Corn ethanol reduces carbon footprint, greenhouse gases

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A study conducted by researchers at the U.S. Department of Energy's (DOE) Argonne National Laboratory reveals that the use of corn ethanol is reducing the carbon footprint and diminishing greenhouse gases.

The study, recently published in *Biofuels, Bioproducts and Biorefining*, analyzes corn ethanol production in the United States from 2005 to 2019, when production more than quadrupled. Scientists assessed corn ethanol's greenhouse gas (GHG) emission intensity (sometimes known as carbon intensity, or CI) during that period and found a 23% reduction in CI.

According to Argonne scientists, corn ethanol production increased over the period, from 1.6 to 15 billion gallons (6.1 to 57 billion liters). Supportive biofuel policies—such as the Environmental Protection Agency's Renewable Fuel Standard and California's Low-Carbon Fuel Standard—helped generate the increase. Both of those federal and state programs evaluate the life-cycle GHG emissions of fuel production pathways to calculate the benefits of using renewable fuels.

To assess emissions, scientists use a process called life-cycle analysis, or LCA—the standard method for comparing relative GHG emission impacts among different fuel production pathways.

"Since the late 1990s, LCA studies have demonstrated the GHG emission reduction benefits of corn ethanol as a gasoline alternative," noted Argonne senior scientist Michael Wang, who leads the Systems Assessment Center in the laboratory's Energy Systems division and is one of the study's principal investigators. "This new study shows the continuous downtrend of corn ethanol GHG emissions."

"The corn ethanol production pathway—both in terms of corn farming and biorefineries—has evolved greatly since 2005," observed Argonne analyst Uisung Lee, first author of the study. Lee pointed out that the study relied on comprehensive statistics of corn farming from the U.S. Department of Agriculture and of corn ethanol production from industry benchmark data.

Hoyoung Kwon, a coauthor, stated that U.S. corn grain yields improved by 15%, reaching 168 bushels per acre despite fertilizer inputs remaining constant and resulting in a decreased intensity in fertilizer input per bushel of corn harvested: reductions of 7% in nitrogen use and 18% in potash use.

May Wu, another co-author, added that ethanol yields increased 6.5%, with a 24% reduction in ethanol plant energy use.

"With the increased total volume and the reduced CI values of corn ethanol between 2005 and 2019, corn ethanol has resulted in a total GHG reduction of more than 500 million tons between 2005 and 2019," Wang emphasized. "For the United States, biofuels like corn ethanol can play a critical role in reducing our carbon footprint."

The Argonne team used Argonne's GREET model for this study. Argonne developed GREET (the Greenhouse gases, Regulated Emissions, and Energy use in Technologies) model, a one-of-a-kind LCA analytical tool that simulates the energy use and emissions output of various vehicle and fuel combinations. Government, industry, and other researchers worldwide use GREET for LCA modeling of corn ethanol and other biofuels.

More information: Uisung Lee et al, Retrospective analysis of the U.S. corn ethanol industry for 2005 – 2019 : implications for greenhouse gas emission reductions, *Biofuels, Bioproducts and Biorefining* (2021). DOI: 10.1002/bbb.2225

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