

An Overview of the Low Carbon Fuel Standard (LCFS)
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Executive Summary

California Governor Arnold Schwarzenegger approved AB 32, the California Global Warming Solutions Act of 2006 on Sept. 27, 2006. Assembly Bill 32 “requires a cap on GHG emissions by 2020, mandatory emissions reporting, identification of discrete early action measures, achievement of the maximum technologically feasible and cost-effective emission reductions from sources, and authorizes the development of a market-based compliance program” (Executive Order S-01-07). Four months later, the Low Carbon Fuel Standard (LCFS) was proposed as a method to jumpstart California’s efforts towards reaching 1990 greenhouse gas levels. Discretion was placed with CARB (CA Air Resources Board) to decide whether the LCFS was suitable for adoption as a discrete early action measure called for by AB 32. The LCFS was approved by the California Air Resources Board (CARB) on April 23, 2009 by Resolution 09-31 and was effective on April 15, 2010. An expert workgroup is currently working with a proposed deadline of December 31, 2010 to compile a report of recommendations and regulatory amendments to be effective beginning in 2011. The first substantive requirements of the LCFS go into effect in 2011 with the intention of expert workgroup recommendations being added to official regulations by January 1st of the same year. In the lead up to a full implementation of a statewide LCFS, there is much discussion about the logistics of the strategy and what will happen when it is put into full effect. This paper will discuss the specific requirements of S-01-07, reasoning behind its creation, how the standard is organized, and an analysis of the progress of the California LCFS, including controversies surrounding the policy.

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I. REGULATIONS

Seven general guidelines are listed in Executive Order S-01-07. The first and foremost requirement of the document is that “a statewide goal be established to reduce the carbon intensity of California’s transportation fuels by at least 10 percent by 2020”. This is referred to as the “2020 Target”. To reach this goal, a Low Carbon Fuel Standard (LCFS) must be established for all transportation fuels sold in state.

The LCFS shall apply to all transportation fuels “providers”, a category which is defined as all refiners, blenders, producers, or importers. Regulations apply, either on a compulsory or opt-in basis, to the following fuel types:

- ✓ California reformulated gasoline (“gasoline” or “CaRFG”)
- ✓ California diesel fuel (“diesel fuel” or “ULSD”)
- ✓ Fossil compressed natural gas (“Fossil CNG”) or fossil liquefied natural gas (“Fossil LNG”)

- ✓ Biogas CNG or biogas LNG
- ✓ Electricity
- ✓ Compressed or liquefied hydrogen (“hydrogen”)
- ✓ A fuel blend containing hydrogen (“hydrogen blend”)
- ✓ A fuel blend containing greater than 10 percent ethanol by volume
- ✓ A fuel blend containing biomass-based diesel
- ✓ Denatured fuel ethanol (“E100”)
- ✓ Neat biomass-based diesel (“B100”) and
- ✓ Any other liquid or non-liquid fuel.

The opt-in provision allows for participation in the LCFS by parties producing or importing certain alternative fuels that inherently meet the lifecycle GHG emissions requirements set by the standard. This includes: electricity, hydrogen and hydrogen blends, fossil CNG derived from

North American sources, biogas CNG, and biogas LNG. By opting in to the LCFS, the company volunteers to become a regulated party under LCFS standards. All biomass-based fuels must submit to the LCFS standards due to their potentially large impacts on land use changes and sustainability. “The proposal exempts any alternative fuel that is not biomass-based or renewable biomass-based and for which the aggregated volume by all parties for that fuel is less than 420 million mega-Joules per year (3.6 million gasoline gallon equivalents per year). This is intended to exempt research fuels entering the market or very low volume niche fuels” (LCFS ISOR, V-3). Furthermore, propane, fuels for jets, racing vehicles, interstate trains, ocean-going vessels, and military tactical vehicles are exempt. Recreational marinecraft, intrastate locomotives, and commercial harborcraft are not part of this exemption.

A). Carbon Intensities - An upstream focus is utilized by the LCFS. Each company is assigned a maximum level of greenhouse gas (GHG) emissions per unit of fuel energy produced. The company is required to comply with the maximum level in the aggregate for each set regulatory period. The carbon-intensity of each fuel pathway must be measured on a full fuels cycle basis to take into account all carbon transfer (absorbed and emitted) from well (or seed) to wheel. Direct baseline carbon intensities for gasoline and diesel are calculated using CA-GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) version 1.8b. Emissions associated with land use or other indirect effects are estimated using the Global Trade Analysis Project (GTAP). GTAP and GREET carbon intensity values (gCO₂e/MJ) are added together to establish a total carbon intensity measurement for each fuel pathway.

B). Regulated Parties, Opt-Ins and Exemptions - A table of carbon intensities for common fuel pathways is created by the ARB as a result. This allows for a default or opt-in approach to be used within the state. Fuels are assigned a conservative default value for GHG emissions. For the defaults, standard gasoline and diesel fuel carbon intensity values are used as the baseline carbon intensities for each year and are lowered annually according to set increments. Gasoline, diesel, and fuels intended as substitutes for either standard gasoline and diesel must have carbon intensities equal to or lower than the baseline carbon intensities in order to

comply with LCFS performance-based standards. There is also an op-in option available for companies to take. Producers can petition for lower carbon intensity values to be assigned to their fuels by providing convincing evidence that their pathway is more efficient than the default baseline value listed in the ARB table.

C). Credits System - Following the specifications of AB 32, the LCFS shall be achieved through market-based compliance mechanisms. A credits system is to be established where any providers “exceeding the performance required by a LCFS shall receive credits that may be applied to future obligations or traded to Providers not meeting the LCFS” (Executive Order S-01-07). Extra credits may be banked by a party, sold on the market to other regulated parties, purchased and retired by a regulated party, or exported to other GHG reduction programs like AB 32. Credits may be saved for an indefinite period of time. Deficits are accumulated from the use of fuels with higher carbon intensities than the standard. A provider is deemed “in compliance” if their credits equal or exceed their deficits for a reporting period. A Low Carbon Fuel Standard Reporting Tool is available online for parties to track their progress. The year is divided into quarters to measure compliance. If a company’s deficit exceeds its credits for more than two consecutive periods, or if it is in possession of less than 90% of its credit obligation, then it is in violation of the LCFS. However, if a regulated party has at least 90% of its credits for a reporting period, it is allowed to carry over the deficit to the following reporting period.

D). Standards Requirements and Timelines - “Starting January 1, 2011, and for each year thereafter, a regulated party (producer or importer) must meet the average carbon intensity requirements set forth for its transportation gasoline and diesel fuel, respectively, in each calendar year. For 2010 only, a regulated party does not need to meet a carbon intensity requirement, but it must meet the reporting requirements...” (LCFS ISOR, A-10). Mandated carbon intensity requirements are shown in Figure 1 for gasoline and gasoline substitutes, and Figure 2 for diesel and diesel substitutes.

Every year the maximum average carbon intensity of a fuel is reduced by a set percentage and fuels must comply with the new lower standard for their category of fuel (gasoline or diesel). Reductions are intentionally back-loaded, with deeper reductions concentrated in the last 5 years of the program and more mild reductions within the first 5 years. This is intended to allow for technology to develop for advanced low carbon fuels and vehicles that can run on those fuels before restrictions become too intense to meet.

Figure 1 - Gasoline and Fuels Used as a Substitute for Gasoline

Year	Average Carbon Intensity	% Reduction
2010	REPORTING ONLY	
2011	95.61	0.25%
2012	95.37	0.5%
2013	94.89	1.0%
2014	94.41	1.5%
2015	93.45	2.5%
2016	92.50	3.5%
2017	91.06	5.0%
2018	89.62	6.5%
2019	88.18	8.0%
2020 and beyond	86.27	10.0%

Figure 2 - Diesel Fuel and Fuels Used as a Substitute for Diesel Fuel

Year	Average Carbon Intensity	% Reduction
2010	REPORTING ONLY	
2011	94.47	0.25%
2012	94.24	0.5%
2013	93.76	1.0%
2014	93.29	1.5%
2015	92.34	2.5%
2016	91.40	3.5%
2017	89.97	5.0%
2018	88.55	6.5%
2019	87.13	8.0%
2020 and beyond	85.24	10.0%

E). Compliance Strategies - With the design of the Low Carbon Fuel Standard, there are 3 compliance strategies that can be employed (individually or in combination) to meet each year's required performance level. The first option is to blend low GHG fuels into gasoline or diesel fuel. The second option is to purchase low GHG fuels such as natural gas, electricity, hydrogen, or biofuels. Lastly, with the market aspect of the LCFS, credits, purchased or banked from previous years, may be used to meet standards. This wide array of options for compliance increases the likelihood of parties meeting each year's compliance level.

II. REASONING

Assembly Bill 32, the Global Warming Solutions Act, calls for a cap on state GHG emissions at 1990 levels for 2020. This would set the cap at 427 million metric tons (MMT), which would require a reduction of GHGs by 16 MMT CO₂ equivalence. Forty percent of California's GHG emissions come from the transportation sector. Furthermore, 96% of transportation technology runs on petroleum-based fuels. A policy such as the LCFS which focuses on curbing emissions from transportation technology is beneficial in that it regulates an organized body of emitters (transportation vehicles) which have a large impact on our climate. Successfully implementing the LCFS would take the state more than halfway to AB 32's 1990 level requirement.

A). Goals - A statewide goal fueling the creating of a LCFS is to diversify the availability of fuel sources, decrease oil use, promote near and long-term transition from oil dependency, encourage innovation in the transportation industry, and to set an example for other regulating entities to follow in the future. There are myriad reasons which make reductions in GHG emissions and weaning from oil dependency a logical and necessary step to be taken by the state of California.

B). Energy Security - Energy security is a national concern that has been at the forefront of the political scene for the last 30 years. Reliance on foreign imports, with 65% of crude oil reserves in the Middle East, is a point of contention that is impossible to resolve without reducing

dependence on oil as our primary energy source. Current actions are only continuing the trend of transferring wealth out of the US. Furthermore, in the current economic state, the control that OPEC countries and the Persian Gulf have over the oil supply is a worrisome topic. Monopolizing around 40% of world crude oil production the effects of OPEC manipulation of the oil market can be seen throughout history

Further aggravating public national anxiety is the issue of oil availability. The concept of Hubert's peak has long been a foreboding left at the bottom of America's agenda, but some say that we are close to hitting the apex of oil production, while others believe the peak has already been passed. Oil is not a renewable resource, and as supply runs out a myriad of problems will arise. Shocks and recessions resulting from disruption costs to the market have been seen before and will be seen again unless changes are made. Working towards to use and expansion of renewable fuels is only logical with the knowledge that our main energy source is on its way to running out.

Another key focus of the economy is employment. Green jobs resulting from the LCFS pushing for innovation are another driving factor for establishing a policy. Working to boost capital within our own country, rather than buying goods from outside nations, is an investment that will profit in the future. Population trends indicate rising demand for transportation services, and an LCFS would prompt changes so that American can meet the needs of its people while generating revenue and lowering unemployment at the same time.

C). Population Trends - In California, population is steadily increasing. It is estimated that more than 386,000 people are added to the state population annually, the equivalent of adding a community the size of Oakland each year. Current development patterns are leading to urban sprawl and contributing to the increasing number of Vehicle Miles Traveled (VMT) per CA resident as well. Coupled with an increase in demand for goods, and therefore an increased need for delivery services, all factors are pointing towards increased use of transportation

technologies and fuels. The paradoxical trends of demand and supply, when looking solely at petroleum-based technologies, are becoming more greatly opposed as time passes.

D). Human Health - Adding to the need for a policy to reduce greenhouse gas emissions is the effect current transportation technologies on human health. The California ARB estimates that 90% of CA residents breathe unhealthy air. Exhaust from petroleum-powered vehicles damages local air quality and also has a negative impact on water quality. Pollution from the transportation factor also plays a major role in contributing to climate change. Nitrous oxides and VOCs (Volatile Organic Compounds) have large impacts on ozone levels and the heat trapping capacity of the atmosphere.

E). Climate Change - While the exact effects of climate change are unknown and almost impossible to accurately estimate, it is widely accepted that climate change, if left unmitigated, will cause a slew of negative consequences. Making adaptations to our current lifestyle is the only way to prevent a business-as-usual scenario from damaging the planet even further. The LCFS is intended as a stepping stone towards reducing California's impact on the environment and reduce contributions to climate change pursuant to the broader AB 32 goals.

F). Alternatives - A combination of regulatory and market mechanisms makes the LCFS a strong policy for implementation in California. With the current state of business, technology, and government regulations, a LCFS is more likely to be effective in the immediate future compared to the Federal Renewable Fuel Standard, a carbon tax or cap and trade policy. This is due to both its greater political acceptability and policy durability.

The Renewable Fuels Standard is weak compared to a LCFS in that it targets only biofuels. Focusing on a small number of fixed fuels categories does not encourage innovation, and in fact, does the opposite. The initial version of the RFS promoted a massive expansion of corn ethanol, only recently reconsidering impacts of biofuels and calling for lifecycle emissions to be considered by the policy. The regulated GHG reduction mandates of 50 and 60 percent are

“admirable, but clumsy” in the opinion of UC Davis’ Dr. Dan Sperling. These factors make a LCFS more logical to actualize than the Renewable Fuels Standard.

Similarly, a carbon tax is not currently a more viable option than a LCFS. The transportation sector is so heavily dependent on petroleum that there would be little change. There would also be little to no response from oil producers to a tax because of their own dependence on oil. Even a tax as high as \$50/ton CO₂ would only raise prices by 45 cents per gallon at the pump. A cap and trade policy suffers analogous shortfalls to a carbon tax. Unless the cap were very stringent, it would be relatively weak for the transportation sector. “Cap and trade and carbon taxes will only be truly effective once advanced biofuels and Electric and hydrogen vehicles become commercially viable options” (Farrell and Sperling).

III. BENEFITS

Ultimately, Farrell and Sperling conclude in their analysis of the CA policy, “a LCFS is the most practical way to start the transition to low carbon fuels given the huge barriers faced in the market”. A LCFS could drive a 3-5x expansion of the renewable fuel market and decrease gasoline consumption by 3.2 billion gallons annually.

A). Investment - A Low Carbon Fuel Standard encourages investment in low-carbon fuels while simultaneously accommodating high-carbon fossil fuels. It would provide strong incentives to produce higher-carbon fuels more efficiently and with low-carbon energy inputs.

B). Leadership - Furthermore, the California policy is designed to be compatible with a broader program. Success within the state would encourage implementation in other states and on a national and international level as well. Expanding the scope of the policy would make it easier to include fuels used in international transport, facilitate standardization of measurement protocol, and increase options within the market, ultimately lowering net costs.

IV. CHALLENGES

A). Market Adjustments - While a Low Carbon Fuel Standard is currently the best option for California, there are several concerns associated with the policy. One possible issue with the LCFS only applying to the CA transportation sector is the likelihood of the market responding to the standards by acting to minimize their costs and disregarding the greater purpose behind the regulations. This would be seen by market “shuffling” or “leakage”, where a company would divert their low GHG fuels to the California market while selling their high carbon fuels elsewhere. This would result in LCFS standards being met but no net change in GHG emissions.

B). Land-Use - Another large apprehension associated with the LCFS is it’s analysis of carbon impacts from indirect land-use changes. Any change in land use can have a significant effect on carbon releases, so it must be considered carefully. Unfortunately, scientific studies have not yet adequately quantified the indirect land-use effects of fuels. Modeling with GTAP(Global Trade Analysis Project) and GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) programs is currently available however, and modifications for increased accuracy are being looked in to.

V. CONTROVERSIES

A). Discrimination - Several controversies have also been brought to light in public discussion and through the media since the first days of the LCFS. Similar to the possible challenge of market shuffling within the US market, there is concern about high carbon fuels being diverted overseas. A demand for low carbon fuels may free up cheaper oil supplies for other markets such as China and India, saving them money while still releasing GHGs to the global atmosphere. Another controversy in regards to high-carbon fuels is that refiners of said fuels feel that the LCFS is unfairly harsh on their products. The oil sands industry is extremely upset

about the standard, claiming that it is discriminating against their industry by putting a higher bar on bitumen than heavy crude.

B). Economic Effects - Furthermore, there is currently a good deal of distress surrounding the state of the economy and what the LCFS could mean California. Gubernatorial candidate Meg Whitman has stated that she supports suspending AB 32 for 1 year or more to help state jobs and the economy rebound. However, opponent Jerry Brown says that he is just in support of adjustments, because a start-and-stop policy only creates investor uncertainty. He also has urged lawmakers not to pre-empt the LCFS and to respect state authority.

C). Lawsuits - In addition to general public, private, and political attitudes about the LCFS, there have been several concerns which have been taken to the judicial level with the filing of lawsuits. The American Trucking Association claims that a law like the LCFS, which only applies to an individual state, is in violation of federal interstate commerce laws. They argue that the standard would cripple the individual truckers by increasing costs, especially if required to switch from diesel to natural gas trucks. A second lawsuit also claims that the LCFS violates federal law. The Growth Energy and Renewable Fuels Association is leading a suit against the CA ARB claiming that it discriminates against Midwest corn ethanol producers. They also believe that the LCFS impedes the Federal Renewable Fuel Standard, therefore violating the Supremacy Clause of the US Constitution.

VI. FUTURE OUTLOOK

As of July 2010, the board approved expert workgroup is still working on “assisting the Board in refining and improving the land use and indirect effect analysis of transportation fuels...”, with instructions to “return to the Board no later than January 1, 2011 with regulatory amendments or recommendations, if appropriate...” (LCFS). There are several more scheduled Expert Workgroup meetings tentatively scheduled for July 15th, September 9th-10th, October 7th-8th,

and November 4th-5th. A draft report is to be submitted in mid-October, with a final completed by December.

The next steps for the LCFS include continuing work on carbon intensities, establishing a credit trading program, and coordinating with regional, national and international groups for possible expansion of the program. The 2020 target is also planned to be followed by a further reaching this goal for later in the future, possibly 2050.