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Public Interest Comment[1] on

The Environmental Protection Agency's Proposed Rule

Renewable Fuel Standard Program: Standards for 2017 and Biomass-Based Diesel Volume for 2018

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Sofie E. Miller, Senior Policy Analyst[2]

The George Washington University Regulatory Studies Center

The George Washington University Regulatory Studies Center improves regulatory policy through research, education, and outreach. As part of its mission, the Center conducts careful and independent analyses to assess rulemaking proposals from the perspective of the public interest. This comment on the Environmental Protection Agency's proposed rule establishing renewable fuel standards for 2017 and 2018 does not represent the views of any particular affected party or special interest, but is designed to evaluate the effect of EPA's proposal on overall consumer welfare and provide recommendations for improving the analysis underpinning this proposal.

Introduction

As a part of its Renewable Fuel Standard (RFS) program, the Environmental Protection Agency (EPA) is proposing biofuel blending targets for 2017 and 2018. The RFS requires refiners to blend specific amounts of renewable fuels into transportation fuel, such as gasoline and diesel.

[1] This comment reflects the views of the author, and does not represent an official position of the GW Regulatory Studies Center or the George Washington University. The Center's policy on research integrity is available at http://regulatorystudies.columbian.gwu.edu/policy-research-integrity.

[2] Sofie E. Miller is a Senior Policy Analyst at the George Washington University Regulatory Studies Center. She can be reached at sofiemiller@gwu.edu or at (202) 994-2974. The author thanks Summer Fellow Lili Carneglia for her research assistance, which supported this analysis and comment.

The RFS program was created in 2005 to reduce both American dependence on foreign oil and domestic gasoline consumption. According to EPA's 2013 proposed rule, the RFS program "was created to promote substantial, sustained growth in biofuel production and consumption" resulting in "reductions in greenhouse gas emissions, enhanced energy security, economic development, and technological innovation."[3] To that end, this proposal would mandate the production of 18.8 billion gallons of total renewable fuel in 2017, a 690 million gallon increase from the 2016 standards.

In its current proposal, EPA includes production standards for biomass-based diesel (biodiesel), total renewable fuel, advanced biofuel, and cellulosic biofuel, which can be seen in the table below. The 2017 standards for biodiesel were determined in the last RFS rulemaking; this proposed rule establishes biodiesel standards for 2018 (2.1 billion gallons).

EPA-Regulated Renewable Fuel Standards

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	***2017***
Biodiesel *(billion gallons)*	0.65[a]	0.8	1.0	1.28	1.63	1.73	1.9	2.0
Cellulosic biofuel *(million gallons)*	6.5	6	10.45	6	33	123	230	*312*
Advanced biofuel *(billion gallons)*	0.95	1.35	2.0	2.75	2.67	2.88	3.61	*4.0*
Total[b]	**12.95**	**13.95**	**15.2**	**16.55**	**16.28**	**16.93**	**18.11**	***18.8***

All gallon values are ethanol-equivalent on an energy content basis, except for biodiesel which is actual

[a] The rule implementing the 2010 RFS combined the 2009 and 2010 biomass-based diesel requirements and applied them to 2010.

[b] The standards set by EPA are a minimum, and the advanced biofuel minimum can be reached by either increases in biodiesel, cellulosic biofuel, or other advanced biofuel production above the minimum standards ascribed by EPA. The remainder of the total renewable fuels will presumably be met by increases in ethanol production.

Although it is the largest type of domestic biofuel, corn ethanol is only one component of the overall total renewable fuel standards promulgated by EPA. The agency also sets advanced biofuel standards, which can be met by the production of three main fuel sources: biodiesel, imported sugarcane ethanol, and cellulosic biofuel. As can be seen in the above table, EPA sets minimum standards for the production of biodiesel and cellulosic biofuel, which also count toward the agency's total renewable fuel standards. The total renewable fuel standards prescribed for 2017 must be met through a combination of corn ethanol and advanced biofuels (e.g. cellulosic and biodiesel).

[3] 78 FR 71731

While the stated goals of the RFS are to reduce crude oil imports and increase the use of renewable fuels, an implicit purpose of the RFS program is to benefit the environment by moving away from fuels that result in substantial carbon emissions (e.g. gasoline and diesel). However, it is not clear whether the increased production of biofuels has actually reduced emissions or benefitted the environment. In fact, the EPA's own Office of the Inspector General (OIG) is currently investigating the lifecycle impacts of the RFS, given progress in that body of research after EPA initially analyzed the program.[4]

EPA and the OIG should both note that the literature is mixed on the environmental effects of biofuel production, with many estimates indicating that the production of ethanol and biodiesel may significantly increase emissions, specifically of the greenhouse gases carbon dioxide (CO_2) and nitrous oxide (N_2O) and criteria pollutants such as particulate matter. The following sections explore the proposed renewable fuel standards for 2017, examine the tradeoffs that the agency faces in setting these standards, and critique the analysis that underpins these proposed standards.

Barriers to Increased Biofuel Production

Under the Clean Air Act (CAA), as amended by the Energy Policy Act of 2005 (EPAct) and the Energy Independence and Security Act of 2007 (EISA), EPA sets the annual volume of biofuel required to meet its renewable fuel standard. Section 211(o)(2)(B) of the CAA specifies annual biofuel targets for EPA's RFS.

EPA's proposed rule increases the overall volume requirements for total renewable fuels from 18.11 billion gallons in 2016 to 18.8 billion gallons in 2017. (Cellulosic biofuel and biomass-based diesel [biodiesel] are both advanced biofuels which are nested within the "renewable fuel" category.) EPA's proposal would set volume requirements for these advanced biofuels at 4 billion gallons in 2017, a 390 million gallon increase over the 2016 standards.

However, these increases fall short of the applicable volumes for 2016 outlined in the statute. For all but one fuel type, EPA proposes to set the volume requirement below the statutory level. Although mandated cellulosic biofuel production is proposed to increase by 36%, the 312 million gallons proposed for 2017 are still 5.19 billion gallons below the levels set in the CAA. The proposed targets for advanced biofuel (a category which includes both cellulosic biofuel and biodiesel) are 5 billion gallons short of the statutory volume levels, and the proposed standards for total renewable fuels are 5.2 billion gallons shy of the volume levels specified in the CAA.

EPA does have discretion to set applicable volume requirements below those specified in the statute in certain conditions. In this proposal, EPA exercises its cellulosic waiver authority under

[4] U.S. Environmental Protection Agency Office of the Inspector General. "Project Notification: Lifecycle Impacts of Renewable Fuel Standard; Project No. OPE-FY16-0005." October 15, 2015. https://www.epa.gov/sites/production/files/2015-10/documents/newstarts_10-15-15_rfs.pdf

CAA section 211(o)(7)(D)(i) and the general waiver authority under CAA section 211(o)(7)(A) to mandate less cellulosic biofuel, advanced biofuel, and total renewable fuel than Congress specified in the EISA.[5] EPA is opting to exercise its waiver authority because there is an insufficient supply of total renewable fuels and advanced biofuels to meet the statutory mandate.

For advanced biofuels, the primary constraint is growth in the cellulosic biofuel market. While Congress set ambitious targets for cellulosic production, actual production has fallen far short of these goals—in 2014 production of cellulosic was less than 2% of the statutory volume requirements for 2014. Due to the high costs of producing cellulosic and the technological barriers facing the industry, it is likely that production will continue to fall short of statutory levels. Increased production of biodiesel, although it currently surpasses the minimum volumes prescribed in the statute, is not sufficient to make up for the shortfall of cellulosic ethanol. Because both of these fuels are nested within the "advanced biofuels" category, EPA must reduce both the cellulosic volume requirements and the advanced biofuel volume requirements as a result of these supply shortages.

Ethanol faces a different set of obstacles. While the U.S. has the capacity and ability to either import or produce more ethanol, more ethanol cannot feasibly be blended into gasoline. Legally, only flex fuel vehicles (FFVs) can use fuel with ethanol concentrations greater than 15%, and as of EPA's 2015 proposal these vehicles only constituted about 6% of all light-duty cars and trucks.[6] Practically, non-flex-fuel vehicles cannot use fuel with ethanol concentrations greater than 10%, which is termed the "blendwall."

While the authorizing statute requires more ethanol to be blended into transportation fuel each year until 2022, the only way this is possible is if demand for gasoline increases significantly in the near term. While Congress and EPA expected gasoline consumption to continue increasing, actual demand dropped from a high of 142 billion gallons of gasoline in 2007, when the EISA was passed, to 140 billion in 2015.[7] This creates a ceiling on the practical growth of ethanol as a transportation fuel. Although EPA was very cognizant of these limitations in its 2015 proposal,[8] in this proposed rule EPA seems to disregard the constraints posed by the 10% blendwall:

> we continue to believe that the constraints associated with the E10 blendwall do not represent a firm barrier that cannot or should not be crossed. Rather, the E10

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5 81 FR 34785-6

6 80 FR 33120

7 U.S. Energy Information Administration. "Petroleum & Other Liquids: U.S. Product Supplied of Finished Motor Gasoline." Accessed January 10, 2016. *Data converted from barrel units to gallons.* http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MGFUPUS1&f=A

8 As EPA stated at the time, "For ethanol blends, there are both legal and practical constraints on the amount of ethanol that can be supplied to the vehicles that can use it, notwithstanding the considerable volumes that can be produced and/or imported." 80 FR 33121

> blendwall marks the transition from relatively straightforward and easily achievable increases in ethanol consumption as E10 to those increases in ethanol consumption as E15 and E85 that are more challenging to achieve. To date we have seen no compelling evidence that the nationwide average ethanol concentration in gasoline cannot exceed 10.0%.

This statement represents a pivot from the agency's prior stance. While EPA is certainly justified in using its waiver authorities given these constraints, it is surprising and troubling to see EPA mandating volume requirements that push ethanol production beyond the blendwall. Because the RFS program is on an unsustainable trajectory, Congress should reevaluate the statutory volume requirements established in the 2007 EISA and consider other approaches that would be more feasible and better for the environment.

Regulatory Analysis

Need for Incremental Analysis

In this proposed rule, EPA provides some cost estimates for increased production of corn ethanol, sugarcane ethanol, and soybean-based biodiesel, but does not provide any estimated benefits.[9] EPA justifies this omission by referring back to two initial analyses of the overall RFS program, which were finalized in 2007[10] and 2010.[11] Because these analyses examine the costs and benefits of the RFS as implemented in 2022, and because they assume that EPA will be able to meet the statutory goals for biofuel production, it's difficult to parse out the actual effects of EPA's current proposal.

This approach fails to appreciate the economic and environmental difference between different biofuel sources, which may be significant for different fuel sources (particularly as EPA deviates from the standards prescribed in the authorizing statute). In its proposal, EPA argues that:

> the costs and benefits of the RFS program as a whole are best assessed when the program is fully mature in 2022 and beyond… as the annual standard-setting process encourages consideration of the program on a piecemeal (*i.e.*, year-to-year) basis, which may not reflect the long-term economic effects of the program. Thus, EPA did not quantitatively assess other direct and indirect costs or benefits of increased renewable fuel volumes such as infrastructure costs, investment, GHG reduction benefits, air quality impacts, or energy security benefits, which all

[9] 81 FR 34801-3

[10] Environmental Protection Agency. April 10, 2007. "Regulatory Impact Analysis: Renewable Fuel Standard Program." http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2005-0161-0282

[11] Environmental Protection Agency. February 2010. "Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis."

> are to some degree affected by the proposed rule. While some of these impacts were analyzed in the 2010 final rulemaking which established the current RFS program, we have not fully analyzed these impacts for the 2017 volume requirements being proposed.[12]

Congress, in authorizing the EPAct and the EISA, did not give EPA a significant amount of time to conduct thorough incremental analyses of the annual RFS standards. As EPA noted in its last proposed rulemaking, "The short time frame provided for the annual renewable fuel rule process does not allow sufficient time for EPA to conduct a comprehensive analysis of the benefits of the 2015 and 2016 standards and the statute does not require it."[13] This is a shortcoming of the legislation rather than a shortcoming with the agency.

However, incremental analysis would be helpful for evaluating the RFS program, particularly because these proposed standards vary significantly from the levels mandated by statute which EPA initially analyzed. Because the program is implemented on a yearly basis, and each yearly standard reflects marginal changes both from the previous standard and from the levels prescribed in the authorizing statute, incremental analysis would be useful for researchers and the public in understanding the effect of EPA's individual proposed renewable fuel standards. This is particularly true in a rulemaking such as this one, in which ethanol and cellulosic fall short of their statutory levels—by 600 million and 5.18 billion gallons, respectively—and biodiesel exceeds its statutory minimum by 1.1 billion gallons. In this case, the benefits of the overall RFS program that EPA calculated in 2007 and 2010 only represent the benefits and costs of a hypothetical RFS program that has not been implemented and likely will not be implemented in the future.

Incremental Analysis of Agricultural Prices

Notably, this proposed rule does not include the projected impact of increased biomass-based diesel production on soybean and soybean oil prices. EPA's 2013 final rule estimated that increasing the biodiesel mandate from 1 billion gallons to 1.28 billion would increase the price of soybeans by $0.18/bushel,[14] which would have led to $592 million in additional costs for consumers in 2013 alone based on soybean production data from the Department of Agriculture's National Agricultural Statistics Service.[15]

This omission is particularly notable for two reasons: 1) because EPA is statutorily required to analyze such effects, and 2) because the proposed biodiesel production surpasses the statutory

[12] 81 FR 34801
[13] 80 FR 33131
[14] 77 FR 59465
[15] USDA, National Agricultural Statistics Service. April 2014. "Crop Production Historical Track Records (April 2014)." Page 163. http://www.nass.usda.gov/Publications/Todays_Reports/reports/croptr14.pdf

threshold by over 1 billion gallons annually. As EPA notes in its proposal, statute requires the agency to determine any biodiesel volume above the statutory threshold based on a review which includes the impact on "the price and supply of agricultural commodities, rural economic development, and food prices."[16]

Because of the underperformance of cellulosic ethanol, biodiesel will continue to ramp up beyond the minimum thresholds outlined in statute. As a result, it is particularly important to review the effects of this production on the prices of agricultural commodities—such as soybeans and soybean oil—and food prices that affect consumers.

Opportunity to Revisit Analytical Assumptions

Since the initial regulatory impact analyses were first conducted in 2007 and 2010, new information has emerged that may affect the assumptions EPA made in its regulatory analyses. Availability of new data and the proliferation of new third-party analyses provide EPA with a key opportunity to revisit the assumptions about environmental effects and demand for gasoline that underpinned its initial benefit-cost assessment.

Relevant Literature

There has been significant development in the relevant literature on the environmental impacts of renewable fuel production since Congress passed the EISA and EPA first analyzed the impacts of the RFS program. Recent research indicates that the environmental benefit of the RFS is extremely modest[17] at best and, at worst, could result in a significant increase in CO_2 emissions over gasoline.[18] Overall, the post-2007 literature largely reinforces this worst-case scenario, although estimates differ as to the extent of the environmental damage posed by biofuel mandates. A number of factors influence the extent of any potential environmental damage as a result of the RFS.

First, increased biofuel production causes land use changes (LUC) that result in the release of soil organic carbon. Increased demand for corn and soy provides farmers with an incentive to produce more crops and convert unused lands into cropland, which releases a significant amount of soil organic carbon and foregoes future carbon sequestration and storage. This increase in release of CO_2 may, depending on tillage practices and land type, outweigh any potential CO_2 savings from combusting ethanol.

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[16] 81 FR 34807

[17] Chen et al. 2014. "Alternative transportation fuel standards: Welfare effects and climate benefits" *Journal of Environmental Economics and Management* 67: 241–257

[18] Searchinger et al. 2008. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change." *Science*. Vol. 319 no. 5867 pp. 1238-1240

For example, in 2008, Searchinger et al. found that that biofuels increase carbon emissions by 93% compared to gasoline when the effects of LUC are considered.[19] Fargione et al. find that diverting domestic grassland and abandoned cropland in the Midwest to ethanol production incurs between 69 and 134 megagrams (Mg) of CO_2 per hectare, requiring a payback period of between 48 and 93 years to repay the initial carbon debt.[20] While LUC in the literature is primarily described as it relates to corn ethanol, researchers have also found that the carbon emissions from LUC are 34% greater per megajoule for soybean-based biodiesel.[21] This is particularly troubling as shortfalls in cellulosic capacity mean that EPA will continue to rely on increases in biodiesel production to meet Congress' ambitious advanced biofuel targets; this most recent proposal would set mandated production of biodiesel at 2.1 billion gallons in 2018.

In addition, these effects are not limited to the United States: changes in worldwide agricultural markets as a result of biofuel mandates may also lead to international land use change (or *indirect* land use change, "ILUC"), which occurs when other countries alter growing habits to replace crops that were previously imported from the U.S. When taking ILUC into account, Chakravorty and Hubert find that international emissions may increase by 33%, in comparison to a modest 1% reduction in domestic emissions.[22] Bento et al. find that the RFS "unambiguously" increases carbon emissions, offsetting more than 70% of the intended emissions savings.[23] Other research finds that, when considering ILUC, the environmental benefit of the RFS is very modest at best.[24,25]

EPA considered both potential LUC and ILUC in its 2010 analysis of RFS by weighing factors such as tilling practices, irrigation, crop yields over time, and supply and demand for agricultural products.[26] However, EPA estimated that production of ethanol results in 34 grams of CO_2 per

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[19] Searchinger et al. 2008. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change." *Science*. Vol. 319 no. 5867 pp. 1238-1240

[20] Fargione et al. 2008. "Land Clearing and the Biofuel Carbon Debt." *Science* 29: 1235-1238

[21] Chen, Huang, and Khanna. "Land Use and Greenhouse Gas Implications of Biofuels: Role of Technology and Policy." Paper prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24- 26, 2011. http://ageconsearch.umn.edu/bitstream/103216/2/CCE_for_AAEA2011.pdf

[22] Ujjayant Chakravorty and Marie-Hélène Hubert. 2012. "Global Impacts of the Biofuel Mandate under a Carbon Tax." American Journal of Agricultural Economics

[23] Bento, Klotz, and Landry. "Are there Carbon Savings from US Biofuel Policies? The Critical Importance of Accounting for Leakage in Land and Fuel Markets" (2012; forthcoming 2015 in Energy Journal)

[24] Oliver and Khanna. 2015. "Implementing the Renewable Fuel Standard with the Renewable Portfolio Standard in the US: Implications for Policy Costs and Greenhouse Gas Emissions."

[25] Chen, Huang, and Khanna. "Land Use and Greenhouse Gas Implications of Biofuels: Role of Technology and Policy." Paper prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24- 26, 2011.

[26] Environmental Protection Agency. 2010. "Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis." §2.4.4 - §2.4.5.

megajoule (MJ), which recent evidence suggests is on the very low-end of plausible values for carbon emissions.[27] Even if EPA's lower estimate is accurate, recent research finds that emissions as little as 27g/MJ are "enough to cancel out the benefits that corn ethanol has on global warming,"[28] meaning that EPA may have seriously underestimated the potential climate costs of implementing the RFS program.

Second, fertilizer input for the production of crops used to produce biofuels results in emissions of N_2O, a greenhouse gas that contributes to climate change. A 2012 analysis found that the necessary fertilizer input for the increased production of corn and rapeseed leads to N_2O emissions that matched or exceeded the corresponding cooling achieved by the reduction in CO_2 emissions resulting from fossil fuel replacement.[29]

One additional result of increased fertilizer usage—especially for corn ethanol—is water pollution. Increased fertilizer runoff damages ecosystems, harms biodiversity, and is contributing to the Gulf of Mexico's "Dead Zone."[30] This damage is most pronounced when acreage is diverted from another crop to corn production, which relies heavily on nitrogen fertilization and requires more irrigation than displaced crops, such as cotton.

Third, increased demand for and consumption of oil from across the globe could displace any domestic reductions resulting from the RFS, which could offset any domestic environmental benefit. EPA estimates that the largest benefit of the RFS program is a "monopsony" benefit. That is, because the U.S. is such a major consumer of international crude oil, less imported crude oil as a result of RFS can reduce the price of crude oil, and any remaining barrels of crude oil imported will be imported into the U.S. at a lower price. However, this lower price has a rebound effect on international gasoline demand, offsetting any reductions effected at the domestic level. This rebound effect could offset more than 60% of the intended emissions savings of the RFS program.[31]

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[27] Plevin, O'Hare, Jones, Torn and Gibbs. 2010. "Greenhouse Gas Emissions from Biofuels' Indirect Land Use Change are Uncertain but May Be Much Greater than Previously Estimated." *Environmental Science & Technology* 44: 8015–8021

[28] Hertel, Golub, Jones, O'Hare, Plevin and Kammen. 2010. "Effects of US Maize Ethanol on Global Land Use and Greenhouse Gas Emissions: Estimating Market-mediated Responses." *BioScience* 60 (3): 223.

[29] Smith, Mosier, Crutzen and Winiwarter. 2012. "The role of N2O derived from crop-based biofuels, and from agriculture in general, in Earth's climate." *Philosophical Transactions of the Royal Society* 367: 1169–1174

[30] Welch, H.L., Green, C.T., Rebich, R.A., Barlow, J.R.B., and Hicks, M.B., 2010, Unintended consequences of biofuels production—The effects of large-scale crop conversion on water quality and quantity: U.S. Geological Survey Open-File Report 2010–1229, p. 6.

[31] Bento, Antonio M., Richard Klotz, and Joel R. Landry. "Are there carbon savings from US biofuel policies? Accounting for leakage in land and fuel markets." *Presentation at the agricultural & applied economics association AAEA & NAREA joint annual meeting.* 2011. Forthcoming in Energy Journal 2015.

Criteria Pollutants

Particulate matter (PM) is a criteria pollutant regulated under the Clean Air Act. PM is "principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size," primarily PM_{10} (less than or equal to 10 micrometers, μm) and $PM_{2.5}$ (less than or equal to 2.5 μm),[32] and is associated with certain undesirable health effects such as premature mortality. In its 2009 RFS2 proposal EPA estimated that in 2022, PM_{10} and $PM_{2.5}$ emissions would have increased by a combined 64,626 annual tons as a result of the RFS program.[33] EPA's initial regulatory impact analysis also indicates that biofuel production causes increased emissions of particulate matter.[34]

In January 2013, EPA released estimates of PM costs per ton by emissions sector, and valued the reduction of one ton of area source $PM_{2.5}$ at between $320,000 and $710,000.[35,36] Based on EPA's per-ton damage estimates, the quantified air quality disbenefits of ethanol production through 2015 for $PM_{2.5}$ alone could be as large as $93 billion.[37]

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[32] Environmental Protection Agency. 2009. "Proposed Rule: Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program." *74 Federal Register:* 25064.

[33] Environmental Protection Agency. 2009. "Proposed Rule: Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program." *74 Federal Register:* 25060, Table VII.A–1.

[34] Environmental Protection Agency. 2012."Regulation of Fuels and Fuel Additives: 2013 Biomass-Based Diesel Renewable Fuel Volume." *77 Federal Register*: 59480-82.

[35] Environmental Protection Agency. 2013. "Technical Support Document Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors." 13, Table 5. http://www.epa.gov/air/benmap/models/Source_Apportionment_BPT_TSD_1_31_13.pdf

[36] There is no corresponding per-ton damage valuation for PM_{10}. However, since all particulate matter that is less than 2.5 μm is also less than 10 μm, valuing increases of both $PM_{2.5}$ and PM_{10} may result in double-counting. This estimate measures only changes in PM2.5 and values those according to EPA's estimate. To see the methodology used, see the appendix to Sofie E. Miller, "Oversight of the Renewable Fuel Standard," *Prepared statement for the record for the U.S. Senate Environment and Public Works Committee Hearing on Oversight of the Renewable Fuel Standard.* February 24, 2016. https://regulatorystudies.columbian.gwu.edu/oversight-renewable-fuel-standard

[37] Sofie E. Miller, "Oversight of the Renewable Fuel Standard," *Prepared statement for the record for the U.S. Senate Environment and Public Works Committee Hearing on Oversight of the Renewable Fuel Standard.* February 24, 2016. *Appendix.* https://regulatorystudies.columbian.gwu.edu/oversight-renewable-fuel-standard

Cost of Particulate Matter Increases from Ethanol Production ($PM_{2.5}$ Only)					
Year	**Ethanol consumption**	**PM2.5 emissions (tons)**	**Lower-bound**	**Base Case**	**Upper-bound**
2006	5,481,210,000	6,541.37	($2,093,237,558)	($3,368,804,194)	($4,644,370,831)
2007	6,885,690,000	8,217.50	($2,629,599,106)	($4,232,011,062)	($5,834,423,017)
2008	9,683,352,000	11,556.27	($3,698,007,573)	($5,951,480,938)	($8,204,954,303)
2009	11,036,592,000	13,171.25	($4,214,800,908)	($6,783,195,211)	($9,351,589,514)
2010	12,858,497,000	15,345.54	($4,910,574,281)	($7,902,955,483)	($10,895,336,686)
2011	12,893,315,000	15,387.10	($4,923,871,043)	($7,924,354,960)	($10,924,838,877)
2012	12,881,879,000	15,373.45	($4,919,503,711)	($7,917,326,285)	($10,915,148,859)
2013	13,215,621,000	15,771.74	($5,046,957,556)	($8,122,447,316)	($11,197,937,077)
2014	13,443,976,000	16,044.27	($5,134,164,808)	($8,262,796,488)	($11,391,428,168)
*2015**	*11,610,910,000*	*13,856.65*	*($4,434,129,123)*	*($7,136,176,557)*	*($9,838,223,992)*
Total	**109,991,042,000**	**131,265.14**	**($42,004,845,666)**	**($67,601,548,494)**	**($93,198,251,322)**

*Data for 2015 are incomplete, and as of 2/11/2016 include consumption only through October, 2015. Actual yearly total will be higher than listed.

Biodiesel production also incurs PM costs. In its 2012 rulemaking mandating the production of 1.28 billion gallons of biomass-based diesel, EPA valued the PM disbenefits of its rule at between -$0.17 and -$0.19/gallon.[38] Using EPA's previous estimate of per-gallon disbenefit, the annual PM cost of the biodiesel standards was $841 million in 2015 and will reach $1.9 billion in 2017.

Particulate Matter Costs of Biodiesel Production			
Year	**PM damages/gallon***	**Gallons biodiesel produced**	**Damages**
2012	$(0.18)	991,000,000	$(178,380,000)
2013	$(0.18)	1,359,000,000	$(244,620,000)
2014	$(0.18)	1,270,000,000	$(228,600,000)
2015	$(0.18)	1,054,000,000	$(189,720,000)
2016	$(0.18)	*1,900,000,000**	*$(342,000,000)**
2017	$(0.18)	*2,000,000,000**	*$(360,000,000)**
2018	$(0.18)	*2,100,000,000**	*$(378,000,000)**
Total		6,574,000,000	**$(1,921,320,000)**

*Projected production/damages based on EPA's 2015 final rule and 2016 proposed rule.

Although the PM costs associated with biodiesel will continue to climb as production increases, EPA does not provide an estimate of projected PM emissions under the proposed standards (2.1 billion gallons in 2018). This omission is troubling because EPA is statutorily required to analyze such effects and because the biodiesel is the only biofuel whose production continues to exceed its statutory minimum threshold. In addition, EPA's reliance on biodiesel will likely continue as cellulosic ethanol continues to significantly underperform. EPA is required by statute

[38] Environmental Protection Agency. 2012b. "Regulation of Fuels and Fuel Additives: 2013 Biomass-Based Diesel Renewable Fuel Volume." *77 Federal Register*: Table VI.B.2.b-3.

to consider "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"[39] when setting biodiesel standards above and beyond 1 billion gallons.

Executive Order 12866

President Clinton's Executive Order 12866, which was reinforced by President Obama's Executive Order 13563, instructs each agency to

> base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.[40]

Despite the emergence of new scientific, technical, and economic information, EPA continues to rely on old analysis to justify economically significant RFS rules. While many aspects of EPA's past analyses are likely still as valid as when they were written, many key assumptions may be challenged by new information. EPA should take this opportunity to revisit the analytical assumptions that underpin its RFS regulations.

Congress

Congress bears primary responsibility for setting unrealistic volume requirements and binding EPA to an unsustainable regulatory approach. As EPA stated in its 2015 proposed rule:

> Over the past few years, we have seen analysis concluding that the ambitious statutory targets in the Clean Air Act exceed real world conditions. Despite significant efforts by the U.S. Departments of Agriculture (USDA) and Energy (DOE) to promote the use of renewable fuels, real-world limitations, such as the slower than expected development of the cellulosic biofuel industry, less growth in gasoline use than was expected when Congress enacted these provisions in 2007, and constraints in supplying certain biofuels to consumers, have made the timeline laid out by Congress extremely difficult to achieve.[41]

In addition, a wealth of new information has become available on the environmental effect of renewable fuel production since Congress authorized the EISA in 2007. Unfortunately, the literature broadly finds that meeting the volume requirements in the statute or in EPA's regulations may increase greenhouse gas emissions, in addition to polluting waterways. This

[39] 81 FR 34807

[40] Exec. Order No. 12866, "Regulatory Planning and Review." 58 FR 51735 (1993).

[41] 80 FR 33101

information is particularly pertinent because Congress in 2007 surely did not envision that its RFS program would cause significant environmental damage. While EPA is constrained in its ability to respond to these unintended consequences, the current Congress is not.

Given the evidence gained from implementation of the RFS program, Congress should reevaluate the goals of the program and attempt to determine whether the RFS is meeting its stated goals.

Conclusion

EPA appropriately uses its waiver authority to set renewable fuel standards below those prescribed in the statute. However, the availability of new scientific, technical, and economic information shows that the RFS program does not work as it was intended to, and is likely causing significant environmental harm through increased greenhouse gas emissions and damage to waterbodies and ecosystems. Given the environmental damage and the large economic impact of the standards, EPA should update its benefits analysis and consider using its waiver authority to further reduce the standards. Responsibility rests with Congress to reevaluate the effects of the statutes it authorized, which are now causing economic and environmental harm.