ETHANOL: A low-cost solution available today to help countries meet their COP climate commitments

Introduction

The 2015 Paris Agreement on climate change was hailed as historic. Adopted by 194 countries and the European Union, it sought to limit the **global temperature increase** to well below 2 degrees Celsius this century compared to pre-industrial levels, and more specifically the signatories endeavored to **keep the increase to no more than 1.5ºC.**

However, as the 28th session of the Conference of the Parties (COP28) to the UN Framework Convention on Climate Change is being convened, the UN Climate Change secretariat issued a report concluding that "**national climate action plans remain insufficient**" to meet the 1.5ºC target.[1] It went on to say, "The latest science … indicates that greenhouse gas emissions need to be cut 43% by 2030, compared to 2019 levels. This is critical to … avoid the worst impacts of climate change."

The United States government simultaneously released its Fifth National Climate Assessment, which found that annual U.S. GHG "emissions fell 12% between 2005 and 2019."[2] Still, this represented a reduction of less than 1% per year on average, and the report concluded that "**the current rate of decline is not sufficient to meet national and international climate commitments and goals**. US net greenhouse gas emissions remain substantial and would have to decline by more than 6% per year on average, reaching net-zero emissions around midcentury."

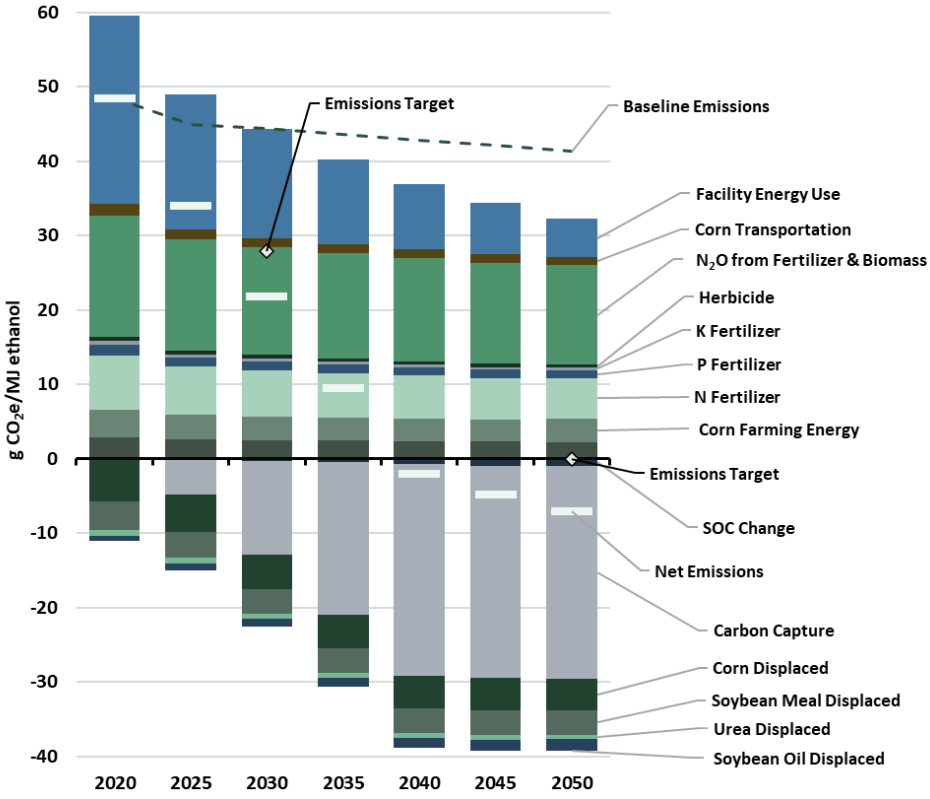
Achieving the 1.5ºC target will require a multifaceted approach and a stronger commitment from the global community. Action will need to be taken sooner rather than later. **One energy source—ethanol—is already cutting GHG emissions** in the U.S. and many other countries. **But with the right policies and commitments, ethanol and**

[1] https://unfccc.int/news/new-analysis-of-national-climate-plans-insufficient-progress-made-cop28-must-set-stage-for-immediate
[2] https://nca2023.globalchange.gov/

other renewable fuels can play a much larger role in future emissions reductions by the global transportation sector.

Corn-based **ethanol** produced in the U.S. **already reduces GHG emissions 44-52% compared to gasoline**.[3] Importantly, there are pathways by which fuel ethanol **can achieve net-zero** emissions as soon as 2040 (Figure 1).[4]

Figure 1: Carbon Intensity of Ethanol Under Core Pathway to Net-zero Emissions



Source: Informed Sustainability Consulting

This white paper reviews the role that ethanol is already playing in the U.S. and demonstrates the steps that the industry is taking to decarbonize further. It concludes by exploring emerging applications for ethanol in transportation.

[3] https://onlinelibrary.wiley.com/doi/10.1002/bbb.2225
[4] https://ethanolrfa.org/media-and-news/category/news-releases/article/2022/02/new-study-corn-ethanol-can-achieve-net-zero-carbon-emissions-well-before-2050

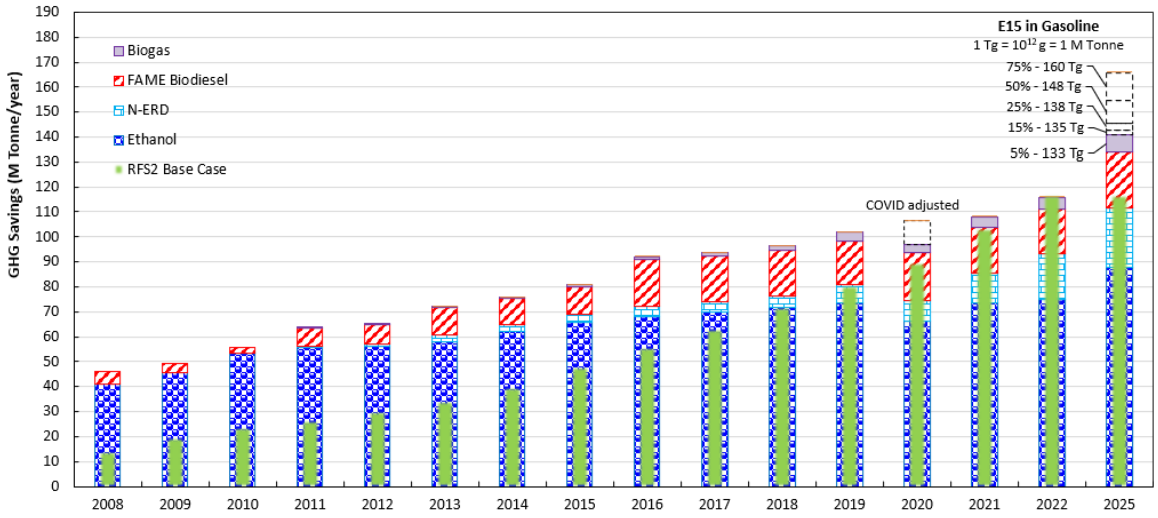
Ethanol Is Cutting U.S. Greenhouse Gas Emissions

The **Renewable Fuel Standard** is the **primary federal program that has promoted the usage of biofuels** in the U.S. over the last two decades. The original RFS was signed into law in 2005, and in 2007 the program was expanded substantially, and consumption requirements were allocated among several categories of renewable fuels. Spurred in part by the RFS, **U.S. ethanol consumption grew to 14.0 billion gallons (53 billion liters) in 2022 – four times the 2004 volume**.

The use of renewable fuels under the program has resulted in **cumulative savings of more than 1.2 billion metric tons of carbon dioxide-equivalent GHG emissions** in the 15 years since the RFS was expanded, with **corn ethanol providing the largest share** of GHG reductions, according to a study by Life Cycle Associates (Figure 2).[5]

These results were achieved through the consumption of E10, a blend of 10% ethanol in gasoline that has become ubiquitous over the last decade. E15, a 15% blend, is approved for use in almost all light-duty vehicles that are currently on the road, and consumption has expanded rapidly in recent years.[6] **Full adoption of E15** would provide **additional GHG savings of roughly 35 million metric tons annually.**

Figure 2: GHG Emissions Reductions Since the RFS Was Expanded in 2007



Source: Life Cycle Associates

[5] https://ethanolrfa.org/media-and-news/category/news-releases/article/2023/03/study-rfs-slashed-ghg-emissions-by-1-2-billion-metric-tons-since-2008

[6] https://ethanolrfa.org/media-and-news/category/blog/article/2023/04/e15-sales-surpassed-1-billion-gallons-in-2022-but-are-at-risk-again-this-summer-due-to-regulatory-uncertainty

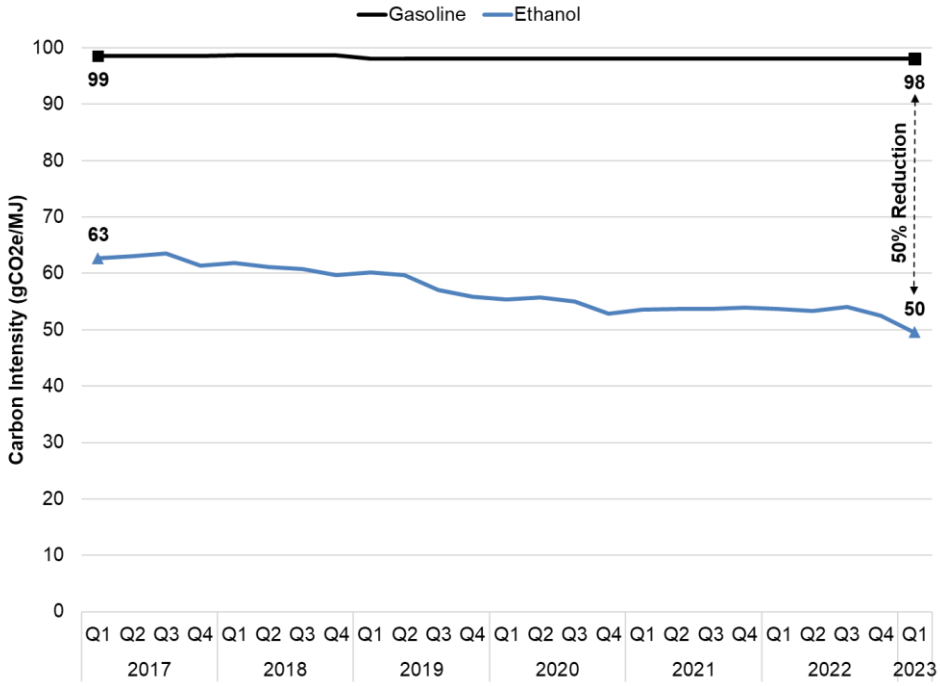
A Leading Contributor to State-level Clean Fuel Programs

All the states on the U.S. West Coast have implemented clean fuel programs. **California's Low Carbon Fuel Standard** was the first, and **since 2011 ethanol has cut GHG emissions** from the state's transportation sector by **36 million metric tons**.[7]

In Oregon, ethanol has represented 41% of the GHG reductions achieved under the state's Clean Fuels Program since 2016, including nearly half of those from liquid biofuels (electricity also has been a significant means of compliance).[8] The life cycle **GHG emissions of ethanol** used toward the state's CFP are estimated to be **50% less than those of gasoline** (Figure 3).

Washington's Clean Fuel Standard was implemented at the beginning of 2023. Compliance data are available only for the first quarter of the year, during which ethanol accounted for nearly two-thirds of credits generated.[9]

Figure 3: Carbon Intensities of Gasoline and Ethanol Under the Oregon CFP



Source: Oregon Department of Environmental Quality

[7] https://ww2.arb.ca.gov/resources/documents/low-carbon-fuel-standard-reporting-tool-quarterly-summaries
[8] https://www.oregon.gov/deq/ghgp/cfp/Pages/Quarterly-Data-Summaries.aspx
[9] https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/clean-fuel-standard/data-reports

Continuous Improvement in Ethanol's Cabon Footprint

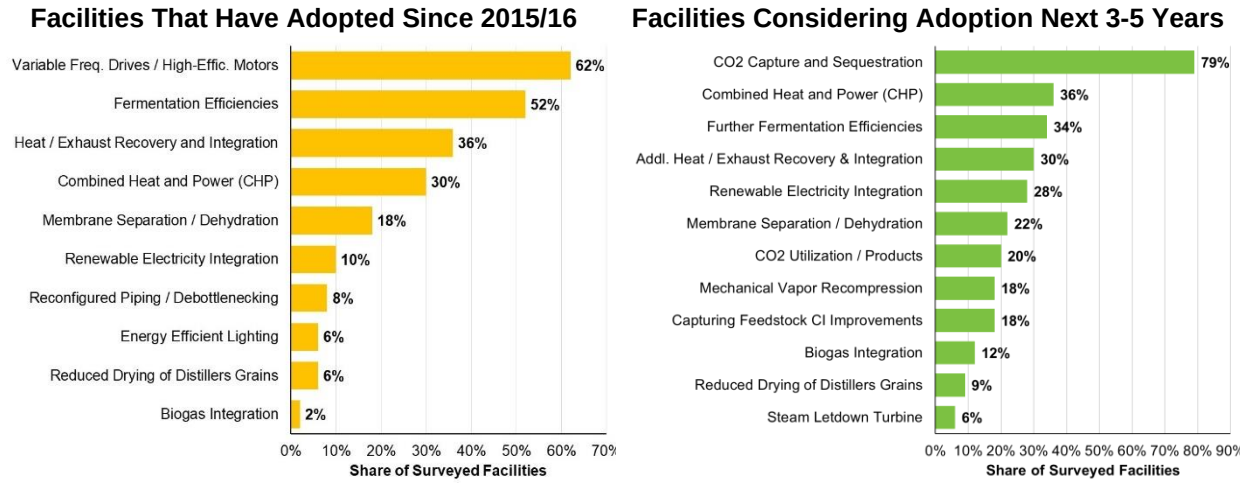
The Department of Energy's **Argonne National Laboratory**, which developed the "gold standard" life cycle analysis model, estimates that ethanol reduces GHG emissions by 44-52% compared to gasoline. According to Argonne researchers, the **carbon intensity of corn ethanol fell 23% from 2005 to 2019**, mainly as a result of increased corn and ethanol yields and decreased energy usage in ethanol processing.[10]

The industry is dedicated to building on these gains. In July 2021, the producer members of the Renewable Fuels Association unanimously **committed to decarbonization goals**:

- **By 2030**, ensuring that **ethanol reduces average GHG emissions by at least 70%** compared to fossil-based gasoline.
- **By 2050**, ensuring that ethanol achieves average **net-zero** lifecycle GHG emissions.[11]

RFA members are **already making progress** toward this pledge. According to a March 2023 survey, virtually all members currently utilize carbon-reducing technologies, and many are investigating multiple carbon reduction solutions (Figure 4).[12] Technologies and practices that have been commonly adopted and that more facilities plan to adopt over the next 3-5 years include improvements in fermentation efficiency, heat/exhaust recovery and integration, and combined heat and power. Nearly 8 in 10 facilities plan to capture and geologically sequester carbon dioxide from fermentation.

Figure 4: RFA Survey of Members' Adoption of Technologies and Practices



[10] https://onlinelibrary.wiley.com/doi/10.1002/bbb.2225
[11] https://ethanolrfa.org/pledge
[12] https://ethanolrfa.org/media-and-news/category/news-releases/article/2023/06/rfa-sees-progress-as-ethanol-industry-advances-toward-net-zero-carbon-emissions

Further Innovation Is in Sight

While ethanol continues to deliver carbon reduction in its traditional role as a fuel for light-duty vehicles operating solely on internal combustion engines, ongoing investments and innovation promise to **expand the decarbonization opportunities** for ethanol.

RFA is demonstrating the potential of a **flex-fuel plug-in hybrid electric vehicle**. RFA purchased a new 2022 Ford Escape PHEV and installed a flex-fuel conversion kit, allowing it to run on any ethanol blend up to E85. It offers better refueling times, more refueling locations, longer vehicle range, and a lower purchase price than a battery electric vehicle. And, in some cases, E85 has a lower carbon intensity than pure electric.[13]

Additionally, there are **emerging applications** for ethanol **in hard-to-electrify areas** of the transportation sector, notably **heavy-duty trucking** and **airline travel**. Technology that allows diesel engines to run exclusively on ethanol is now being tested in the field. It offers the potential to reduce fuel costs and emissions of GHGs and pollutants.[14]

Another very promising application is **sustainable aviation fuel** produced from ethanol. The Biden administration has issued a Sustainable Aviation Fuel Grand Challenge, and the Inflation Reduction Act contains substantial incentives for SAF.[15] Both require a minimum 50% reduction in GHG emissions. Since ethanol is available at scale, it has received considerable attention as a feedstock for SAF.

[13] https://d35t1syewk4d42.cloudfront.net/file/2536/PHEFFV%20Escape%205.25.23.pdf
[14] https://clearflame.com/
[15] https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/

Conclusion

Today's corn-based **ethanol already reduces GHG emissions by roughly 50%** compared to gasoline, and the industry is on a **path to achieve net-zero carbon emissions** in the coming years. Moreover, ethanol is **available at scale, can be used in the vast majority of light-duty vehicles** on the road today, and is **cost-competitive**. And, there are **emerging applications** for ethanol **in hard-to-electrify areas** of the transportation sector, including **heavy-duty trucking** and **airline travel**.

As countries gather for **COP28**, they should **embrace ethanol and other renewable fuels as a proven solution** for reducing emissions. With the **right policies and commitments**, biofuels can play a **much larger role in decarbonizing transportation globally.**

