EVOLVING ISSUES IN THE BIOFUELS DEBATE

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States continue to consider policies encouraging, and in some cases mandating, alternative fuel sales; particularly ethanol and biodiesel. Their stated purposes are to supplement and diversify fuel supplies, and to reduce air pollutants and greenhouse gases. Environmental group support for many of these measures initially was strong, but more recently has been more passive as new information has come to light.

This paper discusses some of this new information to ensure more widespread knowledge. Specifically:

- The federal Energy Independence and Security Act of 2007[i], passed and became effective in December, 2007. It mandates nearly a fivefold increase in renewable fuels from around 4 percent of the nations fuel use in 2012, to 20 percent by 2022 and sets significant volume goals for advanced and cellulosic-based alternative fuels (see Appendix A).
- New reports from UC Berkeley researchers,[ii] the EU,[iii] and the journal *Science* suggests that many biofuels may not be sustainable, and that land use change can significantly increase the global warming impact of many biofuels depending on the type of feedstock.

Also, this paper takes a fresh look at some of the lingering technical issues associated with the sales and use of ethanol and biodiesel.

A. The new federal Energy Independence and Security Act of 2007 requires the use of at least 36 billion gallons of renewable transportation fuels by 2022, nearly 60 percent of which must be cellulosic-based or advanced or lower carbon biofuels. In evaluating their own policies, states should factor this federal initiative into their own policies and programs to both build on established compliance protocols and programs and avoid contributing to the patchwork of federal and state fuels specifications and programs.

The federal Energy Independence and Security Act of 2007, effective December, 2007, modifies the current federal renewable fuels standard (RFS) that sets the minimum annual levels of renewable fuel in U.S. transportation fuel. The previous RFS standard was 5.4 billion gallons for 2008, rising to 7.5 billion, or around 4 percent of the transportation fuels supply, by 2012.

The new standard significantly expands the renewable mandate starting at 9.0 billion gallons in 2008 and rising to 36 billion gallons in 2022, or around 20 percent of current U.S. transportation fuel supplies. Starting in 2016, all of the increase in the RFS target must be met with advanced biofuels, defined as cellulosic ethanol and other biofuels derived from feedstock other than corn. Of the 36 billion gallon total in 2022, 21 billion

gallons is required to be obtained from cellulosic-based and other advanced biofuels.

The EPA Administrator is given authority to temporarily waive part of the biofuels mandate, if it were determined that a significant renewable feedstock disruption or other market circumstance might occur. Renewable fuels produced at future facilities will be required to reduce by at least 20% the life cycle greenhouse gas (GHG) emissions relative to life cycle emissions from gasoline and diesel.

The new law:

- Significantly increases biofuel supplies and diversity by increasing the minimum levels of renewable fuels in the nation's transportation fuel from less than 4 percent to 20 percent by 2022.
- Powerfully drives technological development by capping corn-based fuel ethanol at 15 billion gallons a year in 2015 and ramping up the mandate for advanced and cellulosic based biofuels to at least 21 billion gallons in 2022.
- Builds on established protocols and programs for assuring compliance with the federal renewable fuels program, which employs an effective and understood system for volume accounting, tracking and reporting of renewable fuel production and sales.

Given the significant amount of renewable fuel required by the federal RFS, particularly the size of the advanced fuel requirement, there is little if anything to be gained by individual state mandates. As we have learned in past years, a patchwork of fuels regulations can contribute to volatility in the fuels markets and should be discouraged.

B. **New studies suggest that many current biofuels may not be sustainable and that land use change, or the conversion of forests and grasslands into fields for energy crops, will be found to be a very large contributor to the global warming impact of many biofuels. New government policies and initiatives should be carefully reviewed to be sure they are not counterproductive to greenhouse gas goals.**

A chief objective of biofuels mandates has been to reduce the CO_2-equivalent emissions of a fuel over its full life cycle. For petroleum fuels the life cycle includes crude oil production, refining, transportation, and use, often described as emissions from the wells to the wheels. For biofuels, the life cycle includes indirect land use changes associated with putting new land under cultivation as well as emissions associated with cultivating, planting, fertilizing, harvesting, transporting, processing, and using biofuels, or from the field to the wheels.

Life cycle analysis, or the science for estimating these emissions over the life cycle of a fuel, is evolving. There is currently no accepted approach for valuing emissions due to changes in land use caused by a developing biofuels industry. While independent research is underway at several academic and government institutions in the US and Europe, the results are not yet available. They are expected to yield a range of values, and the debate may continue even after the results are available.

Recent reports and published studies suggest GHG emissions associated with the conversion of forest, grass, and even scrub lands into fields for the energy crops (indirect land use changes) could be significant. Several reports from credible institutions and publications are beginning to report on this. They include:

University of California: California's Air Resources Board (CARB) is in the process of developing regulations to implement a low carbon fuel standard, with adoption scheduled by the end of 2008. CARB contracted with researchers from UC Berkeley and UC Davis (UC researchers) to provide technical assistance to help value emissions from land use changes.

The UC researchers shared their early work with CARB and the public at a workshop on January 17, 2008.[iv] Footnoting their presentation with the caveat that "(t)hese are rough estimates that should be replaced when better estimates are available," the UC researchers told CARB that:

- Land use changes caused by a growing biofuels industry may cause large GHG emissions, because an acre of biofuels feedstock production causes about an acre of land use conversion elsewhere, often tropical rainforest. In the words of the UC researchers,

  > *(t)here is no way around this effect unless we unmake the global economy. Simply said, ethanol production today using U.S. corn contributes to the conversion of grasslands and rainforest to agriculture, causing very large GHG emissions. Thus, indirect (land use changes) must be applied to all biofuels production that uses crops grown on arable land. Uncertainties exist in how to calculate the size of this effect and how to attribute it to biofuel. (Emphasis theirs)*[v]

- Their report and presentation suggested that "most biofuels have *higher* GHG emissions than do fossil fuels" (*emphasis theirs*). For example, the life cycle emissions from corn-based ethanol range from 2.4 to over 6 times that of gasoline.[vi]

- Finally, the UC researchers said "(t)hese estimates have to be very wrong for better analysis to change the qualitative results."

***Science* journal reports**: On February 7, 2008, the journal *Science* pre-published two peer-reviewed articles coauthored by several scientists from prestigious institutions.[vii] [viii] The New York Times described these reports as follows:[ix]

> *These studies for the first time take a detailed, comprehensive look at the emissions effects of the huge amount of natural land that is being converted to cropland globally to support biofuels development. The destruction of natural ecosystems – whether rain forest in the tropics or grasslands in South America – not only releases greenhouse gases into the atmosphere when they are burned and plowed, but also deprives the planet of natural sponges to absorb carbon emissions. * * **

Together, the two studies offer sweeping conclusions: It does not matter if it is rain forest or scrubland that is cleared, the greenhouse gas contribution is significant.

UK Parliament, Environmental Audit Committee report: On January 21, 2008, a committee of UK's parliament issued a report[x] saying that the Government and EU should not have pursued targets to increase the use of biofuels in the absence of robust sustainability standards and that without these measures some biofuels could lead to environmental damage in the UK and the destruction of environmentally crucial rainforests.

The public policy implications of these findings regarding the potential impact of land use changes due to biofuels production could be significant. Government should carefully consider and further investigate these findings before it promotes fuel policies that could do more harm than good.

C. Other matters needing to be part of the biofuels discussion include lingering technical issues associated with the sales and use of ethanol and biodiesel.

Specifically, these include the following:

Biodiesel:

- Legislative proposals to define "biodiesel" are often limiting, in that they propose defining biodiesel in terms of the process and raw materials

used to manufacture FAME-based, (Fatty Acid Methyl Ester) biodiesel. To promote fuel diversity and increase the overall amount of biomass used for transportation fuel, it is important that states not narrowly define biodiesel to prevent "renewable diesel" from counting towards meeting renewable fuel obligations. Renewable diesel, as reflected in the 2005 Energy Policy Act and related regulations, is a form of diesel fuel manufactured from biomass feedstock that is processed using heat or heat in combination with pressure and/or catalysts to decompose the fats or oils into short-chain diesel-range hydrocarbons. The resulting product, unlike FAME-based biodiesel, is fully consistent with the prevailing ASTM conventional diesel product specifications, and is compatible with conventional diesel pipeline, delivery and dispensing equipment. Again, feedstock choice is important in determining the environmental impact.

- Although there is no current ASTM specification for biodiesel blends, final adoption of the relevant specifications are expected soon. The only apparent issue remaining before adoption of B5 blends in D975 (the standard specification for petroleum-based diesel oils), and adoption of a B6/20 stand-alone specification is the adoption of a cold soak filter test specification. Final approval of this test specification and adoption of the blend specification may occur in June, 2008.
- Also, according to the DOE's Energy Information Agency, FAME-based biodiesel also has some performance disadvantages:[xi]
  - ✓ The performance of both soybean and yellow-grease based biodiesels in cold conditions is markedly worse than that of petroleum diesel. Vehicles running on biodiesel blends may therefore exhibit more drivability problems at less severe winter temperatures than do vehicles running on petroleum diesel. This is a potential concern during the winter in much of the United States.
  - ✓ The solvent property of biodiesel can cause other fuel-system problems. Biodiesel may be incompatible with the seals used in the fuel systems of older vehicles and machinery, necessitating the replacement of those parts if biodiesel blends are used.
  - ✓ The initial use of B20 or B100 in any vehicle or machine requires care. Petroleum diesel forms deposits in vehicular fuel systems, and because biodiesel can loosen those deposits, they can migrate and clog fuel lines and filters.
  - ✓ Biodiesel tends to reduce fuel economy. Vehicles running on B20 are expected to achieve 2.2 percent fewer miles per gallon of fuel.
  - ✓ About 11 percent of the weight of B100 is oxygen. Biodiesel and higher level blends tend to increase nitrogen oxide emissions. The California Air Resources Board initiated a $2.5 million test program in 2007 to study biodiesel emissions and potential mitigation measures.
- Biodiesel usually costs more than conventional diesel. According to the US Department of Energy's Energy Information Agency, "(b)iodiesel

from yellow grease is closer to being cost-competitive with petroleum diesel than is biodiesel from soybean oil, but the available supply of yellow grease will probably limit its use for biodiesel production to 100 million gallons per year (6,523 barrels per day) or less. Unless soybean oil prices decline dramatically, it does not appear that biodiesel can be produced in large quantities at a cost that is competitive with petroleum diesel."[xii]

Ethanol and E85:

- Blending ethanol and gasoline increases hydrocarbon emissions it two ways:
  - ✓ According to a report by the credible Coordinating Research Council (CRC),[xiii] low-level ethanol blends (E6, E10 and E20) increased permeation in all the vehicle systems and technologies tested, compared to the non-ethanol fuel (E0). These increases were statistically significant. Permeation emissions are hydrocarbon emissions through vehicle hoses, fittings, and tank walls that are facilitated by the presence of ethanol in gasoline.
  - ✓ Commingling ethanol and gasoline in tanks, including vehicle tanks, increases the mixture's vapor pressure, which results in increased hydrocarbon emissions to the atmosphere.
- Because ethanol contains oxygen, its combustion results in increased NOx emissions.
- Ethanol contains about two-thirds of the energy content of gasoline. Consequently, E85 would produce around 75 to 80 percent of the miles per gallon of gasoline. This is an important consideration for government policies that are trying to encourage energy efficiency and consumer acceptance.
- Ethanol cannot currently be transported by pipeline. It must be separately transported by truck or railcar and blended into gasoline at the terminal or rack. This is because ethanol's high affinity for water absorbs and separates water from the gasoline mixture causing a corrosive environment in the pipeline.
- Substantial retail station revisions/retrofits may be required to dispense E85.
- Current status of E85 dispensing equipment certification: In October 2006 the Underwriters Lab suspended their certifications for individual parts that compose an E85 fuel dispenser. In October 2007, UL published listing procedures for evaluating and certifying E85 equipment, and dispenser manufacturers are expected to submit their equipment to the UL for evaluation and certification. Until dispensers are evaluated and certified by the UL or other appropriate agency, many jurisdictions allow alternate equivalent dispenser designs to be submitted for approval. Each jurisdiction has its own process and

discretion in granting variances or waivers to approve designs not UL certified.

D. Conclusion

The Western States Petroleum Association (WSPA) and its member companies are committed to working cooperatively with legislators, regulators, other policy makers, and involved stakeholders in efforts to promote workable renewable fuels programs. The American Petroleum Institute reports that in 2006 oil industry investments reached more than $174 billion. Included in those investments are alternative and renewable energy, such as hydrogen, solar, wind and biofuels. WSPA's chief concerns in these efforts are to:

- Focus renewable programs on the following:
  - ✓ Responsibly and promptly dealing with the huge uncertainties inherent in the current underlying science of renewable fuels, particularly life cycle analysis and the evaluation of land use impacts.
  - ✓ Achieving technological breakthroughs in renewable technologies, since it is highly likely that existing technologies not only do not achieve intended GHG reductions but may even have significant unintended consequences.
- Avoid mandates and other requirements that trigger expensive investments and contractual commitments that in the end could be proven unnecessary because the science at the time of their adoption was too uncertain.
- Avoid siphoning excessive capital, attention, and other resources from the critical need to maintain and upgrade the state's petroleum-based transportation fuels supplies and infrastructure that will be needed to provide the majority of transportation fuels into the foreseeable future as new generation transportation fuels come into the market.

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[i] http://energy.senate.gov/public/index.cfm?FuseAction=IssueItems.View&IssueItem_ID=58

[ii] http://www.arb.ca.gov/fuels/lcfs/011608ucb_luc.pdf

[iii] http://www.parliament.uk/parliamentary_committees/environmental_audit_committee/eac_210108.cfm

[iv] http://www.arb.ca.gov/fuels/lcfs/011708UCBLUCB&W.pdf

[v] http://www.arb.ca.gov/fuels/lcfs/011608ucb_luc.pdf, page 3.

[vi] http://www.arb.ca.gov/fuels/lcfs/011708UCBLUCcolor.pdf

[vii] Tim Searchinger, *et al*, Published 7 February, 2008 on Science Express (10.1126/science.1151861)

[viii] Joseph Fargione, et al, Published 7 February 2008 on Science Express (10.1126/science.1152747

[ix] Rosenthal, Elisabeth, N.Y. Times, February 8, 2008

[x] http://www.parliament.uk/parliamentary_committees/environmental_audit_committee/eac_210108.cfm

[xi] http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/

[xii] http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/

[xiii] CRC Report No. E-65-3, Fuel Permeation from Automotive Systems: E0, E6, E10, E20 AND E85, Final Report, December, 2006, available at http://www.crcao.com/

Appendix A

RFS (Section 201, 202)
The Energy Act creates a significantly increased RFS standard containing four interrelated parts as set-out in the following table:

Annual Billion Gallons					
Year	***TOTAL Renewable*** **(Conventional PLUS Advanced)**	***Conventional*** **(Total MINUS Advanced)**	***Advanced*** **(Includes Bio-based Diesel & Cellulosic)**	***Biomass-based Diesel***	***Cellulosic***
		Corn only (Calculated)	**>50% GHG Reduction**	**>50% GHG Reduction**	**>60% GHG Reduction**
2008	9.0	9.0			
2009	11.1	10.5	0.6	0.5	
2010	12.95	12	0.95	0.65	0.1
2011	13.95	12.6	1.35	0.8	0.25
2012	15.2	13.2	2	1	0.5
2013	16.55	13.8	2.75		1
2014	18.15	14.4	3.75		1.75
2015	20.5	15	5.5		3
2016	22.25	15	7.25		4.25
2017	24	15	9		5.5
2018	26	15	11		7
2019	28	15	13		8.5
2020	30	15	15		10.5
2021	33	15	18		13.5
2022	36	15	21		16

Definitions
- Expands the definition of transportation fuel to include nonroad vehicles and engines
- Allows “credit” for use of biofuels in home heating oil or jet fuel
- Defines “conventional biofuels” as “ethanol derived from corn starch”
- Renewable diesel is included in definition of “advanced biofuels,” but can not be used to meet the “bio-based diesel” mandate
- Sets a floor of 1 billion gallons of “bio-based diesel” in years after 2012
- Ethanol derived from sugar is eligible to be considered as “advanced biofuel”

GHG Reductions
- Establishes lifecycle GHG reduction requirements:
    - At least 60% for “cellulosic biofuel”

- ✓ At least 50% for “advanced biofuel”
- ✓ At least 50% for “bio-based diesel”
- ✓ At least a 20% for any renewable fuel production facility that “commences construction after the date of enactment”

- All existing corn-based ethanol facilities are grand-fathered and thus have no reduction requirement
- The percent reductions listed above can each be reduced 10% (e.g. from 60% to 50% for cellulosic) by EPA if they are determined to be infeasible
- If the EPA makes an adjustment, that decision is to be reviewed in 5 years
- EPA can not increase the percent reduction requirement above those listed above
- Any change in the percent reduction requirement “shall only apply to renewable fuel from new facilities that comment construction after the effective date of such adjustment”
- Baseline for gasoline and diesel lifecycle GHG emission reductions is 2005
- Requires that “significant emissions from land use changes” be included in lifecycle GHG emission estimates