Forest carbon and biomass energy – LCA issues and challenges

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Six areas that get insufficient (or inappropriate) attention

- Matching the study objective to the accounting framework
- Spatial and temporal scales of accounting
- Market-related effects
- Uncertainty (not discussed in interest of time)
- Non-GHG impacts (not discussed in interest of time)
- Dynamic modeling of radiative forcing (not discussed in interest of time)

Note: The following discussion is focused on the situation in the U.S. Different circumstances may exist in other countries.

1. Selecting the accounting framework

- Attributional
  - Results in estimate of actual net emissions from the bioenergy system in isolation
  - Used in emissions inventories
- Consequential
  - Results in estimate of emissions arising as a consequence of using biomass, including emissions and removals outside of the system boundary that occur as a consequence of using biomass instead of an alternative
  - Used to understand the implications of different policies

1. Selecting the accounting framework

- What we know in the context of forest carbon
  - In attributional accounting, if a biomass-producing (wood-producing) area maintains stable C stocks over time, the net biogenic carbon emissions from biomass energy system are zero.
  - In consequential accounting, a forest with stable C stocks may be found, for a period of time, to result in net emissions of biogenic C *relative to a counterfactual scenario* where harvesting does not occur (i.e. a carbon debt). This is because…
    - Lower combustion efficiency for biomass vs. fossil fuels
    - Non-use of forest may allow additional removals of C from the atmosphere for a period of time
- Understand which framework you need

2. Spatial and temporal scales

- Single plot or supply area or region or larger
  - In attributional studies, single plot analysis ignores uptake on plots that are gaining biogenic C and will supply wood in the future.
  - In consequential assessments, using a single plot involves an unstated assumption that there are no indirect effects that impact plots other than the one being analyzed
- Interplay of spatial and temporal scales
  - In general, all areas supplying wood at present and in the future, as well as areas affected by the demand for wood, should be included in the assessment through time

3. Accounting for market-related effects

- Investment responses to increased demand
  - Can result in additional planted forest area, increased productivity of managed forests
  - Can significantly impact the size and duration of any "carbon debt" incurred in a consequential study
- Forest biomass used for energy is usually a co-product or waste from a forest that also produces other higher value products with their own GHG impacts/benefits. The connections between the markets for these various types of forest biomass are important.
- Market related impacts can be critical in consequential assessments, yet often ignored

Common shortcomings in addressing spatial scale and market-related effects

	Common approach in consequential assessments	The actual situation is often more complex, especially where wood is produced on private land (e.g. US South)
1. Forest area	Assumed equal and constant in both BAU and new-demand case	Over time, forested area in the new-demand scenario is likely to be higher than forested area in the BAU scenario.

Common shortcomings in addressing spatial scale and market-related effects

	Common approach in consequential assessments	**The actual situation is often more complex, especially where wood is produced on private land (e.g. US South)**
2. Pre-harvest carbon accumulation on plots	Carbon accumulates at identical rates in the BAU and new-demand scenarios until the plot is harvested in the wood-producing scenario	In the new-demand scenario, pre-harvest management may change in response to new demand in ways that affect pre-harvest C accumulation (e.g. mid-rotation fertilization)

Common shortcomings in addressing spatial scale and market-related effects

	Common approach in consequential assessments	The actual situation is often more complex, especially where wood is produced on private land (e.g. US South)
3. Post-harvest carbon accumulation on plots	In new-demand scenario, C accumulation curves for replanted plots are unchanged over time.	In the new-demand case, investments in managed forests will increase plot-level productivity and C accumulation rates over time as planting stock and management practices improve.

2. & 3. Spatial/temporal scales and market-related effects

- This seems really complicated. Is it even possible to "do it right"?
- No single study can be expected to have the "right" answer, but there are numerous studies involving different data, models and assumptions that collectively provide important insights for policy makers.
  - These studies tell us that while there are uncertainties in addressing market-related impacts, these impacts are too important to biogenic carbon stocks and flows to ignore, especially where wood is produced in managed forests on private land.

Is there enough wood in the U.S. South?

- Considerable focus on demand for pellets Europe
  - Significant fraction of feedstock is roundwood, including logs of pulpwood size
  - Localized impacts on pulpwood prices possible, exacerbated by tight supply of small diameter wood predicted for some locations
- Adequacy of supply depends on many factors
  - Wood demand and rate at which it ramps up
  - Response of land owners in face of increased demand and a variety of policies affecting forestry
  - Competition for land (crop prices)
  - The health of the pulp and paper industry
  - The recovery of the housing market
- Supply constraints will vary by location

Closing thoughts on the use of LCA in understanding biomass energy systems

- Use an appropriate framework: attributional or consequential
- Use spatial boundaries that include all areas supplying wood and areas affected by new demand
- Understand whether market impacts are likely to be important, and include them where needed
- Perform sensitivity analyses and consider formal uncertainty assessment
- Examine a range of reasonable scenarios
- Consider dynamic modeling of radiative forcing
- Don’t expect LCA to provide all of the answers.