IEA Bioenergy

Comparison of international Life Cycle Assessment (LCA) biofuels models

Summary Series

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Summary

In recognition of the increasing demand for biofuels to decarbonize transport, particularly in the aviation and marine sectors, IEA Bioenergy Task 39 (jointly with Task 38) commissioned a study to improve understanding and confidence in the accuracy of leading LCA models used for biofuels sustainability assessment. The project team compared the U.S.'s GREET, Canada's GHGenius, Europe's BioGrace, and Brazil's Virtual Sugarcane Biorefinery (VSB) models, and another model that the European Commission is developing, to identify their main differences and commonalities and to see how their various assumptions and methodologies influence carbon intensity (CI) estimates. As described in the full report, each of these LCA models can assess a variety of biofuels production scenarios, e.g., field-to-pump through well-to-wheel analyses.

Table 1: Some of the main attributes of the biofuels LCA models studied

	BioGrace	GHGenius	GREET	New EC	VSB
Model version	4d (2015)	5.0a (2018)	2017	2017	2018
Developed for regulatory use	Yes	No	Yes	Yes	No
IPCC GWP method	2001	1995, 2001, 2007, 2013	2013	2013	2013
Default global warming gases	CO_2, CH_4, N_2O	CO_2, CH_4, N_2O, CO, VOC, NOx, fluorinated compounds	CO_2, CH_4, N_2O	CO_2, CH_4, N_2O	CO_2, CH_4, N_2O
Lifecycle data	JRC (2008)	Internal	Internal	JRC (2017)	Ecoinvent
Functional unit	MJ	km, MJ	km, mile Btu, MJ	MJ	km, MJ
Default allocation	Energy	Mostly substitution	Variable	Energy	Economic
Land use change	C stocks	Internal model	CCLUB/GTAP	C stocks	-

As low-carbon drop-in biofuels are increasingly required and used to decarbonise long-distance transport, it is important to continue to assess and improve the LCA models being used to calculate these values. As elaborated in the full report, the continued use of international expertise present in groups such as IEA Bioenergy's Task 39 will ensure that the processes, scenarios, models, and assumptions used to assess the sustainability of biofuels are best-in-class.

There are several reasons for the apparent lack of agreement between the different LCA models. For example, the models make different assumptions about agricultural production practices, such as the location of soybean/palm production, the amount of fertilizer used, etc. They also make different assumptions about the CI of non-feedstock inputs (such as electricity, fertilizer, etc.). For these reasons, variable results were expected in terms of GHG emissions per MegaJoule (MJ) of biofuel produced when using the models' default values. In most cases, the observed differences were justified and well explained in each model. However, as described in the full report, there were several key differences between the various models calculation methodologies, such as the substitution method used to handle coproducts in the GHGenius model compared to the allocation method used by the other LCA models.

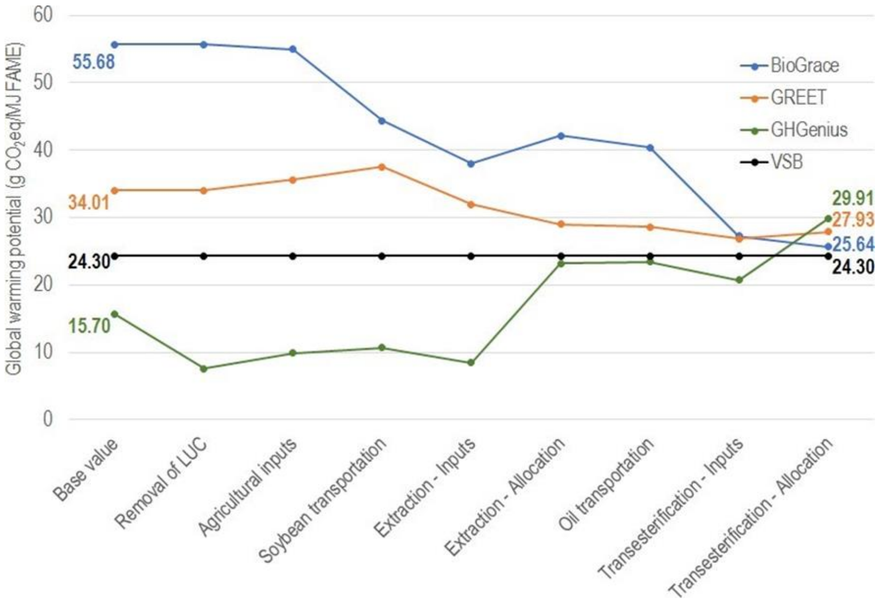

Figure 1: The influence of "harmonizing" the assumptions and default values of the studied LCA models on the estimated CI of soybean FAME production (using the VSB model's assumptions and parameters)

A major study finding is that once the various assumptions within the different models are standardized, all the models give quite comparable results. As shown in Figure 1, when using the VSB's model's assumptions and parameters in the different models to assess the CI of producing fatty acid methyl ester (FAME) biodiesel, the results from each of the models are similar. The remaining small differences between the models' results primarily reflect minor, unharmonized factors.

Conclusions

Many groups around the world are developing low carbon drop-in biofuels to help decarbonise the long-distance transport sector, such as aviation and marine. However, most policies used to date to encourage the production and use of biofuels have been based on volumetric or energy content targets, with the carbon intensity (CI) of the biofuels not specified. Although many jurisdictions have used LCA models to estimate the CI of various biofuels, **different models frequently gave disparate results**. This project showed that it was primarily the default values within the models, and the related assumptions, that lead to the apparent discrepancies. **Once scientists harmonized these assumptions, the models estimated similar CI values for a given biofuel**.