



Memo

Date: March 19, 2013

To: Mr. Todd Dooley
California Air Resources Board (ARB)
Sacramento, California

From: Salil Arora

Subject: Revisions to ADM Columbus Dry Mill – Carbon Intensity Adjustment Feb 1, 2013 Memo

cc: Wes Ingram – ARB, Dean Frommelt – ADM, Steve Dewald – ADM

Dear Mr. Dooley:

ADM is requesting revisions to its original request for small adjustment as listed in Feb 1, 2013 memo. The primary reasons for this revision are listed below:

1. Reconcile plant utility data with receipts – review of utility receipts (in order to comply with ARB draft memo (dated Feb 8, 2013) request for verification of energy use) show that actual total coal use at Columbus Cogen is [REDACTED] lower than previously reported ([REDACTED])^{*} and natural gas use in dry grind ethanol plant is [REDACTED] higher ([REDACTED])^{*}.
2. PRB Coal carbon content – the draft ARB memo referenced above also stipulates that Coal carbon content should not exceed 48%, so that it is in agreement with PRB-Coal composition mentioned in CA_GREET1.8b_dec09 model. The CA_GREET model also lists the PRB-Coal fixed carbon content of 37% and as-is Coal HHV of 17,366,000 BTU/short ton (or 8,683 BTU/lb). In comparison the PRB-Coal fired by ADM-Columbus Cogen has a fixed carbon content of [REDACTED] and HHV of [REDACTED][†]. These values are also reported with each shipment. Therefore, initially ADM decided to use CA-GREET default PRB-Coal fuel specifications. However, based on further due diligence, we realized that the ultimate analysis of our PRB-Coal does not match-up with CA-GREET default specifications, with our coal having a higher carbon content of [REDACTED] on as-is basis ([REDACTED] C-content on dry matter basis and [REDACTED] moisture

^{*} Comparison on HHV basis.

[†] [REDACTED]

content)[†]. The current revision uses the higher coal C-content for carbon intensity calculations.

ADM Columbus dry mill ethanol plant has been operational since fall 2010 and obtained approval for eight corn ethanol pathways under CA-LCFS program. Based on the limited plant operations and projected reduction in energy use after implementing enhanced heat recovery technology, we initially calculated a carbon intensity of 89.80 g CO₂e/MJ-Ethanol. However, based on the 2012 calendar year (Jan 1, 2012 till Dec 31, 2012) operations and revisions listed above, the Columbus dry mill plant has achieved carbon intensity (CI) of 87.11 g CO₂e/MJ-Ethanol, which meets ARB's criteria for small adjustments because of below mentioned facts:

1. Reduction in CI is 3.02% of the original CI approved for enhanced heat recovery scenario with 0% biomass.
2. The reduction is due to higher than expected reduction in energy use from enhanced heat recovery technologies and use of utility receipts instead of plant utility flow meters.
3. None of this reduction can be attributed to operational changes in the plant.

Table 1 lists the user design inputs that were changed in CA-GREET for ADM pathway Midwest, Dry Mill, Dryer Closed-loop Enhanced Heat Recovery, Cogeneration – Coal. All other parameters are unchanged for the proposed sub-pathway including raw materials, ethanol energy content and land use change.

If you have any questions regarding this, please contact me at 217.451.3297.

Sincerely,

Salil Arora
LCA Scientist/Engineer
James R. Randall Research Center
Archer Daniels Midland Company

Table 1 User design inputs for CA-GREET and ADM Pathway MIDWEST, DRY MILL, DRYER CLOSED-LOOP ENHANCED HEAT RECOVERY, COGENERATION – COAL

CA-GREET Worksheet	Cell Reference	Input	Units	CA-GREET Value	ADM Pathway 1 Value
Inputs	B4	Target Year of Simulation		2010	2010
Fuel_Prod_TS	C271	EtOH Yield of Corn Dry Mill EtOH Plant	gal/bushel	2.72	██████
Inputs	C244, D244	Share of corn ethanol plant types	%	85% dry mill, 15% wet mill	100% dry mill, 0% wet mill
Fuel_Prod_TS	K271	Total ethanol energy use (undenatured)	BTU/gal	36,000	██████████
Inputs	C247	Electricity share of process fuel	%	10.2%	0%
Fuel_Prod_TS	S271	Share of Coal in total process fuels	%	20%	Base: 70.57%
Inputs	C255	Share of NG as Process Fuel	%	100%	29.43%
Inputs	C256	Share of Coal as Process Fuel	%	0%	Base: 70.57%
EtOH	C101	DGS Yield	bone-dry lb. per gallon EtOH	5.34	██████
Regional LT	H192	Midwest – Coal LHV	BTU/short-ton	19,546,300	██████████

CA-GREET Worksheet	Cell Reference	Input	Units	CA-GREET Value	ADM Pathway 1 Value
Regional LT	H193	Midwest – Coal HHV	BTU/short-ton	20,608,570	██████████
Regional LT	H194	Midwest – Coal Carbon Content	% wt	63.7%	██████████
Regional LT	H195	Midwest – S ratio	ppm by wt	11,100	██████████

Table 2 Total Well to Tank (WTT) emissions for Dry Milling Corn Ethanol production under ADM Pathway MIDWEST, DRY MILL, DRYER CLOSED-LOOP ENHANCED HEAT RECOVERY, COGENERATION - COAL

Results are specified as BTU or grams per MMBTU of Ethanol	Corn Ethanol: Dry Milling Ethanol			Total WTT (well to tank) results
	Corn w/o loss factor	Corn w/ loss factor	Ethanol	
Loss factor			1.001	
Total energy	183,837	183,929	██████████	██████████
Fossil fuels	178,797	178,887	██████████	██████████
Coal	25,474	25,487	██████████	██████████
Natural gas	86,889	86,933	██████████	██████████
Petroleum	66,433	66,467	██████████	██████████
VOC	16.462	16.470	53.762	70.232
CO	148.521	148.596	26.771	175.367
NOx	71.936	71.972	85.743	157.715
PM10	7.926	7.930	71.042	78.972
PM2.5	4.121	4.123	23.125	27.248
SOx	33.108	33.124	46.181	79.305
CH4	17.083	17.091	41.432	58.524
N2O	40.983	41.004	0.229	41.233
CO2	14,789	14,797	30,848	45,645
GHG Emissions		27,443	31,953	59,396

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Total Direct Emissions	56.31	g CO2/MJ EtOH
Land Use Change	30	g CO2/MJ EtOH
Denaturant (CARBOB blended at 2% with anhydrous EtOH)	0.8	g CO2/MJ EtOH
Total Carbon Intensity	87.11	g CO2/MJ EtOH