turning knowledge into practice

Terrestrial Carbon Sequestration to Offset Greenhouse Gases: U.S. Economic Potential

Presented by

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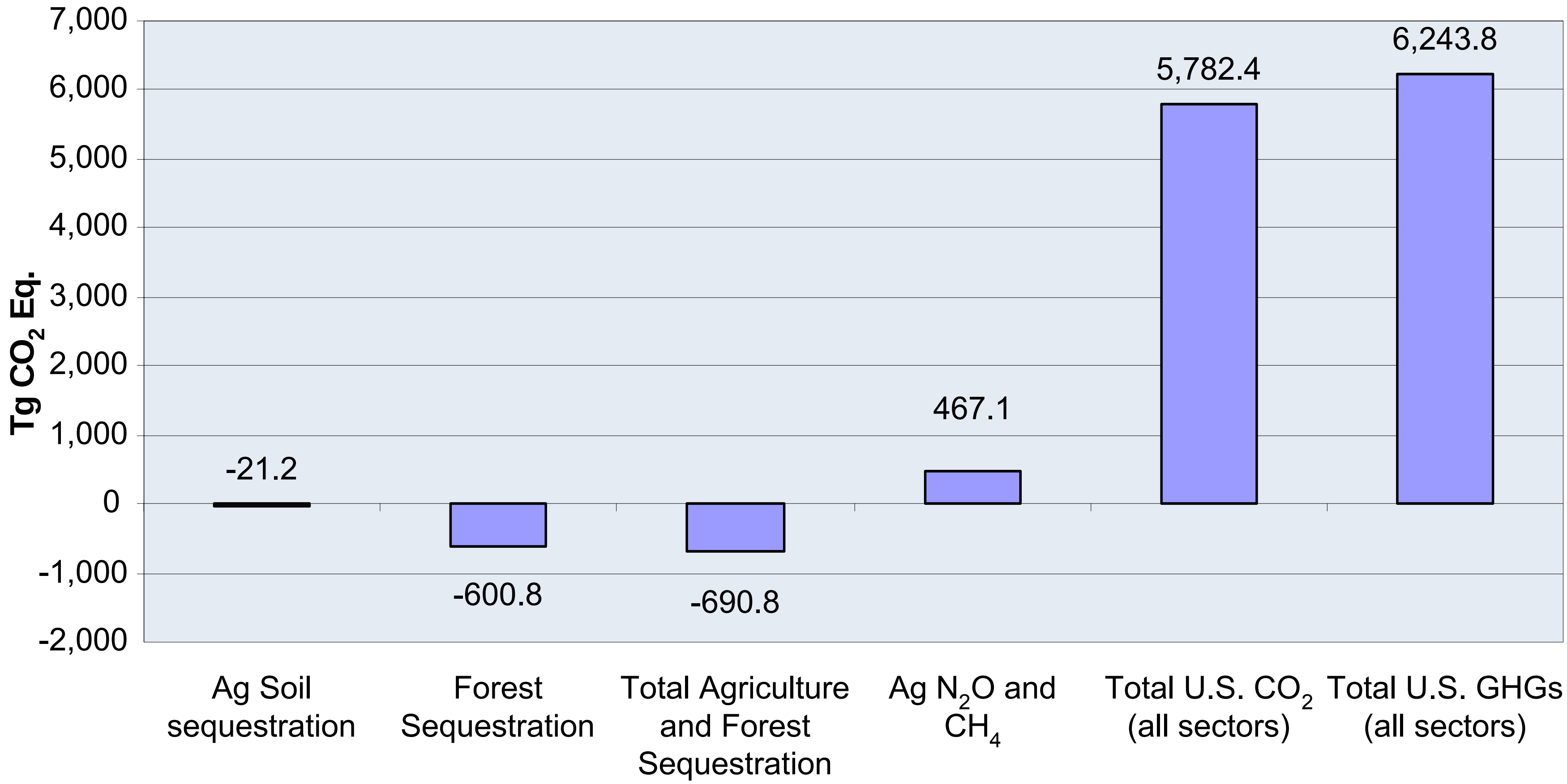
** On sabbatical from Ohio State University*

Can Actual Practice Match the Hype?

Lets first look at the hype

Terrestrial Carbon Sinks Offset 11% of Annual GHG Emissions in the United States, 2002

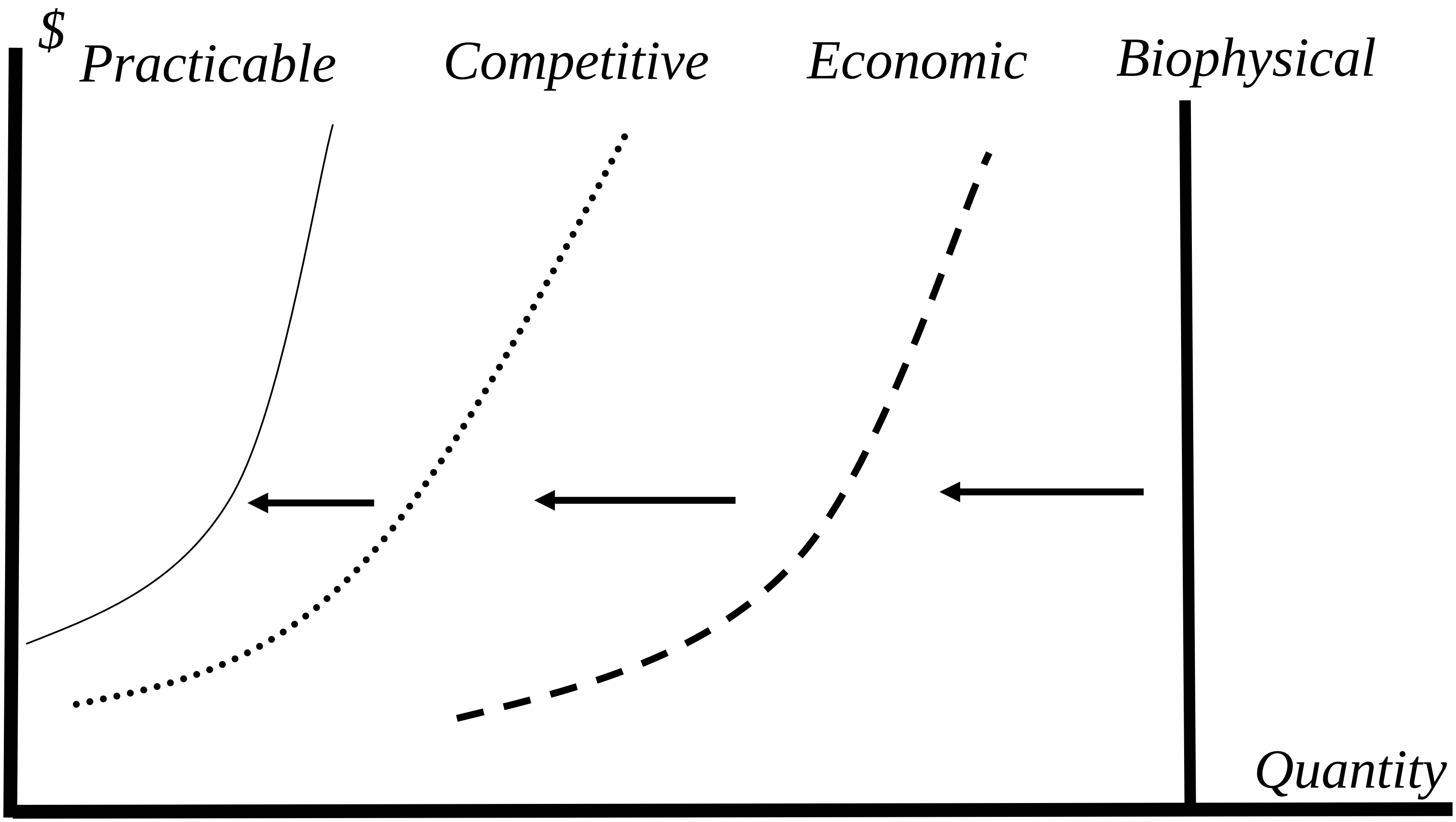


Source: US EPA (2004). "Total" includes urban forests and yard waste (not in forest or ag subtotals)

Several Terrestrial Activities Have High Potential Sequestration Rates (per acre)

Activity	**Representative Carbon Sequestration Rate in U.S.** (Metric tons of CO_2 per acre per year)
Afforestation	2.2 – 9.5
Reforestation	1.1 – 7.7
Avoided deforestation *	83.7 – 172.1
Changes in forest management	2.1 – 3.1
Reduced tillage on croplands	0.6 – 1.1
Changes in grazing management	0.07 – 1.9
Cropland conversion to grassland	0.9 – 1.9
Conservation of riparian buffers	0.4 – 1.0
Biofuel substitutes for fossil fuels	4.8 – 5.5

Can this Biophysical Potential be Tapped Economically, Competitively, and Practically?



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Assessing the Economic and Competitive Potential

- Economic Model of the US Forest and Agricultural Sector: FASOMGHG (w/ B. McCarl and colleagues)
  - Commodity markets
  - Land Use
  - Carbon and GHGs
- Evaluate Sector Responses at range of GHG prices from $1-50 / t CO_2
  - Sequestration
  - Other mitigation (methane, nitrous oxide)

Different Options at Different Prices

	Constant Prices Over Time				
Activity	**$1**	**$5**	**$15**	**$30**	**$50**
Afforestation	0.0	2.3	**137.3**	434.8	**823.2**
Forest management	**24.8**	105.1	**219.1**	314.2	**384.8**
Agricultural soil carbon sequestration	**62.0**	122.7	**168.0**	162.4	**130.6**
Fossil fuel mitigation from crop production	20.5	31.9	53.1	77.6	**95.7**
Agricultural CH_4 and N_2O mitigation	9.4	15.2	32.0	66.8	**110.2**
Biofuel offsets	0.0	0.1	57.2	374.6	**560.9**
All Activities	**116.8**	277.3	**666.7**	1,430.4	**2,105.4**

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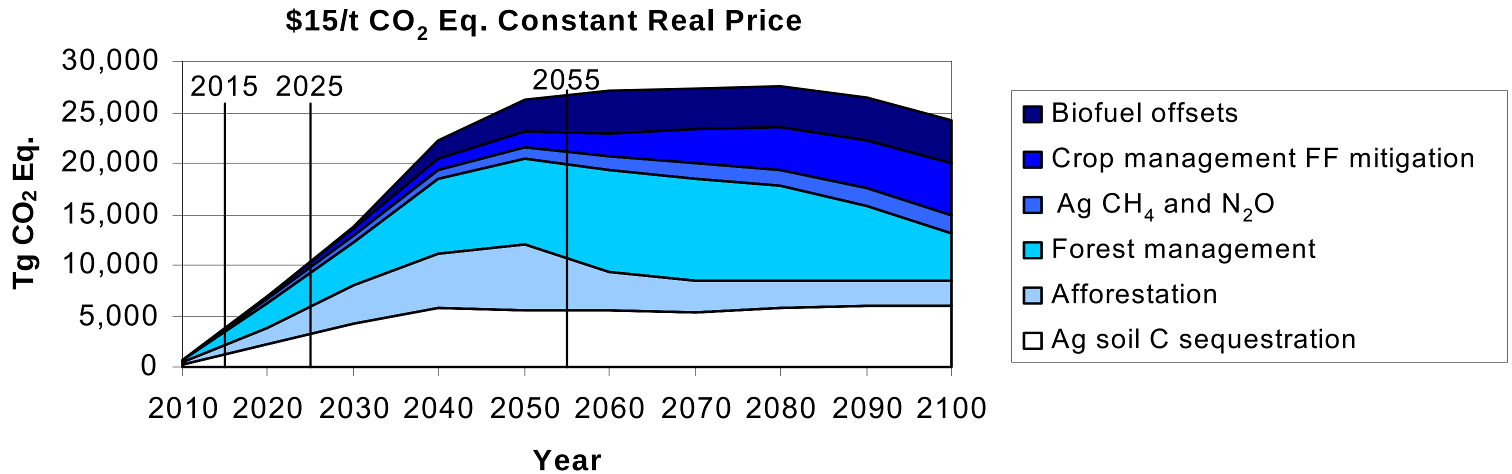
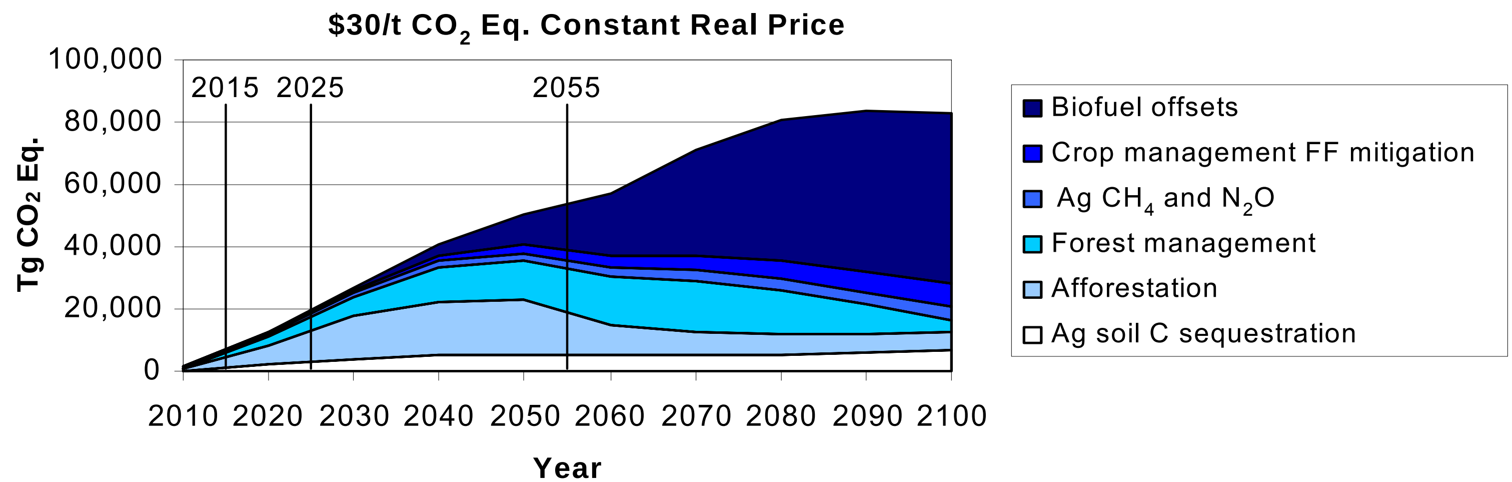
Sequestration is Strong for Several Decades, then Tapers and Reverses





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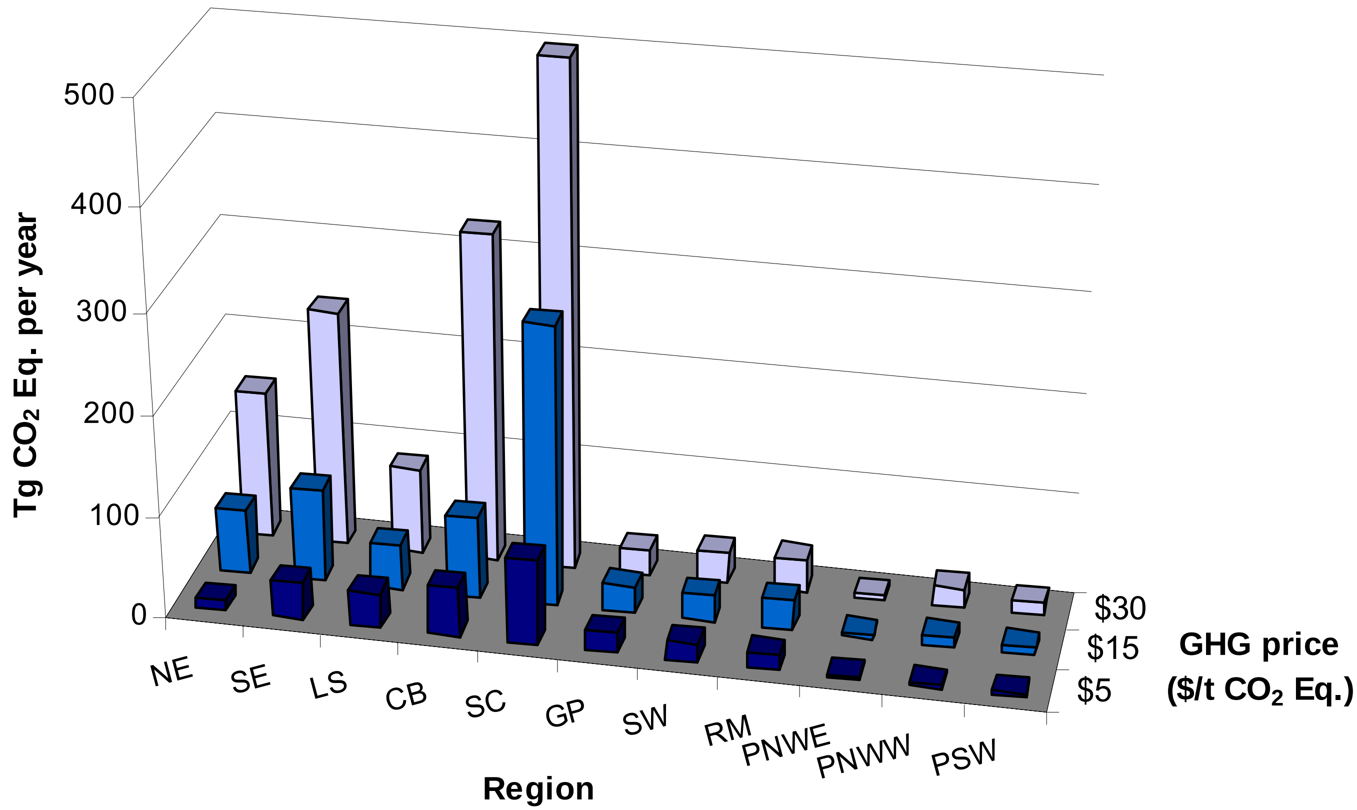
Not all Regions Contribute Equally



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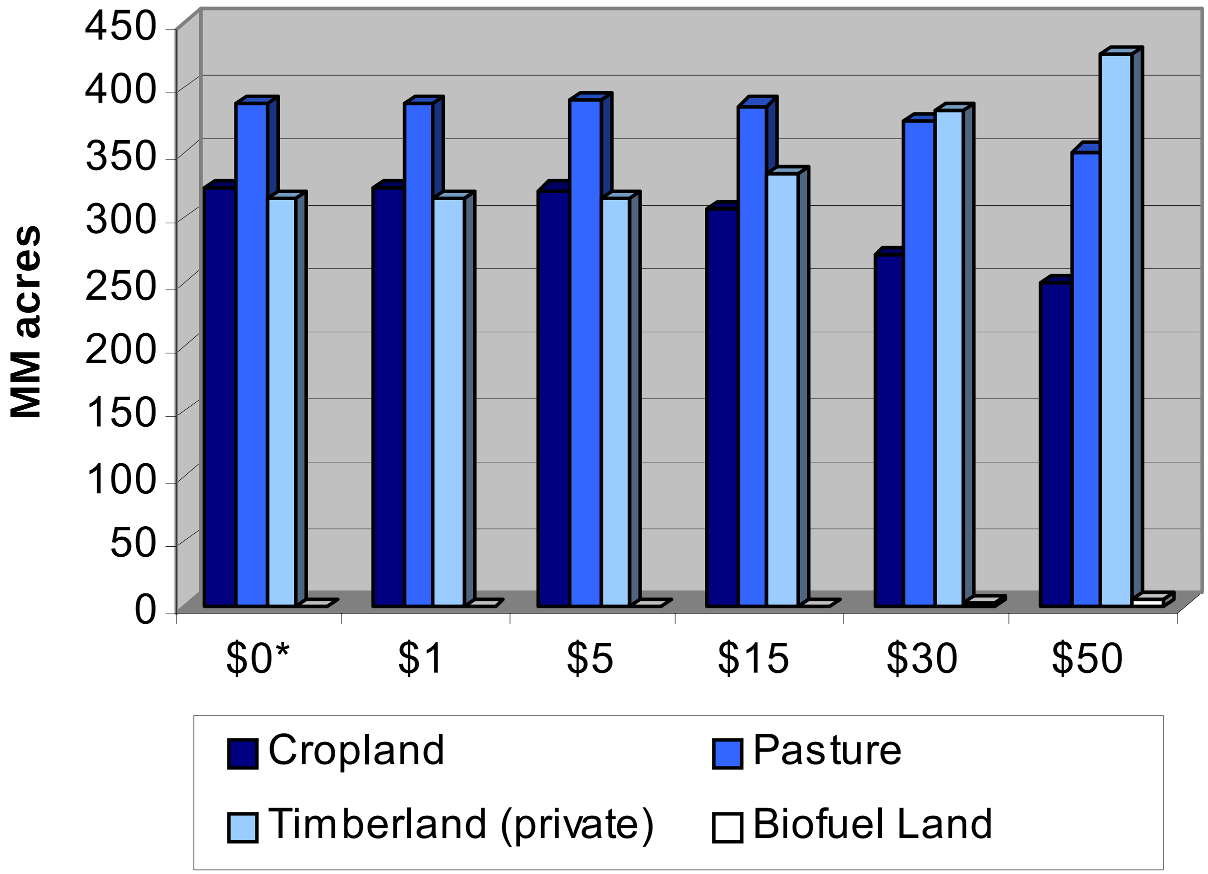
High Sequestration Incentives Alter Land Use

Land Use Projection for 2025 by GHG Price Scenario



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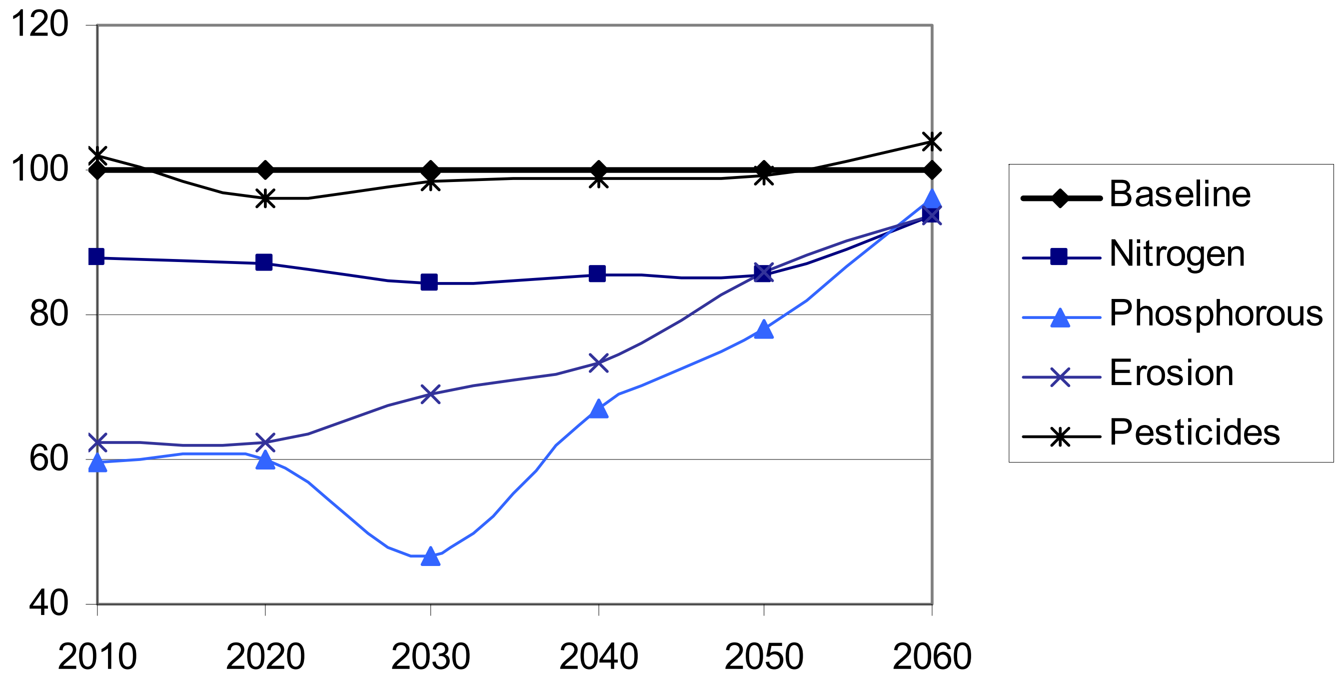
Altered Land Use can change Agricultural Loadings to Waterways

Pollutant loadings at a $15/t CO2 GHG price (relative to baseline)



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Practicability and Implementation: GHG Offset Projects

- No GHG cap in US
- Even where caps exist or are envisioned, sequestration would generally be outside the system
  - "Offset" –generate credits that emitters within the system can buy to reduce net emissions
  - "Projects" – Location-specific action to sequester C (e.g., tree planting project)
- Offset projects create ***transaction costs***

Transaction Cost 1: Measurement, Monitoring, and Verification

- Measurement of above-ground carbon (trees, vegetation) is easier than below-ground carbon (roots, soil)
  - Methods range from sampling to modeling to use of "default values"
- Monitoring frequency will depend on program requirements
  - The more frequent, the more costly
- Verification by a 3'rd party may be required to certify trades

Transaction Cost 2: Market Aggregation

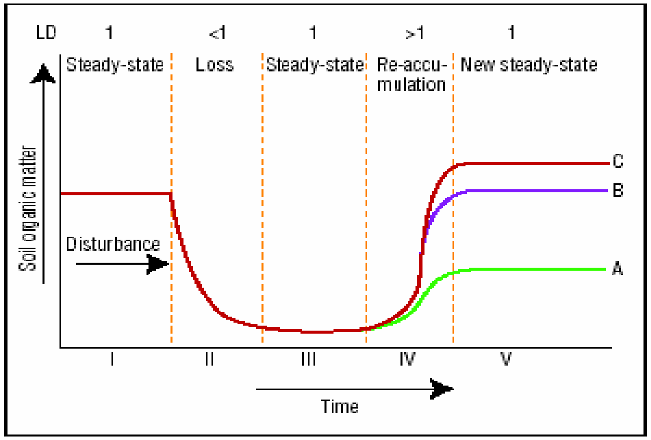
- Aggregation: bringing together sellers and buyers
- If projects are small and sellers are numerous, aggregation costs can be high
- Experiences to draw on – agricultural cooperatives, timberland leasing, crop insurance

Transaction Cost 3: Project Accounting Adjustments

- Because offset projects allow the buyer to emit a ton of GHG, efforts needed to ensure that the real reductions of the project are commensurate
- Issues
  - Permanence
  - Leakage
  - Additionality

Permanence

- Sinks have biophysical limitations ("saturation")



- Reversal: Accumulated carbon can be re-released
  - Harvests
  - Reversion of practices
- Ton sequestered may not equate to a ton of emissions permanently foregone

Leakage

- Displacement of emissions outside the project boundaries
  - Caused by economic forces of **supply and demand**
  - E.g., afforestation in project area can lead to forest-clearing in another area
  - Need to net out the losses outside the project when crediting project
- Leakage is **not unique to sequestration projects**
- But, **features of forestry and agriculture** make them somewhat susceptible to leakage
  - Fixed land base
  - National and global commodity markets

Additionality

- Want to assign credits for activity (and carbon) above what would have occurred anyway
- Set a project baseline: estimate of “business-as-usual” activity and carbon, over time
- **Additional** C = Project C – Baseline
- Only part of the project’s benefits may be deemed additional

Upshot

- Protocol development underway to standardize requirements for MMV, handling of issues such as permanence, leakage, and additionality
  - Internationally: Kyoto-driven
  - US: 1605(b) program, Chicago Climate Exchane, state actions (e.g., California Registry)
- Where demand is high (e.g., Europe), institutions have formed to develop and aggregate projects for GHG offsets

How to Make Practice Match the Hype?

- Match the activity with the level needed
  - Low Price: Ag Soil C, Forest Management
  - Medium Price: Afforestation
  - High Price: Biofuels
- Reduce transaction costs by developing standards and facilitating aggregation of projects
- Think of terrestrial sinks as a “bridge to the future”
  - High potential
  - Reasonable cost
  - Available now
  - But temporary fix