

SENATE BILL 1505

ENVIRONMENTAL & ENERGY STANDARDS FOR HYDROGEN PRODUCTION

WORKSHOP

Sacramento: February 11, 2010

Training Room 1 East

Cal/EPA Headquarters



Agenda

- ☐ Quick recap
- ☐ Renewable resources
- ☐ Cost estimates
- ☐ Exemptions
- ☐ Applicability
- ☐ Emissions
- ☐ Reporting
- ☐ Previous Concerns

Senate Bill 1505 Recap

Directs ARB to develop regulation for transportation hydrogen

Emission reduction requirement (relative to gasoline)

- 50% reduction of NOx and ROG (WTT),
- 30% reduction of greenhouse gas (GHG) (WTW),
- No increase in toxic air contaminants (WTT)

Energy source requirement

- 33.3% renewable hydrogen

Threshold requirement

- 3,500 metric tons/year (3,500,000 kg/yr)

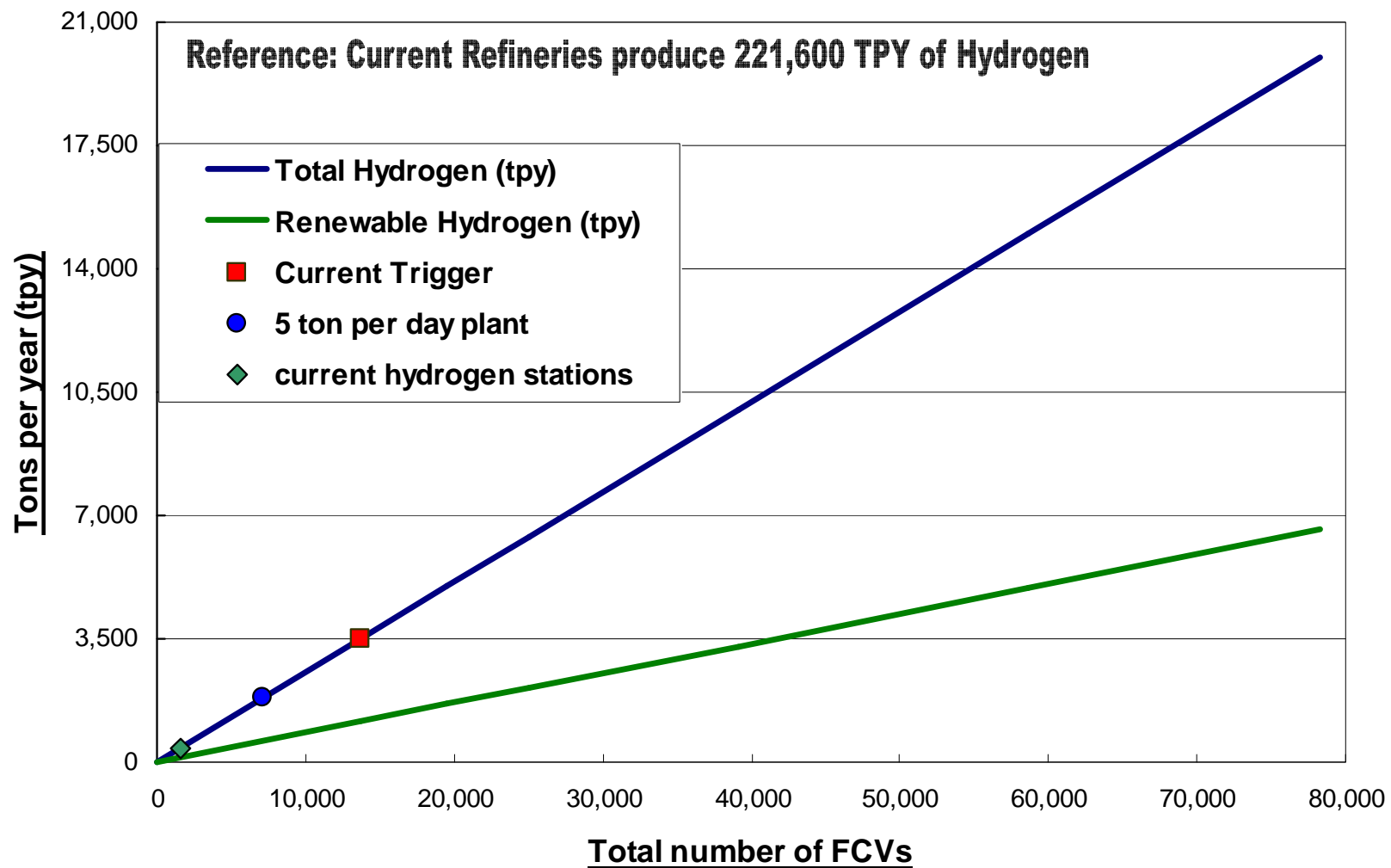
<http://www.leginfo.ca.gov/calaw.html> (search Health & Safety code for section 43868)

Or

<http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=43001-44000&file=43865-43869>



Hydrogen produced compared to # of FCVs (0.7 kg/day/FCV)



Renewable Hydrogen Requirements



Eligible Renewable Resources

- Legislation requires that 33.3% of hydrogen produced for transportation be made from “eligible renewable energy resources” as defined in PUC 399.12
- Must be RPS eligible
(<http://www.energy.ca.gov/2007publications/CEC-300-2007-006/CEC-300-2007-006-ED3-CMF.PDF>)
- No double counting
- Supports movement away from non-renewable transportation fuels



Eligible Renewable Resources

HSC 43868 (SB 1505)

(2) (A) Require that, on a statewide basis, no less than 33.3 percent of the hydrogen produced for, or dispensed by, fueling stations that receive state funds be made from eligible renewable energy resources as defined in Section **399.12** of the Public Utilities Code.

PUC 399.12

(c) "Eligible renewable energy resource" means an electric generating facility that meets the definition of "in-state renewable electricity generation facility" in Section **25741** of the Public Resources Code, subject to the following limitations:

PRC 25741

(b) "In-state renewable electricity generation facility" means a facility that meets all of the following criteria:

(1) **The facility uses biomass, solar thermal, photovoltaic, wind, geothermal, fuel cells using renewable fuels, small hydroelectric generation of 30 megawatts or less, digester gas, municipal solid waste conversion, landfill gas, ocean wave, ocean thermal, or tidal current, and any additions or enhancements to the facility using that technology.**



Renewable Resources - Benefits

- Supports use of renewable feedstocks in existing H₂ production processes
- Supports unique opportunities for R&D and growth
- Continues to facilitate the reduction in emissions
 - 98.3 gCO₂e/MJ (SMR with Natural gas)
 - 76.1 gCO₂e/MJ (SMR with 33.3% renewable biogas)



Renewable Resources - Challenges

- High Cost
 - SMR vs. Distributed Wind (\$5.80/kg difference)
- Limited Availability
 - High demand from RPS
 - Infrastructure

Eligible Renewable Resources

Sources of renewable resources

- Biomass has the potential to provide tons of Hydrogen per year¹.
- Purchase of Renewable Energy Credits (RECs)
 - According to the Green Power Network, prices of RECs can fluctuate greatly (2006: from \$5 to \$90 per MWh, median about \$20)²
- WREGIS - Western Renewable Energy Generation Information System³
 - renewable energy registry and tracking system
 - This system will help ensure the credibility of the "green" value of renewable electricity
 - Account Holders are expected to include load serving entities, balancing authorities, generators, marketers, regulators and others.

1. "Overview of Biomass RD&D Activities in California" Valentino Tiangco, Ph.D. Biomass – PIER Renewables Program, California Energy Commission, Presentation to International Cooperation Forum May 2007; CEC-500-2008-061-B
2. http://en.wikipedia.org/wiki/Renewable_Energy_Certificates#cite_note-1 referenced to <http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=1>
3. www.wregis.org and <http://www.energy.ca.gov/portfolio/wregis/>



What's counted towards the 33.3%?

- Count all energy inputs
 - feedstock (NG, biogas, biomass, electricity)
 - production/reformation and purification
 - compression or liquefaction
 - storage and dispensing
- For example calculate total mmBtu needed to supply kg H₂ and find 33.3%, then find total renewable energy needed based on amount dispensed

Potential Regulation language

Renewable resources requirements.

Except as provided in paragraph (b), the owner or operator of a hydrogen fuel production facility must demonstrate that a minimum of 33.3 percent of the hydrogen produced, transferred or dispensed at their facility is produced for transportation using eligible renewable energy resources.

- *Calculating percentage of eligible renewable resources.*
- *The renewable resource percentage is based on the energy content of the feedstock fuel or fuels and electric energy used to produce the hydrogen for transportation.*

- *Renewable percentage = $\frac{A [\text{mmBtu}] + B [\text{mmBtu}]}{C [\text{mmBtu}] + D [\text{mmBtu}]} \times 100\%$*

- *Where:*

- *A = Amount of renewable feedstock energy used*
- *B = Amount of renewable electrical energy used for hydrogen produced for transportation*
- *C = Total feedstock energy required to produce hydrogen (renewable and otherwise)*
- *D = Total electrical and other energy used to produce and dispense hydrogen for transportation*

Points of Clarification

Statewide compliance target

- State-funded stations assessed in aggregate
- Post threshold non-state funded stations assessed by individual provider's aggregate

Cost Overview

Cost Overview

The State of California requires ARB to do an analysis on the cost of compliance with a new regulation. Therefore Cost assumptions are based on the following direct cost to industry due to this regulation:

1. Renewable cost for:
 - **feedstock**
 - **renewable electricity**
 - **renewable capitol investment cost**
2. Reporting cost for emissions and renewable compliance
3. Emissions components to meet compliance, including but not limited to the cost for equipment upgrades (clean trucks, low NOx burners for SMR)
4. Others?

Transportation & Distribution cost are not included since both renewable hydrogen and non-renewable hydrogen must incur these cost.

Cost Overview – per kilogram

Production Method	\$/kilogram
Baseline Central SMR (Nat. Gas) ¹	\$1.47
Distributed SMR (Nat. Gas) ²	\$2.63
Biomass gasification ³	\$1.44
Distributed Electrolysis	\$6.75
Central Wind Electrolysis	\$3.82
Distributed Wind Electrolysis	\$7.26

Source: "The Impact of Increased Use of Hydrogen on Petroleum Consumption and Carbon Dioxide Emissions" (August 2008) Energy Information Administration (EIA), Office of Integrated Analysis and Forecasting, Office of Coal, Nuclear, Electric and Alternative Fuels, U.S. Department of Energy (DOE).

1. Industrial gas price of \$7.4 per mmBtu, electricity price of 6.4 cents/kwhr (reference November 2009 California Industrial gas price was ~\$6.8 per mmBtu and electricity October 2009 was ~11.43 cents/kwhr)
2. Commercial gas price of \$11 per mmBtu, electricity price of 9.5 cents/kwhr (reference November 2009 California Industrial gas price was ~\$8.41 per mmBtu and electricity October 2009 was ~13.93 cents/kwhr)
3. Biomass feedstock assumption of \$38/ton or \$2.2 per mmBtu

Cost Overview – at threshold

Threshold level of 3500 metric tons 33.3% will have to come from renewable resources effectively 1166 metric tons

Production Method	1166 metric tons
<u>Baseline</u> Central SMR (Nat. Gas)	\$1.75M
Distributed SMR (Nat. Gas)	\$3.13M
Distributed Electrolysis	\$8.03M
Biomass gasification (Renewable)	\$1.71M
Central Wind Electrolysis (Renewable)	\$4.55M
Distributed Wind Electrolysis (Renewable)	\$8.64M
Source: "The Impact of Increased Use of Hydrogen on Petroleum Consumption and Carbon Dioxide Emissions" (August 2008) Energy Information Administration (EIA), Office of Integrated Analysis and Forecasting, Office of Coal, Nuclear, Electric and Alternative Fuels, U.S. Department of Energy (DOE).	

Potential Exemptions

Exemptions

Staff will be asking for the following exemptions during the board hearing:

1. Reduce renewable requirement from 33.3% to 23.3%
2. Exempt transit agencies from renewables requirement for five years
3. Exempt small stations from emissions and renewables for five years
4. Exempt small demonstration or temporary stations from emissions and renewables for five years

All of these are contingent on the hydrogen production emissions not exceeding average gasoline emissions.

Exemptions

1. Reduce renewable requirement from 33.3% to 23.3%

“If insufficient availability of hydrogen from eligible renewable resources board may, on a one-time basis, **reduce the requirement by 10 percentage points**”

The exemption is needed due to the fact that renewable hydrogen supplies are currently very limited, extremely cost prohibited and in direct competition with renewable power generation for Utilities to meet their RPS goals.

Exemptions

2. Exempt transit agencies from Renewable requirement

“If it is **not feasible for a public transit operator to use** hydrogen fuel made from eligible **renewable resources**, the officer **may exempt** the operator for a period of **five years**”

The exemption is needed due to the fact that renewable hydrogen supplies are currently very limited, extremely cost prohibited and in direct competition with renewable power generation for Utilities to meet their RPS goals.

Select Transit agencies are already required to purchase Zero Emission Buses (e.g. Fuel Cell Buses), as a consequence of this they must also provide their own infrastructure. Elevating the fuel cost in addition to these requirements would adversely affect the transition to lower emission transit options.

Exemptions

3. Exempt small stations from emissions and renewables for five years

“exempt for **five years** hydrogen dispensing facilities that average of **100 kilograms fuel per month. limit exemptions** by region, air district, and do **not exceed 10 percent of total hydrogen fuel dispensed**”

The exemption is needed due to the fact that small stations of less than 4 kilograms a day are not expected to be commercial. Most likely they'll be home refuelling or experimental university stations which are used to further the development of clean renewable hydrogen. It would not be cost effective to either require or enforce a small number of low volume stations which have a net emissions benefit.

Exemptions

4. Exempt small demonstration or temporary stations from emissions and renewables for five years

“exempt for **five years** hydrogen dispensing facilities constructed for small demonstration or temporary purposes. **limit number of exemptions** by region, air district, annual mass of hydrogen **shall not exceed 10 percent fuel dispensed.**”

The exemption is needed due to the fact that small or temporary stations are not expected to be operating commercially or for extended periods of time. Test Stations are needed to determine what is necessary for developing a full scale commercial hydrogen infrastructure. Regulating these early small scale stations would be cost prohibitive.

Applicability

Applicability

How the regulation language may read:

b) The requirements of this section apply to regulated parties hydrogen providers that provide hydrogen fuel for transportation, including hydrogen blends, and retail sellers of home fueling appliances, except as otherwise provided in paragraphs (b)(1) through (b)(5) of this section.

1. A home fueling appliance is exempt from all requirements of this section until the home fueling dispensing capacity within the state exceeds 5000 kg/day except for the biannual reporting requirements of paragraph (h)(4);

2. A hydrogen production facility or station associated with a public transit operation is exempt from the requirements of paragraph (g) up to five years beyond the adoption of this regulation (date dependant on when reg is chaptered, exemption subject to board approval);

3. A small demonstration production facility, station or temporary station that produces less than 100 kilograms per month is exempt from the requirements of paragraphs (d), (e), (f) and (g) up to five years beyond adoption of this regulation; (subject to board and executive officer approval);

4. A hydrogen production facility or station that has not received funding from the state of California is exempt from the requirements of paragraphs , (d), (e), (f) and (g) until the beginning of the calendar year following a 12 month consecutive period during which the mass hydrogen dispensed for transportation statewide exceeds 3,500 metric tons;

Definition of Hydrogen Provider (Regulated Party)*

Regulated Party for Hydrogen or Hydrogen Blend

1. *Designation of Regulated Party at the Time of Finished Fuel is created.*

For a volume of finished fuel consisting of hydrogen or a blend of hydrogen and another fuel (“finished hydrogen fuel”), the regulated party is initially the person who owns the finished hydrogen fuel or the finished hydrogen fuel at the time blendstocks are blended to make the finished hydrogen fuel.

2. *Transfer of Ownership and Retaining Compliance Obligation.*

Except as provided under section (c) (3) when a person who is the regulated party transfers ownership of a finished hydrogen fuel to another person, the transferor remains the regulated party.

**Same as LCFS regulation*



Potential Regulation Language

Regulated Party for Hydrogen or Hydrogen Blend

3. Conditions under which a person acquiring ownership of finished hydrogen fuel becomes the regulated party.

Section (c)(2) notwithstanding, a person who acquires ownership of finished hydrogen fuel becomes the regulated party for the fuel if, by the time ownership is transferred, the two parties (transferor and recipient) agree by written contract that the person acquiring accepts the requirements of SB1505 as the regulated party. For the transfer of regulated party obligation to be effective, the transferor must also provide the recipient a product transfer document that prominently states:

- a) The volume and production method of the transferred finished hydrogen fuel; and*
- b) The recipient is now the regulated party for the acquired finished hydrogen fuel and accordingly is responsible for meeting the requirements of the SB1505 regulation with respect to the acquired finished hydrogen fuel.*

Emissions

Greenhouse Gases

- GHG are based on WTW this includes at minimum the following:
 - Feedstock extraction, processing and transport
 - Gaseous Hydrogen production
 - Hydrogen Liquefaction
 - Hydrogen Distribution and Storage
 - Hydrogen Compression

Greenhouse Gases

- Baseline based on the Low Carbon Fuel Standard - Average Fuel Carbon Intensity (AFCI) value for gasoline.
 - Current value 95.85 gCO_{2e}/MJ
 - Conversion factor based on State Alternative Fuel Plan (SAFP)
 - 4.59 MJ/mi
 - Result: (95.85 gCO_{2e}/MJ)X(4.59 MJ/mi) = 440 gCO_{2e}/mi
 - Hydrogen production requirement for GHG must be 30% less: **308 gCO_{2e}/mi GHG**
 - This value may be reviewed once the threshold level is achieved and determined if it is still providing an accurate baseline.

Marginal Emissions

- “Require local well-to-tank emissions of nitrogen oxides plus reactive organic gases are at least 50 percent lower than well-to-tank emissions of the average motor gasoline sold in California on an energy equivalent basis.”
- The NO_x, ROG and TAC emissions from hydrogen production will be based on the following:
 - Petroleum demand met by importing finished product
 - Electricity from natural gas combined cycle power plants (80%) and renewable electricity (20%) (marginal emissions)
 - New stationary sources use BACT
 - Fuel transport vehicles meet CARB requirements
 - Natural gas originates from outside California

Reporting

Reporting Requirements

What's reported and when?

A. General station information

B. Environmental information

- Pre threshold
 - Stations awarded state funding report both A & B
 - All other stations report A
- Post threshold (3,500 metric tons)
 - All stations report both A & B

Reporting A: General Information

All stations (pre-threshold)

- 1. Feedstock**
 - i. natural gas
 - ii. Biogas
 - iii. Water
- 2. Production process**
 - i. SMR
 - ii. Electrolysis
 - iii. Other
- 3. Delivery mode**
 - i. Truck w/LH2 or CH2, capacity, Truck emissions certification, delivery distance one way
 - ii. Pipeline, distance
 - iii. Not applicable (Onsite)
- 4. Mass dispensed (not capacity) w/accuracy**
 - i. kilograms

Reporting B: Environmental Information

- 1. Renewable requirement and how it is met (kWh or kilograms of H₂)**
 - i. Types of renewable used**
 - ii. Copies of documents verifying renewable purchases and use**
- 2. Emissions of**
 - i. NO_x plus ROG (WTT) (g/GJ)**
 - ii. GHG (WTW) (g/mi)**
 - iii. TAC (WTT) (g/GJ)**

Reporting: Format

When to report?

- Quarterly
- All stations general information begins 6 months after regulation adoption (~Dec 2011)
- Post-threshold reporting begins 1 year after threshold reached (~2015-2016)

How to report?

- Electronic on-line, downloadable form, either electronic or hard mail submission
- Goal: 1-2 page reporting form
- We'll provide handbook to determine emissions and renewables

Concerns

Stakeholder Concerns

- ❑ Can hydrogen producers trade renewables (energy or hydrogen) among themselves?
 - ✓ Yes, as long a valid documentation is provided that can demonstrate the regulated party is in compliance with the regulation.

Concerns

❑ How will you track and assess impact of home refuelers?

- ✓ *“Home refueling appliances: A retail seller of home refueling appliances must provide the following to the board on a biannual basis:*
 - *name and address of store, retail outlet or distributor selling home refueling appliances to end users;*
 - *six month period covered in the report;*
 - *number of home refueling appliances sold during the reporting period;*
 - *design throughput of the home refueling appliances in kilograms per day; and*
 - *method of hydrogen production.”*

Concerns

❑ What about HDVs? (e.g. Fuel Cell Buses) Are the emissions requirements based on diesel bus values?

✓ Yes, staffs approach will be to evaluate HDVs against a separate diesel baseline with the same methodology used for the gasoline requirements.

Greenhouse Gases

- A comparison Baseline based on the Low Carbon Fuel Standard - Average Fuel Carbon Intensity (AFCI) value for Diesel.
 - Current value 94.47 gCO_{2e}/MJ
 - Conversion factor based on State Alternative Fuel Plan (SAFP)
 - 35.76 MJ/mi
 - Result: 3378 gCO_{2e}/mi for Diesel Urban Bus WTW
 - Hydrogen production requirement for GHG must be 30% less: **2365 gCO_{2e}/mi GHG**
 - This value may be reviewed once the threshold level is achieved and determined if it is still providing an accurate baseline.

Timeline



- February 2010
 - Comments to staff
- May 7, 2010
 - Release ISOR for 45 day public comment period
- June 24, 2010
 - (ISOR) presented to the Board for approval

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