Is Wood Energy Carbon Neutral?

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Introduction

- Biomass energy is expected to play a major role as a substitute for fossil fuels over several decades.
- The EPA is current deciding how it is to treat carbon emissions from stationary biomass energy facilities.
- Is carbon produced form these facilities to be treated identically to fossil fuel carbon?
- **If the energy producing activity substitutes for fossil fuel energy but does not result in increased carbon in the atmosphere, the activity is carbon neutral.**
- **Note: in the long term forest emissions will be zero if full regeneration occurs.**
- The approach uses a Life Cycle Assessment to examine three stylized forest systems to focus on the implications of net carbon emission from wood.

Issues: Life Cycle Analysis

- Time period
- Boundaries
- Forests Specifics

Three Studies

- Studies represent a spectrum of situations.

Long Periods, Narrow Boundaries

- The **Manamot** study involves harvest a single stand of mature trees for fuelwood.

Intermediate

- The second case looks at the harvesting of a large mature **Canadian** natural forest.

Short time period, Wide Boundaries

- Short rotation planted managed forest where increases in future demand for wood for bioenergy are anticipated.

Approaches to LCA and Carbon Emissions

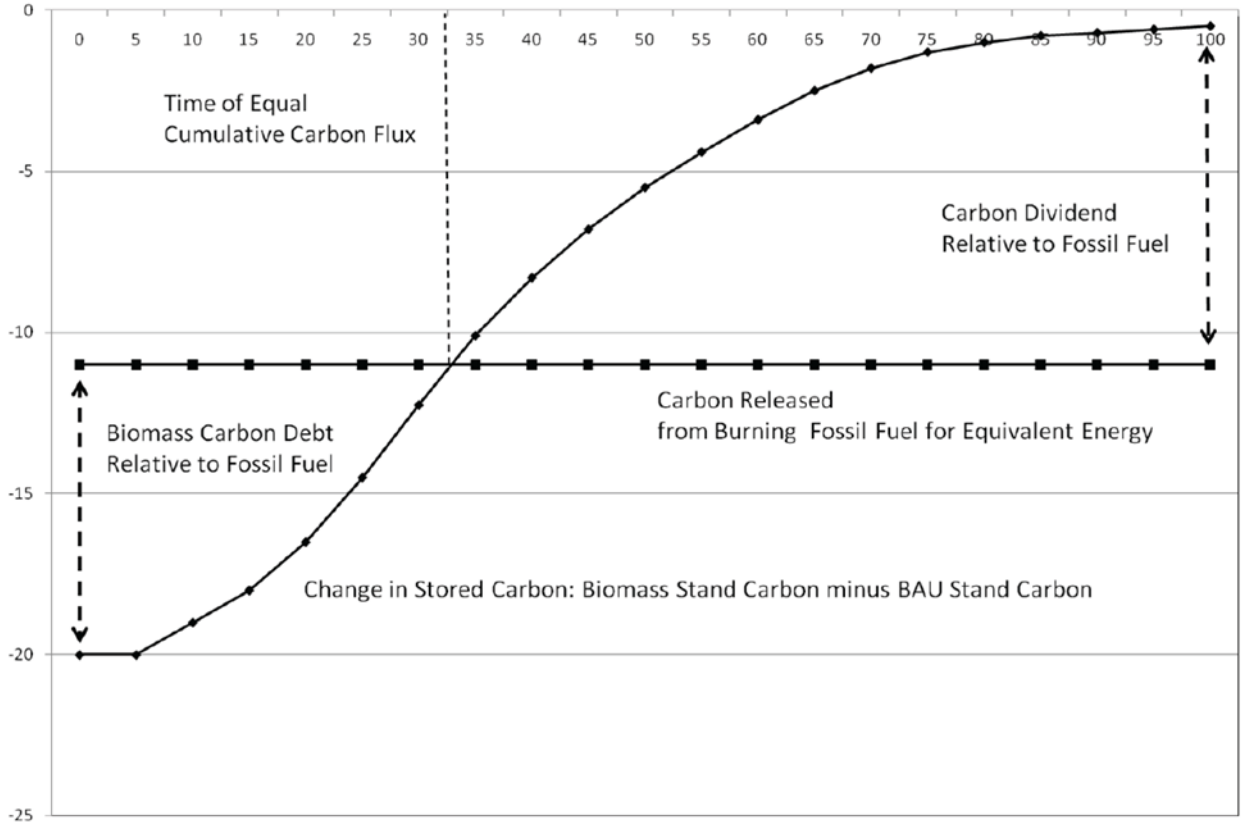
- Stand: The carbon flows can be related to a single stand, a multi-stand forest on a land scape, a single ownership forest, which may be multi-stand and multi-location, or a multi-owners forest system as might apply to a region or a nation.
- Timing: The timing of emissions and subsequent carbon sequestration is important and often related to the physical situation.
- Market Affects: Economics distinguishes between partial and general equilibrium analysis. We can think of this situation as having general equilibrium effects.

What is Life Cycle Assessment (LCA)

- An LCA is a technique to assess environmental impacts associated with all the stages of a product's life from cradle to grave.
- As applied to carbon emissions it has been noted that "Many biomass GHG accounting methods have been developed resulting in notably different conclusions."
- The criticality of the definition of spatial and temporal system boundaries.
- There is an "attributional" assessment where the attributes of the system being study are "as they exist
- There are "consequential" LCA (CLCA) that is defined as a method that aims "to describe how environmentally relevant physical flows would be changed in response to possible decisions that would have been or would be made."

Manomet Study

- The study's LCA examines the effect on atmospheric carbon of a one-time wood harvest and a one–hundred year regeneration, with the wood being substituted for fossil fuels for energy production.
- The study has the implicit assumption of certeris paribus; that is, other things being held constant.
- The approach traces the emissions associated with the wood substitution and the GHGs sequestered (Fig 1).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Time of Equal
Cumulative Carbon Flux
Carbon Dividend
Relative to Fossil Fuel
Carbon Released
from Burning Fossil Fuel for Equivalent Energy
Biomass Carbon Debt
Relative to Fossil Fuel
Change in Stored Carbon: Biomass Stand Carbon minus BAU Stand Carbon

Canadian Forest

- This study involves a large mature natural Canadian forest (5.3 million ha) that relies on natural regeneration for regrowth.

- At the inception of the analysis, the forest begins to be harvested at a constant annual rate that is sustainable in the long term.

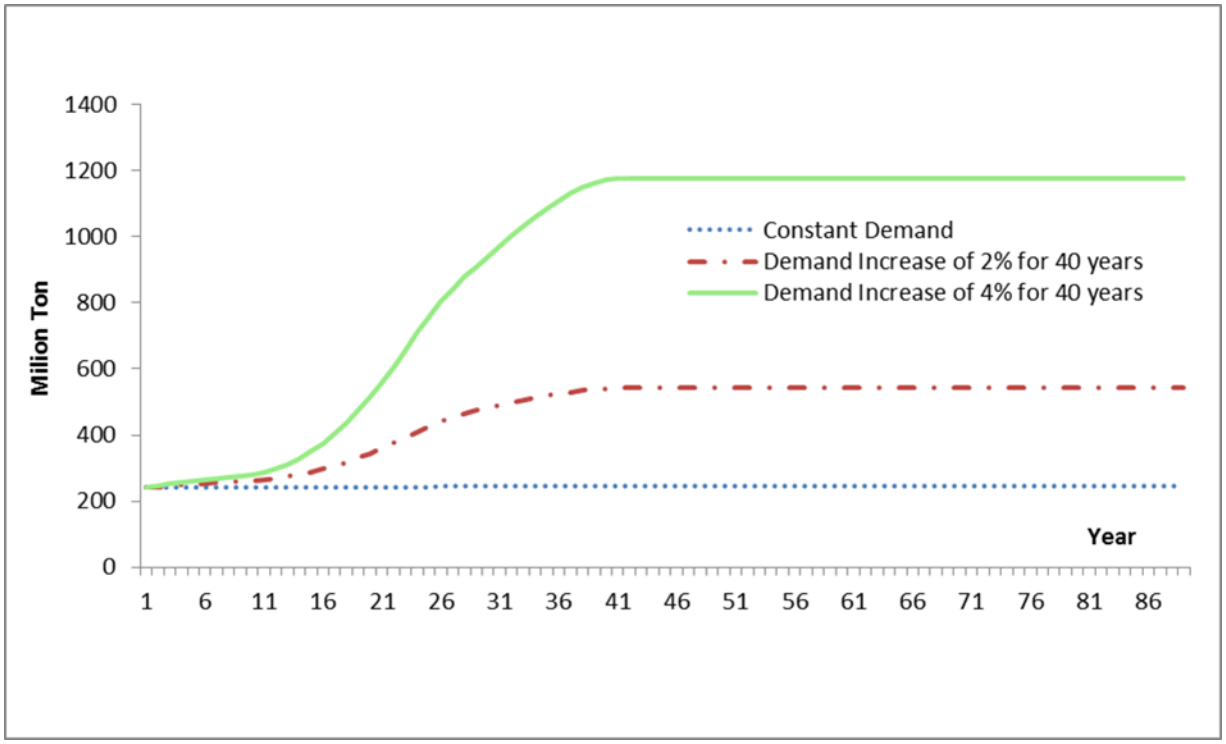
- It requires over 100 years to convert the forest to the steady state—where growth in the harvested areas equals the continuing harvest.

- Total net emissions tend to rise in the early periods and generally decline thereafter as the increased harvest areas experience regrowth and begin to sequester carbon.

- The new forest has less carbon in it than did the initial mature forest, the net effect was to decrease total carbon emissions within the 100-year period or less—in some cases far less.

A Dynamic System With Markets Adjusting

- In the dynamic forest management activities respond to current and anticipated market conditions that maximize financial returns to the forest.
- This approach established a short rotation fuelwood plantation. It recognizes that increased, expected, or actual demand will influence not only harvest levels, but also investments in forest management on existing forests as well as investments in new forests through tree planting.
- The approach examines the **intertemporal path of forest carbon stocks and changes** in this path due to the increased use of wood for bioenergy and the induced increase in forest investments and management.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Demand Increase of 2% for 40 years
Demand Increase of 4% for 40 years
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Can we generalize to all American Forests?

- Note: US forest stock was 50% higher in 2000 than in 1960 despite huge harvests during those 4 decades.
- Tree plantings run roughly 2 million acres per year over those 40 years.
- In anticipation of rising future demand?
- What might we expect if the market anticipates large increases in demand for wood bot bioenergy?

Summary and Conclusions

- This paper examines three case studies in the literature ranging from the Manomet study to the TSM —from a very constrained situation to an unconstrained approach.
- The paper concurs with the common view that over long periods of time most carbon will be recaptured by any of the forest systems if regeneration occurs.
- However, it argues contrary to a common view, that even in the short term carbon emissions from forest harvests for energy can be offset with sequestration if the forest boundaries are sufficiently broad and forest management agents anticipate the increase in future demand and invest according to meet this demand.
- While such a result is obvious for a large multi-stand plantation with room to expand its forest, such an outcome may also relevant for a national forest system where the various management agents are responding to price signals from wood biomass markets.