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Air Resources Board
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Via Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

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A 2nd Opinion, Inc. thanks the California Air Resources Board for the opportunity to submit comments on behalf of its client Neste Oil concerning the:

Detailed California-Modified GREET Pathway for Renewable Diesel Produced in California from Tallow (U. S. Sourced) July 20, 2009 draft

To facilitate the editing of the pathway, we have attempted to identify the first page upon which the issue was noticed and the supporting pages.

Pages 2 & 24: The assumption "Combustion of RD in a heavy-duty vehicle is assumed to generate the same CH_4 and N_2O emissions as ULSD. " is not accurate. The exceptionally high hydrogen content (paraffin composition) and distillation properties of RD causes RD to emit less NOx and THC than typical ULSD when burned. CARB should update this assumption. Using estimated properties of commingled RD, typical CARB ULSD properties and EPA's Unified Model we find we can attribute a 14% reduction in NOx emissions and a 37% reduction in THC emission to RD100. (Supporting Unified Model spreadsheet calculations are attached.) This reduces the gCO2e/MJ for combusting RD from the assumed 0.78 to 0.66 gCO2e/MJ. This is not a big number. It is well below the accuracy of lifecycle GHG calculations. But, it belongs to the clean fuel and should not be lost due to a simplifying assumption. We anticipate that when CARB completes the Biodiesel and Renewable Diesel Research Study they may want to replace the Unified Model results with the new data. You will however need to correct for the actual test CARB ULSD being slightly cleaner than the average CARB ULSD.

Page 3: Concerns about bovine spongiform encephalopathy could also make edible tallow a waste product. CARB will need to monitor the issue.

Pages 5, 9, 10, 21, 22 & 23: The RD Transport and Distribution assumption is wrong for 2 reasons:

1. This is a comingled production process. That means that RD has to be distributed with ULSD and therefore, just like ULSD.
2. Regulatory analyses of fuels programs are typically based upon optimized systems. RD has greater value and lower distribution costs when blended at the refinery level. Its optimum blending location is at the refinery level.

For comingled RD transport and distribution is identical to that of ULSD. For separate processing train RD there could be a transport and distribution component to get the RD to a refinery for blending in addition to the ULSD transport and distribution factors when the RD facility is not adjacent to the blending refinery.

Therefore, based upon the *"**Detailed California-Modified GREET Pathway for Ultra Low Sulfur Diesel (ULSD) from Average Crude Refined in California**"* dated February 29, 2009 the Renewable Diesel Transport and Distribution numbers for the comingled RD should be 4721 Btu/mmBtu RD and 0.33 gCO2e/MJ RD, not 8,662 Btu/mmBtu RD and 0.66 gCO2e/MJ RD as shown in Table A of the draft.

Page 5: Because 0.059 lbs of renewable propane (RP) is produced for every lb of RD a table that is similar to Table A can be created to calculate a fossil propane credit based upon the renewable propane production less the energy and carbon emissions allocated to the co-product. To make it easier to see the basis of the numbers the Energy Required is based upon 1,000,000 Btu RD and the CO_2 Emissions are based upon one MJ of RD. (A spreadsheet containing the calculations is also attached.)

The allocations to RP for tallow production, transport and conversion to RD are simply the total energy and carbon emissions for each step less the amount allocated to RD. Because the propane co-product will either be converted to hydrogen or fuel gas on site no distribution energy or carbon emissions should be attributed to it. Producing 1,000,000 Btu of RD results in the coproduction of (1000000/18925*18568*.059) or 57,887 Btu of propane. Producing 1 MJ of RD results in the coproduction of 0.002954885 lbs of renewable propane (947.817/18925*.059). This displaces fossil propane that would have released 4.02 gCO_2e (947.817/18925*0.059*454*36.033/44.097*44.009/12.011) when either burned or used as hydrogen plant feedstock.

The revised energy numbers in the following table more accurately reflect probable transport and distribution and tank to wheel emissions as well as the net GHG impact of producing RD from U.S. Tallow.

Summary of Adjustments to Reflect Credit for Renewable Propane Co-product, Commingled Renewable Diesel Transport & Distribution and Tank to Wheel Emissions relative to 1 mmBtu and 1 MJ of Commingled Renewable Diesel from Inedible Tallow Waste

Path Element	Energy (BTU/mmBtu)	% Energy Contribution	Emissions (gCO_2e/MJ)	% Emissions Contribution
Tallow Production Energy Allocated to Propane	**16,322**	**1.14%**	**1**	**3.72%**
Tallow Transport Energy Allocated to Propane	**1,096**	**0.08%**	**0.08**	**0.30%**
RD Production Energy Allocated to Propane	**9,564**	**0.67%**	**0.56**	**2.08%**
RD Distribution Energy Allocated to Propane	**0**	**0.00%**	**0**	**0%**
Total (Well to Tank) Allocated to Propane	**26,982**	**1.88%**	**1.64**	**6.10%**
Renewable Propane	**57,887**	**4.03%**	**4.02**	**14.95%**
Net Fossil Propane Offset	**-30,905**	**-2.15%**	**-2.38**	**-8.84%**
RD Transport & Distribution Correction	**-3,941**	**-0.27%**	**-0.33**	**-1.23%**
Draft Total (Well to Tank) RD from Inedible Tallow	**472,263**		**28.92**	
Corrected Total (Well to Tank)	**437,417**	**30.43%**	**26.21**	**97.54%**
Total (Tank to Wheel)	**1,000,000**	**69.57%**	**0.66**	**2.46%**
Corrected Total (Well to Wheel)	**1,437,417**	**100.00%**	**26.87**	**100.00%**

Chemical engineering principles tell us we cannot throwaway or simply ignore mass (renewable propane). Experience indicates that neither CARB nor EPA will allow a process to just emit the propane. Therefore we have to do something with the renewable propane. Given the small volume of the co-product the most efficient regulatory thing to do is to simply allocate net energy and CO_2 emission credits to renewable diesel. This is a valid methodology because:

1. The GHG benefits of renewable propane are real.
2. The renewable diesel production caused the renewable propane production. Thus the GHG benefits of the renewable propane belong renewable diesel.
3. Allocating the net fossil propane offset to renewable diesel more accurately reflects the full GHG benefits of renewable diesel life cycle.
4. Doing so simplifies both the regulatory and enforcement process by eliminating the need to develop complex tracking and enforcement regulations for a relatively small volume of renewable fuel that is chemically identical to fossil propane.
5. Improves the material balance for the pathway.
6. It provides consistent methodology for biomass-based diesel fuels.
7. And, finally it models what happens in real life at both a commingled RD production facility and an optimally located standalone RD facility.

Page 19-Maximum hydrogen consumption was assumed. Why not average? Stoichiometric hydrogen consumption should be determined by the fat species or source. Process hydrogen consumption could vary over the catalyst life cycle. But, assuming either maximum or minimum hydrogen consumption is sure to be wrong. Not knowing how much of the hydrogen consumption is stoichiometric and the shape of the catalyst decline curve I do not have a basis for a hydrogen consumption number at this time. Therefore the adjustment for a more accurate hydrogen consumption assumption has not been calculated for use in the above summary table. But, if we assume a linear catalyst decline curve, the average (2.7) of the high (3.8) and low (1.5) numbers would be a better assumption than either the maximum or minimum consumption number.

I raised similar questions in my comments concerning the February 2009 ***'Detailed California-GREET Pathway for Renewable Diesel from Midwest Soybeans' .*** But I did not create a table like the one above. I will do that calculation now.

I will however shortcut the calculations based upon the facts that 94.5% of the energy and carbon emissions was allocated to RD in the RD from Soybeans Pathway and the remaining 5.5% was allocated to renewable propane (RP). Therefore to calculate the allocations for RP we can simply divide the RD numbers by 0.945 and multiply the result by 0.055. For example 67,180 Btu were allocated to RD for Soybean farming. The allocation for RP is 67,180/.0945*.055 or 3,910 Btu per mmBtu RD.

Because the optimum location for a renewable diesel production facility is adjacent to either a hydrogen plant or a refinery in which the renewable propane can displace fossil propane in either hydrogen plant feedstock or fuel gas the propane distribution values are assumed to be zero. 57,887 Btu of RP is produced with each mmBtu of RD. (1000000*18568*.059/18925) This displaces fossil propane so the net fossil propane offset is the energy allocated to RP (19558) less 57887 or -38,329 Btu /mmBtu RD.

Similarly the renewable propane displaces 4.02 gCO_2e of fossil carbon emissions which creates a net fossil carbon offset of 1.56-4.02 or -2.46 gCO_2e/MJ RD.

Because the optimum blending point for renewable diesel is at the refinery level, RD will be distributed like ULSD and its distribution energy required and carbon emissions will be the same as those for ULSD which are 4721 Btu/mmBtu and 0.33gCO_2e/MJ. That means we need to subtract another 12,262 Btu from the RD Energy Required and another 1 gCO_2e from RD's carbon emissions. Refiners using RD produced in non-adjacent production facilities can simply add appropriate transport energy and CO_2 values to their compliance calculations. When these corrections are added to the Total Well to Tank numbers from the February pathway we get the Corrected Total (Well to Tank) for RD numbers.

Using properties of standalone RD, typical CARB ULSD properties and EPA's Unified Model we find we can attribute a 13% reduction in NOx emissions and a 19% reduction in THC emission to RD100. This reduces the gCO2e/MJ for combusting RD from the assumed 0.78 to 0.68 gCO2e/MJ.

The above adjustments are calculated in the attached spreadsheet and summarized in the following table:

Summary of Adjustments to Reflect Credit for Renewable Propane (RP) Co-product, Separate Process (Non-Commingled) Renewable Diesel Transport & Distribution and Tank to Wheel Emissions relative to 1 mmBtu and 1 MJ of Separate Process Renewable Diesel from Midwest Soy Beans

Path Element	Energy Required (BTU/mmBtu)	% Energy Contribution	Emissions (gCO_2e/MJ)	% Emissions Contribution
Soybean Farming Allocated to RP	**3,910**	**0.30%**	**0.30**	**1.18%**
Fertilizer / Pesticide / Herbicide Allocated to RP	**2,950**	**0.23%**	**0.22**	**0.86%**
N_2O Emissions from Fertilizer Use Allocated to RP	**0**	**0**	**0.23**	**0.90%**
Soy Bean Transport Allocated to RP	**873**	**0.07%**	**0.07**	**0.26%**
Soy oil Extraction Allocated to RP	**6,951**	**0.53%**	**0.41**	**1.60%**
Soy oil Transport Allocated to RP	**985**	**0.07%**	**0.07**	**0.29%**
Renewable Diesel Production Allocated to RP	**3,889**	**0.30%**	**0.27**	**1.05%**
Renewable Propane Distribution	**0**	**0**	**0.00**	**0**
Total (Well to Tank) Allocated to Propane	**19,558**	**1.50%**	**1.56**	**6.16%**
Renewable Propane	**57,887**	**4.45%**	**4.02**	**15.91%**
Net Fossil Propane Offset	**-38,329**	**-2.94%**	**-2.46**	**-9.75%**
Correct RD Transport & Distribution Assumption	**-12,262**	**-0.94%**	**-1.00**	**-3.96%**
Draft Total (Well to Tank) RD from Midwest Soy	**353,029**		**28.02**	
Corrected Total (Well to Tank) for RD	**302,438**	**23.22%**	**24.56**	**97.31%**
Total (Tank to Wheel)	**1,000,000**	**76.78%**	**0.68**	**2.69%**
Corrected Total Well to Wheel	**1,302,438**	**100%**	**25.24**	**100%**

For convenience the draft well to wheel energy and CO2 are compared below:

	Energy, Btu/mmBtu	**Emissions (gCO_2e/MJ)**	**% RD Rqd. for 10% CO_2 Reduction**
Draft RD from Waste Tallow	1,472,263	29.70	14.7
Adjusted RD from Waste Tallow	1,437,417	26.87	14.0
Difference	34,846	2.83	
Draft RD from Soy	1,353,029	28.80	14.4
Adjust RD from Soy	1,302,438	25.24	13.6
Difference	50,591	3.56	

We understand that the Indirect land Use Change (ILUC) factor is zero gCO_2e/MJ for RD from waste tallow and the ILUC factor for RD from soy is still under construction. We do want to point out that the ILUC factor in gCO_2e/MJ should decrease because more net bioenergy production is being attributed to an acre of soy beans.

This logic string began when we noticed biodiesel received a fossil carbon credit for glycerin in the Draft February 27, 2009 version of the "***Detailed California-Modified GREET Pathway for Biodiesel (Esterified Soy oil) from Midwest Soybeans"*** while RD did not get a fossil carbon credit for renewable propane in the draft "***Detailed California-GREET Pathway for Renewable Diesel from Midwest Soybeans"***. Because the glycerin coproduction is 0.213 lbs/lb biodiesel versus 0.059 lbs propane/lb RD CARB the allocation of the co-product net energy and CO_2 emissions to the biodiesel versus tracking and regulating renewable glycerin is not as clear cut. The assumption that increased glycerin production will be boiler fuel is reasonable. Because the biodiesel facility is unlikely to be located adjacent to a glycerin burning facility there will probably be Transport and Distribution energy consumption and carbon emissions associated with burning the co-product. Because EPA studies and the preliminary results from CARB's own Biodiesel and Renewable Diesel Research Study indicate biodiesel causes increased NOx emissions the tank to wheel CO_2 equivalent emissions will probably increase. Even though the larger co-product yield may result in higher net lifecycle energy production and lower net life cycle CO_2 emissions and there will be a net fossil carbon emission in the tank to wheel operation. This should cause the ILUC factor in terms gCO_2e/MJ to be smaller because more net energy will be derived from the same acre of soybeans.

Admittedly this is a change in LCA basis for biodiesel. But it allows the biodiesel LCA to be consistent with the renewable diesel LCA methodology that reflects the real life practice of burning the renewable propane co-product in adjacent facilities. Because consistency in calculation assumptions is an essential part of LCA CARB is urged to allocate the net energy and CO_2 impacts of co-products to the desired biomass-based fuel product.