# $CO_2$ Benefits of 15% Ethanol Use (E15) in New York State

**Air Improvement Resource, Inc.**
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Introduction

New York is considering expanding ethanol use in the state to allow service stations to market E15, a blend of 15% ethanol and 85% gasoline. The EPA has allowed E15 blends to be used in 2001 and later light duty vehicles and light duty trucks. Ethanol generates less greenhouse gases on a lifecycle basis than gasoline. The purpose of this report is to estimate statewide CO2 benefits of an expansion of ethanol use from E10 (i.e., 10% volume ethanol) to E15.

Based on our analysis, we estimate that if New York transitioned from E10 to E15 in the state for 2001 and later model year vehicles, $CO_2$ emissions would be lower by 748,000 tons per year, which is the equivalent of removing approximately 129,400 vehicles from the road.

Method

The method involved a 4-step process:

1. Estimate statewide $CO_2$ inventories from 2001 model year and later gasoline cars and LDTs for the 2018 calendar year, and also statewide vehicle populations
2. Determine the energy percent of ethanol for both E10 and E15 blends
3. Using estimates of the lifecycle emissions of both ethanol and gasoline, determine lifecycle emissions of E10 and E15
4. Estimate the statewide lifecycle emission benefits of transitioning to E15 using the information from 3 and New York vehicle populations

Step 1 - Statewide $CO_2$ and Vehicle Populations

Table 1 shows New York state $CO_2$ inventories for calendar year 2018. We obtained these for the state by running the EPA MOVES2014 model. Model year 2001+ vehicles produce 37.87 million tons of $CO_2$ in 2018.

**Table 1. New York State 2018 $CO_2$ Emissions Using MOVES2014 (millions of tons per year)**

| Source | Model Year 2000 and earlier | Model Year 2001 and later | Total |
|---|---|---|---|
| Passenger Car | 1.66 | 20.69 | 22.35 |
| Passenger Truck | 1.61 | 17.18 | 18.79 |
| Total | 3.27 | 37.87 | 41.14 |

Vehicle populations for the state are shown in Table 2. These estimates also come from MOVES2014.

| Table 2. 2018 New York State Populations, MOVES2014 in Calendar Year 2018 | | | |
|---|---|---|---|
| Type | Model Year 2000 and Earlier | Model Year 2001 and Later | Total |
| Passenger Car | 609,587 | 5,002,688 | 5,612,275 |
| Passenger Truck | 400,970 | 2,874,288 | 3,275,258 |
| Total | 1,010,558 | 7,876,976 | 8,887,534 |

Step 2 - Energy Density of E10 and E15

Energy density is a term used to describe the energy content per gallon of fuel. Table 3 shows the energy content of both ethanol and gasoline. From these values, we have estimated the energy density of both E10 and E15.

| Table 3. Energy Density of E10 and E15 | |
|---|---|
| Energy density of ethanol, btu/gal* | 76,330 |
| Energy density of gasoline, btu/gal* | 112,194 |
| E10, btu/gal | 108,707 |
| E15, btu/gal | 106,814 |
| Ethanol % of energy, E10 | 7% |
| Ethanol % of energy, E15 | 10.7% |

*Source: Argonne GREET2017 model[1]

Step 3 – Lifecycle Estimates

Table 4 shows lifecycle emission estimate of gasoline and ethanol. The gasoline value is from EPA's Renewable Fuel Standard (RFS). [2] The ethanol value is from a recent US Department Agriculture Report. [3] We have estimated the lifecycle emissions of E10 and E15 from these values. Finally, the last row shows tailpipe emissions from gasoline of 79,000 g/mmBTU, which is from the RFS as well.

[1] *Argonne Greenhouse Gases, Regulated Emissions, and Energy use in Transportation Model* (GREET), https://greet.es.anl.gov/

[2] *Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program*, US EPA, March 26, 2010.

[3] *A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol*, by ICF for USDA, January 12, 2017, https://www.usda.gov/oce/climate_change/mitigation_technologies/USDAEthanolReport_20170107.pdf

| Table 4. Lifecycle Emissions of Ethanol, Gasoline, E10 and E15 | |
|---|---|
| Gasoline, g/mmBTU | 98,000 |
| Ethanol, g/mmBTU | 55,731 |
| E10, g/mmBTU | 95,029 |
| E15, g/mmBTU | 93,469 |
| Tailpipe only emissions of gasoline, g/mmBTU | 79,000 |

Step 4 – Estimate Lifecycle $CO_2$ Reductions for New York State for E15

Using the values in Table 3, we can estimate the lifecycle $CO_2$ emissions for both E10 and E15 for New York State. Since the values in Table 1 are tailpipe only, the lifecycle emissions can be estimated with the following expression:

LCA = TP inventory * LCA (g/mmBTU)/TP (g/mmBTU)

Where:

LCA = lifecycle emissions in annual tons
TP inventory = tailpipe inventory of $CO_2$ in tons from Table 1
LCA = lifecycle emissions of each fuel in g/mmBTU
TP = tailpipe emissions of gasoline in g/mmBTU

Thus, the E10 lifecycle emissions are 37.87 million tons * 95,029/79,000 = 45.55 million tons. Similarly, the E15 lifecycle emissions are 37.87 * 93,469/79,000 = 44.81 million tons. The difference in these two estimates is 748,000 tons (annually). Over a 5-year period, this benefit would be 3.74 million tons of $CO_2$.

We also estimated the equivalent number of vehicles that would be removed from the road that would achieve the same benefit as E15. MOVES2014 indicates that there are 7.87 million 2001 and later cars and LDTs on the road in New York State in 2018. On average, each vehicle emits 5.78 tons per year of $CO_2$. When we divide 748,000 tons of $CO_2$ by 5.78 tons per vehicle, we obtain about 129,400 vehicles.