

Interim Guide to the LCFS

Making Sense of California's Low Carbon Fuel Standard

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Introduction

Reduction of the Carbon Intensity (CI) and the Greenhouse Gas (GHG) emissions associated with transport fuel production are the driving principles behind development of California's *Low Carbon Fuel Standard* (LCFS). California is not alone in seeking these goals, nor is the State at the fore-front of the many parallel efforts. Globally, we are witnessing the development and adoption of mandatory, voluntary, and hybrid schemes to ensure a socially, economically, and environmentally sustainable fuel supply.

For California, the emphasis is upon measurement and comparison of the entire life-cycle "pathway" characteristics of transport fuels. For most global schemes of standards and their certification constructs, the emphasis is primarily on the rather elusive concept of *sustainability* while focusing on rapid commercialization and market penetration of Biofuels.

California's LCFS contains provisions paralleling European biofuels sustainability "schemes" along with unique aspects such as "carbon intensity". California's LCFS would be well-advised to clearly meet the European minimum key criteria, assuming a clear "California first" frame of reference. It is not enough to set lofty environmental goals without balancing these against economic reality. We expect to interact with the global biofuels marketplace, especially for the importation of sustainable biofuels. The LCFS program should *first* be designed to garner global recognition and parity. Within that common market, California's LCFS should provide in-state Providers, the *refiners, blenders, producers, and importers* with a market advantage, not a deficit.

Global development of for "clean" fuel standards, whether bio- or petro-sourced, view the relative acceptability in terms of relative impact on the environment per unit energy produced, on a life cycle basis. The European Union starts with "do no harm" mandate for the more fragile, intrinsically high-value components of the landscape, then sets greenhouse gas reduction minimums. California adopts the general minimal-impact principle, then adds a "carbon metric" above and beyond the GHG measurements.

This paper is intended to act as an introductory guide through the myriad rules and references that currently comprise the "live" program activities and interim standards of the on-going LCFS process. Following the LCFS program guide will be a brief look at European schemes to reinforce that programmatic biofuel sustainability development is truly global in nature.

LCFS program documents are due to be submitted by staff to the Air Resources Board (ARB) in December of this year. Between now and then, there are numerous opportunities for public engagement and stakeholder input. This Report concludes with the proposed ARB schedule, engagement points of action for stakeholders, and links to the ARB's LCFS points of contact.

Regulatory Setting

Layer upon layer of law, regulation, policy, research data, public opinion and general conjecture surround the on-going development of the LCFS; select statements of program are offered that we feel best describe the perspective of the agencies of purview, and from these, a very few key statements have been extracted upon which the bulk of the program depends. In an ARB [Regulatory Advisory](#) issued in July 2010, the LCFS regulatory background and purpose are concisely summarized:

"On November 25, 2009, the ARB adopted the LCFS regulation pursuant to the California Global Warming Solutions Act of 2006. The regulation became effective on January 12, 2010 and was codified at Title 17, California Code of Regulations, sections 95480-95490. Additional provisions became effective on April 15, 2010 and were codified in the same sections. The combined final regulation order can be found at: <http://www.arb.ca.gov/regact/2009/lcfs09/lcfscombofinal.pdf>. The LCFS will reduce greenhouse gas (GHG) emissions by reducing the carbon intensity of transportation fuels used in California by an average of 10 percent by the year 2020. Carbon intensity is a measure of the GHG emissions associated with the combination of all of the steps in the "lifecycle" of a transportation fuel. While carbon intensity (CI) standards are not enforced in 2010 (the first year of the regulation), compliance with the reporting and recordkeeping requirements is required for all years, including 2010."

Who is being regulated?

Former Governor Schwarzenegger's January 18, 2007 [Executive Order \(EO\) S-01-07](#) provides an overarching guideline against which can we measure all subsequent LCFS Principles and their sub-parts. EO S-01-07, Item 4 provides the core of the LCFS Program Statement:

"The LCFS shall apply to all refiners, blenders, producers or importers ("Providers") of transportation fuels in California, shall be measured on a full fuels cycle basis, and may be met through market-based methods by which 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."

EO S-01-07 defines four categories of Providers: (1) Refiners; (2) Blenders; (3) Producers; and (4) Importers. A Life Cycle Assessment (LCA) approach cumulatively considers all actions along the supply chain, from initial acquisition, aggregation and processing of feedstock through conversion of the raw resource into raw product to refining and reforming of the raw product into a commodity, and including all transport of materials along the way, finishing with the delivery of the fuel to the end-user. For fossil-sourced petroleum based fuels, this is often called a "well-to-pump" assessment; for biofuels, harvesting stages supplant petroleum extraction. The ARB has produced an Excel-based online registration form for voluntary registration of Biofuel Producers that can be found [here](#).

By December 2010, the ARB was receiving "external" Method 2A/2B [Applications for fuel producer pathways](#) from Providers to be reviewed by staff and heard by the Board. The Method 2A/2B web page provides a summary table listing twenty-six external fuel pathways and six internal pathways. Early submissions naturally were from corn ethanol producers, with sugarcane ethanol and sorghum / mixed feedstock pathways also represented. Green Plains and Archer Daniels Midland were among the first Application Packages received. One "waste beverage ethanol" application from Parallel Products and one application from Clean Energy for liquefied natural gas were received in January 2011.

ARB staff "internal" fuel pathway research continues; staff submitted their own findings in Report Packages to the Board in December 2010 for biodiesel from used cooking oil, corn oil and canola.

What is being measured?

EO S-01-07 requires that a "baseline level" of required performance be established, with carbon intensity and greenhouse assessments made on a "full fuels cycle" basis. CI metrics were described in the ARB's January 2011 Initial Statement of Reasons ([LCFS-ISR](#)) for the proposed rulemaking:

"... the carbon intensity of transportation fuels is the currency of the LCFS; lower carbon intensity fuels have lower lifecycle GHG emissions. Specifically, carbon intensity is a full lifecycle measure of the greenhouse gas emissions associated with the production, transport, storage, and use of a fuel. To facilitate comparison across fuels, carbon intensity is expressed in terms of grams of CO₂ equivalent per megajoule of fuel energy (g CO₂e/MJ). The term "CO₂ equivalent" refers to the fact that CO₂ is the baseline against which the atmospheric warming potential of all other greenhouse gases (GHGs) is measured. Providers of transportation fuels (referred to as regulated parties) must

demonstrate that the mix of fuels they supply meets the LCFS carbon intensity standards for each annual compliance period."

Two "[Look-up Tables](#)" have been in effect since 2009, Table 6 for gasoline and gas substitutes, Table 7 for diesel and diesel substitutes. Significant changes have been [recently proposed](#) (but not yet certified) for CI values in the tables for many of the fuel pathways described. A "Generic CI Value" has also been proposed for ethanol and biomass-based diesel in July 2011 as Regulatory Advisory 10-04A, for cases where the actual values are not known and cannot be reasonably determined for a Blender's purchase of biofuel. This will occur where the supply does not come from a [registered biofuel facility](#) or has not been established through the [Method 2A/2B process](#). The ARB will then "administratively allow" regulated parties to use a CI value of 94.71 grams CO₂ equivalent per megajoule (MJ) of energy; the number is the baseline value for diesel in the Look-up Table.

The following is an excerpt from **Look-up Table 6** for gasoline and gas substitutes, to provide an example of this critical format. Note that the final CI goes beyond direct emissions to include a more nebulous and ill-defined "land use or other indirect effects":

Fuel	Pathway Description	Carbon Intensity Values (gCO ₂ e/MJ)		
		Direct Emissions	Land Use or Other Indirect Effect	Total
Gasoline	CARBOB – based on the average crude oil delivered to California refineries and average California refinery efficiencies	95.86	0	95.86
Ethanol from Corn	Midwest average; 80% Dry Mill; 20% Wet Mill; Dry DGS	69.40	30	99.40
	California average; 80% Midwest Average; 20% California; Dry Mill; Wet DGS; NG	65.66	30	95.66
	California; Dry Mill; Wet DGS; NG	50.70	30	80.70

The excerpt below is from **Look-up Table 7** (2009) for diesel and diesel substitutes:

Fuel	Pathway Description	Carbon Intensity Values (gCO ₂ e/MJ)		
		Direct Emissions	Land Use or Other Indirect Effect	Total
Diesel	ULSD – based on the average crude oil delivered to California refineries and average California refinery efficiencies	94.71	0	94.71
Biodiesel	Conversion of waste oils (Used Cooking Oil) to biodiesel (fatty acid methyl esters -FAME) where "cooking" is required	15.84	0	15.84

Strict measurements of CI and GHG may be the prime directive, yet impact assessment of "indirect effects" is a far-reaching task, as anyone who has ever dealt with the California Environmental Quality Act (CEQA) can attest. Consider then that in addition to all other project-related assessment and permitting that might be required, the LCFS now increases the preeminence of GHG assessment, and adds an entirely new metric: measurement of CI.

Where do the numbers come from?

It is with establishing this *Baseline* that so much effort is currently being expended. The California Global Warming Act of 2006, through the implementing regulation of the LCFS and the subsequent Regulatory Advisories provided methods for investigating all aspects of the LCFS. The LCFS is a work-in-progress; only registration is requested at this time, and emissions data submissions are not yet mandatory. As noted above, regulated parties as prospective LCFS Fuel Providers have been submitting Application Packages for ARB review and approval in the interim prior to full implementation, using the [Reporting Tool](#) to register organizations and biofuels users. A few of these pathways were approved in the Board's February 2011 hearings and are now considered "interim" standards. The CI Table values will be expanded and modified as more registrations are received, as new data are available, and as the ARB finalizes on-going investigations into more than a dozen specific LCFS issues.

A series of Workgroups were mandated to carefully consider first metrics and then methods for establishing that baseline level of required performance. Following the January 2010 [approval of the LCFS regulatory action](#) and same-day incorporation within Title 17 of the California Code of Regulations, the ARB's [Resolution 09-31](#) directed staff to develop a series of LCFS Workgroups to address stakeholder questions and concerns from the Rulemaking process in a series of Resolution elements intended to provide guidelines for program implementation. Finding the status of specific topics is aided by knowing which group is assigned that issue:

- Expert Workgroup ([EWG](#)) - Address the indirect land use change (iLUC) of the biofuels.
- Program Review [Advisory Panel](#) - Participate in the reviews of the LCFS program and provide comments on ARB staff's assessments of each review area. The Advisory Panel provides the "high-level" oversight, accumulating detail from the other workgroups and the public to address a series of Topics specifically called out in the LCFS regulations.
- Reporting Tool Workgroup (LRT) - Development of the Compliance Tools and Enforcement Protocol for the LCFS (11-2010 [Version 2.2 of the Reporting Tool](#) is available on-line).
- Sustainability Workgroup ([SWG](#)) - Develop sustainability provisions for the LCFS and bring recommendations back to the Board by December 2011.
- Electricity Workgroup - Created to address issues related to regulated parties of electricity as a transportation fuel. [July 11, 2011 Workgroup meeting presentation](#) available on-line.
- High Carbon Intensities Crude Oil (HCICO) Screening Workgroup – Screening process for petroleum sourced raw oils; a [Crude Screening Decision Tree](#) is now available on-line.
- Lifecycle Analysis Workgroup (LCA) - Lifecycle of Energy Use and Greenhouse Gases, using a [California-modified GREET](#) pathway model ([FAME pathway](#), for example).
- Policy and Regulatory Workgroup – Rulemaking information and revisions; proposed 2011 Regulatory Amendments [July 22, 2011 workshop materials](#) are available on-line.
- Environmental and Economic Workgroup – propose economic and environmental analyses; 2008 [Economic Analysis](#), for example).

On June 16, 2011, the Advisory Panel released their [Draft Workplan Version 2](#), a "high-level" outline addressing thirteen topics assigned by the regulations plus the HCICO issue needed for comparison and a chapter on the growing Credit Market. The topics cover report progress and compliance schedules, advancements in our understanding of LCA methods, production technologies, supply and commercialization, revenues and impacts. Barriers are considered, and the "advisability" of harmonization

with the full sweep of local, state, federal and international programs. A timeline is proposed, culminating with submission of an overall LCFS report to the Air Resources Board in December 2011. The Panel's current Draft Workplan is open for comment and addressed in more detail at the end of this Focus Report.

How does this compare globally?

The European Commission (EC) has been engaged in detailed comparison of both mandatory and voluntary biofuels sustainability programs to determine compatibility with their core principles guiding advancement of biofuels and reduction in dependence on fossil fuels. On July 19, 2011, the EC formally recognized [seven sustainability certification programs](#) providing sustainability criteria and certification for production of biofuels.

The EC's recognition of the seven biofuels sustainability schemes depends upon their meeting a set of **minimum key criteria**, yet only three of those criteria are mentioned, and those are only very roughly defined:

- "A set of **land use criteria**: It is not allowed to convert land with high carbon stock or land with high biodiversity value into land used for production of biofuels. In plain words: No forests – whether tropical forests or natural forests – can be destroyed to grow biofuels. No wet land can be dried or protected areas" used.
- "A minimum amount of **greenhouse gas savings** over the whole production chain: Biofuels need to stand a comparison with fossil fuels such as petrol: Only if it is proven that they emit at least 35% less greenhouse gases than petrol, than they are seen as sustainable. In 2017 these savings have to be at least 50%. Biofuels produced from new installations have to save at least 60% from 2018."
- "The system needs to **monitor the whole production chain** from how the crops are grown through the manufacturing process to the pump."

To receive governmental support or to count toward renewable energy targets, biofuels used inside the European Union must comply with sustainability criteria, either through various Member States national systems or through voluntary programs with the common aim of preventing the conversion of areas of high biodiversity and high carbon stock to the production of raw materials for biofuels. Further, value chain life cycle greenhouse gas (GHG) emissions need to be at least 35% lower than comparable use of fossil fuels, a threshold designed to increase over time. Commission-assessed and approved voluntary programs receive its recognition for five years.

LCFS Program Timing and Stakeholder Engagement Opportunities

The ARB's [Rulemaking Calendar](#) tracks progress toward finalization. Modifications to the CI Look-up Tables were adopted in an ARB hearing and submitted to the Office of Administrative Law (OAL), with expected approval early in 2012. Revisions to the LCFS were adopted May 26, 2011; a new set of revisions should be ready for Board hearing in October 2011.

There currently seems to be significant confusion between what constitutes a *fuel pathway*, a *fuel production technology*, and what is simply a feedstock starting point that can and often does lead to very different "pathways" or integrated supply chains and output fuel products. There is no clear demarcation; "pathways" are not adequately described and are commonly simplified to indicate only the key components, while "technologies" encompass these and other supply chains. Yet this approach remains more cohesive and holistic in perspective than many other energy-related programmatic planning efforts, as we have recently discussed in our article, [Blueprint for California's Clean Energy Future](#).

Fuel Pathway Engagement: Stakeholders are currently registering and submitting Application Packages for ARB review and possible Board approval; greater participation during these early stages can only improve the overall program's breadth and accuracy. Each supply chain category from source to product is considered a "fuel pathway", with inherent characteristics of CI and GHG. The LCFS process is

collecting and defining pathways right now, with around 20 types defined. The LCFS-ISR also provided definitions of pathways:

"Fuel pathways describe the production process and transport of transportation fuels and are used use to determine the appropriate carbon intensity for a given fuel. New pathways can be added to the LCFS Lookup Table in two ways: fuel providers may apply to ARB for new pathways under the regulatory "Method 2" process, and staff may develop new pathways internally. Pathways falling into each of these two categories are proposed under this rulemaking. The Method 2 application process consists of two variants known as Methods 2A and 2B. Method 2A is reserved for applicants whose proposed pathways consist of modified versions of existing pathways. Method 2B, on the other hand, is reserved for entirely new fuels or production processes."

As discussed, the LCFS regulation requires fuel providers to determine the CI of the fuels they provide, and report this information to the ARB. A [New Fuel Pathway](#) guidance document issued in August 2010 describes the Method 1 process current fuel providers are to use to determine their fuel CI using the interim assigned numbers from the Look-up Tables, and beyond these "core values", how a Provider may use one of the two Methods to establish a new pathway.

Workplan Engagement: As the Workgroups continue their assessments and as Providers register and submit Application Packages, the underlying data accumulation will allow refinement of all aspects of the LCFS. The "First Public Meeting to discuss review progress" in the Advisory Panel Workplan [Version 2](#) schedule below took place on July 25, 2011.

LCFS Advisory Panel Draft Workplan Version 2 Schedule as of June 16, 2011.

ITEM	TIME FRAME
First Advisory Panel Meeting	February 16, 2011
Workplan, status updates on topics 5, 9, and 10	April 26, 2011
Status updates on topics 6, 7, and 12, along with HCICO and credit market discussion. Revisit 5, 9, and 10.	June 30 and July 1, 2011
First Public Meeting to discuss review progress	July 25, 2011
Status updates on topics 1, 2, 3, 4, 8, 11, and 13	August 25 and 26, 2011
Second Public Meeting to discuss review progress	September 29, 2011
Draft Review Report Discussed with Advisory Panel	October 27, 2011
Deadline for Panel/Public Comments on Draft Report	November 2011
Public Hearing for Board on Report	By December 2011

The [staff presentation](#) for the meeting included an outline of the Panel's many Topics under development for December submission to the Board. Draft outlines for many of the Topics are provided; in each case, stakeholders could provide additional information. As just one example of a Topic needing input:

"[Topic 4: Technology Assessment](#)" outlines LCFS transport fuels technologies that Panel members feel are available today, those that will be commercialized in the near term, and those that may become available over the next several years. Briefly mentioned in the draft as available now are ethanol from grains and sugars, biodiesel from crops and waste fats and oils, AD-generated biogas, reformed gasoline, natural gas, hydrogen, and electricity as a transport fuel. "Near-term future technologies" only includes ethanol from lignocellulosic biomass. In the category of "long-term future technologies", we find no mention of algal biofuels and biobutanol.

Missing from the assessment entirely are (a) biofuels produced by genetically engineered bacterial and fungal organisms, (b) thermal conversion of biogenic wastes for production of synthetic fuel gas or syngas, (c) enzymatic, catalytic and/or microbial conversion of syngas to liquid fuels, (d) thermal

conversion of non-biogenic waste materials (i.e.: non-recyclable plastics, refinery waste secondary materials), (e) microbial direct CO₂ / hydro-carbon rich emissions fixation and fuel synthesis, and (f) any discussion of fully integrated, multi-technologic, multi-feedstock biorefineries.

As with the Fuel Pathways, stakeholder direct comment to the Workplan is needed. In conjunction with the July 25th workshop, the public has been invited to [submit comments](#) on-line to the Advisory Panel Workplan by August 15, 2011 on the Panel's comment web page. Primary points of contact for questions on submission of comments are noted on the [last slide of the workshop presentation](#). Individual ARB staff contacts are provided for questions related to [Method 2A/2B Pathway](#) issues on that program's webpage.

The [list serve subscribe / unsubscribe webpage](#) for the LCFS Program website is administered by the ARB. By signing up for this list serve, you will receive a notice when information updates have been made to this area of our website. In most instances, the ARB will provide you with an email explaining the upcoming activity and/or the document(s) added to the site and the appropriate URL so that, if interested, you can download them at your convenience. Also, the ARB maintains and can provide a current archive of all email notices broadcast to this list.

Conclusion & Recommendations

California is about half way through development of a method to judge and compare transport fuels for their relative lifecycle impacts upon society and the environment. All the LCFS program development elements, as complex as they are, still remain open for stakeholder discussion, debate, and revision, or simple acceptance for those who choose not to participate in the process. This paper provides a relatively compact guide to the major program elements and encourages stakeholder engagement, not because what is being developed is *wrong*, but because the implementation of this program will so dramatically affect the future of biofuel technology selection and market development in California, and indeed globally.

California's place in that global marketplace needs to be kept in perspective, surely from an economical perspective, but perhaps more importantly because what this State does will set a global benchmark. Whether the LCFS will *improve* biofuel development and petroleum displacement is a matter of conjecture; the implementation of the LCFS however is *certain* to have a significant impact globally.

Sustainability does not imply strict hands-off preservation, no more than sustainable methods should include resource depletion. The LCFS goes beyond the basic global concepts of *sustainability* in attempting to define a measurable metric, the "Carbon Intensity" and to use this measurement tool to answer the broader question. California has not arbitrarily accepted that "biofuel" or *any* fuel is inherently "cleaner", better, more sustainable. Instead, the LCFS is an attempt to develop and implement a standardized mechanism to compare and contrast *all* forms of transport fuel. This lofty goal also bears the inherent hazard of so encumbering the Providers, those stakeholders directly engaged in Refining, Blending, Producing and Importing low-carbon fuels, that the program defeats its stated purpose. This is why stakeholder involvement in development of the LCFS program is so important.

This is a delicate balance between economics and environment, one clearly recognized by the [EPA](#):

"The traditional definition of sustainability calls for policies and strategies that meet society's present needs without compromising the ability of future generations to meet their own needs ... Sustainable development reflects not the trade-off between business and the environment but the synergy between them."

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