California Environmental Protection Agency

Air Resources Board

Low Carbon Fuel Standard Reconsideration:

CA-GREET Model Update

August 22, 2014

Workshop Purpose

The LCFS reconsideration includes a proposed CA-GREET version update

- This update will change pathway CIs—many will rise
- In the interests of full transparency, we are presenting these changes to, and soliciting feedback from, the public
- The information presented in these slides is preliminary, since work on CA-GREET 2.0 is ongoing

GREET Update Approach

Direct GHG emissions have always been estimated using a model based on Argonne's GREET

- GREET is still preferred:
  - Considered to be authoritative for U.S. fuel pathways
  - Freely available to the public
  - Very flexible; readily modified (spreadsheet format)
- On the downside, GREET is:
  - Very large and full of linked, sometimes recursive calculations
  - Not easy to master

GREET Update Approach (Cont.)

Argonne is aware of these drawbacks

- Has released a non-spreadsheet version: GREET.net
- Standalone application
- Found it to be very promising
- Did not have time to make the transition during this rulemaking
- Will consider adopting GREET.net in a future rulemaking

CA-GREET 1.8b & 2.0 Compared

- CA-GREET 2.0 is based on Argonne's GREET 1 2013 (not CA-GREET 1.8b)
- CA-GREET 1.8b was based on Argonne's GREET 1.8b
- Updates from both ARB staff and Argonne are reflected in CA-GREET 2.0
- More pathways and feedstocks are built-in:
  - Biomethane
  - Used cooking oil to bio- and renewable diesel
  - Corn oil biodiesel—wet DGS-associated

CA-GREET 1.8b & 2.0 Compared (Cont.)

- More pathways and feedstocks are built-in (Cont.)
  - Animal waste biomethane pathway with methane-emissions-avoided credit
  - Liquefied-compressed natural gas (L-CNG)
- Extensive life cycle inventory data updates
  - Fertilizer production
  - Farming and fuel production energy
- Emission factors are updated
  - Updated California on-road mobile-source emission factors from ARB's EMFAC 2011 inventory
  - Updated CNG/LNG tailpipe emissions data

CA-GREET 1.8b & 2.0 Compared (Cont.)

- Emission factors are updated (Cont.)
  - Updated natural gas leakage rates
  - Crude production emissions data from ARB's OPGEE model
  - Soil N_2O emissions
- Process efficiency factors are updated
- Electrical energy generation mixes are all based on latest USEPA eGRID database
- Tier 1 pathway calculator for expedited estimation of first-generation pathway CIs
- Some changes move CIs up; some move them down

Illustrative CI Examples

- Best way to summarize the differences is to look at actual direct (no ILUC) CIs
- The following comparisons are ***tentative***
  - Still in the verification stage
  - All values presented are still subject to change
  - Final CA-GREET 2.0 version will go public when the 45-day comment period begins
- Tentative differences for baseline fuels

	Model Version		
Fuel	**1.8b**	**2.0**	**Change**
CARBOB	98.38	99.20	0.82
ULSD	98.01	102.55	4.54
CaRFG	98.95	99.78	0.83

Illustrative CI Examples (Cont.)

Tentative differences for natural gas

- Fossil and landfill gas
- Shows effects of updated methane leakage rates (additional efforts to quantify are ongoing)

	Model Version		
Fuel	**1.8b**	**2.0**	**Change**
N. American NG - CNG	68.01	78.37	10.36
N. American NG - LNG	83.13	96.92	13.79
Landfill Gas - CNG	11.26	33.52	22.26
Landfill Gas - LNG	26.31	54.50	28.19

Illustrative CI Examples (Cont.)

Tentative direct CI differences for biodiesel

	Model Version		
Biodiesel Feedstock	**1.8b**	**2.0**	**Change**
Soybean	21.25	23.90	2.64
Tallow	39.08	46.31	7.23
UCO	18.73	23.69	4.96
Canola	31.98	41.72	9.73
Corn Oil, WDGS-Associated	29.27	34.35	5.08

Illustrative CI Examples (Cont.)

Tentative direct CI differences for renewable diesel

	Model Version		
RD Feedstock	**1.8b**	**2.0**	**Change**
Soybean	20.16	19.58	-0.58
Tallow	39.33	44.56	5.23
UCO	17.22	19.26	2.04
Canola	--	36.85	--
Corn Oil, WDGS-Associated	29.72	--	--

Illustrative CI Examples (Cont.)

Tentative direct CI differences for sugarcane ethanol

	Model Version		
Sugarcane Ethanol Pathway	**1.8b**	**2.0**	**Change**
No Harvest or Electricity Credit	27.40	34.55	7.15
Mechanized and Power Export	12.40	23.30	10.90
Mechanized Harvesting only	--	29.52	--
Power Export only	20.40	28.33	7.93

Illustrative CI Examples (Cont.)

Tentative direct CI differences for corn and sorghum ethanol

	Model Version		
Pathway by Feedstock	**1.8b**	**2.0**	**Change**
Grain Sorghum	61.83	71.47	9.64
Corn Ethanol (100% NG)	68.32	59.86	-8.46

Current Work Priorities

Staff is focusing on these priorities as we finalize the model

- CARBOB and USLD refining efficiencies
- CNG and LNG truck tailpipe emission factors
- California NG leakage rate
- Used Cooking Oil rendering energy
- Bio- renewable diesel production energy

Summary

The primary drivers of CI differences are:

- Corn, soybean, sorghum, and sugarcane CIs driven by changes in fertilizer use and soil N_2O emissions
- Natural gas and biomethane pathways are higher due to
  - An approximate doubling of the leakage rate, and
  - An approximate 4x increase in pipeline energy requirements
- Tallow and UCO pathways now account for the transport of feedstocks

Feedback and Contact Information

We welcome your feedback

- Please submit feedback by September 15th, 2014
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Thank You