

Studies Show Renewable Fuels Reduce Greenhouse Gases Considerably

Two recently released reports show that biofuels are a major player in reducing greenhouse gas (GHG) emissions. The first study is an independent third-party analysis of Canadian renewable fuel production that conclusively confirms Canadian produced ethanol and biodiesel significantly reduce GHG emissions.

Cheminfo Services, Inc., a specialized environment, energy, transportation, and chemicals consulting firm, was hired by the Canadian Renewable Fuels Association (CRFA) to analyze a sample of eight ethanol plants and three biodiesel plants in Canada. The analysis was conducted using the most recent version of the Natural Resources Canada GHGenius life cycle assessment model for transportation fuels. The study is the first of its kind in Canada to draw exclusively upon Canadian renewable fuel facilities.

- Volumetric results from GHGenius that show that the reduction in fuel cycle GHG emissions from one liter of a 95 percent diesel/five percent tallow biodiesel (TD5) fuel blend is 164 grams (g) carbon dioxide equivalent (CO₂e) per liter (L) of TD5, or 4.7 percent of the fuel cycle GHG emissions for one liter of petroleum diesel. The calculation of this reduction is based on equivalent vehicle performance by distance.

- Adjustment of the volumetric fuel cycle GHG intensity from -164 g/L TD5 (a TD5 basis) to -3,273 g/L 100 percent tallow biodiesel (TD100 basis) by dividing by five percent the tallow diesel content in TD5; and

- Adjustment of the volumetric fuel cycle GHG intensities for petroleum diesel and TD100 to an energy basis using the energy contents of the respective fuels (38.65 MJ/L for petroleum diesel and 36.94 MJ/L for tallow biodiesel).

Table 1. Relative Fuel Cycle GHG Reduction from Biodiesel (based on tallow diesel used in a five percent blend at equivalent vehicle performance distance)

	Calc.	Petroleum Diesel (PD)*	Difference TD5 Basis		Difference TD100 Basis	
		(g CO ₂ e/L PD)	(g CO ₂ e/L TD5)	(% of PD)	(g CO ₂ e/L TD100)	(% of PD)
Volume Basis:						
Fuel cycle GHG intensity (g/L)	A	3,463	-164	-4.7%	-3,273	N/A
Energy content (MJ/L)	B	38.65			36.94	96%
Energy Basis:						
		(g CO ₂ e/MJ PD)			(g CO ₂ e/MJ TD100)	(% of PD)
Fuel cycle GHG intensity (g/MJ)	A/B	89.6			-88.6	-99%

*PD is on-road petroleum diesel at 15 parts per million sulfur, the reference diesel fuel in GHGenius.

Analysis of the Canadian renewable fuel plants found:

1. On an energy basis, the reduction in fuel cycle GHG emissions from one megajoule (MJ) of ethanol (when used in a 10 percent fuel blend) is 62 percent of the fuel cycle GHG emissions for one MJ of gasoline.

2. On an energy basis, the reduction in fuel cycle GHG emissions from one MJ of tallow-based biodiesel (when used in a five percent fuel blend) is 99 percent of the fuel cycle GHG emissions of one MJ of petroleum diesel (applied over the same road performance distance).

Biodiesel production of 93.6 million liters (24.7 million gallons) was reported by three plants in Canada, all of which used tallow rendered from animal carcasses as feedstock. This is approximately 85 percent of total Canadian biodiesel capacity active during the data reporting period of April 2008 to March 2009. More than half of the reported production came from an Ontario plant, with plants in Quebec and Alberta contributing the remainder.

The study reports that volume of biodiesel resulted in a reduction of 306,601 tons of life cycle GHG emissions compared to petroleum diesel. The study's finding that the reduction in fuel cycle GHG emissions from one MJ of tallow biodiesel (when used in a five percent blend) is 99 percent of the fuel cycle GHG emissions of one MJ of petroleum diesel is calculated based on three factors (results are shown in Table 1):

It is important to note that the -3,273 g/L TD100 reduction in GHG intensity (on a volumetric TD100 basis) cannot be directly compared to the 3,463 g/L petroleum diesel volumetric baseline GHG intensity because they are expressed on a different basis. The 4.7 percent reduction in volumetric GHG intensity from the use of one liter of TD5 (versus one liter of petroleum diesel) does not directly convert by 20 times to a 94 percent reduction in volumetric GHG intensity from the use of one liter of TD100 (versus one liter of petroleum diesel) because the energy content of one liter of TD100 is slightly lower than that of petroleum diesel.

Details of the calculation of the difference in GHG intensity are provided in the full report. The input factors for life cycle analysis using GHGenius are also detailed in the report, entitled "Life Cycle Assessment of Renewable Fuel Production from Canadian Biofuel Plants for 2008-2009," which can be downloaded at www.greenfuels.org.

Biofuels Cause Major Drop in Global GHG

A second report also confirms that biofuels reduce GHG emissions considerably, this time on a global scale.

Data prepared by (S&T)² Consultants, Inc., an energy and environmental consulting firm based in Canada, demonstrates that world biofuels production in 2009 has reduced global GHG emissions by 123.5 million tons, representing an average

Table 2. World Biodiesel Production, 2009

Region	Production Million Gallons	GHG Reduction kilograms CO₂e/L	GHG Reduction 1,000 tons	Feedstocks
European Union	2,602	2.13	20,986	Rapeseed (50%), soy (40%), palm (5%), tallow (5%)
United States	444	2.40	4,030	Soy (40%), tallow (20%), canola (20%), palm (20%)
Brazil	366	2.38	3,302	Soy (80%), tallow (10%), other veg. oils (10%)
Argentina	330	2.39	2,988	Soy
Thailand	162	1.70	1,043	Palm
Malaysia	75	1.70	483	Palm
Colombia	54	1.70	348	Palm
China, Republic of	50	3.00	573	Waste veg. oil
South Korea	48	2.34	425	Palm (33%), soy (33%), waste veg. oil (33%)
Indonesia	45	1.70	290	Palm
Singapore	33	1.70	211	Palm
Philippines	29	1.70	184	Coconut
Canada	27	3.00	307	Tallow
South America (other)	17	1.70	106	Palm
Europe (other)	15	1.88	109	Rapeseed
Australia	15	3.00	170	Tallow
Taiwan	11	2.34	101	Palm (33%), soy (33%), waste veg. oil (33%)
North/Central America	10	3.00	113	Palm (other)
India	6	3.00	68	Waste veg. oil
Oceania (other)	2	3.00	17	Waste veg. oil
Asia (other)	1	3.00	14	Waste veg. oil
World Total	4,342		35,866	

reduction of 57 percent compared to the emissions that would have occurred from the production and use of equal quantities of petroleum fuels.

Of note, the report found:

- World biofuels production has surpassed 100 billion liters (26.4 billion gallons) of annual production in 2009. After accounting for energy contents, this is displacing 1.15 million barrels of crude oil per day, which creates approximately 215 million tons of GHG emissions annually.

- For 2009, world biodiesel production forecasts of 16.4 billion liters (4.3 billion gallons) reduced GHG emissions by 35.9 million tons – greater than the GHG emissions reported for Croatia in 2007 (see Table 2 on page 15).

- The combined GHG emissions reduction from global ethanol and biodiesel production of 123.5 million tons is equal to the national GHG emissions of Belgium or Greece.

The study utilized a life cycle assessment approach to estimate global GHG emissions reduction achieved through the production and use of biofuels from “cradle-to-grave,” including the acquisition of raw material, manufacture, transport, use, maintenance, and final disposal.

The full study, entitled “GHG Emission Reductions from World Biofuel Production and Use,” can be downloaded at www.globalrfa.org. The report was commissioned by the Global Renewable Fuels Alliance. **R**