Meeting the Goals of AB 32: Fuels of the Future

An Informational Hearing of the
Senate Transportation and Housing Committee
October 24, 2011 – 1:00 PM
State Capitol, Room 112

BACKGROUND PAPER

Purpose

This informational hearing of the Transportation and Housing Committee will examine the long-term viability of available fuels to meet California's transportation demands – demands that reflect state policies on air quality and greenhouse gases.

Background

State law assigns the California Air Resource Board (ARB) with primary responsibility for implementing California's air quality and greenhouse gas (GHS) emission policies. State law gives ARB authority to control of mobile source air pollution, including the adoption of rules for the reduction of harmful vehicle emissions and the specification of vehicular fuel composition.

In 2006, the Legislature passed and the Governor signed AB 32 (Núñez and Pavley), Chapter 488, to establish a statewide GHG emissions limit such that by 2020 California shall reduce its GHG emissions to the level they were in 1990. Carbon dioxide is but one greenhouse gas. Others include methane, nitrous oxide, hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

AB 32 requires the ARB, among other things, to:

- Inventory GHG emissions in California. (ARB's measurement shows that transportation accounts for 38 percent of GHG emissions in the state.)

- Implement regulations and impose fees that achieve the maximum feasible and cost-effective reduction in GHG emissions.

- Identify and adopt regulations for Discrete Early Actions to reduce GHG.

In analyzing GHG emissions by economic sector, ARB found that no one sector had a sufficiently large share of GHG emissions to become the primary focus for emissions reductions. ARB recognized the need for significant reductions in the transportation, electricity, commercial and residential, and industrial sectors, as well as contributing reductions from other sectors of the economy. Consequently, ARB has initiated multi-faceted GHG emissions strategies since the 2006 enactment of AB 32. Those strategies combine market-based regulatory approaches, other regulations, voluntary measures, fees, policies, and programs, including nine Discrete Early Actions.

In January 2007, Governor Schwarzenegger issued Executive Order S-01-07 in which he ordered the establishment of a statewide goal of reducing the carbon intensity of California's transportation fuels by at least 10 percent by 2020 and ordered ARB to establish a low-carbon fuel standard (LCFS) for the state. In June 2007, ARB included implementing a LCFS as an early action measure as provided by AB 32.

In December 2008, ARB adopted its AB 32 Scoping Plan to map out to achieve the reduction in GHG emissions by 2020, as required by AB 32. ARB established that reduction to be 174 $MMTCO_2E$ (million metric tons of carbon dioxide equivalent, a measure of greenhouse gas emissions). The scoping plan attributes a reduction of 15 $MMTCO_2E$ to the LCFS strategy.

ARB adopted the LCFS regulation in April 2009. The regulation entered into full effect on April 15, 2010 and was the first standard in the nation to restrict GHG emissions produced by fuels.

Additionally, the Scoping Plan included ARB adoption of clean car standards. In November 2011, the ARB will propose a suite of regulations affecting new cars sold between 2017 and 2025. These regulations are collectively called the Advanced Clean Cars Program and will combine regulations for reducing smog and GHG emissions and promoting zero-emission vehicles (ZEVs), such as battery electric, fuel cell, and plug-in hybrid electric vehicles.

The LCFS

ARB staff designed the LCFS to reduce GHG emissions by reducing the carbon intensity (CI) of transportation fuels used in California by an average of 10 percent by the year 2020.

CI is a measure of the direct and indirect GHG emissions associated with each of the steps in the full fuel-cycle of a transportation fuel (also referred to as the "well-to-wheels" for fossil fuels, or "seed or field-to-wheels" for biofuels). The overall GHG contribution from each particular step in the production and delivery process is a function of the energy that step requires. Thus, if a fuel that requires little energy to produce and produces little carbon when consumed has to be

trucked a long way to market, it can still have a high fuel-cycle CI because of the high energy requirements of getting it to market.

The LCFS achieves a 10 percent reduction in average CI by establishing an initial intensity level for specified providers of transportation fuels ("regulated parties") and incrementally lowering the allowable CI in each subsequent year. For example, modest targeted reductions of 0.25 and 0.5 percent are required for 2011 and 2012, respectively. The reductions become more substantial with each year, such that by 2020, the 10 percent average reduction is achieved. The graduated reduction allows low-CI alternative fuels, such as cellulosic ethanol and appreciably more electricity, to enter the marketplace.

A regulated party's overall CI for its transportation fuels needs to meet each year's specified CI level target. If the reduction in intensity exceeds the target, the provider earns a credit, which can be sold or carried forward. The LCFS allows for the reporting of fuels like electricity, hydrogen, and natural gas – which already meet the CI standards through 2020 – in order to generate LCFS credits that may be sold.

Regulated fuel providers, therefore, can meet their annual CI levels through several compliance strategies:

- Making low-GHG fuels, such as biofuels from waste products;
- Carrying forward credits from previous years from their own production process; or
- Buying credits from other fuel producers.

A fuel provider would meet the CI requirements of the LCFS if the amount of credits at the end of the year is equal to, or greater than, the deficits. A provider determines its credits and deficits based on the amount of fuel sold, the CI of the fuel, and the efficiency by which a vehicle converts the fuel into useable energy. Fuel providers may retain and trade credits so that they can meet their assigned obligations.

Under the LCFS, a regulated party's compliance with the annual CI requirements is based on end-of-year credit/deficit balancing.

Transportation Energy Forecasts

In August, the California Energy Commission (CEC) produced a draft report entitled, *Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report (IEPR).* In the report, CEC staff project consumption of transportation energy in California to increase in the future under a variety of fuel price and regulatory conditions; yet, they express substantial uncertainties associated with the future contributions of various renewable and alternative transportation fuels and technologies. While emerging fuels are expected to displace substantial amounts of petroleum, which would reduce the need for petroleum-specific infrastructure enhancements, the report explains that alternative fuels have their own set of marketing, supply, infrastructure, and regulatory challenges affecting market penetration. Moreover, the report explains that transportation-related energy industries must develop the

means of distributing emerging fuels through public retail refueling and recharging sites and home refueling and recharging systems, and then align the installation of these systems with the rollout of appropriate numbers of vehicles.

The draft CEC report makes the following points in regard to the LCFS:

- Federal mandates, such as the revised Renewable Fuel Standards, in conjunction with the LCFS are expected to increase quantities of ethanol and biodiesel use in California over the next several years, including a longer-term move to renewable hydrocarbons that will begin to displace a portion of the gasoline and diesel fuel used for transportation.

- The High Carbon Intensity Crude Oils (HCICO) provision of the LCFS identifies and discourages significant use of HCICOs in California refineries because they require more energy to produce and result in higher carbon emissions over the lifecycle of the fuel. The HCICO provision could impact refiner profitability and, ultimately, the cost of petroleum fuel in California.

- Refineries may close in California, given recent announcements made by several oil companies and an assumption that California refinery operating costs are higher than other regions of the United States.

- Traditional relatively-high CI biofuels, such as corn-based ethanol and biodiesel, will still have a role under the LCFS but will eventually lose market share to other fuels with lower CI including a variety of renewable hydrocarbons, natural gas, electricity, and hydrogen.

- Of the emerging renewable transportation fuels, only biomethane and renewable diesel are or are likely to be produced in commercial quantities to comply with the LCFS.

- Twenty-two other states are developing or considering LCFS rules, either singly or in regional groups. If such rules are adopted in a significant number of these states, competition and prices for desirable fuels and feedstocks will increase, as would the environmental benefits of more widespread use of low-carbon fuels.

Issues of Discussion

The committee may wish to consider the following during the hearing.

Achieving AB 32 Goals. In recognition of the threat to our environment, human health, and human society posed by global warming, California enacted AB 32 to reduce GHG emissions significantly by 2020. ARB states that reducing GHG emissions to 1990 levels means cutting approximately 30 percent from business-as-usual emission levels projected for 2020 or about 15 percent from today's levels.

Transportation is the largest single contributor of GHG emissions in California, making up 38 percent of emissions. It is, therefore, unlikely that without significant reductions derived from lowering the GHG emissions of transportation fuels that we could achieve the required GHG reductions.

Fuel Properties Comparison. Attached is a Fuel Properties Comparison Chart, derived from the US Department of Energy and modified to reflect California data. Fuel source, energy content, energy security impacts, number of fueling stations, price, and maintenance are issues to considered when comparing fuels for light-duty vehicles. Additionally, price should be considered in relation to energy content, as some fuels provide more or less energy than gasoline on a per unit basis.

The LCFS and CI values. The LCFS contains CI values for a variety of fuel pathways (fuels and their production and distribution processes) that ARB staff have analyzed. These CI values are the crux of the LCFS regulation for fuel providers. One issue in particular for biofuel producers is the CI derived from the indirect land use effects of crop-based fuels. Indirect land use impacts of significance result when, for example, an acre of soybeans grown in the United States is used for transportation fuel purposes rather than exported for food purposes. Somewhere else in the world, then, a new acre of soy beans has to be planted to replace the lost food, and that acre, if it replaces virgin land, then results in a large CI score for the crop-based biofuel.

Fuel source and supporting infrastructure. A larger alternatively-fueled vehicle fleet will increase demand for alternative energy sources, and these vehicles will require new supporting infrastructure. For example, with natural gas and electricity, acquisition practices and environmental repercussions should be considered when augmenting vehicle fleets. Additionally, for electricity, permitting and installation of electric vehicle charging stations should be considered such that power lines have sufficient capacity to handle increased demand. With fuel cell vehicles, a synergy between fuel providers and auto makers could assist in the development of the technology such that there are adequate stations for the consumer base when vehicles become more prevalent, but there may not be incentives for this kind of synergy.

Co-evolution of technologies. Alternative fuels are in their early generations, and it could be argued that a co-evolution of technologies is needed to support energy objectives while progressing toward the environmental objectives of AB 32. Continued research and lifecycle assessments of alternative fuels would provide a better understanding of how these technologies could fill niches in the present and future. Some of these technologies may not, however, help achieve the ultimate goals of AB 32 but could provide intermediate solutions until other technologies evolve to transition to a stable marketplace. Market stability depends, in part, on government signals that allow for the development and transition of technologies. Additionally, consumer demand influences market stability, and government signals can encourage consumers to choose cleaner technologies.

Witnesses

This hearing will include three panels of witnesses, background for whom is provided below, plus time for public testimony.

Panel 1: Transportation Fuels Overview

Mary D. Nichols is the Chairman of ARB, a post she has held since 2007. One of her priorities as chairman is moving ahead on the state's landmark climate change program, AB 32. Her testimony will provide ARB's vision for implementing AB 32, including the LCFS and other fuels policies.

Daniel Kammen, Ph.D is the Class of 1935 Distinguished Professor at the University of California, Berkeley, with appointments in the Energy and Resources Group, the Goldman School of Public Policy, and the Department of Nuclear Engineering. He is also director of the Transportation Sustainability Research Center and the Renewable and Appropriate Energy Laboratory.

Dawn Manley, Ph.D is the Deputy to the Vice President at Sandia National Laboratories in Livermore, California and has been responsible for developing and leading transportation energy programs with government, industry, academic, and international partners. Her research group has examined the feasibility of and technology options for future transportation energy pathways, including advanced efficiency, biofuels, hydrogen, and electric vehicles. Dr. Manley has organized energy policy and systems modeling workshops for interdisciplinary exchange between energy policy and technology communities.

Panel 2: Providing Fuels of the Future

Tim Carmichael is the President of the California Natural Gas Vehicle (NGV) Coalition, an advocacy organization working to promote NGV technologies to reduce greenhouse gas emissions, air pollution, and petroleum dependence. Membership includes 27 natural gas vehicle and engine manufacturers, utilities, fuel providers, and fleet operators.

Catherine Dunwoody is the Executive Director of the California Fuel Cell Partnership (CaFCP). The CaFCP is a collaboration of 29 organizations, including auto manufacturers, energy providers, government agencies, and fuel cell technology companies, that work together to promote the commercialization of hydrogen fuel cell vehicles.

Catherine Reheis-Boyd is the President of the Western States Petroleum Association (WSPA). WSPA is a trade association for companies that account for the bulk of petroleum exploration, production, refining, transportation, and marketing in the six western states of Arizona, California, Hawaii, Nevada, Oregon, and Washington. Membership includes 27 companies, such as Chevron, ConocoPhillips, ExxonMobile, Shell, and Valero.

Denise Gitsham is the Director of Corporate Affairs and Legislative Counsel for Sapphire Energy, Inc., a San Diego-based company that produces renewable algal biofuel. She is representing the Advanced Biofuels Association (ABFA). ABFA supports public policies that are technology-neutral, utilize sustainable feedstocks, and offer subsidy parity for viable advanced biofuels. ABFA has 33 member companies, representing a wide range of technologies, feedstocks, and molecules within the advanced biofuels industry.

Eileen Tutt is the Executive Director of the California Electric Transportation Coalition (CalETC), which is an association working to reduce GHG emissions and air pollution through the development and use of electric transportation and goods movement technologies. Members of CalETC include Southern California Edison, San Diego Gas & Electric, Pacific Gas & Electric, the Sacramento Municipal Utility District, the Los Angeles Department of Water and Power, General Motors, BMW, and Nissan.

Panel 3: Impacts of Fuels of the Future

Don Anair is a Senior Analyst/Engineer with the Union of Concerned Scientists (UCS), which is a 250,000-member science-based nonprofit working for a healthy environment and a safer world. UCS combines independent scientific research and citizen action to achieve changes in government policy, corporate practices, and consumer choices.

David Campbell is the Secretary-Treasurer of the United Steelworkers (USW) Union Local 675. The United Steelworkers Union represents 1.2 million active and retired members nationwide and locally represents workers in the oil, chemical, mail order pharmacy, and solar panel manufacturing industries.

Bonnie Holmes-Gen is the Senior Policy Director of the American Lung Association of California, which works to prevent lung disease and promote lung health through educational and advocacy programs on air quality and other health-related issues.

Simon Mui, Ph.D is a Clean Vehicles and Fuels Scientist for the Natural Resources Defense Council (NRDC). NRDC is an approximately 40-year-old environmental organization that has as its mission safeguarding the Earth – its people, plants, and animals – and the natural systems on which all life depends. It has over 1.3 million members and on-line activists.

Jane Williams is the Executive Director of California Communities Against Toxics, which works to protect communities from industrial pollutants and advocates for environmental justice, pollution prevention, and world peace.

FUEL PROPERTIES COMPARISON CHART[1]

	Gasoline	No. 2 Diesel	Compressed and Liquified Natural Gas	Electricity	Ethanol (E85)	Hydrogen
Main Fuel Source	Crude Oil	Crude Oil	Underground reserves	Coal, nuclear, natural gas, hydroelectric, wind, and solar	Corn, grains, or agricultural waste (cellulose)	Natural gas, methanol, and electrolysis of water
Energy Content as Compared to One Gallon of Gasoline	100%	One gallon of diesel has 113% of the energy of one gallon of gasoline.	5.66 lbs or 126.7 ft^3 of CNG has 100% of the energy of one gallon of gasoline. One gallon of LNG has 64%.	33.7 kWh has 100% of the energy of one gallon of gasoline.	One gallon of E85 has 77% of the energy of one gallon of gasoline.	One kg or 2.2 lbs of H^2 has 100% of the energy of one gallon of gasoline.
Energy Security Impacts	Manufactured using oil, of which nearly ⅔ is imported.	Manufactured using oil, of which nearly ⅔ is imported.	Produced domestically. The US has vast natural gas reserves.	Generation is 8% coal, 11% large hydroelectric, 42% natural gas, 14% nuclear, 14% renewable, and 11% other sources.[2]	Produced domestically. E85 reduces lifecycle petroleum use by 70%, and E10 reduces it by 6.3%.	Produced domestically, primarily from natural gas, but can be produced from renewable sources.
Number of Light-Duty Vehicles in California (2009)[3]	25,240,074[4]	462,936	24,819	15,031[5]	409,636 (Flex Fuel)	178[6]
Number of Alternative Fueling Stations in California	N/A	N/A	CNG: 224; LNG: 35	992 (excludes home stations)	62	22
Price per Gallon (unless otherwise denoted)[7]	$3.77	$4.14	$2.45/gasoline gallon equivalent		$3.36	$7/kg[6]
Vehicular Maintenance Issues			High-pressure tanks require periodic inspection and certification.	Fewer than with gasoline or diesel; however, it is likely that the battery will need replacement before the vehicle is retired.	Special lubricants may be required. Practices are similar to those for conventionally-fueled operations.	When hydrogen is used in fuel cell applications, maintenance should be minimal.

[1]Chart modified from: US Department of Energy (DOE): http://www.afdc.energy.gov/afdc/fuels/properties.html.

[2]Data sourced for California from California Energy Commission: http://www.energyalmanac.ca.gov/electricity/total_system_power.html.

[3]Data sourced from: Schremp, G.; M. Weng-Gutierrez, R. Eggers, A. Bahreinian, J. Gage, Y. van der Werf, G. Zipay, B. McBride, L. Lawson, G. Yowell. 2011. Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report. California Energy Commission. CEC-600-2011-007-SD.

[4]Hybrid vehicles account for an additional 384,567 vehicles.

[5]Includes Neighborhood Electric Vehicles.

[6]Data sourced from the California Fuel Cell Partnership.

[7]Data sourced for West Coast from: US DOE. July 2011. Clean Cities Alternative Fuel Price Report. http://www.afdc.energy.gov/afdc/pdfs/afpr_jul_11.pdf