Lifecycle Greenhouse Gas Emissions for Select Pathways (kg CO_2e per mmBtu)[1]

Feedstock	Fuel	Production Process	Ag. Impacts	Land Use Change[2]	Feedstock Transport[3]	Fuel Production	Fuel Dist. & Use	Net Emissions[1]	Percent Reduction[4]
Algal oil	Biodiesel	Transesterification (Open Pond, Mid)	0.0	0.0	0.0	31.5	1.5	33.0	66%
Algal oil	Biodiesel	Transesterification (PBR, Mid)	0.0	0.0	0.0	26.3	1.5	27.8	71%
Barley[5]	Ethanol	Dry Mill (<36,800 Btu/gal NG, <0.19 kWh/gal Elec.)	-4.0	11.3	3.6	35.1	2.1	48.2	51%
Barley	Ethanol	Dry Mill NG	-4.0	11.3	3.6	39.1	2.1	52.1	47%
Biogas from landfills	Renewable electricity	Any	0.0	0.0	0.0	12.3	0.0	12.3	87%
Canola oil	Biodiesel	Transesterification	8.2	33.9	1.6	2.9	1.5	48.1	50%
Cellulose from corn stover	Cellulosic diesel	Fischer-Tropsch process	11.6	-11.2	1.2	5.4	2.0	9.0	91%
Cellulose from corn stover	Ethanol	Biochemical enzymatic process	11.2	-10.8	1.2	-32.6	2.1	-29.0	129%
Corn starch	Butanol	Dry Mill Biomass (dry DDGS)	13.3	21.2	2.9	10.1	1.8	49.4	50%
Corn starch	Butanol	Dry Mill NG Base Plant (dry DDGS)	13.3	21.2	2.9	32.6	1.8	71.9	27%
Corn starch	Butanol	Wet Mill Coal	13.3	21.2	2.9	51.5	1.8	90.8	8%
Corn starch	Ethanol	Dry Mill Biomass (2022 Average)	16.5	27.8	3.0	11.2	2.1	60.6	38%
Corn starch	Ethanol	Dry Mill NG (2022 Average)	16.5	27.8	3.0	27.9	2.1	77.2	21%
Corn starch	Ethanol	Wet Mill Coal	16.5	27.8	3.0	67.6	2.1	117.0	-19%
Grain sorghum	Ethanol	Dry Mill, 92% Wet DGS, Biogas, CHP	12.7	27.6	2.4	1.6	2.1	46.4	53%
Grain sorghum	Ethanol	Dry Mill, Dry DGS, NG	12.7	27.6	3.0	31.4	2.1	76.8	22%
Palm oil[6]	Biodiesel	Transesterification	4.8	46.1	1.3	25.1	3.4	80.7	17%
Palm oil	Renewable diesel	Hydrotreating	4.8	46.8	2.0	30.9	2.2	86.7	11%

[1] Results based on lifecycle analyses conducted for the Renewable Fuel Standard program. For more information see: http://www2.epa.gov/renewable-fuel-standard-program/fuel-pathways-under-renewable-fuel-standard-program

[2] Results include EPA's mean estimate of land use change GHG emissions.

[3] Includes emissions associated with co-product transport.

[4] Percent reduction compared to the petroleum baseline fuel replaced. Results include EPA's mean estimate of land use change GHG emissions.

[5] GHG estimates for barley ethanol are from a Notice of Data Availability (78 FR 44075).

[6] GHG estimates for fuel produced from palm oil feedstock are from a Notice of Data Availability (77 FR 4300).

Feedstock	Fuel	Production Process	Ag. Impacts	Land Use Change[2]	Feedstock Transport[3]	Fuel Production	Fuel Dist. & Use	Net Emissions[1]	Percent Reduction[4]
Soybean oil	Biodiesel	Transesterification	-8.8	33.6	2.7	13.2	1.5	42.2	57%
Sugarcane	Ethanol	Fermentation (Trash, No CBI, Marg. Elec.)	39.4	5.3	1.9	-41.5	3.7	9.0	91%
Sugarcane	Ethanol	Fermentation (No Trash, No CBI, Marg. Elec.)	38.2	5.3	1.8	-11.0	3.7	38.1	61%
Switchgrass	Cellulosic diesel	Fischer-Tropsch process	6.5	13.1	1.6	5.4	2.0	28.6	71%
Switchgrass	Ethanol	Biochemical enzymatic process	6.3	12.6	1.6	-32.6	2.1	-10.1	110%
Switchgrass	Ethanol	Thermochemical gasification process	6.6	13.1	1.6	3.7	2.2	27.2	72%
Yellow grease	Biodiesel	Transesterification	0.0	0.0	2.7	9.6	1.5	13.8	86%
Petroleum[7]	Baseline Gasoline	Refining	0.0	0.0	0.0	19.2	79.0	98.2	0%
Petroleum	Baseline Diesel	Refining	0.0	0.0	0.0	18.0	79.0	97.0	0%

[7] For baseline gasoline and diesel, the emissions reported under the fuel production stage include emissions associated with crude oil production and transport.