ENERGY & NATURAL RESOURCES

A Reset for the Renewable Fuels Standard?

The environmental record for biofuels is bleak, but upcoming regulatory reviews offer a chance to change course.

BY ARTHUR R. WARDLE

In 2017, the Gulf of Mexico's dead zone—an area where algae growth depletes water oxygen levels, killing or stunting marine life—grew to the size of the state of New Jersey. Scientists writing in the *Proceedings of the National Academy of Sciences* held biofuels partly to blame for this, stating that reducing the nitrogen pollution—resulting from runoff from agricultural land—that causes the dead zone will be "practically impossible" in the face of the Renewable Fuel Standard's ethanol mandate.

Initially sold as a dual path to energy independence and a cleaner environment, the Renewable Fuel Standard (RFS) was adopted as part of the 2005 amendments to the Clean Air Act. Today, research on the RFS is nearly unanimous that its corn ethanol mandate degrades the environment. The policy's consequences extend to a wide variety of ongoing environmental problems, including water pollution and water scarcity, habitat degradation, and air pollution.

The Environmental Protection Agency, which administers the standard, will soon have an opportunity to adjust ethanol mandate volumes under the RFS. Unfortunately, recent reporting suggests that the agency may treat the RFS as if it were a part of the Farm Bill, not the Clean Air Act, which would mean more mandated ethanol, not less. As the EPA considers altering the RFS, it should give special attention to the unintended harmful environmental consequences that the ethanol mandate creates.

RFS DESIGN AND IMPLEMENTATION

The RFS is a volumetric consumption mandate, obligating refiners and fuel importers to buy biofuels and blend them into transportation fuels. The mandate started small in the mid-2000s but crescendos to 36 billion gallons in 2022.

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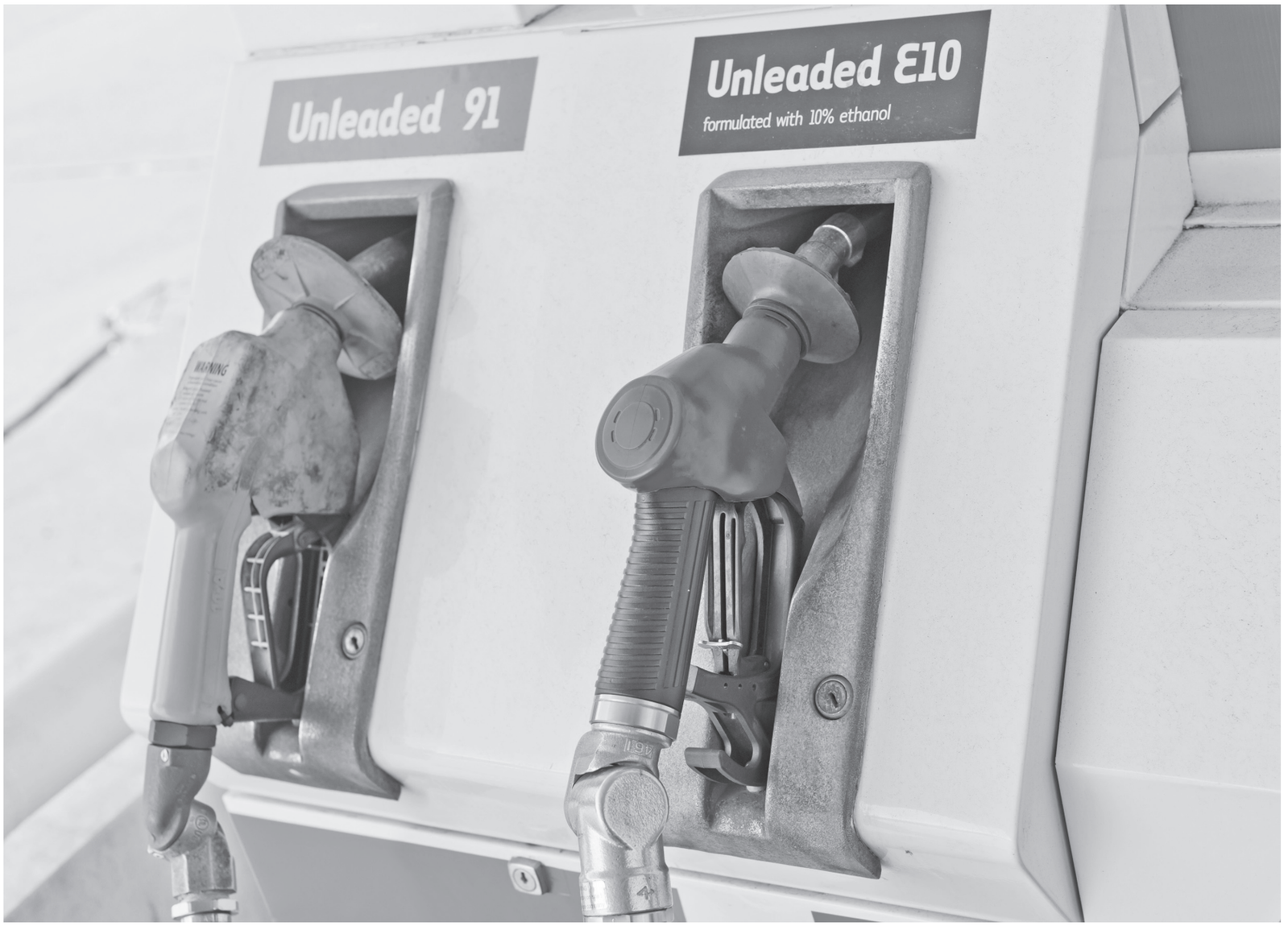
The total mandate is made up of four nested mandates: cellulosic, biomass-based diesel, "advanced," and the total mandate. Cellulosic biofuels and biomass-based biodiesel count toward their own, smaller mandates as well as the advanced and total mandates. Advanced biofuels—primarily ethanol produced using sugarcane as the feedstock—similarly meet their own mandate and the larger total mandate. Whatever is left of the total mandate after refiners meet their obligations to the cellulosic, biomass-based diesel, and advanced mandates is generally met with conventional biofuels like corn ethanol.

The original idea was that conventional biofuels would transition the fuel industry to using much higher sums of ethanol, paving the way for better (i.e., cellulosic) biofuels to take over. That's why the non-advanced remainder of the total mandate that conventional biofuels are left to fill was supposed to cap out at 15 billion gallons in 2015. After that, biofuel growth was supposed to be driven by the higher-level mandates. The idea of widespread cellulosic biofuel use was particularly enticing because it would allow wastes like corn husks and stalks or specialty energy crops grown on otherwise useless land to be turned into valuable fuel.

But cellulosic biofuel development has been a disappointment by any measure. Despite a consumption mandate for whatever cellulosic ethanol is produced, a production tax credit, and millions of dollars in research and development support from the government and billions more from oil companies, cellulosic ethanol production in the United States is an order of magnitude lower than its mandated levels, forcing the EPA to drastically modify the cellulosic mandate downward year after year. The 2019 final rule set a cellulosic mandate of 418 million gallons, a mere sliver of the 8.5 *billion* gallons set in statute. If cellulosic ethanol growth continues at anywhere near this sluggish pace, conventional biofuels will continue to make up a majority of the mandate,



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as they have every year since the law's inception. According to a retrospective piece by University of California, Davis agricultural economist Aaron Smith, written to guide future climate policy, the lesson is: "Do not mandate things that don't exist."

E10 gasoline (motor fuel containing up to 10% ethanol) is now ubiquitous, car manufacturers attempt to sell "flex fuel" vehicles that can handle E85 (up to 85% ethanol), and the Trump administration recently made regulatory reforms that will allow for year-round sales of E15. Without the materialization of a cellulosic ethanol industry (and none appears on the horizon), the RFS's chief result has been the dramatic expansion of a biofuel that's older than the Model T: corn ethanol.

THE RFS AND THE ENVIRONMENT

The entire point of the RFS is incentivizing the production of more biofuels. Because corn ethanol is cheaper than other types of biofuels, refiners use it to meet as much of the mandate as possible. Producing the ethanol to meet that demand required a major expansion of corn production.

Most of the environmental consequences of the RFS result from expanded corn production. Farms increase production in two ways: by intensifying production on current cropland and by putting new land into production. Farmers initially tried the former approach to the RFS, skipping crop rotations so that they could produce more corn in the short-term. In the long run, farms increased the amount of land they have under the plow. Because the best areas for growing corn were already being farmed, expansions occurred in areas that weren't as well-suited to production. Those areas were often environmentally sensitive or "marginal" land.

Some of this marginal land had previously been protected by the Conservation Reserve Program (CRP), which pays farmers to leave particularly sensitive areas fallow. In the six years following the RFS's 2007 expansion, nearly half of expiring CRP signatories elected not to re-enroll. Throughout the Corn Belt's periphery, grasslands, shrublands, wildlife habitat, and high-risk erosion zones have been put into production. Between 2008 and 2012, 4.2 million acres converted to cropland within 100 miles of a biorefinery. The National Wildlife Federation documented that these significant losses in habitat for grassland birds caused a drop in both species diversity and abundance in the Prairie Pothole Region.

Corn fields on marginal lands require more inputs like water and fertilizer than their more productive counterparts. Unlike most Iowa cropland, new corn plantings in places like Nebraska require irrigation. Though ethanol from any feedstock consumes more water than gasoline—E85 from unirrigated corn grain requires more than twice as much water per vehicle mile traveled—irrigating the feedstock magnifies the problem more than 100-fold. It requires an average of 28 gallons of irrigation water to produce enough biofuel for a vehicle to travel a single mile on E85 fuel as compared to about a fourth of a gallon if the corn is not irrigated. (See Table 1.) Much of this irrigation is sourced from groundwater, including the Ogallala Aquifer, whose unsustainable drawdown rate has been well-publicized.

Producing corn on marginal lands and intensifying production on existing farms also results in additional nitrogen fertilizer application. Runoff from that fertilizer enters nearby waterways and, in the heartland, eventually makes its way to the Gulf of Mexico. This results in the water oxygen depletion that drives the growing hypoxic dead zone. For every billion gallons of ethanol production, environmental economists estimate the dead zone grows by roughly 30 square miles.

The litany of environmental effects from ethanol production makes the new politics of RFS regulation bizarre and unique. On what other issues do Exxon Mobil, the Sierra Club, Chevron, the National Wildlife Federation, and the Clean Air Task Force align?

WHAT ABOUT THE CLIMATE?

Transportation accounts for 29% of U.S. greenhouse gas (GHG) emissions, and reducing emissions from this sector is notoriously difficult. President George W. Bush often referred to GHG reduction as an important benefit of the RFS. As concerns about energy independence waned in response to the fracking boom, GHG reduction became the chief purported benefit of biofuel production.

Mitigating climate change is seemingly guaranteed by the very text of the RFS statute. Only biofuels that emit 20% fewer GHG emissions than gasoline count toward the conventional biofuel standard, with even higher percentage requirements for the advanced biofuel mandates. There's no doubt that ethanol burns cleaner than gasoline in a car engine, but the RFS holds an even higher standard, as biofuels are required to emit 20% less on a *lifecycle* basis.

Despite those high standards, there's good reason to doubt that ethanol is doing the climate much good. Understanding a fuel's climate effects requires more than knowing the emissions that directly result from burning it. Different production processes, feedstocks, and transportation requirements also affect a fuel's ultimate GHG emissions. When the EPA first measured corn ethanol's lifecycle emissions, they concluded that corn ethanol actually *raised* GHG pollution relative to gasoline. Only after a public comment period where agricultural interest groups decried the results did the EPA adjust its modeling decisions to conclude that corn ethanol offers a 21% reduction in emissions—just barely high enough to qualify as a conventional biofuel under the RFS.

To be fair, modeling lifecycle emissions for biofuels is difficult and results are always dependent on subjective assumptions. Not only does a modeler need to understand how land use will change directly, such as when a farmer pulls out of a CRP contract to begin farming, but also how international land-use changes will be indirectly affected.

For example, if U.S. farmers transition from soybeans to corn, that can have implications for global soybean markets that encourage deforestation in Brazil. Adequately accounting for indirect and uncertain responses like these is important—it exerts real influence over the results of the analysis—but it is also difficult.

Numerous research teams have studied whether ethanol mitigates GHGs and come to widely varied conclusions. A meta-analysis published in the *American Journal of Agricultural Economics* reviewed every paper released on this question and attempted to combine their results, taking into account the modeling decisions each individual project made. Their final conclusion was that corn ethanol offers an unimpressive 0.23% (not 23%, mind you) reduction in GHG emissions relative to gasoline throughout its lifecycle. Within the sample of estimates they considered, there were exactly as many estimates claiming that ethanol emits

TABLE 1

Average Water Consumed per Mile Traveled

	GALLONS
E85 from Irrigated Corn Grain	28.00
E85 from Non-Irrigated Corn Grain	0.25
Conventional Gasoline	0.105
Conventional Diesel	0.08
Electric	0.24
Hydrogen from Water	0.42
F-T Diesel from Coal	0.385
Tar Sands Gasoline	0.33
F-T Diesel from Natural Gas	0.275
Oil Shale Gasoline	0.26
CNG Compressed by Electricity	0.065
Hydrogen from Natural Gas	0.06
CNG Compressed by Natural Gas	0.03

Note: Calculated for light-duty vehicles.
Source: "Water Intensity of Transportation" by Carey W. King and Michael E. Webber. *Environmental Science & Technology* 42(21): 7866–7872 (2008).

more GHG than gasoline as there were claiming that ethanol meets the EPA's 20% reduction standard.

What we can say for certain is that if ethanol reduces emissions, it is not by much. In an E10 mixture, at least 90% of the fuel is still gasoline; a small percentage reduction in the GHG emissions of a small percentage of the fuel supply makes no noticeable dent in U.S. transportation emissions, let alone global climate change. We'll need to dream bigger and better to tackle transportation emissions, but the increasing marginal environmental costs of corn production indicate that we've already dreamed larger than we should have with ethanol.

Despite its laudable intentions, the research on the Renewable Fuels Standard is clear that it degrades the environment. The reset process presents a real chance to rein in the RFS and mitigate this degradation.

THE POTENTIAL FOR AN RFS RESET

Two major developments in the RFS's administration offer an opportunity to scale back the environmental damage caused by corn ethanol. First, the RFS statute only specifies biofuel volumes through 2022, after which the EPA is supposed to review the program and come up with new mandates. Second, the EPA is allowed to reduce mandate volumes when the statute is deemed unreasonably high. If the EPA reduces the total mandate by more than 20% for two consecutive years, that automatically triggers a review similar to the one slated for 2022. In setting the 2019–2020 rules, the EPA triggered that threshold.

Both "resets," as they are frequently termed, allow the EPA administrator to develop new volumetric mandates based on several criteria. The first is "the impact of the production and use of renewable fuels on the environment, including on air quality, climate change, conversion of wetlands, ecosystems, wildlife habitat, water quality, and water supply." Other criteria include issues like U.S. energy security and the effect of the RFS on farm income and agricultural interests. If the EPA takes this task seriously, it will be hard to justify continuing the corn ethanol mandate on environmental grounds, at least at current levels.

It's reasonable to worry about how the biofuel industry might influence the EPA's decisions. Of course, industries work to maintain government mandates for their products, but doomsday prophecies that the entire ethanol industry will collapse if the EPA adopts more reasonable mandates are unfounded. Ethanol is the most popular fuel oxygenate on the market, having earned market dominance when its chief alternative, methyl tertiary butyl ether, was banned throughout the United States out of concern for its effect on groundwater. The RFS mandates certainly increase ethanol demand, but demand will still be much stronger for ethanol than it was in 2005.

Nobody can predict how the RFS resets will shake out. In April, a group of 15 Republicans asked EPA Administrator Andrew Wheeler to limit the RFS's volume to a maximum of 14.2 billion gallons in 2020 out of concern that higher blends would harm consumers. Other news is less encouraging. Wheeler recently rejected a staff proposal to cut the conventional ethanol mandate by less than 5% and is taking numerous meetings with biofuel trade organizations and legislators representing Corn Belt states.

One can still hope that a statutory obligation to square the reset decision with environmental results will temper the EPA's decision. Perhaps the environmental lobby will even mount a larger campaign against the policy; recent rulemakings have attracted comments from numerous environmental organizations, and the National Wildlife Federation hosts an entire website publicizing the RFS's harms.

With evidence building against ethanol's environmental reputation and the fracking boom eliminating the energy security anxieties of the mid-2000s, there's little remaining reason to support an ethanol mandate. Despite its laudable intentions, the research on the RFS is clear that the policy degrades the environment. The reset process presents a real chance to rein in the RFS and mitigate that degradation. *R*

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