

**Comments on the science behind the EPA's proposed  
Accounting Framework for Biogenic CO<sub>2</sub> Emissions From Stationary Sources,  
(Draft of September 2011)**

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The proposed framework (as reflected in chapters 3 and 4) for calculating the net impact of using biogenic feedstocks on atmospheric carbon is largely appropriate and scientifically correct. The regional-based approach assures that the carbon accounting is sensitive to the major differences among forest and land-use types typical of the different bioregions and captures landscape-wide changes resulting from management adjustments and market forces. At the same time, the approach does not necessitate chain of custody for all biomass in order to accurately indicate the impacts of a single biomass facility on net carbon emissions to the atmosphere. In addition, the proposed 5-year moving average time frame provides a reasonable method for reflecting these changes as closely as possible to the time the atmospheric impacts are occurring, given the limitations of current data. It is crucial that the implications of incremental biomass use on net emissions to the atmosphere (emissions minus incremental forest and/or agricultural feedstock growth) are reflected accurately to the marketplace in a scientifically sound manner that keeps transaction costs low. We believe the proposed framework lays the foundation to do that – though it does require some modification to ensure an accurate outcome, as we discuss below.

In thinking through how to ensure that the use of biogenic feedstocks has a positive impact on greenhouse gas concentration in the atmosphere it is important to note that a significant portion of the increase in carbon dioxide levels in the atmosphere today are the result of past management of the forests and grasslands. About one third (range reported from 12% to 49% depending on assumptions) of the increase in atmospheric carbon dioxide over the past 150 years is the direct result of land use.<sup>1</sup> It is thus critical that any accounting of the

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<sup>1</sup> Brovkin, V., Sitch, S., Von Bloh, W., Claussen, M., Bauer, E. and Cramer, W. (2004), Role of land cover changes for atmospheric CO<sub>2</sub> increase and climate change during the last 150 years. *Global Change Biology*, 10: 1253–1266. Also: Forster P, Ramaswamy V, Artaxo P, Berntsen T, Betts R, Fahey DW, Haywood J, Lean J, Lowe DC, Myhre G, Nganga J, Prinn R, Raga G, Schulz M, Van Dorland R (2007) Changes in Atmospheric Constituents and

implications of burning increased amounts of bioenergy accurately reflect its implications on the carbon cycle, as those impacts could be very large.

While bioenergy currently represents a modest share of the U.S. energy supply and associated combustion emissions, bioenergy is projected to be the fastest growing segment of gross combustion emissions in the US energy sector.<sup>2</sup> The U.S. Energy Information Administration (EIA) reports that in 2009 gross CO<sub>2</sub> emissions from biomass combustion (solid, liquid, and gaseous) accounted for 4% of total gross US energy sector CO<sub>2</sub> emissions from both fossil and biomass sources, and this share is projected to grow to 10% by 2035 under their reference case. The EIA's estimates of gross emissions from bioenergy combustion only reflect the emissions from the smokestack or tailpipe and do not account for the change in landscape carbon stocks due to shifts in land-use and land management. Accounting for these landscape effects is vital, and could decrease or increase the net effect of the use of bioenergy on US emissions of greenhouse gases.

The framework covers the key issues and for the most part they are resolved in a manner consistent with the underlying science. The framework would benefit from defining its overarching purpose as most of the scientifically appropriate choices from the different accounting options discussed in section 3 would flow logically once the goals were clearly established. In particular, the purpose of creating an "Accounting Framework for Biogenic CO<sub>2</sub> Emissions from Stationary Sources" is to create a method to adjust the smokestack emissions of stationary sources in a way that accurately accounts for the net change in CO<sub>2</sub> sequestration and emissions attributable to marginal increase in the use of biomass for energy. This should be done in a way that 1) allows consistent comparison of net emissions impacts across all stationary sources using biogenic and non-biogenic fuels and 2) accurately measures the correct sign of the effect on the atmosphere and order of magnitude of that change.

The most significant problem with the overall structure of the proposed accounting framework is the internal inconsistency between a regional based approach highlighted in chapters 3 and 4 and determination of the Biogenic Accounting Factor (BAF) in chapter 5, which relies in part on a site level approach. Resolving this inconsistency is relatively simple and critically important to implementing an accounting framework that achieves operational simplicity, scientific integrity, reliance on existing data and low transaction

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in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 129-234.

<sup>2</sup> U.S. Energy Information Administration. 2010. *Annual Energy Outlook 2010 with Projection to 2035*. DOE/EIA-0383. Office of Integrated Analysis and Forecasting, U.S. Department of Energy. Washington, DC. In particular, see [http://www.eia.doe.gov/oiaf/aeo/carbon\\_dioxide.html](http://www.eia.doe.gov/oiaf/aeo/carbon_dioxide.html)

costs. The draft equations can be rewritten to meet these goals and in so doing reduce complexity and the chances of perverse outcomes while increasing transparency and consistency. Some important adjustments are also needed to the proposed methods for estimating the variables that will fit within the accounting framework if this is to achieve the goals stated above.

Overall the draft framework is sound. Below are several critical issues that require further attention to ensure the BAF accurately reflects the net change in landscape carbon attributable to marginal increase in biomass demand.

- **Influencing the marginal facility should be the focus of the accounting scheme.** The accounting framework should be designed so that new entrants or other incremental growth of biomass use in the region are assigned a BAF equal to their marginal impact on net emissions. The current levels of biomass use by existing facilities are reflected in current economic signals and management plans and comprise a modest share of energy supply. The priority of the framework should be to ensure that the potentially large future growth in biomass use for energy occurs in a way that accurately considers the net emissions implications. This can be accomplished in two ways consistent with what we know about the carbon cycle: 1) existing facilities can be assigned a BAF of 0 for the quantities of biomass they are currently using, which would last for the life expectancy of the facility, and all marginal increments from biomass use from additional entrants, along with any incremental growth in biomass use from existing facilities, are assigned a BAF based on empirical data from the region. This approach would allow a facility to maintain a BAF for the life of the facility (i.e. 20 years) if it had no incremental growth in biomass use. 2) An alternate approach would be to assign all facilities a regional average BAF that is updated on a regular basis so as to account for the impact of new entrants and other marginal changes in biomass use. To avoid penalizing existing users for the impacts of marginal actors and preserve the right signal on marginal units of biomass use, under this arrangement facilities should be offered the option to demonstrate that their feedstocks have a lower net atmospheric impact than the regional BAF (e.g. that they use mill waste or logging residues) and that feedstock would be removed from the regional calculation with the net effect of raising the BAF for other facilities, bringing it into closer alignment with the BAF of the marginal material a new plant can acquire in the region. This may allow more efficient biomass users to enter the market at the expense of less efficient facilities. In both options, facilities would be able to compete with each other in the marketplace to acquire feedstocks with a demonstrated low or 0 BAF.
- **Baselines need to be defined accurately but simply.** If the regional approach outlined in the draft framework is going to provide a consistent accounting of net emissions impacts from different stationary sources, it is not sufficient to merely answer the question “Is there more or less carbon stored in the system...at the end of an assessment period than there was at the beginning?” as noted in section 4.9 of the framework. Rather, the baseline, along with the closely related issue of the spatial scope to which the baseline corresponds, must be designed in a way that accurately

measures changes in landscape carbon resulting from incremental changes in bioenergy demand, rather than reflecting changes due to other drivers. The framework provides three possible baselines, and each one has the potential to be misused. The anticipated future baseline approach is intuitively appealing, but the extreme volatility in the forest products industry and macroeconomic fluctuations means that the calculation of any projected scenario would be ripe for abuse, as assumptions are heavily dependent on the temporal reference point (i.e. does projection assume recession or rapid growth in the housing market; pre or post high levels of recycling, etc.) and assumptions about future conditions (i.e. planting and growth rates; industry demand, etc.). On the other hand, the reference point approach gets away from this potential for the type of assumption based concerns that could occur in the future baseline approach but is subject to a different type of misuse or abuse. Specifically, the reference point approach is only appropriate as a benchmark against which to measure the effect of marginal changes of biomass use in the case that the carbon stocks in the region under examination are currently stable. In a managed forest case, this would be the situation in the case of a sustainable management regime with an even age class distribution. As a result, an appropriate use of the reference point approach requires very careful calibration of the region's scope and eliminating any free-riding off of 'non-working' lands, as well as potential adjustments to the baseline if the current carbon stocks in the region are not currently stable. Each of these issues are discussed below.

- **Determining the size of the region is critically important.** A regional Goldilocks problem exists: if the region is too large then the marginal actor has no impact on the BAF so there will be no signal not to over utilize biomass with the result that it will contribute to increased net flux of emissions; on the other hand, if the region is too small, the data constraints emerge and shifts in existing facility's demand will have a major impact on the BAF independent of whether that change is the result of bioenergy actions (e.g. a single pulp mill closes as a result of market shifts unrelated to bioenergy). The minimum possible size of a region will be determined by the requirement for statistically accurate and regularly updated data (i.e. no smaller than permitted given FIA's sampling). And the region is too large if the marginal entrant does not affect the BAF (i.e. national or more than a few states). In short, the goal is to create regions large enough to ensure accurate data and averaging of expected market forces but small enough that the marginal entrant into the region will impact the BAF. The region would ideally coincide with a bioregion such that forest types are consistent across the region in order to harmonize silvicultural and market forces. The region's size should also be considered with respect to the definition of included lands within the framework. (See below for further discussion of which working land to include in the framework.)
- **Defining which lands to include in the baseline is critical to establish an accurate reference point baseline.** The framework correctly identifies the importance of which lands to include in a regional accounting system in section 3.8. Working lands or those lands that are in active management are often cited by foresters to be in equilibrium, i.e. forests that re-cut are replanted/natural regrowth with a continuous supply of age classes maturing. This equilibrium is the basis for a reference point baseline, providing an appropriate benchmark against which to measure impacts due to marginal changes in biomass use, whether positive or negative, for the purposes of computing the BAF. In

other words, this approach assumes minimal net sequestration on the landscape and any increase in sequestration allows for a LAR of 1.0 or greater, i.e. all biogenic emissions are sequestered on the landscape. In this reference point baseline, any decrease in sequestration must also be accounted for in the BAF.

For the reference point approach to accurately measure landscape carbon changes attributed to the use of bioenergy, only the managed landbase can be included in the baseline. But all regions have lands that are legally or socially off limits from harvesting. Additional lands are unmanaged for economical or legal constraints. The sequestration on these unmanaged or 'non-working' lands can significantly increase the rate of carbon sequestration occurring on the landscape and mask changes in stocks of working or managed lands. If the carbon sequestered on these 'non-working' lands are included in calculation of the baseline it allows for facilities to 'free ride' on the sequestration occurring on these lands that are not influenced by biomass use. In this situation, forests on working lands can have increased harvests such that their carbon stocks are declining and yet it would not be reflected in the BAF, although net emissions of carbon to the atmosphere are increasing. The challenge is defining the working land base. It is essential to attempt to determine those lands that will not be harvested for legal, geographical, economic or social reasons. The definition of working lands will vary by geographic region but a common system should be created to establish such a definition. If the assumption that carbon stocks are approximately in equilibrium over an appropriately defined region and working landscape is not supported by the empirical data, the baseline could be projected based on a historic trend of carbon stock changes on those lands. If there is a desire to account for historic increases in forest stocks on working lands that is possible based on FIA data but needs to incorporate slowing accumulation rates as the forests approach saturation, these reductions are biologically dictated.

In the case of agricultural biomass feedstocks or short rotation woody crops, the framework correctly notes that these are typically grown on annual or cycles over which harvest and regrowth are approximately equal over a short time frame. However, these feedstocks cannot in all cases be categorically considered to have a LAR of 1, with combustion perfectly offset by growth, as was assumed in Case Study 5. The same principles of regional accounting should apply to both forestry and agricultural feedstocks. While lands currently producing biomass feedstocks could be considered to be in equilibrium, any changes in the land area to produce agricultural biomass feedstocks should be evaluated in terms of its net impact on the region's carbon stock, which could be positive or negative. As discussed in section 3.7 of the framework, there may be net emissions stemming from direct land-use changes for the purpose of growing this feedstock, as well as associated leakage that need to be considered.

- **The proposed framework is correct that categorical inclusion or exclusions assumptions are not supported by the science.** However, under the accounting framework, enterprises should be allowed on a case-by-case basis to demonstrate that they are using biomass sourced from materials with no or limited impacts on net emissions. Differentiating among feedstocks beyond the three broad classes outlined in the report (forest biomass, agricultural biomass, non-forestry/agricultural solid

waste) would be needed to provide such flexibility. In the cases where BAFs can be applied differentially among facilities in a region based on differences within the three broad categories of feedstocks, they can be applied on a voluntary basis with a requirement for proof of chain of custody (as noted below no consideration for byproducts is warranted). Those who can demonstrate they are using wastes and other low emissions feedstocks would be assigned a BAF of 0 or near 0. Any remaining changes in stocks would be assigned to the BAF of the facilities using that broad class of feedstocks in a region. Such a modified BAF would require a revised baseline for the region that applies to the facilities that do not opt out.

- **Leakage needs to be included in the framework.** Analyses suggest that activities that displace forest products could induce significant shifts in production (i.e. “leakage”) both within and outside the country. Conservation programs that reduce forestry production in the US have estimated leakage rates between 10 and 90% within the country<sup>3</sup> while international leakage from reducing forestry production has been estimated at 42-95%.<sup>4</sup> If bioenergy feedstock use is displacing agricultural or forestry products, the leakage effects should be accounted for to properly account for the net emissions impacts, even if carbon stocks in the region are not declining relative to the baseline. Shifts in production within the country will be implicitly captured by the accounting framework as long as it covers a sufficiently large proportion of the working landscape, but potential international leakage needs to be considered. If a large portion of the forest products industry were to move overseas as a result of shifting prices for bioenergy and/or shifting economics in a sector (e.g. pulp wood) the carbon stocks within a region (and the US as a whole) could thus remain constant or even increase while emissions from production of the materials increased in another part of world to meet what had previously been produced domestically, with the net effect that net emissions increase. Accounting for potential international leakage can be accomplished with simple methodology despite relatively high volatility in associated markets (pulp; timber). By using ratios of the amount of net trade (importation-exportation) versus national production over time it is possible to adjust the baseline to reflect any increase in the relative rate of net trade. This calculation is simplest if done on a national scale by product category, but could be also done so as to adjust among regions as well. If proportional net trade rises by more than the 95% CI then BAF’s are adjusted to compensate for the displaced emissions.
- **Stochastic/exogenous events do not need to be considered except in extreme cases.** If the regions are sized appropriately then the influence of stochastic/exogenous disturbances (tropical cyclones; high levels of wild fire, insect outbreaks) are relatively constant over 5- or 10-year time periods and do not need to be considered in BAF determination. For example Gulf Coast hurricanes have had a relatively constant impact on the forest of the region over 50 years and while the impacts of a single event seems extreme the reduced stocks are offset by the regrowth of forests impacted in

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<sup>3</sup> Murray, Brian C., Bruce A. McCarl, and Heng-Chi Lee. 2004. Estimating leakage from forest carbon sequestration programs. *Land Economics* 80(1): 109–124.

<sup>4</sup> Gan, Jianbang and Bruce A. McCarl. 2007. Measuring transnational leakage of forest conservation. *Ecological Economics* 64:423-32.

previous years by other hurricanes – the consistency in stochastic events at the regional scale is another reason for adopting a regional approach to BAF calculation. There will be one-off regional level stochastic events that should cause BAF adjustments (e.g. intermountain west pine beetle devastation, hurricanes in regions where they are rare, such as the 1938 hurricane in New England, the 2005 wildfires in Alaska), these will need to be addressed on an individualized basis as there is no way to routinize how they are handled.

- **Two equations (eq 7 and eq 8) should be deleted from the calculation of BAF as they are not relevant and could distort net emission calculations.** The PGE (eq 2) should be calculated using only the amount of feedstock associated with any emissions. The accounting scheme being considered is under the mandate of the Clean Air Act, which only regulates point source emissions. If the biomass feedstock being used is not associated with an emission, then it should not be included in this framework. Therefore equation 7 is unnecessary. Similarly, any biomass feedstock that is removed from the region's landscape for a process that involves an emission should be counted. This includes biomass that is not combusted (i.e. ash) or that is returned to the landscape as a carbon supplement (i.e. biochar). If these combustion residuals are returned to the landscape in a way that increases regional carbon stocks, then net sequestration will increase on the landscape and will be accounted for in the BAF. Otherwise, these residuals are part of a process that eventually results in net carbon loss and should be accounted for in the BAF. If there is carbon capture and sequestration (eq. 8), then the biomass does not result in an emission and the carbon sequestered should be considered part of the landscape carbon stocks. Deleting equations 7 and 8 from the BAF framework both simplifies the framework and achieves a more accurate BAF.
- **Two equations (eq 3 and eq 9) as proposed do not implement the regional approach accurately or consistently with the principles laid out earlier.** Both equations require determining site or facility level data, inconsistent with a regional approach.
  - Equation 3 requires knowing the feedstocks used in every facility – ultimately requiring chain of custody accounting and separate streams for differing feedstocks. If the BAF is calculated based on stock changes on the working lands of the region then the correct answer from a net emissions perspective will be calculated correctly without accounting for facility, transport or storage losses. Any lost or destroyed feedstocks will be subtracted from the regional sequestration rates and thus negatively influence the BAF.
  - Equation 9 requires collecting site specific data, inconsistent with a regional approach. It appears the primary purpose of equation 9 is to account for any losses to soil carbon and any use of feedstocks that would rapidly decompose anyway. Any shifts between row crops and energy crops or other land-use shifts within the region will be accounted for in the regional sequestration rates. If soil carbon losses are likely in a region, any net emissions should be accounted for in the BAF. Similarly, feedstocks derived from “anyway emissions”, i.e. forest residuals, mill residues, black liquor, etc, should be accounted for in the regional factor.

- **Simplify the BAF equation to ease understanding, transparency and accurate application.** As discussed above, equations 3, 4, 5, 7, 8, 9, 10 and 11 should be deleted from the BAF calculation. The final NBE equation should be rewritten:

$$\text{NBE} = \text{PGE} * (1 - \text{LAR}) + \text{Leakage}$$

- **The use of municipal solid waste (MSW) should not be credited for avoided methane emissions.** The majority of methane emissions from landfills is now captured and the overwhelming majority of new landfills will collect methane upon closure, making crediting for avoided emissions of methane inappropriate. The relatively slow decomposition of materials in landfills means that the emissions factor for solid waste has to be much higher than 0, while less than 1. Each type of solid waste should be assigned a BAF based on the decomposition rate if not combusted.