Review comments on the draft Accounting framework for biogenic CO2 emissions…

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Questions

4. Evaluation of the accounting framework

- Does the framework accurately represent the changes in carbon stocks that occur offsite, beyond the stationary source? (i.e., the BAF)
- Is it scientifically rigorous?
- Does it utilize existing data sources?
- Is it easily updated as new data become available?
- Is it simple to implement and understand?
- Can the SAB recommend improvements to the framework to address the issue of attribution of changes in land-based carbon stocks?
- Are there additional limitations of the accounting framework itself that should be considered?

My focus

Estimating LAR (level of atmospheric reduction) and BAF (Biogenic accounting factor) for

1. Forest residue (logging residue)*
2. Mill residue
3. Non- merchantable forest biomass*
4. Roundwood harvest in a commercial market area*
5. Roundwood harvest from a dedicated source*

   -- C “recovered” in advance use?

   -- Dedication of existing forest?

* Carbon is recovered from the atmosphere over a few to many decades after harvest

What is the objective for the accounting framework?

- The “carbon outcome” is not defined
- The **implicit** “carbon outcome” goal = count biogenic emissions in cases where such emissions may potentially deepen already negative forest C change or make forest C change negative in the current year.

- Suggested definition: The **difference in CO2 (GHG) concentration** the atmosphere sees over some **time frame** **as a result of** wood use for energy.

- BAF = the portion of current year emissions that will be a net increase in CO2 in the atmosphere at some point in the future as a wood use for energy
- “difference in CO2 concentration” =
  - Baseline requirement = Carbon storage without wood energy use?
- “time frame” = ~ 100 years

A measure of the "difference in CO2" –
Fraction of C emissions recovered by time t- FCR(t)

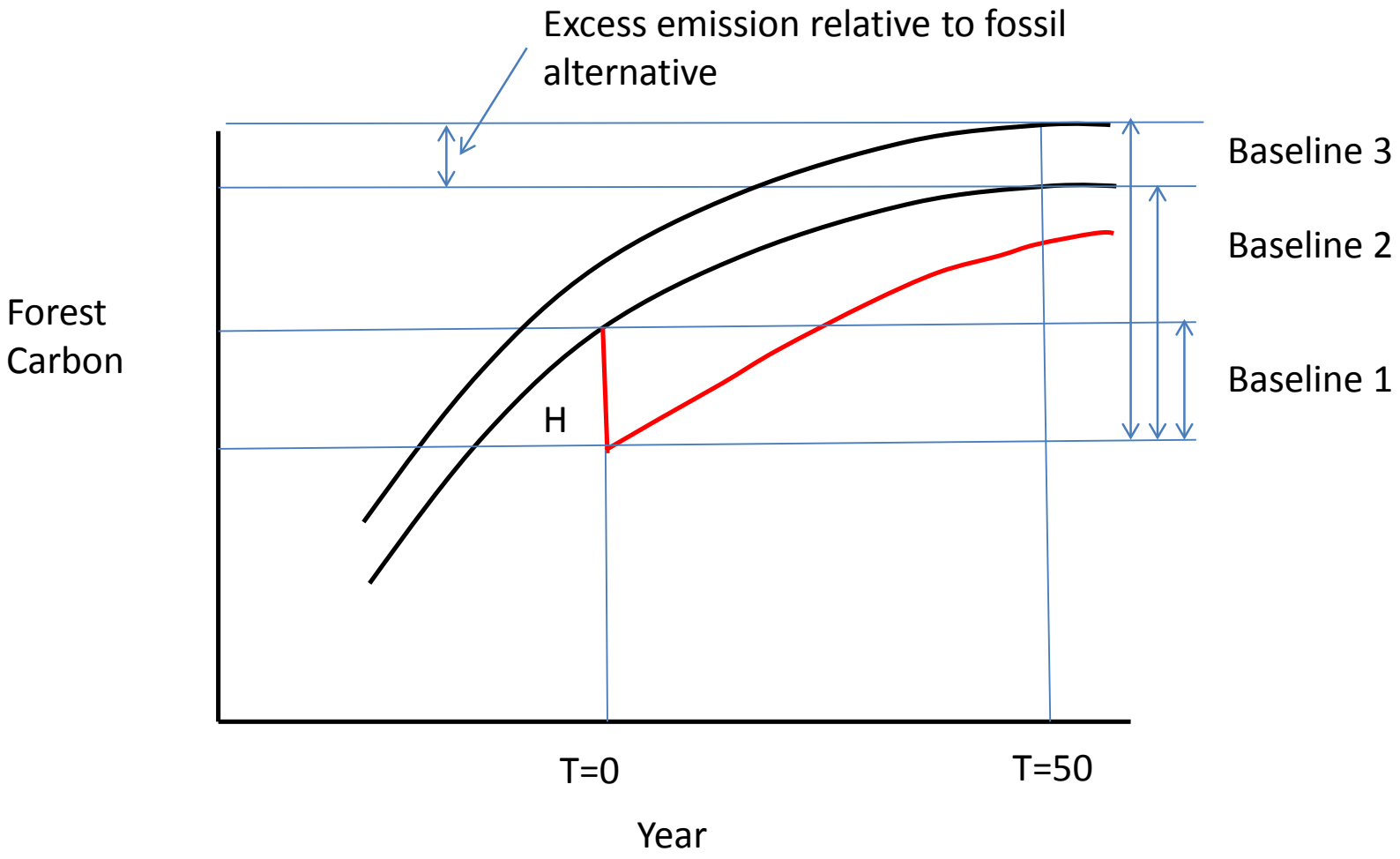
Let **FCR(t)** = fraction of the carbon emitted in the current year that is recovered (in net) from the atmosphere by year t

Let

LAR2 = FRC(t) for a chosen t

BAF2 = (1 – LAR2) = (1 – FRC(t))

Alternate Carbon recovery baselines (what is full C recovery in year 50?)



LAR and BAF for forest roundwood harvest - Baseline 2

Let **FCR(t)** = fraction of the carbon emitted in the current year that is recovered (in net) from the atmosphere by year t

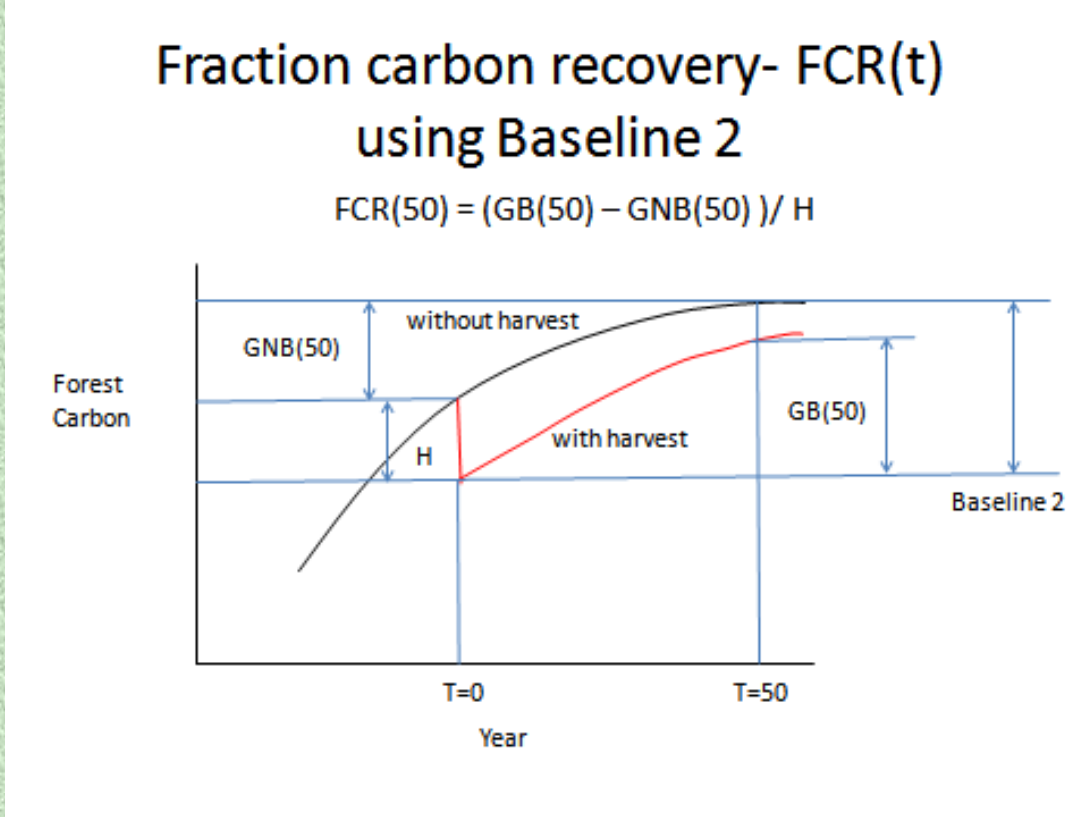
FCR(t) = (GB(t) – GNB(t))/ H (1)

GB(t) = growth with biomass harvest to t
GBN(t) = growth w/o biomass harvest to t
H = C lost due to harvest

LAR2(t)=FCR(t)*RRF(t)

e.g.
BAF2(50) = (1-LAR2(50))

RRF(t) = risk reduction factor to avoid overestimating LAR2(t)



Draft BAF versus BAF2 indicating forest carbon recovery in 50yrs

Current year Growth vs Removals	Old dense slow growing forest – clearcut, 10% recovery in 50 yrs		Mid age stand, moderate thinning, 60% recovery in 50 yrs		Old slow growing stand, light thining, 80% recvery, in 50 years	
	BAF	BAF2(50)	BAF	BAF2(50)	BAF	BAF2(50)
G > R	0	0.9	0	0.4	0	0.2
G < R	1	0.9	1	0.4	1	0.2
Plant takes 50% of G-R	0.5	0.9	0.5	0.4	0.5	0.2

BAF = 1 means all emissions counted

BAF does not reflect how forests recover based on e.g. forest condition, removal rate

Answers to review questions

- **Does the framework accurately represent the changes in carbon stocks that occur offsite, beyond the stationary source?**
  - No, not if “carbon outcome” is net atmospheric CO2 change over some time frame. Current year excess growth LAR = 1 to 0 is not correlated with “difference in CO2 concentrations” in over 50- 100 years.
- **Is it scientifically rigorous?**
  - No, the BAF value is not likely to reflect the “difference in CO2 concentrations” in the atmosphere in 50 - 100 years.
- **Does it utilize existing data sources?** Yes
- **Is it easily updated as new data become available?** Yes
- **Is it simple to implement and understand?** The procedure yes; how the accounting reflects the “difference in CO2 concentrations” in the atmosphere, no.
- **Can the SAB recommend improvements to the framework to address the issue of attribution of changes in land-based carbon stocks?** Yes?
- **Are there additional limitations of the accounting framework itself that should be considered?**

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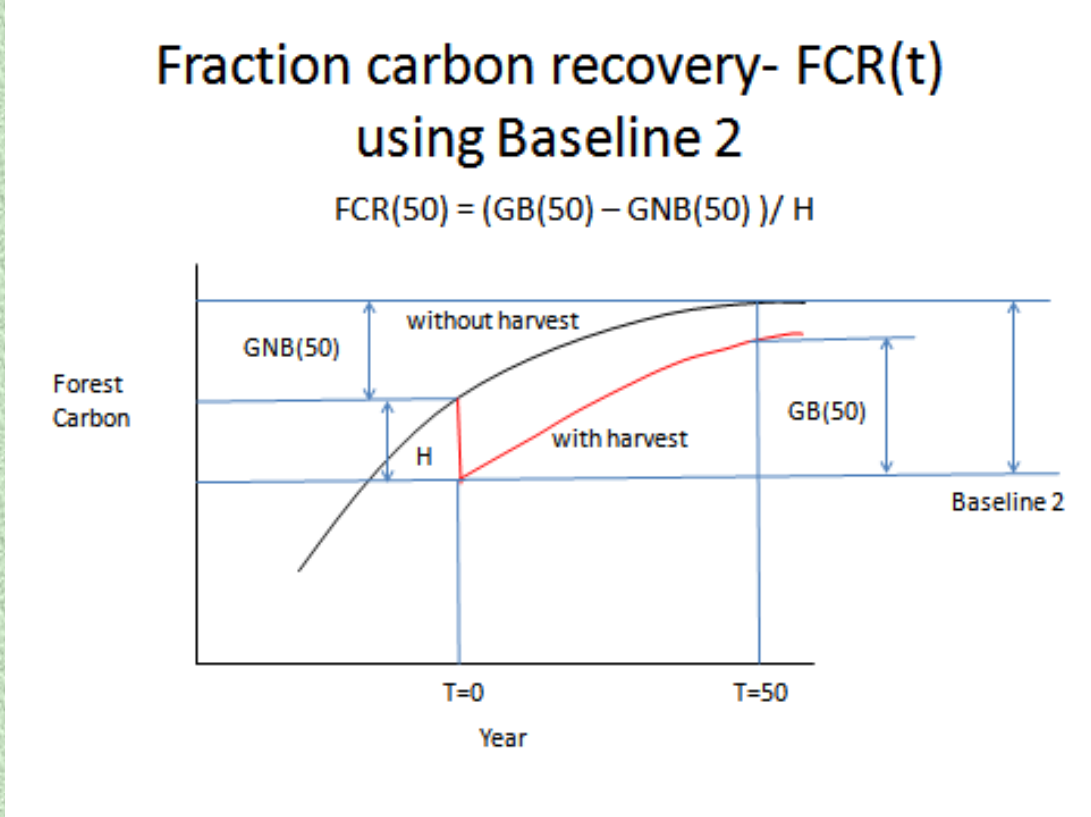

Net growth with biomass over time

GB(t) = PGB(t) - CNONBIOHARVEST(t) - CFORCONV(t) + CNONFORCONV(t) **(2)**

Net growth with biomass harvest over time

GNB(t) = PGNB(t) - CNONBIOHARVEST(t) - CFORCONV(t) +NONFORCONV(t)+ ∆HWPC(t) **(3)**

Where

PGNB(t), PGB(t) = potential growth to time t

CNonBioHarvest(t) = C loss - harvest not for energy to time t

CFORCONV(t) = C loss - conversion of forest to nonforest to time t

NONFORCON(t) = C gain - conversion of nonforest to forest to time t

∆HWPC = Change in C stored due to change in wood products production to time t (relative to no harvest baseline)

Estimating Regional FCR(t) Matrix for Roundwood harvest

Step 1 - Matrix of raw FCR(t) values for roundwood harvest a region for t = 50 to 100

Assume "normal" mortality, assume land remains forest

	Forest density (% of Max stand density index)								
Site productivity	Low			Medium			High		
	Fraction removed % of SDI			Fraction removed % of SDI			Fraction removed % of SDI		
	Low	Med	High	Low	Med	High	Low	Med	High
Low	Model all FIA plots in each cell								**Lowest**
Medium									
High	**High**			**High**					

Step 2 – Adjust roundwood FCR(t) matrix cells

- Adjustment less important than correct relative FCR values in basic matrix – to send **relative** "difference in CO2" **signal to users**
- Adjust for
  - Intensity of non biomass harvest (less total carbon gain)
  - net shift non forest to forest (if models give unambiguous result)
  - Shift C recovery due to climate change

Step 3? – If region has G < R then

1) Land must be certified to get full FCR(t) values
2) If land not certified – reduce FCR(t) values?

Simplest method

FCR(t) values for logging residue, for t= 50 to 100

	Region		
	North	South	West
Logging residue	0.8	0.9	0.7

FCR(t) values for roundwood, for a given region for t= 50 to 100

	Forest density (% of Max stand density index)		
Site productivity	Low	Medium	High
Low	Model all FIA plots in each cell		**Lowest**
Medium			
High	**Higher**	**Higher**	

What wood suppliers need to report

- For FCR (t) matrix method – for roundwood
  - Lat long
    - Get Site productivity from GIS
    - Get stand density from GIS
  - Amount delivered
  - Area harvested
- For Simplest method – for roundwood
  - Lat Long –
    - Get stand density, site productiviy from GIS

Potential Models/ data

- Basic roundwood matrix/ simple roundwood table
  - FVS variants (USFS) (FIA Plots/ FIA mortality)
  - BiomBGC? (Gower)
- Matrix Shifters
  - RPA Assessment models (FIA Plots)
  - SERTS (Abt)

How to estimate FCR(t) values for regions.

- Estimate for successively larger values of H (biomass removal) for the region
- Estimate FCR(t) for groupings of FIA plots (forest conditions) that may be harvested

Criteria for parameters to group FIA plots

- Identify parameters that account for variation in FCR(t)
- Use parameters that wood suppliers can identify on the ground. e.g. stand density, intensity of harvest, Lat. Long. (to link to GIS layer of forest productivity)

Wood suppliers role

- Biomass suppliers would report basic parameter data needed to look up previously estimated FCR(t) values. (e.g. density, fraction of basal are removed, lat long to get GIS on productivity)

Models to estimate growth with and without harvest (GNB(t), GB(t))

USDA FS – RPA Forest Projection models (David Wear et al. Peter Ince et al.)

- 50 year projections
- Projects individual FIA plots, above ground carbon
- Projections are stochastic - would yield distribution of FRC(t) values
- Historical patterns of natural mortality are endogenous
- C harvest for non bioenergy uses is endogenous
- C loss from conversion of forest to non forest is endogenous
- C gain from conversion of non forest to forest is endogenous
- Could – in principle – implement H limited to different forest sources
- ΔHWPC(t) – change in wood products carbon storage is endogenous
- Climate change effects could be included based on 4 GCMs

Models to estimate growth with and without harvest (GNB(t), GB(t))

USDA FS Forest Vegetation Simulator Regional Variants (N. Crookston et al.)

- Projection for 50+ years
- Projects growth for individual FIA plots
- Can project individual plots with and without increased harvest) for energy
- Can vary intensity and type of harvest treatment
- CNONBIOHARVEST, CFORCONV, CNONFORCONV would have to be specified exogenously
- FRC(t) could be computed for FIA plots by e.g. location, forest condition, harvest intensity
- Historical or modified levels of fire rate could be included and fire intensity and emissions would be estimated endogenously

Comments on the proposed alternate framework

- Policies and practices to retain forest will enhance likelihood of reaching full C recovery.
- By estimating FRC(t) by regions, and by e.g. forest conditions/ removal intensity there would be an incentive to use biomass from locations providing the fastest and highest C recovery.
  - Substantial harvest of older stands would be avoided. Harvesting of very slow growing stands would be avoided.
- Effect of high removals versus growth on FCR(t) would be endogenous in computing GB and GNB
- FRC(t) values could credit use of enhanced regeneration methods (planting) or improved genetic stock
- FRC(t) values could be computed for fire hazard reduction treatments where the projections include fire probabilities. FVS simulations could take into potential carbon loss.
- Could monitor harvest locations to check 1) growth rate versus projections, 2) probability of conversion , 3) probability of harvest.

LAR and BAF for Logging residue

- LAR(t) = FCR(t) = FLRDECAY(t) (4)
- FLRDECAY(t) = fraction of logging residue that would have decayed by time t.
- For example
- BAF50 = (1 – FRC(50)) = (1 – FLRDECAY(50)) (5)
- Data sources – existing studies, new FIA plot data on loss rates for dead and down wood by region (raw data is available for Eastern U.S.)

LAR and BAF for dedicated wood plantations

- BAF should account for 1) carbon accumulation on the land prior to its use for energy and 2) carbon loss due to the land conversion

- LAR(t) = 1+ (AVECINV (t) –CONVLOSS)/ TOTH(t) (6)

- Where
- t = 0 - time the plantation was established
- AVECINV = average standing carbon inventory per acre through time t
- CONVLOSS = C loss at the time of conversion to a plantation.
- TOTH(t) = C in total harvest from the plantation through time t
- For example
- BAF(50) = (1-LAR(50)) = (1-(1+(AVECINV (50) –CONVLOSS)/TOTH(50)))
  = - (AVECINV (50) –CONVLOSS)/ TOTH(50) (7)

Answers to review questions for alternate framework

- **Does the framework accurately represent the changes in carbon stocks that occur offsite, beyond the stationary source?** Yes, within error bounds. Indicates C recovery for given levels of biomass harvest in a region by type/ location of forest and removals.
- **Is it scientifically rigorous?** Yes, accounts for major factors that determine carbon recovery over time. Making the framework rigorous requires 1) assessing uncertainty of FRC(t) values/discounting for risk, and 2) monitoring recovery on the ground. FRC(t) estimates would be based on scientific understanding contained in forest projection models
- **Does it utilize existing data sources?** It uses FIA plot data , other FIA data on disturbance, and existing projection models.
- **Is it easily updated as new data become available?** Yes
- **Is it simple to implement and understand?** Contingent yes – contingent on work of several parties.
  - Researchers need to compute the FCR(t) value tables.
  - Wood suppliers need to certify forest condition and harvest parameters to look up FCR(t) values in tables.
  - Policy makers need to select the time periods of interest to determine FCR(t) values for current year LAR.

Key points

- “Carbon outcome” (measure) must be defined
- Suggest – **Difference in CO2** atmosphere sees over a **specific time due to** use of biomass for energy in the current year
- Proposed Framework for BAF does not give “difference in CO2” correctly for forest sources with long C recovery times
- “Difference in CO2” is determined by fraction of forest C recovery by time t
- Baseline = Forest C recovery **target amount** at time t
- FCR(t) = fraction current yr emissions recovered given recovery target by t
- Should compute FCR(t) for forest sources, by region, by forest condition/removal rates
- Forest Service models (FVS, RPA Forest models) could estimate FCR(t) for regional levels of harvest, various forest conditions out 50+ years

Thank you

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