The importance of considering ecosystem and economic feedbacks as a basis for carbon policy

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OUTLINE

- Progress in carbon accounting
- Expanding model boundaries to capture leakage
  - The Bioeconomy
- Food vs fuel and carbon-negative landuse leakage
- Forest bioenergy and the possibility of carbon positive landuse leakage
- Why are carbon positive landuse results so controversial?
- Bioeconomic models and science-based carbon policy

Carbon Accounting

- Baseline and Additionality
  - Estimating the net carbon impact of a policy
- Direct leakage example - restricting harvest in one area just causes harvest to shift to another area.
- Indirect (market) leakage example – increased demand for corn for ethanol raises the price of corn and expands cropland at the expense of forest.
- The accounting boundaries (spatial and temporal) have to expand to capture indirect effect.

Bioeconomic models have become standard for science based policy

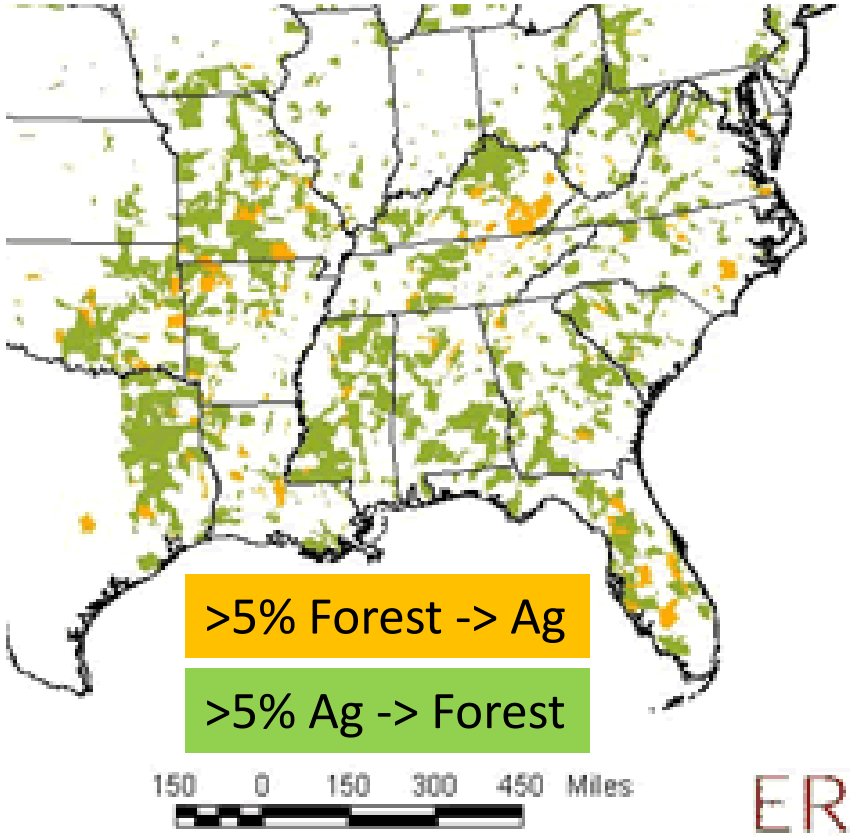
- A 2009 EU Directive led to four bioeconomic commissioned studies: one found negative carbon leakage for 1st gen biofuels, and positive carbon leakage for cellulosic biofuels
- US EPA Biogenic Carbon Science Advisory Board 2016 preliminary report*; "An integrated modeling approach that captures biophysical and economic dynamics".
- IEA Bioenergy Copenhagen workshop in 2014: *"(ii) studies that quantify greenhouse gas balances should adopt a full life cycle, comprehensive system view and preferably use information and data from biophysical and socio-economic modelling studies that consider market effects [and] several alternative scenarios".*

Positive carbon leakage

- Simple negative carbon leakage story
  - increased demand for corn for ethanol raises the price of corn, intensifies corn production and expands cropland at the expense of other land with more carbon.

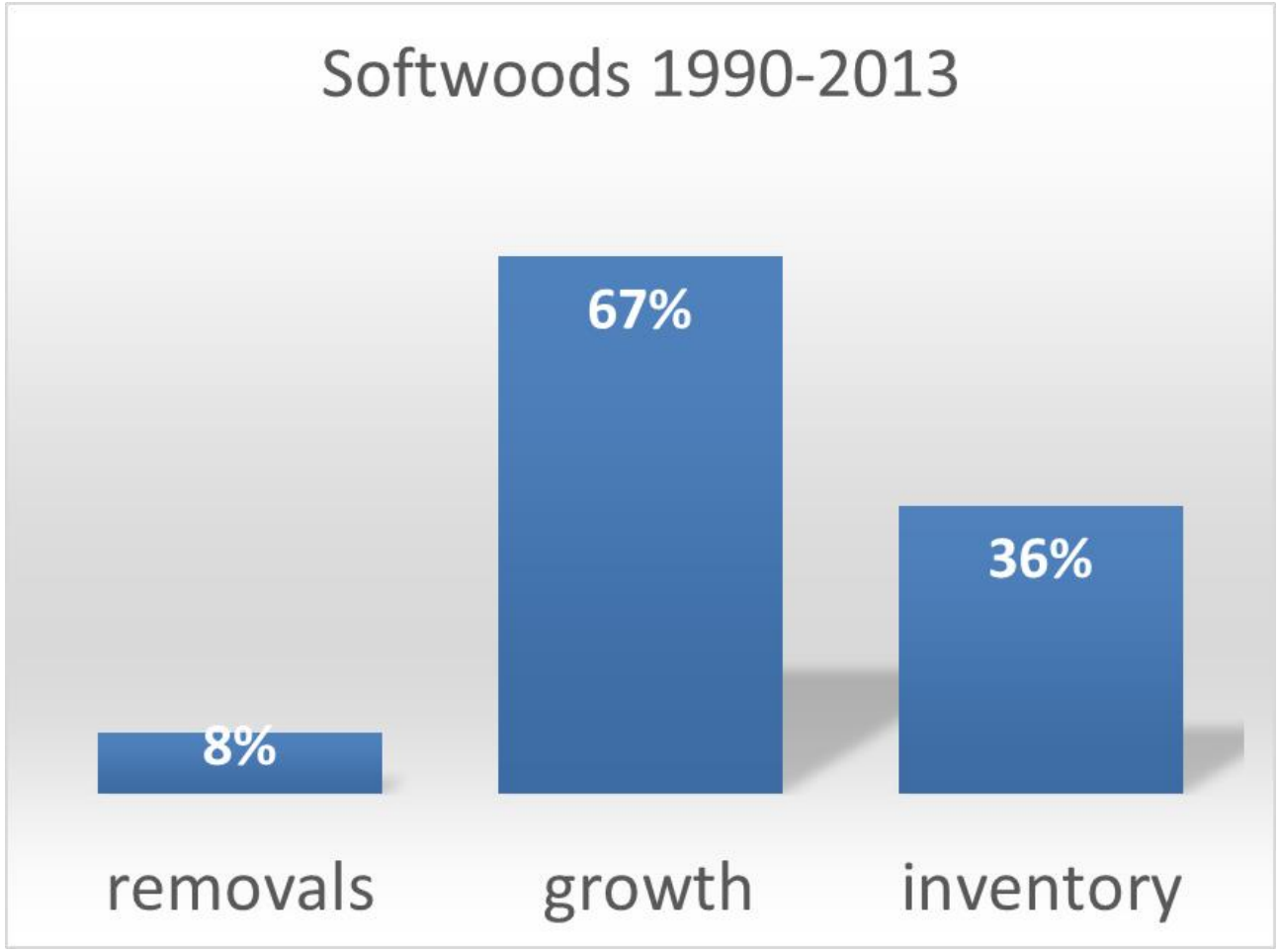
- Simple positive carbon leakage story
  - Increased demand for wood for bioenergy raises the price of timber, intensifies wood production and expands forest land at the expense of other land.
  - US South as an example, privately owned largely un-regulated landscape where marginal agriculture competes with forest land

For the last 50 years forestland area stable, but not static

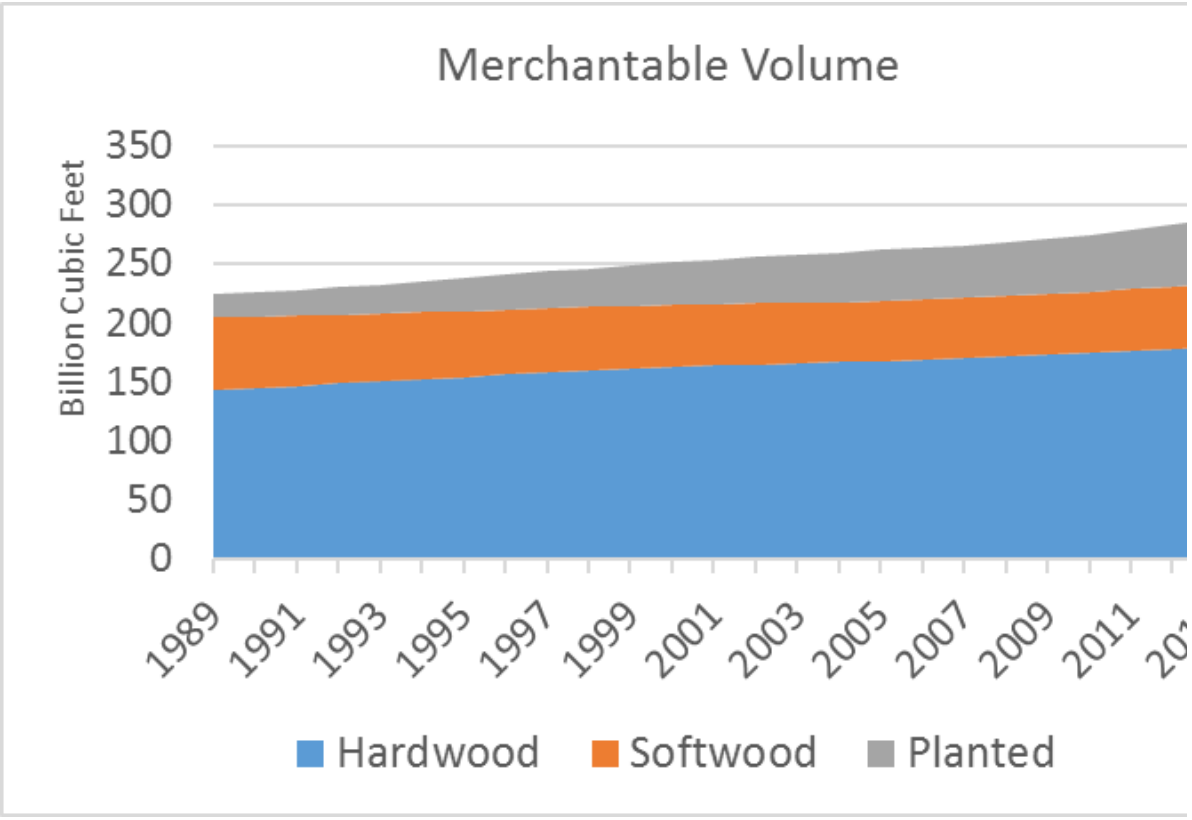


"…we identified the rise in timber net returns as the most important factor driving the increase in forest areas between 1982 and 1997. This is consistent with reports that the increase in forests largely involved timberland acreage." (Lubowski et al. 2008)

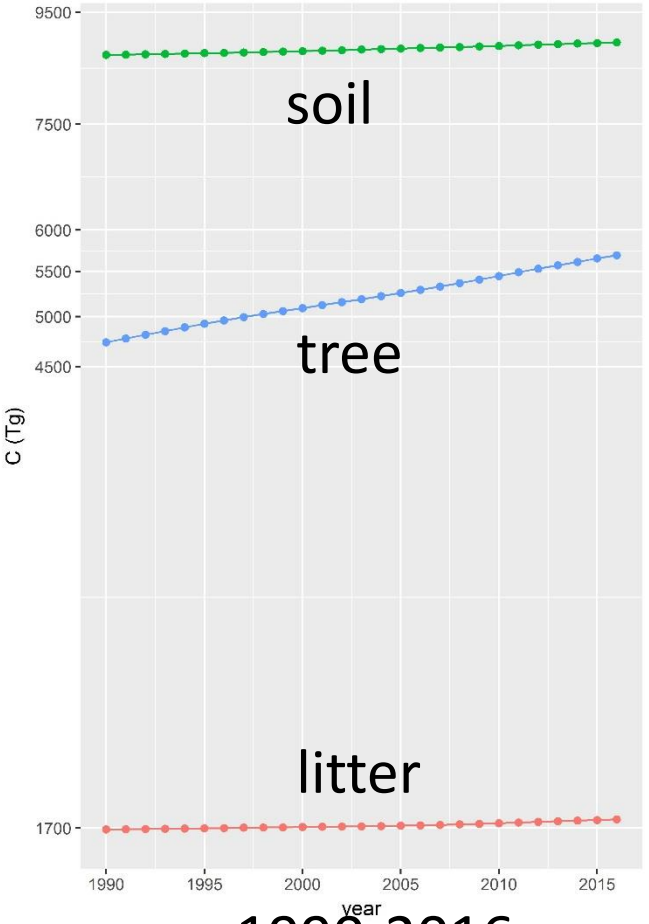
Removals, Growth, Inventory



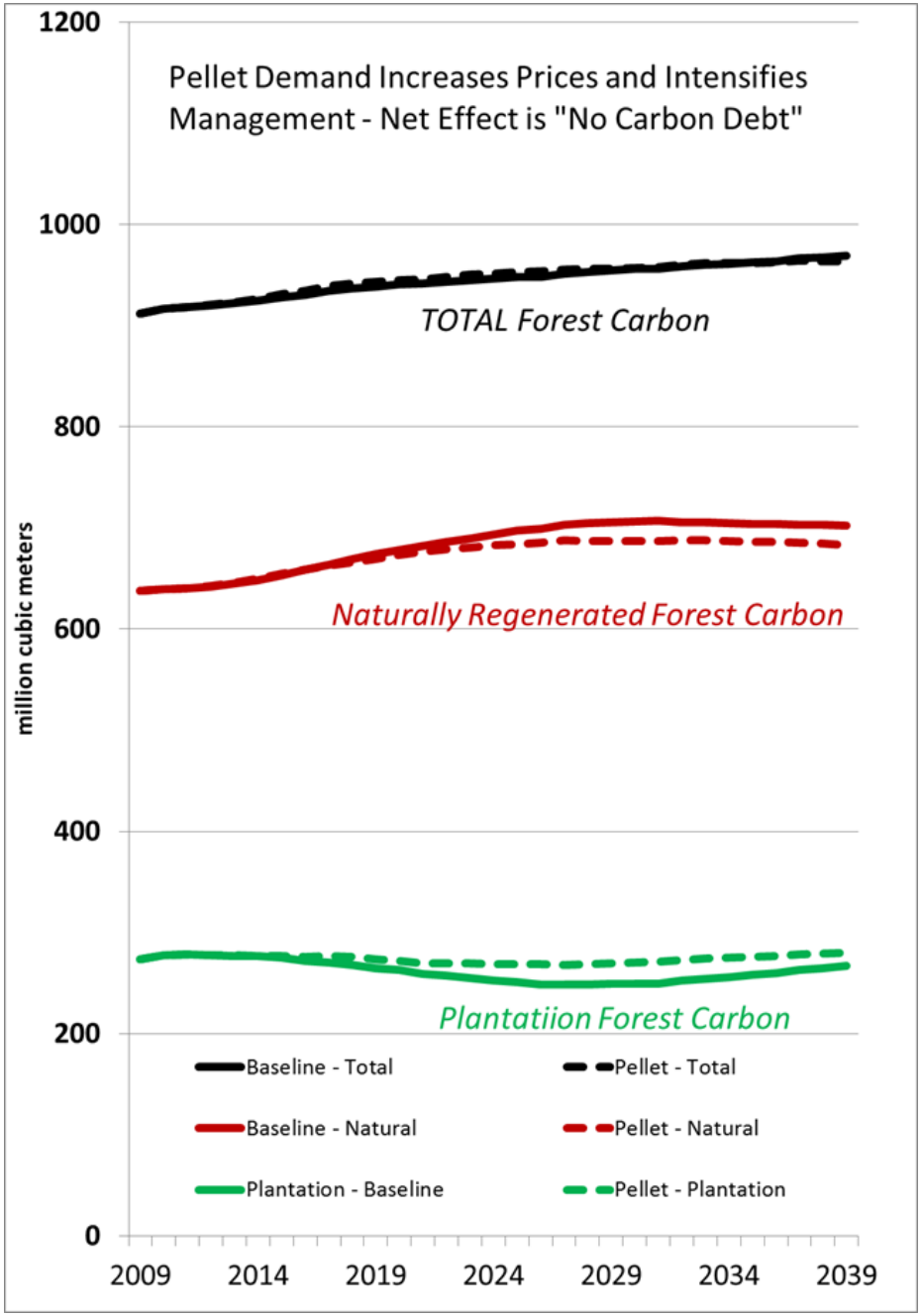
Forest Inventory



Carbon Stock



1990-2016



Pellet Demand

Projection Results:

Increasing forest value affects area in forest and distribution of forest types.

This model does not assume that forest owners are profit maximizers. It uses empirical estimates of how landuse changes when prices change.

This is just the forest carbon story.

Positive Land Carbon Leakage

- Plausible under the right conditions
- Consistent with historical trends
- Not **the** solution, but seems to improve carbon sequestration and stock in some regions
- Seems controversial
- Recent experience in US meetings

Two high level scientific meetings

- Meeting 1
  - Government convened panel of scientists *(ecologists, economists, forest & ag carbon modelers, policy experts)*
  - Agree on bioeconomic modeling approach *(lots of discussion, general agreement but not without skeptics)*
  - Integrated forest-agriculture national level bioeconomic model results included positive and negative carbon leakage.
  - Report passed to another group of eminent scientists for approval.
  - Response from prominent ecological scientists – not accepted – *results too dependent on economics*

Two high level scientific meetings

- Meeting 2
  - Foundation convened panel of scientists (ecologists, economists, forest & ag carbon modelers, policy experts)
  - Discussed emerging literature and results from biophysical and bioeconomic models, the latter with both positive and negative carbon leakage.
  - Summary conclusion from prominent ecological scientist – “need to get economics out of these models”

Why are these results controversial?

What are the implications for science based policy?

My thoughts as an economist in a natural resources college:

“Bioeconomic models require another order of magnitude of assumptions”

- Linked economic and biophysical models require additional layers of ***explicit*** economic assumptions
- Projecting a future without market feedbacks requires a particular set of ***implicit*** economic assumptions.
- Ignoring implicit assumptions and their likelihood might reduce variability in model results, but it will not improve model accuracy or strengthen its basis for policy.

"Economists cannot predict the short run, why should we believe long run forecasts"

- Long-term dynamics of key macroeconomics drivers like GDP have less variability than short run variables tied to business cycles.
- Forest stocks change slowly; given data on age class structure and growth, long-term supply trends for forests are easier than crops, for example.
- Accuracy of the reference or baseline projection is not a prerequisite for a policy relevant model.
- **The direction and scale of the marginal effect of a new policy on forest and atmospheric carbon outcomes is the policy relevant information.**
- **This probably depends on economics.**

“You trust what you can see”

- Easy to identify the trees preserved in a carbon offset project.
- Harder to identify the harvest caused by project leakage elsewhere.

- For positive landuse leakage you see the harvest from increased demand
- Harder to identify the specific area planted or not lost to landuse change due to increased demand.

- Forest harvest has more visible aesthetic and ecological implications.
- Forest growth is not so dramatic.

Models results seem wrong, so the assumptions must be wrong

- Confirmation bias - at some level, we all choose what science to believe.
- The concept that harvesting trees and using them for energy can possibly lead to a future with more forest carbon and less atmospheric carbon is not intuitive.
- It is human nature to view science as more credible if it matches your intuition.
- For example there is considerable evidence that skepticism of anthropogenic climate change is not related to less understanding of climate science.
- Internal biases are not easily changed by science.

Climate policy has an asymmetric loss function

- Relatively positive forest and atmospheric carbon outcomes seem valid, but
- Rational policy choices might be conservative simply to avoid catastrophic outcomes.
- **It is critical, to separate a conservative policy choice based on the best available information from a skepticism of science that leads to more optimistic outcomes.**

Conclusion

- Ultimately the role of models is to increase our understanding of complex systems and to help guide policy toward better choices.
- **For scientists, careful scrutiny of fully informed models with explicit assumptions leads to better understanding of the bioeconomy.**
- **Science based policy requires the same.**

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