Evaluation of methodological issues in the EPA “Accounting Framework for Biogenetic Carbon Dioxide Emissions” study

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Evaluation of methodological issues in the Accounting Framework (p 3)

Address the questions of p 3.

- Q. Do we "support how these factors (those evaluated by EPA) should be included in accounting…" ? **A. Not Fully. incomplete**
- Q. "are there additional factors that should be included?" **A. Yes, should include effects of anticipatory forest management (investments) in forests stocks and growth associated with expectations of increased future demand.**

THE NATURE OF A FOREST

- **Wild forest**: unmanaged, if increase harvests for biomass energy, reduce the forest stock and rely on natural regeneration to replace. If demand increases the stock decreases. This is the type of forest implicit in most of the analyses.
- **Managed Commercial Forest**: if expect increased future demand will manage by offsetting harvest with planting and area expansion. This is the type of forest that provides most of the industrial wood for the US and indeed for the world.
- Literature addressing this transition from wild to managed (Planted Forests and the Optimal Drawdown.)

Commercial Forests: Expansion and Contraction

- If demand is expected to increase, two countervailing forces:
  1) increased harvest **decreases** the forest stocks,
  2) forest managers increase investments in management to **increase** forest stocks meet expected increase in future demand.
- The EPA Accounting Framework addresses 1), but ignores 2).
- Need system rather than site assessment
- So the accounting question is how do the system expansions and contractions relate. AGAIN, the Accounting Framework **ignores expansions initiated by anticipated future increases in demand.**

Management Activities

- Expand area of forest
- New plantings
- Genetically improved seedlings
- Change Rotation length
- Adjust harvest levels

Note: Commercial Forest Management is inherently anticipating future markets, otherwise they would never plant a tree

When do we start the accounting cycle?

- **When the tree is harvest?** as in the Manomet study that examined a single mature forest site.

or

- **When the tree is planted?**
- Is this planting **additive**, i.e., in **anticipation** of an increased demand, or is it BAU?
- If additive, the carbon releases (later) are of the carbon sequestration (earlier) in anticipated of the new demand.
- When we start the cycle strongly influences our perception of the results. Net releases or net accumulation.
- Commercial Forest Management **is inherently anticipating** future markets.

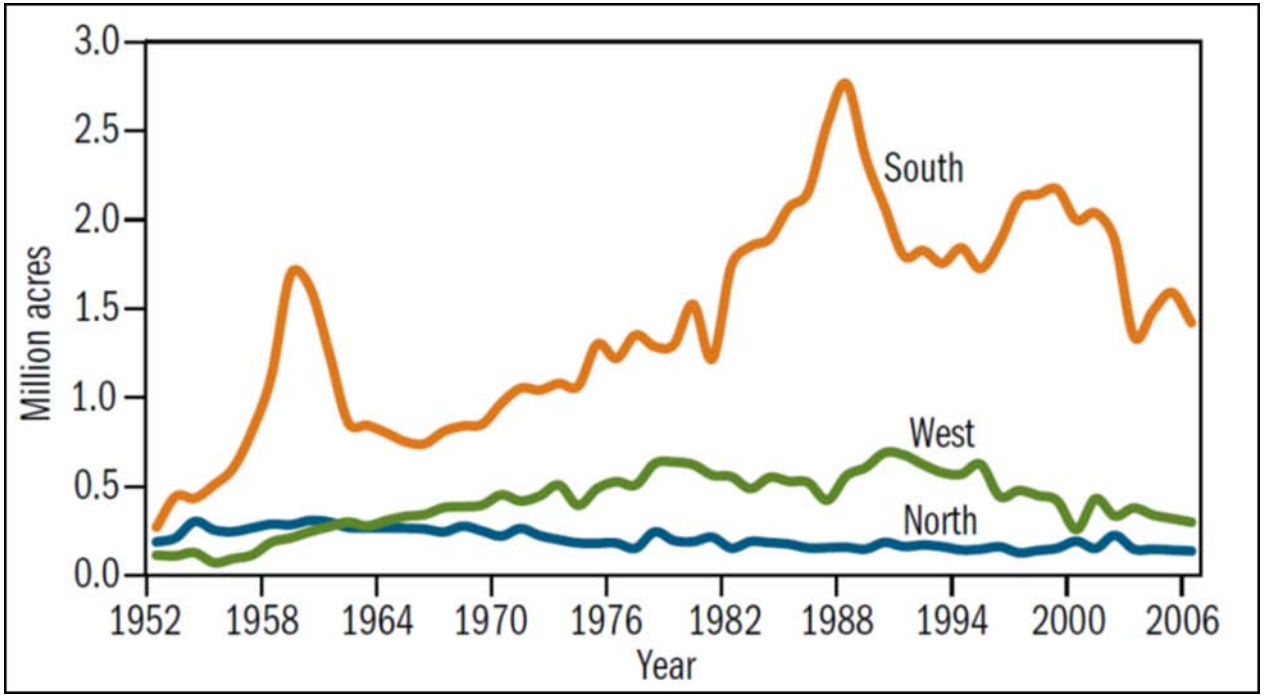
Basic Concept

- If most commercial wood comes from managed forests. Anticipated increased demand will increase investments and management.
- The increased investment will anticipate the increase in demand. (**Rational expectations concept** for which Thomas Sargent was recently awarded the 2011 Nobel prize in economics.)
- **Proper accounting will consider the carbon implications of anticipatory investments** that some carbon may be captured in forests in advance of later releases.
- We will demonstrate the effects of anticipation.

Examples of Market Anticipation

- Benefit/Cost Analysis: The costs are largely current and known, while the benefits are in the future and only anticipated and estimated.
- Tree planting for commercial purposes:
  - Figure 1
  - Costs occur today but returns in thirty years. Nevertheless, large investments in anticipation of future expected returns.

Figure 1: Forest Planting in the US by Region, 1952-2006



Review Situation

- Start in a world of limited wood biomass energy and have an expectation of an increasing demand through time.
- If assume no management (all forests wild): demand will draw wood from forest and forest stock will be drawn down and gradually replaced through natural regeneration.

We examine a situation where we assume that forests are managed in response to economic forces (demand):

- Note: increased demand will generate opposite forces on forests and forest stocks:
  - incentives to harvest wood for biomass energy, thereby **reducing** forest stocks, but also
  - increased incentives to invest in management for more forest, thereby **increasing** forest stocks. **This feature is missing in most of the EPA analysis.**

Examine a Representative Forest

- Examine a Representative Forest and see how optimizing management will respond to an increase in demand.
- Inferences: suppose now had 1000 managers that all were reacting to the common market conditions. We would get the same type of results.
- **So, the results apply to the forest system, not simply to a particular firm.**

Representative Managed Regulated Forest

Want sustainable biomass production from our **base case** forest: start with

- 16 million ha forest
- 32 year rotation
- Have 32 age classes
- With 500,000 ha per age class
- In steady state would harvest 500,000 ha per year or 16 million cubic meters. (@10 m3 x 32 x 500,000)
- And release 4 million tons of carbon. (@ 0.25 tons C/m3)

Model parameters and values

- Table 1 Parameters and values
- Parameters Value
- **Demand function** **〖Q(t)〗_((tc)) =95.334-0.4768*〖p(t)〗_(($/tc))**
- **Discount rate** **0.95**
- **Carbon conversation rate** **0.20tC/m3**
- **Demand increase scenarios** **Constant Demand**
- **/Demand Increase of 2% per year for 40 years**
- **/Demand Increase of 4% per year for 40 years**
- **Yield functions** **Base Yield Function: ln(V(a))=7.82-(52.9/a)**
- **Land supply function** **Constant Land Rent of $200 per Hectare**
- **/Land Supply Elasticity of 0.5 : R=〖(L/ 1.265)〗^2**
- **/Land Supply Elasticity of 0.0, no land expansion allowed.**

BASE CASE
Representative Managed Regulated Forest

- Move from some arbitrary point to long-term equilibrium under:
  - Constant demand
  - Demand increase at 2%/yr. for the first 40 years and stable thereafter.

Figure 2 Scenario B-Forest area path

Start with 16 million hectares in 32 equal age classes; Base Yield Function**; Constant Land Rent;**

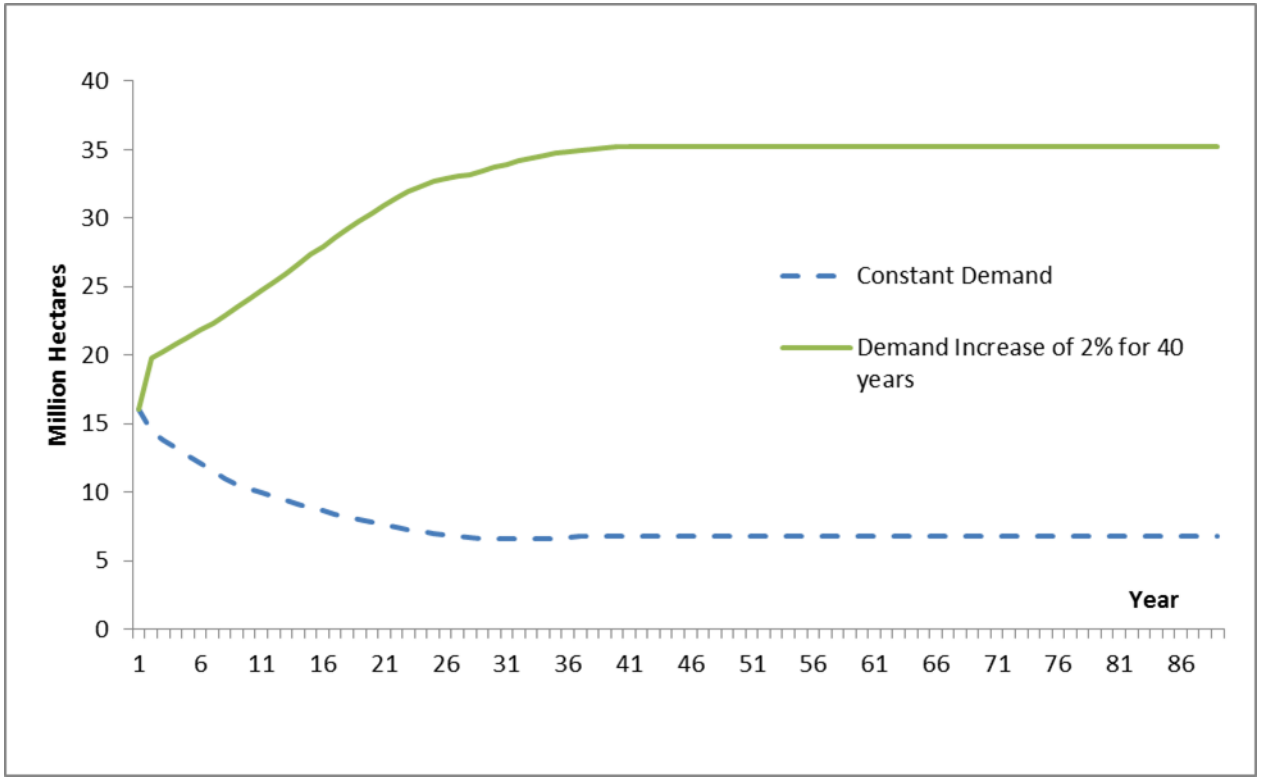


Figure 3 Scenario B-Carbon capture path

Start with 16 million hectares in 32 equal age classes; Base Yield Function; **Constant Land Rent;**

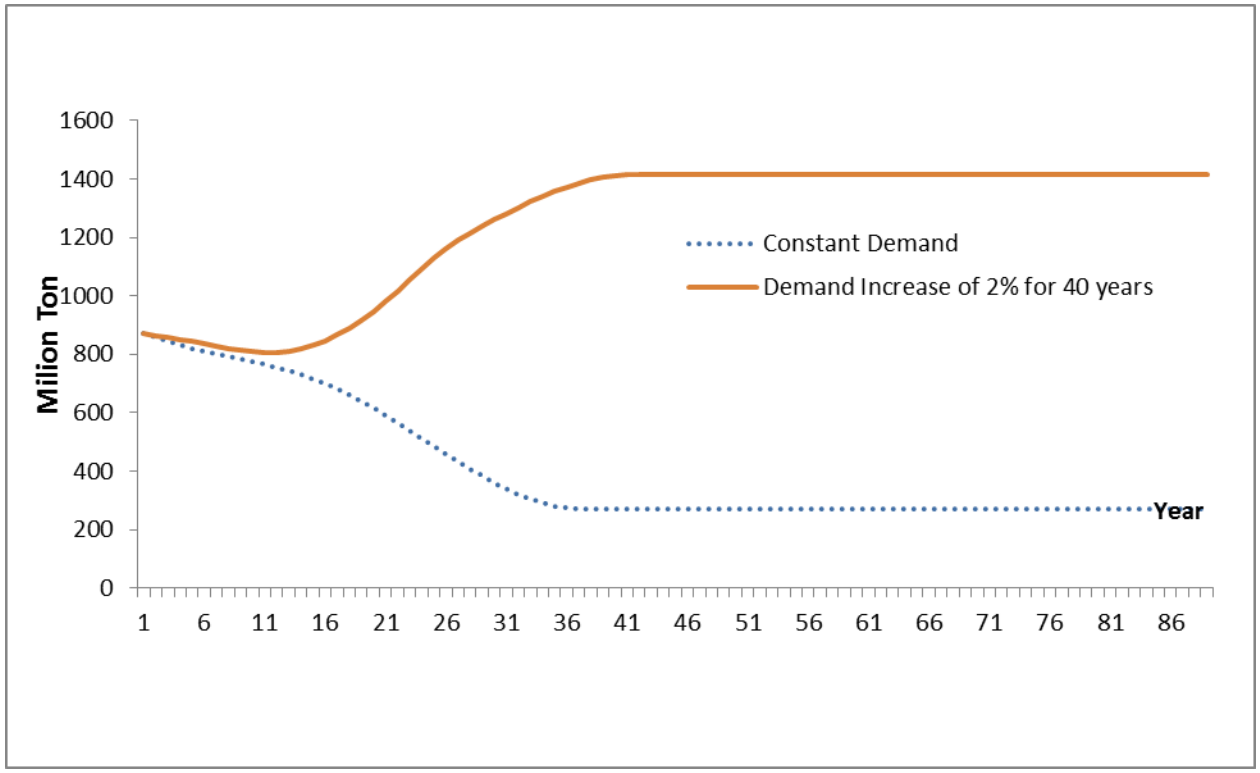


Figure 4 Scenario B-Wood biomass price path

Start with 16 million hectares in 32 equal age classes; Base Yield Function; Constant Land Rent;

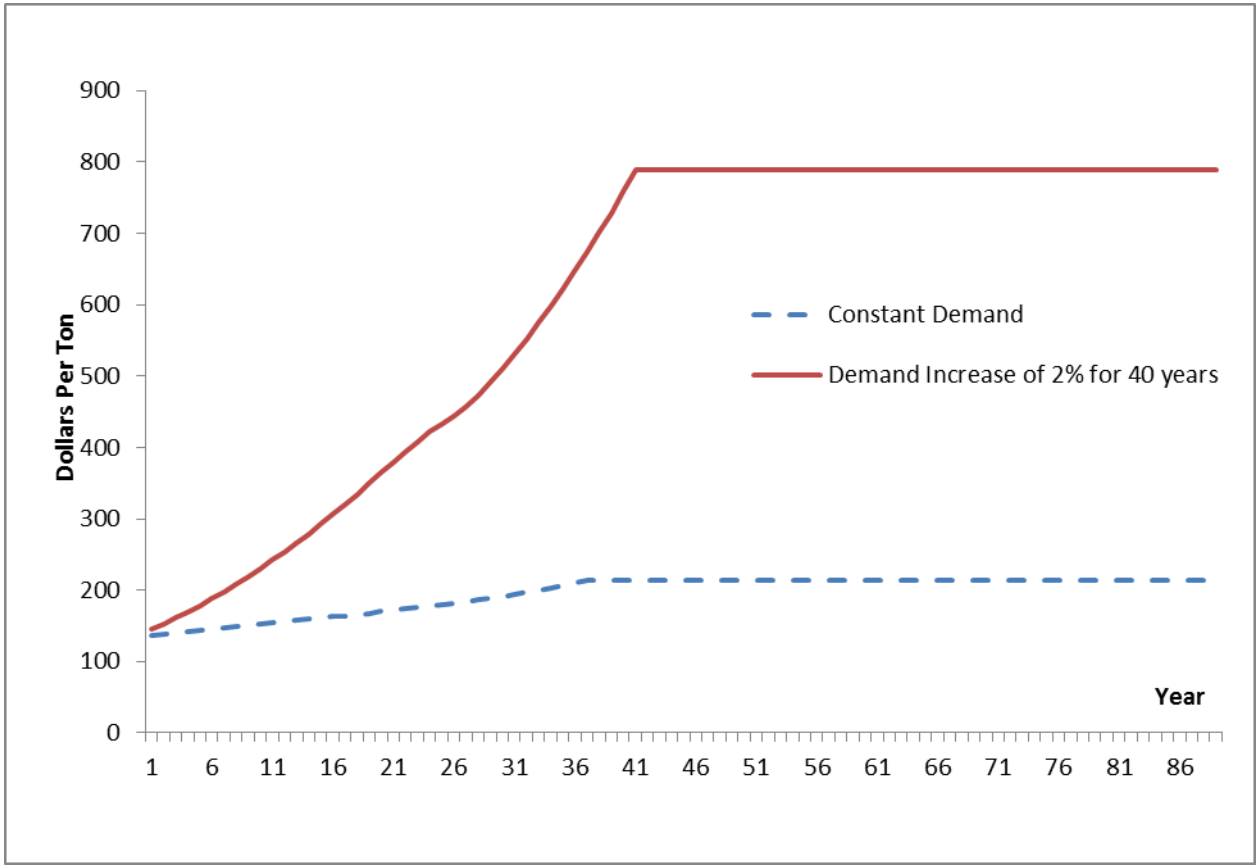


Figure 5 Scenario B-harvest path

Start with 16 million hectares in 32 equal age classes; Base Yield Function; Constant Land Rent;

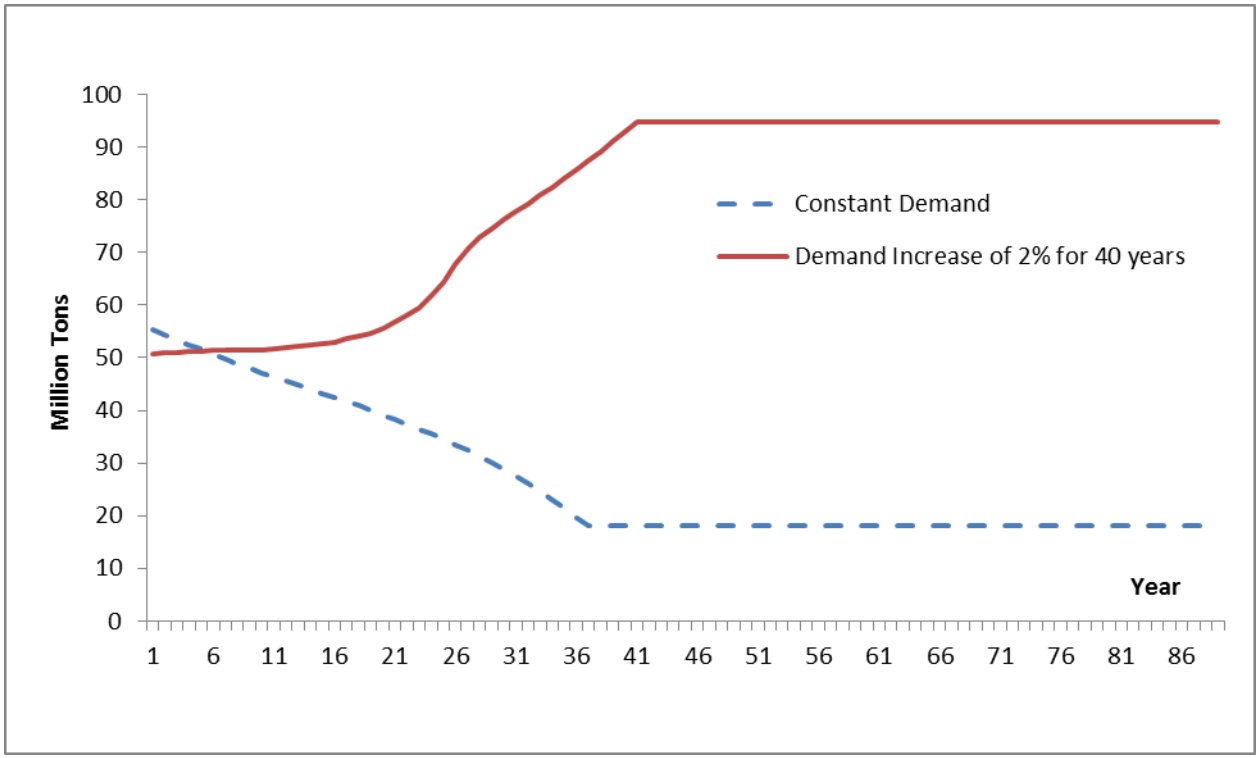


Figure 16 Scenario 4-Carbon capture path

Forest land fixed at 16 million ha in 28 equal age classes; Base yield function, fixed land

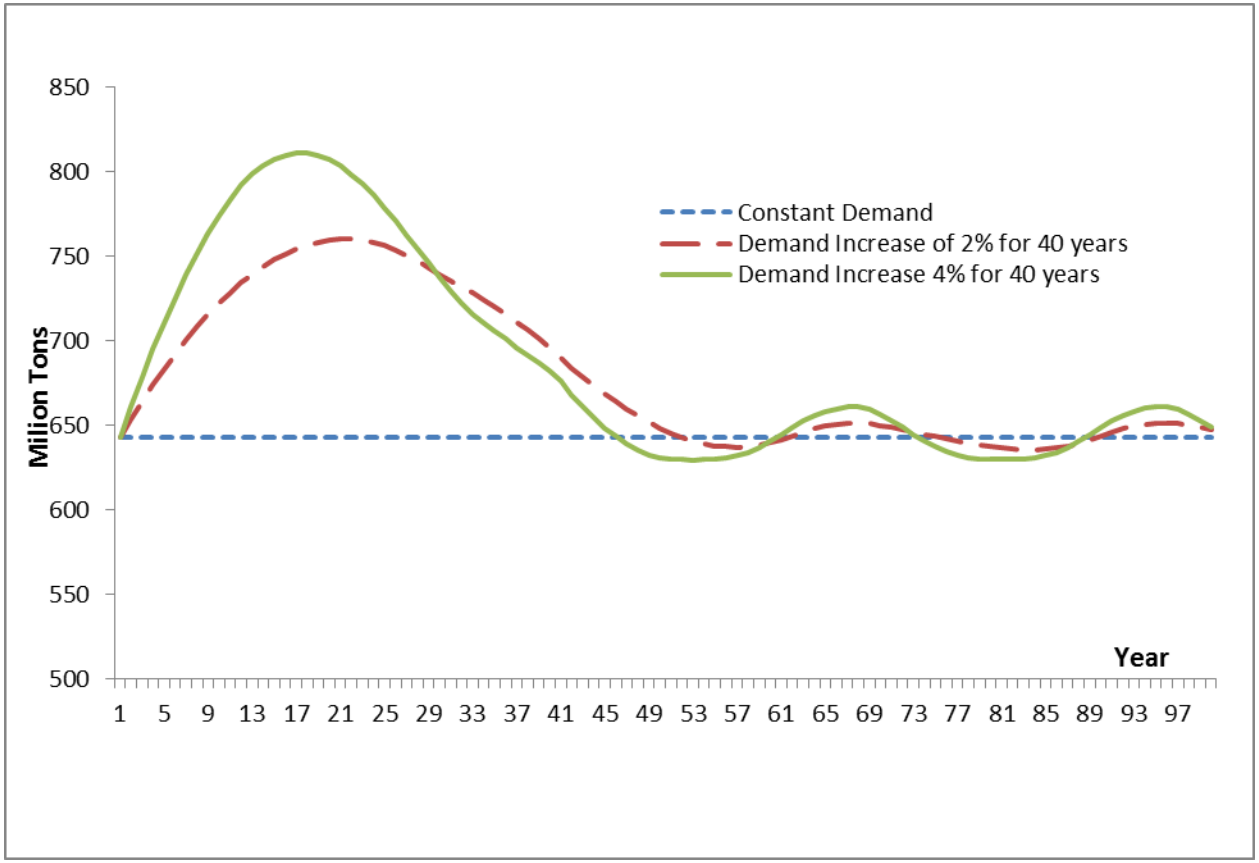


Figure 17 Scenario 4-Wood biomass price path

Forest land fixed at 16 million ha in 28 equal age classes; Base yield function.

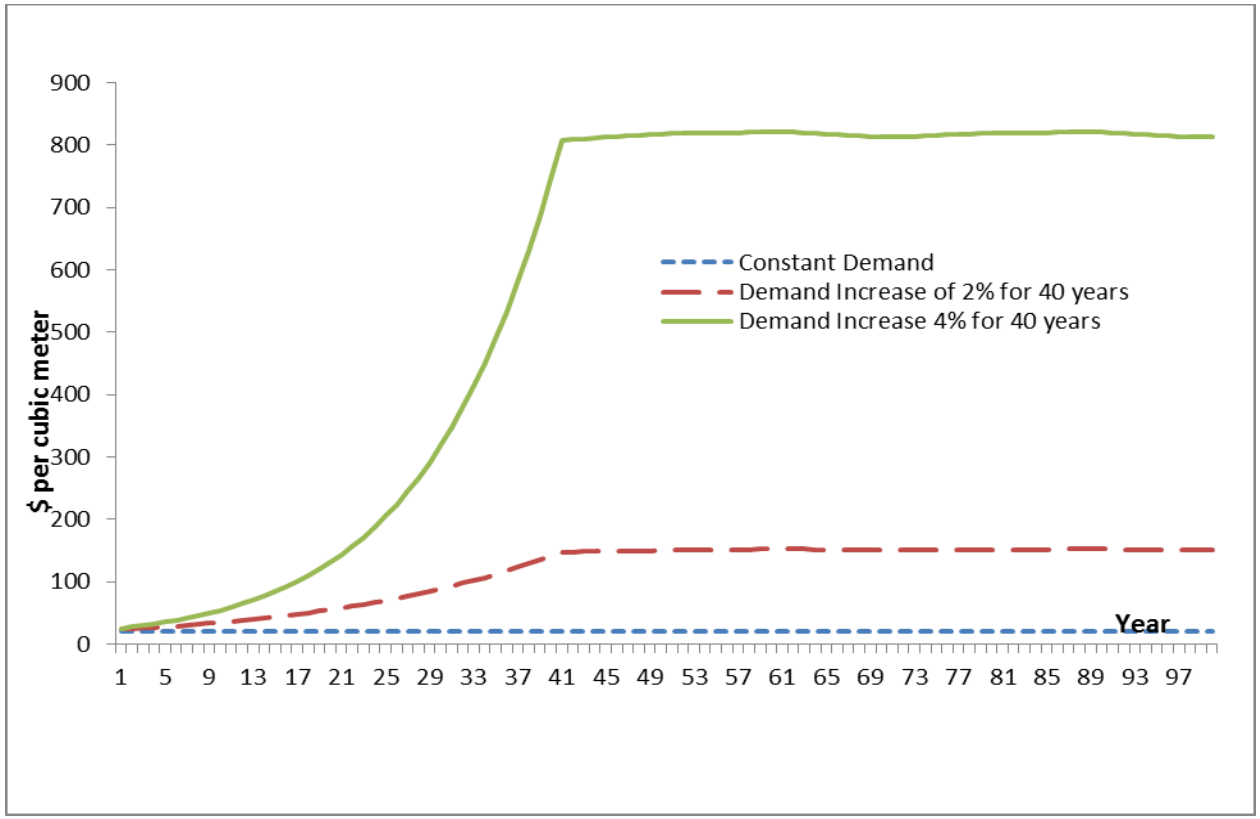
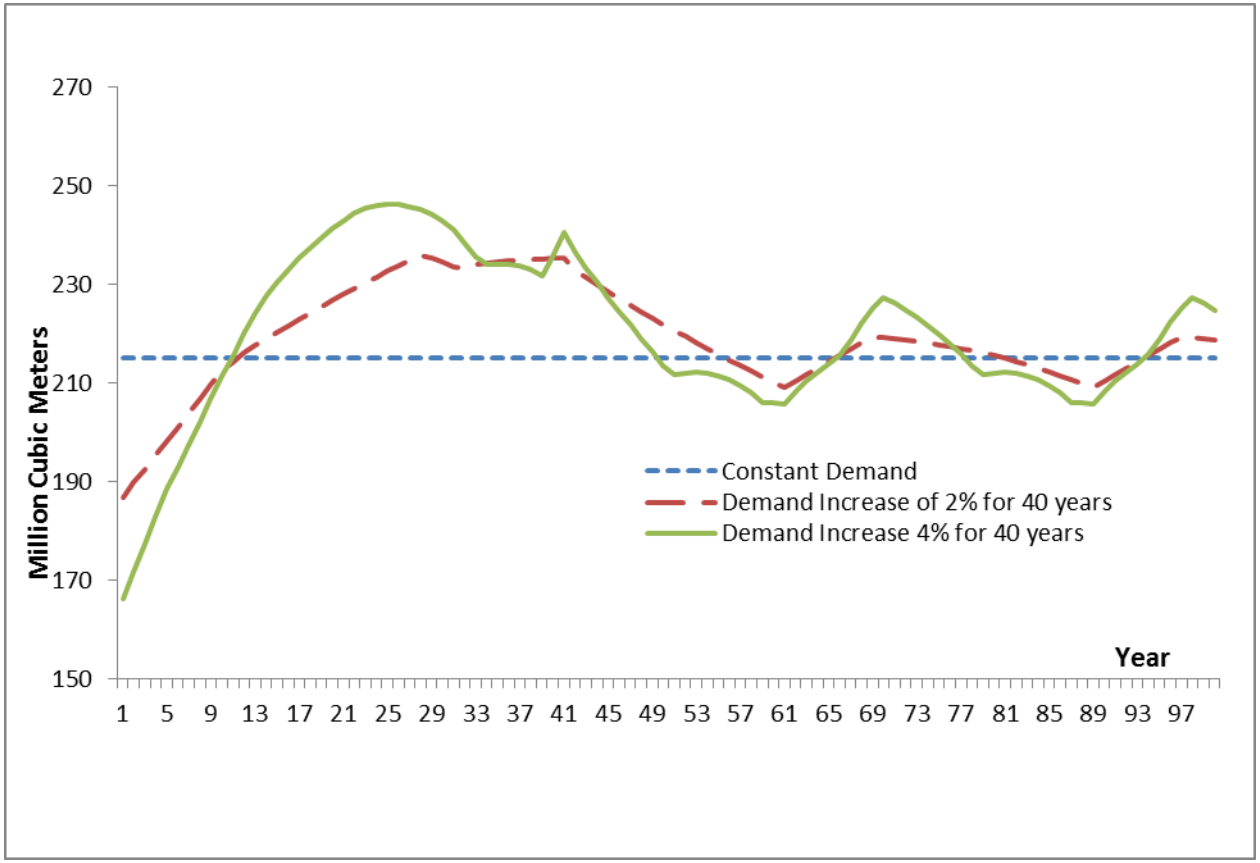


Figure 18 Scenario 4-Harvest path

Forest land fixed at 16 million ha in 28 equal age classes; Base yield function.



Conclusions

- While the EPA Accounting Framework captures carbon releases due to biomass energy, it does not account for forest management and forest expanding investments that expand forest carbon in response to anticipated demand increase for biomass for energy.
- Therefore the Accounting Framework is incomplete.
- For a managed regulated forest (most commercial forests), an anticipated **substantial increase in future demand** will **generally increase the forest stock and forest carbon**.
- These results are system wide and occur not only for an individual forest but also for an **interconnect forest system** where the various managers react to common market forces.

Conclusions (2)

- This result for the carbon footprint of biomass energy is **consistent with the IPCC treatment**, which treats net carbon emissions from the wood energy as zero. Any net carbon changes are monitored via changes in forest stocks.
- We find that the commercial forest stock will increase if a larger wood biomass demand is anticipated.