U.S. Venture

Finding a better way

February 12, 2024

Matthew Botill
Division Chief, Industrial Strategies Division
California Air Resources Board
1001 I Street
Sacramento, CA 95814
VIA ELECTRONIC DELIVERY

RE: Potential issue with CA-GREET 4.0 Electricity Emission Factor

Dear Mr. Botill,

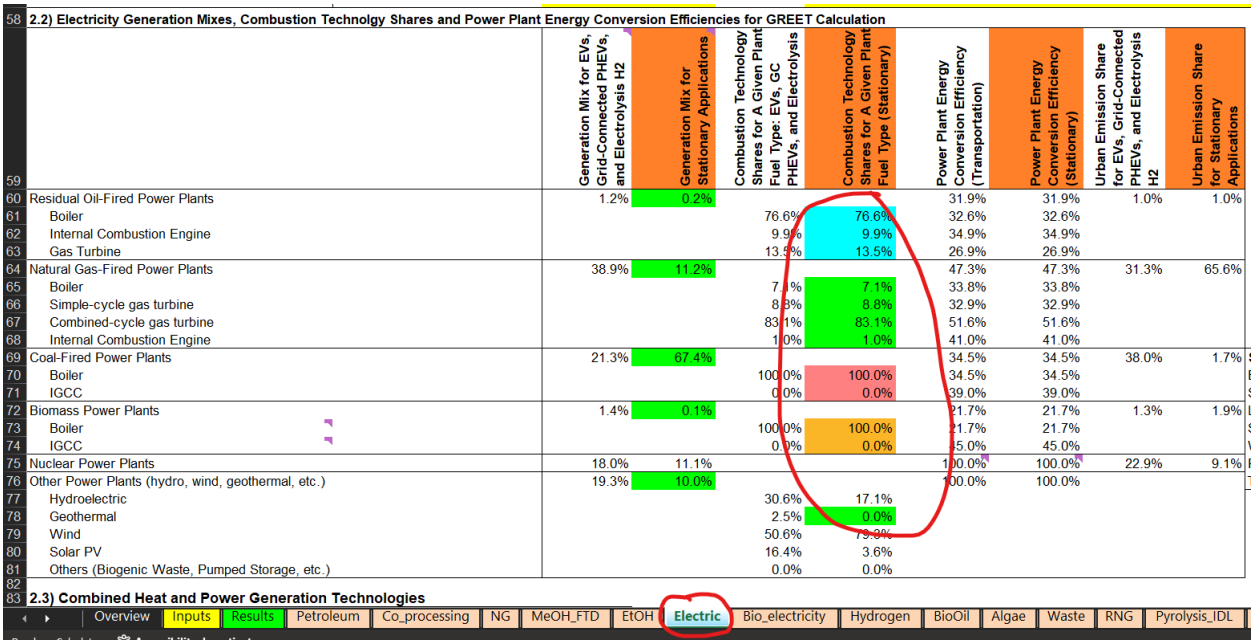
In review of the default electricity emission factors proposed in the 2024 Low Carbon Fuel Standard (LCFS) Amendments, U.S. Venture has identified a potential modeling issue we submit for your consideration. As you know, U.S. Venture has actively participated in the LCFS since 2017. U.S. Venture is a leading vertically integrated solutions provider proficient in refined products, alternative fuels, and environmental credits. We will submit an additional set of comments on the LCFS Amendments, but submit this feedback on the CA-GREET 4.0 (CA-GREET) model to facilitate improvements to the model and emission factors.

In review of the default electricity emission factors in the CA-GREET model, an issue was identified in the regional refactoring by CARB staff that may need attention. U.S. Venture was evaluating the various calculation approaches utilized across the different methodologies (CA-GREET, National GREET, GHGenius, OpenLCA, etc.), when we ran into an issue which we could not reconcile. We found that the default electricity emission factors within CARB's Tier 1 calculators, which are derived from the CA-GREET model, (relative to the EPA eGRID 2021 numbers used in GREET) may be off by a significant amount.

CARB provided document "Appendix B: CA-GREET 4.0 Supplemental Document", which explains how they recalculated the electricity emission factors using the fuel mix from eGRID 2021. Unfortunately, as we reviewed the draft CA-GREET calculator to figure out how these fuel mix factors were utilized, we identified an issue. CARB adjusts the National GREET calculator, which uses an NERC region map (11 regions) to determine electricity emission profiles, to one that uses the eGRID subregions (27 regions). This appears to be okay on the surface, but there is a core INDEX formula inaccuracy in the CA-GREET calculator which is being caused by the adjustment of 11 regions to 27, and can't be fixed with the data which is available in the calculator. The formula inaccuracy is not easily noticeable, because there is an IFERROR correction in the formula which defaults ("value in error") to an incorrect conclusion, so the formula doesn't simply fail with reference errors. If this INDEX function was corrected, the default electricity emission factors could change significantly.

Below are some screenshots from the CA-GREET 4.0 draft calculator which layout my findings.

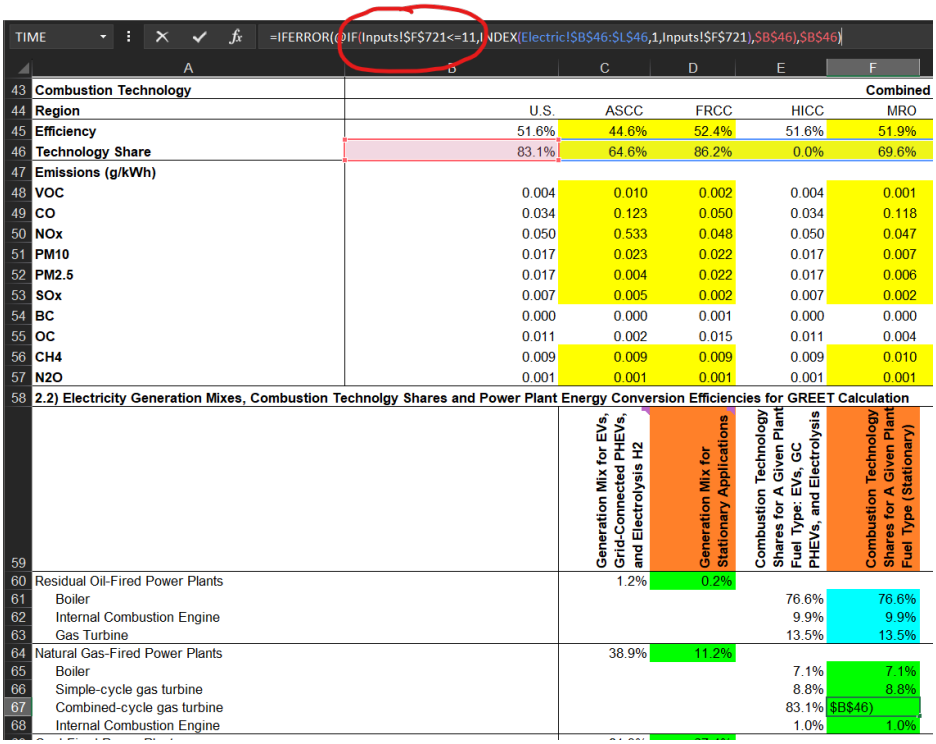
1. Fuel/Technology Mix-Electric tab: Circled cells show all formula inaccuracies mentioned. These cells feed numerous downstream formulas which ultimately produce the default electricity emissions for each subregion in the Tier 1 calculators.



58	2.2) Electricity Generation Mixes, Combustion Technolgy Shares and Power Plant Energy Conversion Efficiencies for GREET Calculation								
59		Generation Mix for EVs, Grid-Connected PHEVs, and Electrolysis H2	Generation Mix for Stationary Applications	Combustion Technology Shares for A Given Plant Fuel Type: EVs, GC PHEVs, and Electrolysis	Combustion Technology Shares for A Given Plant Fuel Type (Stationary)	Power Plant Energy Conversion Efficiency (Transportation)	Power Plant Energy Conversion Efficiency (Stationary)	Urban Emission Share for EVs, Grid-Connected PHEVs, and Electrolysis H2	Urban Emission Share for Stationary Applications
60	Residual Oil-Fired Power Plants	1.2%	0.2%			31.9%	31.9%	1.0%	1.0%
61	Boiler			76.6%	76.6%	32.6%	32.6%		
62	Internal Combustion Engine			9.9%	9.9%	34.9%	34.9%		
63	Gas Turbine			13.5%	13.5%	26.9%	26.9%		
64	Natural Gas-Fired Power Plants	38.9%	11.2%			47.3%	47.3%	31.3%	65.6%
65	Boiler			7.1%	7.1%	33.8%	33.8%		
66	Simple-cycle gas turbine			8.8%	8.8%	32.9%	32.9%		
67	Combined-cycle gas turbine			83.1%	83.1%	51.6%	51.6%		
68	Internal Combustion Engine			1.0%	1.0%	41.0%	41.0%		
69	Coal-Fired Power Plants	21.3%	67.4%			34.5%	34.5%	38.0%	1.7%
70	Boiler			100.0%	100.0%	34.5%	34.5%		
71	IGCC			0.0%	0.0%	39.0%	39.0%		
72	Biomass Power Plants	1.4%	0.1%			21.7%	21.7%	1.3%	1.9%
73	Boiler			100.0%	100.0%	21.7%	21.7%		
74	IGCC			0.0%	0.0%	45.0%	45.0%		
75	Nuclear Power Plants	18.0%	11.1%			100.0%	100.0%	22.9%	9.1%
76	Other Power Plants (hydro, wind, geothermal, etc.)	19.3%	10.0%			100.0%	100.0%		
77	Hydroelectric			30.6%	17.1%				
78	Geothermal			2.5%	0.0%				
79	Wind			50.6%	79.8%				
80	Solar PV			16.4%	3.6%				
81	Others (Biogenic Waste, Pumped Storage, etc.)			0.0%	0.0%				
82									
83	2.3) Combined Heat and Power Generation Technologies								

Overview | Inputs | Results | Petroleum | Co_processing | NG | MeOH_FTD | EtOH | Electric | Bio_electricity | Hydrogen | BioOil | Algae | Waste | RNG | Pyrolysis_IDL

2. INDEX formula-Electric tab: This screenshot shows the INDEX formula is searching for a result of 11 or under (from the GREET NERC regions), but is unlikely to function correctly given the 27 eGRID subregions breakout CARB adjusted the CA-GREET 4.0 model to.

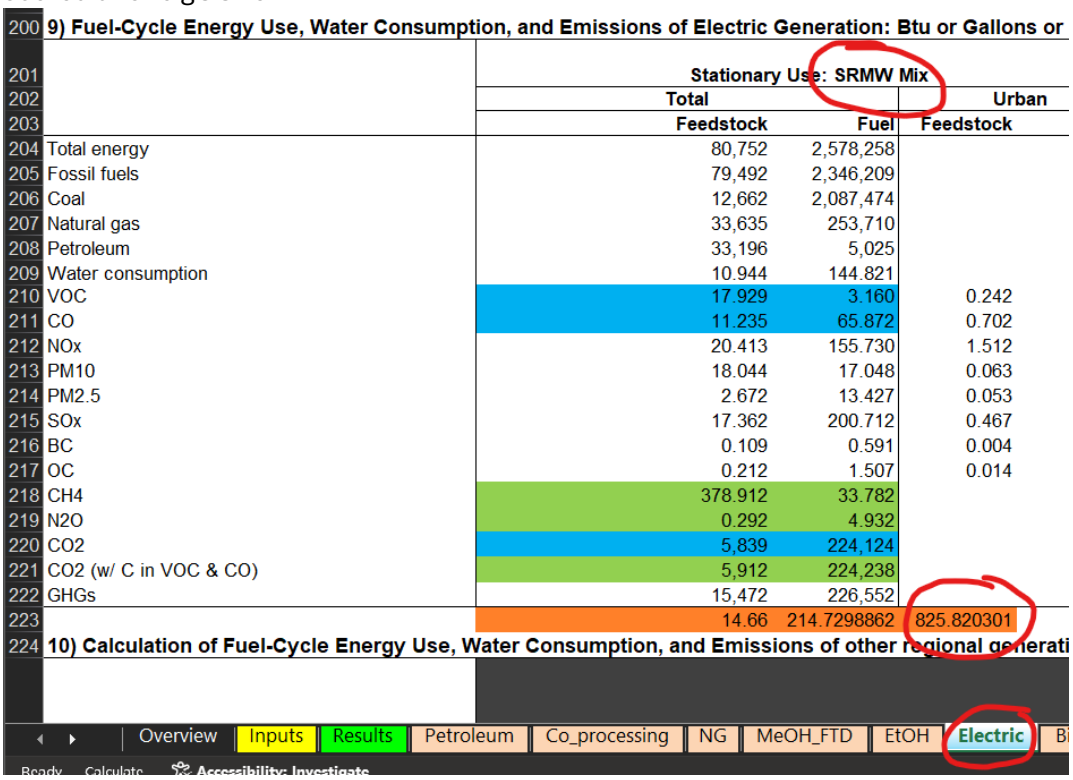


TIME | =IFERROR(IF(Inputs!$F$721<=11,INDEX(Electric!$B$46:$L$46,1,Inputs!$F$721),$B$46),$B$46)

	A	B	C	D	E	F
43	Combustion Technology					Combined
44	Region	U.S.	ASCC	FRCC	HICC	MRO
45	Efficiency	51.6%	44.6%	52.4%	51.6%	51.9%
46	Technology Share	83.1%	64.6%	86.2%	0.0%	69.6%
47	Emissions (g/kWh)					
48	VOC	0.004	0.010	0.002	0.004	0.001
49	CO	0.034	0.123	0.050	0.034	0.118
50	NOx	0.050	0.533	0.048	0.050	0.047
51	PM10	0.017	0.023	0.022	0.017	0.007
52	PM2.5	0.017	0.004	0.022	0.017	0.006
53	SOx	0.007	0.005	0.002	0.007	0.002
54	BC	0.000	0.000	0.001	0.000	0.000
55	OC	0.011	0.002	0.015	0.011	0.004
56	CH4	0.009	0.009	0.009	0.009	0.010
57	N2O	0.001	0.001	0.001	0.001	0.001

58	2.2) Electricity Generation Mixes, Combustion Technolgy Shares and Power Plant Energy Conversion Efficiencies for GREET Calculation				
59		Generation Mix for EVs, Grid-Connected PHEVs, and Electrolysis H2	Generation Mix for Stationary Applications	Combustion Technology Shares for A Given Plant Fuel Type: EVs, GC PHEVs, and Electrolysis	Combustion Technology Shares for A Given Plant Fuel Type (Stationary)
60	Residual Oil-Fired Power Plants	1.2%	0.2%		
61	Boiler			76.6%	76.6%
62	Internal Combustion Engine			9.9%	9.9%
63	Gas Turbine			13.5%	13.5%
64	Natural Gas-Fired Power Plants	38.9%	11.2%		
65	Boiler			7.1%	7.1%
66	Simple-cycle gas turbine			8.8%	8.8%
67	Combined-cycle gas turbine			83.1%	$B$46)
68	Internal Combustion Engine			1.0%	1.0%

3. Default Regional EF-Electric tab: This screenshot displays the electricity emissions factor used in the Tier 1 calculators. The example below is from the SRMW sub-region, which was scored at 826 gCO2e/kwh.

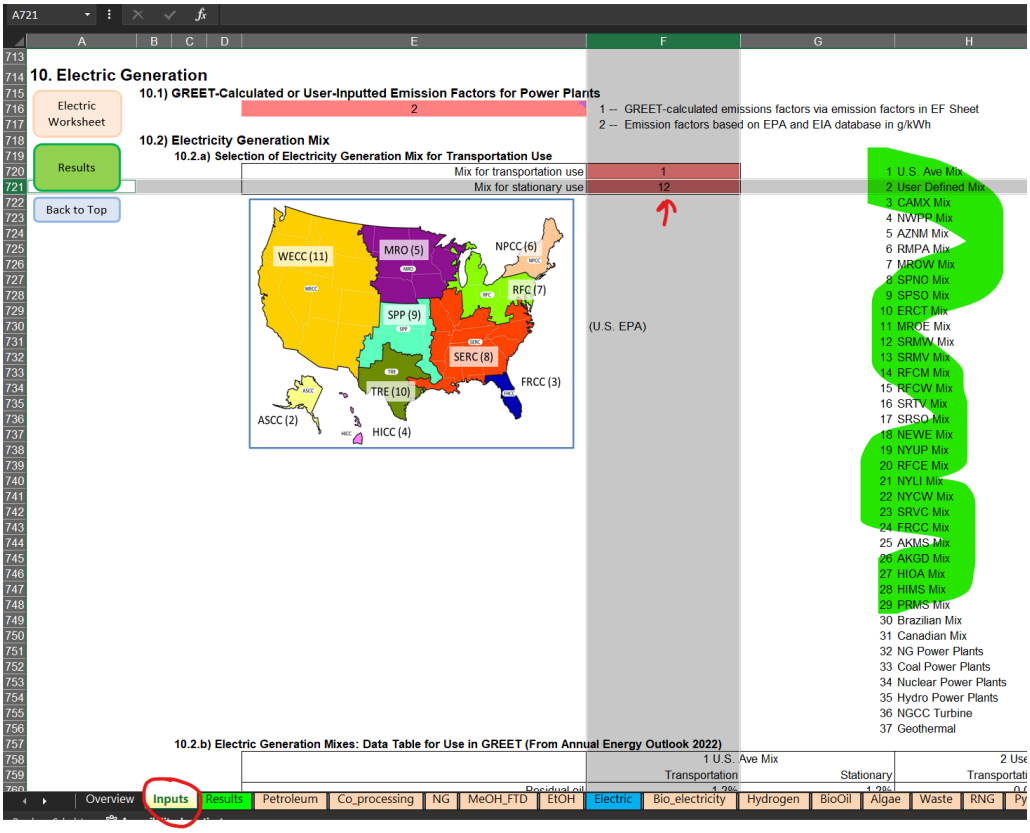


200	9) Fuel-Cycle Energy Use, Water Consumption, and Emissions of Electric Generation: Btu or Gallons or			
201		Stationary Use: SRMW Mix		
202		Total		Urban
203		Feedstock	Fuel	Feedstock
204	Total energy	80,752	2,578,258	
205	Fossil fuels	79,492	2,346,209	
206	Coal	12,662	2,087,474	
207	Natural gas	33,635	253,710	
208	Petroleum	33,196	5,025	
209	Water consumption	10.944	144.821	
210	VOC	17.929	3.160	0.242
211	CO	11.235	65.872	0.702
212	NOx	20.413	155.730	1.512
213	PM10	18.044	17.048	0.063
214	PM2.5	2.672	13.427	0.053
215	SOx	17.362	200.712	0.467
216	BC	0.109	0.591	0.004
217	OC	0.212	1.507	0.014
218	CH4	378.912	33.782	
219	N2O	0.292	4.932	
220	CO2	5,839	224,124	
221	CO2 (w/ C in VOC & CO)	5,912	224,238	
222	GHGs	15,472	226,552	
223		14.66	214.7298862	825.820301
224	10) Calculation of Fuel-Cycle Energy Use, Water Consumption, and Emissions of other regional generati			

Overview | Inputs | Results | Petroleum | Co_processing | NG | MeOH_FTD | EtOH | Electric | Bi

Ready Calculate Accessibility: Investigate

4. Subregion Selection-Inputs tab: Screenshot 2 is looking for something 11 and under, but since there are 27 subregion selections, the vast majority (subregion selections 12 - 27) will drive the formula above to IFERROR correct to the U.S. average. This does not seem correct. Even if this were to be the case, for any subregion selection 11 and under, the INDEX formula operates "correctly," but then pulls a reference for an NERC region which has no association with the eGRID subregion selection the user made, which in turn drives an inaccurate calculation.



Thank you for the opportunity to provide feeback on the proposed LCFS regulations. We support CARB in its efforts to accelerate the carbon intensity reduction of transporation fuels through the LCFS Program, and appreciate the inclusiveness of stakeholders and thoroughness of its actions throughout the 2023/2024 LCFS rulemaking process. If CARB would like any further clarification on the comments above, please let us know.

Sincerely,

/Josh Thome/

Josh Thome, CPA
Manager of Environmental Analytics
U.S. Energy, a U.S. Venture company