NATURAL RESOURCES DEFENSE COUNCIL and CLEAN AIR TASK FORCE

Comments On

DRAFT SCIENCE ADVISORY BOARD REVIEW OF ENVIRONMENTAL PROTECTION AGENCY'S FRAMEWORK FOR ASSESSING BIOGENIC CO_2 EMISSIONS FROM STATIONARY SOURCES

September 2018

SUMMARY OF RECOMMENDATIONS

The following is a Summary of Recommendations submitted jointly by the Clean Air Task Force and the Natural Resources Defense Council. Attached to this Summary are our full-length comments, offering additional discussion and citations in support of our recommendations. Our organizations appreciate the opportunity to comment on this important process and look forward to working further with the SAB and the EPA to ensure that biogenic CO2 emissions from stationary sources are properly counted.

RECOMMENDATION 1: AMEND PARAGRAPHS ON REFERENCE POINT ACCOUNTING

This Board, in its 2012 final report to the EPA on biogenic carbon accounting,[1] accurately summarized the purpose of a biogenic CO2 accounting framework:

> "[T]he Framework should provide a means to estimate the effect of stationary source biogenic feedstock demand, on the atmosphere, over time, comparing a scenario with the use of biogenic feedstocks to a counterfactual scenario without the use of biogenic feedstocks….estimating additionality, i.e. the extent to which forest stocks would have been growing or declining over time in the absence of harvest for bioenergy, is essential, as it is the crux of the question at hand."

It also reviewed the reference point baseline approach against this additionality criterion and concluded:

> "EPA's reference point baseline approach (comparing the net change in carbon stocks between two points in time) does not provide an estimate of the additional emissions and the sequestration changes in response to biomass feedstock demand. …and implies that forest biomass emissions could be granted an exemption simply because the location of a stationary facility is in an area where forest stocks are increasing."

Finally, the Board's 2012 final report recommended accounting that does not credit or penalize bioenergy users for changes that would otherwise occur:

[1] SAB Review of EPA's Accounting Framework for Biogenic CO2 Emissions from Stationary Sources (September 2011) at page 5 (September 28, 2012) (https://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf).

> "An anticipated baseline requires selecting a time period and determining what would have happened anyway without the harvesting and comparing that impact with the carbon trajectory associated with harvesting of biomass for bioenergy."

Concern: We are concerned that the passage below from the 2018 draft's Executive Summary breaks from these findings in favor of adjustments to the reference point baseline:

> "In 2012, the SAB recommended a future anticipated baseline approach to capture the additional CO2 emissions to, or uptake from, the atmosphere created by any increased use of biomass for energy. The EPA acknowledged this limitation of its earlier approach and included a future anticipated baseline analysis along with a reference point approach in its 2014 Framework. The reference point approach, if adjusted at regular intervals (e.g., every 5 to 10 years) to account for any additional regional sequestration, would address the SAB's earlier concerns, allowing for the more direct establishment of a baseline while capturing additional increases in carbon stocks." (page 2, lines 8-14).

Recommended Change: We recommend the following changes (and recommend applying comparable changes to a similar paragraph on page 7 of the report):

> In 2012, the SAB recommended a future anticipated baseline approach to capture the additional CO2 emissions to, or uptake from, the atmosphere created by any increased use of biomass for energy. The EPA acknowledged this limitation of its earlier approach and included a future anticipated baseline analysis along with a reference point approach in its 2014 Framework. ~~The reference point approach, if adjusted at regular intervals (e.g., every 5 to 10 years) to account for any additional regional sequestration, would address the SAB's earlier concerns, allowing for the more direct establishment of a baseline while capturing additional increases in carbon stocks.~~ **Whatever baseline is used, it must be coupled with a modeling structure that evaluates only the incremental effects of the bioenergy use and does not credit or penalize bioenergy users for changes that would otherwise occur.**

RECOMMENDATION 2: DELETE PARAGRAPHS CONCERNING "LANDSCAPE APPROACHES"

In Section 3.4, the 2018 draft report's recommendation *requires* a "landscape approach" to account for the impacts of biomass demand on carbon stocks, stating "[s]tationary facilities require a continuous supply of feedstock, thus a landscape approach is required for accounting for the impacts of feedstock demand on carbon stocks." (page 9, lines 22-23). The draft report supports this recommendation in two passages, which use similar and sometimes duplicative language:

> At pp. 8-9: Stationary facilities require a continuous supply of feedstock, thus a landscape approach for accounting of impacts on carbon stocks is more appropriate than a stand-level approach. A landscape approach expands the boundaries of analysis to include all effects and recognizes that there is uptake as well as loss of carbon associated with the production of feedstocks concurrently occurring across the landscape. It is the overall balance of losses and credits that determine carbon stock effects. Moreover, economic considerations will determine the size of the landscape providing feedstocks over time and the potential for land-use changes that can positively or negatively impact carbon stocks. As noted by Cintas et al. (2016), "assessment at the landscape scale integrates the effects of all changes in the forest

management and harvesting regime that take place in response to – experienced or anticipated – bioenergy demand. Taken together, these changes may have a positive, negative or neutral influence on the development of forest carbon balances."

At p. 11: Since stationary facilities require a continuous supply of feedstock, multiple stands will be disturbed in a regulated manner (i.e., completely asynchronously), and the order in which losses and gains occur becomes meaningless at the landscape level because both simultaneously occur; thus, the operative issue is the overall balance between losses and gains of carbon at the landscape scale. Thus, stand level accounting is not relevant to the calculation of BAFs. If harvest does not exceed the rate of carbon accumulation, the landscape-level carbon stocks are stable or increasing. However, there could be a net loss of carbon to the atmosphere at the landscape level, compared with the reference scenario, if trees are harvested at younger ages or if trees that would otherwise have been unharvested are harvested.

Concern: These paragraphs rely on undefined terms and do not distinguish among key measures of carbon stock changes.[2] As a result, the SAB's basis for its recommendation is ambiguous, difficult to understand, and open to multiple interpretations. The SAB should not support, let alone *require*, an analytic approach that suffers from such flaws, as is the case for the "landscape approach." Moreover, the SAB should not rely on economic models without a careful review of their validity.

Recommended Change: We recommend that the SAB delete these two paragraphs, as well as the accompanying recommendation at the end of Section 3.4 (on p. 9).

[2] For example, the paragraphs do not distinguish between *carbon stored* for an individual scenario and the *net change in stored carbon* based on the difference between two scenarios, two fundamentally different quantities. As a result, the paragraphs could be interpreted in vastly different ways – one of which would contradict the SAB's earlier finding that "merely knowing whether carbon sequestration at the landscape level has increased or decreased tells us nothing about the incremental effect that bioenergy production has on carbon emissions." (SAB, 2012)

NATURAL RESOURCES DEFENSE COUNCIL | CLEAN AIR TASK FORCE

Thomas Carpenter
Designated Federal Officer
Science Advisory Board—Biogenic Carbon Emissions Panel
US Environmental Protection Agency
Via email

Re: Draft Science Advisory Board Review of Environmental Protection Agency's Framework for Assessing Biogenic CO_2 Emissions from Stationary Sources

Dear Dr. Carpenter and Members of the EPA Science Advisory Board:

Natural Resources Defense Council and Clean Air Task Force appreciate the opportunity to provide the following comments on the Environmental Protection Agency Science Advisory Board (SAB) Draft Review of EPA's 2014 Framework for Assessing Biogenic CO_2 Emissions from Stationary Sources.

The central task of the Science Advisory Board's (SAB) review is written into the title of the report it is charged with reviewing: *A Framework for Assessing Biogenic CO2 Emissions from* ***Stationary Sources.*** This title grounds this effort in a practical need—namely, evaluating the greenhouse gas (GHG) emissions of regulated power stations burning biomass. The outcome of any biogenic CO2 accounting system must enable EPA to determine whether, and to what extent, to credit a regulated, biomass-burning facility with offsetting carbon re-sequestration based on new plant growth that would not have otherwise occurred. Specifically, it must allow EPA to determine and regulate, not retroactively, but in real time, the impacts of an individual stationary source; prevent free-ridership and avoid crediting or penalizing stationary sources for the actions of independent actors over which they have no control; and ensure alignment with climate policy goals by comparing what happens to forest carbon stocks under a policy scenario, in which biomass is harvested and converted into energy in response to new policy-driven demand, to a baseline scenario, which assumes business as usual .

For its part, the SAB's report must be written in a way that advances EPA's understanding of the key scientific underpinnings of such an accounting system.

Since 2012, the Chartered SAB (henceforth: SAB) and its Panel on Biogenic Carbon Emissions (henceforth: the Panel) have repeatedly recognized the importance of the importance of these threshold requirements, and in particular emphasized that any system for evaluating the net emissions of a biomass-burning stationary source must compare the biogenic CO2 emissions that occur under the biomass use scenario against the emissions that would occur in a well-characterized baseline. We are concerned that the 2018 draft report's discussion of the merits of two different types of baselines—the anticipated baseline approach and the reference point approach—is incomplete, and we fear that it could be read in a way that is inconsistent with numerous statements provided elsewhere in the 2018 draft report, and in previous statements co-signed by the chair of the SAB.

Below, we address three key sections of the 2018 draft report. Wherever possible, we lay out specific passages that appear contradictory or subject to multiple interpretations, and recommend specific fixes, indicated in bold and via strikethrough.

1. Language from the 2018 draft report breaks from previous statements by the SAB that caution EPA against the use of a reference point approach[3] and urge the Agency to develop "an anticipated baseline approach that allows assessment of *additional* emissions."[4]

The process of reviewing EPA's 2011 and 2014 Accounting Frameworks generated a range of disagreements around complex issues, including, most notably, the disagreement between the SAB and the Panel over the appropriate time horizon for calculating a BAF. Clearly, the SAB is not bound by previous analyses presented in Panel-authored reports. At the same time, there has been widespread support among members of the SAB and the Panel for including a counterfactual baseline scenario, just as there has been widespread concern about the use of a historic reference point scenario. The SAB should be reluctant to set aside these consensus positions.

In a cover letter to the SAB's 2012 Report (considered final by EPA and henceforth referred to as the 2012 Final Report) reviewing EPA's 2011 Framework, SAB Dr. Chair Deborah L. Swackhamer and Panel Chair Dr. Madhu Khanna wrote jointly:

> In general the Framework should provide a means to estimate the effect of stationary source biogenic feedstock demand, on the atmosphere, over time, comparing a scenario with the use of biogenic feedstocks to a counterfactual scenario without the use of biogenic feedstocks. In the attached report, the SAB provides some suggestions for an "anticipated baseline" approach while acknowledging the uncertainty and difficulty associated with modeling future scenarios.[5]

The letter from Drs. Swackhamer and Khanna also emphasized the importance of "additionality"

> Estimating additionality, i.e., the extent to which forest stocks would have been growing or declining over time in the absence of harvest for bioenergy, is essential, as it is the crux of the question at hand. To do so requires an anticipated baseline approach.[6]

The argument for including an anticipated baseline approach as an option for determining a BAF is described at length in the SAB's 2012 Final Report:

> To accurately capture the carbon outcome, an anticipated baseline approach and landscape level perspective are needed. An anticipated baseline requires selecting a time period and determining what would have happened anyway without the harvesting and comparing that impact with the carbon trajectory associated with harvesting of biomass for bioenergy. Although

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[3] SAB Review of EPA's Accounting Framework for Biogenic CO2 Emissions from Stationary Sources (September 2011)—Cover Letter to EPA from Drs. Deborah L. Swackhamer, Chair of Science Advisory Board and Madhu Khanna, Chair of SAB Biogenic Carbon Emissions Panel to EPA, at ii (September 28, 2012) ("SAB Cover Letter September 2012") (https://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf).

[4] SAB Draft Report (8/27/15)—Cover Letter to EPA from Drs. Peter S. Thorne, Chair of Science Advisory Board and Madhu Khanna, Chair of SAB Biogenic Carbon Emissions Panel to EPA, at ii (emphasis in original) (August 27, 2015) ("SAB Cover Letter August 2015") (https://yosemite.epa.gov/sab/sabproduct.nsf/0/BE340711E6D9B47385257EAE006ED147/$File/8-27-15+Draft+Advisory_changes+accepted.pdf).

[5] SAB Cover Letter September 2012 at ii.

[6] *Id*.

> any "business as usual" projection would be uncertain, it is the only means by which to gauge the incremental impact of woody biomass harvesting.[7]

The Final Report and the subsequent draft Panel reports from 2015-2017 point out that the 2011 Framework did not distinguish the incremental effects of bioenergy from effects that would have otherwise occurred. EPA's 2011 Framework could have improperly credited or penalized bioenergy operations with gains or losses in terrestrial carbon stocks that would occur anyway. It also failed a basic test of logic in that the same bioenergy plant, burning the same biomass, could appear to have dramatically different CO2 emissions depending on where it was located. The 2012 Final Report rejected this approach on the basis that it could not assess the "additionality" of any carbon benefit claims and would allow for free-ridership:

> The choice of a fixed reference point may be the simplest to execute, but it does not properly address the additionality question, i.e., the extent to which forest stocks would have been growing or declining over time in the absence of bioenergy. The agency's use of a fixed reference point baseline coupled with a division of the country into regions implies that forest biomass emissions could be granted an exemption simply because the location of a stationary facility is in an area where forest stocks are increasing. The reference point estimate of regionwide net emissions or net sequestration does not indicate, or estimate, the difference in greenhouse gas emissions (the actual carbon gains and losses) over time that stem from biomass use. As a result, the Framework fails to capture the causal connection between forest biomass growth and harvesting and atmospheric impacts and thus may incorrectly assess net CO2 emissions of a facility's use of a biogenic feedstock.[8]

We are concerned that a passage in the Executive Summary breaks from these previous analyses:

> In 2012, the SAB recommended a future anticipated baseline approach to capture the additional CO2 emissions to, or uptake from, the atmosphere created by any increased use of biomass for energy. The EPA acknowledged this limitation of its earlier approach and included a future anticipated baseline analysis along with a reference point approach in its 2014 Framework. The reference point approach, if adjusted at regular intervals (e.g., every 5 to 10 years) to account for any additional regional sequestration, would address the SAB's earlier concerns, allowing for the more direct establishment of a baseline while capturing additional increases in carbon stocks.

A similar passage on page 7, lines 2 – 21 reads:

> In the 2012 SAB report, we noted temporal problems with the reference point baseline approach. The EPA has acknowledged this in its 2014 Framework and included a future anticipated baseline analysis alternative along with a reference point approach. The limitations of a reference point approach can be reduced by deploying a shifting reference point (updated at regular intervals using empirical data (e.g. every 5 or 10 years)), which is designed to capture increased regional carbon stocks.

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[7] SAB Review of EPA's Accounting Framework for Biogenic CO2 Emissions from Stationary Sources (September 2011) at 5 (September 28, 2012) (https://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf).

[8] *Id*. at 5-6. Each of the draft SAB reviews released in 2015, 2016, and 2017 includes a similar discussion of the merits of the anticipated baseline approach and the shortcomings of reference point approach.

> The SAB's 2012 advice on the anticipated baseline approach explored the use of complex modeling in order to try to capture interactions among the market, land use, investment decisions, and emissions and ecosystem feedbacks, and to construct a counter-factual scenario that does not include increased bioenergy use. In the case of long rotation feedstocks, bioenergy demand can affect carbon stocks in many ways including the ages at which trees are harvested, the diversion of forest biomass from traditional forest product markets to bioenergy, and the rates of afforestation and deforestation. The complexity of such a modeling approach makes it difficult to parameterize and validate. The lack of empirical data regarding many of these relationships and the resulting uncertainties pose a significant challenge to use of this type of model in a regulatory context. Estimating the net effect of these changes on carbon stocks requires a model that integrates market demand and supply conditions with biophysical conditions that determine growth of forest biomass, losses via decomposition, carbon sequestration and fluxes due to harvests and land use change and incorporates the spatial variability in these effects across the U.S. Employing models of this complexity is likely beyond the capabilities of many practitioners.[9]

All approaches to biogenic CO2 accounting have strengths and weaknesses, and ultimately must be compared against the relative strengths and weaknesses of a viable alternative. While the debate over the Panel's support for an extended time horizon for calculating the BAF dominated the SAB's August 2017 public meeting and ultimately led the SAB to reject the Panel's 2014 report, there has been no comparable public debate over whether the SAB should revisit its recommendations that EPA ought to consider the use of an anticipated baseline approach or that it ought to be wary of relying on reference point scenarios. The 2012 Final Report, the draft Panel reports, and the transmittal letters signed by the SAB Chair consistently supported the use of anticipated baselines and expressed concerns about reference point scenarios.

The various reports and letters openly acknowledged the "uncertainty and difficulty" associated with counterfactual modeling and pointed out that, "practical considerations must weigh heavily in the agency's decision making."[10] They note, as the current 2018 SAB draft report does, that estimating the net effect on carbon stocks from changes in average harvest age, the diversion of forest biomass from traditional markets to energy markets, and the rates of afforestation and deforestation requires a model that integrates market demand and supply conditions with a variety of biophysical conditions.[11]

However, these earlier reports and discussions do not support the assertion that, "Employing models of this complexity is likely beyond the capabilities of many practitioners."[12] Several biophysical models have been developed and documented in the peer reviewed literature.[13] As indicated above, we

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[9] SAB Draft Report (8-29-18)—Cover Letter to EPA from Chartered SAB, at 7, lines 2 - 21 (August 29, 2018) ("SAB Draft Report August 2018") (https://yosemite.epa.gov/sab/sabproduct.nsf/LookupWebProjectsCurrentBOARD/521CDCBF9B028BCE852582F80065B320/$File/Biogenic_Carbon_+Qual_Rev-8-29-18.pdf).

[10] SAB 2016 Draft Report at 11.

[11] *Id*. at 10.

[12] SAB Draft Report August 2018 at 7.

[13] Mitchell, S. R., Harmon, M. E. & O'Connell, K. E. B. Carbon debt and carbon sequestration parity in forest bioenergy production. GCB Bioenergy 4, 818–827 (2012).
Holtsmark, B. Harvesting in boreal forests and the biofuel carbon debt. Clim. Change 112, 415–428 (2012).
Hudiburg, T. W., Law, B. E., Wirth, C. & Luyssaert, S. Regional carbon dioxide implications of forest bioenergy production. Nat. Clim. Change 1, 419–423 (2011).

therefore recommend that the SAB remove the sentence in the 2018 draft report (at page 7, line 21) that suggests that these types of models are too complex to be used.

Similarly, there is no indication from the earlier reports and discussions that, "The limitations of the reference point approach can be reduced by deploying a shifting reference point (updated at regular intervals using empirical data (e.g. every 5 or 10 years)), which is designed to capture increase regional carbon stocks."

We recommend that the SAB to remove that text (at page 7, line 2 – 7), and revise the passage to read as follows:

> In the 2012 SAB report, we noted temporal problems with the reference point baseline approach. The EPA has acknowledged this in its 2014 Framework and included a future anticipated baseline analysis alternative along with a reference point approach. ~~The limitations of a reference point approach can be reduced by deploying a shifting reference point (updated at regular intervals using empirical data (e.g. every 5 or 10 years)), which is designed to capture increased regional carbon stocks.~~ **Whatever baseline is used, it must be coupled with a modeling structure that evaluates only the incremental effects of the bioenergy use and does not credit or penalize bioenergy users for changes that would otherwise occur.**
>
> The SAB's 2012 ~~advice on~~ **Report recommended** the anticipated baseline approach **and** explored the use of complex modeling in order to try to capture interactions among the market, land use, investment decisions, and emissions and ecosystem feedbacks, and to construct a counter-factual scenario that does not include increased bioenergy use. In the case of long rotation feedstocks, bioenergy demand can affect carbon stocks in many ways including the ages at which trees are harvested, the diversion of forest biomass from traditional forest product markets to bioenergy, and the rates of afforestation and deforestation. The complexity of such a modeling approach makes it difficult to parameterize and validate. The lack of empirical data regarding many of these relationships and the resulting uncertainties pose a significant challenge to **the** use of this type of model in a regulatory context. ~~Estimating the net effect of these changes on carbon stocks requires a model that integrates market demand and supply conditions with biophysical conditions that determine growth of forest biomass, losses via decomposition, carbon sequestration and fluxes due to harvests and land use change and incorporates the spatial variability in these effects across the U.S. Employing models of this complexity is likely beyond the capabilities of many practitioners.~~

We likewise urge SAB to revise the text in the Executive Summary at page 2, lines 8 – 14, as follows:

> In 2012, the SAB recommended a future anticipated baseline approach to capture the additional CO2 emissions to, or uptake from, the atmosphere created by any increased use of biomass for energy. The EPA acknowledged this limitation of its earlier approach and included a future anticipated baseline analysis along with a reference point approach in its 2014 Framework. ~~The reference point approach, if adjusted at regular intervals (e.g., every 5 to 10 years) to account~~

McKechnie, J., Colombo, S., Chen, J., Mabee, W. & MacLean, H. L. Forest bioenergy or forest carbon? Assessing trade-offs in greenhouse gas mitigation with wood-based fuels. Environ. Sci. Technol. 45, 789–795 (2011).
Holtsmark, B. The outcome is in the assumptions: analyzing the effects on atmospheric CO2 levels of increased use of bioenergy from forest biomass. GCB Bioenergy 5, 467–473 (2013).

~~for any additional regional sequestration, would address the SAB's earlier concerns, allowing for the more direct establishment of a baseline while capturing additional increases in carbon stocks.~~ **Whatever baseline is used, it must be coupled with a modeling structure that evaluates only the incremental effects of the bioenergy use and does not credit or penalize bioenergy users for changes that would otherwise occur.**

2. The 2018 draft report's recommendation requiring use of a "landscape approach" is confusing and subject to multiple interpretations.

In Section 3.4, the 2018 draft report's recommendation *requires* a "landscape approach" to account for the impacts of biomass demand on carbon stocks, stating "[s]tationary facilities require a continuous supply of feedstock, thus a landscape approach is required for accounting for the impacts of feedstock demand on carbon stocks." (Page 9, lines 22-23). The draft report supports this recommendation in two passages, which use similar and sometime duplicative language:

> At pp. 8-9: Stationary facilities require a continuous supply of feedstock, thus a landscape approach for accounting of impacts on carbon stocks is more appropriate than a stand-level approach. A landscape approach expands the boundaries of analysis to include all effects and recognizes that there is uptake as well as loss of carbon associated with the production of feedstocks concurrently occurring across the landscape. It is the overall balance of losses and credits that determine carbon stock effects. Moreover, economic considerations will determine the size of the landscape providing feedstocks over time and the potential for land-use changes that can positively or negatively impact carbon stocks. As noted by Cintas et al. (2016), "assessment at the landscape scale integrates the effects of all changes in the forest management and harvesting regime that take place in response to – experienced or anticipated – bioenergy demand. Taken together, these changes may have a positive, negative or neutral influence on the development of forest carbon balances."
>
> At p. 11: Since stationary facilities require a continuous supply of feedstock, multiple stands will be disturbed in a regulated manner (i.e., completely asynchronously), and the order in which losses and gains occur becomes meaningless at the landscape level because both simultaneously occur; thus, the operative issue is the overall balance between losses and gains of carbon at the landscape scale. Thus, stand level accounting is not relevant to the calculation of BAFs. If harvest does not exceed the rate of carbon accumulation, the landscape-level carbon stocks are stable or increasing. However, there could be a net loss of carbon to the atmosphere at the landscape level, compared with the reference scenario, if trees are harvested at younger ages or if trees that would otherwise have been unharvested are harvested.

These paragraphs rely on undefined terms and do not distinguish among key measures of carbon stock changes.[14] As a result, the SAB's basis for its recommendation is ambiguous, difficult to understand, and open to multiple interpretations. We therefore recommend that both paragraphs be deleted.

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[14] For example, the paragraphs do not distinguish between *carbon stored* for an individual scenario and the *net change in stored carbon* based on the difference between two scenarios, two fundamentally different quantities. As a result, the paragraphs could be interpreted in vastly different ways – one of which would contradict the SAB's earlier finding that "merely knowing whether carbon sequestration at the landscape level has increased or decreased tells us nothing about the incremental effect that bioenergy production has on carbon emissions." (SAB, 2012)

3. The 2018 draft report relies on economic models in its recommended "landscape approach."

The SAB should not endorse economic models without a careful review of their validity. Many of the existing economic models share the same shortcomings as FASOM, and the 2018 draft report properly notes that, "[s]uch models have not been validated for this application, and heavy reliance on them is unwarranted." (SAB, 2018, page 2). Moreover, many of these models draw selective and/or arbitrary boundaries that do not properly count benefits and costs.

We do not object to modeling individual scenarios at a *landscape scale* (which we note is vastly different from the "landscape approach" proposed in the current draft report) using biophysical models that have been demonstrated for this application. Many biophysical models are suited for this purpose and have been documented in the peer reviewed literature.[15] These biophysical models rely on stand-level analysis that is aggregated in space to the landscape scale and integrated over time. One such study underscores the need for models "to consider the full range of landscape effects. The landscape includes a spatial component that requires aggregating across all stands that might be affected by bioenergy expansion. In addition, since a new bioenergy facility is likely to operate for many years, there is a temporal dimension that includes the effects of aggregating harvests over time."[16]

The SAB should not support, let alone *require*, an analytic approach based on concepts that are not defined, poorly understood, unvalidated, and subject to multiple interpretations, as is the case for the "landscape approach." We recommend therefore that the SAB delete these two paragraphs, as well as the accompanying recommendation at the end of Section 3.4 (on p. 9).

We appreciate the opportunity to comment on this important process and look forward to working with the SAB and the EPA to ensure that biogenic CO2 emissions from stationary source are properly accounted for.

Respectfully submitted,

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[15] Mitchell, S. R., Harmon, M. E. & O'Connell, K. E. B. Carbon debt and carbon sequestration parity in forest bioenergy production. GCB Bioenergy 4, 818–827 (2012).
Holtsmark, B. Harvesting in boreal forests and the biofuel carbon debt. Clim. Change 112, 415–428 (2012).
Hudiburg, T. W., Law, B. E., Wirth, C. & Luyssaert, S. Regional carbon dioxide implications of forest bioenergy production. Nat. Clim. Change 1, 419–423 (2011).
McKechnie, J., Colombo, S., Chen, J., Mabee, W. & MacLean, H. L. Forest bioenergy or forest carbon? Assessing trade-offs in greenhouse gas mitigation with wood-based fuels. Environ. Sci. Technol. 45, 789–795 (2011).
Holtsmark, B. The outcome is in the assumptions: analyzing the effects on atmospheric CO2 levels of increased use of bioenergy from forest biomass. GCB Bioenergy 5, 467–473 (2013).

[16] Thomas Walker, Peter Cardellichio , John S. Gunn , David S. Saah & John M. Hagan (2013): Carbon Accounting for Woody Biomass from Massachusetts (USA) Managed Forests: A Framework for Determining the Temporal Impacts of Wood Biomass Energy on Atmospheric Greenhouse Gas Levels, Journal of Sustainable Forestry, 32:1-2, 130-158