

GAO Spotlights Ethanol Production as Prime Carbon Capture Opportunity

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Late last week, the U.S. Government Accountability Office published a [technology assessment](#) on carbon capture, utilization, and storage (CCUS), drawing on findings from peer-reviewed literature, a meeting of experts, and stakeholder interviews that included the Renewable Fuels Association.

Overall, the research found that out of all the potential sources of carbon dioxide for CCUS that GAO examined—power generation, cement, iron and steel, direct air capture, and ethanol—ethanol is the most promising. At a time when decarbonization is essential for a climate-friendly future, the GAO report makes clear that policymakers should embrace ethanol as the best available near-term opportunity for transformative and sustainable CCUS. GAO reached the following conclusions about ethanol's viability as a source for CCUS:

Ethanol Biorefineries Have the Highest CO₂ Concentration and Purity

Integrating carbon capture technologies into industrial facilities is easier in sectors where there is one singular CO₂ emission source and waste gas streams have higher concentrations of CO₂. Fermentation of sugars in ethanol production yields 99.9 percent pure CO₂ and requires little processing before use or storage in geologic formations. Further, the CO₂ concentration in ethanol waste gas streams is upwards of 95 percent.

Ethanol Offers the Lowest Cost of Capture

GAO estimates the cost of CO₂ capture at ethanol plants ranges from \$0-\$35 per metric ton of CO₂. In contrast, carbon capture is costly for high-emitting point sources like power generation and iron and steel manufacturing, which run in the \$40-\$290/mt range. GAO estimates direct air capture is higher still, topping out at a whopping \$600/mt CO₂.

The Ethanol Industry Has a High Number of Potential Capture Sources

GAO found that if every ethanol biorefinery captured and sequestered its CO₂ emissions from fermentation, some 45 million metric tons of CO₂ would be removed from the atmosphere every year. That's comparable to the amount of potential CO₂ sequestration if every iron and steel facility or every cement facility adopted CCUS. As of 2021, only twelve facilities—including three ethanol plants—had integrated commercial-scale CCUS operating in the U.S. However, GAO says CCUS projects at another 34 ethanol plants were in advanced development—triple the existing number of commercial CCUS projects across all sectors. Further, a quarter of the nation's 200-plus ethanol plants already capture CO₂ for sale in the food-grade CO₂ market, making them prime candidates for CCUS adoption.

Ethanol CCUS Has the Highest Technology Readiness Score

The ethanol industry has a history of innovation to reduce energy and water use, drive down costs, generate new sources of revenue from value-added co-products, and lower its carbon intensity. Additionally, the industry has been implementing commercial technologies to capture

CO₂ emissions for years, with the added advantage of requiring no separation technologies due to the high-purity CO₂. Based on GAO's technology readiness metric, ethanol is the clear winner with an ample jump on the other sectors. In other words, the ethanol industry is ready **today** to adopt low-cost CCUS technologies that can have a significant impact on reducing greenhouse gas emissions.

While not mentioned in the GAO report, it's worth noting that CO₂ emissions from ethanol fermentation are biogenic, meaning they come from natural, renewable sources. The CO₂ released during fermentation is the same CO₂ that was recently sucked out of the atmosphere by the corn plant via photosynthesis. That means permanent sequestration of CO₂ from fermentation results in permanent removal of atmospheric CO₂.

The GAO also identified policy options to address the challenges and benefits of CCUS technologies. Key recommendations include the development of technology-neutral standards, including a national low carbon fuel standard, standardized lifecycle analysis guidelines, and support of community engagement to credibly reinforce the advantages of CCUS like local job creation, economic development, and climate change mitigation. Many of GAO's suggestions align with and reinforce RFA's existing policy objectives for CCUS.

As Congress evaluates future climate-smart policies that can help the economy achieve net zero emissions, this report makes a strong case that the ethanol industry should play a central role in scaling up carbon management.