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United States
Low Carbon Fuel Policies

There are two major low carbon fuel policies in place in the United States: the US Renewable Fuel Standard (often referred to RFS2) and the California Low Carbon Fuel Standard (known as LCFS). RFS2 regulates renewable fuels (biofuels) in the entire US while LCFS covers both renewable and non-renewable fuels in California. Both RFS2 and LCFS rely on life cycle analysis (LCA) as a tool to regulate fuels, incorporating greenhouse gas (GHG) emissions from indirect land use change (ILUC) in their LCA framework.

The RFS2 is a volumetric standard that will significantly increase biofuel use in the US to 36 billion gallons by 2022. The US EPA estimates that this would result in a reduction of 138 million metric tons (MMT) of GHG in 2022, although uncertainties remain, particularly with regard to ILUC GHG emissions. Approximately 13.5 billion gallons (bgl) of biofuels were produced in the US in 2010, with biodiesel and corn ethanol accounting for 0.3 bgl and 13.2 bgl, respectively. The LCFS is a carbon-intensity-based, fuel neutral standard and aims to reduce GHG emissions from the transportation sector in California by 10%, or approximately 16 MMT per year by 2020. Market-based mechanisms, primarily credit trading and banking, will play a major role in LCFS compliance.

In addition to LCFS and RFS2, efforts are underway to establish regional low carbon fuel standards in Northeast and Mid-Atlantic States, as well as in Midwestern states. These regional initiatives are likely to be modeled after the California LCFS.

The purpose this policy paper is to summarize recent developments in the implementation phases of RFS2 and LCFS and to provide the status of emerging LCF policy initiatives at regional levels.

Renewable Fuel Standard (RFS2)

2011 is the second year of the US Envirnomental Protection Agency's (EPA) RFS2 program. Each year, obligated parties refiners and importers of gasoline and diesel and blenders are required to meet volumetric targets for four broad categories of biofuels: (1) renewable fuels; (2) cellulosic biofuels; (3) bio-based diesels; and (4) advanced biofuels. These biofuels categories are defined based on the nature of feedstock/technology used in production and minimum GHG

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reduction thresholds. The minimum GHG reduction thresholds that must be reached to qualify as renewable fuel, advanced biofuels, bio-based diesel and cellulosic biofuel are 20%, 50%, 50% and 60%, respectively.

Volumetric targets are tracked through Renewable Identification Numbers (RINs), unique identification numbers assigned to each gallon of biofuel that specifies how and where it is produced. The value of a RIN associated with a gallon of biofuel depends on the energy content and is calculated on an ethanol-equivalent basis. As an example, 1 gallon of bio-based diesel earns 1.7 RINs. Each year, obligated parties must generate or acquire a minimum number RINs by producing or purchasing renewable fuels. RINs can be traded between obligated parties and non-obligated parties, such as renewable fuel producers. Excess RINs can be used by obligated parties to meet the requirements in the following year or sold to another obligated party. Information on RIN generation and transaction is submitted to the EPA using the EPA Moderated Transaction System (EMTS).

Each November the EPA is required to determine the amount of cellulosic biofuel that will be produced for use in transportation for the following year. If it is determined that the projected volume of cellulosic biofuel production is less than the minimum required volume specified in the RFS2 Final Rule, the EPA should revise the required volume and publish it in the Federal Register. The EPA may also opt to revise the volumetric requirements for advanced biofuel and renewable fuel if required.

Accordingly, the EPA estimated the availability of cellulosic biofuel in 2011 primarily from the US Energy Information Administration (EIA) projections of gasoline and diesel use in the US and biofuel industry surveys of production capabilities. The cellulosic biofuel production potential assessment took into account existing facilities as well those that are in the planning and construction phases. The EPA estimated that likely production of cellulosic ethanol in 2011 would be significantly lower than the required volume, and hence has revised the required volume as shown in Table 1. The EPA has not revised the volumetric standards for other biofuels for 2011.

Table 1 Proposed vs. Revised Volumetric Requirements for 2011[1]

Biofuel	Applicable volume in Final Rule 2010	Revised (actual volume)	Ethanol equivalent volume	% of total gasoline and diesel
Cellulosic biofuel	0.25 bgal	6.6 mgal	6.0 mgal	0.003
Advanced biofuel	1.35 bgal	1.35 bgal	1.35 bgal	0.78
Bio-based diesel	0.80 bgal	0.80 bgal	1.20 bgal	0.69
Renewable fuel	13.95 bgal	13.95 bgal	13.95 bgal	8.01

mgal- million gallons, bgal-billion gallons

The volumetric standard for bio-based diesel has not yet been specified for 2013 and beyond. The EPA is hence required to develop a volumetric standard going forward from 2013 that should be at least 1 billion gallons per annum.

1 2011 Renewable Fuel Standards: Regulation of Fuels and Fuel Additives. 75 Fed. Reg. 76790 (2010) (40 CFR Part 80).

In the final RFS2 rule, the EPA calculated life cycle GHG emissions for a handful of feedstock-specific biofuels, including corn ethanol, sugarcane ethanol, cellulosic biofuels from corn stover and switchgrass, and soy biodiesel. Through a supplemental rule making process, the EPA is determining if other fuel-specific pathways qualify as renewable fuels based on GHG reduction thresholds. The supplemental rules do not look into economic or environmental impacts of biofuel pathways beyond what is already described in the final RFS2 rule. Recently the EPA determined that canola oil-based biodiesel qualifies as biomass based biodiesel and advanced biofuel, with its life cycle GHG emissions of 45.5 g CO_2 eq./MJ representing a GHG emission reduction of more than 50%. Other biofuel pathways under active consideration include palm oil, sorghum, and woody biomass.

After the publication of the final RFS2 rule in 2010, the EPA made amendments to the RFS2 mainly pertaining to RINs and compliance requirements. The major amendments include:

- Defining the "permitted capacity"
- Technological requirements for non-grandfathered ethanol facilities to generate RINs
- Clarifying how information about RINs can be submitted to the US EPA

Low Carbon Fuel Standard (LCFS), California

In 2011 the California LCFS entered into compliance phase. Regulated parties, broadly defined as fuel producers and importers and including some owners of alternative fuels or alternative fuel sources, are required to reduce the carbon intensity of their fuels by an average of 1% per year until 2020. Carbon intensity reductions are relative to a baseline of 95.86 g CO_2 eq./MJ for gasoline and 94.71 g CO_2 eq./MJ for diesel, the average carbon intensity of the 2006 California crude mix. The California Air Resources Board (CARB) calculates current carbon intensities of various fuel pathways and sub-pathways and lists them in lookup tables. Figure 1 depicts the carbon intensities of many of the fuel pathways listed in the lookup tables. To calculate net reduction in carbon intensity, GHG emissions should be adjusted for vehicle efficiency using the energy economy ratios (EER). As an example, an electric power train is rated as 3 times more efficient than a conventional gasoline engine.

LCFS incorporates a credit system. If the carbon intensity of fuel supplied is higher than the target carbon intensity for a given year, it results in deficits. If the carbon intensity of fuel in question is lower than the target carbon intensity, it results in credits. Total credits or deficits are calculated by taking into account the amount of energy (gasoline or diesel) displaced by fuel and the difference between the carbon intensity of fuel and the target carbon intensity in a given year. The amount of energy displaced is calculated by taking into account EER. Regulated parties may sell or purchase credits or may bank credits for future compliance or trading.

There is no formal credit trading mechanism in place yet. California is in the process of creating a framework for credit trading. The California market has already started to differentiate high carbon intensity fuels from low carbon intensity fuels. For example, corn ethanol with carbon intensity of about 90 g CO_2/MJ fetches 2 to 3 cents more per gallon in the California market than corn ethanol with carbon intensity 98 g CO_2/MJ.

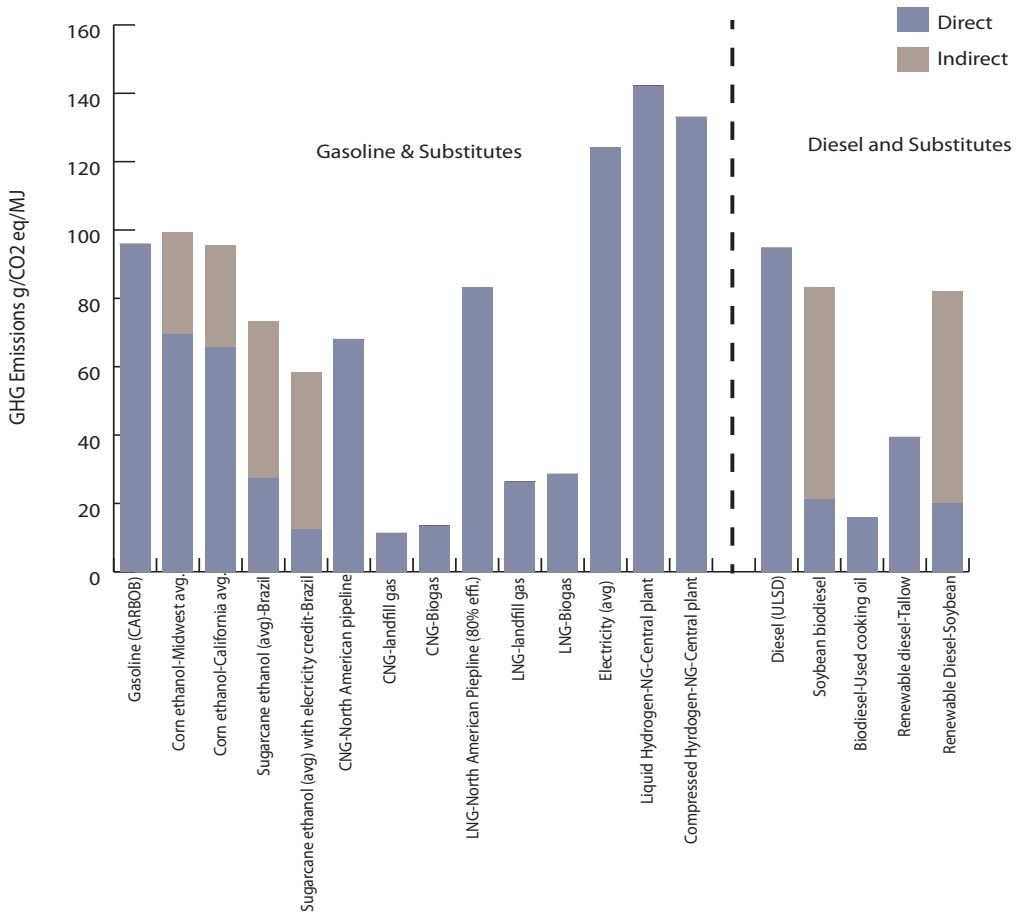

Figure 1. Carbon Intensities of Selected Fuel Pathways Listed in the Look-Up Tables *(figures not adjusted for vehicle efficiency)*. Source: CARB 2011[2]

Both regulated parties and unregulated parties can petition CARB to include new fuel pathways/fuel sub-pathways or to revise carbon intensity values of fuels already in the lookup tables. This requires a lengthy process that involves an evidence-based application, public hearings and comments, and final CARB approval. To date, more than 60 domestic and foreign bio-refineries have submitted requests to CARB to establish carbon intensities for new pathways or sub-pathways including corn oil biodiesel, sorghum ethanol, and canola biodiesel. Some of these requests claim much improved carbon intensity numbers than the values listed in the lookup tables. The first public hearing on carbon intensity values was held on February 24, 2011.

Regulated parties submit information on the volume and carbon intensity of their obligated fuels via CARB's online LCFS Reporting Tool. The tool calculates credits and deficits. The regulated parties are required to report the information quarterly and annually.

The LCFS recognizes that not all crude oils contribute equal GHG emissions when their lifecycles are

2 CARB (2011). Retrieved from http://www.arb.ca.gov/fuels/lcfs/010611lcfs_lutables.pdf

considered. Some crude oils are extracted and processed using highly energy intensive processes and some crudes are associated with significant flaring and venting. To ensure that the stated goal of 10% reduction be achieved, CARB intends to differentiate high carbon intensity crude oils (HCICO) from low carbon intensity crude oils by assigning specific carbon intensity values very soon. HCICO is defined by CARB as crude oil that has a carbon intensity of 15g/MJ or higher in crude oil extraction and transport.[3] CARB has developed screening criteria for identifying HCICO. If a crude oil comes from tar sands or thermal enhanced oil recovery (TEOR) or is associated with flaring and venting of more than 10 scm/bbl, it is considered HCICO. If crude is deemed HCICO, fuel suppliers have an option of reporting special circumstances to prove that it is not HCICO, conducting an LCA to provide evidence that its carbon intensity is lower than 15 g/MJ, or choosing a default value assigned by CARB (known as the 2A/2B method).

CARB created an LCFS Expert Workgroup in 2010 to provide recommendations on how to improve the estimates of iLUC GHG emissions of biofuels using the GTAP model and indirect impacts of other fuels. Several subgroups were created to tackle the various aspects of GTAP modeling, such as elasticity values, co-product credits, land cover, time accounting, direct emissions, etc. In December 2010, the expert-subgroups submitted reports outlining recommendations for further research and analysis for near term, medium term, and long-term.

Based on the discussions of final recommendations of the LCFS expert workgroup, CARB has decided to re-evaluate its ILUC factors by undertaking a revised GTAP analysis. The revised analysis is likely to include changing the GTAP baseline from 2001 to 2006, including a "cropland pasture" land category in Brazil and the US, re-evaluating elasticity and co-product credits and modifying estimates of crop yields from new cropland, among others. CARB also intends to make the treatment of co-product substitution in GTAP and GREET consistent and to harmonize model inputs for all biofuel pathways. CARB is developing spatially differentiated carbon stocks and emissions factors for more accurate estimates of land use GHG emissions.

In parallel, CARB aims to develop sustainability provisions and compliance framework for the LCFS to ensure that it does not create adverse environmental, societal, and economic impacts. Towards this goal, an LCFS Sustainability Expert Workgroup has been tasked with the responsibility of recommending sustainability provisions by December 2011. Currently the expert workgroup is reviewing various sustainability standards, including the Roundtable on Sustainable Biofuels (RSB), and assessing the local factors and conditions required to develop appropriate sustainability provisions. The group will also make a recommendation on how to incorporate sustainability provisions in the LCFS, either as regulations within the LCFS or as policy guiding the LCFS. With regard to compliance framework, the group will explore the possibility of benchmarking or using existing standards for compliance including chain of custody verification and reporting requirements.

To evaluate the progress of LCFS implementation, CARB has established an advisory panel consisting of 40 members from academia, NGOs, and industry (including representation from the ICCT). The

3 Low Carbon Fuel Standard: Final Regulation Order (2010). Retrieved from http://www.arb.ca.gov/regact/2009/lcfs09/finalfro.pdf

panel is expected to meet bi-monthly to review various aspects of the LCFS program and its implementation, identify areas of concerns and submit recommendations to CARB by the end of 2011.

Northeast and Mid-Atlantic States LCFS

A consortium of eleven Northeast and Mid-Atlantic states is pursuing a low carbon fuel standard. With the intention of reducing GHG emissions from transportation and potentially heating fuel, governors from these states signed a Memorandum of Understanding (MOU) in 2009. In the signed MOU, these states agreed to develop a framework for a low carbon fuel standard that takes economic and environmental impacts, including indirect land use change, into account. The proposed LCFS, currently in conceptualization and design phase, is intended to be modeled after the California LCFS with ample room for market mechanisms for achieving compliance.

An economic impact analysis is an important consideration in developing an LCFS framework. The Northeast States for Coordinated Air Use Management (NESCAUM), a non-profit organization, has been tasked to complete this analysis. The analysis will look into how the goal of carbon intensity reduction can be achieved considering the availability of existing and potential fuels and the feasibility of complying with a range of carbon intensity targets including a 10% GHG reduction.

Such an analysis is currently underway using the well-established REMI model. The modeling of economic impact considers three scenarios where a combination of biofuel, natural gas, and electricity achieve the 10% GHG reduction target. In addition to transportation, heating is an important end use of petroleum fuel in Northeast states. Hence, heating fuel receives appreciable attention under the proposed LCFS. The economic analysis report is expected to be released in early 2011 followed by stakeholder meetings and public comments. According to the MOU, an LCFS framework should be finalized in 2011. If a participating state chooses to implement a LCFS, it can adopt the framework and its main elements through state legislative authority or rule making process.

Midwestern Low Carbon Fuel Policy

The Midwestern Governors Association (MGA), which consists of ten Midwestern states, has begun exploring the idea of low carbon fuel policy (LCFP). The ten states are Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, South Dakota and Wisconsin. Towards this goal, the MGA created a Low Carbon Fuel Policy Advisory Panel in 2009 to develop recommendations for federal and regional LCFPs. Guided by four overarching principles: (1) incentive creation for low carbon fuel in the Midwest, (2) carbon intensity reduction of transportation fuels, (3) exploiting industrial and agricultural strengths while protecting natural resources, and (4) complementing the existing policies, the advisory panel analyzed how the federal and regional LCFP should be designed and developed a list of recommendations. The advisory panel felt that a unified federal LCFP would be the best option but suggested a regional LCFP as the second best option considering the uncertainty in policy at the Federal level. The recommendations of the Advisory Panel are summarized in the report entitled "Energy Security and Climate Stewardship Platform for the Midwest."

In general, the advisory panel envisions the federal LCFP to be based on best available science and data, be consistent and flexible enough to achieve compliance through market mechanisms, set realistic yet ambitious GHG reduction targets, and exhibit incremental GHG reduction benefits over the existing policies. The advisory panel also recommends that the Federal LCFP does not include ILUC until more evidence emerges on its existence and magnitude.

With respect to a regional LCFP, the Advisory Panel recommends a similar framework to the California LCFS. It recommends that the regional LCFP should achieve a minimum of 10% carbon intensity reduction compared to the carbon intensity of Midwestern oil mix in 2005, use LCA to calculate carbon intensity scores for various fuels, and cover both renewable biofuels and non-renewable fuel including electricity, and hydrogen. If indirect effects such as ILUC are to be included in the regional LCFP, they should be applied to all fuels. The regional LCFP should be cost effective and flexible with provisions of credit trading and banking.

Before designing the regional LCFP, the Advisor Panel recommends the MGA to conduct an economic impact analysis of such a policy in the Midwest. Therefore, a likely next step for the Midwestern LCFP initiative would be an economic impact assessment of an LCFP.

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