

GHG Benefits of 15% Ethanol (E15) Use in the United States

**Air Improvement Resource, Inc.
November 30, 2020**

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Introduction

The EPA has allowed E15 blends to be used in 2001 and later passenger cars, passenger trucks, and light commercial trucks. Ethanol generates less greenhouse gases (GHG) on a lifecycle basis than gasoline. The purpose of this report is to estimate nationwide GHG benefits of an expansion of ethanol use from E10 (i.e., 10% volume ethanol) to E15.

Based on our analysis, we estimate that if the United States transitioned from E10 to E15 in the nation for 2001 and later model year vehicles, GHG emissions would be lower by 17.62 million tons per year, which is the equivalent of removing approximately 3.85 million vehicles from the road.

Method

The method involved a 3-step process:

1. Using MOVES2014b, estimate the energy use in mmBTU in 2001 and later vehicles in 2020 for the sum of cars, light passenger trucks, and light commercial trucks in the U.S.
2. Estimate the GHG emissions difference in lifecycle emissions between E10 and E15 in g/mmBTU.
3. Multiply the energy use in Step 1 by the difference in lifecycle emissions in Step 2.

Step 1 – Energy Use

Table 1 shows the national energy use by vehicle type for calendar year 2020. We obtained these estimates by running the EPA MOVES2014b model.

Table 1. National Energy Use Using MOVES2014b for 2001 and Later Vehicles			
Source	Joules	BTU	mmBTU
Passenger Car	5.86E+18	5.55E+15	5.55E+09
Passenger Truck	4.87E+18	4.61E+15	4.61E+09
Light Commercial Truck	1.23E+18	1.16E+15	1.16E+09
Total	1.20E+19	1.13E+16	1.13E+10

Step 2 – Lifecycle Emissions Difference Between E10 and E15

Table 2 shows lifecycle emission estimate of gasoline and ethanol. The gasoline value is from EPA’s Renewable Fuel Standard (RFS).¹ The ethanol value is from a recent U.S. Department Agriculture Report.² The lifecycle emissions for E10 and E15 are obtained by weighting the values for gasoline and ethanol by the energy fraction of gasoline and ethanol in E10 and E15. The energy fraction of gasoline in E10 is 0.930, and in E15 is 0.893.³ The emissions benefit of E15 compared to E10 is 1,411 g/mmBTU.

Fuel	Lifecycle GHG Emissions (g GHG/mmBTU)
Gasoline	98,000
Ethanol	59,776
E10	95,314
E15	93,903
Difference (E10-E15)	1,411

Step 3 – Estimate Lifecycle GHG Reductions for the United States for E15

Combining the information from Tables 1 and 2, the lifecycle benefit of GHG in 2020 in the U.S. is 17.621 million tons.

We also estimated the equivalent number of vehicles that would be removed from the road that would achieve the same benefit as E15. MOVES2014b indicates that there are 208.13 million 2001 and later cars, passenger trucks, and light commercial trucks on the road in the United States in 2020, and that these vehicles emit 952.8 million tons of GHG in 2020. Thus, on average, each vehicle emits 4.58 tons per year of GHG. Dividing the benefit of 17.621 million tons by 4.58 tons per year gives a result of 3.85 million vehicles.

Table 3 shows state-by-state emission reductions and equivalent vehicles removed. These values were obtained by running MOVES2014b in by-state mode.

¹ *Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program*, US EPA, March 26, 2010, page 14788 (FR Vol 75, No. 58).

² *A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol*, by ICF for USDA, September 15, 2018, www.usda.gov/sites/default/files/documents/LCA_of_Corn_Ethanol_2018_Report.pdf

³ According to the Argonne GREET model, gasoline has an energy density of 112,194 BTU/gal and ethanol a value of 76,330 BTU/gal. Thus, E10 has an energy density of 108,608 BTU/gal and E15 has an energy density of 106,814 BTU/gal. Gasoline’s energy fraction in E10 is therefore 0.930 ($0.9 \times 112,194 / 108,608$), and in E15 is 0.893 ($0.85 \times 112,194 / 106,814$).

Table 3. State-by-State GHG Reductions and Vehicles Removed						
State	GHG Reduced (1000 tons/yr)	Vehicles Removed (1000s)		State	GHG Reduced (1000 tons/yr)	Vehicles Removed (1000s)
AK	29.0	6.3		NC	623.1	136.1
AL	377.5	82.5		ND	52.0	11.4
AR	187.0	40.8		NE	109.3	23.9
AZ	363.4	79.4		NH	75.7	16.5
CA	1,882.1	411.1		NJ	410.0	89.6
CO	274.5	60.0		NM	146.3	32.0
CT	177.6	38.8		NV	148.4	32.4
DC	25.2	5.5		NY	773.9	169.1
DE	54.0	11.8		OH	746.0	163.0
FL	1,206.9	263.6		OK	275.1	60.1
GA	621.5	135.8		OR	190.5	41.6
HI	62.5	13.6		PA	591.5	129.2
IA	180.2	39.4		PR	121.6	26.6
ID	89.5	19.5		RI	49.6	10.8
IL	634.5	138.6		SC	280.8	61.3
IN	454.9	99.4		SD	50.7	11.1
KS	173.0	37.8		TN	413.2	90.3
KY	279.8	61.1		TX	1,429.3	312.2
LA	273.7	59.8		UT	159.7	34.9
MA	317.7	69.4		VA	487.7	106.5
MD	328.0	71.7		VI	2.4	0.5
ME	81.1	17.7		VT	40.5	8.8
MI	580.0	126.7		WA	334.7	73.1
MN	332.3	72.6		WI	331.3	72.4
MO	349.9	76.4		WV	100.7	22.0
MS	222.6	48.6		WY	52.4	11.4
MT	66.1	14.4		Total	17,621.0	3,849.1