

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**

**AIR RESOURCES BOARD**

**STAFF REPORT: INITIAL STATEMENT OF REASONS**

**ADVANCED CLEAN CARS**

**2012 PROPOSED AMENDMENTS TO THE**

**CLEAN FUELS OUTLET REGULATION**

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## Executive Summary

Continuing its leadership role in the development of innovative and ground breaking emission control programs and to achieve California's goals of meeting ambient air quality standards and reducing climate changing greenhouse gas emissions, ARB has developed the Advanced Clean Cars (ACC) program. The ACC program combines the control of smog-causing pollutants and greenhouse gas emissions into a single coordinated package of requirements for model years 2015 through 2025 and assures the development of environmentally superior cars that will continue to deliver the performance, utility and safety car owners have come to expect. The Zero Emission Vehicle (ZEV) regulation will act as the technology forcing piece of the ACC program, pushing manufacturers to produce ZEVs and plug-in hybrid electric vehicles (PHEVs) in the 2018 through 2025 model years. In addition, the ACC program also includes amendments to Clean Fuels Outlet (CFO) requirements (with amendments proposed herein) that will assure that ultra-clean fuels such as hydrogen are available to meet vehicle demands brought on by amendments to the ZEV regulation.

Beyond 2025, the driving force for lower emissions will be primarily climate change. In order to meet our 2050 GHG goal, the new vehicle fleet will need to be primarily composed of advanced technology vehicles such as electric and fuel cell vehicles by 2035 in order to assure sufficient fleet turnover. Accordingly, the ACC program coordinates the goals of the Low emission Vehicle (LEV), ZEV, and CFO programs in order to lay the foundation for commercialization and support of ultra-clean vehicles. A more complete description of the impacts and benefits of the ACC can be found in the LEV staff report, including in its Executive Summary.

The current CFO regulation requires the construction and operation of alternative fuel outlets for a particular fuel when there are 20,000 alternative fuel vehicles (AFVs) using that fuel. Coordinating the development of alternative fuel infrastructure with AFV deployment is critically important to the successful commercialization of both. This is especially true for ZEVs, specifically hydrogen fuel cell vehicles, where customers rely solely on publically available fuel to use their vehicles. Without fueling stations, hydrogen fuel cell vehicles cannot be sold.

With the proposed changes, to the CFO regulation would:

- Apply only to zero emission vehicles (ZEVs) and ZEV fuels. Staff is proposing to change the types of AFVs subject to the regulation from all AFVs certified as low emission vehicles to only those certified as ZEVs when operating on the designated clean fuel.

- Add a regulatory review for plug-in electric vehicles. Electricity is currently excluded from the definition of a designated clean fuel in the regulation. Staff is proposing to add regulatory language that requires ARB to evaluate the development and usage of workplace and public charging infrastructure, and make recommendations for further actions two years following adoption of the regulation.
- Change the regulated party to be the major producer/importers of gasoline. California's seven major petroleum companies supply 93 percent of the gasoline consumed in California, while owning only 13% of the retail gasoline outlets. Changing the regulated party from owner/lessors of retail gasoline outlets to "major refiner/importers of gasoline," evenly spreads the requirement to build CFOs among the parties that continue to benefit financially from California's use of gasoline.
- Modify calculations for determining the number of new CFOs and allocating responsibility among the regulated parties. Staff is proposing to modify how the number of required CFOs is calculated to account for the fuel requirements of hydrogen and FCVs. When determining how many CFOs each regulated party is responsible for, the proposed changes include allocating stations among each regulated party based on their share of the gasoline market, rather than the number of gasoline outlets each owns.
- Add a year to both fuel cell vehicle reporting requirements and the compliance timeframe. Staff is proposing to modify the AFV reporting requirements to make auto manufacturers report FCV production plans three model years into the future (the current requirement is two) and provide FCV placement numbers by air basin. This provides the regulated party with an additional year to locate, permit, and build CFOs.
- Add a lower regional activation trigger. Staff is proposing to add a 10,000 vehicle activation trigger that would apply to an air basin before the statewide trigger of 20,000 is reached. The lower trigger complements auto manufacturers' early commercialization plans to market FCVs in regional clusters.
- Streamline the compliance requirements. The proposed amendments include modifying the compliance requirements to be less prescriptive and more like performance standards, giving the regulated party the flexibility to determine how best to meet the minimum requirements. Hydrogen infrastructure can be placed at an existing gasoline station or at a freestanding site.

- Add a penalty provision for auto manufacturers. Since the number of required CFOs is driven by auto manufacturer projections of sales and leases, staff is proposing to add a penalty that could be assessed to automakers that deliver less than 80 percent of their projected number of FCVs.
- Lower the regulation sunset provision. Under the current regulation, the requirement to build CFOs ceases when the total number outlets offering a particular clean fuel equals ten percent of the total number of retail gasoline outlets. Staff is proposing to reduce this provision to five percent based on findings that hydrogen fueling infrastructure can achieve commercial viability at five percent saturation and, therefore, a mandate would no longer be necessary.

Projected environmental impacts associated with this regulation will be minimal if any. The fueling stations will be located close to where the vehicles are operated, and the lower emissions of the vehicles will dominate any increased emissions associated with providing the fuel to the station.

The anticipated economic impacts of the regulation will mainly be felt during the onset, when hydrogen stations are not anticipated to be fully utilized. As station utilization improves due to increased consumer acceptance of FCV technology and confidence in fuel availability, the cost to dispense hydrogen will decrease. Staff projects that, with high station utilization, fuel providers will be able to sell hydrogen at an affordable price and realize a return on their investment within three to four years.

Offering hydrogen fuel in convenient commercial settings is critical to the successful launch of zero emission vehicles, which will contribute to achieving clean air and be the cornerstone of achieving climate change emission reduction goals.

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## I. Introduction and Background

The Clean Fuels Outlet (CFO) regulation, contained in Title 13, California Code of Regulations (CCR) sections 2300-2318, was originally adopted in a 1990-1991 rulemaking and became effective in September 1991. The CFO Rulemaking was an integral part of the 1990 Low Emission Vehicle (LEV) regulation because of the expectation that clean alternative fuels would play a key role in enabling automobile manufacturers to certify vehicles to LEV standards, which were considered challenging at the time. The CFO requires the development of alternative fuel outlets that coincide with the market launch of alternative fuel vehicles (AFVs), ensuring the viability of selling AFVs in the marketplace.

The CFO regulation was amended in 2000 primarily to: 1) account for fleet vehicles and the availability of private fleet fueling infrastructure; 2) allow for more existing public and private alternative fueling facilities to qualify for compliance with the regulation; and 3) add a sunset provision.

To date, the CFO regulation has not been used to require the building of alternative fueling infrastructure. With the advancement of vehicle emission control technologies and cleaner burning gasoline formulations, vehicles have been able to meet emission requirements far lower than LEV standards without using alternative fuels. However, conventional fuels and vehicles are not sufficient to meet California's zero emission vehicle (ZEV) standards, which today can only be achieved through electric drive vehicles fueled with either electricity or hydrogen. While the lack of abundant public charging infrastructure does not currently appear to be hindering auto manufacturers deployment of battery electric vehicles (BEVs), well-placed and accessible public hydrogen fueling infrastructure is a necessary prerequisite to the success and commercialization of fuel cell vehicles (FCVs) that operate on compressed hydrogen gas.

Today, the larger auto manufacturers are focusing on both BEVs and FCVs to meet their future ZEV requirements, while counting on hydrogen fueling infrastructure advancing with (or ahead of) their deployment of FCVs. While early demonstration programs and government funding are helping advance hydrogen fueling technology development and station commercialization, public funding in its current form<sup>1</sup> alone is insufficient to meet increasing demand for hydrogen, bring hydrogen infrastructure to the point of commercial viability, and create a business case that encourages private investment. Public hydrogen fueling infrastructure available to today's FCV drivers is

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<sup>1</sup> To date, government funding has provided grants to cover the majority of capital equipment and installation costs for hydrogen stations (see Section I B 1).

minimal, causing automakers to limit the number of FCVs they release.<sup>2</sup> In the near future, ARB estimates that government funding allocated for hydrogen infrastructure could meet the fueling needs of up to 7000 to 9000 FCVs but, after that, there is no guarantee of continued government funding for infrastructure or that infrastructure will grow on its own. This uncertainty has left auto manufacturers in limbo as they try to plan ahead how they will meet their ZEV requirements. Acknowledging how this uncertainty affects the ZEV regulation as a whole, the board directed staff to explore options to spur hydrogen infrastructure with one option being “mandating hydrogen through modifications to existing regulations or through a new regulation.”<sup>3</sup>

Staff is responding to this directive by recommending modifications to the existing CFO regulation. To support development of the Clean Fuels Outlet Regulation, beginning in April 2010, ARB staff held three public workshops to engage stakeholders and to get input on the proposed regulations. These stakeholders primarily included representatives from the petroleum industry, trade associations for the petroleum industry, automobile manufacturers, alternative fuel station developers and fuel providers, and environmental and clean transportation advocacy groups.

These workshops were held at the Cal EPA Building in Sacramento. The announcements and materials for these workshops were posted on the ARB website and distributed through a list serve that included over 740 recipients. Each workshop attracted just over 50 attendees in person. Almost all of the meetings were either telecast, webcasted or available by teleconference. The dates and materials presented at the workshops are available on the ARB website <http://www.arb.ca.gov/fuels/altfuels/cf-outlets/cf-outlets.htm>.<sup>4</sup> The ARB staff has also participated in 30 individual meetings with various stakeholders, supported by numerous individual telephone calls.

The following sections include a summary of the existing regulation and an update on the status of alternative fuel vehicles and infrastructure, including policies, regulations, and incentives affecting alternative fuels and vehicles in California. Proposed changes to the CFO regulation are included in Section II, and other alternatives are discussed, followed by analyses of the environmental and economic impacts of the proposed regulatory changes.

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<sup>2</sup> NYT, 2011. New York Times article. Motavalli, Jim. “In U.S., Hydrogen Cars May Line Up With Few Places to Fill Up.” Dec. 6, 2011.

<sup>3</sup> ARB, 2009a. California Air Resources Board. Resolution 09-66, December 9, 2009.

<sup>4</sup> The dates and materials from the ARB workshops are presented at: <http://www.arb.ca.gov/fuels/altfuels/cf-outlets/cf-outlets.htm>

## A. Existing Regulation

The CFO program, adopted in the early 1990s, is unique in its structure and requirements. The following section briefly describes the main elements of the current regulation in order to provide context for the proposed changes.

The current regulation requires that certain owner/lessors of retail gasoline stations equip an appropriate number of their stations with clean alternative fuels. The regulation does not require establishing retail outlets for a designated clean fuel until the number of designated clean fuel vehicles projected to be sold using that fuel reaches 20,000 in a given year. If, after applying the fleet discount per section 2303.5(a)(2), the projected number of vehicles for a given year is 20,000 or greater, the regulations specify a formula for determining the number of new clean fuel outlets required (section 2304).

### 1. The Regulated Party

The regulation applies to the larger owner/lessors of operating retail gasoline outlets (i.e., those who own a minimum number of retail gasoline outlets), and that minimum number is calculated each year pursuant to Section 2306 of the regulation. The franchisor, refiner or distributor is considered the “owner/lessor” if it owns, leases or controls the retail outlet. Otherwise the actual retail outlet owner is the “owner/lessor.”

### 2. Designated Clean Fuels and Designated Clean Fuel Vehicles

The regulation pertains to designated clean fuels used in low emission vehicles. This includes dedicated clean fuel vehicles that are designed to be operated solely on the designated clean fuel, as well as flex-fuel and dual-fuel vehicles that are capable of operating on gasoline and the designated clean fuel. Only those vehicles certified to LEV standards when operating on the designated clean fuel are considered to be designated clean fuel vehicles. Alternative fuels in use today and captured under the regulation include compressed natural gas (CNG), E85 (a blend of 85% ethanol, 15% gasoline) and hydrogen.

The current regulation includes both liquid and gaseous fuels; it excludes electricity from the definition of designated clean fuel (section 2300). In the 1991 Final Statement of Reasons for the original regulation (pg. 137), staff justified removing electricity from the regulation based on its belief that charging infrastructure needs would be readily met without the regulation within the timeframe of the introduction of BEVs.

### 3. Vehicle Trigger and Regulation Activation

Each year, auto manufacturers must submit to ARB their alternative fueled vehicle production plans per requirements set forth in California's vehicle exhaust emission test procedures.<sup>5,6</sup> With this submittal, auto manufacturers must provide sales projections for alternative fuel vehicles (including dedicated, flex-fueled and dual-fueled vehicles) for the current model year, and production estimates for two subsequent model years. ARB then uses automaker projections, Department of Motor Vehicle registration data, and formulas set forth in Section 2303(b) to estimate how many designated clean fuel vehicles certified on a particular designated clean fuel are projected to be on the road and available for sale in California within the next two years.

Triggering the regulation for the first time involves notification and information sharing, as described in sections 2311.5, 2313 and 2305, to give owner/lessors and other affected parties advance notice of the possibility that they may be required to build stations. Station requirements are based on the vehicle projections, trigger calculations detailed in section 2303(b), and the fleet adjustments in section 2303.5.

### 4. Calculating Fuel Demand and Required New Clean Fuel Outlets

Once the determination to activate the regulation is made, the required number of new clean fuel outlets is calculated pursuant to section 2304, which is based on fuel demand volume calculations made pursuant to section 2303(c). The *total projected maximum volume* (TPMV) is the sum of the annual fuel demands for each model year and vehicle class reported. Before calculating the number of outlets, the TPMV is adjusted to reflect: (a) the dual and flex fuel vehicles that will not fuel solely on the designated clean fuel (section 2304(a)(2)(A)); and (b) fleet vehicles that will fuel at both private and public fueling stations.

The adjusted TPMV is then divided by an annual per station throughput volume of 300,000 gallons gasoline equivalent (based on BTUs per gallon)<sup>7</sup> for liquid fuels and 400,000 therms per year for gaseous fuels, and the result, rounded to the nearest integer, is the total number of clean fuel outlets required for a particular fuel. The

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<sup>5</sup> "California Exhaust Emission Standards and Test Procedures for 1988 Through 2000 Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles" as incorporated by reference in Title 13, California Code of Regulations, section 1960.1. Amended Aug. 5, 1999.

<sup>6</sup> "California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles" as incorporated by reference in Title 13, California Code of Regulations, section 1961. Amended Sept. 27, 2010.

<sup>7</sup> ARB, 1991. "Final Statement of Reasons: Proposed Regulations for Low-Emission Vehicles and Clean Fuels," July 1991. The regulation assumes that a gallon gasoline equivalent of any clean fuel will allow one to travel the same distance as a gallon of gasoline. (Pg. 132).

number of *new* clean fuel outlets required to be added in the compliance year<sup>8</sup> is adjusted to reflect certain pre-existing outlets pursuant to section 2304(a)(2)(C).

#### 5. Identifying Affected Owner/lessors and Allocating Outlets

Owner/lessors must own a minimum number of retail gasoline stations before they are required to comply with the retail requirements of section 2302. This *minimum ownership level* (MOL) is the total number of retail gasoline stations (that do not offer clean fuel) divided by the number of new clean fuel outlets required for a given year. For example, if 25 new outlets were needed and there are 9,700 retail gasoline stations in the state that do not offer clean fuel, the MOL would be 388.

If a person or company is the owner/lessor of a number of retail gasoline outlets equal to or greater than the MOL, ARB will notify them of their compliance obligation for the year (i.e., how many new clean fuel outlets they must install). Compliance obligation for an affected owner/lessor is determined by multiplying the clean fuel fraction (calculated pursuant to Section 2307(c)) by the number of non-clean fuel retail gas stations owned by the affected owner/lessor. The intent is to ensure that the required number of new clean fuel outlets is equitably distributed among the owner/lessors with the most retail gasoline stations. A constructive allocation clause in the regulation (Section 2308) allows an owner/lessor of a stand-alone retail clean fuel outlet to allocate its outlet toward the compliance obligation of an affected owner/lessor through mutual agreement among the two parties.

To help ensure that the clean fuel outlets are placed in locations that are near the vehicles requiring the particular clean fuel, affected owner/lessors must submit proposed locations for each required outlet and optional locations equal to 20 percent of the proposed locations pursuant to section 2309(a). Locations are finalized after consultation with ARB.

#### 6. Responsibilities for Maintaining Fuel Supply and Outlet Operation

The regulation details specific requirements for the different entities involved with the fuel supply chain. Section 2309(b) sets facility requirements that must be met by owner/lessors for clean fuel outlets located at retail gasoline outlets. These requirements ensure that customers seeking clean fuel have the same experience in terms of fuel supply, access, payment and other amenities as those seeking gasoline. Similarly, section 2309(c) establishes fuel supply, directional and amenity requirements that owner/lessors must meet at outlets that do not offer gasoline. Section 2309(d)

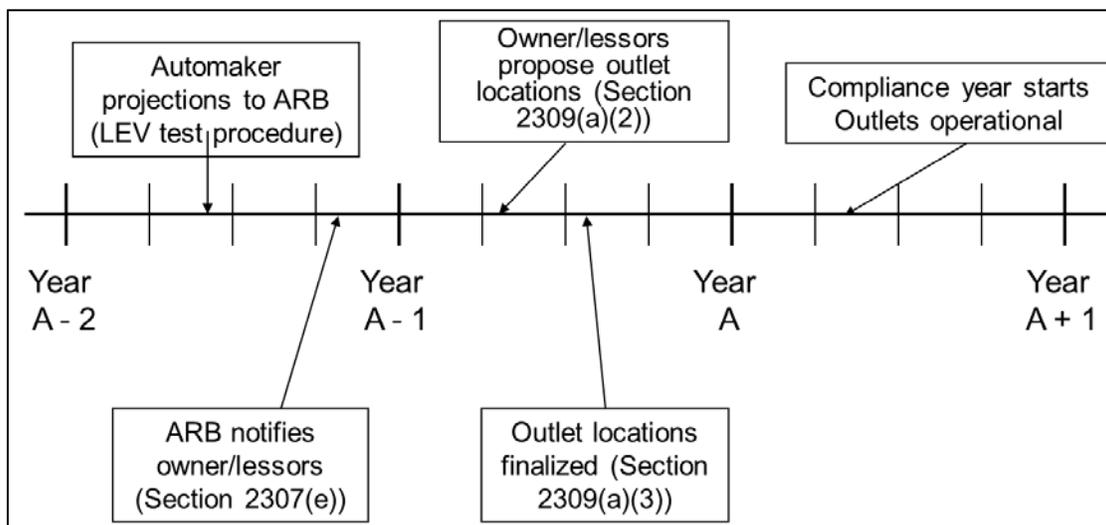
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<sup>8</sup> "Compliance year" is defined in section 2300 as "the 12 month period running from May 1 through April 30."

establishes who is responsible (i.e., the owner/lessor or the station operator) for maintaining the supply of clean fuel to the station. Section 2310 details requirements that must be met by the station operator, which pertain mostly to signage and day-to-day station operation.

## 7. Timing

The timing of activities (i.e., reporting, notices, and other actions) required in the regulation is stated in terms of the year in which new clean fuel outlets would be required should the regulation be activated. “Year” in this sense means calendar year whereas “compliance year” means the 12 month period starting on April 1 of the year that the owner/lessor is required to have operating clean fuel outlets. Figure I-1 provides a simplified illustration of the timing of key activities associated with activating the regulation in “Year A.”



**Figure I-1. Timeline of activities for current regulation**

In order to give advanced notice to potentially affected parties, the regulation also contains notice and reporting requirements that precede activation of the regulation (section 2311.5). This section requires that owner/lessors, fleet operators and fuel providers be notified when the “Executive Officer determines that there is a substantial possibility that the 20,000 vehicle trigger level for the first time will be reached” for a given clean fuel vehicle and fuel type.

## 8. Violations

If an owner/lessor fails to equip its required number of outlets with clean fuel per section 2302, or fails to meet the fuel supply and station amenity requirements at their clean

fuel outlets per section 2309(b), it will be subject to financial penalties that are based on the number of conventional vehicles they sell gasoline to. The penalty fee is \$500 per violation and can amount to daily fines of up to: \$5,000 per noncompliant station for violating section 2302, and \$2,500 per station for noncompliance with sections 2309(b) and 2310.

## 9. Sunset provisions

The current regulation will sunset for a particular clean fuel when the number of outlets offering that fuel represents at least 10 percent of all retail gasoline outlets in the state (section 2318). This provision was added to the regulation in 2000 to provide an end point that represents when fueling infrastructure would be sufficient to no longer require siting of new outlets. Studies at the time indicated that consumers would be relatively unconcerned about the availability of an alternative fuel if the fuel were available at 10 to 20 percent of the retail service outlets.<sup>9</sup> Today, there are approximately 9,700 retail gasoline outlets in California meaning the regulation would sunset for a particular fuel when that fuel is offered at 970 outlets.

## B. Status of Zero Emission Infrastructure and Vehicles

California's current ZEV regulation, as well as the proposed changes, requires auto manufacturers to develop and produce zero emission vehicles for sale in ever increasing volumes. This section discusses the current status of FCV and BEV production and deployment, and the efforts underway to develop infrastructure to support increasing numbers of these vehicles.

### 1. Hydrogen Fueling Infrastructure and Vehicles

FCV and hydrogen infrastructure development efforts were initiated in California in early 2000 with the assistance of the U.S. Department of Energy's (DOE) Hydrogen Program,<sup>10</sup> the California Hydrogen Highway Network (CaH2Net) initiative<sup>11</sup> and the

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<sup>9</sup>ORNL, 1997. Oak Ridge National Laboratory. Green, David L. "Survey Evidence on the Importance of Fuel Availability to Choice of Alternative Fuels and Vehicles." Nov. 11 1997.

<sup>10</sup> The DOE Hydrogen Program works in partnership with industry, academia, national laboratories, federal and international agencies to: 1) overcome technical barriers through research and development of hydrogen production, delivery, and storage technologies, and fuel cell technologies for transportation; 2) address safety concerns and develop model codes and standards; 3) Validate and demonstrate hydrogen and fuel cell technologies in real-world conditions; and 4) educate key stakeholders whose acceptance of these technologies will determine their success in the marketplace.

<<http://www.hydrogen.energy.gov/>>

<sup>11</sup> CaH2Net, a public-private partnership directed by ARB, was initiated in 2004 by Executive Order S-07-04 to support and catalyze the transition to a clean, hydrogen transportation economy in California in

California Fuel Cell Partnership (CaFCP).<sup>12</sup> From 2006 to 2009, ARB provided \$15.2 million dollars to begin the expansion of a hydrogen fueling network. Starting in 2010, additional funding for hydrogen fueling infrastructure has been allocated through the Alternative and Renewable Fuel and Vehicle Technology Program (AB 118).<sup>13</sup> AB 118 funding is administered by the California Energy Commission (CEC) according to investment plans that are updated annually. Also assisting in the development of hydrogen infrastructure is a federal tax credit of \$200,000 for those who build hydrogen stations by the end of 2015.<sup>14</sup> Following is a summary of initiated hydrogen infrastructure and vehicle demonstration programs, and an assessment of future hydrogen supply and demand.

a) *Early Hydrogen Infrastructure*

The US DOE's Hydrogen Program provided cost sharing for most of the hydrogen stations built in the early 2000's. These were research/demonstration stations, usually built to supply fuel for small private automaker fleets of three to five vehicles, and often sited on local government or local utility property. They were operated by energy companies such as Shell, British Petroleum and Chevron and served prototype FCV fleets from auto manufacturers such as Ford, GM, Daimler Chrysler, Honda, Hyundai and Toyota. Most of the stations were located in the greater Los Angeles area with a few in the San Francisco, Sacramento and San Diego areas. These early stations had limited capacity and were able to dispense only 12 to 25 kilograms per day (kg/day). While a kilogram of hydrogen has the same energy content as a gallon of gasoline, a FCV can travel more than twice the distance on one kilogram of hydrogen when compared to a gallon of gasoline in similar sized gasoline vehicle. All of these early stations dispensed hydrogen at 5000 pounds per square inch (psi) (350 bar).<sup>15</sup> Most of these stations operated through 2006 as part of the DOE's Technical Validation Program. The CaFCP also built a station in early 2000 to serve all CaFCP member auto manufacturers' FCV development programs in West Sacramento, and this station is still in operation.

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order to reduce dependence on foreign oil, reduce greenhouse gas emissions, improve air quality and grow the California economy. <http://www.hydrogenhighway.ca.gov/>.

<sup>12</sup> CaFCP is a consortium of federal, state and local government agencies, energy companies, automakers and industrial gas companies, created in 1999 to demonstrate and promote the potential for fuel cell vehicles as a clean, safe, and practical alternative to vehicles powered by internal combustion engines. <http://www.fuelcellpartnership.org/>.

<sup>13</sup> AB 118, 2007. California Assembly Bill. Nuñez, Fabian (Assemblymen). "The Alternative and Renewable Fuel and Vehicle Technology Program," Chapter 750, Statutes of 2007, Oct. 14, 2007.

<sup>14</sup> U.S.DOE, 2005. United States Department of Energy. Website. "Alternative Fuel Infrastructure Tax Credit," Aug. 5, 2005, <http://www.afdc.energy.gov/afdc/laws/law/US/351>.

<sup>15</sup> Most of today's FCVs require fueling at 10,000 psi (700 bar) to get a full tank and meet their maximum target driving ranges.

Most of the stations build in early 2000 were built behind fences, providing limited access through security gates. Persons refueling vehicles were required to attend training on hydrogen properties and fueling, as well as wear eye protection and fire resistant personal protection equipment while fueling. While private fueling enabled the development of FCV technology and infrastructure, auto manufacturers acknowledged that public fueling, mimicking the customer experience of gasoline would be critical to FCV commercialization.

The first publicly accessible hydrogen fueling stations began appearing around 2004. The South Coast Air Quality Management District's "Five Cities Program" funded the building of five stations – one each in: Burbank, Ontario, Riverside, Santa Monica and Santa Ana. These stations dispensed gaseous hydrogen that was trucked in from industrial suppliers or produced on-site via electrolysis. These stations provided up to 25 kg/day to a fleet of 25 Toyota Prius hybrids converted to run on hydrogen and approximately 30 additional hydrogen fuel cell vehicles produced by various automakers. The University of California at Irvine and Davis also built limited public access stations. Shell Hydrogen built California's first retail hydrogen station in Santa Monica, and though it is only 350 BAR, it is still in operation today.

b) *State Funding for Hydrogen Infrastructure to Date*

In 2004, Governor Arnold Schwarzenegger signed an Executive Order calling for the development of a California Hydrogen Blueprint Plan. This order resulted in a 2005 plan that called for the State to provide co-funding for the phased construction of public hydrogen infrastructure. This infrastructure provided fuel for hydrogen fuel cell vehicles being built in response to the state's ZEV regulation. From 2006 through 2009, ARB awarded \$15.2 million in state co-funding for eight public access hydrogen stations. In 2010, the CEC provided an additional \$15.7 million to co-fund an additional eight stations, and upgrade three existing stations. Further hydrogen infrastructure funding will be made available in early 2012 as discussed in the next subsection.

As of November 2011, there are six operational hydrogen stations that are open to the public, four undergoing final commissioning, and nine in the final permitting process. The aforementioned five cities AQMD stations are still open on a limited access basis. Table I-1 below provides the locations, capacity, and status of each of these stations.

**Table I-1: Public Hydrogen Fueling Stations in California (open and pending)**

Station Operator	City/ Location	Community/City Served	State Funded	Capacity (kg/day)	Status	Funding Ends
<i>Northern California</i>						
A.C. Transit	Emeryville	East Bay area, Oakland, Berkeley	Yes	60	Testing	2014
San Francisco International Airport	Millbrae	San Francisco/San Mateo/San Bruno	Yes	240	Permit	2014
Linde LLC	West Sacramento	West Sacramento	Yes	240	Permit	2015
<i>Southern California</i>						
City of Burbank	Burbank	Burbank, Glendale, I-5 commuters	Yes	100	Open	2014
Cal State University Los Angeles	Los Angeles	Los Angeles, I-5 & I-10 commuters	Yes	60	Testing	2014
Shell Hydrogen	Santa Monica	Santa Monica, West L.A. I-405 & I-10 commuters	No	25	Open	2011
South Coast Air Quality Management District	Diamond Bar	Diamond Bar, highway 55 commuters	No	25 (180)	Open	2014
Shell Hydrogen	Torrance	Torrance, Redondo Beach, I-405 commuters	No	50	Open	unknown
Air Products/University California of Irvine	Fountain Valley	Huntington Beach, Fountain Valley, I-405 commuters	Yes	100	Open	2014
University of California Irvine	Irvine	Irvine, I-405 commuters	No	25 (180)	Open	2014
Mebtahi-Chevron	Harbor City	Palos Verdes, Lomita, Harbor City, Pacific Coast Hwy	Yes	100	Testing	2014
Shell Hydrogen	Newport Beach	Newport Beach, Costa Mesa	Yes	100	Testing	2014
University of California	Los Angeles	Santa Monica, Westwood, Beverly Hills	Yes	100	Permit	2015
City of Ontario	Ontario	Ontario	No	25	Open	2012
City of Santa Ana	Santa Ana	Santa Ana	No	25	Open	2012
City of Riverside	Riverside	Riverside	No	25	Open	2012
City of Santa Monica	Santa Monica	Santa Monica	No	25	Open	2012
Air Products and Chemicals Inc. (APCI)	Santa Monica	Santa Monica	Yes	180	Permit	2015
APCI	Beverly Hills	Los Angeles, Beverly Hills	Yes	180	Permit	2015
APCI	Los Angeles	Los Angeles	Yes	180	Permit	2015
APCI	Hermosa Beach	Hermosa Beach	Yes	180	Permit	2015
APCI	Irvine	Irvine	Yes	180	Permit	2015
APCI	Hawthorne	Hawthorne	Yes	180	Permit	2015
Linde LLC	Laguna Nigel	Laguna Nigel	Yes	240	Permit	2015

c) *Factors Considered when Administering State Funding*

In order to ensure that state funds for hydrogen infrastructure are allocated to the most worthwhile projects, grants are awarded on a methodical, competitive basis in response to solicitations. Before releasing each solicitation, meetings with auto manufacturers are held and confidential surveys are conducted (discussed below) to help pin-point, as

much as possible, in what communities and in what numbers, FCVs are most likely to be placed with customers. Based on this information, teams of experienced and qualified individuals<sup>16</sup> (i.e., bidders) seek out sites and or retail stations that would best serve the FCV customers of the auto manufacturers. Station proposals are awarded only if auto manufacturers clearly commit to vehicle numbers and placement locations. The results of these confidential surveys are also included in one vehicle ramp-up scenario used in the environmental and economic analyses presented later in this report.

Studies supporting the strategic rollout of hydrogen infrastructure are also factored into station funding deliberations. CEC, ARB, CaFCP, auto manufacturers, and the University of California's Transportation Studies Programs at Irvine and Davis are collaborating in the modeling of different scenarios to help ensure the most effective rollout of hydrogen infrastructure. The annual confidential auto manufacturer vehicle surveys are also be taken into account when planning future infrastructure and how best to allocate government resources.

#### d) *Future Hydrogen Infrastructure*

The next round of hydrogen infrastructure funding will include \$18.7 million administered through CEC by way of a Program Opportunity Notice (PON) to be released in late 2011. At this time, it is not possible to know the exact locations, numbers or sizes of stations that will be awarded as a result of the upcoming PON. However, one can estimate from prior station awards and from industrial gas suppliers' statements that same-size stations will cost less in future funding cycles due to economies of scale and existing production and delivery system investments. Therefore, one could conclude that these new funds will result in anywhere from 10 to 14 new stations, and add 2400 to 4600 kg/day of new hydrogen capacity.

Estimates of the number of stations and total capacity into the near future must account for the fact that hydrogen stations co-funded by the state are obliged to operate for a minimum of three years. After three years, the stations can close. Ideally, increasing vehicle numbers and fuel demand will generate enough revenue to make a business case for keeping the stations open. Unfortunately, it is difficult to predict whether or not stations will remain open after the obligatory three years.<sup>17</sup>

To establish a baseline for hydrogen infrastructure in 2015, staff assumed that the estimated 10 to 14 new stations added via the \$18.7 million PON discussed above, plus

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<sup>16</sup> Teams bidding on the most recent Program Opportunity Notice typically included industrial gas suppliers, station builders, and property owners.

<sup>17</sup> Stations more likely to stay open are those located at retail gasoline fueling stations, easily accessible from major thoroughfares with safe and convenient public access.

many of the existing and previously funded stations operating in 2014 will continue to operate beyond the requisite three years and well into the future. Together, these 25 to 30 stations could supply 4800 to 7000 kg/day, which could support 6000 to 9000 fuel cell vehicles.

e) *Hydrogen Vehicle Deployments and Plans*

As mentioned above, ARB and CEC jointly conduct an annual confidential auto manufacturer FCV rollout survey to ascertain, as close as possible, the timing, numbers and locations of planned FCV placements. The survey requests manufacturer name, model and class of vehicle, and preferred fueling pressure. In completing the survey, each auto manufacturer is requested to identify how many FCVs they plan to place in each county, city and community listed in the survey, as well as the year that the vehicles will be placed. The individual auto manufacturer’s survey numbers are combined to form a summary. This data helps guide the development of infrastructure in those select communities. The 2010 survey drew responses from seven auto manufacturers. The combined statewide results of the survey, as well as the portion of FCVs planned to be placed within the south coast air basin are summarized in Table I-2.

**Table I-2: Summary of ARB/CEC Auto Manufacturer Survey Results (2010)**

<b>2010 Survey</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015-17</b>
<b>Cumulative FCVs Statewide</b>	312	430	1,389	53,000
<b>FCVs in South Coast Air Basin</b>	240	347	1,161	34,230

It is important to note that while completing the surveys, auto manufacturers make two key assumptions: 1) that adequate hydrogen fueling infrastructure will indeed be in place in the communities ahead of their vehicle deployments; and 2) customers will lease or buy these vehicles.

California and the federal government currently offer incentives for buying or leasing a fuel cell vehicle, such as high occupancy vehicle (HOV) lane access, federal tax credits, state rebate and, in some communities, free parking. While all of these incentives will likely end eventually, they offer positive motivation for customers contemplating the purchase or lease of a FCV in the early years.

f) *Evaluating Hydrogen Supply and Demand*

The 2010 auto manufacturer survey numbers indicate that the majority of FCVs will likely be placed in five major areas, referred to as clusters. These clusters include: 1) San Francisco Bay Area; 2) Sacramento area; 3) Santa Monica/Westwood/Beverly Hills; 4) Torrance/South Bay area; and 5) Irvine/Newport Beach area. Although some auto manufacturers are planning placements in the two northern California clusters, all of them are planning vehicle rollouts in the three southern California clusters. Therefore, to support the FCV placements discussed above during the timeframe shown in Table I-2, most of the fueling infrastructure is being built in southern California, which is apparent in Table I-1. Additionally, if auto manufacturer's survey data continues to indicate that the majority of their FCVs will be placed in communities within the south coast air basin, it is likely that the next round of CEC station co-funding will also focus on placing stations in these areas.

In evaluating both the FCV and hydrogen station projections, it appears that fueling infrastructure would be more than sufficient to support the projected number of FCVs through 2014. However, the hydrogen infrastructure as estimated above will become insufficient at some point in 2015 or 2016. This date is dependent upon how quickly FCV placements meet the auto manufacturer's projections of 53,000 vehicles.

California's requirements for auto manufacturers to introduce ever increasing numbers of zero emission vehicles into the California light duty vehicle market will likely result in FCVs comprising a significant percentage of the state's zero emission vehicle fleet. Early hydrogen infrastructure co-funding, vehicle rebates and other incentives illustrate the state's commitment to bringing FCV technology to commercialization. Unfortunately, there's no guarantee of future government funding for infrastructure.

## 2. Battery Electric Vehicles and Charging Infrastructure

Auto manufacturers introduced roughly 4,400 full function BEVs into the fleet from 1997 through 2003 as part of California's early ZEV program. In 2008, auto manufacturers started deploying BEVs in response to ARBs revised ZEV regulation, and now are developing product lines that include full-function BEVs as well as plug-in hybrid electric vehicles (PHEVs).<sup>18</sup> Unlike FCVs, a significant portion of the potential BEV and PHEV market is not dependent on public fueling infrastructure. BEVs and PHEVs are sold with home Electric Vehicle Supply Equipment (EVSE), while home fueling is currently not an option to FCVs. In addition, some public charging will be available at retail locations where charging is currently free and some workplace charging is available.

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<sup>18</sup> Plug-in hybrid electric vehicles are hybrid vehicles with larger batteries that can be charged by plugging in to Electric Vehicle Supply Equipment or standard 110V or 220V outlet.

Most BEVs and PHEVs are expected to be primarily charged at home. Home charging will facilitate off-peak charging, which will reduce the need for grid expansion and allow better optimization of power generation equipment. While public charging is not needed for the early market deployment of BEVs and PHEVs, it may make these vehicles more attractive to a potentially broader market. The following paragraphs discuss the current status of EV charging infrastructure and vehicle development.

In addition, EVSE operate fundamentally differently than today's retail petroleum fueling or hydrogen fueling. Conventional vehicles are currently refueled in well under ten minutes, and state-of-the-art hydrogen stations also refuel FCVs in less than ten minutes. Refueling of PHEVs and BEVs typically takes from four to eight hours, when using a 110 or 220 volt outlet. While limited fast charging is available, it will take well over ten minutes and it is not certain that all battery types will be suitable for fast charging. The success of retail fueling outlets relies on quick customer turnaround.

a) *Existing EV Charging Infrastructure*

It is estimated that over 1,200 "legacy" Electric Vehicle Supply Equipment (EVSE) units also referred to as charging stations, remain in public locations throughout California. The EVSEs were installed in the late 1990s and early 2000s to facilitate BEV demonstration programs as well as support initial consumers. These older EVSEs utilize connectors that are not compatible with the current Society of Automotive Engineers (SAE) J1772 plug standard in use by new BEVs and PHEV. A few hundred older BEVs continue to use the legacy EVSEs. Plug adaptors are available for these BEVs to connect to new and upgraded public charging stations, as well as for new BEVs and PHEVs to connect to the legacy systems.

b) *Future Charging Infrastructure Developments*

An interest in expanding public charging infrastructure has resulted from current and anticipated BEV and PHEV deployments in California. The CEC provided funding through AB 118 to update legacy EVSEs to install J1772 compliant connectors to allow charging for older BEVs as well as BEVs and PHEVs being currently deployed. Up to 900 legacy systems will be upgraded. In addition, CEC with funding from a variety of partners including the United States Department of Energy, Association of Bay Area Governments, Bay Area Air Quality Management District, South Coast Air Quality Management District, Sacramento Municipal District, and EV Sacramento Coalition will co-fund the installation of over 5,000 level two home chargers and public EVSEs and almost 100 fast charge EVSEs. These projects, along with additional EVSE supplier installations, will result in several thousand public charging stations in California within the next few years.

Consumer demand for and use of public EVSEs is poorly understood. The EV Project, funded by DOE, state, and local entities, will place 8,300 Plug-in Electric Vehicles (PEVs) and more than 5,300 public EVSEs in six regions of the United States, and collect data on vehicle and EVSE use. ECotality North America, Nissan North America, and General Motors are partners for this ambitious vehicle and infrastructure deployment project. San Diego, Los Angeles, and the San Francisco Bay Area are the three California sites participating in The EV Project. Over 2,000 BEVs and PHEVs, along with close to 1,000 new public charging stations will be monitored in California. The collected data will be analyzed to characterize vehicle use, effectiveness of charging station infrastructure, and impact of variable pricing on public EVSE use. Results from this work as well as other studies conducted are anticipated to identify the amount of public charging infrastructure needed for the increasing number of BEVs and PHEVs in California.

Auto manufacturer's projections for sales and leases in California include 69,600 BEVs and 21,500 PHEVs in the 2011 to 2014 timeframe.<sup>19</sup> Some auto manufacturers believe that public chargers are needed to expand the BEV market significantly beyond the early adopters or people who purchase BEVs as a second or third vehicle.

Similar to FCVs, California and the federal government offer incentives for buying or leasing BEVs and PHEVs, such as high occupancy vehicle (HOV) lane access, federal tax credits, and a state rebate. The major utilities offer low time-of-use rates to households to encourage off-peak charging. Some offer rebates and permitting assistance to offset the cost of installing home chargers. Several cities are also offering rebates for BEVs and PHEVs while funds last, as well as free parking with free charging.<sup>20</sup> These incentives are an important factor in customers' decisions to purchase BEVs.

Because electric vehicle technologies are an important component of emission reduction strategies for light duty vehicles, the state and federal government will continue to support the commercialization BEVs and PHEVs through the efforts and incentives discussed above, and will continue to gain information on how to increase the sale and utilization of electric vehicles.

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<sup>19</sup> Earlier BEVs are not included in this number because their connectors are not compatible with the current J1772 plug standard. Projections past 2014 were requested but not required. In 2011, automakers were only required to project through model year 2013 as required in test procedure AFV reporting requirements (see Section I A 3).

<sup>20</sup> ARB's DriveClean website provides a complete list of incentives offered to BEV and PHEV owners. <http://www.dirveclean.ca.gov>.

### **C. Status of Non-ZEV Alternative Vehicles and Fuel Infrastructure**

Currently, the light and medium duty AFV population in California is comprised primarily of flex fuel vehicles (FFVs) that can operate on E85 and gasoline, and vehicles that operate solely on CNG. Approximately 224 outlets offer CNG and 118 offer E85; most of these outlets are not associated with a retail gasoline outlet, and roughly 55 percent offer alternative fuel to the public. Sales and leases of CNG and E85 alternative fuel vehicles in California have increased substantially since the late 1990s. By 2010, approximately 760,000 E85 FFVs and 25,000 CNG vehicles had been sold or leased in California.

Recently, federal stimulus funding and state funding through AB 118 have been allocated for alternative fuel infrastructure and vehicle rebates. To date, \$27 million has either been invested or allocated towards CNG and E85 infrastructure, \$19 million towards development and production of advanced ethanol, and another \$12 million for vehicle rebates. See Appendix C for a more detailed discussion on the current status of California's alternative fuel vehicles, infrastructure, and government funding allocated for both.

#### **1. CNG Vehicles Relative to CFO**

There were approximately 25,000 CNG vehicles operating in California in 2010 and, by 2013, auto manufacturer's project that the numbers will increase to 30,000. The CFO has never been triggered for CNG because the majority of vehicles are in fleet use and, therefore, subject to the regulation's fleet discount provision. With 126 public and 98 private CNG stations in place, and funding for roughly 30 new public stations allocated or pending, CNG infrastructure will continue to be sufficient to support vehicles into the near future.

#### **2. E85 FFVs Relative to CFO**

Numbers of E85 FFVs have steadily increased during the past decade to over 700,000 vehicles. However, since utilization of E85 is not essential to the operation of FFVs, customers do not always choose E85. Plus, E85 provides 23 to 28 percent less energy than a gallon of gasoline. Of the 63 public retail stations that offer E85, some station operators are finding that they must price E85 proportionately lower on an energy equivalent basis to get customers to choose E85 over gasoline, making it difficult to justify their investment.

### 3. Future of Non-ZEV Fuels and Vehicles

While use of E85 and CNG help reduce GHG emissions, they do not play a significant role in meeting California's long-term air quality goals for light and medium duty vehicles. Rather than supporting all alternative fuels, infrastructure regulations should be linked to near-term and future requirements pertaining to vehicle fleet emission reduction needs.

## II. Recommended Actions and Alternatives

Staff is proposing a substantial number of modifications to the CFO regulation so that it aligns with proposed changes to both the LEV and ZEV regulations and supports commercialization of zero emission vehicles. These proposed modifications are detailed below, followed by an analysis of alternatives to the proposed changes.

### A. Proposed Regulatory Amendments

This section provides a description of the proposed changes to the CFO regulation and the rationale behind those changes.

#### 1. Regulation Title

Staff is proposing to change the title of the regulation from “Clean Fuels Program” to “Clean Fuels Outlets” because the current title too broad and implies that the regulation also pertains to fuel quality. Clean Fuels Outlets is a more succinct title.

#### 2. The Regulated Party

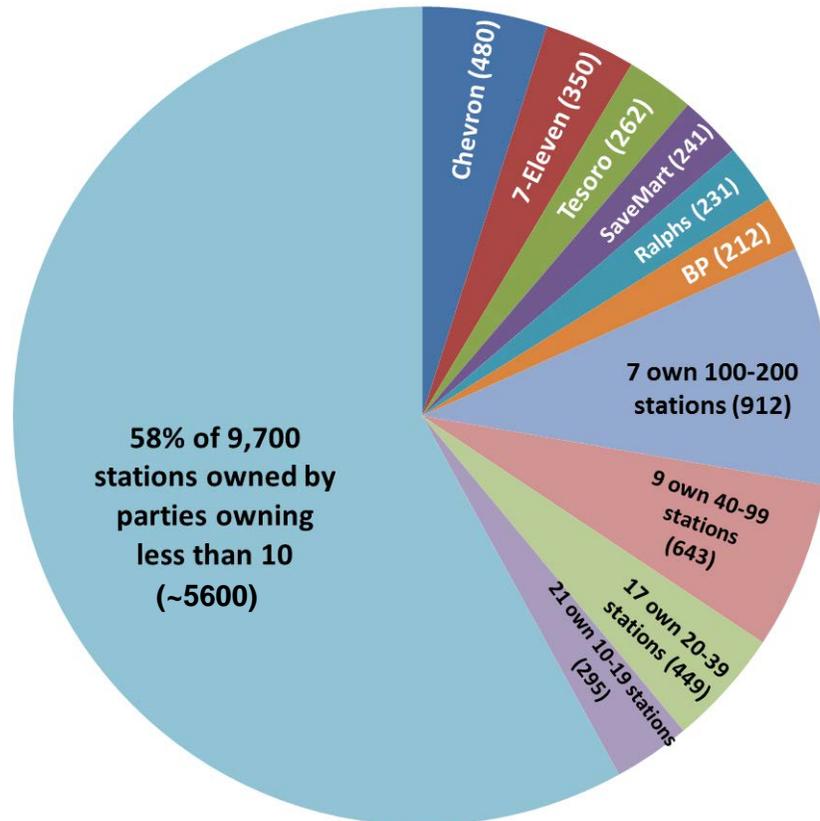
The proposed amendments would shift the requirements to equip retail outlets with designated clean fuel from “owner/lessors” to “major refiner/importers of gasoline.” Owner/lessors would be removed from the regulation language and a new definition added to section 2300 for “refiner/importers,” which includes companies that produce in or import into California 500 million gallons or more of gasoline per calendar year.

This modification recognizes the refiner/importers as the intended regulated party in the original CFO regulation since, at the time; they were the owner/lessors of most of California’s retail gasoline stations, either as the *franchisor* or the *refiner or distributor*. When the regulation was modified in 2000, about 15 percent of the retail stations were directly owned and operated by refiners. The majority of the state’s retail gasoline outlets, approximately 70 percent, were “lessee dealer stations” where the refiner or wholesale distributor (also known as a branded jobber) owns, or controls by a lease, the land, buildings, and equipment then leases them to the dealer-operator. Such lease agreements were predicated on supply agreements requiring the lessee dealers to purchase the refiner’s gasoline exclusively and, in turn, the refiner bore the responsibilities customarily applied to an owner/lessor. The remaining 15 percent of the stations in 2000 were owned and operated by independent wholesale dealers, or unbranded jobbers.”<sup>21</sup>

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<sup>21</sup> AG, 2000. California Attorney General. Lockyer, Bill (Attorney General), “Report on Gasoline Pricing in California.” May 2000.

Today, the ownership profile for retail gasoline outlets has shifted heavily toward small business as illustrated in Figure II-1, 58 percent of California’s approximate 9,700 retail gasoline outlets are owned by people who own fewer than 10 stations. Figure II-1 also shows the companies that own more than 200 retail stations (with the number of stations each owns in parentheses), as well as a breakdown of numbers of entities that own more than 10 stations.



**Figure II-1: Owner/Lessors of Retail Gasoline Outlets, January 2011<sup>22</sup>**

Approximately 13 percent of the state’s stations (1260 stations) are owned and operated by 6 out of 7 of the major refiner/importers; and only three, Chevron, Tesoro and BP, own enough outlets to be subject to the retail requirements of the regulation in the early years. While the majority of stations today are independently owned by small business owners, those independent stations carrying a major refiner’s brand are only linked to the supplier via contractual agreements.

<sup>22</sup> BOE, 2011a. California State Board of Equalization. Sales and Use Tax account registration information for businesses operating under NAICS Code 4471. Jan. 14, 2011.

Table II-1 provides a breakdown of refiner/importer-owned and operated stations and independently owned stations identified as selling that company’s fuel brand as of January 2011.

**Table II-1. Gasoline station ownership including major refiner/importers and Independents selling branded fuel<sup>23</sup>**

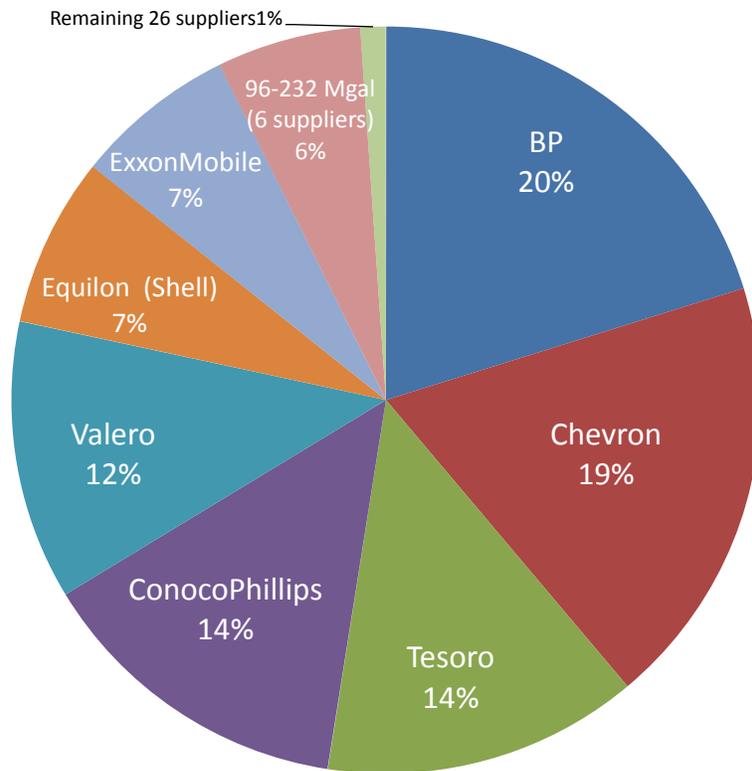
Major Refiner/Importer	Company-owned stations	Brands sold by independents	Independents selling major’s brand	Total branded Stations	% of all CA stations
Chevron USA, Inc. and Chevron Stations, Inc.	480	Chevron and Chevron with Techron	470	950	9.8%
BP West Coast Products LLC	212	BP, Arco, AM/PM	458	670	6.9%
Equilon Enterprises LLC.	126	Shell	414	540	5.5%
ConocoPhillips Co.	0	76 and Union 76	330	330	3.4%
ExxonMobil Oil Corp.	96	Exxon and Mobil	210	306	3.1%
Tesoro Refining and Marketing Co.	262	Tesoro	3	265	2.7%
Valero Marketing and Supply Co.	84	Valero	155	239	2.5%
Totals	1,260		2,040	3,300	34%

In addition to the few refiner/importers who still own relatively large numbers of retail gasoline outlets, the current CFO regulation, if applied today, would also target other owner/lessors of retail gasoline outlets that are not in the business of producing gasoline – 7-Eleven, SaveMart Supermarkets and Ralphs Grocery Company. Petroleum companies that have divested most or all of their retail outlets would likely not be affected by the requirements of the current regulation.

As such, the proposed modification recognizes that, while most refiner/importers have significantly divested their interests in the retail aspect of the gasoline supply chain, they continue to play an active role in the upstream aspects of the supply chain (oil exploration and production, and refining). Of the 14.86 billion gallons of gasoline

<sup>23</sup> Ibid.

produced in or imported into California in 2010, California's seven major oil companies were responsible for 13.77 billion gallons. Figure II-2 illustrates the percent of gasoline production and imports by company in calendar year 2010.



**Figure II-2: California gasoline production and imports by company (2010)<sup>24</sup>**

From the above, it is clear that refiner/importers continue to benefit financially from California's use of gasoline while relying on small business owners to deliver their product to the end user. For example, refinery profit margins for branded fuel in 2010 ranged from 24 to 62 cents per gallon.<sup>25</sup> The profit associated with the distribution and marketing of branded gasoline, on the other hand, ranges from 12 to 27 cents per gallon,<sup>26</sup> which is split between the distributor and the retailer.

<sup>24</sup> BOE, 2011b. California State Board of Equalization. Monthly Motor Vehicle Fuel Distribution Reports for calendar year 2010. January 2010 through December 2010. [www.boe.ca.gov/sptaxprog/spftrpts.htm](http://www.boe.ca.gov/sptaxprog/spftrpts.htm). Accessed June 2011.

<sup>25</sup> CEC, 2011a. California Energy Commission. Energy Almanac: Estimated 2011 Gasoline Price Breakdown & Margins Details webpage. <http://energyalmanac.ca.gov/gasoline/margins/index.php>. Accessed Sept. 22, 2011.

<sup>26</sup> Ibid.

### 3. Vehicles included in designated clean fuel vehicle count

Proposed amendments would modify the regulation to apply only to dedicated clean fuel vehicles that operate on ZEV fuels, with a placeholder for electricity as discussed in the next subsection. Once implemented, the regulation would pertain only to hydrogen and fuel cell vehicles; however, in the future it could be applied to electricity for plug-in hybrids and BEVs depending on the outcome of a BEV needs assessment discussed in the next subsection.

Focusing on ZEV fuels aligns the CFO regulation with the ZEV and LEV III GHG regulations, which conclude that, by 2025, new cars and trucks will on average have to reduce their GHG emissions by about 51 percent from 2008 levels. Plug-in electric vehicles and FCVs will continue to offer the lowest CO<sub>2</sub> emissions of all. For conventionally fueled vehicles, CO<sub>2</sub> emission reductions in the overall fleet will largely be attributed to a variety of powertrain and efficiency improvements, and an increase in the availability of hybrid vehicle platforms.<sup>27</sup>

Regarding alternative fuels other than electricity and hydrogen, the LEV III staff analysis does not project that CNG vehicles will be a significant strategy for LEV III GHG regulatory compliance. Similarly, utilization of E85 fuel by FFVs was not assumed in the projected analysis of LEV III GHG compliance; however, the LEV III staff report includes a proposal for allowing automakers to petition to use E85-capable FFVs for LEV III compliance. To petition, an automaker must submit verifiable data of E85 usage by their vehicles in California. In evaluating this petition, ARB would apply the average Low Carbon Fuel Standard (LCFS) rating of the E85 ethanol consumed that year to determine the GHG rating of the E85 vehicles.

The LEV III staff report also notes that there are many uncertainties about the amount of E85 fuel that will be used, E85 refueling availability, whether E85 owners know their vehicles are E85-capable, and reliable data-tracking about actual real-world E85 usage. As discussed in Appendix C of this staff report, the price of E85 will also affect the amount of E85 dispensed such that it must be priced proportionately lower than gasoline to persuade FFV drivers to choose E85 over gasoline.

Staff's proposal to make CFO ZEV-only is in line with the ZEV and LEV III regulations: LEV, being primarily focused on technology and efficiency improvements in conventional vehicles, does not rely on additional alternative fuels for compliance; and

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<sup>27</sup> Section III of "Staff Report: Initial Statement of Reasons for proposed rulemaking, public hearing to consider the "LEV III" amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emissions Standards and Test Procedures, and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-duty Trucks, and Medium-duty Vehicles, and to the Evaporative Emission Requirements for Heavy-duty Vehicles." Dec. 8, 2011.

the ZEV regulation, which is focused on commercializing plug-in and fuel cell electric vehicles, will rely in the successful build out of retail hydrogen stations and, possibly, public charging stations, for compliance.

#### 4. Charging Infrastructure Needs Assessment

The proposed changes would add a placeholder for electricity in the definition of designated clean fuel, and add section 2302(c) which details the components and timeframe of an electric vehicle charging infrastructure needs assessment. The assessment will involve evaluating the development and usage of workplace and public charging infrastructure to determine if additional public charging is needed, what types of public charging would have the highest likelihood of increasing zero-emission vehicle miles traveled by full function battery electric vehicles and plug-in hybrids, and the associated environmental and economic impacts. The assessment would also include further recommendations on whether a charging infrastructure mandate is warranted and, if so, a timeline for a regulatory proposal.

#### 5. Estimating the number of Clean Fuel Vehicles

Staff is proposing several changes to the methodology for estimating the number of clean fuel vehicles that would trigger activation of the regulation. Proposed changes include the following:

##### a) *Modifying the test procedure reporting requirement*

The California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles is the authority cited in Section 2303(a) of the CFO regulation that requires automakers to provide ARB with alternative fuel vehicle production plans. To provide ARB with the additional information needed to plan for hydrogen infrastructure, staff is proposing to modify the alternative fuel vehicle reporting requirements to include additional reporting for ZEVs certified on hydrogen fuel.

These changes for FCVs will require automakers to submit FCV projections for three model years into the future instead of two, include FCV placement numbers by air basin, and submit this data by March 1 every year (instead of June 1). FCV projections by air basin will be used by ARB to determine if the regulation should be activated within an air basin as discussed below. The automaker projections required under this modification will eliminate the need to conduct the annual automaker FCV surveys detailed in Section I B 1.

b) *Modify the calculations in section 2303(b)(1)*

To estimate the number of ZEVs certified on hydrogen three model years into the future, staff is proposing to use the data submitted by the automakers discussed above and modify the procedure in section 2303(b)(1) to include:

The sum of:

- [i] The projections for ZEVs certified on hydrogen for the year for which the estimates are being made plus ~~one~~two prior model years. For example, calculations done in 2012 to estimate the number of vehicles in 2015 would include total projected numbers of model year 2015, 2014 and 2013 vehicles.
- [ii] One ~~sixth~~third of the number of ZEVs certified on hydrogen projected for the model year that is ~~two~~three years prior to the year for which the estimates are being made. Following the example above, this would be one third of the model year 2012 projections.
- [iii] The number of ZEVs certified on hydrogen that are registered with the DMV through ~~July 30~~May 31 of the year three years prior the year for which the estimates are being made. This would include all vehicles registered through May 31, 2012, following the above example.

As a result, the change to [i] adds one more model year to the estimate. Changing registered vehicles included in the sum in [iii] to include those registered through May 31 instead of July 31 accounts for staff's proposal to move the compliance timeframe up. By doing this, it becomes necessary to increase the fraction of projected vehicles in [ii] to account for the fact that fewer of the projected vehicles will be sold or leased and therefore, not reflected in the DMV records.

6. Lower Regional Activation Trigger

The proposed changes include adding a lower vehicle trigger of 10,000 to section 2303.5(a) that would be applied within an air basin in the early years, before the statewide trigger of 20,000 vehicles is reached. The lower regional trigger captures automakers' desire to deploy fuel cell vehicles in regional clusters, as discussed in Section I B 1. Based on what we know today about automaker deployment plans for fuel cell vehicles, the South Coast air basin would very likely be where the regional trigger would be first applied.

The notion of a 10,000 vehicle regional trigger is not new. When the CFO regulation was first being developed, staff proposed a 10,000 vehicle trigger for the South Coast

air basin that would have applied from 1994 to 1996, and a 20,000 vehicle statewide trigger that would apply from 1997 on.<sup>28</sup> The 10,000 vehicle trigger was removed from the final regulation and both triggers were set at 20,000, primarily to address concerns raised by the regulated party about being able to adequately recover their costs. Automakers expressed an opposing concern – that a 10,000 South Coast trigger was too *high*. They reasoned that most customers would not be willing to take the risk of buying an alternative fuel vehicle unless they are assured clean fuel. They also reasoned that automakers would not want to risk developing and producing cars for which there is no fuel. ARB countered automakers concerns with the conclusion that “the widespread availability of clean fuel will not be a prerequisite for consumers to purchase these vehicles” because ARB “expects that most of the clean fuel vehicles, particularly in the early years, will be FFVs.”<sup>29</sup>

However, the rationale for using the higher 20,000 vehicle trigger presented during the original CFO development cannot be applied to dedicated clean fuel vehicles (i.e., those that operate solely on clean fuel). The argument made by automakers for the lower trigger back in 1990 can be made today; validating the important role that fueling infrastructure plays when customers are considering purchasing an alternative fuel vehicle. If government and private commitment to invest in hydrogen infrastructure were sufficient to support the first 20,000 vehicles, there would be no reason to create a lower regional trigger (or activate the regulation if the lower trigger were in place). State funded stations are sufficient to establish an early network to support the first commercial vehicle placements. However, they will not be able to keep pace with the vehicle deployments projected to exceed the 10,000 threshold in the South Coast Basin in 2015.

## 7. Determining Required Number of Clean Fuel Outlets

As discussed in Section I A, the process for determining the required number of CFOs involves first estimating the total projected maximum volume (TPMV) for the year, then dividing that number by a per station clean fuel throughput volume. Staff is proposing the following three changes to this process.

### a) *TPMV calculations*

Staff is proposing minimal changes to the TPMV calculations in section 2303(c). TPMV is the estimated demand of clean fuel required during the year for which the calculations are being made. It includes the sum of estimated maximum demand volumes for each

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<sup>28</sup> ARB, 1990. “Staff Report: Proposed Regulations for Low-Emission Vehicles and Clean Fuels.” August 13, 1990.

<sup>29</sup> ARB, 1991. “Final Statement of Reasons: Proposed Regulations for Low-Emission Vehicles and Clean Fuels.” July 1991. Pg. 113.

vehicle class and model year. Staff is only proposing to change the oldest model year vehicles included in the calculation from 1994 to 2000. Since the regulation is being modified to include ZEVs, primarily FCVs,<sup>30</sup> this change is justified by the fact that there is no pre-2000 FCVs in operation.

b) *Conversions*

The current regulation includes estimated fuel demand from vehicle conversions in the formula in section 2304(a)(1) for determining the required number of CFOs.

Staff is proposing to exclude conversions from the formula because, unlike natural gas conversions, there are no companies currently involved in the aftermarket conversion of conventional vehicles to ZEVs that use hydrogen. All hydrogen powered FCVs will be created by automakers in response to our ZEV regulation requirements, and fuel demand from these cars will be included in the TPMV calculation above. Conversions for FCVs, if any, would play a very minimal role in the future fleet – it does not make sense economically to convert and certify an existing vehicle into an FCV when compared to buying or leasing a new FCV from an automaker.

c) *Per station throughput volume*

The proposed changes include reducing the per station clean fuel throughput volume used in the formula in section 2304(a)(1) for calculating the required number of CFOs for gaseous fuels (in terms of hydrogen gas, the existing volume of 400,000 therms/year is the same as 351,600 kilograms/year [kg/y]).<sup>31</sup>

Staff is proposing to reduce this value to 146,000 kg/y to account for the reduced per mile fuel consumption of hydrogen based on the following rationale. As mentioned earlier, there is an underlying assumption in the existing regulation that one gallon equivalent of an alternative fuel will allow one to travel the same distance as a gallon of gasoline on an energy equivalent basis. However, the LCFS recognizes that certain vehicle technologies and alternative fuels offer significant fuel consumption benefits that are not reflected when comparing fuels solely by their energy content.<sup>32</sup> For this reason, LCFS uses an energy economy ratio (EER)<sup>33</sup> when calculating carbon intensity values of alternative fuels. The EER is also a ratio of the per mile fuel consumption of an alternative fuel vehicle compared to that of a conventional gasoline or diesel vehicle,

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<sup>30</sup> In the future, this regulation could be modified to include charging and battery electric vehicles.

<sup>31</sup> The accepted way of measuring hydrogen gas used for transportation is kilograms, which represents hydrogen's energy density of 120 mega joules per kilogram on a lower heating value basis.

<sup>32</sup> ARB, 2009b. "Staff Report: Initial Statement of Reasons for Proposed Regulation to Implement the Low Carbon Fuel Standard." March 5, 2009.

<sup>33</sup> EER is also known as a Fuel Displacement Factor in the LCFS to account for the amount of gasoline or diesel that is displaced by the use of an alternative fuel.

and provides a more accurate way to compare fuels and fuel pricing than energy content alone.

Proposed modifications include changing the EER for hydrogen to 2.5 based on most recent available fuel consumption data for FCVs.<sup>34</sup> Using 2.5 to adjust the throughput volume for gaseous hydrogen would reduce it to 140,640 kg/y. Staff's proposal to reduce the throughput volume for hydrogen to 146,000 kg/y, which represents a 400 kg/day station, reflects the fuel consumption benefits of hydrogen.

Staff is also proposing to eliminate from this calculation the provision to double the clean fuel throughput volume when more than five percent of all retail gasoline outlets are required to dispense a particular liquid clean fuel. This change recognizes that the decision to increase a station's capacity should be based on fuel demand and a business case, which ensures that the station owner sees a return on their investment. As such, staff is proposing to sunset the regulation at five percent as discussed later in this report.

#### 8. Change how requirements are distributed based on market share

Staff is proposing the following changes to how the retail outlet requirements are distributed among regulated parties:

##### a) *Market share vs. minimum ownership level*

The proposed amendments include replacing section 2306, which establishes regulated party responsibility based on the number of retail gasoline outlets each owns, with the new section 2306.5. This new section requires the Executive Officer to annually calculate each refiner/importer's market share by dividing their total gasoline production and imports for the two consecutive calendar years by the sum of gasoline production and imports for the same calendar years. The data source for these calculations will be State Board of Equalization's Motor Vehicle Fuel Distribution reports<sup>35</sup> and will include the most recent data for which two consecutive calendar years is available.

This amendment will ensure that those refiner/importers that have the largest stake in supplying gasoline to the California market have a commensurate role in developing the state's hydrogen infrastructure.

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<sup>34</sup> ARB, 2011a. Proposed Regulation Order "Subchapter 10. Climate Change, Article 4. Regulations to Achieve Greenhouse Gas Emission Reductions, Subarticle 7. Low Carbon Fuel Standard." <http://www.arb.ca.gov/fuels/lcfs/regamend/101411regorder.pdf>. Oct. 14, 2011.

<sup>35</sup> State Board of Equalization Monthly Motor Vehicle Fuel Distribution Reports, <http://www.boe.ca.gov/sptaxprog/spftrpts.htm>.

b) *Allocating retail station requirement by market share*

The proposed amendments include minor modifications to section 2307 to reflect the above change. Section 2307(a) determines the number of new retail outlets each refiner/importer must install in the year by multiplying their market share by the required number of new outlets calculated per section 2304(b), rounding to the nearest integer. If the product is less than 0.5, that refiner/importer is not required to install a CFO in the year for which the calculations are being made.

9. Tools for Evaluating Proposed Outlet Locations

The proposed amendments include updating the types of existing stations deemed to satisfy the station location criteria in section 2309(a) to include any retail clean fuel outlet that was equipped to dispense a designated clean fuel and received funding from the State to do so prior to January 1, 2015.

The proposed changes also include adding the option to use modeling tools to section 2309(a)(2) to help identify geographic areas where additional outlets are needed as well as evaluate the locations proposed by the regulated parties. The purpose of this addition is to help identify outlet locations that would best meet drivers' fueling needs and, in turn, result in greater outlet usage and faster return on investment for the owner. An example of such as model is the Spatially & Temporally Resolved Energy & Environmentally Tool (STREET) model developed by the Advanced Power and Energy Program at the University of California at Irvine (UCI).<sup>36</sup> This model is capable of evaluating possible station locations based on vehicle densities and travel times, and identifying areas where stations could be best placed for customer convenience and high utilization. Also of potential use is the near-term analysis of hydrogen vehicle roll-out scenarios developed by the Institute of Transportation Studies at the University of California at Davis.<sup>37</sup>

The proposed modifications also include a slight change in how existing clean fuel outlets that are owned or leased by someone other than a regulated party are considered when determining the required number of new outlets. The current section 2304(a)(2)(C) requires that, for existing outlets to be counted toward the total, they must be operating for 15 months before the start of the year. Staff is proposing that, for existing outlets to count, they must certify that they will operate throughout the

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<sup>36</sup> UCI, 2011. University of California, Irvine. UCI Advanced Power and Energy Program. "STREET: Determining Hydrogen Fueling Station Needs in Targeted Communities." July 13, 2011.

<sup>37</sup> UCD, 2010. University of California, Davis. Nicholas, Mike, and Joan Ogden. UCD Institute of Transportation Studies. "An Analysis of Near-Term Hydrogen Vehicle Rollout Scenarios for Southern California." Jan. 29, 2010.

compliance year. Staff is also proposing to change the definition of compliance year to mean the calendar year – January 1 through December 31.

#### 10. Extending the Timeline for Compliance

The proposed changes include adding approximately 14 months to the compliance timeline from the point when the regulated parties are notified of their compliance obligation to when they must have operating stations. The main reason for adding 14 months to the timeline is to account for the extra time required to site, permit, secure equipment and construct early hydrogen fueling stations when compared to other types of alternative fueling stations. Table II-2 illustrates how this change will affect the various reporting and compliance aspects of the regulation.

**Table II-2: Proposed Timeline for Notifications and Compliance Requirements**

Section	Requirement: Existing and Proposed	Due date and months prior to January 1 of Year A	
		Existing	Proposed
2311.5	<p><u>Existing:</u> On or before this date, Executive Officer (EO) shall identify if the trigger has a <i>substantial possibility</i> of being reached in Year A. If so, EO notifies regulated parties and ZEV fleet operators that the trigger may be reached in Year A and what their reporting requirements would be.</p> <p><u>Proposed:</u> Move initial notification timeframe up 12 months to give regulated parties additional lead time to prepare for compliance.</p>	Mar. 1, A-2 22 months	Mar. 1, A-3 34 months
LEV Test Procedure	<p><u>Existing:</u> Automakers submit reports of sales to date and projected AFV sales 19 months prior to January 1 of Year A.</p> <p><u>Proposed:</u> Modify LEV test procedure to require projected sales and leases of vehicles that use hydrogen 33 months prior to January 1 of Year A. Add requirement to include the air basins where manufacturers plan to deliver their hydrogen vehicles for sale or lease.</p>	June 1, A-2 19 months	April 1, A-3 33 months
2313	<p><u>Existing:</u> If EO determines that reaching the trigger for first time is likely in Year A, fleet operators respond to Section 2311.5 and supply EO with AFV fleet and fueling information.</p>	June 30, A-2 18 months (same for both)	May 1, A-3 32 months
2304(a)(2) (B)	<p><u>Existing:</u> EO revises fleet discount factor, if necessary, based on input provided per Section 2313 or other relevant info.</p> <p><u>Proposed:</u> Move fleet reporting timeframe up 14 months and EO revision time up 13 months to provide adequate opportunity and analysis for adjusting fleet discount factors.</p>		June 1, A-3 31 months

**Table II-2 (Continued)**

2303.5(b)	<p><u>Existing:</u> EO identifies fuel for vehicles that are projected to reach trigger for the first time. OEM projections through model year A plus DMV registration data through July 31, A-2 used in this calculation</p> <p><u>Proposed:</u> Add 14 months to include DMV registration data through May 31, Year A-3 and an additional year to automaker projections.</p>	Sept. 1, A-2 16 months	July 1, A-3 30 months
2303.5(c)  2304	<p><u>Existing:</u> EO issues final trigger determination and fleet discount factor.</p> <p><u>Existing:</u> EO calculates maximum demand volume (Section 2303(c)), determines total number of required CFOs, and required new CFOs.</p> <p><u>Proposed:</u> Move the review and decision-making process up 15 months.</p>	Nov. 1, A-2 14 months (same for both)	Aug. 1, A-3 29 months (same for both)
2312	<p><u>Existing:</u> By this date following the EO notification made pursuant to 2311.5 and July 31 thereafter, owner/lessors must report total number of retail gasoline stations in the state of which they are the owner/lessor.</p> <p><u>Proposed:</u> Move requirement to respond up 12 months, similar to section 2311.5, to give EO sufficient time to quantify station ownership by refiner/importers.</p>	July 31, A-2 17 months	Aug. 1, A-3 29 months
2306 Repeal  2306.5 Add	<p><u>Existing:</u> EO calculates a minimum ownership level determining which regulated parties are required to equip outlets to dispense clean fuel based on the number of gasoline stations they own.</p> <p><u>Proposed:</u> EO calculates market share, expressed in percentage, that will be used (in Section 2307) to determine the number of new CFOs required by each major refiner/importer</p>	Nov. 1, A-2 14 months	Aug. 1, A-3 29 months
2304(a)(2) (D)  2307(e)	<p><u>Existing:</u> EO issues notice of adjustments to the number of outlets made pursuant to Section 2304(a)(2)(C)2.</p> <p><u>Existing:</u> EO notifies each affected regulated party in writing of their required minimum number of CFOs.</p> <p><u>Proposed:</u> Move adjustment and notification timeframe up 14 months.</p>	Nov. 1, A-2 14 months	Sept. 1, A-3 28 months
2304(a)(2) (E)	<p><u>Existing:</u> EO considers requests, if any, to revise adjustments made pursuant to Section 2304(a)(2)(C)2, and makes final determination on those adjustments.</p> <p><u>Proposed:</u> Move adjustment determination up 14 months.</p>	Jan.1, A-1 12 months	Nov.1, A-3 26 months

**Table II-2 (Continued)**

<p>2309(a)(2)</p> <p>2309(a)(2) (A) &amp; (B) Added</p>	<p><u>Existing:</u> Regulated party submits to the EO its proposed CFO locations and optional locations (representing 20% of their total requirement). Proposal may include constructively allocated stations per Section 2308. Following the submittal, regulated parties shall consult with ARB on optimal locations for new outlets.</p> <p><u>Proposed:</u> Move submittal time up 14 months; change the amount of required optional locations to 40% of their total requirement. Add the option for ARB to employ modeling tools to evaluate fuel infrastructure scenarios and proposed locations.</p>	<p>Apr. 30, A-1 8 months</p>	<p>Mar. 1, A-2 22 months</p>
<p>2309(a)(3)</p>	<p><u>Existing:</u> Regulated party notifies EO of their final locations for all new outlets for Year A.</p> <p><u>Proposed:</u> Move notification up 14 months.</p>	<p>July 1, A-1 5 months</p>	<p>June 1, A-2 19 months</p>
<p>2302(a)</p>	<p><u>Existing:</u> Each regulated party equips its required number of retail CFOs for the entire compliance year (defined as the 12 month period running from May 1, Year A through April 30, Year A+1). Regulated parties have nine months from finalizing their locations to when their outlets need to be operational.</p> <p><u>Proposed:</u> Change compliance year to represent calendar year A, giving the regulated party 19 months from finalizing their locations to when their outlets need to be operational.</p>	<p>May 1, Year A -4 months</p>	<p>Jan. 1, Year A 0 months</p>

In the future, when the process can be accelerated due to shared learning experiences, permit streamlining and economy of scale benefits, the extra 12 months may not be necessary.

## 11. Compliance Requirements

The proposed amendments to the compliance requirements include modifying the minimum dispensing requirements of section 2302(b) for gaseous fuels to include fueling at two pressures (5000 and 10,000 psi) to meet the needs of FCVs projected for deployment. The proposed amendments refer to the Society of Automotive Engineers standard J2601, “Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles,”<sup>38</sup> as the required fueling protocol.

The proposed amendments to section 2309 include consolidating the responsibilities that are currently allocated among owner/lessors and suppliers (section 2309(b) and

<sup>38</sup> SAE, 2010. Society of Automobile Engineers. “Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles.” SAE standard J2601. March 16, 2010. Accessed November 8, 2011.

(c)), and operators (section 2310) into one set of requirements assigned to the affected refiner/importers.

Modifying the compliance requirements to be more like performance standards recognizes the refiner/importers as the responsible party for ensuring that stations are built, maintained, and operated to meet the minimum requirements of sections 2302(b) and 2309(b). Some have expressed concern that refiner/importers are not in a good position to develop and operate retail hydrogen fueling infrastructure because they have divested most or all of their retail assets. However, three major refiner/importers, through their participation in the DOE Hydrogen Program, have demonstrated competence in developing and maintaining hydrogen fueling stations.<sup>39</sup> One refiner/importer is currently operating two hydrogen fueling stations in Southern California. Also, the constructive allocation provision (section 2308) allows station operators who are not refiner/importers to allocate their outlet toward the compliance requirements of a regulated party through constructive allocation agreements.

## 12. Violations

The proposed amendments to section 2315 account for shifting the outlet compliance requirements to refiner/importers as proposed above. The proposal includes eliminating one of the mechanisms for assessing penalties in sections 2315(a) and (b) – the one based on the first five or ten conventional vehicles fueled with gasoline each day by the regulated party - and simply assesses daily fines. The proposed changes also include citing Health and Safety Code sections 43027 and 43028 as the appropriate penalty statutes for non-compliance. With these changes, violating the regulation by willfully failing to install the required number of CFOs could result in penalties that may not exceed \$250,000 per station per day. Violations due to negligence could result in penalties that may not exceed \$50,000 per station per day.

The proposed amendments add a penalty (section 2315(d)) that could be assessed on automakers. The penalty would apply to automakers that knowingly provide false information in their vehicle projections submitted pursuant to the test procedure reporting requirements discussed earlier in this section. In addition, each automaker that fails to deliver for sale or lease at least 80 percent of their projected number of vehicles by the end of the calendar year for which the projections are being made would be fined \$35,000 according to Health and Safety Code section 42402.5. The reason for adding this provision is to address concerns raised by refiner/importers that stations

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<sup>39</sup> USDOE, 2006. United States Department of Energy. US DOE Hydrogen and Fuel Cells Program. "2006 Annual Merit Review and Peer Evaluation Report, Technology Validation." [http://www.hydrogen.energy.gov/annual\\_review06\\_report.html](http://www.hydrogen.energy.gov/annual_review06_report.html). Accessed Nov. 10, 2011.

may be underutilized if automakers do not actually deliver the approximate number of vehicles they projected.

### 13. Breakdown of Dispensing Equipment-Release from Liability

The proposed amendments to section 2311 regarding major breakdowns of dispensing equipment include requiring that the equipment be prepared within one month instead of six months. With the limited amount of infrastructure available to fuel cell vehicle drivers, six months of station downtime would be too disruptive. Additionally, fuel and technology providers possess the necessary capabilities to repair stations, and have the ability to provide temporary fueling, such as mobile refuelers, in the event of equipment breakdown.

### 14. Sunset provision

The proposed amendments would include reducing the threshold for sunsetting the requirements. No new outlets would be required when the number of outlets offering a particular clean fuel reaches five percent of the total number of retail gasoline stations in the state. Staff applied the following rationale for changing the sunset threshold from ten to five percent.

The rationale for the 10 percent sunset threshold, discussed in Section I A 9, may still be valid today but may not be necessary for hydrogen infrastructure. Comments submitted at a March 2011 AB 118 advisory committee meeting<sup>40</sup> suggest that increasing vehicle deployments and major technological improvements to the processing and delivery of transportation hydrogen will make hydrogen cost competitive with traditional fuels. As the five percent station threshold is approached, the number of new vehicles sold or leased is expected to increase more rapidly in terms of absolute numbers. More FCVs create greater demand for hydrogen. In addition, the development of light weight, high pressure delivery vehicles allow for the consolidation of several steps of the supply chain into a central production location, thereby increasing cost effectiveness, potentially reducing the initial cost of a station from over \$2 million to less than \$1 million. With nearer term and potentially higher ROI, it is anticipated that more station operators will be attracted to the retail hydrogen market independent of the CFO regulation.

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<sup>40</sup> CEC, 2011b. California Energy Commission. Transcript: "Advisory Committee Meeting before the California Energy Resources Conservation and Development Commission in the matter of: Alternative and Renewable Fuel and Vehicle Technology Program," Sacramento, California, March 7, 2011, [http://www.energy.ca.gov/2010-ALT-1/documents/2011-03-07\\_meeting/2011-03-07\\_Transcript.pdf](http://www.energy.ca.gov/2010-ALT-1/documents/2011-03-07_meeting/2011-03-07_Transcript.pdf).

## 15. Substitute Fuels

The proposed amendments include removing section 2317, which allows one to petition ARB to designate a substitute fuel that could be used instead of the primary designated clean fuel on which a ZEV was certified. The primary reason for removing this section is that it cannot be applied to hydrogen fuel cell vehicles, which are designed to operate only on high purity hydrogen gas. If another type of FCV is introduced that can operate on something other than hydrogen, that vehicle would be considered a different type of designated clean fuel vehicle.

### **B. Alternatives Considered**

Several options were considered while developing this CFO regulatory proposal including keeping the CFO regulation as-is (no action) and non-regulatory options such as incentives and binding agreements. Each alternative is presented below and evaluated in the context of the primary objective to ensure that adequate hydrogen infrastructure is developed to support fuel cell vehicle commercialization.

#### 1. No Action

With the “no action” alternative, the CFO regulation would remain as-is requiring the larger owner/lessors of retail gasoline outlets to equip their outlets with designated clean fuels once the designated clean fuel vehicles reach 20,000 after applying the fleet vehicle discount. Required fuels may include CNG, hydrogen, and potentially, E85.

There are several limitations with the no action alternative. First, as discussed in Section II A, the regulation originally targeted the fuel providers who, at the time, also owned or otherwise controlled most of the state’s retail gasoline outlets. Now, fuel providers have divested most of their retail outlets. Three major refiner/importers of gasoline would share the compliance burden with three convenience store and super market chains in the early years, and the other four major refiner/importers would not be brought into the regulation until later, if at all. This would likely result in even more entities divesting from the retail gasoline market thereby thinning the pool of regulated parties and stations. With the growing trend of retail gasoline stations shifting to independent small business owners, the number of entities capable of financing the development of alternative fueling stations will continue to shrink.

Second, for dedicated clean fuel vehicles that can only operate on the designated clean fuel, a 20,000 vehicle trigger is unattainable if existing and planned infrastructure is insufficient to support vehicle population growth to 20,000.

Third, much has changed since the adoption of the CFO regulation. Namely, conventional fuels and vehicle technologies have advanced such that alternative fuels are not needed to achieve LEV standards. All of the major automakers are supplying conventional vehicles that achieve the most stringent LEV emission standard today. Therefore, by keeping the regulation as-is and requiring CFOs for all alternative fuels would result in additional costs for compliance without air quality benefits.

## 2. Low Carbon Fuel Standard Credit Multiplier for Hydrogen

Staff considered an alternative to the CFO regulation to incentivize hydrogen station development by using a credit-multiplier approach within the Low Carbon Fuel Standard (LCFS). Regulated parties can earn credits in the LCFS program by providing transportation fuels that have lower carbon intensities (CIs) than the gasoline or diesel standard currently in effect. CI takes into account the greenhouse gas (GHG) emissions from the production, transport, and use of a transportation fuel. If used as a transportation fuel, hydrogen would receive LCFS credits because its CI is well below the annual CI requirements of the LCFS. A credit-multiplier would give hydrogen additional credits, thereby increasing its value as a low-CI transportation fuel and incenting its use.

Potential drawbacks of a multiplier incentive include: a reduction in the benefits of the LCFS program; setting a precedent for other fuels to request a multiplier, further reducing LCFS benefits; and possible conflicts with AB 118 funding. Although analysis shows that a multiplier could potentially cover some portion of the cost to build a hydrogen station, stakeholders cite the uncertainty in future credit value as a significant drawback to this approach. Refiner/importers also commented that their need to rely on credits derived from ZEV fuels will not likely occur until 2015 or later, which may not result in the increase in operating stations needed by 2015. Staff will continue to analyze the potential of a credit multiplier incentive; however, at this time staff believes the LCFS multiplier would not be an effective incentive approach for the reasons listed above. Since the automakers need certainty that hydrogen fueling stations will be available to commercially launch FCVs, an incentive that does not have considerable interest from LCFS-regulated parties was deemed insufficient to ensure station deployment.

## 3. Market Protection Licenses

Staff also considered an alternative that would involve issuing “licenses” to hydrogen providers who installed stations early, before there is sufficient demand to justify a business case. Under this alternative, a provider who installs the first station in a defined geographic area would be the only provider for that area for a defined period of

time. Competitors could not build hydrogen stations in that area until the license holder is able to gain a return on their investment. Protection against competition by licensing would reward the license holder for taking the early risk by installing and maintaining hydrogen stations when demand is low and a positive cash flow is uncertain. This concept is similar to licenses that are issued private taxicab companies in New York by the New York City Taxi and Limousine Commission. Licensed taxicab companies must abide by the requirements of the commission, and only licensed cabs can operate in New York City.<sup>41</sup> The licenses would have been of limited duration to allow free market growth once a sufficient number of FCVs were on the road.

While some hydrogen providers viewed this proposal positively, it did not generate adequate interest to justify further pursuit.

#### 4. Memorandum of Agreement

Staff and stakeholders have been exploring an alternative to the CFO regulation involving a multiparty agreement to supply hydrogen stations to meet fuel cell vehicle fueling needs. Such an agreement, possibly executed through a Memorandum of Agreement (MOA) could lay out a framework for interactions between the regulated parties, retail gasoline stations, hydrogen fuel providers, automakers and government to establish hydrogen stations during the crucial early market ramp up period. The advantage of such an agreement would be shared understanding and purpose among the participants regarding timing, location and functionality of hydrogen stations. Ideally, an MOA would include specific, enforceable commitments for meeting hydrogen demand needs within a specified timeframe. ARB staff continues to work on development of an MOA with stakeholders, in parallel to the regulatory effort. All parties recognize that a mutually agreed upon process for ensuring hydrogen infrastructure is preferable to a regulatory mandate; however, if an agreement cannot be reached or if it cannot be developed in time to meet vehicle fueling needs, the proposed regulatory amendments will remain necessary.

### **C. Comparable Regulations**

State and federal regulations pertaining to the advancement of alternative transportation fuels, both prescriptive and performance-based, are in affect today. California's Low Carbon Fuel Standard and the federal Renewable Fuels Standard are summarized below and compared to the Clean Fuels Outlet regulation and proposed amendments.

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<sup>41</sup> NYC Taxi, 2011. New York City Taxi & Limousine Commission. Website. [http://www.nyc.gov/html/tlc/html/licenses/medallion\\_main.shtml](http://www.nyc.gov/html/tlc/html/licenses/medallion_main.shtml). Accessed Nov. 10, 2011.

## 1. Low Carbon Fuel Standard

The 2009 LCFS regulation requires producers and importers of transportation fuels to ensure that the mix of fuel they sell into the California market meets, on average, a declining standard for lifecycle GHG emissions measured in grams CO<sub>2</sub>-equivalent per unit of fuel energy sold. The LCFS is a performance standard that allows fuel providers to choose how they reduce GHG emissions while responding to consumer demand. By 2020, the LCFS requires a 10 percent reduction in the carbon intensity of all passenger vehicle fuels sold in California relative to the gasoline baseline.

Today, most parties regulated under LCFS are complying by blending biofuels, primarily ethanol, with conventional fuels for use in conventional vehicles. Even though ethanol producers are finding it challenging to reduce the lifecycle carbon emissions of ethanol over time, regulated parties have viewed E85 as the light-duty vehicle fuel substitute with the most potential to achieve the greatest carbon reductions at the least cost.

While, hydrogen on a unit energy basis, has a significantly lower carbon intensity compared to gasoline, parties regulated under LCFS are not currently choosing hydrogen as a compliance path due in part to high cost of infrastructure and low number of vehicles. LCFS only provides compliance credits through actual fuel sales. In the early vehicle deployment years, hydrogen infrastructure needs to lead FCV placements to provide confidence that fuel will be available. Early hydrogen infrastructure will likely be underutilized, therefore making it difficult for a regulated party to earn sufficient compliance credits.

## 2. Federal Renewable Fuels Standard

The Renewable Fuels Standard, which was updated in 2007 (see discussion in Appendix C), requires the use of biofuels in transportation fuels.<sup>42</sup> By 2022, a minimum of 36 billion gallons of biofuels must be used annually for transportation in the United States. Because the Renewable Fuels Standards applies specifically to liquid fuels, regulated parties today do not have an option to use renewable ZEV fuels, such as electricity or hydrogen, for compliance.”

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<sup>42</sup> Federal Register, National Archives and Records Administration, March 26, 2010, pages 14669-15320 <http://edocket.access.gpo.gov/2010/pdf/2010-3851.pdf>

### III. Emissions and Health Impacts

This section presents the environmental analysis of the benefits and impacts associated with the implementing of the CFO regulation. Included within is a summary of the Environmental Impact Analysis completed for the Advanced Clean Cars program with the complete environmental analysis in Appendix B. Next is a summary of the Emissions Impacts Analysis, which focuses on estimating how Greenhouse Gas (GHG) emissions and local criteria pollutant emissions would change due to the displacement of petroleum-based fuels by hydrogen used in fuel cell vehicles. The detailed emissions analysis presented in Appendix D.

#### A. Environmental Impact Analysis

ARB is the lead agency for the proposed regulation and has prepared an environmental analysis pursuant to its certified regulatory program. The California Environmental Quality Act (CEQA) at Public Resources Code section 21080.5 allows public agencies with regulatory programs to prepare a plan or other written document in lieu of an environmental impact report or negative declaration once the Secretary of the Resources Agency has certified the regulatory program. ARB's regulatory program has been certified by the Secretary of the Resources Agency.<sup>43</sup> As required by ARB's certified regulatory program for the proposed regulations, the environmental analysis is included in the Staff Report: Initial Statement of Reasons (ISOR) for the rulemaking.<sup>44</sup>

Appendix B to the Staff Report is an Environmental Analysis (EA) that provides an evaluation of the potential for environmental impacts associated with the proposed Advanced Clean Cars (ACC) Program. The proposed ACC Program consists of amendments to The Clean Fuels Outlet (CFO) regulation as well as amendments to the Low-Emission Vehicle (LEV III), the E-10 Fuels Certification, Environmental Performance Label (EPL), and the Zero Emission Vehicle (ZEV) regulations. Three separate Regulatory Notices and Staff Reports have been prepared for these proposed amendments. A single coordinated analysis of the potential environmental impacts is analyzed in Appendix B. The EA assesses the potential for significant long or short term adverse environmental impacts associated with the proposed actions and an analysis of those impacts.<sup>45</sup> In accordance with ARB's regulations, the EA also describes any beneficial impacts.<sup>46</sup> The resource areas from the state CEQA

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<sup>43</sup> State CEQA Guidelines section 15251 (d); California Code of Regulations (CCR), title 17, sections 60005-60008.)

<sup>44</sup> CCR section 60005.

<sup>45</sup> CCR section 60005, subd (b).

<sup>46</sup> CCR 60005, subd. (d).

Guidelines environmental checklist were used as a framework for assessing potentially significant impacts.<sup>47</sup>

If comments that are received during the public review period raise significant environmental issues, staff will summarize and respond to the comments in writing. The written responses will be included in the Final Statement of Reasons (FSOR) for the regulation. In accordance with ARB certified regulatory program, prior to taking final action on the proposed regulation, the decision maker will approve the written responses.<sup>48</sup> If the regulation is adopted, a Notice of Decision will be posted on ARB's website and filed with the Secretary of the Natural Resources Agency for public inspection.<sup>49</sup>

## **B. Environmental Justice Outreach**

The ARB has made the achievement of environmental justice an integral part of its activities. State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies.

The Board approved Environmental Justice Policies and Actions (Policies) on December 13, 2001. These Policies establish a framework for incorporating environmental justice into the ARB's programs consistent with the directives of State law. The Policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

### **1. Outreach to Minority and Low Income Communities**

Staff conducted workshops in communities with environmental justice concerns. The dates of all the workshops were as follows:

<b>Date</b>	<b>Location</b>
July 12, 2011	Fresno
July 19, 2011	Pacoima
July 26, 2011	Oakland

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<sup>47</sup> State CEQA Guidelines, Appendix G.

<sup>48</sup> CCR 60007, subd (a).

<sup>49</sup> CCR 60007, subd. (b).

Each of the three workshops included an expert panel with opening remarks from a local community leader. The panels included one expert that focused on background information and environmental impacts of air pollution, one expert in the medical field that focused on the health impacts of air pollution, one expert from the American Lung Association of California that discussed its report titled “The Road to Clean Air,” and in some workshops also had an expert speak about local concerns. For instance, in Fresno, one speaker addressed agriculture impacts of climate change. Having local community members and leaders participate in the workshops was greatly appreciated and added value and a local context to ARB's presence in these communities. After community members heard from the panel members, staff presented information about the advanced clean cars regulations and the CEQA scoping process.

There were a number of different comments and concerns expressed at each workshop and staff was able to engage in a constructive dialogue with attendees about many air quality and climate change related issues.

In general, community leaders and community members were very supportive of the work ARB is doing to take steps to reduce emissions from passenger cars and light-duty trucks.

### **C. Emissions Impact Analysis**

The following describes the assumptions and modeling protocol used to estimate emissions associated with supplying compressed hydrogen gas to increasing numbers of fuel cell vehicles, followed by a summary of the analysis results.

#### **1. Assumptions**

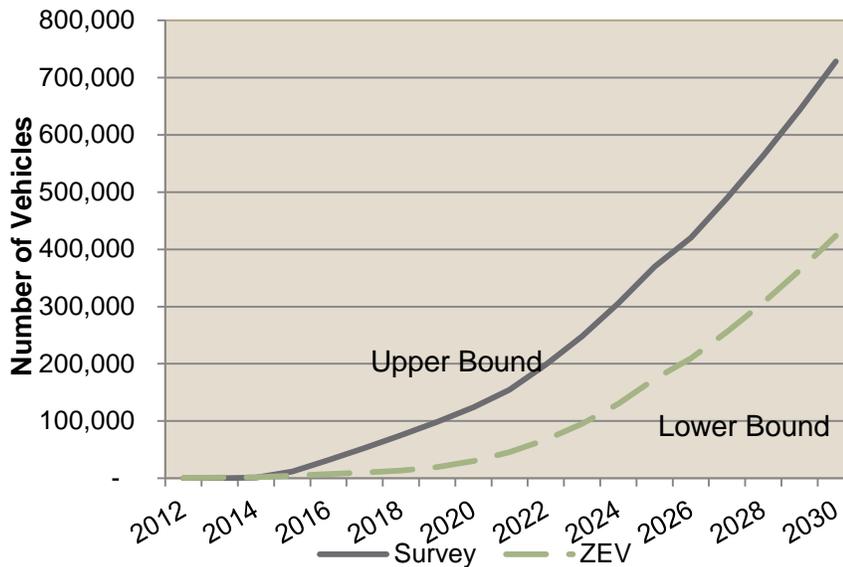
Emissions estimates are affected by the numbers and timing of fuel cell vehicle placements, fuel consumption and miles traveled, as well as how the hydrogen is produced and delivered to the station. The following assumptions were used in performing the GHG and criteria pollutant emissions analysis.

##### **a) *Numbers and timing of FCV placements***

In order to create lower and upper bounds for the analysis, staff used two vehicle roll-out scenarios to estimate the anticipated number of FCVs to be deployed in California from present until the regulation sunsets. The Lower Bound is the FCV portion of the ZEV ramp-up scenario referred to as the “most likely compliance scenario,” which is

used in the ZEV staff report.<sup>50</sup> The Upper Bound includes FCV numbers through 2017 as reported by the automakers in the survey discussed in Section I B 1 of this staff report. To expand the survey data beyond 2017, a ZEV compliance scenario using only FCVs was applied.<sup>51</sup> In both vehicle population data sets, staff utilized graphical best-fit algorithms to fill in data gaps (i.e., between 2014 and 2017 in the survey data) as well as extend the data beyond what is provided in the projections. Figure III-1 shows graphically the cumulative number of FCVs anticipated under each scenario from 2012 through 2030. The vehicle ramp up scenarios shown below were developed for the purpose of analyzing potential impacts of the regulation; however, the actual CFO regulation would be triggered based on automaker projections as discussed in Section II A.

**Figure III-1: Estimated Number of FCVs 2012 to 2030**



b) *Timing of Regulation Triggering and Sunset*

As discussed in Section II A 6, the regulation would be triggered within an air basin when the projected number of vehicles reaches 10,000 and statewide when the projected number reaches 20,000. In Section II A 13, the proposed modifications include sun setting the regulation when the number of CFOs equals five percent (currently 485) of the total retail gasoline outlets in California. Today, this would mean

<sup>50</sup> Section 3, Table 3.6 of the “Staff Report: Initial Statement of Reasons for 2012 proposed amendments to the California Zero Emission Vehicle Program regulations.” Dec. 8, 2011.

<sup>51</sup> Staff applied the ZEV calculator to estimate what compliance to the ZEV regulation would look like if automakers chose to comply strictly with FCVs in lieu of a mix of FCVs, BEVs and PHEVs.

that once the number of hydrogen stations statewide reaches 485, regulated parties would no longer be required build new hydrogen stations.

For both FCV ramp-up scenarios, staff assumed that a large percentage of FCVs will be placed in southern California in the early years where hydrogen infrastructure development is currently underway. For the Upper Bound scenario, staff assumed that, by the end of 2015, 85 percent of the FCVs in California – just over 10,000 – would be deployed within the south coast air basin thereby activating the regional trigger. In 2016, the statewide trigger would be activated and, by 2024, there would be a sufficient number of vehicles – just over 306,000 – to have required 485 hydrogen stations and, therefore, sunset the regulation.

For the Lower Bound scenario, staff assumed that the regional trigger would be activated in 2018, the statewide trigger in 2020, and the sunset in 2028.

c) *Fuel consumption and VMT*

Use of hydrogen each year is dependent on number of FCVs, vehicle miles traveled (VMT), and fuel consumption. Staff referred to EMFAC 2011<sup>52</sup> for average VMT and the LEV staff report<sup>53</sup> for average fuel consumption values for FCVs by model year. For VMT, staff assumed that, due to the full-functionality of fuel cell vehicles,<sup>54</sup> drivers would use FCVs for all of their driving. To calculate emissions for a specific year, staff used a fleet average fuel consumption representing the population of different model year vehicles and a total FCV fleet VMT for that year.

The analyses involved comparing the FCV fleet to the same number of conventional gasoline vehicles in a given year. For the gasoline baseline, staff assumed that the fleet average fuel consumption would decrease over time due to light-duty GHG emission reduction requirements pursuant to Pavley and LEV III.<sup>55</sup>

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<sup>52</sup> ARB, 2011b. California Air Resources Board. EMFAC2011 Technical Documentation, September 19, 2011.

<sup>53</sup> Section III of “Staff Report: Initial Statement of Reasons for proposed rulemaking, public hearing to consider the “LEV III” amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emissions Standards and Test Procedures, and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-duty Trucks, and Medium-duty Vehicles, and to the Evaporative Emission Requirements for Heavy-duty Vehicles.” Dec. 8, 2011.

<sup>54</sup> FCVs produced today can travel 350 miles on one full tank of hydrogen making their functionality comparable to conventional vehicles, provided there is adequate fueling infrastructure.

<sup>55</sup> AB 1493, 2002. California Assembly Bill. Pavley, Fran (Assemblyman). “Vehicular emissions: greenhouse gases,” Chapter 200, Statutes of 2007. July, 2, 2002.

d) *Fuel cycle and vehicle emissions*

Since FCVs are zero emission vehicles, there are only fuel cycle emissions (i.e., from the collection and transport of feedstock's, and production, transport and dispensing of hydrogen) contributing to the well-to-wheel emissions. GHG emissions were evaluated for six hydrogen production pathways including: 1) central plant steam methane reformation (SMR) with liquid hydrogen delivery; 2) central plant SMR with gaseous hydrogen delivery; 3) onsite SMR; 4) onsite SMR using 33 percent renewable resources; and 5) two different pathway combinations containing central plant and onsite production technologies. Hydrogen GHG emissions were compared to well-to-wheel gasoline baseline GHG emissions, which include emissions reductions over time due to the existing California Low Carbon Fuel Standard (LCFS) regulation.<sup>56</sup>

Well-to-wheel criteria pollutant emissions were calculated for four distinct hydrogen pathways – central SMR with liquid delivery, central SMR with gaseous delivery, on-site SMR and on-site electrolysis – and were compared, on a tons per day basis, to the same size fleet of conventional vehicles using California Reformulated Gasoline (CaRFG) with 10 percent ethanol content by volume.

2. Modeling Protocol

The models employed to estimate both GHG and criteria pollutant emission reductions that would result from the proposed regulations are discussed below.

a) *GHGs*

GHG emissions were analyzed using version 1.8b of a life cycle analysis model called Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) that was modified for California conditions (CA-GREET). GHG emissions per mile and total annual GHG reductions were evaluated for the six hydrogen production options listed above.

The GHG emissions analysis takes into consideration SB1505, the Environmental and Energy Standard for Hydrogen Production (SB 1505, Statutes of 2006, Chapter 877),<sup>57</sup> which is anticipated to be in effect shortly after the CFO is triggered. SB 1505 sets GHG and criteria pollutant standards for transportation hydrogen and requires the use of renewable resources in hydrogen production once a specific fuel throughput is reached. For the gasoline baseline, it was assumed that the LCFS regulation would result in lowering the gasoline carbon intensity 10 percent by 2020.

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<sup>56</sup> ARB, 2011a.

<sup>57</sup> SB 1505, 2006. California Senate Bill. Lowenthal, Alan (Senator). Chapter 877, Statutes of 2006, September 20, 2006.

For the Upper Bound scenario, four years were evaluated: 2015 and 2016 (regional and statewide triggers); 2020 (Upper Bound scenario midpoint); and 2024 (sunset). In the early years prior to 2016, it is assumed that some of the hydrogen produced is SB1505 compliant. As the number of commercial-scale stations increases around 2016 and beyond, it is assumed that all hydrogen produced will be SB1505 compliant.

For the Lower Bound scenario, the years modeled include: 2018 and 2020 (regional and statewide triggers); 2023 (midpoint); and 2028 (sunset). By 2018, some of the hydrogen produced will be SB1505 compliant, and by 2020, all transportation hydrogen will meet SB 1505 requirements.

#### b) *Criteria Pollutants*

Staff performed well-to-wheel lifecycle analyses of the criteria pollutants using GREET. Following the requirements established in SB1505 to mitigate local criteria pollutant emissions associated with hydrogen, this well-to-wheel evaluation includes those emissions occurring on a local level. Local criteria pollutant emissions were modeled for four hydrogen production pathways using year 2020 fuel demand associated with the midpoint of the Upper Bound FCV scenario.

### 3. Results

Both GHG and criteria pollutant emissions were compared to the gasoline well-to-wheel baseline with emissions consistently lower regardless of the hydrogen pathway modeled. The results from the emissions modeling are summarized below with greater detail provided in Appendix D. The emission reductions discussed below are well-to-wheel reductions. The U.S. EPA-proposed fleet average GHG emission standard for 2025 is 163 grams per mile in terms of tank-to-wheel. The equivalent well-to-wheel value for the average gasoline car in 2025 would be 314.9 grams per mile. FCV have zero tank-to-wheel GHG and criteria emissions. Baseline years were based on the CFO trigger years determined in the example scenarios.

#### a) *GHG Modeling Results*

The total GHG emissions reductions for the Upper Bound scenario ranged from approximately 0.03 to 0.8 million metric tons of carbon dioxide equivalent per year (MMTCO<sub>2e</sub>/year), depending on the hydrogen production method and year modeled. While gaseous hydrogen delivery will be used significantly in the early years with smaller stations, hydrogen produced by central SMR with liquid delivery, which is more efficient at larger volumes, is anticipated to largely contribute to the commercialization

effort of hydrogen.<sup>58</sup> The central SMR with liquid delivery pathway showed a per-mile well-to-wheel GHG reduction in of 25 to 38 percent compared to the average gasoline vehicle, with values ranging from 244.73 grams carbon dioxide equivalents per mile (gCO<sub>2</sub>e/mi) at CFO onset to 239.74 gCO<sub>2</sub>e/mi at sunset.

For the Lower Bound scenario, GHG emission reductions ranged from 0.02 to 0.7 MMTCO<sub>2</sub>e/year. For the central SMR liquid delivery pathway, per mile GHG reductions were lower compared to the other scenario with reductions ranging from 21 to 32 percent.

Well-to-wheel emissions in both FCV scenarios were also compared to the 30 percent GHG reduction requirement in SB1505. Meeting this reduction requirement becomes increasingly challenging because the GHG emissions of the gasoline baseline continue to improve over time. Only pathways that include a lower percentage of SMR with liquid delivery satisfy the SB1505 GHG reduction targets over the life of the regulation.

#### b) *Criteria Pollutant Modeling Results*

Local criteria pollutants are expected to be reduced, on average, by more than 50 percent when compared to gasoline for the hydrogen production pathways mentioned above. Based on lifecycle results, the proposed CFO regulation is expected to result in no additional adverse impacts to California's air quality due to emissions of criteria pollutants. There may be additional reductions as the technology matures.

#### 4. Future Hydrogen Production

As demand for transportation hydrogen increases, new hydrogen production facilities will eventually be needed, and will likely be built in California. New facilities may be needed before the regulation sunset if existing hydrogen production in California is insufficient.<sup>59</sup> Hydrogen production on a commercial scale will require development of new technologies as well as the continued use of conventional technology used today. New technology could include hydrogen produced from renewable sources and novel fuel transportation and delivery technologies such as pipeline transport of hydrogen. On

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<sup>58</sup> In the early years before the CFO regulation is triggered, central SMR with gaseous delivery is expected to be the predominant hydrogen pathway; however, once demand requires 400 kg/day stations, central SMR with liquid delivery will play an increasing role as it is expected to be more efficient.

<sup>59</sup> US DOE, 2011a. US DOE Hydrogen Analysis Resource Center. "Merchant Liquid and Compressed Gas Hydrogen Production Capacity in the U.S. and Canada by Company and Location." Sept. 6 2005. Last modified June 21, 2011. <http://hydrogen.pnl.gov/cocoon/morf/hydrogen/article//706>. Accessed October 19, 2011 Staff utilized this information from this source to estimates that annual transportation hydrogen demand upon regulation sunset will about 9% of California's merchant hydrogen production capacity.

a statewide basis, GHG and criteria pollutants emissions will likely be offset by reductions in motor vehicle emissions. ARB is committed to making the achievement of emissions reduction an integral part of the CFO. Staff will continue to develop tools to ensure that the proposed regulation does not disproportionately impact low-income and minority communities, does not interfere with the attainment and maintenance of ambient air quality standards, and considers overall societal benefits (such as diversification of energy resources).

## **IV. Economic Impacts**

This section presents a summary of staff's evaluation of initial costs, and operation and maintenance costs associated with hydrogen stations developed pursuant to this regulatory proposal. This economic analysis evaluates hydrogen station deployment scenarios associated with both the Upper Bound and Lower Bound FCV rollout scenarios. The complete economic analysis is included in Appendix E.

### **A. Assumptions and Modeling Parameters**

The following summarizes the assumptions and calculations used to estimate the number and timing of CFO development, and the costs of compliance to the regulated parties. The same assumptions for quantities and timing of FCV placements, VMT, and other factors (shown in Table IV-1) that were used in the Emissions Impact analysis discussed in Section III B were applied in this economic analysis.

**Table IV-1. Number of FCVs for Upper and Lower Bound FCV Scenarios**

Year	FCV Fuel Economy <sup>60</sup> (miles/kg)	Lower Bound Scenario		Upper Bound Scenario	
		FCVs/year <sup>61,62</sup>	Cumulative FCVs	FCVs/year <sup>63</sup>	Cumulative FCVs
2014	62.2	600	1,900	970	1,400
2015	68.0	2,700	4,600	10,600	12,000
2016	73.9	2,900	7,500	20,000	32,000
2017	72.6	3,000	10,500	21,000	53,000
2018	68.4	2,900	13,400	22,000	75,000
2019	68.1	6,200	19,600	23,000	98,000
2020	68.1	10,600	30,200	26,000	124,000
2021	68.1	15,400	45,600	31,000	155,000
2022	68.1	21,600	67,200	44,000	199,000
2023	68.1	27,800	95,000	49,000	248,000
2024	68.1	35,200	130,200	58,000	306,000
2025	68.1	43,600	173,800		
2026	68.1	36,000	209,800		
2027	68.1	46,300	256,100		
2028	68.1	51,000	307,100		

Numbers rounded to the nearest 100. Shaded cells indicate CFO regulation sunset for each scenario.

1. Estimating the Number of Required CFOs

Determining the number of required clean fuel outlets for a given year first involves calculating annual maximum demand volume (MXDV), which is based on the number of vehicles by model year and the average fuel consumption and VMT for each model year vehicle. In addition, to analyze how a regional vehicle trigger could initiate the development of hydrogen stations within an air basin, staff assumed that a large majority of the first FCVs, and hence, fuel demand, would be in the South Coast air

<sup>60</sup> See “ACC Compliance Scenarios Summary” Worksheet posted on the following website for fuel economy assumptions, developed for the Advanced Clean Cars rulemaking:  
[http://www.arb.ca.gov/msprog/clean\\_cars/clean\\_cars\\_ab1085/clean\\_cars\\_ab1085.htm](http://www.arb.ca.gov/msprog/clean_cars/clean_cars_ab1085/clean_cars_ab1085.htm)

<sup>61</sup> Source for 2014-2017 Lower Bound FCV numbers. “Zero-Emission Vehicle Standards for 2005 through 2008 Model year Passenger cars, Light-Duty trucks, and Medium-Duty vehicles.” California Code of Regulations, title 13, section 1962. Adopted Dec. 17, 2008.

<sup>62</sup> Source for 2018-2025 Lower Bound FCV numbers: Section 3, Table 3.6 of the “Staff Report: Initial Statement of Reasons for 2012 proposed amendments to the California Zero Emission Vehicle Program regulations.” Dec. 8, 2011. Graphical best used for 2026-2028 FCV numbers.

<sup>63</sup> Source of Upper Bound FCV numbers: OEM surveys for 2014-2017. For 2018 and beyond, staff assumed FCV growth based on automaker compliance with the ZEV regulation using FCVs only. For both FCV scenarios, see “StationCostCalculator.xlsx” worksheet posted on the following website developed for the Advanced Clean Cars rulemaking:  
[http://www.arb.ca.gov/msprog/clean\\_cars/clean\\_cars\\_ab1085/clean\\_cars\\_ab1085.htm](http://www.arb.ca.gov/msprog/clean_cars/clean_cars_ab1085/clean_cars_ab1085.htm).

basin. When the CFO is first triggered, some of the fuel demand will be met by existing and funded hydrogen stations discussed in Section I B 1. Additionally, stations added pursuant to the CFO regulation in a given year will be considered “existing supply” in later years. Each year, the estimated existing hydrogen supply is subtracted from the MXDV to determine a hydrogen supply deficit, and ultimately the required number of new stations for that year. Tables IV-2a and IV-2b present a summary of estimated vehicle numbers, annual MXDVs and hydrogen supply deficit for the Lower and Upper Bound FCV ramp-up scenarios.

The number of required new stations is calculated by dividing the hydrogen supply deficit by a per-station throughput volume of 146,000 kilograms per year (or 400 kg/day). Recognizing that new CFOs will not all be the same, staff assumed that the new stations in the early years would receive delivered hydrogen from a central SMR facility, with 25 percent gaseous delivery and 75 percent liquid delivery. It is important to note that, before the CFO regulation is triggered, central SMR with gaseous delivery is expected to be the predominant hydrogen pathway; however, once demand requires 400 kg/day stations, central SMR with liquid delivery will play an increasing role as reflected in staff’s assumptions used in the cost analyses. When there are roughly 300 hydrogen stations in California (representing three percent of the total number of gasoline stations), staff assumed that the new stations would be 85 percent delivered liquid and 15 percent on-site SMR. Tables IV-1a and IV-1b also show the number and types of new stations added each year for both FCV scenarios from when the regulation is triggered to its sunset. It should be noted that each table represents a *scenario* of the types of stations that could be constructed to comply with the CFO regulation and not a requirement to build certain types of stations.

**Table IV-2a. Hydrogen Demand and Station Deployments Using the Lower Bound FCV Scenario**

Year	FCV Population Cumulative Statewide	FCVs in SCAQMD Region	Annual H2 Demand (1000 kg/year)	Existing H2 Supply (1000 kg/year)	H2 Shortage (1000 kg/year)	Total Stations	New Stations Installed per CFO				Notes
							Total	Delivered Gaseous	Delivered Liquid	On-site SMR	
2017	10,500	7,861	2,578	1,668	910	29	0	0	0	0	
2018	13,400	10,100	3,198	1,668	1,530	33	5	1	4	0	Regional trigger
2019	19,600	14,700	4,756	2,398	2,358	42	9	2	7	0	
2020	30,200		7,461	3,712	3,749	67	26	7	19	0	State trigger
2021	45,600		11,290	7,508	3,782	93	26	6	20	0	SB1505 threshold
2022	67,200		16,574	11,304	5,270	131	38	9	29	0	
2023	95,000		23,170	16,560	6,610	177	46	11	35	0	
2024	130,200		31,374	23,276	8,098	231	54	13	41	0	
2025	173,800		41,375	31,160	10,215	300	68	0	58	10	3% Saturation
2026	209,800		48,279	41,234	7,045	348	48	0	41	7	
2027	256,100		57,981	48,242	9,739	415	67	0	57	10	
2028	307,100		68,494	58,024	10,470	487	72	0	61	11	5% - Sunset

**Table IV-2b. Hydrogen Demand and Station Deployments Using the Upper Bound FCV Scenario**

Year	FCV Population Cumulative Statewide	FCVs in SCAQMD Region	Annual H2 Demand (1000 kg/year)	Existing H2 Supply (1000 kg/year)	H2 Shortage (1000 kg/year)	Total Stations	New Stations Installed per CFO				Notes
							Total	Delivered Gaseous	Delivered Liquid	On-site SMR	
2014	1,400	1,200	437	1,726	0	31	0	0	0	0	
2015	12,000	10,200	3,528	1,668	1,860	38	9	2	7	0	Regional trigger
2016	32,000		8,529	2,982	5,547	77	39	10	29	0	State trigger
2017	53,000		13,302	8,676	4,626	109	32	8	24	0	SB1505 threshold
2018	75,000		18,304	13,326	4,978	142	34	8	26	0	
2019	98,000		23,289	18,290	4,999	176	34	8	26	0	
2020	124,000		28,855	23,188	5,667	215	40	10	30	0	
2021	155,000		35,543	29,028	6,515	261	46	0	39	7	3% Saturation
2022	199,000		45,590	35,744	9,846	328	67	0	57	10	
2023	248,000		56,239	43,946	12,293	402	74	0	63	11	
2024	306,000		68,713	56,502	12,211	488	86	0	732	13	5% - Sunset

## 2. Cost Assumptions

Following is a summary of the cost data, assumptions, and information sources used in the CFO economic analysis.

### a) *Initial Costs*

The costs to construct hydrogen fueling stations have come down in recent years. Cost estimates provided by station developers who have successfully competed for State funding (discussed in Section I B 1) show a 40 percent decrease in costs from 2008 to 2010, even though the average capacity of the 2010 stations is greater.<sup>64</sup> It is important to recognize, however, that the 2010 bids reflect stations with capacities of 180 to 240 kg/day, and not 400 kg/day, which is the basis of the throughput volume used in the station calculations discussed above.

UC Davis' Institute of Transportation Studies and the US Department of Energy's Hydrogen Program have conducted in-depth analyses and consulted with several hydrogen providers and station developers to estimate future initial and O&M costs associated with the development, operation and maintenance of hydrogen fueling infrastructure. Table IV-3 presents initial costs associated with 400 kg/day hydrogen fueling stations in both the early years, 2012 to 2015, and the later years (2017 and beyond). The studies predict that costs would come down even with a moderate amount of learning, approximately five to ten stations per year, and costs will come down more quickly when stations are deployed at a faster rate. Initial costs include site preparation, permitting, engineering, utility installation, structures, and hydrogen storage, compression and dispensing equipment (including 5000 and 10,000 psi dispensing equipment).

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<sup>64</sup> CEC, 2010. California Energy Commission. "Revised Notice of Proposed Award, Alternative and Renewable Fuel and Vehicle Technology Program Grant Solicitation PON-09-608, Hydrogen Ruel Infrastructure." Nov. 17, 2010. [http://www.energy.ca.gov/contracts/PON-09-608\\_Revised\\_NOPA.pdf](http://www.energy.ca.gov/contracts/PON-09-608_Revised_NOPA.pdf). Percent reduction based on four of the stations awarded funding from ARB in 2008 (average per station cost of \$3.27 million) and eight stations awarded funding from CEC in 2010 (average per station cost of \$2 million).

**Table IV-3. Initial Costs for 400 kg/day Hydrogen Fueling Stations (2009 dollars)**

Type of 400 kg/day station	Early years	Later years
Central SMR with delivered gaseous hydrogen <sup>65</sup>	\$2 million	\$1.5 million
Central SMR with delivered liquid hydrogen <sup>66</sup>	\$1.8 million	\$1.4 million
On-Site SMR <sup>67</sup>	\$3.8 million	\$2.4 million

Note: Shaded cells represent initial costs used in the economic impact analysis.

For the economic impact analysis, staff used the lower value for the delivered gas pathway based on the likelihood that the cost of this technology will come down due to economy of scale before the regulation is triggered. For delivered liquid, staff used the higher initial cost in the early years until approximately 30 of these stations have been installed in California. This would occur in 2017 in the Upper Bound Scenario and 2021 in the Lower Bound Scenario. After that, staff assumed that initial costs would drop to the lower value due to technology advancements. For hydrogen produced on-site using SMR, staff used the lower costs because, as shown on Tables IV-2a and IV-2b, this technology is not included in the station mix until 2021 in the Upper Bound Scenario, and 2025 in the Lower Bound Scenario. While stations using delivered hydrogen have lower initial costs compared to on-site SMR, staff believes that some stations that can produce hydrogen on site may be necessary to service areas where hydrogen delivery may not be economically viable.

b) *Operation and Maintenance*

Operation and maintenance (O&M) costs consist of two components – fixed and variable. Fixed O&M costs cover hydrogen station upkeep, regular maintenance, repair and replacement of station equipment due to normal wear and tear, and rental of retail space. Variable O&M covers costs that are dependent on hydrogen throughput such as the purchase of hydrogen (or the on-site production of hydrogen) and the electricity required to chill and dispense the hydrogen at 5000 and 10,000 psi. Additionally, SB 1505, which includes requirements for using 33 percent renewable resources for hydrogen production, will come into effect in 2017 in the Upper Bound Scenario and 2021 in the Lower Bound Scenario. For the cost analysis, staff assumed that hydrogen providers would pay a premium to supplement 33 percent of their electricity usage with renewable electricity credits and 33 percent of their natural gas feedstock with biogas

<sup>65</sup> UCD, 2011. University of California, Davis. Ogden, Joan et al. UCD Institute of Transportation Studies. "Analysis of a "Cluster" Strategy for Introducing Hydrogen Fuel Cell Vehicles and Infrastructure in Southern California." Sept. 16, 2011. Revised Oct. 5, 2011. Note: Range provided for 2015 and beyond.

<sup>66</sup> US DOE, 2010a. United States Department of Energy. Nguyen, Tien et al, DOE Hydrogen Program Record (Draft), Sept. 22, 2010.

<sup>67</sup> Ibid.

credits, resulting in an additional cost of \$0.70 per kilogram. Table IV-4 summarizes these assumptions and information sources used.

**Table IV-4. Fixed and Variable Operation and Maintenance Costs (2009 dollars)**

<b>Fixed Costs</b>	\$100,000 per year (all pathways) <sup>68</sup>			
<b>Variable costs</b>	<b>Dollars per kilogram of hydrogen produced/dispensed</b>			
<b>Hydrogen Pathway</b>	<b>Delivered H2 Cost<sup>69</sup></b>	<b>On-site Electricity</b>	<b>On-site Natural Gas</b>	<b>SB 1505 Premium<sup>70</sup></b>
<b>Delivered Gaseous</b>	\$2.85	\$0.15 <sup>71</sup> (1 kwh/kg) <sup>72</sup>	N/A	\$0.70
<b>Delivered Liquid</b>	\$2.70	\$0.15 (1 kwh/kg)	N/A	\$0.70
<b>On-site SMR</b>	N/A	\$0.45 (3 kwh/kg)	\$1.00 <sup>7374</sup>	\$0.70

### 3. Station Utilization and Payback Assumptions

Critical to this cost analysis is evaluating payback and return on investment, which are dependent on station utilization and hydrogen price, as well as station financing and interest rates. For the cost analysis, staff assumed that the initial costs for each required station will be paid over a seven year period with a six percent interest rate.<sup>75</sup>

Since the CFO regulation uses a 400 kg/day throughput to calculate the number of required stations, this same throughput is used in the cost model as a daily capacity even though station operators may provide greater throughput if needed to meet demand. The model assumes that stations will operate 365 days per year and recognizes that stations will not be fully utilized when they first open, especially those

<sup>68</sup> UCD, 2011.

<sup>69</sup> US DOE, 2011b. United States Department of Energy. Satyapal, Sunita. US DOE Fuel Cell Technologies Program. "Overview of Hydrogen and Fuel Cells." March 3, 2011.

<sup>70</sup> Staff assumed that a kilowatt-hour of renewable electricity would cost almost three times that of commercial grid electricity, and biogas inputs would cost 2.5 times that of conventional natural gas.

<sup>71</sup> Based on average commercial electricity for California's three investor-owned utilities.

<sup>72</sup> UCD, 2011.

<sup>73</sup> US DOE, 2001. United States Department of Energy, National Renewable Energy Laboratory. Spath, Pamala, L. and Margaret K. Mann. "Life Cycle Assessment of Hydrogen Production via Natural Gas." Document No. NREL/TP-570-27637. Revised February 2001. Provided following data to support \$1.00 cost: 158 scf of natural gas is needed to produce one kg of hydrogen via SMR.

<sup>74</sup> EIA, 2011. United States Energy Information Administration. US Natural Gas Price. November 29, 2011 Website. <http://www.eia.gov/dnav/ng/hist/n3035us3m.htm>. Accessed Dec. 1, 2011. Supports average price for natural gas of \$6.00/1000 standard cubic feet used to determine \$1.00 cost.

<sup>75</sup> FRS, 2011. Board of Governors of the Federal Reserve System. Selected Interest Rates Historical Data website. Last updated 13 April 2011. <http://www.federalreserve.gov/releases/h15/data.htm> Accessed 1 Nov. 2011. Note: A 6% annual interest rate represents annual corporate AAA bond interest rates averaged from 2000 to 2010.

opening in the early years after the regulation is first triggered. Later, as numbers of FCVs grow and become increasingly commercially viable, station utilization upon opening is expected to be greater compared to the earlier stations. Table IV-5 shows estimated station utilization rates based on the year in which a station was installed and operational for both the Upper and Lower Bound FCV ramp-up scenarios.

**Table IV-5. Station Utilization Rates by Year of Operation**

Year of Operation	Year Station Opened (Lower Bound/Upper Bound Scenarios)		
	2018 / 2015	2019 / 2016	2020+ / 2017+
First	25%	50%	75%
Second	50%	75%	100%
Third	75%	100%	100%
Fourth and later	100%	100%	100%

#### 4. Price for Hydrogen

It is difficult to project the price of hydrogen for transportation, particularly in the next few years when a network of distribution stations is first being formed. A supporting factor that will contain costs for early networks is that hydrogen production will predominantly come from existing centralized industrial facilities. In the early years, when station utilization is anticipated to be lower, hydrogen may be sold at a loss or it may be priced high to account for low utilization. In the later years when utilization is higher, station operators may be able to sell hydrogen at a profit and recoup their earlier losses. In order to perform the economic analyses for both the ZEV the CFO regulations, staff assumed a linear decreasing price scenario as shown as “Price A” in Table IV-6.

From a different perspective, consumers may accept hydrogen if it is priced at twice the cost of premium gasoline to reflect the per mile fuel consumption benefits and achieve roughly equal dollars per mile cost. Over time, however, the cost to produce hydrogen could drop below that of gasoline (on an energy and mileage equivalent basis) and, therefore, price would likely be set by natural market forces. As such, staff also included a flat pricing scenario “Price B” in the economic analysis that assumes hydrogen is priced at \$8 per kilogram, roughly twice the cost of premium gasoline today. For both price scenarios, staff assumed that the credit card fees are captured in the price. Although the information in Table IV-6 was developed for the economic analyses, it is by no means intended to serve as a pricing schedule for retail hydrogen.

**Table IV-6. Example Hydrogen per Kilogram Price Scenario by Year - Upper and Lower Bound (2009 dollars)**

Upper/Lower Bound Year	2015/2018	2016/2019	2017/2020	2018/2021	2019/2022	2020/2023	2021/2024	2022/2025 and beyond
Price A	\$13	\$12	\$11	\$10	\$9	\$8	\$7	\$6
Price B	\$8	\$8	\$8	\$8	\$8	\$8	\$8	\$8

**B. Economic Analysis Results**

Initial costs, fixed and variable O&M costs, pricing and utilization assumptions presented above were used to calculate total annual costs to all regulated parties as well as annual costs associated with a single station installed during various years of the regulation lifespan. All cost estimates are in 2009 dollars. Results are detailed in Appendix E and summarized below.

1. Cost of Regulation - Lower Bound FCV Ramp-up Scenario

Table IV-7 below shows total annual cost to comply with the CFO regulation assuming a Lower Bound FCV ramp-up scenario. Costs include the total annual payments associated with seven annual loan payments for each station, fixed O&M costs, and variable O&M costs associated with station throughput (as discussed earlier). The total annual costs were then divided by the annual hydrogen throughput, which is based on the station utilization assumptions in Table IV-5, resulting in an average annual cost per kilogram of hydrogen. Hydrogen production costs were then compared to hydrogen sales using the two different pricing scenarios shown in Table IV-6.

**Table IV-7. Annual Cost to Comply and Estimated Cumulative Profits Assuming Lower Bound FCV Ramp-up Scenario**

Year	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
2018	\$2,584	183	\$14.16	\$13	(\$212)	(\$212)	\$8	(\$1,124)	(\$1,124)
2019	\$8,699	1,022	\$8.51	\$12	\$3,565	\$3,354	\$8	(\$523)	(\$1,647)
2020	\$29,008	4,380	\$6.62	\$11	\$19,172	\$22,526	\$8	\$6,032	\$4,386
2021	\$56,745	8,687	\$6.53	\$10	\$30,125	\$52,652	\$8	\$12,751	\$17,137
2022	\$87,078	13,797	\$6.42	\$9	\$35,616	\$88,268	\$8	\$21,819	\$35,956
2023	\$126,187	20,221	\$6.33	\$8	\$33,842	\$122,110	\$8	\$33,842	\$72,798
2024	\$172,588	27,813	\$6.27	\$7	\$20,365	\$142,475	\$8	\$48,178	\$120,976
2025	\$229,383	37,230	\$6.19	\$6	(\$7,001)	\$135,473	\$8	\$67,459	\$188,435
2026	\$270,695	44,968	\$6.04	\$6	(\$1,757)	\$133,716	\$8	\$88,179	\$276,614
2027	\$318,356	54,057	\$5.91	\$6	\$5,114	\$138,831	\$8	\$113,227	\$389,841
2028	\$373,428	64,386	\$5.81	\$6	\$12,019	\$150,850	\$8	\$140,791	\$530,632
2029	\$373,005	67,014	\$5.57	\$6	\$28,711	\$179,561	\$8	\$162,739	\$693,372
2030	\$361,272	67,014	\$5.40	\$6	\$40,445	\$220,006	\$8	\$174,473	\$867,844

Note: Shaded cells represent regulation sunset where no new stations are required after 2028.

As expected, the cost of production in the first year (2018) is high due to the assumption that the stations will only operate at 25 percent capacity. As more stations are added each year and utilization steadily increases, the average cost of production declines quickly. Using the Price A scenario, the average amount of time it will take for a regulated party to see a return on their investment could be less than two years. A decrease in the average annual profit is apparent from 2025 through 2028 when the price of hydrogen drops to \$6. The addition of the more costly on-site SMR stations starting in 2025 also factors into this decrease; however, with increasing fuel demand, it is expected that the SMR stations will realize a return on their investment within 5 years. In every year except 2018, however, the cumulative profits remain positive and continue to grow under the Price A scenario.

Using the Price B scenario implies that hydrogen would be priced below cost in 2018 and 2019, resulting annual losses totaling \$1.2 and \$0.95 million. Starting in 2020, the average cost of production drops below \$8 per kilogram, resulting in net profits in 2020 and beyond. With high station utilization, production costs would continue to decrease indicating that market forces would soon factor into hydrogen price.

## 2. Cost of Regulation – Upper Bound FCV Ramp-up Scenario

The total annual cost of compliance assuming the Upper Bound FCV ramp up scenario is shown in Table IV-8. In 2015 and 2016 when the regional and statewide triggers are reached, average cost of production is comparable but slightly lower than the first two years of the Lower Bound Scenario. Under the Price A scenario, cumulative profits over time grow more quickly which is consistent with the faster introduction rate for vehicles and stations. When the hydrogen price drops to \$6 per kilogram in 2022, the cost of production is slightly higher than \$6 affecting the average annual profitability for that year only. Cumulative profits continue to grow after the first year under the Price A scenario.

The cost analysis results using the Price B scenario are similar to the Lower Bound Scenario results in that the cost to produce hydrogen is greater than the price for only the first two years. Annual losses during 2015 and 2016 are greater (\$2 and \$1.7 million) due to greater numbers of stations with low utilization. Early station operators could start to recoup their investments in 2017.

**Table IV-8 Annual Cost to Comply and Estimated Cumulative Profits Assuming Upper Bound FCV Ramp-up Scenario**

Year	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
2015	\$4,642	328.5	\$14.13	\$13	(\$371)	(\$371)	\$8	(\$2,014)	(\$2,014)
2016	\$29,750	3,504	\$8.49	\$12	\$12,298	\$11,927	\$8	(\$1,718)	(\$3,732)
2017	\$62,427	8,760	\$7.13	\$11	\$33,933	\$45,859	\$8	\$7,653	\$3,921
2018	\$98,321	15,403	\$6.38	\$10	\$55,709	\$101,568	\$8	\$24,903	\$28,824
2019	\$128,863	20,477	\$6.29	\$9	\$55,426	\$156,994	\$8	\$34,949	\$63,773
2020	\$163,371	26,134	\$6.25	\$8	\$45,701	\$202,695	\$8	\$45,701	\$109,474
2021	\$202,807	32,631	\$6.22	\$7	\$25,610	\$228,305	\$8	\$58,241	\$167,715
2022	\$255,421	41,647	\$6.13	\$6	(\$5,542)	\$222,763	\$8	\$77,751	\$245,466
2023	\$ 306,562	52,195	\$5.87	\$6	\$ 6,608	\$ 229,371	\$8	\$ 110,998	\$ 356,464
2024	\$ 371,354	64,313	\$5.77	\$6	\$14,740	\$ 243,895	\$8	\$ 143,150	\$ 449,614

Note: Shaded cells represent regulation sunset where no new stations are required after 2028.

## 3. Cost and Payback Period for One Station

While the above tables provide a comprehensive example of the overall cost of the regulation, it is valuable to examine cost and payback on a single station basis. Staff

evaluated the cost and payback associated with the three different types of stations installed during different periods of the regulation.

a) *Station Installed at Onset of CFO Regulation*

Examples of annual costs and payback associated with a single station installed when the CFO regulation is first triggered are presented in Table IV-9 for delivered gaseous hydrogen and Table IV-10 for delivered liquid hydrogen. The same cost and gradual utilization ramp-up assumptions were applied, and it was assumed that SB 1505 renewable premium would apply starting in the third year of station operation.

**Table IV-9. Cost of One Delivered Gaseous Station Installed First Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$478	36.5	\$13.10	\$13	(\$3.7)	(\$3.7)	\$8	(\$186)	(\$186)
2	\$588	73	\$8.05	\$12	\$288	\$285	\$8	(\$4)	(\$190)
3	\$774	109.5	\$7.07	\$11	\$431	\$715	\$8	\$102	(\$88)
4	\$909	146	\$6.23	\$10	\$551	\$1,266	\$8	\$259	\$171
5	\$909	146	\$6.23	\$9	\$405	\$1,671	\$8	\$259	\$430
6	\$909	146	\$6.23	\$8	\$259	\$1,931	\$8	\$259	\$690
7	\$909	146	\$6.23	\$7	\$113	\$2,044	\$8	\$259	\$949
8	\$640	146	\$4.38	\$6	\$236	\$2,279	\$8	\$528	\$1,476
9	\$640	146	\$4.38	\$6	\$236	\$2,515	\$8	\$528	\$2,004
10	\$640	146	\$4.38	\$6	\$236	\$2,751	\$8	\$528	\$2,532

Depending on how hydrogen is priced, the operator of a delivered gaseous hydrogen station could start becoming profitable by their fourth year of operation – sooner if the station were used more during the first three years. Applying the same utilization and pricing assumptions to a delivered liquid hydrogen station, which has greater initial costs during the early years, shows that it will take slightly longer for the operator to become profitable in the first few years following CFO onset (Table IV-10).

**Table IV-10. Cost of One Delivered Liquid Station Installed First Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$526	36.5	\$14.42	\$13	(\$52)	(\$52)	\$8	(\$234)	(\$234)
2	\$630	73	\$8.64	\$12	\$246	\$194	\$8	(\$46)	(\$281)
3	\$811	109.5	\$7.41	\$11	\$393	\$587	\$8	\$65	(\$216)
4	\$941	146	\$6.44	\$10	\$519	\$1,106	\$8	\$227	\$11
5	\$941	146	\$6.44	\$9	\$373	\$1,479	\$8	\$227	\$238
6	\$941	146	\$6.44	\$8	\$227	\$1,707	\$8	\$227	\$466
7	\$941	146	\$6.44	\$7	\$81	\$1,788	\$8	\$227	\$693
8	\$618	146	\$4.23	\$6	\$258	\$2,046	\$8	\$550	\$1,243
9	\$618	146	\$4.23	\$6	\$258	\$2,303	\$8	\$550	\$1,792
10	\$618	146	\$4.23	\$6	\$258	\$2,561	\$8	\$550	\$2,342

b) *Station Installed Five Years Following CFO Onset*

For hydrogen stations installed five years after the first CFO stations are installed, staff assumed that they would have greater utilization during the first year of operation (75 percent) and complete utilization after that. Also, at this point, the initial cost of a delivered liquid station will have decreased due to technology advancements as discussed above in Section IV A 2, and all stations would be required to meet the SB 1505 renewable hydrogen requirements. Tables IV-11 and IV-12 provide examples of annual costs and payback associated with gaseous and liquid stations installed five years after the CFO regulation is first triggered.

If hydrogen stations are highly utilized as expected starting the fifth year after the CFO regulation is triggered, the analysis shows that total cost to produce hydrogen at both liquid and gaseous delivered hydrogen stations is less than both price scenarios evaluated with one exception. In the Price A scenario when the price drops to \$6 per kilogram in year four, both gaseous and liquid hydrogen stations show a decrease in annual profits when the cost to produce hydrogen is greater than or equal to \$6. Stations become more profitable in year eight once the seven year loan is paid off.

**Table IV-11. Cost of One Delivered Gaseous Station Installed Fifth Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$774	110	\$7.07	\$9	\$212	\$212	\$8	\$102	\$102
2	\$909	146	\$6.23	\$8	\$259	\$471	\$8	\$259	\$361
3	\$909	146	\$6.23	\$7	\$113	\$584	\$8	\$259	\$620
4	\$909	146	\$6.23	\$6	(\$33)	\$551	\$8	\$259	\$879
5	\$909	146	\$6.23	\$6	(\$33)	\$518	\$8	\$259	\$1,139
6	\$909	146	\$6.23	\$6	(\$33)	\$485	\$8	\$259	\$1,398
7	\$909	146	\$6.23	\$6	(\$33)	\$452	\$8	\$259	\$1,657
8	\$640	146	\$4.38	\$6	\$236	\$688	\$8	\$528	\$2,185
9	\$640	146	\$4.38	\$6	\$236	\$924	\$8	\$528	\$2,712
10	\$640	146	\$4.38	\$6	\$236	\$1,160	\$8	\$528	\$3,240

**Table IV-12. Cost of One Delivered Liquid Station Installed Fifth Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$740	110	\$6.75	\$9	\$246	\$246	\$8	\$136	\$136
2	\$869	146	\$5.95	\$8	\$299	\$545	\$8	\$299	\$435
3	\$869	146	\$5.95	\$7	\$153	\$698	\$8	\$299	\$734
4	\$869	146	\$5.95	\$6	\$7	\$705	\$8	\$299	\$1,033
5	\$869	146	\$5.95	\$6	\$7	\$712	\$8	\$299	\$1,332
6	\$869	146	\$5.95	\$6	\$7	\$719	\$8	\$299	\$1,631
7	\$869	146	\$5.95	\$6	\$7	\$725	\$8	\$299	\$1,930
8	\$618	146	\$4.23	\$6	\$258	\$983	\$8	\$550	\$2,480
9	\$618	146	\$4.23	\$6	\$258	\$1,241	\$8	\$550	\$3,029
10	\$618	146	\$4.23	\$6	\$258	\$1,499	\$8	\$550	\$3,579

c) *Station Installed Eight Years Following CFO Onset*

Staff also evaluated single station costs for CFOs built eight years following the first required CFO stations to assess the economic impacts of a station installed after the market has developed substantially. Staff assumed the same utilization ramp-up, initial and O&M costs, and renewable hydrogen requirements as above. In both the Lower and Upper Bound FCV ramp-up scenarios, staff assumed that the new stations installed in year eight would consist of mostly delivered liquid with some on-site SMR (see Tables IV-2a and IV-2b for station mix). Starting in year 8, the price for hydrogen using the Price A scenario would be \$6 per kilogram. Tables IV-13 and IV-14 provide examples of annual costs and payback associated with delivered liquid stations and on-site SMR stations installed eight years after the CFO regulation is first triggered.

**Table IV-13. Cost of One Delivered Liquid Station Installed in Eighth Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$740	110	\$6.75	\$6	(\$83)	(\$83)	\$8	\$136	\$136
2	\$869	146	\$5.95	\$6	\$7	(\$76)	\$8	\$299	\$435
3	\$869	146	\$5.95	\$6	\$7	(\$69)	\$8	\$299	\$734
4	\$869	146	\$5.95	\$6	\$7	(\$62)	\$8	\$299	\$1,033
5	\$869	146	\$5.95	\$6	\$7	(\$55)	\$8	\$299	\$1,332
6	\$869	146	\$5.95	\$6	\$7	(\$48)	\$8	\$299	\$1,631
7	\$869	146	\$5.95	\$6	\$7	(\$41)	\$8	\$299	\$1,930
8	\$618	146	\$4.23	\$6	\$258	\$217	\$8	\$550	\$2,480
9	\$618	146	\$4.23	\$6	\$258	\$474	\$8	\$550	\$3,029
10	\$618	146	\$4.23	\$6	\$258	\$732	\$8	\$550	\$3,579

**Table IV-14. Cost of One On-Site SMR Station Installed in Eighth Year of CFO**

Year of Operation	Total costs (\$1000/year)	Total H2 Demand (1000 kg/year)	Cost of Hydrogen (\$/kg)	Price A			Price B		
				Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)	Retail Price (\$/kg)	Annual Profit (\$1000/year)	Cumulative Profit (\$1000/year)
1	\$765	110	\$6.99	\$6	(\$108)	(\$108)	\$8	\$111	\$111
2	\$844	146	\$5.78	\$6	\$32	(\$76)	\$8	\$324	\$435
3	\$844	146	\$5.78	\$6	\$32	(\$44)	\$8	\$324	\$759
4	\$844	146	\$5.78	\$6	\$32	(\$12)	\$8	\$324	\$1,083
5	\$844	146	\$5.78	\$6	\$32	\$20	\$8	\$324	\$1,407
6	\$844	146	\$5.78	\$6	\$32	\$53	\$8	\$324	\$1,732
7	\$844	146	\$5.78	\$6	\$32	\$85	\$8	\$324	\$2,056
8	\$414	146	\$2.83	\$6	\$462	\$547	\$8	\$754	\$2,810
9	\$414	146	\$2.83	\$6	\$462	\$1,009	\$8	\$754	\$3,564
10	\$414	146	\$2.83	\$6	\$462	\$1,471	\$8	\$754	\$4,318

Except for the first year, when the stations are assumed to be utilized at 75 percent, hydrogen production costs are over \$6 per kilogram, which results in loss during the first year using the Price A scenario. In both hydrogen station types, these losses are difficult to make up in the following years with the per kilogram cost just below \$6. This is not the case with the Price B scenario. It is important to note that, under either vehicle ramp-up scenario, there would be significant numbers of vehicles (174,000 to 199,000 FCVs) requiring fuel during the eighth year following the onset of the CFO regulation. At this time, new stations will likely be built with the ability to supply more than 400 kilograms per day with a nominal increase in cost.<sup>76</sup> With greater throughput, station operators will be able to pay down their fixed annual costs with greater ease and realize a return on their investment sooner than illustrated above.

#### 4. Cost to Regulated Parties if Stations are Not Utilized

The economic analyses presented above rely on the assumption that fuel cell vehicles will be deployed at the rates presented in the Upper and Lower Bound ramp-up scenarios. But it is important to evaluate the cost to the regulated parties if the FCVs are not deployed as illustrated in the Lower and Upper Bound Scenarios. The regulation will require the first round of mandated stations to be operational at the beginning of the calendar year for which the regulation was triggered.

<sup>76</sup> US DOE, 2010a. DOE estimates that the capital cost of a liquid delivery station with a 1000 kg/day capacity will cost the same or slightly more than the same station with 400 kg/day capacity.

For the following analysis, staff created absolute worst-case scenarios for both FCV ramp up scenarios. Staff assumed that regulated parties were notified during three consecutive years of their CFO obligations in compliance years 2018, 2019 and 2020 in the Lower Bound Scenario and 2015, 2016 and 2017 in Upper Bound Scenario. Then during the first year of CFO onset, staff assumed that OEMs introduced no new FCVs and abandoned all future FCV production plans. Even though there would be some FCVs in the statewide fleet, staff assumed that the required CFO stations were not utilized. For estimating the cost to the regulated party, staff assumed that they incurred 100 percent of the initial and decommissioning<sup>77</sup> costs plus one year of fixed O&M costs for the stations required in the first year; 75 percent of the initial and decommissioning costs for the stations required in the second year; and 10 percent of the initial costs for the stations required in the third year. Under this worst case example, staff assumed that by the third quarter of the first year following the onset of the CFO it would be clear to all parties that no additional effort or financial commitment to hydrogen infrastructure would be required. Table IV-15 illustrates the estimated total costs incurred by all regulated parties by the end of the first year of CFO onset.

**Table IV-15. Estimated Total Cost to Regulated Parties at End of 2018 Lower Bound FCV Scenario and 2015**

<b>Year</b>	<b>Required New Stations</b>	<b>Total Cost (\$million)</b>
<b>2018</b>	5 (regional trigger)	\$11.91
<b>2019</b>	9	\$14.18
<b>2020</b>	26 (statewide trigger)	\$4.47
<b>Total cost incurred under Lower Bound Scenario</b>		<b>\$30.56</b>
<b>2015</b>	9 (regional trigger)	\$21.36
<b>2016</b>	39 (statewide trigger)	\$61.10
<b>2017</b>	32	\$5.52
<b>Total cost incurred under Upper Bound Scenario</b>		<b>\$87.98</b>

To give these numbers perspective, staff compared both totals to the amount of gasoline that the regulated parties, the seven major refiner/importers of gasoline, supply

<sup>77</sup> Decommissioning cost is estimated to be \$50,000 to \$10,000. Sources: bids received by CaFCP to decommission their liquid delivery hydrogen fueling station in West Sacramento, and information provided by sources to be quoted later. \$100,000 was used in the above estimates.

to the California market (which was approximately 13.77 billion gallons in calendar year 2010). However, it is anticipated that existing policies guiding the reduction in gasoline consumption through 2016, as well as the gasoline consumption reductions anticipated to occur as a result of this Advanced Clean Cars program, could result in a 17 percent reduction in gasoline consumption from 2010 to 2020.<sup>78</sup> A 17 percent reduction in gasoline produced or imported by the regulated party amounts to 11.43 billion gallons per year. If the worst case scenario discussed above occurred, the regulated parties may desire to pass the cost they incurred as a result of the CFO regulation on to their customers through gasoline sales. If this were to occur in a single year, it would amount to \$0.003 per gallon in the Lower Bound Scenario and \$0.008 per gallon in the Upper Bound Scenario.

## 5. Summary of Economic Analysis Results

This economic analysis illustrates that, under the two example hydrogen price scenarios considered, the owner of a hydrogen station will be able to recoup their initial investment and start making a profit within three years. The analysis supports the notion that hydrogen could be priced competitively with gasoline when compared on a gallon-gasoline-equivalent per mile basis, and that with high station utilization, hydrogen could be priced comparatively lower than gasoline.

Station utilization is the key factor in how quickly a profit can be derived at a station. This analysis uses equations from the CFO regulation to determine how many stations are needed based on FVC projections and fuel demand, and the assumption that, after a period of adjustment, FCV owners will use their FCVs for all of their driving (see Table IV-5 for assumptions on station utilization rates). The CFO is intended to match supply with demand thereby facilitating high utilization. The results presented in this section indicate that a lower utilization, for example 90 instead of 100 percent, does not have a significant effect on the timing for recoupling investment and turning a profit.

Under the worst case scenario, if the projected vehicles do not materialize and required stations are underutilized or not utilized at all, the regulated parties will not be able to recoup their investment through hydrogen sales. If the amounts in Table IV-15 were distributed equally among the seven regulated parties, total losses could amount to \$4.4 to 12.6 million each. It is important to note, however, that the losses under the worst case scenario would be limited to this amount since no additional stations would be required. If vehicle deployments materialize later or in smaller quantities than projected,

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<sup>78</sup> Table V-D-1 of "Staff Report: Initial Statement of Reasons for proposed rulemaking, public hearing to consider the "LEV III" amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emissions Standards and Test Procedures, and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-duty Trucks, and Medium-duty Vehicles, and to the Evaporative Emission Requirements for Heavy-duty Vehicles." Dec. 8, 2011.

regulated parties could start selling fuel; however, it would take more time to recoup their investments.

## 6. Other Economic Impacts

As more hydrogen stations are constructed in the state, local authorities will be required to permit and inspect these stations, potentially adding to their workload. Staff anticipates that local permitting agencies will pass the cost through permitting fees onto the station developer and, as such, these costs are included in this economic analysis.

Additionally, hydrogen dispensing equipment will require routine testing to ensure that it conforms to requirements set forth by the California Department of Food and Agriculture, Division of Measurement Standards (DMS). DMS will develop a protocol for certifying hydrogen dispensers with funding through CEC. Once developed, the cost of certifying individual dispensers will be passed on to the station owner.

Finally, staff expects that the increase in station construction and operation activity will result in new jobs associated with station construction, hydrogen production, hydrogen delivery, station operation and maintenance. Job losses may include those associated with the production, delivery and retail sale of gasoline.

## V. Legal Authority

When the Clean Fuels Outlet Regulation was first proposed by ARB staff in 1990, some stakeholders questioned whether ARB had the authority to adopt the regulation. In response, ARB General Counsel Michael P. Kenny issued a legal opinion dated July 31, 1990, entitled “*Authority of Air Resources Board to Adopt Requirements for the Distribution and Retail Availability of Clean Motor Vehicle Fuels.*” The opinion concluded that the Board had the legal authority to adopt the proposed regulation, upon making appropriate findings of necessity, cost-effectiveness, and technological feasibility. This legal opinion can be found in Appendix F.

The reasoning set forth in July 31, 1990 legal opinion applies with equal force to staff’s current proposed amendments to the Clean Fuel Outlet Regulation. To briefly summarize, Health and Safety Code section 43018 is the primary source of ARB’s legal authority to adopt the proposed regulation. This section was enacted as part of the California Clean Air Act of 1988 (CCAA; Stats. 1988, Chapter 1568), which expanded ARB’s previous authority to regulate and control the sale of motor vehicle fuels. Section 43018 does not limit the Board’s regulatory options to adopting “specifications” of fuels. Rather, it authorizes the Board to adopt whatever control measures pertaining to fuels that are technologically feasible, cost-effective, and necessary to attain the state ambient air quality standards by the earliest practicable date. A more detailed discussion of the ARB’s legal authority and the CCAA can be found in the July 31, 1990 legal opinion.

Some commenters have argued that even if Health and Safety Code section 43018 provided ARB with such authority in 1990, it no longer provides such authority now. These commentators base their argument on language in Health & Safety Code section 43018(b), which directs the Board “not later than January 1, 1992” to “take whatever actions are necessary, cost-effective, and technologically feasible” in order to achieve specified amounts of emission reductions by December 31, 2000. It is argued that these provisions of section 43018 are all concerned with actions to be taken in order to achieve emissions reductions by December 31, 2000. Because this date has now passed, the contention is that section 43018 no longer provides any authority for ARB to adopt the proposed regulation.

We do not agree with this argument. Aside from the fact that section 43018 simply requires ARB to meet an ambitious time schedule and does not actually say that the Board’s authority would lapse in 2000, this argument is inconsistent with the Legislature’s intent in enacting the California Clean Air Act (CCAA). “Statutory time limits ordinarily are considered directory rather than mandatory and jurisdictional unless the Legislature clearly expresses a contrary intent.” (*Plastic Pipe and Fittings Ass’n v.*

*California Building Standards Commission*, 124 Cal.App.4<sup>th</sup> 1390, 1411 (2004.) “If depriving an agency of the power to act after a deadline has passed would defeat the purpose of the statute, a court should reject such a construction.” (*Ibid.*) One of the overarching purposes of the CCAA was to attain the state and federal ambient air quality standards by the earliest practicable date, and to give ARB the necessary additional authority to accomplish this (see Health and Safety Code sections 40910, 43000.5, and 43018(a), and uncodified section 1(b) of Stats. 1988, Chapter 1568). Most of California has still not attained the state and federal ambient air quality standards, and attainment is many years away for some nonattainment areas. It is not credible to believe that the Legislature intended to give ARB a deadline of December 31, 2000, to adopt regulations to attain the state and federal air quality standards and protect public health, and then take away this authority on that date even if these standards had yet not been attained and public health was still jeopardized. We therefore believe that section 43018 continues to provide ARB with the authority to adopt the proposed regulation.

## **VI. Summary of Proposed Regulatory Changes**

This section provides explanation or rationale for each proposed change included in the proposed regulation order in Appendix A. to the Clean Fuels Outlet Regulation

### **Amendments to Title 13, CCR, Chapter 8.**

The name of the chapter is being changed to “Clean Fuel Outlets.” This change identifies the purpose of the chapter to be clean fuel distribution outlets.

### **Amendments to Title 13, CCR, Section 2300. Definitions.**

Modifications to this section include deletion of definitions that no longer apply, modification to definitions that are needed to address the unique qualities of zero emission fuels, and the additions of terms needed to incorporate fuels needed for zero emission technologies.

#### ***The following definitions are being removed:***

(1) The definition of “affiliate” is being removed because the word is no longer used in the regulation.

(4) The definition of “CNG” is being removed because CNG is not used in ZEVs and, therefore, is no longer covered by this regulation.

(8) The definition of “dual fuel vehicle” is being removed because the definition states that the vehicle also operates on gasoline, which is not a zero emission vehicle (ZEV) fuel. Only ZEVs are included in this regulation. Dual fueled ZEVs are inherently captured in this regulation.

(11) The definition of “flexible fuel vehicle” is being removed because the definition states that the vehicle also operates on gasoline, which is not a zero emission vehicle fuel. Only ZEVs are included in this regulation.

(13) The definition of “gasoline supplier” is being removed because the term is no longer used in the regulation.

(15) The definition of “liquid designated clean fuel” is being removed because it is no longer used in the regulation, and staff believes that the definitions of “designated clean fuel” and “designated clean fuel vehicle” capture all ZEV fuels, regardless of state of matter.

(16) The “low emission vehicle” definition is being removed. This regulation is being modified to only apply to fuels for ZEVs.

(21) The definition of “owner/lessor” is being removed. The definition was used to determine the responsible party based on gasoline station ownership. The determination of the responsible party is being modified so that it is based on the amount of gasoline provided to the California market. A new definition for the responsible party, “major refiner/importers of gasoline,” has been added, therefore, the owner/lessor definition is no longer needed.

(22) The “primary designated clean fuel” definition is being removed to reflect the modification of the regulation to only include fuels used to certify ZEVs.

(23) The “produce” definition is being removed because it is no longer used in the regulation.

(26) The “refinery” definition is being removed because it is no longer used in the regulation.

(31) The definition for “vehicle conversion” is being removed. The regulation is being modified to include only original equipment manufacturer vehicles. Staff believes that vehicle conversions will not be in a significant quantity due to cost and production issues.

***The following definitions are being modified:***

(3) The definitions of “clean alternative fuel” and “clean fuel” are being modified to include only fuel for ZEVs. ZEVs, ZEV-enabling technologies, and technological improvements to gasoline-powered low emission vehicles (as proposed in the amendments to the Low Emission Vehicle regulation) together have the greatest potential for achieve long-term reductions in emissions of criteria pollutants and greenhouse gasses in the light duty vehicle sector. ZEVs, especially hydrogen fuel cell vehicles that require hydrogen fueling stations, face the greatest infrastructure challenge.

(4.1) The definition of “compliance year” is being changed from the original equipment manufacturers’ production cycle to the calendar year to address the need for hydrogen infrastructure to be in place before full scale fuel cell vehicle deployments so that potential customers are more likely to have confidence of hydrogen fuel availability before they purchase or lease a fuel cell vehicle.

(4.2) The "dedicated clean fuel vehicle" definition is being modified to remove low emission vehicles and only include ZEVs operated solely on clean alternative fuels. This definition is used to determine the amount of clean fuel needed.

(5) The "designated clean fuel" definition is being modified to reflect which fuels are included in the regulation. Addition, references to low emission vehicles are being removed as only ZEVs are being included in the regulation. Also, the definition adds the reference for the process for including electricity as a designated clean fuel, if deemed necessary.

(10) The "fleet operator" definition is being modified to limit the category to only ZEVs to be consistent with the other proposed changes.

(10.1) The "fleet vehicle" definition is being modified to limit the category to only ZEVs.

(14) "Import" means to bring motor vehicle fuel into California for the first time for use in motor vehicles in California.

(17) "Major breakdown" is being modified to apply to all fuels used for ZEVs.

(19) "Minor breakdown" is being modified to apply to all fuels used for ZEVs.

The following definitions are being modified for minor edits, updating numbering, or for clarification purposes:

(2) "CEC," (9) "Executive Officer"

***The following definitions are being added.***

(12.1) The definition of "Gasoline" is being added and is used in the determination of the responsible parties, and in the calculation of clean fuel outlets.

(14.1) The definition of "Importer" is being added and is used in the determination of the responsible parties.

(17.1) The definition of "Major refiner/importer of gasoline" and "refiner/importer" are being added and are used in the determination of the responsible parties.

(18) The calculation to determine number of outlets required by each responsible party has changed and is determined by market share. A definition of "Market share" was added to address this change.

(21.1) The responsible party and the determination of outlets has changed. The definition of "Position holder" is needed in the determination of the responsible party.

(23.1) The responsible party and the determination of outlets has changed. The definition of “Producer” is needed in the determination of the responsible party.

(24.1) The responsible party and the determination of outlets has changed. The definition of “rack” is needed in the determination of the responsible party.

(30) The responsible party and the determination of outlets has changed. The definition of “Terminal” is needed in the determination of the responsible party.

(32) The regulation has changed to only include fuels for ZEVs. A definition of “Zero emission vehicle” and “ZEV” is being added to the regulation.

### **Amendments to Title 13, CCR, Section 2302. Equipping Retail Gasoline Outlets or Other Outlets to Dispense Designated Clean Fuels.**

This section addresses the requirements necessary for the outlets to dispense clean fuels.

(a) The modifications to this section are being made to address the changes to the way the industry handles fuel and thus the changes to the responsible party.

(b) The modifications to this section are being made to address the changes needed for clean fuels used in ZEVs.

(1) This new subsection provides information on the pressures required to fill the ZEVs.

(2) This new subsection identifies that the Society of Automotive Engineers standard J2601 must be adhered to for fueling zero emission hydrogen fuel cell vehicles.

(3) This new subsection identifies that the requirements in section 2309(b) for clean fuel outlets must be met.

(c) This section is being added to require staff to (1) evaluate electric vehicle charging infrastructure; (2) determine the need for a charging infrastructure mandate; and (3) develop a time line for a regulatory proposal if the need for a mandate is determined. The requirements of this added section must be met within two years following the adoption of the regulation.

### **Amendments to Title 13, CCR, Section 2303. Determination of Total Projected Maximum Volumes of Designated Clean Fuels.**

This section identifies how to determine the annual amount of fuel necessary for clean vehicles. The section was modified to remove low emission vehicles and only include ZEVs. Modifications are being made to the timeline for notification from 14 months to

28 months. This modification is necessary to accommodate for the additional time required to permit and construct hydrogen fueling stations.

(a) Identification of designated clean fuels.

The proposed modifications to this section reflect the changes necessary for ZEVs and the test procedures for those vehicles. In addition, a sentence was added to clarify that the Executive Officer has the ability to determine if fuels should be designated as a clean fuel.

(b) Estimation of number of designated clean fuel vehicles.

(1) Modifications to this section include clarification corrections and typographical corrections. In addition, language was changed to reflect the proposed modification to include only fuel for ZEVs. Staff also proposes to extend the notification timeline for the responsible party. Following are rationale for the proposed modifications for estimating the number of ZEVs certified on hydrogen:

[i] The cited Low Emission Vehicle test procedure includes revisions that require vehicle manufacturers to provide projections of ZEVs that operate on hydrogen for an additional year into the future.

[ii] Because the compliance year was modified to start in January, this paragraph was modified to increase the fraction of projected vehicles included in the equation to account for the fact that fewer vehicles will have been sold and registered with DMV when the calculations are being made.

[iii] The modification to use DMV records for ZEVs certified on hydrogen through May 31 instead of July 31 accounts for staff's proposal to change the start of the compliance year to January 1.

(2) Vehicle manufacturers reporting will be modified to require vehicle projections and sales data by air basin. This paragraph was added to provide regulated parties with information on where fueling infrastructure is needed.

(c) Determination of total projected maximum volumes of designated clean fuel.

This section identifies how the volume of clean fuel for ZEVs will be calculated. The existing language provides calculations for determining the volume of fuel needed statewide. The modifications being proposed provide the calculation procedures for determining the volume of fuel needed by air basin. Some modifications are also made for clarification purposes. The units used for measurement for gaseous fuel are being changed to kilograms as that unit of measurement is used with gaseous zero emission

fuels. Therefore, the model year included for vehicle tracking is being changed. The number of remaining model year 2000 and earlier ZEVs is limited and not significant enough to affect vehicle numbers counting toward the trigger calculation. Also, fueling protocol for the early electric vehicles is not consistent with what is being required and standardized today.

(d) Characterization of certain dual-fuel or flexible-fuel vehicles.

This section was removed as dual fuel vehicles, as previously defined, and flex fuel vehicles are not ZEVs and are therefore not part of the regulation.

### **Amendments to Title 13, CCR, Section 2303.5. Identification of Designated Clean Fuels Projected to Reach the Trigger Level In a Particular Year.**

(a) The trigger level requirement.

This section sets the number of clean fuel vehicles that are necessary to trigger the regulation. Modifications are being proposed to provide an additional determination for vehicles within an air basin. Other modifications clarify that only ZEVs are clean fuel vehicles.

(1) Number of designated clean fuel vehicles necessary to trigger a retail clean fuel outlet requirement.

Modifications are being proposed to provide an additional determination for vehicles within an air basin. Other modifications clarify that only ZEVs are clean fuel vehicles.

(2) Reducing the discount factor for fleet vehicles.

Modifications to this section are to correct typographical errors.

(b) Yearly projections regarding the trigger level.

References to vehicles are being changed to ZEVs as low emission vehicles are no longer covered under this regulation. As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. The Executive Officer will notify interested parties thirty months prior to the start of the year instead of sixteen. Other proposed modifications to this section are to correct typographical errors.

(c) Requests to revise trigger level projections.

As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. Therefore, the timeline for the Executive Officer to issue a final determination is being changed to twenty–nine months before the start of the year from

fourteen months. Other modifications to this section are to correct typographical errors or for clarification purposes.

**Amendments to Title 13, CCR, Section 2304. Determination of Total and Additional Number of Retail Clean Fuel Outlets Required for Each Designated Clean Fuel in Each Year.**

This section describes the process for determining the number of stations required under the regulation and evaluates the current status of stations to determine the need for additional stations. Modifications to this section include those to incorporate the determination the station need by air basin. As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. The Executive Officer will notify interested parties twenty-nine months prior to the start of the year instead of fourteen. Other proposed modifications to this section are to correct typographical errors.

(a) Determination of total number of retail clean fuel outlets required for each designated clean fuel in each year.

This section describes how to determine the total of clean fuel stations needed. Modifications to this section are for clarification purposes or are the correction of typographical errors.

(1) Formula for calculating required number of clean fuel outlets.

This section provides the formula for determining the total number of clean fuel stations needed. The proposed modifications include the deletion of the volume of fuel needed from vehicle conversions because vehicle conversions are no longer included in the regulation.

(2) Executive Officer adjustments to the number of required retail clean fuel outlets.

This section provides information regarding potential adjustments to the number of clean fuel outlets based on types of vehicles, fleets of vehicles, and existing outlets. Other modifications include typographical errors.

(A) Reducing projected clean fuel volume to reflect the volume of gasoline used in dual-fuel or flexible-fuel vehicles.

This section, which provided adjustments from dual fuel vehicles and flexible fuel vehicles, was removed because these vehicles are no longer included in the regulation.

(B) Change to the discount for fleet vehicles.

This section described the adjustments that are made if ZEVs are fleet vehicles. As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. Dates were changed to thirty-one months prior to the start of the year instead of eighteen. Other modifications include typographical errors or addition of information for clarification purposes.

(C) Reducing the number of required retail clean fuel outlets to reflect certain preexisting outlets.

This section identifies how to reduce the number of additional clean fuel outlets required based on the existing clean fuel stations. Modifications to this section represent the change to the responsible party. Modifications also include requiring operators of existing clean fuel stations who are not considered “regulated parties” to certify that they will operate their station throughout the compliance year before their station can be used to reduce the number of required clean fuel outlets per this subsection. Other modifications correct typographical errors or for clarification purposes.

(D) Notification regarding any adjustments.

This section describes the process for notification of adjustments. As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. Dates were changed to twenty-eight months prior to the start of the year instead of fourteen. Other modifications made are to correct typographical errors or for clarification purposes.

(E) Requests to revise the Executive Officer's adjustments.

This section describes the process requests from industry to revise Executive Officer's adjustments. As previously mentioned, the notification timeframe for required clean fuel outlets is being increased. Dates were changed to twenty-six months prior to the start of the year instead of twelve. Other modifications made are to correct typographical errors or for clarification purposes.

(b) Determination of total number of additional clean fuel outlets required each year for each designated clean fuel.

This section describes the means to determine the number of additional clean fuel stations needed. A clause in the second sentence of this paragraph was removed because it was previously repeated in error. Other modifications made are to correct typographical errors or for clarification purposes.

**Amendments to Title 13, CCR, Section 2306. Identification of Affected Owner/Lessors Required to Equip Additional Retail Clean Fuel Outlets Each Year.**

This section provides the means to determine for who is responsible for installing stations. The responsible party is being changed to refiners/importers and is no longer based on station ownership. Therefore, this section is being removed and replaced by section 2306.1.

**Amendments to Title 13, CCR, Section 2306.1. Determination of Market Share for Each Major Refiner/Importer of Gasoline**

This new section provides the means to determinate market share for refiners and importers of gasoline. It also identifies that the calculations will begin twenty-nine month prior to the start of the year.

**Amendments to Title 13, CCR, Section 2307. Allocation Among Major Refiner/Importers of Gasoline of the Total Number of Retail Clean Fuel Outlets.**

This section provides the means to determine who is responsible for installing stations and the how many stations each major refiner or importer is responsible for. Modifications proposed include correction of typographical errors.

(a) Allocation among affected major refiner/importer of gasoline of the number of additional retail clean fuel outlets for each year.

Modifications include changing the responsible party from Owner/Lessor to major refiners and importers of gasoline and references to sections that apply to the new regulated party. Additional modifications proposed include correction of typographical errors and changes for clarity.

(b) Determination of an owner/lessor's number of non-clean fuel retail gasoline outlets.

Gasoline stations are now primarily owned by private parties who own relatively small numbers of stations. The number of clean fuel stations required to be installed by a regulated party is no longer determined by the number of their existing gasoline stations. As such, this section was removed.

(c) Determination of clean fuel fraction.

Gasoline stations are now primarily owned by private parties who own relatively small numbers of stations. The number of clean fuel stations required to be installed by a regulated party is no longer determined by the existing gasoline stations owned. This section was removed.

(d) Determination of each major refiner/importer of gasoline's total required minimum number of retail clean fuel outlets for each clean fuel for each year.

This section determines the number of stations for each major refiner and importer of gasoline. Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Modifications also include the additional requirements to determine the number of stations by air basins. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

(e) Notification of refiner/importers.

This section describes how the refiners and importers will be notified and when they will be notified. Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Modifications also include the additional time for notification. Notification is proposed to be twenty-eight month prior to the start of the year instead of fourteen months.

### **Amendments to Title 13, CCR, Section 2308. Constructive Allocation of Retail Clean Fuel Outlets**

This section addresses the requirements of the fueling stations.

(a) Modifications include changing the responsible party from Owner/Lessor to major refiners and importers.

(b) No modifications are proposed.

(c) No modifications are proposed.

(d) This section only applied to existing retail gasoline stations. Proposed modifications to this section change this to apply to all proposed constructive allocations of clean fuel outlets. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

(e) Modifications place the responsibility of complying with the station requirements on the owner of the constructively allocated clean fuel outlet to reflect changing the responsible party from Owner/Lessor to major refiners and importers.

(f) Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

(g) Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

## **Amendments to Title 13, CCR, Section 2309. Responsibilities of Refiner/Importers of Selected Retail Clean Fuel Outlets.**

This section describes the responsibilities of the refiners/importers of clean fuel outlets. Modifications provide requirements for previously installed stations to be included as a clean fuel outlet. These requirements must be met with the requirements prior to January 1, 2015.

### **(a) Locations of required clean fuel outlets.**

Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Obsolete text regarding the CEC methanol program has been removed. Modifications also include additional time for installation of stations. The timeline for the responsible party to provide proposed locations for clean fuel outlets to the Executive Officer is extended to twenty-two months from eight months. In addition to the proposed locations, the amount of optional locations shall be in excess of the required locations by 40 percent. This proposed modification of optional locations was changed from an excess of twenty percent. Proposed modifications include the addition of modeling tools to establish and evaluate clean fueling infrastructure scenarios. Notification of the final determination of the station location has been modified from five to nineteen months. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes. .

### **(b) Requirements for selected retail clean fuel outlets.**

This section outlines the requirements for clean fuel outlets and identifies that the refiner/importer be responsible for ensuring the requirements are met. Non-duplicative requirements of sections 2309(c) have been added to this section. This section was also modified to remove obsolete terms and requirements. Additions include identification of requirements necessary for zero emission fuels.

### **(c) Requirements regarding facilities at selected clean fuel outlets at which gasoline is not offered to the public.**

This section is being removed and non-duplicative requirements are being added to section 2309(b).

### **(d) Requirements regarding supply of designated clean fuels to selected retail clean fuel outlets.**

(1) This subsection is being removed because the requirements to ensure the supply of reasonable quantities of clean fuel to each outlet are encompassed in the compliance requirements of the responsible party set forth in sections 2302 and 2309(b).

(2) Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Added to the notification requirements of this subsection is the requirement that the regulated party identify contractors hired for the operation and maintenance of the clean fuel outlet. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

(e) Annual reports regarding compliance with section 2302.

This section describes what is required in the annual reports from refiners and importers. Modifications include changing the responsible party from Owner/Lessor to major refiners and importers. Additional modifications proposed include correction of typographical errors and modifications for clarification purposes.

### **Amendments to Title 13, CCR, Section 2310. Responsibilities of Operators of Selected Retail Clean Fuel Outlets.**

This section described the responsibilities of operators for clean fuel outlets. This section is proposed for removal and non-duplicative requirements are being added to 2309(b).

### **Amendments to Title 13, CCR, Section 2311. Relief from Liability Caused by Breakdowns of Clean Fuel Dispensing Equipment.**

This section establishes the conditions of liability related to breakdown of dispensing equipment. Modifications include: changing the type of equipment from CNG equipment to clean fuel equipment thereby including hydrogen and potentially electricity, and changing responsibility from owner/lessor or operator to refiner/importer.

Provisions for a major equipment breakdown were modified to reduce the amount of time required for a responsible party to repair a major equipment breakdown from six months to one month. Allowing a station to be nonoperational for six months without being in violation would be too disruptive to fuel cell vehicle drivers depending fueling stations. Additionally, if the responsible party is unable to make the necessary repairs within a month, temporary fueling equipment can be used to provide fuel to customers while equipment is being repaired.

### **Amendments to Title 13, CCR, Section 2311.5. Notification of Executive Officer Reporting Obligations**

This section establishes when the Executive Officer shall notify identified parties that there is a possibility that the vehicle based trigger may be reached. Modifications include changing the vehicle threshold to include a 10,000 vehicle air basin based trigger (only a 20,000 vehicle statewide trigger was in place previously). Modifications

also include changing the notification period from 22 months to 34 months prior and including zero emission fleet operators and major refiner/importers of gasoline in the notifications.

### **Amendments to Title 13, CCR, Section 2312. Reporting Requirements for Major Refiner/Importers of Gasoline**

This section requires responsible parties to report the number of retail gasoline outlets that they own or are affiliated with. Modifications include changing the responsible party from Owner/Lessor to major refiners and importers, and including information about the refiner/importers affiliation with the stations, whether it be as an owner, distributor, franchisor, or affiliated with the brand of fuel supplied at the station.

### **Amendments to Title 13, CCR, Section 2313. Reporting Requirements for Fleet Operators**

This section establishes reporting requirements for fleet operators. Modifications include changing the reporting period from 18 months to 32 months prior to the start of the year and modifying the vehicle requirement from low-emission vehicles to ZEVs.

### **Amendments to Title 13, CCR, Section 2314. Reporting Requirements for Producers and Distributors**

This section addresses reporting requirements for distributors on clean fuel. It was modified to include requiring producers of the designated fuel to report the required data, when previously, only distributors had to report. Modifications include the additional requirement that persons who produce or distribute the clean fuel report the volume of fuel distributed to each outlet on a quarterly basis. This provision was added to assist staff in quantifying the amounts of clean fuel being distributed by geographic area.

### **Amendments to Title 13, CCR, Section 2315. Determination of Violations**

This section describes determination of violations of the regulation and related penalties.

(a) Violation of section 2302.

This part addresses the failure of the primary regulated party to provide the required number of outlets. It was modified to reflect that the regulated party is now the refiner/importer and removed the provision that the penalty be assessed based on the first ten vehicles fueled. This provision was removed because some refiner/importers do not own a single outlet, thereby providing no metric to assess a penalty for non-

compliance. Modifications to this section include assessing a fixed daily penalty for non-compliance with section 2302. The relevant penalties are described in Health and Safety Code sections 43027 and 43028. These modifications seek to ensure that penalties equitably capture non-compliant regulated parties regardless of the number of retail gasoline outlets they own.

(b) Violation of section 2309 (b)

This part addresses the failure to operate the stations according to the specifications in section 2309(b). The modifications reflect the regulated party is now the refiner/importer versus the owner/lessor previously and removes the provision that penalties be assessed based on the first five vehicles fueled. As stated above, this provision was removed because some refiner/importers do not own a single outlet, thereby providing no metric to assess a penalty for non-compliance. Modifications include assessing a fixed daily penalty for failure to comply with section 2309(b). The relevant penalties are described in Health and Safety Code sections 43027 and 43028. These modifications seek to ensure that penalties equitably capture non-compliant regulated parties regardless of the number of retail gasoline outlets they own.

(c) Violation of section 2310

This part addresses requirements of the operator of a station. The requirements of section 2310 were combined with section 2309. This subsection is no longer needed.

(d) Violations of Section 2303 (b)(2)

This section was added to include penalties for motor vehicle manufactures that fail to deliver for sale or lease at least 80 percent of the projected number of designated clean fuel vehicles. The relevant penalties are described in Health and Safety Code 42402.4. This addition establishes a penalty to motor vehicle manufacturers for over reporting that did not exist before. Over reporting could result in undue burden on refiner/importers requiring them to build more clean fuel outlets than necessary.

**Amendments to Title 13, CCR, Section 2316. Determination of Energy Equivalency of Fuels**

This section provides information on energy equivalency values for clean fuels compared to gasoline. Modifications include: revising the volumetric energy content for gasoline to 109,600 BTUs per gallon to reflect the new standards and ethanol content of California reformulated gasoline specified in the Low Carbon Fuel Standard regulation; removing all fuels that are not zero emission fuels; and adding the energy equivalency value for gaseous hydrogen in BTUs per gallon gasoline equivalent based. This

modification reflects changes in gasoline standards and that the regulation only pertains to ZEVs and ZEV fuels.

**Amendments to Title 13, CCR, Section 2317. Section Provided for the Designation of a Substitute Fuel**

This section was removed. This section previously established the procedure that allowed a substitute fuel to be used instead of a primary designated fuel, for example requesting the use of a CNG fuel with a slightly different energy content than the certification CNG fuel. Since the regulation will now exclusively focus on zero emission fuels, hydrogen in the near term and potentially electricity at a later time this section is no longer applicable. The fuel quality of hydrogen is set by the Department of Food and Agriculture through the Division of Measurement and Standards.

**Amendments to Title 13, CCR, Section 2318. Sunset for Particular Designated Clean Fuels.**

This section identifies when the regulation ceases to require the construction of clean fuel outlets. The modifications reduced the ratio of clean fuel outlets to gasoline outlets from ten percent to five percent as ratio is a likely signal of adequate consumer acceptance of the technology to support the necessary expansion of hydrogen infrastructure absent a mandate.

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**APPENDIX A**  
**PROPOSED REGULATION ORDER**

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