MEMO RE: Proposal for Adequate Biomass Carbon Regulations
TO: SAB Biogenic Carbon Emissions Panel
FROM: The Natural Resource Defense Council
DATE: May 28, 2015

I. Introduction

Accurately accounting for the carbon emitted from large biomass-burning stationary sources will help deliver the greenhouse gas (GHG) reductions at the center of the Administration's Clean Power Plan (CPP). A successful biogenic carbon accounting system within this policy context should include: (1) additionality, without which facilities can claim credit for emissions reductions independent of their activities; (2) policy-relevant timeframe of analysis. EPA's modeling should also accurately differentiate among forest-derived fuels and determine their carbon impacts, incorporating the influence of diameter size-class; establish verification and documentation to place the burden of proof on regulated entities and avoid "gaming" the system; and ensure uncertainties are resolved conservatively.

This memo makes recommendations on several scientific factors essential to accurate biogenic carbon accounting. For "long-recovery" biomass fuels, such as whole trees and other large diameter wood, this determination requires a comparison of emissions from a bioenergy project against a modeled "business-as-usual" (BAU) counterfactual scenario that projects carbon sequestration absent increased biomass harvest for bioenergy. Such an approach is the only way to ensure that any emissions reductions credited to covered biomass-burning sources are *additional*—i.e. that the bioenergy project results in a net decrease in atmospheric carbon that would not have happened anyway.

We propose an analytic approach based on the application of "default Biogenic Accounting Factors" (BAFs) to the stack emissions of biomass-burning sources and a methodology for determining the counterfactual baseline. Below we outline the BAF conceptually, followed by specific recommendations related to modeling the BAF, including detailed sections on model inputs, spatial scale, time horizon, economic dynamics and leakage. In the final sections, we propose simple, precautionary assumptions that reduce the risk of undercounting emissions.

II. Background

The BAF is defined as a ratio of Net Biogenic Emissions and Gross Emissions. Since the net change in carbon stock in the system from which the biomass is removed is a measure of the net biogenic emissions from that system (ignoring other inputs to/outputs from the system), then:

BAF = Net change in stored carbon / Biogenic C released by burning

Where "Net change in stored carbon" is calculated as:

Carbon stored under BAU scenario – Carbon stored under biomass harvest scenario

The default BAF is a dimensionless number (expressed between 0 and 1) that describes what proportion of the carbon released from an individual biomass-burning source has not been re-sequestered by the terrestrial ecosystem, and thus contributes to net atmospheric CO_2 loading. The greater its value, the more carbon from a bioenergy facility remains in the atmosphere.

The "default BAF" approach originated in a recommendation by the EPA's Science Advisory Board's (SAB) in its 2012 review of EPA's Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources (September 2011):

> *Default BAFs for each category of feedstocks would differentiate among feedstocks using general information on their role in the carbon cycle. An anticipated baseline would allow for consideration of prior land use, management, alternate fate (what would happen to the feedstock if not combusted for energy) and regional differences. Default BAFs might vary by region, prior land use and current land management practices due to differences these might cause in the interaction between feedstock production and the carbon cycle. They would be applied by stationary facilities to determine their quantity of biogenic emissions that would be subject to the agency's Tailoring Rule. (SAB, September 2012)*

EPA would identify feedstock categories and regions of analysis, then carry out biophysical modeling to determine the net change in stored carbon resulting from the removal and combustion of a feedstock for each region. Knowing this net change, EPA would calculate a "default BAF" for each feedstock by region, producing a lookup table of generalized factors to apply to stack emissions based on a source's fuel mix. This approach facilitates source-level accounting (while allowing the agency to avoid facility-by-facility accounting) and addresses several scientific issues essential to accurate biogenic accounting:

- Differentiates among different forest-derived fuel types;
- Employs an "anticipated future baseline," a key SAB recommendation for forest biomass;
- Uses a general regional factor, which nevertheless can be applied to individual facilities;
- Provides regional specificity;
- Accounts for land use, management approaches, and end uses;
- Relies on readily-available information and data, such as growth/mortality, decay rates, climatic variables, and customary silviculture.

III. Recommendations

EPA should put in place a biogenic carbon accounting framework that will:

- Be independent of the size of the region over which calculations are made;
- Model changes in stored carbon using a counterfactual or "anticipated future" baseline capable of capturing the additionality of emissions or sequestration resulting from a bioenergy project;
- Assess, in particular, feedstocks that have large net carbon emissions and long recovery timeframes, especially those derived from forests;
- Use simple, precautionary assumptions that reduce the risk of undercounting emissions and ensure uncertainties in the model are resolved conservatively;
- Place the burden of proof with regulated facilities to demonstrate their biomass sourcing results in additional carbon sequestration beyond BAU through rigorous verification and documentation;
- Emphasize short timeframes relevant to reducing GHG emissions in line with US climate goals, both because of regulatory precedents and as a way to minimize uncertainties;
- Appropriately capture and differentiate between key characteristics of biomass feedstocks, land use histories, forest management regimes, and end uses;
- Ensure accounting results reflect what the atmosphere "sees" in terms of emissions; and

DRAFT

- Capture key economic factors without introducing large uncertainties associated with dynamic economic modeling.

MODELING INPUTS

We propose employing a biophysical model to generate a lookup table of fuel-specific BAFs that EPA could use to discount some or all smokestack emissions from a biomass-burning source. The LANDCARB model developed by USDA and Oregon State University is an example of a biophysical model that adequately captures key parameters, such as climatic factors, growth, mortality, decay, and soil carbon.

EPA would use the model to create feedstock-specific "anticipated future" baselines for biomass use in a region—i.e. what would happen to regional forest carbon stocks absent bioenergy. It would likewise model cases reflecting added biomass harvest for bioenergy. The net change in stored carbon would be the difference between the two cases: one in which current management (silviculture and end uses) is continued vs. the new management system in which biomass harvests occur for new bioenergy uses.

We recommend five categories of model specifications that are not overly cumbersome and that differentiate inputs where the data are available, but that capture the important distinctions in climate impacts among fuel types, land management, and end uses. These are:

1. Fuel type: distinguish between boles versus branches/limbs (residues).
2. Size class: for both boles and residues, distinguish between large and small diameter size classes.[1]

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[1] The size-class of the biomass material burned can serve as an important first-order indicator of carbon impacts. The larger the diameter class of the material, the more likely it is to generate higher carbon impact–regardless of the material type. First, numerous forest-carbon modeling studies show that burning boles (including large tops and trunks) that would otherwise remain standing or go to long-lived end uses (pulp/lumber markets) will increase carbon emissions for decades compared with fossil fuels. Generally speaking, the longer the rotation age (or the larger the diameter of the material removed) the greater the length of time for recovery of atmospheric carbon through forest regrowth.

Second, when burning a forest-derived material that would otherwise be left to decay in the forest (in any form—slash, tops, branches, and/or tree boles), the decay rate of the material is a predominant factor determining emissions impacts. If decay time is short (e.g. a few years), burning the material creates less disparity with the emissions that would have happened anyway, indicating a potentially lower carbon feedstock. On the other hand, when a fuel's decay time is decades, the carbon emitted from its combustion will persist in the atmosphere much longer than it otherwise would have. This will generally be true, except in cases where the material would otherwise be burned for silvicultural reasons (e.g. broadcast or roadside burns).

Based on:

[1] Stephenson, A. L., and MacKay, D., *Life Cycle Impacts of Biomass Electricity in 2020: Scenarios for Assessing the Greenhouse Gas Impacts and Energy Input Requirements of Using North American Woody Biomass for Electricity Generation in the UK*, UK Department of Energy and Climate Change, July 2014.

[2] Lamers, P., & Junginger, M. (2013). The 'debt' is in the detail: A synthesis of recent temporal forest carbon analyses on woody biomass for energy. *Biofuels, Bioproducts and Biorefining*, *7*(4), 373-385 http://www.researchgate.net/profile/Patrick_Lamers/publication/259576449_The_debt_is_in_the_detail_a_synthesis_of_recent_temporal_forest_carbon_analyses_on_woody_biomass_for_energy/links/00b7d52cb045d39e5e000000.pdf

[3] Colnes, A., et al., *Biomass Supply and Carbon Accounting for Southeastern Forests*, The Biomass Energy Resource Center, Forest Guild, and Spatial Informatics Group, February 2012.

Harmon, M., *Impacts of Thinning on Carbon Stores in the PNW: A Plot Level Analysis*, Oregon State University, May, 2011.

Mitchell, S., Harmon, M., and O'Connell, K., *Carbon Debt and Carbon Sequestration Parity in Forest Bioenergy Production*, GCB Bioenergy, May, 2012.

Repo, A., et al., *Sustainability of Forest Bioenergy in Europe: Land-use-related Carbon Dioxide Emissions of Forest Harvest Residues*, GCB Bioenergy, March 2014.

Stephenson, A. L., and MacKay, D., *Life Cycle Impacts of Biomass Electricity in 2020: Scenarios for Assessing the Greenhouse Gas Impacts and Energy Input Requirements of Using North American Woody Biomass for Electricity Generation in the UK*, UK Department of Energy and Climate Change, July 2014.

DRAFT

3. Land use history: distinguish among major forest types and species; distinguish between planted vs. naturally regenerating.
4. Harvest regime: distinguish between complete removal and partial cuts.
5. End uses and alternate fates: divide end uses into short-term uses and long-term structural objects; in the case of harvest residues, distinguish between slash burning and slash decay.

SPATIAL SCALE

A key test of the scientific rigor of any biogenic carbon accounting framework is its ability to assess emissions and reductions consistently, regardless of the region in which they occur. In its 2011 Draft Framework, EPA proposed evaluating the emissions of a biomass-burning facility based on an assessment of overall changes to forest carbon stocks in the region where that facility is located. Whether a facility is assessed as having greater than zero net biogenic emissions would depend on the size, location, and overall trends of the region in which it is evaluated, not based on the factors we've identified as key to modeling what would have happened to forest carbon stocks absent bioenergy.

A central criticism of this approach is that facilities are treated differently depending on where they locate and results are dependent on how large or small fuelsheds are drawn. The SAB called this the "central weakness of the Framework", leading to "the nonsensical conclusion that a ton of carbon emitted in one part of the country may be treated differently from a ton of carbon emitted elsewhere."[2]

We propose BAFs be modeled independently of the physical fuelshed area. Instead, what should drive the choice of area is the spatial scale over which it makes sense to collect the necessary model input data: fuel type; size class for woody biomass feedstocks; land use history, current harvest regime and alternate biomass uses in existing wood products markets. This may be by physiographic regions within states or a higher level of resolution, such as the state level. Data for model inputs would be specific to/derived from these regions, so that the results of the BAF calculation are independent of region size. Modeling fuelsheds would thus be "virtual", meaning a facility could be sourcing wood from a number of non-contiguous plots. However, as long as model inputs for those lands were available, EPA could model the necessary BAFs to reflect the facility's biomass sourcing.

TIME HORIZON

The default BAF is dimensionless number that measures how much of the carbon released from combustion of a specific feedstock in a biomass-burning facility is recycled back into the terrestrial ecosystem over time. Because these processes are variable and projected into the future, the BAF is a time-dependent factor; that is, it changes year-to-year. Thus, the value of a BAF applied to adjust a

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Ter-Mikaelian, M., et al., *Carbon Debt Repayment or Carbon Sequestration Parity? Lessons from a Forest Bioenergy Case Study in Ontario, Canada,* GCB Bioenergy, May 2014.

Walker, T., et al., *Biomass Sustainability and Carbon Policy Study*, The Manomet Center for Conservation Sciences, June 2010.

[2] We strongly support this assessment. We believe this approach fails to capture the causal connection between biomass harvesting and atmospheric carbon impacts. In each case study presented in the Draft Framework, the forest carbon accumulation being credited would occur anyway. If applied, this type of regional approach would mean that a power plant burning whole trees from a given region would have *zero* "net biogenic emissions" as long as total tree harvesting in that region doesn't exceed annual forest growth. Yet, from the perspective of the atmosphere, eliminating a carbon sink has the same impact as creating an equivalent-sized smokestack. Plants burning biomass cannot be given credit for forest growth and carbon sequestration that would be happening anyway without increasing net carbon emissions to the atmosphere. We also agreed with the SAB's view that this approach is likely to create a "free rider" problem that invites abuse, as well as perverse incentives for both land-owners and investors that encourage use of biomass fuels with carbon emissions profiles that compare unfavorably to fossil fuels, and discourage use of biomass fuels with a favorable profile.

facility's emissions will depend on the policy timeframe chosen. This timeframe should be relevant to existing climate goals and policy imperatives. In particular, any modeled GHG reductions (or increases) accrued in the future—and reflected in the BAF—should be assessed over a time period consistent with and comparable to federal, state, and international GHG reduction policies and initiatives.

We propose a 10-20 year horizon, which takes into account important precedents in the California Low Carbon Fuel Standard; the President's Climate Action Plan; the Massachusetts Renewable Portfolio Standard; and the Federal Renewable Fuel Standard.[3] These reflect both climate imperatives and key economic considerations and planning horizons for facilities. This time horizon has four key benefits:

1. It is in line with efforts to avoid the worst consequences of climate change. Emissions must be stabilized within the next few decades in order to limit expected global warming to 2 degrees Celsius. The framework EPA adopts needs to be consistent with this reality;
2. It helps drive consistency across existing climate policies and emission reduction commitments;
3. It reduces modeling uncertainty, which can increase dramatically over longer time horizons; and
4. It models BAFs on approximately the same timeframe as industry planning horizons for long term-contracts and operations.

ECONOMIC DYNAMICS & TREATMENT OF LEAKAGE

Leakage refers to displaced demand for wood resulting from bioenergy production, without which it is impossible to accurately assess the emissions impacts of biomass use at covered sources. While incorporating economic dynamics into EPA's modeling is one way to tackle this, we believe uncertainties associated with long-term economic forecasts are substantial and largely outweigh the benefits of added market dynamics. We recommend two simplifying assumptions to capture the interactions of demand for wood products and ultimately land and supply in the anticipated future baseline:

1. For any wood product not produced in a given region because all or some of the wood is diverted to bioenergy, demand for that product remains and so it is produced elsewhere. New biomass harvest therefore displaces demand on a full 1-to-1 basis to a new, similar forest stand.
2. This wood product is produced out of wood from virgin forests that are biologically and climatically identical to its original wood source. Thus, the carbon impacts associated with this displacement are added to the carbon debt of the biomass diverted to bioenergy.

Combined with shorter timeframes, these assumptions would allow EPA to rely on biophysical models of forests and wood production and avoid the complexity and uncertainty inherent in dynamic economic modeling. Periodically updating BAFs (e.g. every 10 years) will help ensure that the environmental factors used to establish the BAF for each biomass type are consistent with evolving scientific research, while promoting the integrity of Prevention of Significant Deterioration and Title V permitting programs and harmonizing the process with USDA's 10-year update of the Renewable Resource Assessment.

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[3] President's Climate Action Plan (2013) US commitment announced at Copenhagen in 2009: Reduce GHG emissions by 17% below 2005 level, by 2020. Target confirmed by President's Climate Action Plan (2013); Massachusetts Renewable Portfolio Standard: 225 CMR 14.02—Lifecycle period of 20 years: The aggregate quantity of greenhouse gas emissions, including direct emissions and significant indirect emissions such as significant emissions from land use changes, and temporal changes in forest carbon sequestration and emissions resulting from biomass harvests, regrowth, and avoided decomposition…. 225 CMR 14.05: "… over a 20 year life cycle …"; Federal Renewable Fuel Standard2 contemplates a *30 year analytic horizon for assessing lifecycle GHG emissions.* In the RFS2 preamble (75 Fed. Reg. 14670, 14780), EPA's rationale is: *The full life of a typical biofuel plant seems reasonable as a basis for the timeframe for assessing the GHG emissions impacts of a biofuel, because it provides a guideline for how long we can expect biofuels to be produced from a particular entity using a specific processing technology. Also, the 30 year time frame focuses on GHG emissions impacts that are more near term and, hence, more certain.*

IV. Establishing conservative simplifying assumptions

Critical to the success of a biogenic carbon accounting system—i.e. to its alignment with the GHG reduction goals of the CPP—is its approach to treating uncertainties in modeling and implementation. Even with a robust model that incorporates our proposed methods and parameters (accurate degree of differentiation for forest types, management regimes, alternate fates, leakage; appropriate regional scale; correct timeframes, etc.), this does not guarantee a match with biomass sourcing as it occurs in practice for a particular facility/state. EPA's modeling of counterfactuals should therefore rely on simple, precautionary assumptions that reduce the risk of undercounting emissions and ensure uncertainties are resolved conservatively. Below we propose simplifying conservative assumptions related to leakage and displacement of demand for whole trees from timber harvests for three counterfactual scenarios.

(a) Feedstock Used for Bioenergy: Merchantable trees that would have otherwise gone to a non-biomass use (for example, paper or oriented strand board (OSB)):

Proposed Modeling Assumption: The new biomass demand is displaced 1-to-1 to a new, similar forest stand. The "leakage" is additive, and "new" standing trees are cut in similar forest stands.

(b) Feedstock Used for Bioenergy: Merchantable trees that would have otherwise gone to a non-biomass use (for example, paper or OSB) but the original use is expected to "disappear" due to anticipated market contraction or other factor(s):

Proposed Modeling Assumption: The tree would have been left uncut on site during the market contraction. Instead the standing trees are cut for biomass. This is also mathematically similar to estimating that they would be cut elsewhere.

(c) Feedstock Used for Bioenergy: A non-merchantable tree (deformed, decayed, etc.) from a timber operation that would otherwise have been left on site (as a standing/downed tree or "cull" log):

Proposed Modeling Assumption: The tree would have been left on site as a standing tree or decaying downed log. Instead the tree is cut/removed for biomass.

Other feedstock scenarios that warrant conservative simplifying assumptions include: (i) boles from pre-commercial thins that would have likely been scattered/burned; (ii) whole trees from fuels treatment operations (distinct from timber harvest) that are used to meet biomass demand; (iii) slash from timber harvests that is used to meet biomass demand.

V. Implementation

This default BAF approach would be coupled with a pathway for biomass projects to demonstrate additional sequestration above and beyond BAU or what the default BAFs project. The burden of proof would be placed with the facility/states attempting to secure a carbon credit. Specifically, emissions from a biomass-burning facility should be presumed to be the stack emissions until a state/facility has demonstrated that the conditions "on the ground" in terms of avoided carbon emissions or additional sequestration exceed those assumptions underlying the applicable BAF.

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