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A CHANCE TO PHASE OUT SUPPORT FOR CORN ETHANOL IN THE RENEWABLE FUEL STANDARD

BY DR. NOAH KAUFMAN | NOVEMBER 2022

The Renewable Fuel Standard (RFS) mandates the blending of biofuels into the US transportation fuel mix. To date, it has failed to achieve its goals of materially reducing greenhouse gas emissions or improving energy security for Americans. Despite these failures, detailed in this commentary, the RFS has eluded major reforms due to the powerful political allies of farmers and biofuel producers who benefit from the regulation.

The legislation that created the RFS included a schedule from 2008 until 2022 of requirements to blend increasing quantities of biofuels—liquid fuels produced from renewable sources—into transportation fuels like gasoline and diesel (EPA 2022a). The regulation is maddeningly complex,[1] but it essentially amounts to a subsidy for biofuels combined with a tax on petroleum fuels (Stock 2015). While the RFS can be a tool to help deploy different types of biofuels, the focus of this commentary is on ethanol produced from corn, which has been the predominant source of compliance with the RFS to date (EPA 2022a).[2]

A comprehensive national strategy for a clean, equitable, and cost-effective transportation system will ultimately require congressional action that builds on measures in the Bipartisan Infrastructure Law and Inflation Reduction Act. However, with the ongoing crises in global food and fuel markets occurring at the moment the US Environmental Protection Agency has unprecedented flexibility to reform the RFS with the specific statutory requirements expiring this year, the country has a unique opportunity to improve the regulation and start phasing out harmful aspects—in particular, its support for ethanol produced from corn.[3]

First-Generation Biofuel Mandates Fail to Accomplish Goals of RFS

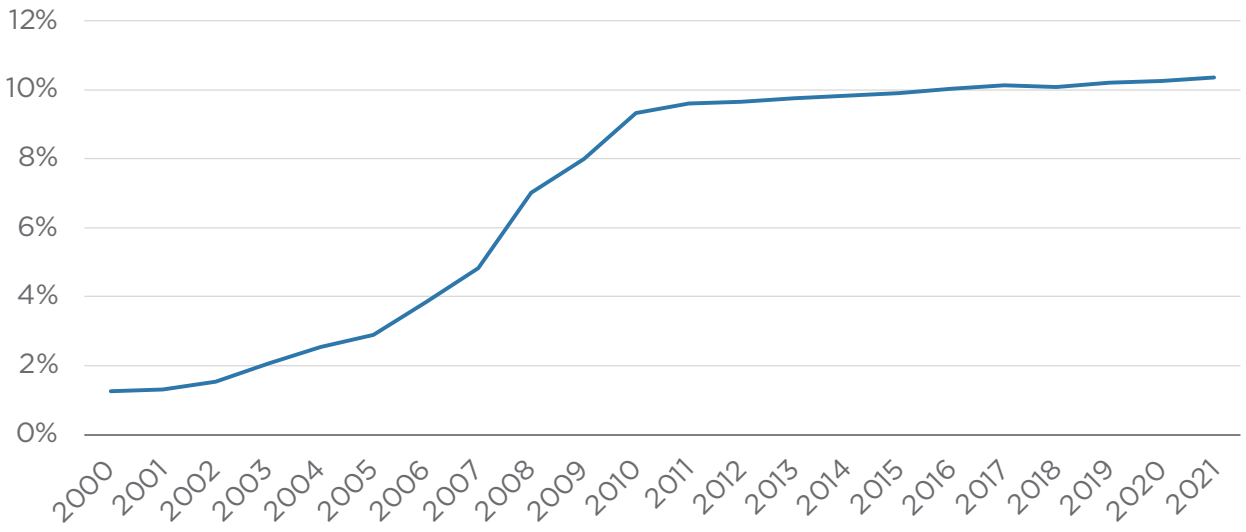
In addition to benefiting the biofuel and corn industries, the RFS was supposed to benefit the country as a whole by reducing greenhouse gas emissions and improving energy security. The RFS has helped to promote the production and use of corn ethanol, but the associated climate and energy security benefits have been vanishingly small.

Corn ethanol produced in the United States is referred to as a "first-generation" biofuel, which provides few emissions benefits and competes with food crops (Stock 2015). The production of ethanol is resource intensive and uses land that could instead be used for other purposes. Any estimate of the effects of biofuels on greenhouse gas emissions will be highly uncertain, not least because such calculations hinge on how land would otherwise be used and how that hypothetical land use would affect emissions. But estimates suggest that emissions benefits of first-generation corn ethanol compared to petroleum-based gasoline are small (EPA 2022b) or even negative (Lark 2021). Modifications to the production process, for example, adding carbon capture and sequestration (CCS), can improve the emissions profile of corn ethanol, but few facilities with CCS exist today.

To the extent that biofuels have a major role to play in a cleaner transportation system,[4] this contribution would need to come from advanced biofuels that cause fewer emissions and compete less with food crops. The RFS attempts to encourage the deployment of advanced (e.g., cellulosic) biofuels, but it has mostly failed due to various problems scaling up those technologies.[5]

Despite the lack of emissions benefits, ethanol is a transportation fuel that is produced domestically—not by foreign petrostates—which is notable given the potential geopolitical benefits from a large-scale shift away from imported oil. However, ethanol is not a realistic solution to the country's dependence on imported oil because it is not a scalable substitute for petroleum-based gasoline. The country's fuel supply infrastructure and vehicle engines are not universally compatible with gasoline that consists of more than about 10 percent ethanol, which is the composition of most gasoline sold in the United States today (EIA 2022a). Figure 1 shows how domestic ethanol production has roughly stalled since this 10 percent "blend wall" was approached a decade ago. In theory, the country could invest in ensuring infrastructure and vehicle compatibility with much higher ethanol blends, but in practice, consumers, industry, and governments are instead investing in electric vehicles (EVs). Scaling up EVs involves big hurdles as well, but when combined with a clean electricity system, EVs offer the potential for climate and local pollution benefits that ethanol does not.

Figure 1: US average concentration of ethanol in gasoline



Source: US Environmental Protection Agency, "Renewable Fuel Standard (RFS) Program: RFS Annual Rules. Regulatory Impact Analysis," June 2022, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10155TQ.pdf.

Ethanol Mandates Distort Markets, though at Little Cost—for Now

The main effects of the RFS are the economic distortions caused by, in essence, forcing payments from petroleum refiners and importers to biofuel producers and refiners. The downstream effects on fuel markets are particularly salient to consumers and politicians, and the RFS requires the blending of biofuels whether or not it is cost-effective to do so.

The RFS also puts upward pressure on food prices. Over 90 million acres of US land is used to plant corn, and over one-third of that land is used to grow ethanol—that's about 28 million football fields devoted to ethanol (USDA 2021). This land could be used to grow food or for other productive activities, including activities that could materially reduce greenhouse gas emissions.

But the costs of the ethanol mandates appear to be very small at the moment. When producers have been allowed to increase or decrease how much ethanol they blend into gasoline in recent years, they have chosen to continue blending ethanol around current levels.[6] That is because producers use ethanol to add oxygen to gasoline (it is a "fuel oxygenate"), which improves performance and reduces certain pollutants (CARB 1998). While it's possible the country would be better off using the land that is used to produce ethanol for more societally productive purposes,[7] under current conditions, weakening the RFS mandates probably would not cause a large immediate change in ethanol use, or in fuel or food prices in turn (EPA 2022a).

Still, conditions can change. A fuel oxygenate that is preferable to ethanol may emerge. In addition, biofuel mandates (which are expressed in volumes of fuel) in recent years have aligned with gasoline consisting of roughly 10 percent corn ethanol to not overshoot the previously mentioned "blend wall" of compatibility. Mandates above that level would become increasingly expensive to achieve. And if the country begins to reduce its gasoline use, even keeping the biofuel mandates at today's levels would cause the percentage of corn ethanol in the fuel mix to rise well above this costly threshold.[8]

RFS Reform Faces Strong Headwinds, Which May Be Weakening

One might think that a regulation opposed by the oil industry and environmental groups would not last long in the United States (American Petroleum Institute 2021, Sierra Club et al. 2022), but the farmers and biofuel producers that benefit from the RFS also have powerful allies in Washington (American Farm Bureau Federation 2021). The top ethanol-producing states include traditional red states like Nebraska and blue states like Illinois (Nebraska Department of Environment and Energy 2018), so there has been bipartisan support for ethanol mandates to help businesses in these states.

The largest ethanol-producing state by far is Iowa. Iowa has traditionally been a swing state with unique importance to the presidential primaries, leading candidates to pledge allegiance to the state's biofuel industry (Grunwald 2019). The secretary of agriculture is former Iowa Governor Tom Vilsack, who has called for the continued growth of all parts of the RFS, including first-generation biofuels (USDA 2015).

But ongoing global economic crises affecting energy and food prices make this an opportune moment for policy makers to take actions that can plausibly put downward pressure on prices, even actions that are small or symbolic. Prices of corn are roughly two times larger than they've been in recent years (Trading Economics 2022), contributing to global fears of food insecurity and associated unrest, as occurred when food prices spiked around the world between 2006 and 2013 (Lele et al. 2021). In the United States, average retail gasoline prices rose above $5 per gallon earlier this year (EIA 2022b).

Meanwhile, the need for a national biofuel strategy has diminished with the surge in EVs. At the same time, the domestic biofuel industry will have its best opportunity to shift toward producing more societally beneficial biofuels, given the tax credits for such advanced biofuels in the Inflation Reduction Act (Deloitte 2022) and the EPA's leeway to improve the incentives for advanced biofuels in the RFS starting next year. Changes to the RFS could ensure stronger and more stable incentives for the most promising biofuel feedstocks and production processes, focusing on the decarbonization of energy uses that are difficult to electrify (e.g., heavy-duty trucking, aviation, and shipping).

Even the political headwinds to RFS reform may be less fraught for President Biden compared to his predecessors due to the dwindling number of ethanol supporters in his party. For example, when the RFS passed in 2007, Iowa's congressional delegation was comprised of two Republicans and four Democrats, compared to five Republicans and just one Democrat today.

Conclusion

Developing low-carbon transportation fuels remains a critical policy imperative to meet climate targets, but the mandates for first-generation biofuels have failed to deliver on the goals of reducing greenhouse gas emissions or improving energy security. The Biden administration has until later this year to propose a future for the RFS. It will be subject to public comment before being finalized next year. On ethanol, the forthcoming proposal will send an important signal about whether the federal government intends to increase, sustain, or start to phase out support for first-generation biofuels.

The political challenges of phasing out government support for corn ethanol while the farm lobby is calling for additional support remain sky high (American Farm Bureau Federation 2021), and relaxing the ethanol mandates would not provide much if any immediate relief to energy and food price spikes (Cazzola 2022). But for any policy maker willing to fight for a better national biofuels policy, there may never be a better time to try.

References

American Petroleum Institute. 2021. "Renewable Fuel Standard Facts." https://www.api.org/oil-and-natural-gas/energy-primers/renewable-fuel-standards.

American Farm Bureau Federation. 2021. "Time to Grow Biofuel Use." March 24. https://www.fb.org/viewpoints/time-to-grow-biofuel-use.

California Air Resources Board. 1998. "An Overview of the Use of Oxygenates in Gasoline." September. https://www.arb.ca.gov/fuels/gasoline/pub/oxyrprt.pdf.

Carter, Colin A., Gordon C. Rausser, and Aaron Smith. 2017. "Commodity storage and the market effects of biofuel policies." *American Journal of Agricultural Economics* 99, no. 4: 1027–1055. https://files.asmith.ucdavis.edu/2017_AJAE_CRS_ethanol.pdf.

Cazzola, Pierpaolo. 2022. "Biofuels for Transport: Feasibility of a Ramp-Up to Lessen Dependence on Russian Oil En Route to a Decarbonized Future." Columbia SIPA Center on Global Energy Policy. September 19. https://www.energypolicy.columbia.edu/research/commentary/biofuels-transport-feasibility-ramp-lessen-dependence-russian-oil-en-route-decarbonized-future.

Chen, Rui, Zhangcai Qin, Jeongwoo Han, Michael Wang, Farzad Taheripour, Wallace Tyner, Don O'Connor, and James Duffield. 2018. "Life cycle energy and greenhouse gas emission effects of biodiesel in the United States with induced land use change impacts." *Bioresource Technology* 251: 249–258. https://www.sciencedirect.com/science/article/pii/S0960852417321648.

Deloitte Tax. 2022. "Inflation Reduction Act reinstates excise tax credits and Superfund excise tax." August 25. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/Tax/us-tax-inflation-reduction-act-reinstates-excise-tax-credits-and-superfund-excise-tax.pdf.

Jenkins, Jesse D., Erin N. Mayfield, Eric D. Larson, Stephen W. Pacala, and Chris Greig. 2021, "Mission net-zero America: The nation-building path to a prosperous, net-zero emissions economy." *Joule* 5, no. 11: 2755-2761.

Grunwald, Michael. 2019. "How the 2020 Democrats Learned to Love Ethanol." *Politico*. March 5. https://www.politico.com/magazine/story/2019/03/05/2020-democrats-ethanol-225517/.

Lark, Tyler J., Nathan P. Hendricks, Aaron Smith, Nicholas Pates, Seth A. Spawn-Lee, Matthew Bougie, Eric G. Booth, Christopher J. Kucharik, and Holly K. Gibbs. 2022. "Environmental outcomes of the US renewable fuel standard." *Proceedings of the National Academy of Sciences* 119, no. 9: e2101084119. https://www.pnas.org/doi/full/10.1073/pnas.2101084119.

Lele, Uma, Manmohan Agarwal, and Sambuddha Goswami. 2021. "2007–2012 Food Price Spikes and Crisis—A Decade and a Half Later." In *Food for All: International Organizations and the Transformation of Agriculture*, 139 –195. Oxford: Oxford University Press. https://doi.org/10.1093/oso/9780198755173.003.0004.

Nebraska Department of Environment and Energy. 2018. "Ethanol Facilities' Capacity by State." Updated July 3. https://neo.ne.gov/programs/stats/inf/121.htm.

Schnepf, Randy, and Brent D. Yacobucci. 2013. "Renewable Fuel Standard (RFS): Overview and Issues." Congressional Research Service. March 14. https://sgp.fas.org/crs/misc/R40155.pdf.

Sierra Club, American Bird Conservancy, Clean Air Task Force, Mighty, and National Wildlife Federation. 2002. "Environmental Principles to Reform the Ethanol Mandate." https://www.sierraclub.org/sites/www.sierraclub.org/files/program/documents/1519%20RFS-FactSheet_02_web.pdf.

Stock, James H. 2015. "The renewable fuel standard: a path forward." Columbia SIPA Center on Global Energy Policy. https://energypolicy.columbia.edu/sites/default/files/Renewable%20Fuel%20Standard_A%20Path%20Forward_April%202015.pdf.

Smith, Aaron. 2022. "Changing Ethanol Policy Isn't Going to Help." https://asmith.ucdavis.edu/news/ukraine-rfs.

Trading Economics. 2022. "Corn." https://tradingeconomics.com/commodity/corn.

US Department of Agriculture. 2021. "Corn is America's Largest Crop in 2019." July 29. https://www.usda.gov/media/blog/2019/07/29/corn-americas-largest-crop-2019.

US Department of Agriculture. 2015. "Statement from Secretary Tom Vilsack on Finalization of the Renewable Fuel Standard." https://www.usda.gov/media/press-releases/2015/11/30/statement-secretary-tom-vilsack-finalization-renewable-fuel.

US Department of Agriculture. 2022. "U.S. Bioenergy Statistics." Updated October 20. https://www.ers.usda.gov/data-products/u-s-bioenergy-statistics/.

US Energy Information Administration. 2022a. "Biofuels explained." Updated April 5. https://www.eia.gov/energyexplained/biofuels/ethanol-use.php#:~:text=The%20blend%20wall%20

is%20the,greater%20than%2010%25%20since%202017.

US Energy Information Administration. 2022b. "Petroleum and other liquids." October 24. https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emm_epm0_pte_nus_dpg&f=m.

US Environmental Protection Agency. 2022a. "Renewable Fuel Standard (RFS) Program: RFS Annual Rules. Regulatory Impact Analysis." June. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10155TQ.pdf.

US Environmental Protection Agency. 2022b. "Summary Table of Lifecycle Greenhouse Gas Emissions for Select Pathways." Updated February 17. https://www.epa.gov/fuels-registration-reporting-and-compliance-help/summary-table-lifecycle-greenhouse-gas-emissions.

Notes

1. The RFS requires transportation fuels sold in the United States to contain minimum volumes of various categories of biofuels. The EPA enforces compliance with the annual volume requirements through a system of tradeable credits, referred to as Renewable Identification Number (RIN). Each time one gallon of transportation fuel is blended with any of the four categories of renewable fuels, one RIN that corresponds to the type of biofuel being blended is created and awarded to the refiner. By the end of each compliance year, refiners must present the EPA with a minimum number of RINs to meet their volume requirement for each category, which they can obtain either by blending renewable fuels themselves or purchasing them from other refiners.

2. For brevity and simplicity, the important but complex topic of biodiesel/renewable diesel is omitted. The country produces one-eighth as much biodiesel/renewable diesel as ethanol, but that was still 2.5 billion gallons in 2021 (USDA 2022). Like ethanol, biomass-based diesel fuel is often considered a "first-generation" biofuel (Stock 2015), but unlike ethanol, the data seem to suggest considerable emissions reductions compared to petroleum diesel—perhaps in the range of 60 to 70 percent (Chen et al. 2018). Most biomass-based diesel is produced from soy plants, which means there are land use implications as well. However, the majority of the soy plant is used for other purposes, such as animal feed.

3. A couple caveats may be necessary here. First, the EPA has always had some authority to waive the RFS blending requirements, for example, if it determined that the program would cause economic or environmental harm. Second, fuel produced by facilities that either existed or commenced construction prior to 2010 are exempt from greenhouse gas emissions requirements, which could limit the EPA's ability to scale back the program specifically by updating emissions thresholds. However, that should not limit changes to the blending requirements (Schnepf and Yacobucci 2013).

4. For example, Princeton's "Net Zero America" study shows across five net-zero-consistent scenarios that biomass accounts for between 14 percent and 28 percent of US primary

energy by 2050, compared to just 4 percent in 2020 (Jenkins et al. 2021).

5. Stock (2018) notes that core to the RFS was the development and deployment of fuel derived from cellulosic feedstocks, such as corn stover (corn stalks, leaves, and cobs) and energy grasses, which he describes as "second-generation biofuels." The production of these fuels has been miniscule due to a combination of economic factors, technological setbacks, an uncertain regulatory environment, and poor legislative design.

6. Smith (2022) points to two recent examples. Producers had the opportunity to reduce ethanol blending in 2017 and 2018 when the EPA exempted small refiners from complying with the RFS. Meanwhile, producers are allowed to blend more than 10 percent in various parts of the country at various times of the year. In both cases, producers have continued to blend about 10 percent of ethanol into gasoline.

7. For example, according to one recent study, corn prices were about 30 percent higher from 2006 to 2014 than they would have been without the RFS (Carter et al. 2017).

8. Illustrating this point, the prices of conventional biofuel RINs (the tradable credit used to comply with the RFS) increased dramatically when the country's gasoline mix approached the 10 percent ethanol blend wall in 2012 (Stock 2015).

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