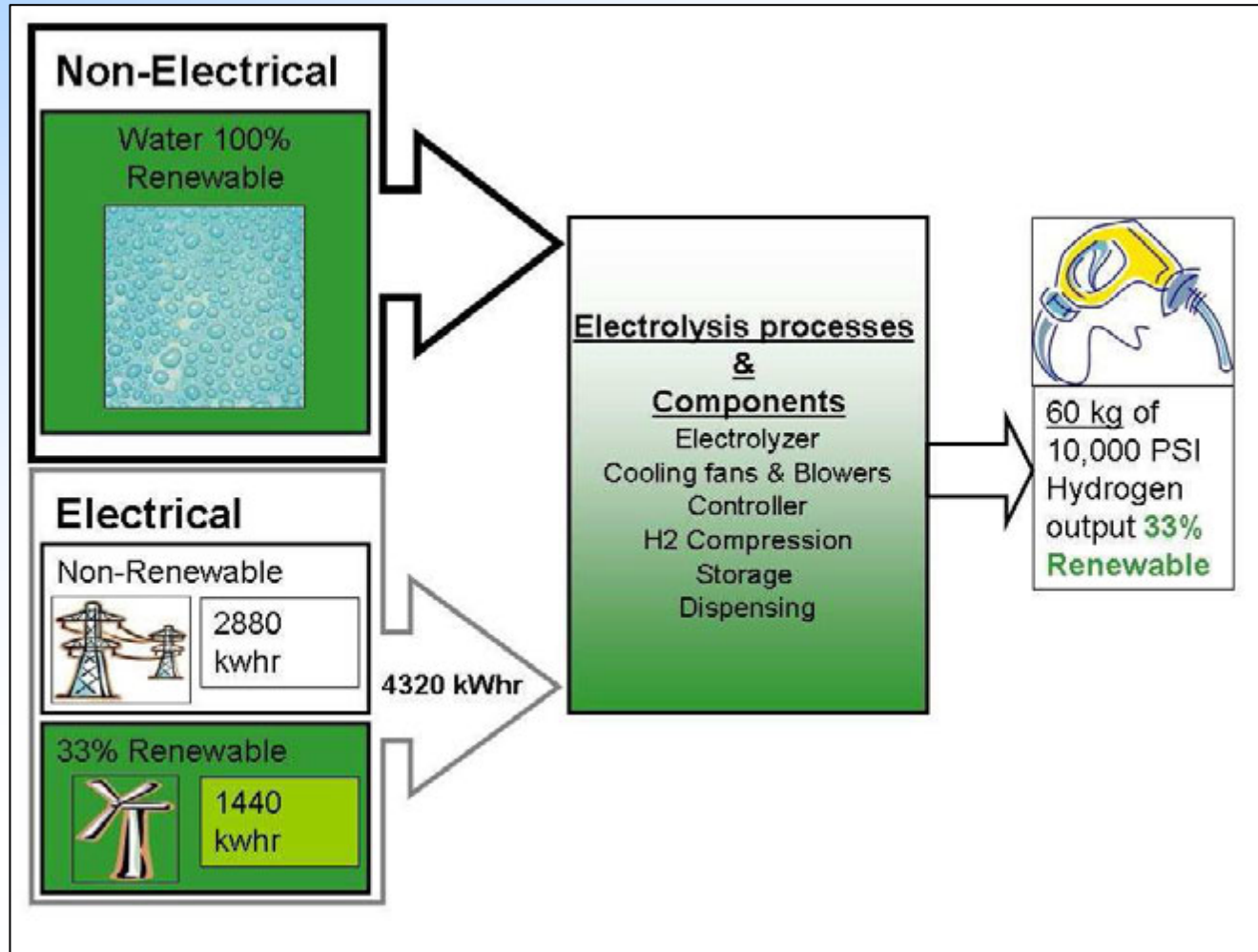
# Renewable H2 Electricity

- Onsite Electrolyzer
- Generate renewable electricity
  - Solar, Wind, Geothermal, Fuel Cells using renewable fuels, Biomass, Digester gas, Geothermal, Landfill gas, Municipal Solid waste
- Purchase Renewable Electricity
  - Purchase Renewable Electricity Credits (RECs)<sup>1</sup>
  - Must be Renewable Portfolio Standard eligible<sup>2</sup>
  - May not be double counted

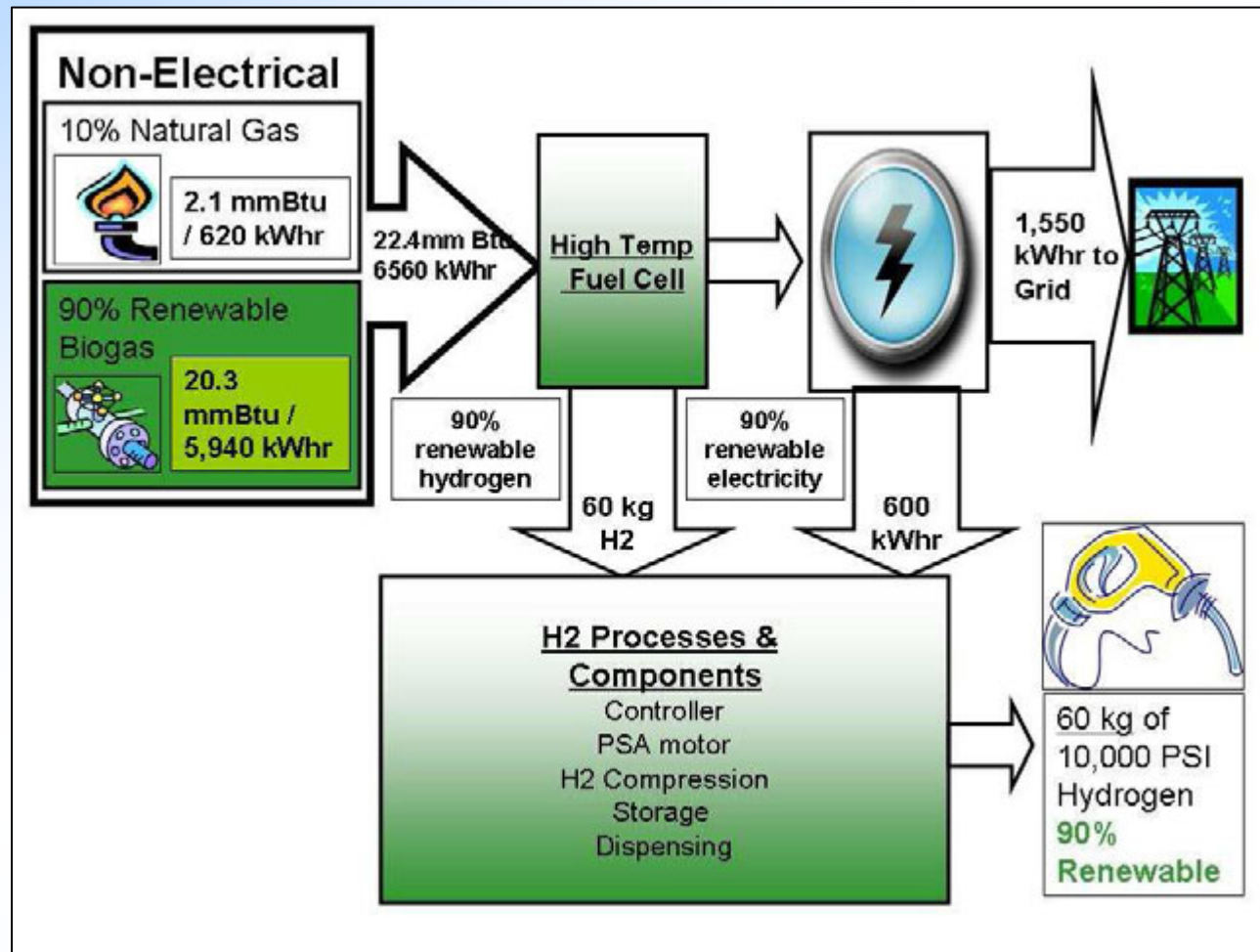
1. <http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/070824recworkshop.htm>

2. <http://www.energy.ca.gov/2007publications/CEC-300-2007-006/CEC-300-2007-006-ED3-CMF.PDF>

# Renewable H2 with Electricity



# Renewable H2 with Fuel Cell and Biogas



# Clean Fuels Outlet

- Requires owner/lessors of gasoline retail outlets to add alt fuel when statewide dedicated fuel vehicle count reaches 20,000.<sup>3</sup>
- Originally written when alt fuels were thought to be only way to achieve LEV standards.
- 2010 regulatory modifications may include:
  - Focusing on complementing ZEV deployments and meeting GHG reduction targets
  - Shifting compliance burden upstream, lowering vehicle trigger and targeting locations
- Will seek direction at December 09 board hearing

**3. Clean Fuels Program, California Code of Regulations Title 13, Chapter 8, last updated Dec. 8, 2000.**

# Low Carbon Fuel Standard

- Requires 10 percent reduction of carbon intensity of transportation fuel pool by 2020
  - Compared to 2010 gasoline and diesel fuel
- Fuels with lower carbon intensity:
  - Low carbon corn or sugarcane ethanol
  - Cellulosic ethanol
  - Renewable diesel and biodiesel
  - Electricity, hydrogen, natural gas
- Example market value of renewable H<sub>2</sub> @\$50/MT of CO<sub>2</sub>



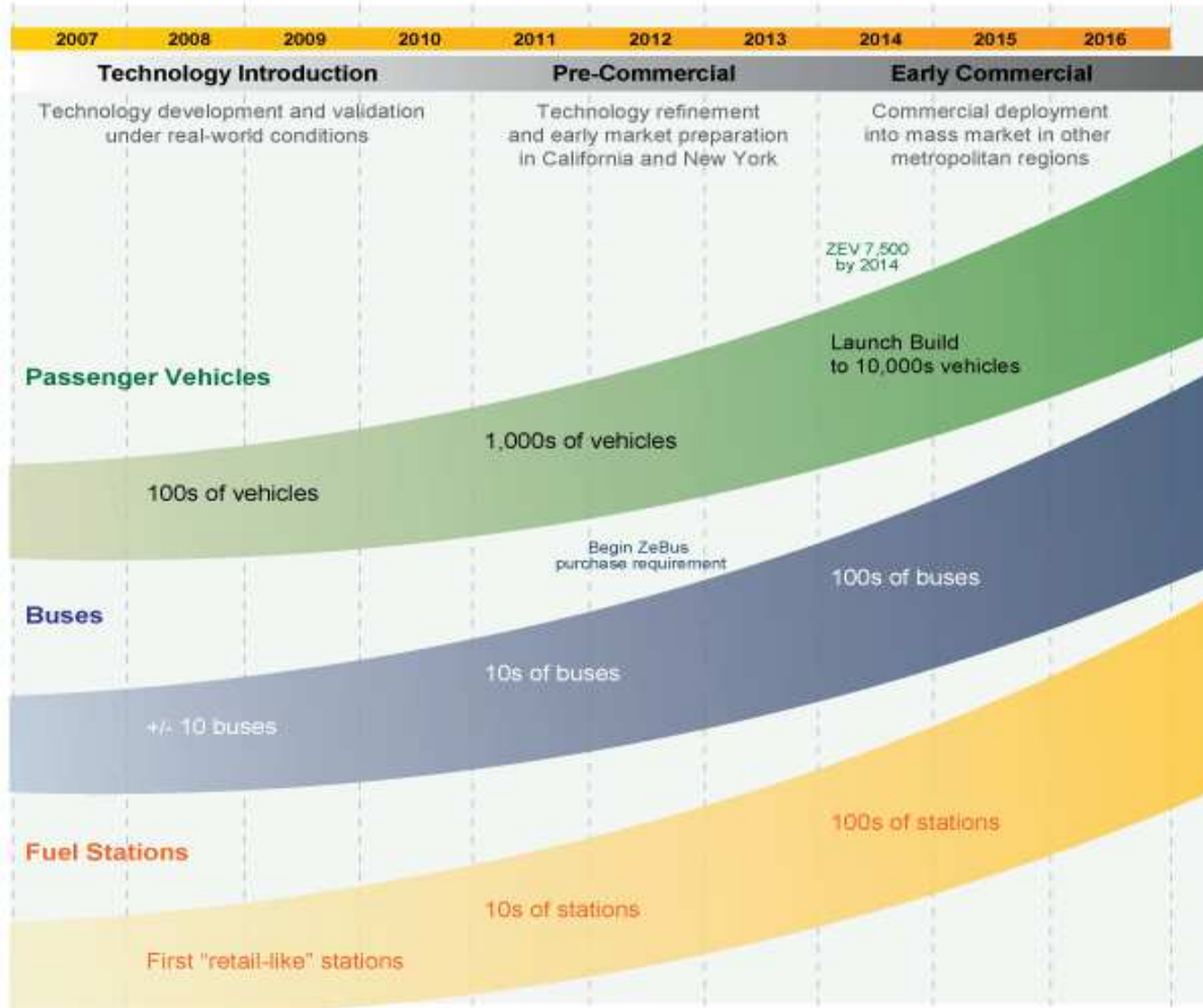
# Interactions of Regulations and Funding

- ZEV2 may require minimum #s of vehicles
  - Incentives to vehicle purchaser (e.g. AB118) ok
- SB 1505 H2 renewable requirement
  - Doesn't prevent use of credits in LCFS
- LCFS
  - No restriction on using credits from a station that was mandated by a Clean Fuel Outlet regulation

# Interactions of Regulations and Funding

- AB 118 funding
  - If H2 fuel subsidized, credit could not be used for other programs e.g. LCFS
  - If production process development or infrastructure funded, credits for H2 fuel sold not restricted
  - If station required by CFO, AB 118 funding not allowed for stations (renewable portion could be funded)

# Fuel Cell Vehicle/Station Rollout Concept



# California Policies

- **ZEV Regulation**—Requires automakers to produce zero emission and advanced technology vehicles
- **ZBus Regulation**—Requires transit agencies to operate zero-emission buses
- **Low Carbon Fuel Standard**—Requires 10% lower carbon intensity of transportation fuels by 2020
- **Clean Fuels Outlet**—Requires large station owners to supply alternative fuels
- **AB 118**—State investment plan for funding alternative fuel infrastructure
- **SB 1505**—Requires 33% renewable hydrogen today

ARB's Zero Emission Vehicle Program

[www.arb.ca.gov/msprog/zevprog/zevprog.htm](http://www.arb.ca.gov/msprog/zevprog/zevprog.htm)

California Hydrogen Highway Network

[www.HydrogenHighway.ca.gov](http://www.HydrogenHighway.ca.gov)

Zero Emission Bus Regulation

[www.arb.ca.gov/msprog/bus/zeb/zeb.htm](http://www.arb.ca.gov/msprog/bus/zeb/zeb.htm)

Hydrogen Production SB1505

[www.arb.ca.gov/msprog/hydprod/hydprod.htm](http://www.arb.ca.gov/msprog/hydprod/hydprod.htm)

Low Carbon Fuels Standard

[www.arb.ca.gov/fuels/lcfs/lcfs.htm](http://www.arb.ca.gov/fuels/lcfs/lcfs.htm)