EPA-SAB- XXX- XXX

The Honorable Michael S. Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Subject: DRAFT Commentary on the *Volume Requirements for 2023 and Beyond under the Renewable Fuel Standard Program* (RIN 2060-AV14)

Dear Administrator Regan,

Almost two decades after the Renewable Fuel Standard (RFS) program's creation, the efficacy of the program in reducing greenhouse gas (GHG) emissions remains highly uncertain from a scientific perspective, and many other environmental concerns regarding the RFS have been raised. This SAB commentary focuses on the first of these issues – the rule's GHG impacts. The SAB commends the EPA for its extensive analysis of the non-GHG environmental impacts of the RFS in documents supporting the 2023 rule. However, the SAB finds that resolving the scientific question of whether use of corn starch ethanol as a fuel reduces GHG emissions or not, relative to gasoline and diesel, is absolutely central to determining whether the EPA is implementing and enforcing a RFS that has net climate benefits, neutral climate impacts, or even net climate damages. According to the best available science, it appears there is a reasonable chance there are minimal or no climate benefits from substituting corn ethanol for gasoline or diesel. Therefore, the SAB recommends that the EPA conduct more extensive research into the role the RFS plays in reducing GHG emissions. Future rulemakings that set volume requirements for renewable fuels should more directly address the scientific question of whether corn starch ethanol has lifecycle GHG emissions no higher than 80% of those of gasoline and diesel. This is a statutory requirement for renewable fuels that are included in the volume targets established under the RFS program.

Process Used by the SAB to Develop This Commentary

The SAB established a RFS Workgroup to develop an initial draft of this commentary, which was then [reviewed, revised and approved by the full SAB] on XXXX. The SAB Workgroup consisted of Drs. Sheila Olmstead (chair of the Workgroup), Joseph Arvai, Steven Hamburg, Austin Omer, Emma Rosi, and Peter Thorne. The Workgroup considered the proposed rule, *Volume Requirements for 2023 and Beyond under the Renewable Fuel Standard Program,* the supporting materials and documents, and the deliberations of the entire chartered SAB at its public meeting on January 20, 2023, in developing this commentary.

Commentary on the proposed rule titled: *Volume Requirements for 2023 and Beyond under the Renewable Fuel Standard Program* (RIN 2060-AV14)

The Renewable Fuel Standard (RFS) program was created by the Energy Policy Act of 2005 and amended to its current basic form by the Energy Independence and Security Act (EISA) of 2007. The RFS mandates annual volume targets for a set of renewable fuel categories: cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel. In the statutes that created the RFS program, the U.S. Congress set a schedule of volume targets for each of the first three of these four renewable fuel categories, with those statutory targets expiring in 2012 for biomass-based diesel, and in 2022 for the remaining three categories. The total renewable fuel category equates to the sum of the advanced biofuel categories specified in the statute and conventional biofuel (mostly corn starch ethanol). The original schedule of biofuel volume targets set by the Congress under the RFS has proven infeasible, given technological and other constraints, so EPA has used its authority to waive most of the cellulosic mandate since 2011, and some of the advanced biofuel and total renewable fuel mandates since 2013 (Lade et al. 2018, Congressional Research Service 2022).[1, 2]

The 2023 RFS rulemaking, governing volumes for 2023, 2024, and 2025, represents the first rulemaking under the Standard in which direct Congressional guidance on volume targets has now expired for all fuel categories, and the EPA is directed to set *de novo* volume targets, in consultation with the Department of Energy and the Department of Agriculture. The SAB has identified this as an opportunity for the EPA to incorporate the best available science on the environmental impacts of conventional and advanced biofuels in setting new volume requirements.

The SAB finds that a linchpin of the statutory definition of the fuels regulated by the RFS is the requirement that renewable fuels included in targets established under the RFS have lifecycle greenhouse gas (GHG) emissions of no more than 80% of those of gasoline and diesel. Of the three often-cited Congressional purposes in creating the RFS (reducing GHG emissions, expanding the nation's renewable fuel sector, and reducing U.S. reliance on imported oil) reducing GHG emissions is the only purpose that falls squarely within the mission of the EPA to "protect human health and the environment." The SAB commends the EPA for its research on non-GHG environmental impacts of the RFS, summarized in the 2023 Rule's Regulatory Impact Analysis (RIA) (U.S. EPA 2022)[3] and described more extensively in a report to Congress (U.S. EPA Office of Research and Development 2023),[4] which is currently undergoing external peer

[1] Lade, Gabriel E., C.-Y. Cynthia Lin Lawell, and Aaron Smith. 2018. Designing climate policy: lessons from the Renewable Fuel Standard and the blend wall. *American Journal of Agricultural Economics* 100(2): 585-599.

[2] Congressional Research Service. 2022. The Renewable Fuel Standard (RFS): Waiver Authority and Modification of Volumes. CRS Report R44045.

[3] U.S. EPA. 2022. Draft Regulatory Impact Analysis: RFS Standards for 2023-2025 and Other Changes. EPA-420-D-22-003, November. https://www.epa.gov/system/files/documents/2022-12/420d22003.pdf

[4] U.S. EPA, Office of Research and Development. 2023. Biofuels and the Environment: Third Triennial Report to Congress, External Review Draft (ERD). EPA/600/R-22/273. Washington, DC. https://cfpub.epa.gov/ncea/biofuels/recordisplay.cfm?deid=353055

review. The SAB recommends that the EPA conduct similar extensive research on GHG impacts of future RFS rules.

For the past three years (2020-2022), conventional biofuels have comprised 73% of the qualifying renewable fuels under the RFS (Congressional Research Service 2022),[5] and the vast majority of this has been corn starch ethanol. There is vigorous scientific debate as to whether corn starch ethanol meets the necessary requirement of having no more than 80% of the lifecycle GHG emissions of gasoline or diesel. Chapter 4 of EPA's RIA for the 2023 RFS rule (U.S. EPA 2022)[6] and the Agency's Model Comparison Exercise Technical Document accompanying the rule (U.S. EPA 2023)[7] cite this literature extensively. In the RIA, estimates of the lifecycle emissions of petroleum gasoline and petroleum diesel range from 84-98 gCO2e/MJ [8](U.S. EPA 2022, pp. 170-171).[9] Thus, to meet the 80% threshold in the RFS, qualifying renewable fuels must have lifecycle GHG emissions no higher than 67-78 gCO2e/MJ. In Figure 4.2.3.3-1 of the RIA (p. 166), seven of the 20 estimates from the models used in the RIA for corn starch ethanol's lifecycle GHG emissions are *above the upper bound* of that threshold. All three of the most recent estimates in that group exceed even the highest estimates of gasoline and diesel lifecycle GHG estimates in Figures 4.2.3.2-1 and 4.2.3.2-2 (U.S. EPA 2022).[10] Thus, corn starch ethanol may not meet the definition of a renewable fuel under the EISA, requiring biofuel GHG emissions not exceed 80% of that of gasoline or diesel.

In particular, recent estimates by Lark et al. (2022a)[11] suggest that the carbon intensity of corn starch ethanol is no less than that of gasoline or diesel, and perhaps up to 24% higher. On the low end, the RIA also cites work by Scully et al. (2021a),[12] which estimates a carbon intensity for corn starch ethanol of 38 gCO2e/MJ, lower than any other study cited. The SAB recognizes that the science is divided on this issue; both Lark et al. (2022a)[13] and Scully et al. (2021a)[14] prompted published and unpublished comments and replies (Spawn-Lee et al. 2021, Scully et al. 2021b, Alarcon Falconi et al. 2022, Lark et al. 2022b, Lark et al. 2022c, Taheripour et al.

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[5] Ibid.
[6] Ibid.
[7] U.S. EPA. 2023. Model Comparison Exercise Technical Document. EPA-420-R-23-017, June. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1017P9B.pdf
[8] grams CO2 emitted per millijoule
[9] Ibid.
[10] This is also clear in Table 4.2.3.13-1 of the RIA, in which the lifecycle GHG emissions for corn starch ethanol range from 38 to 116 gCO2e/MJ, clearly overlapping the 67-78 gCO2e/MJ threshold (U.S. EPA 2022).
[11] 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. 2022a. Environmental outcomes of the US Renewable Fuel Standard. *Proceedings of the National Academy of Sciences* 119(9): e2101084119.
[12] Scully, Melissa J., Gregory A. Norris, Tania M. Alarcon Falconi, and David L. MacIntosh. 2021a. Carbon intensity of corn ethanol in the United States: state of the science. *Environmental Research Letters* 16: 043001.
[13] Ibid.
[14] Ibid.

2022).[15, 16, 17, 18, 19, 20] Many other estimates of corn starch ethanol's lifecycle GHG emissions fall within the wide range indicated by these studies as endpoints. The SAB also applauds the EPA for its careful and thorough analysis in the RIA (U.S. EPA 2022)[21] and in its Model Comparison Exercise Technical Document (U.S. EPA 2023),[22] and recognizes that the law requires the EPA to issue new RFS volume requirements in a timely fashion.

However, the SAB finds that resolving the scientific question of whether corn starch ethanol reduces emissions or not, relative to gasoline and diesel, is absolutely central to determining whether the EPA is implementing and enforcing an RFS that has net climate benefits, or one that has neutral climate impacts, or even has net climate damages. According to the best available science, it appears there is a reasonable chance there are minimal or no climate benefits from substituting corn ethanol for gasoline or diesel.

A recent report by the National Academies recommends that when lifecycle analysis (LCA) is used in policy evaluation with respect to the emissions of low-carbon transportation fuels, analysts should include "an assessment of the degree of confidence that a proposed policy will result in reduced GHG emissions and increased social welfare" (National Academies 2022, p. 4).[23] In promulgating another three years of volume standards with significant uncertainty about the sign as well as the magnitude of the RFS's climate impacts, the Agency missed an opportunity to use the 2023 rulemaking to engage the scientific community on the vital question of whether the majority fuel used for compliance with the RFS, corn starch ethanol, meets this criterion. The SAB emphasizes that, if the RFS does not reduce GHG emissions, it cannot fulfill one of Congress's three stated objectives for the RFS, and the rule may potentially conflict with

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[15] Spawn-Lee, Seth A., Tyler J. Lark, Holly K. Gibbs, Richard A. Houghton, Christopher J. Kucharik, Chris Malins, Rylie E. O. Pelton, and G. Philip Robertson. 2021. Comment on 'Carbon intensity of corn ethanol in the United States: state of the science'. *Environmental Research Letters* 16: 118001.

[16] Scully, Melissa J., Gregory A. Norris, Tania M. Alarcon Falconi, and David L. MacIntosh. 2021b. Reply to comment on 'Carbon intensity of corn ethanol in the United States: state of the science.' *Environmental Research Letters* 16: 118002.

[17] Alarcon Falconi, Tania M., Fatemeh Kazemiparkouhi, Brittany Schwartz, and David L. MacIntosh. 2022. Letter: Inconsistencies in domestic land use change study. *Proceedings of the National Academy of Sciences* 119(51):e2213961119.

[18] 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. 2022b. Reply to Falconi et al.: Economic red herrings and resistance to new modeling hinder progress in assessing ethanol's land use change. *Proceedings of the National Academy of Sciences* 119(51): e2216091119.

[19] Lark, Tyler J., Nathan P. Hendricks, Aaron Smith, Nicholas Pates, Seth A. Spawn-Lee, Matthew Bougie, Eric Booth, Christopher J. Kucharik, and Holly K. Gibbs. 2022c. Reply to Taheripour et al.: Comments on "Environmental outcomes of the U.S. Renewable Fuel Standard," https://files.asmith.ucdavis.edu/Reply_to_Taheripour_et_al.pdf.

[20] Taheripour, Farzad, Steffen Mueller, Hoyoung Kwon, Madhu Khanna, Isaac Emery, Ken Copenhaver, and Michael Wang. 2022. Comments on "Environmental outcomes of the U.S. Renewable Fuel Standard." https://d35t1syewk4d42.cloudfront.net/file/2210/Comments-on-Paper-on-Environmental-Outcomes-of-the-U.S.-Renewable-Fuel-Standard-final.pdf

[21] Ibid.

[22] Ibid.

[23] National Academies of Sciences, Engineering and Medicine. 2022. Current Methods for Life-Cycle Analyses of Low-Carbon Transportation Fuels in the United States. Washington, DC. The National Academies Press. https://doi.org/10.172.26/26402.

the Agency's mission. We note that it might have been helpful for the EPA to address this extremely important scientific question within the scope of its otherwise very thorough environmental impacts report currently under peer review (U.S. EPA Office of Research and Development 2023).[24] It would also have been helpful to indicate in the RIA Figure 4.2.3.3-1 (as well as the others in this section) the range of the threshold (67-78 gCO2e/MJ) for achieving lifecycle emissions not above 80% of those of gasoline or diesel so that it is clear to the reader that corn starch ethanol stands out among the fuels considered on this critical point.[25]

Much of the scientific disagreement over the lifecycle GHG emissions of corn starch ethanol and the uncertainty regarding whether it has climate benefits relative to gasoline and diesel has to do with its impacts on land-use change – how much cropland has expanded to grow corn for ethanol in the United States as a result of the RFS, as well as the location and previous use of the land newly used to grow corn for ethanol production. These facts are difficult to pin down, partly because the carbon intensity of any induced land-use change to produce corn starch ethanol is a moving target, varying with prices, corn yields, and many other variables which change over time and space. It is also true that nitrous oxide emissions are not well constrained by existing models, and given the potency of this GHG, the net GHG benefits can be greatly impacted by the underlying assumptions about these emissions at both the field scale as well as within the receiving waters affected by field application of fertilizers.[26]

The uncertainty around corn starch ethanol's lifecycle GHG emissions impacts might be reduced if the RFS allowed differentiated incentives or constraints on corn starch ethanol qualifying as conventional renewable fuel. For example, ethanol produced from corn grown using varying practices can affect field-scale GHG emissions.[27] In addition, ethanol production facilities may install carbon capture and storage technologies, reducing carbon intensity and making it more likely that this fuel would meet the 80% threshold required under the RFS. Additional data

[24] Ibid.

[25] EPA's Model Comparison Exercise Technical Document accompanying the Rule (U.S. EPA 2023) does an excellent job summarizing the models used in the RIA and the sources of variation in life-cycle GHG emissions intensity estimates. However, this analysis does not include among its broad conclusions the important qualitative difference between corn starch ethanol and soybean oil biodiesel in terms of the likelihood of positive vs. neutral or even negative climate impacts. The Technical Document does note that the models included in this Exercise "produced a wider range of LCA GHG estimates for soybean oil biodiesel than corn ethanol" (p. 3). The SAB appreciates this point, but the point obscures the critical nature of the 80% threshold for qualifying fuels. In Figure 4.2.3.4-1 of the RIA (U.S. EPA 2023) describing soybean oil biodiesel's lifecycle GHG emissions, no estimates are above the upper bound of the 67-78 gCO2e/MJ range for gasoline and petroleum diesel. Only two of the 20 estimates of soybean oil biodiesel's lifecycle GHG emissions are above the lower bound of that gasoline/diesel range, and those estimates cite literature between five and 13 years old. All of the estimates drawing on literature from the past three years on soybean oil biodiesel in Figure 4.2.3.4-1 are well below the 80% threshold.

[26] Assumptions about the land-use change impacts of the RFS are also important factors in determining its other environmental impacts, such as impacts on water quality through increased fertilizer application, erosion and other means. EPA's draft Third Triennial Report to Congress on Biofuels and the Environment (U.S. EPA Office of Research and Development 2023) addresses the attribution of impacts from corn ethanol production on water quality and many other environmental endpoints.

[27] The National Academies devote a chapter of their recent report to describing the potential for verification of such practices and technologies, which would be necessary for any standard incorporating differential GHG emissions impacts within the same biofuel category (National Academies 2022).

quantifying the impact of climate-smart practices within corn ethanol's lifecycle are warranted for future evaluation of this renewable fuel's climate impacts.

The volume requirements set under the 2023 RFS rule extend through 2025. The SAB recommends that future rulemakings setting volume requirements for 2026 and beyond more directly address the central scientific question of whether corn starch ethanol has lifecycle GHG emissions no higher than 80% of those of gasoline and diesel.

Sincerely,

Alison C. Cullen, Sc.D.
Chair
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