

**United States Environmental Protection Agency (U.S. EPA)
Chartered Science Advisory Board (SAB)
Meeting Minutes**

Date and Time: Thursday, March 31, 2016 1:00 p.m. – 5:00 p.m.
Friday, April 1, 2016 9:00 a.m. -1:00 p.m.

Location: Westin Crystal City
1800 Jefferson Davis Highway, Arlington, VA 22202

Purpose: To receive remarks from the EPA Administrator, conduct a quality review of the SAB report on the Biogenic Emissions Framework; receive briefings from the Office of Research and Development; and to discuss information provided by the EPA on planned actions and their supporting science.

Meeting Participants:

SAB Members

Dr. Peter Thorne, Chair	Dr. Robert Johnston	Dr. Kenneth Ramos
Dr. Joseph Arvai	Dr. Kimberly L. Jones	Dr. David Richardson
Dr. Kiros Berhane	Dr. Madhu Khanna	Dr. Tara Sabo-Atwood
Dr. Sylvie M. Brouder	Dr. Francine Laden	Dr. William Schlesinger
Dr. Ingrid Burke	Dr. Robert Mace	Dr. Daniel O. Stram
Dr. Anna Diez Roux	Dr. Sue Marty	Dr. Jay Turner
Dr. Michael Dourson	Dr. Denise Mauzerall	Dr. Jeanne VanBriesen
Dr. Joel Ducoste	Dr. Kristina Mena	Dr. John Vena
Dr. David A. Dzombak	Dr. Surabi Menon	Dr. Elke Weber
Dr. Elaine Faustman	Dr. James R. Mihelcic	Dr. Charles Werth
Dr. Susan Felter	Dr. Kari Nadeau	Dr. Peter J. Wilcoxon
Dr. H. Christopher Frey	Dr. James Opaluch	Dr. Robyn Wilson
Dr. Steven Hamburg	Dr. Thomas Parkerton	
Dr. Cynthia Harris	Dr. Kenneth Portier	

(For the Full SAB see Roster¹)

SAB Staff:

Mr. Thomas Carpenter, Designated Federal Officer (DFO) for the Chartered SAB and SAB Work Group on EPA Planned Actions for SAB Consideration of the Underlying Science
Mr. Christopher S. Zarba, SAB Staff Office Director
Dr. Holly Stallworth DFO, SAB Biogenic Carbon Emissions Panel

Other Attendees: Names of those who attended the meeting are listed in Attachment A. Names of those who requested the teleconference call-in number are provided in Attachment B.

Meeting Summary: **Convene the meeting**

Mr. Thomas Carpenter, Designated Federal Officer (DFO) for the chartered SAB, formally opened the meeting and noted that this federal advisory committee meeting was announced in the Federal Register.² The SAB is an independent, expert scientific federal advisory committee chartered under the authority of the Federal Advisory Committee Act (FACA). The SAB is empowered by law, the Environmental Research, Development, and Demonstration Authorization Act (ERDDAA), to provide advice to the EPA Administrator on scientific and technical issues that support the EPA's decisions. The DFO noted that the Federal Register notice announcing the meeting provided the public with an opportunity to provide written and oral comment.

The DFO stated that the SAB consists entirely of special government employees (SGEs) appointed by the EPA Administrator to their positions. As SGEs, chartered SAB members are subject to all applicable ethics laws and implementing regulations. EPA has determined that advisors participating in this meeting have no financial conflicts of interest nor the appearance of a loss of impartiality under ethics regulations specified in 5 CFR §2635 relating to the topics of this meeting.

Purpose of the teleconference and review of the agenda

The SAB Chair, Dr. Peter Thorne, stated that the purpose of the meeting was to receive remarks from the EPA Administrator, conduct a quality review of the SAB report on the Biogenic Emissions Framework; receive briefings from the Office of Research and Development; and to discuss information provided by the EPA on planned actions and their supporting science in the Fall 2015 Regulatory Agenda. Dr. Thorne reviewed the meeting agenda³ and noted that there were registered speakers for the review SAB report on the Biogenic Emissions Framework and no speakers registered to address the SAB Review of the Fall 2015 Regulatory Agenda.

Discussion of Planned Agency Actions in the Fall 2015 Regulatory Agenda and their Supporting Science

Dr. Thorne briefly reviewed the purpose of the SAB's regulatory agenda science screening activity, which is to determine, as authorized by the ERDDAA, whether to review the adequacy of the science supporting the Agency's planned regulatory actions in the Semi-annual Regulatory Agenda. He introduced Dr. James Mihelcic, Chair of the SAB Work Group on EPA Planned Actions for SAB Consideration of the Underlying Science, to review the recommendations from the Work Group and informed participants that the Work Group memorandum⁴ contained background on this activity.

Presentation of the Work Group Recommendations

Dr. Mihelcic reviewed the Board's statutory authority for screening the science associated with planned actions and the process used by the Work Group in evaluating available agency information to develop recommendations for the chartered SAB. He acknowledged the

contributions of Work Group members Drs. H. Christopher Frey, Denise Mauzerall, Madhu Khanna, Surabi Menon, Charles Werth and Mr. Richard Poirot. He discussed the major planned actions that were the focus of SAB attention, the Work Group's recommendations, and supporting rationales. The Work Group recommended that no further SAB consideration was merited for five actions:

- Municipal Separate Storm Sewer System General Permit Remand Rule
- Revisions to the Prevention of Significant Deterioration and Title V Greenhouse Gas (GHG) Permitting Regulations and Establishment of a GHG Significant Emissions Rate
- Renewables Enhancement and Growth Support Rule
- Proposed Renewable Fuel Volume Standards for 2017 and Biomass Based Diesel Volume (BBD) for 2018
- Considering Cost in Appropriate and Necessary Finding for the Mercury and Air Toxics Standards (MATS)

Dr. Mihelcic presented an overview of the Work Group's recommendations and noted that agency staff would be available on Friday to answer any additional questions from the members and noted the discussion would be concluded after that opportunity^a. He informed the Board that the Work Group had initial fact finding regarding the Renewables Enhancement and Growth Support Rule. During the fact finding the EPA staff noted that carbon capture is currently used to provide CO₂ as a commodity and carbon storage using geologic sequestration is regulated under the Safe Drinking Water Act's Underground Injection Control (UIC) program. The Work Group noted that a facility's carbon emissions for the production of renewable fuel sources were most likely produced at a smaller scale than emissions for coal-fired electric generating units discussed in the proposed rule (2060AQ91). The Work Group further found that the agency uses the same approach in both rules to use underground injection and geologic carbon sequestration to reduce CO₂ emissions.

The Work Group agrees with the Board's previous concern that a regulatory framework for commercial-scale carbon sequestration needs to ensure the protection of human health and the environment. Therefore, the Work Group recommended SAB should request a briefing on how the agency is responding to the National Research Council (NRC) Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration (October 2015) and considering carbon capture and sequestration research.

Ms. Sharyn Lie, Director of the Climate Economics and Modeling Center, EPA Office of Air responded to questions from members regarding the regulatory framework of deep well injection for CO₂ storage. She explained the reliance on the UIC program, that the agency is considering allowing a credit for capturing carbon via injection. She noted that carbon capture technologies are currently being used by ethanol facilities for other purposes (e.g., selling to the beverage industry) and the same methodologies used in the life cycle analyses developed for the 2010 and 2012 rule makings will be used to support the current action. Ms. Lie clarified that the agency is not evaluating advanced carbon capture and sequestration (CCS) technologies for the rule, but

^a The summary of the SAB Discussions of EPA Planned Agency Actions and their Supporting Science in the Fall 2015 Regulatory Agenda is presented *in toto* rather than chronological order to provide continuity in the summary. A short discussion was completed the SAB deliberations on April 1, 2017 as noted in the agenda.

that the RFS considers biofuels or technologies as advanced when they meet the 50% greenhouse gas emission reduction as defined in the RFS.

Mr. Mark DeFigueiredo, (EPA Office of Air) and Mr. Bruce Kobeleski from the EPA Office of Ground Water and Drinking Water provided an overview of the carbon capture and storage being considered by the agency. Mr. DeFigueiredo noted that the regulatory structure for CO₂ capture and storage is under the UIC program since 2010 when the agency promulgated the UIC permitting process for Class 6 wells that may be used for geologic sequestration of CO₂. He also noted the agency is working with the Department of Energy and other federal interagency Work Groups on larger scale projects, responding to National Research Council recommendations that cover many technologies in addition to injection and geologic sequestration.

Responding to a member's question regarding health risk associated with injection and onsite storage of CO₂, he noted that under the UIC there is required monitoring, specific requirements for owners and operators of Class 6 wells as well as new source performance standard requirements for greenhouse gases and onsite storage. They commented that the Office of Research and Development is collaborating on research through the Science To Achieve Results (STAR) grant program on health implications, mobilization of constituents and protection of underground sources of drinking water. EPA Staff offered to provide future briefings to the SAB with updates how the agency is considering recent carbon capture and sequestration research, NRC publications, coordination with Department of Energy programs and the Agency's cross programmatic efforts to reduce greenhouse gas emissions.

Dr. Thorne thanked the Work Group for its analysis and its thoughtful report of recommendations. He suggested the disposition of the Board's Review of Planned Actions in the Spring 2015 Regulatory Agenda be for the Board to develop a letter to the Administrator conveying the deliberations noting:

- the regulatory framework for commercial-scale carbon sequestration needs to ensure the protection of human health and the environment;
- the agency should monitor technological progress on carbon capture and noted that research on carbon sequestration merits review by the NRC or the SAB; and
- the Board welcomes future briefings on these issues.

Dr. Thorne asked for concurrence on the disposition of the activity which was accepted unanimously with no abstentions. Drs. Thorne and Mihelcic agreed to draft the letter to the Administrator.

EPA's Scientific Integrity Policy

Dr. Francesca Grifo, Scientific Integrity Officer in the EPA Office of the Science Advisor presented a summary of the EPA Scientific Integrity Policy and how the agency ensures scientific integrity in its research and products.⁵ She discussed the agency use of ISO 17025 implementation program, the agency's principles and framework, and mandatory training to maintain transparent scientific processes and open communication of science. She also explained the annual requirements in the policy. She focused on strengths of the policy particularly with respect to federal advisory committees.

One member asked if Dr. Grifo could address how the Scientific Integrity Policy applied to SGEs. Dr. Grifo noted that the Scientific Integrity Policy did apply to SGEs in their role as advisors to the Administrator and participating in the federal advisory committee process.

Other members asked how the policy is applied to discern between scientific integrity and miscommunicating information to the public. The Office of the Science Advisor would only look into this situation if it were brought to the offices attention. The Science Integrity staff and Inspector General Office staff works closely on these type of matters (i.e. plagiarism). The Science Integrity office provides the advice on the questions scientific issues of data, interpretation, and analyses. The Inspector General's office has jurisdiction over the misconduct aspects. The Science Integrity staff does follow up on recommendations and how the agency is implementing the corrective actions to ensure the Scientific Integrity policies are being met. She noted that the line between integrity and misconduct is a gray area and her office works closely with the Inspector General's Office.

A member asked how the policy applies to contractor-led peer reviews, how are peer review contractors trained and does the agency follow up and evaluate contractor-led peer reviews? Dr. Grifo noted the Agency has the Peer Review Handbook^b and developed a process for peer review by contractors. The protocol to conduct Conflict of Interest Review process for Contractor-led Peer Reviews of EPA Highly Influential Scientific Assessments and Influential Scientific Information Documents^c explains the operational requirements. Both are available on the Agency Web pages. The Science Integrity staff work closely with program offices to apply conflict of interest protocols and may assist in the conflict of interest evaluations.

Quality review of the draft report, *Draft (2-8-2016) SAB Review of Framework for Assessing Biogenic CO₂ Emissions from Stationary Sources (2014)*⁶

Dr. Thorne noted the quality review of the *Draft (2-8-2016) SAB Review of Framework for Assessing Biogenic CO₂ Emissions from Stationary Sources (2014)* would begin with oral statements from the registered speakers and an opportunity for SAB members to ask clarifying questions. That would be followed by Dr. Madhu Khanna, Chair of the SAB Biogenic Carbon Emissions Panel providing an overview of the report followed by the lead reviewer comments and then comments from other board members.

^b <https://www.epa.gov/osa/peer-review-handbook-4th-edition-2015>

^c https://www.epa.gov/sites/production/files/2015-01/documents/epa-process-for-contractor_0.pdf

Dr. Thorne reminded members that the purpose of the quality review is to determine if the report is ready to transmit to the Administrator as an SAB report and under what conditions. In reaching that determination he asked them to focus on the SAB's four quality review questions:

- Were the charge questions adequately addressed?
- Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?
- Is the draft report clear and logical?
- Are the conclusions drawn or recommendations provided supported by the body of the draft report?

He then introduced the registered speakers.

Registered Speakers

The first speaker was Dr. Caroline Gaudreault, National Council for Air and Stream Improvement, Inc. (NCASI)⁷ provided a summary of her written comments. Her comments focused on four areas temporal scales, stock-based accounting; modeling approaches; and baselines.

She agreed with the panel's assessment of future impacts on forest carbon noting that cumulative emissions over roughly a 100-year period that lead to a climate response and different scenarios of emissions pathways over the next several decades that have equivalent cumulative emissions over the next 100 years are likely to lead to remarkably little difference in global temperature response. She also agreed with the stock-based accounting approach has a number of advantages compared to the flow-based approach contained in EPA's draft framework report. Regarding modeling approaches NCASI suspects there are situations where this uncertainty will lead EPA to conclude that, although the development of regulations can be informed by model based projections, the implementation framework for regulations should focus on what is actually happening instead of what models suggest may happen. This observation is especially relevant to the selection of baseline approaches. Regarding baselines, NCASI's analysis has documented why EPA should not be precluded from using reference point baselines in situations where, for both technical and non-technical reasons, reference point baselines are best suited to meeting EPA's specific policy objectives.

Mr. Sami Yassa, Senior Scientist, Natural Resources Defense Council (NRDC)⁸ provided a copy of his statement and noted the NRDC has concerns regarding two premises of the report: 1) that damage from CO₂ is a function only of cumulative emissions over long time frames; and 2) the premise that the timescale for assessing the biogenic accounting factor (BAF) must be chosen to capture all positive and negative terrestrial effects – only. The panel's report presents a singular focus on long-term emissions horizons by arguing that the global temperature response is a function only of cumulative emissions at roughly 100 years, and therefore is not influenced by short-term emissions. These considerations ignore another body of scientific literature showing that short-term CO₂ emissions (measured in decades) can cause irreversible damage within the first 100 years, and showing that short-term emissions can pose warming risks as well. In sum, the report's timeframe recommendation is based on a limited reading of the underlying climate science. The concerns over short-term emissions are well established in the scientific community – as evidenced by comments from external scientists to this Board – but they are not reflected in a balanced way in the current report, notwithstanding the Panel's response to earlier comments.

The second issue is the timescale for assessing the BAF must be chosen to capture all positive and negative terrestrial effects. While NRDC agrees that the “emissions horizon” is the time period that “captures all terrestrial effects on carbon stocks,” they do not agree that it is singularly the only time at which a BAF value can be assessed; indeed its value can and should be assessed as a measure of the degree of terrestrial effects at any chosen time. Therefore, an alternate formulation to the panel’s current timeframe recommendation might read: Insofar as different climate policies have different time requirements for reductions, the degree of the terrestrial effects on carbon stocks at a particular time is measured by the BAF at that time. NRDC believes the report’s timeframe discussion and recommendation should be revised in two respects. First, reflect the findings in the peer-reviewed literature relating to threats from short-term emissions, and second, abandon the reliance on one single timeframe for assessing climate impacts and instead acknowledge and reflect the time-dependence of the BAF.

Mr. Jonathan Lewis, Senior Counsel, Clean Air Task Force (CATF) spoke next.⁹ He summarized the written comments submitted by the CATF and emphasized they are concerned that the “emissions horizon” approach presented in the draft report considers net CO₂ emissions over such a long time period it is incapable of distinguishing biomass-based power systems that may help mitigate climate change from those that would exacerbate the problem. He provided an overview of the timeframe recommendations in the report. He concluded respectfully urging the SAB to address some of the problems with the draft report discussion of temporal scale by clarifying that the timeframe over which EPA should determine BAFs depends on the policy in which the BAF is being utilized and ensuring that the final report reflects the legitimate findings in the peer-reviewed literature concerning threats from short-term emissions.

Dr. Timothy D. Searchinger, Research Scholar, Woodrow Wilson School of Public and International Affairs, Princeton University, summarized his written public comments.¹⁰ He noted that burning biomass for energy emits carbon into the environment just like burning fossil fuels, and typically emits more carbon than burning fossil fuels because of various lower efficiencies. He expressed concern that the report does not adequately address the immediate release of stored carbon, the different rates of sequestration in regrowth of stocks, inefficiencies in biomass use of energy (i.e., carbon release from decomposition). He also expressed concern regarding the valuing of emissions and mitigation over a specific time frame, discussed the report’s endorsement of economic models and proposed alternatives for the Board’s consideration. He noted the early and later changes in CO₂ emissions, literature discussion the social cost of carbon should be included in the report and expressed concern about the validation of models.

Dr. William Moomaw, Emeritus Professor, Tufts University¹¹ stated that the framework does not conform to what is actually happening in the use of bioenergy in stationary sources. He noted that it does not conform with national policies such as the Clean Power Plan or the Paris agreements which set specific dates (i.e., 2030 and 2050) for reductions in CO₂ emissions. He cited the use of pulse models in the analysis and notes the cutting and burning of biomass is continuous. Also the report treats combustion and regrowth as equally certain while not accounting for uncertainties in the regrowth cycle. Lastly, he noted the report does not provide the spatial and production scales requested in the charge.

Clarifying questions from SAB Members

One member noted biomass is inefficient compared to other fossil fuels and referred to Dr. Searchinger's written comments that "one of the modeling analyses in the draft EPA framework sent to the SAB found that every ton of carbon removed from a southeastern forest for bioenergy resulted in an increase in forest carbon of 1.4 tons. If this analysis were true, not only would forest biomass be better than carbon-free, but paper and cardboard recycling programs in the United States that depress forest product demand would be harmful to the climate. The SAB member asked if there are data that support this analysis? Dr. Searchinger responded that it is important to distinguish between the total carbon and the rate of regrowth. The models predicted instantaneous demand for biomass for energy resulted in additional total carbon in that forest.

One member addressed forest growth with an example to show why the time frame is paramount. If an area of forest of 1,000 tons was harvested that releases 1,000 tons of carbon that was capturing 10 tons per year carbon. If this was replaced by a forest re-growth that captured 40 tons of carbon per year the system would be in balance at year 25. That is a reasonable scenario if the policy time frame is also 25 years. If the policy time frame to arrive and net zero emission is 15 years the scenarios do not work.

Dr. Khanna responded to Dr. Searchinger and Moomaw's comment that the panel did not use the social cost of carbon in the approach. She noted that the social cost of carbon is used to develop a monetary value for the damages due to climate change. The charge asked the SAB to come up with a quantity of carbon not a monetization damage. She noted the report's reliance on models to estimate the baseline. The report is cautious on the use of models and includes caveats on validation and sensitivity analysis. She noted that relying on models is very important. Dr. Searchinger agreed that models are needed but the question is which models are reliable enough to use and how should uncertainties be applied? He noted that the types of models used in the report have 100's of unknown parameters and he is not aware of validation of these models. Regarding the social cost of carbon, the model used to develop the monetization estimate is well documented by a vast literature that includes timing changes and how those timing changes are developed and validated. He found that the social cost of carbon literature would be valuable to the accounting framework.

Another member responded that the spatial scale matters a great deal. One cannot think about the accounting factor in terms of a single stand. The framework needs to account for many stands over a wide spatial scale. He continued to note that Mr. Lewis' comments introduced a policy framework. When asked to comment if cumulative emissions would address his concerns, Mr. Lewis noted that there are a complex set of conditions necessary for the 100-year time to work.

On member compared work in atmospheric research modeling using the past for validation and then predict future estimate. Dr. Searchinger expressed concern that this type of validation was not conducted. He posited, is there a place for integrating modeling tools and what type of validation is needed?

Dr. Searchinger noted the question is: "what carbon should be discounted?" There are economic models that are reliable enough to determine of discounting should be applied. He has not seen a

validation in the past to future scenarios as described. His concern with the model approach is the constraining parameters of the model applied to prohibit extreme results. He is concerned that the constraints are not empirically supported. The simplest method is to count the carbon in the smokestack as one ton of carbon, if a bioenergy user can demonstrate they have managed resources to increase carbon uptake by one ton an offset should counted.

Presentation from the Panel Chair

Dr. Thorne thanked the public commenters and introduced Dr. Madhu Khanna, Chair of the SAB Biogenic Carbon Emission Panel and asked her to provide an overview of the draft report as an introduction to the quality review discussion.

Dr. Khanna thanked the members the panel, the SAB and the public commenters and noted the issues they presented had been raised to the Biogenic Carbon Emissions Panel during their review discussions.

She noted that the SAB provided recommendations to EPA several years ago and those recommendations led to this revised report. She noted the Biogenic Carbon Emissions Panel had met five times and held numerous teleconferences to develop the report. The public comments raised today were also raised during the Panel's deliberations and discussed as the panel developed the report.

The charge to the SAB was to comment on a policy neutral framework to account for the physical amount of biogenic CO₂ emissions from stationary sources using biogenic feedstock. The panel did not use the social cost of carbon as a consideration. The panel evaluated physical CO₂ emissions related to the carbon cycle as well harvest processing combustion of biogenic feedstock and developed a general conceptual framework related to a temporal, spatial and production scale in a policy neutral framework.

In addition to responding to the charge questions the panel went beyond the charge finding it important to discuss:

- Absence of policy context made it difficult to provide specific advice to all charge questions. The panel found a policy context was needed for the BAF and other related policies (i.e., land use, renewable energy, sustainable forest management) are needed to estimate choice of feedstocks, replanting, and regrowth and application of the BAF.
- The recommendations from a previous SAB review of the biogenic CO₂ emissions framework^d advised the Agency to use a future anticipated baseline approach rather than a reference point baseline approach because it did not account for additionality. Creating the counterfactual scenario for the future anticipated approach also requires the use modeling. The Agency used the Forestry Agriculture Sector Optimization Model (FASOM) and the panel recommends validation and other caveats in the use of this model.
- The panel considered the time scales, defined the impact of biogenic harvests, and carbon debt to develop an alternative framework than the EPA proposed framework. This

^d SAB Review of EPA's Accounting Framework for Biogenic CO₂ Emissions from Stationary Sources (September 2011). (PDF, 81 pp., 815,452 bytes), EPA-SAB-12-011

approach uses a landscape view that will manage carbon debt in a different manner than managing stand forestry. FASOM allows management to reduce debt on a landscape. The panel also found that forest owners will make decisions in foresight rather than a myopic approach. The panel went outside the scope of the charge questions to evaluate the climate impact to address public comments. The climate impact chosen was cumulative that occurs over 100 years to account for all the debt and dividends. A policy horizon should not be used to develop a single BAF for use across time horizons. Implementation, revocation, or other changes may shift the time.

The panel developed a carbon stock approach rather than carbon flux approach to improve the clarity of the framework. After Dr. Khanna completed her remarks, Dr. Thorne asked the lead reviewers to briefly summarize their comments.¹²

Chartered SAB Discussion and Disposition of the Report

Presentation by Lead Reviewers

Dr. Steven Hamburg, the first lead reviewer, noted the SAB Panel on Biogenic Carbon Accounting has been asked to take on a challenging topic with a challenging charge. He found the report raises some critical issues and brings forward important recommendations for the EPA to consider. Dr. Hamburg expressed concern that the draft report is dense and may be overly policy prescriptive. The report requires significant editing to pare it down and clarify the key concepts as well as address policy questions based judgments and treatment of time.

Revision of the draft report is feasible but will require significant effort. He summarized key comments on the major recommendations. His written comments address each of the major recommendations followed by specific comments on the report and provide specific suggestions and citations.

Recommendation 1) EPA should specify a policy context,

Dr. Hamburg agreed that the policy context is critical to the design of an implementable carbon accounting approach. He noted that defining the wider set of exogenous variables is inappropriate as they may or may not be related to the policy context to be considered. This conclusion and the underlying text needs to be modified to reflect that some of the ‘desirable’ information and constraints are likely to never be available. The report should consider the influence of these likely uncertainties on the ability to project a baseline and the strengths and weaknesses of doing it using a variety of approaches. The report falls short of providing the guidance required and critically examining the possible options.

Recommendation 2) Appropriate time scale for calculating a BAF

He found this recommendation to be very problematic and that it conflates two ideas - one supported by the science and one unsupported. This recommendation and the underlying text needs to be revised to remove policy prescriptive language and recommendations. As written, the treatment of time presumes that the SAB understands the policy outcomes that are desired and the temporal elements of such outcomes. There are many possible policy goals related to addressing climate change and the temporal aspects vary widely, yet the draft report suggests

that the net changes in carbon stocks should be addressed over 100 years for minimization of long-term maximum temperature change. Such a recommendation is well beyond the scope of the charge or what can be determined scientifically.

Recommendation 3) An alternative cumulative BAF

This recommendation is supported by the science and is an important insight. The key is ensuring that the cumulative metric is not temporally prescriptive, but rather reflects the net radiative forcing impacts for whatever period of time is selected in the policy context. This distinction is not currently clear in the body of the report and thus requires clarification. The selection of a timeframe is a policy decision that involves trade-offs for which there is no scientific basis that can be deployed.

Recommendation 4) A BAF formulation based on changes in carbon stocks

This recommendation provides a critically important insight that needs further development in the text. This is one of the most important findings of the report but the operational difficulties of using flux rates is not fully detailed nor the operational advantages of using stocks explained. The presence of a strong historical record of stock changes is critical to understanding the value of basing biogenic carbon accounting on stock changes, but the value of this observation is not developed.

Recommendation 5) EPA should identify and evaluate its criteria for choosing a model and modeling features

This recommendation states the obvious, simply stated ‘use models supported by good data and science’. The challenge is that in the text the discussion drifts far from this recommendation and assumes much about what the best models would be *a priori*. The report needs to critically examine if econometric or other models have and can provide accurate projections of carbon stock changes in the absence of bioenergy demand. The assumption that such models actually work is not born out by the very limited literature in this field (see Buchholz et al. 2014, Nature Climate Change 4:1045-1047). A neutral review of the accuracy of simple assumptions versus complex econometric models needs to be included for this recommendation to provide anything useful to the underlying challenges faced by EPA.

Dr. Robert Johnston, the second lead reviewer, noted that this was an ambitious review. Many of EPA’s charge questions addressed narrow technical issues. The relevance of issues such as these are conditional upon a consistent and sound underlying approach to comparing biogenic carbon emissions and deriving relevant BAFs across scenarios. This led the panel to recommend broader changes to EPA’s BAF calculations than were implied by the charge questions. These recommendations could lead to a more consistent treatment of net biogenic carbon emissions and related BAFs. He agreed with the panel that extending the report beyond the original, relatively narrow charge questions is justified.

The panel made two primary recommendations beyond the immediate charge questions posed by EPA. First, the panel recommended calculating BAFs based on changes in carbon stocks rather than changes in carbon fluxes. Second, the panel recommended a new approach to BAFs, which they denote $BAF_{\Sigma t}$, which is intended to explicitly account for the residence time of carbon in the atmosphere. Intuitively, this may be thought of as a relative difference in carbon tons/year.

This is distinct from the EPA’s original approach, which models a BAF based on the ratio between net biogenic emissions (NBE) and potential gross emissions (PGE) at a single time t . Although modeling changes in net biogenic carbon emissions is fraught with empirical challenges, the stock-based approach proposed by the SAB appears to have a number of advantages compared to the flux-based approach in the original EPA framework. The motivation of proposed $BAF_{\Sigma t}$ metric is also sound, reflecting the fact that the residence time of carbon in the atmosphere is an important factor (among others) in its climate effects. The current BAFs proposed by the agency do not have a direct mechanism to account for residence time.

Dr. Johnston agreed with the panel’s recommendations:

- Not to use the social cost of carbon;
- Time frame without a policy context was almost a contractable task; and
- The use of bio-economic models. They have been used to estimate long term policy (e.g., fish stocks).

The panel’s comments—and the proposed BAF models—also support the use of model results to inform such influential factors as temporal scales and national/regional demand, rather than relying on potentially arbitrary judgments. This is an appropriate approach. EPA’s charge questions sometimes imply an intent to specify important components of the model exogenously (the quantity of demand for each feedstock in each region), when some these components may instead be simulated as an endogenous aspect of the model. The panel’s comments also highlight the challenges associated with the estimation of a “policy-independent” BAF, as many of the factors that influence BAFs over time are conditional on policy factors.

Finally, he strongly concurred with the panel’s recommendation that the models used by the EPA for their BAF estimates (FASOM) require additional validation, evaluation, justification and sensitivity analysis, including a formal means to characterize uncertainty. The validity and accuracy of BAF calculations depend on the underlying intertemporal optimization model, and forecasts of these complex models are subject to myriad assumptions and uncertainties. For example, FASOM presumes that landowners optimize based on current and expected economic returns—assumed behavior that may or may not match observed behavior. Without careful validation and periodic updating, the performance of such models is unknown.

The SAB panel’s report does a good job of describing a complex set of issues and challenges. However, the scope of the panel’s recommendations—in effect recommending that EPA (1) adjust their fundamental BAF approach to one based on stocks rather than fluxes, and (2) develop BAFs that explicitly account for residence time—also raises a few questions that should be addressed in some way.

First, the treatment and role of carbon stocks in water (within the panel’s proposed carbon stocks approach) would benefit from greater clarification. The panel’s report comments that (p. 18) “the effect on the atmosphere (what the atmosphere sees) from the sequence of biogenic emissions will be the difference in carbon stocks on the land and water,” but then explicitly comments that “Neither the EPA’s framework nor any modifications we offer take into account ... oceanic uptake of carbon.” Hence, stocks of carbon in water do not appear to enter the model. Are there any scenarios in which aquatic carbon stocks are endogenous in a significant way and/or could

have non-trivial implications for BAFs? Clearer discussion of the role of aquatic versus terrestrial carbon would improve the report, particularly because a focus on stocks leaves open the question of how much carbon stock is held in aquatic environments (and whether this influences BAF estimation in any significant way). This need not require lengthy text—merely some concise additions to highlight the role (or lack thereof) of aquatic carbon considerations for BAFs, and how these are treated in the panel’s proposed approach. This is particularly relevant if the storage of carbon in water has a potentially different impact on the calculation of a flux-based BAF than a stock-based BAF. It is possible that storage of carbon in water has little impact on BAF calculations using either approach. If this is the case, it would be useful if the report could state this.

The panel’s report also notes that “there still remain the issues of selecting appropriate temporal or spatial boundaries, considering variability within a class of feedstocks, accounting for non-CO₂ greenhouse gases such as nitrous oxide and methane, and quantifying stocks and fluxes that are difficult to measure or estimate.” The difficulty and relevance of these issues could differ between the EPA’s carbon flux approach and the panel’s stock-based approach. Given this, it would be useful if the report could provide some insight into whether these or other challenges would be increased or decreased by the panel’s proposed stock-based approach. For example, from an empirical perspective, is it easier to quantify stocks or fluxes? Does this difference affect model uncertainty in any significant way? Are challenges with spatial scale increased or decreased by a stock-based approach? Are challenges for non-CO₂ greenhouse gases different across the two approaches? If the challenges related to these issues are essentially unchanged across flux-based and stock-based approaches to BAFs, it would be useful if the report could state this explicitly. Again, this need not be a lengthy addition.

More generally, it would be instructive to include a general statement of the pros and cons of the two competing approaches (stock-based versus flux-based BAFs). The panel report implies (although never states explicitly) that there are few or no advantages of a flux-based approach to BAFs. Is this true? Greater clarity in this area would be helpful, particularly given that the panel is recommending that EPA change its fundamental approach. For example, it would be helpful to know whether there are any significant disadvantages of switching to a stock-based BAF that should be considered.

Dr. Surabi Menon was the third lead reviewer. She noted she agrees with Drs. Johnston and Hamburg that the charge questions were confining and the framework needs to be broadened to better address the time issue. The report needs to clarify short vs long-term issues and the need for a policy framework. The model choice discussion also needs to be enhanced.

The charge questions to the panel were related to a future anticipated baseline approach and temporal scale (how policy and other factors may impact the BAF for carbon emissions associated with combustion of biogenic feedstocks); scale of biogenic feedstock demand changes and the impact on biogenic CO₂ emissions, without links to any particular policy frameworks. These charge questions were addressed well by the panel.

The panel in particular provided a useful recommendation on accounting for biogenic carbon using mass conservation formulations that is carbon stock based (and not carbon emissions based

as considered by the EPA) and provided very specific details on the formulation as well as the use cases in the Appendices of the report. While Dr. Menon did not go into details of the formulation and application, she found the approach provides sufficient information to guide the development of an accounting framework.

On time scale, the report recommended the use of cumulative BAF rather than one at the end of the time horizon and one that can capture all effects and be the same across feedstocks and policies. They also provided useful recommendations on value of reducing cumulative emissions versus likelihood of tipping points in the future. Additionally, in the absence of specific policy applications that can be used to capture scale of the demand change for a future anticipated baseline approach, the recommendation of capturing demand changes at incremental levels of demand using BAF from a simulation model is a good suggestion.

Dr. Khanna addressed the issues identified by lead reviewers. She noted the report may be overly policy prescriptive – but this was not the intent of the panel. The recommendations were based on science where science could give us an answer. The panel found it inappropriate to consider exogenous parameters for FASOM. This model needs to make assumptions on other policies. The panel used the current set of policies to estimate the framework where required for FASOM to function.

She noted the panel found that the time frame needs to account for all the positive and negative aspects. The 100-year time frame was supported by cumulative emissions from the literature. To respond to the concerns of SAB members regarding the 100-year time frame, she noted the report could be made more generic. The 100-year discussion could be removed and revised to address the positive and negative effects on the carbon cycle and stocks that should be considered in developing the BAF.

Dr. Khanna said the discussion regarding model validation can be strengthened. However, she noted the panel did not agree that the Buckholtz et al. paper provides a good prediction of forest growth vs actual forest growth. The report should be looking at the difference between the reference and the policy scenarios of greenhouse gas emission with and without bio-energy and biogenic emissions. She explained that the delta would not be effected as both the baseline and counterfactual estimates will move in the same direction – negating a difference in the delta between the estimates.

She explained the panel did not intend to place more emphasis on the near-term or longer-term emissions. The intent was to compare the difference between the two BAFs are presented for policy makers to decide and this may be able to clarified in the report. Looking at the radiative forcing and what the impacts on the climate and using the global warming potential was discussed and the panel decided not to use it as a metric. Regarding the use of a landscape approach the panel did not want to use the fuelshed approach. They anticipated it would be available in the future representative versions of the BAF for regions.

Dr. Thorne thanked Dr. Khanna for her response to the lead reviewers and opened the discussion to the SAB.

Dr. William Schlesinger agreed with the mass balance / fuel stock approach. This version of the report represents a major effort by the panel to tackle a difficult and multi-faceted issue, covering a large range of spatial and temporal scales. He finds that some forms of biomass, especially grasses and existing short-rotation plantation trees, can offer valuable contributions to reducing our nation's CO₂ emissions by providing "biofuels" to replace fossil fuels. Nevertheless, he was concerned that the draft report's recommendations concerning woody biomass are much too general and thus dangerous to the environment.

He noted the response regarding time frame and lack of EPA information on the policy context needs to be strengthened. He expressed concern that the report does not address effects in the next 20 years inferring that they will not make a difference, the report could have compared several time periods. The time-frame is of the essence and he expressed concern about forest harvesting, tree replacement and recovery periods required to store the carbon that was previously stored on the site. The report treats all biomass as equivalent and does not account for increases in CO₂ release from increased biomass use in the shorter time frames.

Dr. Schlesinger thought the report should also consider the type and quality of the forested landscape in the United States. If old-growth forests are replaced by short-rotation plantation forests, the value of habitat for wildlife conservation and preservation of biodiversity is much reduced, as reviewed by Root and Betts (2016, *Journal of Forestry* 114: 66-74). The recent paper by Nandts et al. (2016, *Science* 351: 597-600) finds that decades of forest management in Europe reduced forest area and carbon storage. While he recognized that models are tools appropriate for the analysis he questioned whether the complexity of the FASOM was needed.

Dr. Jeanne VanBriesen referred to her written comments and emphasized a couple of points. She agrees the comments provided by members so far (i.e., the policy context, 100-year time scale, and insufficient quantitative analysis) and noted the report has many comments that are not directly germane to the charge or responses. The lack of a specified policy context made the panel's task much more difficult. The report's discussion of timeframe and policy context needs to be strengthened. The response to charge question 1 is not convincing and does not sufficiently support the time frame recommendation. Many other sections of the report refer back to this section and a revision needs to provide more specific advice.

Dr. VanBriesen found that the report's discussion of the delta between the baseline and the counterfactual estimates does not provide sufficient support and that both estimates move in the same direction and negate considering if uncertainties in the model assumption. The response needs to convince the reader that the model predicts the baseline and that the reference works the same for both scenarios. The model needs to perform similarly so that a delta can be predicted. She also note that the recommendation to "update the model periodically but not too frequently" needs to be expanded upon. What factors should the agency consider so the model may be updated to be scientifically accurate? What data should be used to update the models and what are the challenges might this bring to the agency?

Dr. Ingrid Burke commented that there are large portions of the report that seem to range far outside of the charge questions (6 pages relative to 10 that focus on the charge questions). It seems that the charge questions were focused on specific technical details of the revised

Framework. For example, she found the section beginning on page 14, line 29, about the impacts of greenhouse gases on climate dynamics on earth, and how long it takes greenhouse gases to influence climate and sea level to be particularly inappropriate. She noted that there are a number of places where the text was difficult to read and understand, both because of logic flow and quality of writing. The Executive Summary needs rewriting. Paragraphs are poorly organized and sentences interminable, particularly in that section, but throughout the report.

At the end of that summary, there is a statement about how using a longer integral over time will be better, which Dr. Burke agrees with, but it does not decrease any uncertainties. Once one aggregates uncertainties across landscapes, associated with how direct and indirect land use will change, and whether and how carbon will accumulate in the recovering ecosystem, there remains plenty of uncertainty. Addressing how one might estimate that uncertainty would really strengthen the report.

Dr. Thomas Parkerton commented that he is also concerned about a 100-year timeframe and the limited discussion regarding other greenhouse gases in addition to CO₂.

Dr. Khanna thanked the members for their comments and provided responses.

- She thought there could be more description about the emission horizon.
- Regarding the issue about predicting delta correctly. She stated that there is no way to know delta in reality as the counterfactual case is never observed. There is a circularity to the discussion. Regarding how frequently the model and analysis should be updated she feels is better left to the judgement of modelers.
- The panel strongly recommended that any time horizon used to calculate the BAF should be based on the biophysical aspects of biomass production not a policy context. Base the BAF on the impact of the feedstock – a policy context becomes important to determine whether short- or long-term emissions matter. Some guidance on where to go beyond the charge would be helpful.
- The panel could choose a different timeframe. Should the emission horizon be defined by parameters, or should it be climate impact; this is a policy decision. Adding more to the report may be speculative.

Dr. Mauzerall noted there are so many issues that have been brought up it might be worth asking EPA to clarify the charge questions and convene a different panel.

Dr. Opaluch noted that the scientific basis framework is not a number but a framework that could be applied to any policy. He noted that a life cycle framework would allow a different approach than a numerical approach. Models provide a reasoned basis for decision making.

Dr. Hamburg asserted the panel should provide an option to use simpler empirical models rather than complex biophysical. The Buckholtz paper should be referenced. Dr. Elke Weber commented that there is evidence that nonlinear approaches are difficult to implement and simpler and more accurate models may be better suited.

Dr. Khanna commented that she and the panel find the only way forward is to use a model that predicts for the future. A simpler model will just not do. The Buckholtz paper treats forestry too

simply. The FASOM is national in scale and incorporates the complex factors that need to be considered. Models have limitations and as information becomes available they can be adapted.

Dr. Thorne noted that there was more discussion needed to resolve the quality review and asked Dr. Khanna to consider the member's comments and the Board would find time in the next day's agenda to reach a conclusion on the disposition of the report. The Designated Federal Officer adjourned the meeting for the day^e.

Dr. Khanna provided some observations on the SAB member's comments and some suggestions on how to revise the report. She noted there are some areas that will be difficult to address with the panel's input if they can be addressed.

- Regarding the public comments and SAB concerns on old growth forests, it is important to note that it is not just one source and agricultural biomass raises limited concerns in greenhouse gases. The Billion Ton Study by the Department of Energy and other studies find the dominant source of biomass feed stock will be agricultural residue. Forests products have higher value uses and are unlikely to be competitive for use in this market.
- Regarding the concerns from the comparisons of bioenergy use versus forest growth the report is addressing private forest, and she noted that public forests have other protections. The panel reported that for private lands being actively managed, biomass was not found to be a higher value use for these trees. Biodiversity and conservation benefits of old growth forests need to be addressed in other policies. The accounting framework is not designed to ensure forest conservation objectives. The framework has a much narrower focus.
- The previous report (SAB 2011) approved the timescales of emissions and the use of models. The SAB should discuss if they wish to reverse the previous recommendations.
- The greenhouse gas intensity of biomass versus coal if taken at a landscape approach sees saving from the use of biomass. Dr. Khanna said her research indicates as much as 50% savings even if forest biomass is used and more if agricultural sources are used.

Dr. Khanna noted these revisions could be made to the report.

- The emissions horizon discussion could be expanded to clarify the basis of the 100-year time frame. Graphics from the appendixes could be brought forward to better illustrate the BAFs and how they vary over time.
- Discussion could be added to the alternative BAF approach elaborating on the positive and negative aspects.
- Clarify that the report is assuming the biomass is from actively managed private forests.
- References to temporal impacts of emissions are outside the charge and can be omitted from the report.
- A more explicit discussion of how forest biomass effects GHG emissions can be brought forward to clarify and discuss carbon impacts from the appendixes.

^e The SAB recesses at this point and continued the discussion the morning of April 1, 2017. The summary is presented *in toto*.

Dr. Thorne thanked Dr. Khanna and called on SAB members

Dr. Schlesinger said that there are currently plans to use woody biomass for this purpose and noted there is a growing body of science that a 10-year timeframe is important and changes will occur within that timeframe. He finds the report needs to describe what the concerns would be at several time intervals possibly 30 and 100 years. If there are data on the comparisons between woody biomass and coal they should be referenced in the report.

Dr. Johnston noted the SAB members are discussing issues and making requests that are not in the charge. He found the panel did a pretty good job in responding to the charge questions. He suggested the focus could be altered on how to calculate a BAF and task the agency to focus on different timescales. The report could highlight the boundary conditions and state that many policy issues cannot be addressed with the narrow charge questions. The panel should consider adding a section on other important issues and discuss the available literature and then move on to the BAF.

Several members noted one of the reasons for the 100-year timeframe cited in the report is climate effects. Dr. Khanna responded that this is an ancillary point and can be removed from the report.

Dr. Hamburg noted there is literature available on the global warming potential (GWP) and the science does not require one to set a timescale, and thus the 100-year timeline discussion is not needed in the report. Regardless of the narrow charge questions the SAB needs to be broad enough to be clear on our advice.

Dr. VanBriesen reminded members about the purpose of the quality review. The SAB's goal is to determine if the report makes sense to experts in the field. For example, the report is not clear on the difference between agricultural and forest feedstocks. The report needs to be clear on all the assumptions made and must justify those assumptions.

Dr. Burke proposed a motion to send the report back to the panel with the addition of SAB vetters to revise the report. Dr. Thorne noted that there were still members that wished to comment and asked if the motion could be tabled.

Dr. Opaluch seconded the motion and notes that the panel chair will need specific guidance on the revisions to the report.

Dr. Ramos agrees with the approach, but notes that SAB needs to focus on how to revise the report and provide guidance to Dr. Johnston.

Dr. Thorne suggested the motion be amended to identify a subgroup of SAB members to work with Dr. Johnston on guidance of revisions. The guidance and report would be given to the panel for revision and returned to the SAB for a quality review. Dr. Burke and Dr. Opaluch agreed to the amendment.

Drs. Thorne, Johnston and Ramos discussed the need to keep the panel involved and for the SAB vetters to provide guidance on the revisions needed for the report. There was a request to restate the motion:

The report will be sent back to the Biogenic Carbon Emission Panel for revision. A subgroup of SAB members will develop guidance for the revisions and be available to the panel as revisions are made. The report will then be resubmitted to the SAB for a quality review.

The vote was called. Dr. Khanna abstained and the motion passed unanimously.

Attachment C, Summary of Chartered SAB Requested Revisions to the Draft (2-8-16) SAB Review of Framework for Assessing Biogenic CO₂ Emissions from Stationary Sources (2014), to these minutes is the SAB guidance provided to the panel.

Remarks from the Administrator and discussion with SAB Members and Liaisons

Administrator Gina McCarthy began her remarks by thanking SAB members for their service. She emphasized the importance of science to EPA's mission, both to understand the risks to be addressed and to develop solutions. She said that science drives agency decisions and that EPA requires both science and the law to do its work. She welcomed the SAB to "help think through" the science questions relating to EPA's actions regarding sustainability, environmental justice and climate change. She acknowledged the contributions of the Science Advisor to the Administrator, Dr. Thomas Burke, and the significance of the appointment of the EPA's new Science Integrity Officer, Dr. Francesca Grifo. She also noted that EPA must begin to address future environmental challenges. It would be helpful to seek SAB advice in identifying those challenges.

She commented that public health is the agency's key mission and the importance of environmental exposures to health is raising awareness at medical schools to teach more about environmental exposures. The agency is addressing exposure to the elderly, children, the underserved and other vulnerable populations. Environmental exposures need to look at the mix of exposures that occur. At the same time the agency needs to be transparent in how they conduct evaluations.

Part of that transparency will be how EPA deals with all the different data and information. Smart phones and crowd sourcing are providing many sources of data. Emerging types of pollution monitoring technologies are going to raise questions the Environmental Protection Agency must be prepared to address. That's going to be a huge challenge as smart phones begin to be air monitors. New technologies and new ways of gathering data can reliably detect pollutants at lower and lower levels, she said. "We are going to be inundated with data, and people are going to be inundated with data." People are going to demand to know what their exposures mean, "and we have to be ready for them." She used the Flint, Michigan water crisis as an example of a system designed 70 years ago that they are dealing with. It was not designed to address the emerging contaminants we are seeing today. She challenged the members to identify the "next horse we need to ride into the future." The Administrator concluded noting the agency needs science as its compass.

After the Administrator concluded her remarks, she engaged chartered SAB members in discussion. The SAB Chair, Dr. Peter Thorne, noted that the SAB has provided advice or is developing advice on the topics of environmental justice, sustainability, air, climate and energy.

He asked whether she saw other areas where the SAB should examine the impacts of climate change. The Administrator responded that the major substantive topic of discussion at the most recent EPA Senior Executive Service meeting was adaptation to climate change, which affects the entire agency. A major challenge for the EPA is to articulate climate change as a public health issue that impacts the most vulnerable populations, including children, the elderly and environmental justice communities. She welcomed an opportunity to talk with the SAB about how to prioritize adaptation activities so that the most vital needs are addressed in the most expeditious way.

Dr. Hamburg noted the Administrator's mention of data and cited air monitoring as a good opportunity for the EPA build collaborations and coalitions. It would be a new role for the agency and critical to test and decide what data to release and be able to define the context of the data. Administrator McCarthy agreed and further noted EPA needs to be able to prioritize and be able to keep small threats from taking up a majority of the resources.

Dr. Frey, briefly summarized the importance of exposure and was glad to hear that focus. He noted that engineering controls don't necessarily address exposure. Perhaps citizen science and low-cost sensors could help the agency move forward. He posited that guidance and education on exposure management could help. He also noted that community based science needs more focus, for example new science is needed on ultra-fine particulate matter to understand the health effects. Ms. McCarthy noted the agency needs to go beyond setting standards. There are still pockets and areas that are out of compliance and there are issues beyond EPA authorities. EPA could look for opportunities to collaborate.

Dr. Thorne note that EPA does not get credit for improvements and asked - How can the SAB help to identify areas where credit can be attributed to the agency? Ms. McCarthy identified climate as an example where the public doesn't see a personal impact. The agency and the SAB need to continue to do the credible work. She looks to the SAB for developing and delivering science that is actionable. Where are the points where EPA can make a difference? How can we balance between action and long-term plans? Can 80% percent of the Agency's focus be on prevention? These are the questions we need to ask. Lead is an example – how can we still be dealing with lead?

Dr. Arvai asked whether the Administrator had an interest in using decision science to help the agency make science-based decisions. He noted that decision science research shows that simply making science available does not necessarily improve decision making. The Administrator responded that she had a strong interest in talking with him about how decision science could be helpful. She noted that “economists don't have the answers” to all of decision makers' questions and that people don't always act in rational, science-based ways. Motivating individuals and organizations to change can be complex. The EPA's leadership has a strong interest in how to influence people's behavior by providing the right information to them.

Dr. Harris asked how the agency can best communicate the scientific information and data to communities and asked specifically about the Flint response. The Administrator noted that you have to be in the community. EPA went door-to-door and was the biggest presence of any organization in the area. The agency is also working with the faith-based groups as a bridge to

the community that may not be working with or even trust the EPA. The EPA is also looking at ways to leverage other resources to address concerns in underserved communities and coordinate across agencies.

The final question came from Dr. Dourson regarding the IRIS program and the lessening of resources available to IRIS. He asked how IRIS might become more of a collaborative effort and is EPA open to working with groups or possibly co-op agreements? The Administrator said she was open to a discussion on ways to expedite the IRIS process but noted that there are lines the agency cannot cross to maintain the credibility of the program. She agrees that there needs to be lots of views at the table and this helps to get the best decisions. She notes that she demands lots of outreach on rules to make sure that the agency heard different views and from various experts.

Dr. Thorne concluded the discussion by thanking the Administrator for taking time to meet with the Board.

Update on Activities of the Office of the Science Advisor

Dr. Thomas Burke, Science Advisor to the EPA Administrator, provided the SAB with a briefing entitled “Research Results and Science-Based Decision Making at the EPA.”¹³ He provided background on the functions of the Office of Research and Development, the agency’s research priorities and challenges. Science and Technology Policy Council (STPC), and STPC activities relating to risk assessment, peer review, and other science activities (i.e., the Laboratory Enterprise Study, response to NRC Risk Assessment Reports, and Increasing Public Access to Data and Publications). He spoke of his role providing input on broad science and technology issues (including hydraulic fracturing research), overseeing the agency’s scientific integrity program, and human subjects research.

Dr. Burke listed the types of questions agency scientists are challenged to answer and for which they will need the SAB’s help:

- Is it safe to play on artificial turf?
- What are the impacts of climate change on public health?
- Does—you name it—cause cancer?
- Does hydraulic fracturing impact drinking water resources?
- How much certainty do you need to make science-based policy decisions?

After Dr. Burke concluded his remarks, SAB members asked several questions. Dr. Thorne asked if EPA has the talent to do more with the social and decision making sciences. Dr. Burke noted the importance bringing the social sciences to bear at EPA – we are not quite there but are committed. The Agency needs to make the case for social science. For example, EPA may not be asking the right questions and therefore may not get the public trust to use the data EPA develops.

Dr. Weber continued the line of discussion noting that the agency needs to more systematically translate lab results into information that communities can and will use. Dr. Burke agreed saying that he is looking for a way to present the continuum and show where the social behavioral and decision-making sciences fit into the process. Something similar to how the National Academy of Sciences Red Book demonstrated the continuum and risk assessment

Dr. Johnston asked how the SAB can help the agency to “ask the right questions”? For example, the charge questions on the biogenic carbon emissions report were too narrow and do not include the broader scientific concerns. Dr. Burke agreed that the initial discussions about charge questions are very important. The SAB should ask itself what should the report address? The SAB needs to be comfortable with the questions and feel free to augment those questions if needed.

Dr. Thorne thanked Dr. Burke and the SAB members for their thoughts and an interesting discussion. He noted we had reached the end of the agenda and reviewed actions items from the meeting and upcoming projects:

- He and Dr. Mihelcic would develop a letter to the Administrator conveying the Board’s discussion on the Fall 2015 Regulatory Agenda;
- He and the lead reviewers would develop guidance on the revision of the Draft (2-8-2016) SAB Review of Framework for Assessing Biogenic CO2 Emissions from Stationary Sources (2014) to be sent to the Biogenic Carbon Emission Panel;
- The Board will be meeting to conduct a quality review of the SAB Review of the EPA’s draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources; and
- The SAB will convene a Work Group to review conclusions in Efficacy of Ballast Water Treatment Systems: a Report by the Science Advisory Board.

Dr. Thorne then turned to the DFO to adjourn the meeting. The DFO adjourned the meeting at 12:55 p.m.

Respectfully Submitted

Certified as Accurate

/s/

/s/

Mr. Thomas Carpenter
SAB DFO

Dr. Peter S. Thorne
SAB Chair

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by committee members during the course of deliberations within the meeting. Such ideas, suggestions, and deliberations do not necessarily reflect definitive consensus advice from the panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters, or reports prepared and transmitted to the EPA Administrator following the public meetings.

Materials Cited

The following meeting materials are available on the SAB website, <http://www.epa.gov/sab>, at the page for the March 31-April 1, 2016 Chartered SAB Meeting: <https://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/1a5a2fd1c8fce7c585257f390054fd5c!OpenDocument&Date=2016-03-31>

- 1 Roster
- 2 Federal Register Notice Announcing the Meeting
- 3 Agenda
- 4 Recommendations regarding major planned EPA actions in the Fall 2015 Regulatory Agenda.
- 5 Scientific Integrity at EPA presentation. March 31, 2016. Dr. Francesca T. Grifo, Scientific Integrity Official
- 6 Draft (2-8-2016) SAB Review of Framework for Assessing Biogenic CO2 Emissions from Stationary Sources (2014)
- 7 Comments on the Accounting Framework for Assessing Biogenic CO2 Emissions Review. National Council for Air and Stream Improvement, Inc. submitted by Reid Miner and Dr. Caroline Gaudreault
- 8 Oral statement of Sami Yassa, Senior Scientist, Natural Resources Defense Council
- 9 Comments on the Accounting Framework for Assessing Biogenic CO2 Emissions Review. Clean Air Task Force submitted by Jonathan Lewis.
- 10 Comments on the Accounting Framework for Assessing Biogenic CO2 Emissions Review submitted by Drs. Searchinger, Moomaw, Scott, and Souza-Rodrigues
- 11 Oral testimony from Dr. William R. Moomaw
- 12 Quality Review Comments on the Draft (2/8/2016) SAB Review of Framework for Assessing Biogenic CO2 Emissions from Stationary Sources (2014). As of March 28, 2016.
- 13 Research Results and Science-Based Decision Making at the EPA, Thomas Burke, PhD, MPH, Deputy Assistant Administrator, U.S. EPA's Office of Research and Development

Attachment A: Members of the Public Attending the Meeting

March 31, 2016

Stephanie Sanzone, US Environmental Protection Agency (USEPA)
Brittany Patterson, E&E Publishing
Pat Rizzuto, Bloomberg BNA
Kate Shenk, Biotechnology Industry Organization (BIO)
Max Broad, National Wildlife Federation
Sharyn Lie, USEPA
Sundara Bhandaram, American Forest & Paper Association
Paul Noe, American Forest & Paper Association
Sara Ohrel, USEPA
Jefferson Cole, USEPA
Max Williamson, Williamson Law Practice (WLP)
Stan Lancey, AF&PA
John Steller, USEPA
Dan Chartier, Corn Refiners Association
Jonathan Lewis, Clean Air Task Force (CATF)

April 1, 2016

Bruce Kobelski, USEPA
Stephanie Sanzone, USEPA
Nina Heikkinen, E&E Publishing
Iris Goodman, USEPA
Brittany Patterson, E&E Publishing
Nancy Beck, American Chemistry Council (ACC)
Becky Fried, USEPA
Maria Hegstad, Inside EPA
Pat Rizzuto, Bloomberg BNA
Max Broad, National Wildlife Federation

Attachment B: Names of those who requested the teleconference call-in number

Steve Gibb, Bloomberg BNA,
Jessica Montanez, US EPA,
John Steller, US EPA
Kristina Friedman, US EPA
Steve Risotto, American Chemistry Council
Kate Shenk, BIO
Denise Sadler, Harvard University
Sharyn Lie, US EPA
Sarah Ohrel, US EPA
Jeff Cole, US EPA
Scott Mathias, US EPA
Yvonne Johnson, US EPA
Nick Hutson, US EPA
Alan Fawcett, US EPA
Mark DeFigueiredo, US EPA
Andy Miller, US EPA
Bruce Kobelski, US EPA
Carl Mazza, US EPA
Kenneth E Skog, Ph.D. USDA Forest Service
Ben Larson, National Wildlife Federation
Linda Tsang, American Forest & Paper Association
Carrie Annand, Biomass Power
Gregg Morris, Future Resources Associates, Inc
Vincent Camobreco, US EPA
Amanda Reilly, Greenwire
Sandra Evalenko, USEPA
Debra Clovis, USEPA
David Carr, Southern Environmental Law Center,
Maria Hegstad, Inside EPA
Mark E. Harmon, Oregon State University
Kyle Harris, Corn Refiners Association,
Rhea Hale, WestRock
Jack Huntington
Nancy Beck, ACC,
Stan Lancey, American Forest & Paper Association
Stephen Woock, Weyerhaeuser Company
Nicholas Mazuroski, Biomass Power Association
Jonathan Lewis, Clean Air Task Force
Steven Rose, EPRI
Marilyn Buford, USDA Forest Service Research and Development,
Pat Rizzuto, Bloomberg BNA, Inc.
John Upton, Senior Science Writer, Climate Central
Erin Voegele, Biomass Magazine & Ethanol Producer Magazine

**Attachment C: Summary of Chartered SAB Requested Revisions to the
Draft (2-8-16) SAB Review of Framework for Assessing
Biogenic CO₂ Emissions from Stationary Sources (2014)**

Members of the Chartered SAB discussed the revisions needed for the Draft (2-8-16) SAB Review of Framework for Assessing Biogenic CO₂ Emissions from Stationary Sources (2014) (hereafter called the draft report). During the quality review the SAB acknowledged the Biogenic Carbon Emission Panel was presented with a very challenging topic and a charge that addressed narrow technical issues. Members noted that the panel's review was ambitious and found that recommendations in the report extend beyond the charge. The SAB identified revisions to the draft report in order to clarify the Panel's recommendations and in some cases to reframe them to ensure they are not policy prescriptive. The major revisions are summarized below and supplement the written comments provided for the quality review on March 31 and April 1, 2016.

- SAB members agreed with the Panel that the lack of a policy context made it difficult for the Panel to fully evaluate the proposed 2014 Framework except in a general way. The draft report may be understating how the lack of a policy context limits the SAB's ability to provide policy-relevant scientific evaluations. The draft report should explain the complexity of the underlying issues that were considered in order to provide clarity and a foundation for the general recommendations that put forth a scientific basis for policy decision-making moving forward (e.g., the use of stock versus flux and the importance of temporal context to determining the climatic impacts of using woody biomass).
- Among the challenges discussed by the SAB is that BAFs and time horizons may be selected according to multiple criteria, reflecting different outcomes that can be affected directly or indirectly by the BAF. These include atmospheric GHG concentrations, climate forcing potential, implications for the harvesting of forests to provide biomass, and others. Although EPA's charge to the Panel emphasized GHG concentrations, many on the SAB expressed concerns regarding other relevant issues related to the BAF timeline, such as impacts on climate forcing (particularly over short time horizons) and forest harvest decisions. A BAF or timeline optimized to meet one criterion will (or may) be suboptimal for others. This issue should be more clearly addressed in the draft report, along with implications for the recommended BAF calculations and timelines (if indeed a timeline is recommended – see note below).
- Members expressed concern regarding the proposal to specify a timeframe for the emission horizon. They found that there is variation in the BAF at points along the 100-year timeline and the draft report should not be prescriptive relative to time. Members suggested that graphs from the appendix should be brought forward into the body of the report to illustrate the variation in the BAF over different time horizons. Members noted that the proposed stock-based approach to BAFs is valid for any chosen time horizon, and some argued that a suitable time frame could not be specified without additional details on the policy context. The relevant emission timeframes are dependent on the timeframe required for specific policies, and the justification for any specific timeframe should include a discussion of the positive and negative impacts on the climate for the selected

timeframe and if relevant other timeframes. Members identified references (e.g., Davis SJ et al. 2010) that examine the climate impacts as close in as 10 years rather than the 100-year timeline proposed in the report. Members noted that the draft report could compare net greenhouse gas emission/ net radiative forcing associated with different timeframes (i.e., 30 to 50 years) to better illustrate the importance of policy makers selecting a timeframe, and thus weighing the temporal tradeoffs.

- There needs to be more discussion on how the models were selected and the advantages and disadvantages of the selected and other approaches to modeling the alternative case. The positive and negative aspects of the assumptions and decision points need to be more clearly articulated. The draft report should provide sufficient information for the agency to evaluate a range of options relevant to a various policy decisions and the implications with regard to using simpler or more complex models. The draft report should also show how the assumptions impact the use of the BAF. One member suggested that the draft report should highlight the boundary conditions of the framework and identify any limitations to its use beyond the range of conditions for which it has been validated. That discussion should identify the important issues for consideration and cite the implications of their use. One member provided Buchholz et al. (2014) as a reference to the limited literature in the field and the observed complications with models actually deployed to make similar predictions.
- The draft report makes assumptions that net CO₂ emissions are based on actively managed forestry practices, yet much of the timberlands that might produce biomass are privately owned and under limited to no active management. The report should specify which silviculture treatments and associated biomass feedstocks are the basis for assumptions and approaches discussed and how management differences might impact those assumptions. The draft report also makes assumptions regarding the type of forestlands that will provide feedstock and should be very clear about those assumptions.
- SAB members expressed concern over the use of minimizing the long-term maximum temperature change as the basis for the time horizon recommendations, when that is only one potential criteria for US policy. Members noted that making this the exclusive frame is outside the charge to the Panel and asked that this be removed or expanded to a host of potential policy frameworks.
- There needs to be more explicit discussion of how the use of forest biomass effects net greenhouse gas emissions over time. There is discussion in the draft report appendixes and the EPA Framework (2014) document discussion of what the 2014 Framework covers in the draft report. Members found that bringing that discussion forward, from both the EPA Framework and the draft report appendixes, may help clarify the draft report.
- The Board expressed concern regarding the economic assumptions used to estimate biomass use. They noted that there are already plants in place that plan to use woody biomass for electricity generation and requested additional discussion and references to support the assumptions made.

- It would be helpful to clarify why approaches such as the social cost of carbon were not used as the basis for selecting BAFs and timelines, including relevant citations as appropriate.

Reference:

Buchholz T, Prisley S, Marland G, Canham C, Sampson N. 2014 Uncertainty in projecting greenhouse gas emissions from bioenergy. *Nature Climate Change*, 4, 1045–1047.

Davis SJ, Caldeira K, Matthews HD. 2010. Future CO₂ emissions and climate change from existing energy infrastructure. *Science*. Sep 10;329(5997):1330-3. doi: 10.1126/science.1188566. PMID: 20829483