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Comments on the TIAX Report: Full Fuel Cycle Assessment, Well to Tank Energy Inputs, Emissions and Water Impacts as prepared for the California Energy Commission February 2007

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General Comments

The TIAX "Well to Tank" Report is a complex and well organized analysis that integrates new assumptions (using calculations and estimates specific to CA) with older published data on fuel energy inputs, emissions and water that were generated years ago for a broader national average. Although this approach has merit, it also has risks that the new assumptions may not necessarily apply to the protocols and data generated with those protocols in the literature.

In the case of the biodiesel assessment, we are concerned that emission and life cycle data for biodiesel that was generated by the US Department of Energy at the National Renewable Energy Laboratory appears to be unfairly weighted by new assumptions made in this report for biodiesel production, distribution and use as an alternative fuel in CA. On one hand, the report cites the life cycle analysis data from NREL and utilizes energy input values that are similar to the NREL protocols, which we commend, but then the report makes new assumptions that make biodiesel appear unfavorable in terms of energy input (for transportation) and emissions. Many of these assumptions appear to be based on simple extrapolations of the current low level use of biodiesel in CA in which virtually all of the product is imported from the Midwest (soybean oil biodiesel) or the South Pacific (palm oil biodiesel). There is no mention of ANY local feedstock nor is there any discussion of biodiesel production plants under construction or about to open in CA (and Nevada, Oregon and Washington). The report infers that palm oil biodiesel will be the other major feedstock when, in fact, very little palm oil biodiesel is being imported to CA, and the product that has been imported on a limited basis has proven to be unsuitable for use in cooler weather, even in southern California. In ignoring the emerging biodiesel production industry here in CA and neglecting to consider energy inputs and emission benefits of the regional feedstock (not soy, not palm but recycled cooking oil, animal tallow, mustard seed, cotton seed, safflower seed, sunflower oil and others under development), the report unfairly penalizes biodiesel by insisting it will remain a transportation-intensive alternative fuel.

In reality, biodiesel has the greatest initial opportunity of developing as a regional industry by encouraging the growth of small or medium-sized regional plants (under 10 million gallons/yr) that utilize local feedstock for local transportation markets. This market and production strategy is unlike the ethanol industry's approach in which smaller plants have been closed as the industry consolidated into enormous plants located in the heart of corn production by monoculture cultivation. Biodiesel in California will not necessarily follow the same path as the ethanol industry despite the construction of larger production plants in the Midwest (for soy oil), and, eventually, even at major ports along the west coast (for imported feedstock).

The overall green house gases (GHG) benefits that have been established nationally by NREL for the B20 blend of biodiesel show a 15% improvement in overall emissions over petroleum diesel fuel. The Well to Tank report, by imposing a significant transportation penalty and applying other, as yet undefined, assumptions for biodiesel production, reduced the estimated GHG reduction benefits of a B20 blend of biodiesel by 33% down to only a 10% benefit over petroleum diesel. In doing so, the report is marginalizing biodiesel benefits simply by applying unfair assumptions (presumably largely due to the presumed long distance transportation) and ignoring the local production of biodiesel from regional feedstock in keeping with the Governor's GHG Reduction Plan for the state.

Similarly, emission benefits neglect the advantages of utilizing biodiesel to reduce 'street level' PM, CO and toxics emissions from older heavy duty truck engines operating in our congested cities, busy ports and across our border with Mexico. These older engines, usually owner-operator rigs, represent up to 90% of the on-road truck traffic at the Ports of Los Angeles and Long Beach according to the technical panel presentations at the recent "Faster Freight, Cleaner Air" conference held last month in Long Beach. Biodiesel offers an immediate opportunity to cost effectively reduce PM, CO and toxics emissions from the large number of heavy duty diesel trucks that represent a large percentage of the overall diesel exhaust emission inventory but that are not readily amenable or practical to retrofit, retire, repower or replace in the immediate future.

Specific Comments – Well to Tank Report

Energy Crops, Section 3.7.2 Vegetable Oils: On page 3-42, the first paragraph lists examples of crop oils (soybean, rapeseed and palm) that are used to produce biodiesel (there are actually many more, including tropical plant oils beyond palm). However, the yields quoted say "gallons of ethanol per acre" when they are gallons of biodiesel per acre. On the next page, the palm oil clusters from the African Red Palm (as grown in much of Central and South America) yields clusters of fruit that are much heavier than 20 pounds (actually they weigh hundreds of pounds).

Biomass Feedstock Energy Inputs- We find inconsistencies between what has been presented in tables and figures as prior data for comparing, for example, feedstock, and what is actually discussed in the main body of text. There is data presented for mustard seed production but then the text discusses palm and soy, not mustard when referring to examples and anticipated feedstock for biodiesel. In table 3-23 on page 83, the mustard seed and other feedstock 'farming and collection energy' data are reported in completely different units (per bushel vs. per acre). Could this data be recalculated to provide a uniform unit system for feedstock yield, for example, on a kg per hectare basis? Please use footnotes and legends to explain the origin and derivation of the data cited in this table. For example, the table indicates no fertilizers are used for mustard cultivation. Is that accurate? It should be pointed out that irrigation is critical to most of these oil seed crops but that mustard, for example, can yield high productivity of oil under dry farm cultivation. Water requirements should be included among the assessment parameters when comparing different feedstock and the production of biofuels in general.

Section 3.9 Biodiesel – First sentence should refer to plant oils and animal fats, not "matter" since methyl esters need to be distinguished from other non-biodiesel products made, for example, by thermal depolymerization. Further in the report, there is mention of thermal depolymerization as another production method for making biodiesel. This is incorrect and an unfortunate error, given that biodiesel is, by definition (as cited in the beginning of the report) an alkyl mono ester. We request that all references to thermal depolymerization be removed on page 3-47 (simply delete the first two sentences after the 3 bullets, which also need to be edited).

On page 3-47, the three bullets are somewhat misleading. Only one method, base catalyzed transesterification, is typically used in the industry, either in batch mode or in continuous production. The acid direct catalysis is the first step in producing biodiesel from low grade, high free fatty acid recycled cooking oils. The acid esterification converts free fatty acids in the degraded cooking oil and grease (or animal tallow) directly to methyl esters in the presence of methanol and sulfuric acid. This step is not common for biodiesel plants using virgin plant oils or high quality animal fats that have less than 4%-6% free fatty acids. The base catalyzed transesterification is the most common method employed worldwide to produce biodiesel methyl esters from a wide range of feedstock, unless, as noted, the free fatty acid level of the raw material is higher. Conversion of oils to fatty acids and then acid catalysis of the fatty acids to biodiesel is relatively rare; this last bullet should be dropped and the other two reversed in order.

The subsequent description of biodiesel production is simplistic and does not mention the removal of catalyst through extensive water washing or subsequent fuel polishing. The reference cited regarding the production of biodiesel from chicken fat is from a newspaper article. We urge a more diligent explanation of how biodiesel is manufactured (with regard to care in assuring a high quality product) and the citation of several well referenced, authoritative documents describing the production of biodiesel (e.g., those cited on the website, biodiesel.org and textbooks such as the Biodiesel Handbook, published in 2005, authored by Van Gerpen et al). We would be happy to assist TIAX with rewriting this section and providing a well rounded list of appropriate references for the production and characterization of biodiesel that meets ASTM D-6751.

Table 3-25 Energy Inputs for Transesterification: We commend the use of the selected values that more closely follow the recommendations and calculations of the prior NREL Life Cycle Analysis of biodiesel production.

In general, the report appears to ignore the more energy efficient production of biodiesel from locally grown crops, and to the extent available, recycled oil and grease feedstock. The report focuses on the production of biodiesel in CA from imported soybean from the Midwest and palm from Malaysia or other areas of the south Pacific. The soybean oil, while currently popular (the soybean is raised in America for its meal as animal food, not for its oil as a fuel feedstock), is a poor choice, energetically speaking. The soybean oil production is water, energy and fertilizer intensive agriculture, plus it requires transport from the Midwest states where it is produced to California where it would be processed into biodiesel fuel for local transportation markets.

Similarly, the palm oil would be imported large distances from other countries by ship and barge, with environmental penalties associated with that transport as well. Neither feedstock is local. Although it would seem limited in scope, there is a significant amount of animal tallow and recycled cooking oil already available in California that will be processed into biodiesel at small to medium sized biodiesel plants already under construction or in operation today. Additional plants could utilize even lower grade, lower cost feedstock derived from recycled trap grease and sewer grease. By broadening the scope of recycled feedstock options through more robust biodiesel process technologies, more biodiesel could be produced in California from local raw materials that would make the biodiesel with less energy input – and less emissions by reducing transportation distances.

Not until Section 4.16 (page 113) does the report mention mustard oil as an example of a local feedstock that could be grown in California, and to a greater extent in Nevada and eastern Oregon.

In terms of transport energy and emissions penalties, the report (Section 4.13, p. 120) assumes 720 miles of rail distance from the Midwest and it assumes an imaginary "border" extending out

100 miles out to see in terms of air emissions. Similar penalties must apply to petroleum diesel and other fuels.

The transport of biodiesel locally from regional plants is by truck, just as petroleum diesel is hauled from local shipping and pipeline terminal racks. Low blends of biodiesel may one day be moved in pipelines but there are issues with potential cross contamination with jet fuel that would prevent that from being allowed at the current time. The point is, however, that biodiesel blends could eventually be moved efficiently and cleanly through the state through pipelines that are currently in use today for petroleum distillates.

Summary – Well to Tank Report

Although generally well researched, the report is lacking sound references for feedstock and production issues associated with the production of biodiesel in California in coming years. Several of the key assumptions made tend to ignore local feedstock options and tend to penalize the biodiesel based on transport, energy inputs and emissions that would not be as severe for locally produced biodiesel. In terms of green house gas emissions, the assumptions made in the report dropped the overall GHG emission benefits of biodiesel relative to petroleum diesel by a third, from a 15% advantage established by NREL / DOE down to a 10% advantage deduced by TIAX.

In terms of other environmental and public health benefits, the report fails to emphasize the reduction in toxicity associated with biodiesel exhaust (blends) relative to petroleum diesel. Please refer to the Tier I and Tier II health effects studies conducted on biodiesel that demonstrate significantly lower air toxics emissions for biodiesel and blends of biodiesel. In particular, please not the major reduction in polyaromatic hydrocarbons (PAHs) and mutagenicity measured in engine exhaust for B100 and B20 relative to petroleum diesel. Overall, both the quantitative amount of particulate material, and the qualitative chemical composition of those particulates, for biodiesel exhaust will reduce the 'street level' toxicity in our communities impacted by heavy diesel engine exhaust inventory, including the central valley where so many older agricultural diesel engines are still in use.

Well to Wheel Report

In addition to the comments above for the emissions, energy input and GHG life cycle analysis of biodiesel, we found a problem with the assumptions made in calculating NOx emissions for biodiesel. In Figure 3-12 on page 3-17 regarding criteria pollutant emissions for BD20, the figure

reports unusually high NOx emissions that are out of line with current and previously published NOx emission results published in the past two years by Dr. Robert McCormick et al.

We can provide data and publications to assist TIAX with adjusting these figures and text so that it is clear that biodiesel exhaust (BD20) produces about the same or less NOx than would be measured for ULSD.

The way in which the emission data is presented in Figure 3-12, the benefits of biodiesel in terms of PM reductions get lost due to the fact that all the criteria pollutants are graphed on the same scale. Since NOx is a predominant pollutant, it tends to dwarf the presentation of the PM, HC and CO data, making it difficult to discern the emission reductions of these pollutants by BD20.

In terms of overall GHG reductions in this report, the biodiesel emission benefits again have been reduced by 33% from the NREL published value of 15% reduction relative to petroleum diesel to the TIAX value of only a 10% reduction in GHG. We are requesting that TIAX provide more insight into the assumptions used to establish GHG reduction estimates since they are 33% lower than the values established by the same NREL report cited in the study. We suspect the differences might include assumptions regarding nitrous oxide emissions (due to presumed decomposition of root nodules) during the cultivation of soybeans, but there is no specific mention of this factor.

The report also seems to suggest increased use of intensive agricultural practices in our country. In fact, the acreage dedicated to soybean plantations in the US is decreasing this year. There will be approximately 217 million acres of corn, soybean and wheat cropland this coming year vs. 211.4 million acres this past year, with all of that increase due to increased cultivation of corn, not soybean. Our soybean acreages are relatively stable and are shifting to non-till farming practices to avoid cultivation methods that used to damage highly erodible land. Overall, America is reducing soybean and corn exports as we utilize more of our crops and oils for domestic fuel and feed, rather than shipping them to overseas markets. In the meantime, our country is gradually increasing oil imports like palm oil as we are tapping into other domestic oil sources like new regional oil crops, animal tallow and recycled oil/grease feedstock.

We hope to obtain more explanations of the assumptions and calculations used for biodiesel emissions and energy impacts cited in this report. The NBB is available to assist the CEC with information, data, and ideas relating to the successful use of biodiesel in California.

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