COMMENTS ON USED COOKING OIL BIODIESEL
CALIFORNIA GREET MODEL
FOR THE
LOW CARBON FUEL STANDARD DEVELOPMENT

Prepared For:

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EXECUTIVE SUMMARY

California has taken a lead in North America of promoting, developing, and implementing a Low Carbon Fuel Standard (LCFS) for transportation fuels. The concept is that the effective carbon content of transportation fuels will be reduced by 10% by the year 2020. The means of achieving this reduction will be left to the marketplace but the benefits of all of the fuel options will be determined through a lifecycle assessment of each fuel. Other states and some Canadian provinces have announced plans to follow California's lead or are considering doing so.

The California Air Resources Board (CARB) has begun to release a series of papers, each one covering a fuel production pathway, and inviting comments on the results and findings of the California GREET model. A report covering used cooking oil biodiesel (esterified used cooking oil) was released on July 20, 2009. The used cooking oil pathway is not included in GREET and the most recent version of GREET released by CARB is from February 2009 so the details of this pathway are not currently available. The comments that are provided here are therefore based only on the draft document released by CARB.

The report shows that the GHG emissions for this pathway are 13.70 g CO_2eq/MJ of fuel. This represents an 85 % reduction compared to the reference diesel fuel. CARB has determined that there are no indirect land use emissions associated with this fuel.

The pathway is relatively simple and CARB have generally done a good job in identifying the relevant inputs into the process that are required for modelling purposes. The NBB did supply CARB with the results of their Energy Survey of producing members but it does not appear that these were taken into account during the development of this new pathway.

There are two issues that the NBB have raised before with respect to the biodiesel pathways that remain unresolved in this pathway. These are the quantity of glycerine produced, which impacts the allocation of energy and emissions in the system, and the allocation of biogenic carbon in the system between biodiesel and glycerine.

The impact of the glycerine quantity error in the CARB documents is small and it results in an underestimation of the GHG emissions for all biodiesels. When it is eventually found it will reduce the credibility of the significant reduction in GHG emissions that are provided by biodiesel fuels. It is very easy to correct this values in GREET and CARB should make this correction.

In the first version of the GREET soybean biodiesel document CARB included GHG emissions associated with the fossil carbon portion of biodiesel. The NBB in their comments pointed out that this approach, while technically correct, would then require an emissions impact of the biodiesel glycerine compared to the alternative product. An alternative approach was suggested, which was to assume that all of the carbon in the biodiesel was biological in origin and that all of the carbon in the glycerine was fossil in origin. The overall system impact is the same but the alternative is simpler. The second version of the soybean biodiesel pathway analysis this emission source was removed from the soybean biodiesel pathway.

The approach in the used cooking oil document was to revert back to the original approach. If the rationale is that there is a greater chance that glycerine from used cooking oil might not be fully utilized as a displacement product for fuel or synthetic glycerine then perhaps the option is to have two values reported for biodiesel fuels, one that would be applicable to facilities that waste the glycerine and a second value for plants that utilize the glycerine as a feedstock to replace synthetic glycerine or used as a fuel. This alternative approach would provide equity to all biodiesel producers and should provide and incentive for plants to optimize the utilization of the glycerine.

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1. INTRODUCTION

Climate change advocates point to increased levels of anthropogenic carbon emissions as the primary cause of global warming. As such, most greenhouse gas mitigation strategies are focused on reduction of carbon dioxide (CO_2) in the atmosphere. Since typically 30-40 percent of all carbon emissions are derived from mobile sources, automobiles and off-road equipment serve as focal points for many of these policies.

California has taken a lead in North America of promoting, developing, and implementing a Low Carbon Fuel Standard (LCFS) for transportation fuels. The concept is that the effective carbon content of transportation fuels will be reduced by 10% by the year 2020. The means of achieving this reduction will be left to the marketplace but the benefits of all of the fuel options will be determined through a lifecycle assessment of each fuel. Other states and some Canadian provinces have announced plans to follow California's lead or are considering doing so.

The California Air Resources Board (CARB) has begun to release a series of papers, each one covering a fuel production pathway, and inviting comments on the results and findings of the California GREET model. A report covering used cooking oil biodiesel (esterified used cooking oil) was released on July 20, 2009. The used cooking oil pathway is not included in GREET and the most recent version of GREET released by CARB is from February 2009 so the details of this pathway are not currently available. The comments that are provided here are therefore based only on the draft document released by CARB.

The report shows that the GHG emissions for this pathway are 13.70 g CO_2eq/MJ of fuel. This represents an 85 % reduction compared to the reference diesel fuel. CARB has determined that there are no indirect land use emissions associated with this fuel.

The pathway is relatively simple and CARB have generally done a good job in identifying the relevant inputs into the process that are required for modelling purposes. The NBB did supply CARB with the results of their Energy Survey of producing members but it does not appear that these were taken into account during the development of this new pathway.

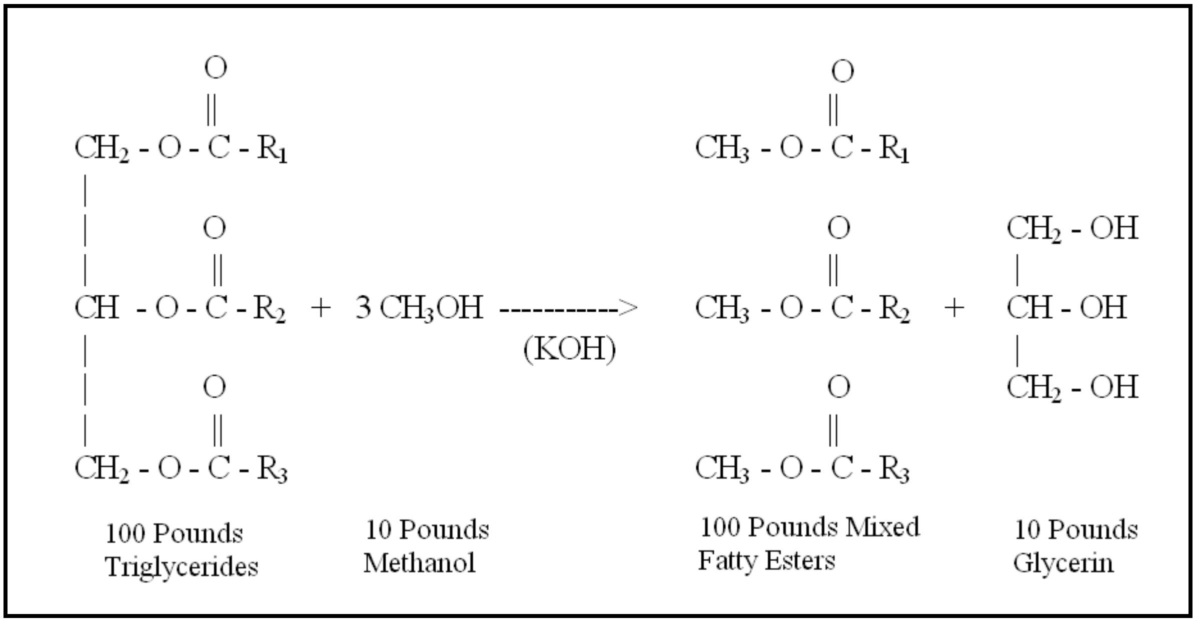
There are two issues that the NBB have raised before with respect to the biodiesel pathways that remain unresolved in this pathway. These are the quantity of glycerine produced, which impacts the allocation of energy and emissions in the system, and the allocation of biogenic carbon in the system between biodiesel and glycerine. These issues are discussed in the following sections.

2. GLYCERINE

The GREET model has mass balance for biodiesel production that is based on the NREL biodiesel LCA that was undertaken during the 1990s. The model assumes that the quantity of glycerine that is produced is 21.3% by weight of the quantity of biodiesel produced. This value is incorrect, both from considering the stoichiometric ratio for the biodiesel reaction and from the industry experience.

The basic biodiesel reaction is shown in the following figure. One hundred pounds of triglycerides reacts with 10 pounds of methanol to produce 100 pounds of biodiesel and 10 pounds of glycerine.

Figure 2-1 Basic Biodiesel Reaction



The value that was reported in the NREL report and adopted by GREET was probably the quantity of crude glycerine produced. This would be a combination of water, glycerine, salts, and perhaps some methanol. It has considerably different chemical properties than pure glycerine. The glycerine properties that are included in GREET are those for pure glycerine.

The mass balance data that was reported by the NBB in their 2008 Energy Survey are summarized in the following table. The NBB survey did not differentiate between crude and refined glycerine and since both are produced this probably accounts for the slightly higher than stoichiometric quantity of glycerine reported.

Table 2-1 Mass Balance Results – NBB Energy Survey

	Virgin Oils	Industry Average
Inputs per gal biodiesel	(Soy & Canola)	(including all feedstocks)
	lbs	lbs
Feedstock	7.3285	7.7834
Methanol	0.6735	0.7208
Outputs		
Glycerin	0.8881	0.9075
Fatty Acids	0.0153	0.0340

The impact of the error in the CARB documents is small and it results in an underestimation of the GHG emissions for all biodiesels. When it is eventually found it will reduce the credibility of the significant reduction in GHG emissions that are provided by biodiesel fuels. It is very easy to correct this values in GREET. Cell C39 on the BD sheet needs to be set to 0.10 instead of 0.213.

3. COMBUSTION EMISSIONS

In the first version of the GREET soybean biodiesel document CARB included GHG emissions associated with the fossil carbon portion of biodiesel. The NBB in their comments pointed out that this approach, while technically correct, would then require an emissions impact of the biodiesel glycerine compared to the alternative product. An alternative approach was suggested, which was to assume that all of the carbon in the biodiesel was biological in origin and that all of the carbon in the glycerine was fossil in origin. The overall system impact is the same but the alternative is simpler. The second version of the soybean biodiesel pathway analysis this emission source was removed from the soybean biodiesel pathway.

Glycerine has many different uses in foods, cosmetics, and other consumer products. Almost all of the products would eventually be oxidized to carbon dioxide and water vapor. If the glycerine, or a portion of it, were biological in origin then the CO_2 emissions would not be included in an emission inventory. If the glycerine were fossil derived, then all of the CO_2 would have to be included in an emission inventory. Because this can get quite complicated to keep track of, most of the LCA work that has been done with biodiesel has taken the simple approach and assumed that all of the carbon in the biodiesel is biological and all of the carbon in the glycerine is fossil in origin.

This source of emissions has now been included in the used cooking oil biodiesel document. There is no discussion in the document of why this has been changed back to the format of the early soybean version. Glycerine is produced from all biodiesel feedstocks so there is no fundamental reason why the used cooking oil should be treated differently than soybeans.

The approach used here of proportioning the carbon in biodiesel between biological and fossil really needs a similar calculation to be undertaken for the glycerine and a credit added back to this system in order to portray an accurate picture of the GHG emissions. It is recommended that California take the same, simplified approach as used by other models (and the standard GREET model) and assume that all of the carbon in the biodiesel is biological and all of the carbon in the glycerine is fossil. This would reduce the GHG emissions associated with biodiesel by 3.7 g/MJ.

If the rationale is that there is a greater chance that glycerine from used cooking oil might not be fully utilized as a displacement product for fuel or synthetic glycerine then perhaps the option is to have two values reported for biodiesel fuels, one that would be applicable to facilities that waste the glycerine and a second value for plants that utilize the glycerine as a feedstock to replace synthetic glycerine or used as a fuel. This alternative approach would provide equity to all biodiesel producers and should provide and incentive for plants to optimize the utilization of the glycerine.