Example of Implementation of Corn Oil Allocation

Prepared by Stefan Unnasch and Love Goyal, Life Cycle Associates, LLC
Date: April 23, 2018

Pathway: Corn Ethanol with CO extraction

Comment

Corn oil credit calculation in the calculator continues to perpetuate the corn oil energy accounting issue. The LCFS attempts to assign carbon intensity according to a well-established life cycle analysis framework. Accurate distribution of the emissions between ethanol and corn oil helps maintains confidence in the system. Even though the adjustments are small the allocation of emissions between ethanol and corn oil reflects a significant quantity of LCFS credits.

In our previous comments, we suggested multiple ways of rectifying the double counting of corn oil extraction energy. In this comment, we illustrate the implementation of one of the proposed solutions; allocating the total electricity used in the ethanol plant to both ethanol and corn oil produced based on energy content. This would produce a small amount of credit for the ethanol producers in terms of their ethanol CI and an equivalent amount of debit to be assigned to the biooil facilities using the corn oil as feedstock. The methodology maintains the system-wide consistency by creating an equal amount of credits and debits. Therefore, we provide the following table as an example of how ARB could calculate the average electricity used for corn ethanol plants to extract corn oil and to process ethanol.

	Existing Data					*Additional Calculation*			
Facility	**EtOH consumption**	**Corn Oil prod**	**Elec consumption**	**Elec use**	**CO yield**	**CO yield**	**EtOH**	**Elec credit**	**CO burden**
Unit	***gal/yr***	***lb/yr***	***kWh***	***kWh/gal***	***lb/gal***	***Btu/gal***	***Btu/gal***	***kWh/gal EtOH***	***kWh/lb CO***
1	66,557,036	19,146,449	38,547,255	0.58	0.29	4,601	76,330	0.03	0.11
2	76,754,542	15,508,102	48,432,009	0.63	0.20	3,231	76,330	0.03	0.13
3	90,290,644	14,876,638	46,463,833	0.51	0.16	2,635	76,330	0.02	0.10
4	92,129,485	0	53,471,005	0.58	0.00	0	76,330	0.00	0.00
5	89,641,321	16,788,530	62,932,666	0.70	0.19	2,995	76,330	0.03	0.14
6	54,812,964	10,287,224	40,051,057	0.73	0.19	3,002	76,330	0.03	0.15
7	90,360,856	21,887,695	48,284,297	0.53	0.24	3,874	76,330	0.03	0.11
8	72,112,930	16,538,538	55,606,689	0.77	0.23	3,668	76,330	0.04	0.15
9	53,541,132	9,098,748	39,592,231	0.74	0.17	2,718	76,330	0.03	0.15
10	99,080,283	20,422,393	56,933,420	0.57	0.21	3,296	76,330	0.02	0.12
Weighted Average/Total								**0.02**	**0.13**

We randomly generated data for 10 ethanol production plants in a realistic range of production values. Using only the information which is part of every LCFS pathway application, we calculate the yield of specifically corn oil in terms of Btu of corn oil produced per gal of ethanol produced. The only assumed factor in this calculation was the energy content of corn oil at 15993 Btu/lb (constant for all pathways). The EtOH energy yield is constant at 76,330 Btu/gal. The electricity consumed is then allocated between the EtOH and CO based on their energy proportions. The electricity allocated to the CO in kWh/gal represents the effective credit

received by the ethanol pathway. The same value is then re-calculated in terms of kWh/lb of CO to be allocated to the CO produced, subsequently added to the CO to BioOil pathways.

	Balance Check	
Facility	**Total EtOH credit**	**Total CO Burden**
Unit	***kWh***	***kWh***
1	2,191,328	2,191,328
2	1,967,062	1,967,062
3	1,550,512	1,550,512
4	0	0
5	2,376,305	2,376,305
6	1,515,361	1,515,361
7	2,332,186	2,332,186
8	2,549,563	2,549,563
9	1,361,279	1,361,279
10	2,357,015	2,357,015
Total	**18,200,610**	**18,200,610**

As previously mentioned, we also checked for the balance between the total credits and debits generated using this methodology. As it can be seen in the following image, the total credits given to ethanol exactly match the burden added to the corn oil. Additionally, this method works perfectly system-wide even if some ethanol facilities do not produce any corn oil. Please refer to the attached excel file for more details on calculation.

The same procedure could also be part of the verification procedure for corn ethanol plants. We hope that this approach provides a transition to more accurate accounting of co-products from corn ethanol.

Thank you for your consideration.

Best Regards,

Stefan Unnasch
Managing Director
Life Cycle Associates, LLC

Love Goyal
Environmental Scientist
Life Cycle Associates, LLC

Attachments: tier1-starch-fiber-etoh-calculator_CO_elec _credit.xlsm; LCA_-_iLUC_Corn_ethanol v2.pdf; Unnasch_-_COB Allocation.pdf; LCA_-_Corn Ethanol biogenic VOC.pdf

