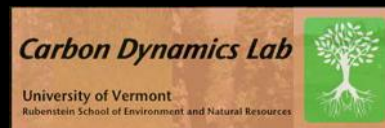
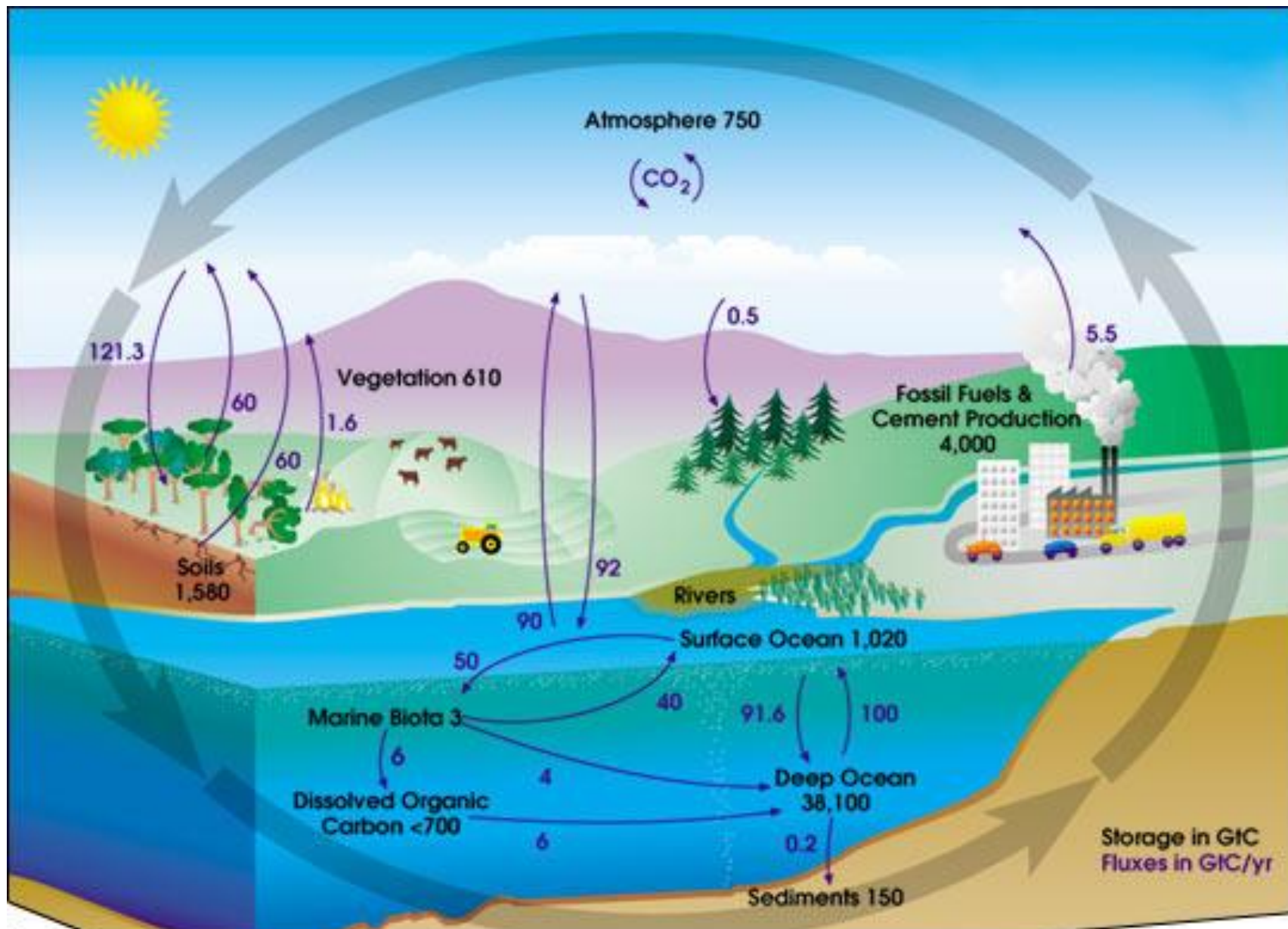


Opportunities for Forest Carbon Projects in Vermont

*Testimony provided to the House
Natural Resources and Energy
Committee, Vermont State
Legislature, April 30, 2015*

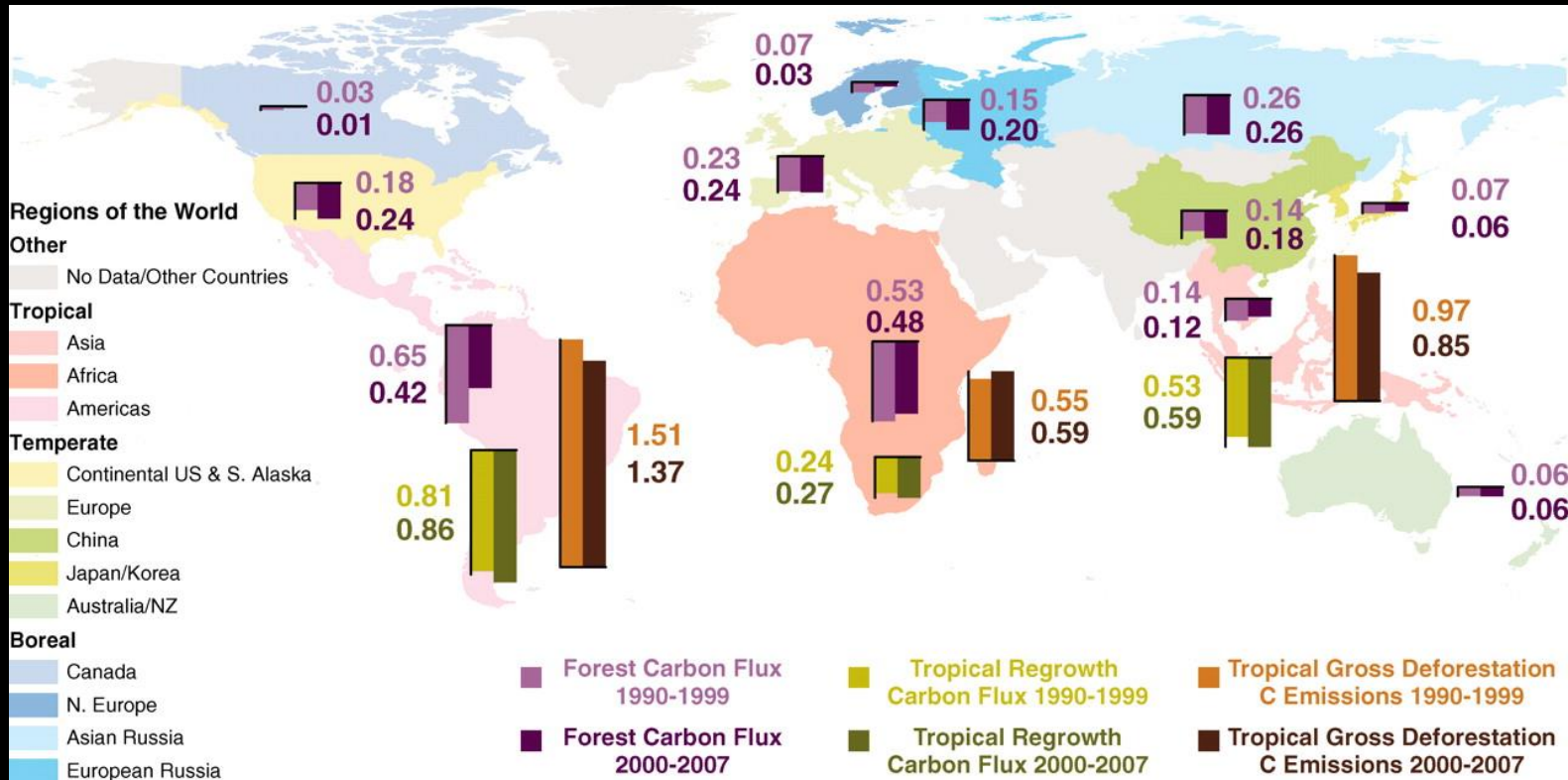
William Keeton University of Vermont,
Rubenstein School of Environment and
Natural Resources and Gund Institute
for Ecological Economics





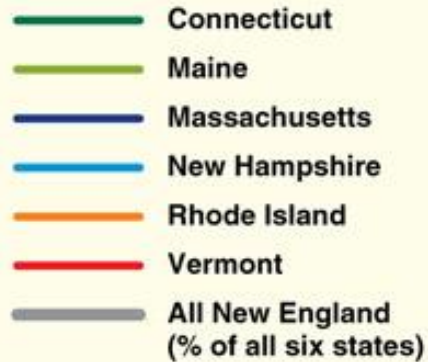
The Carbon Cycle

Pan et al. 2011. A Large and Persistent Carbon Sink in the World's Forests. Science

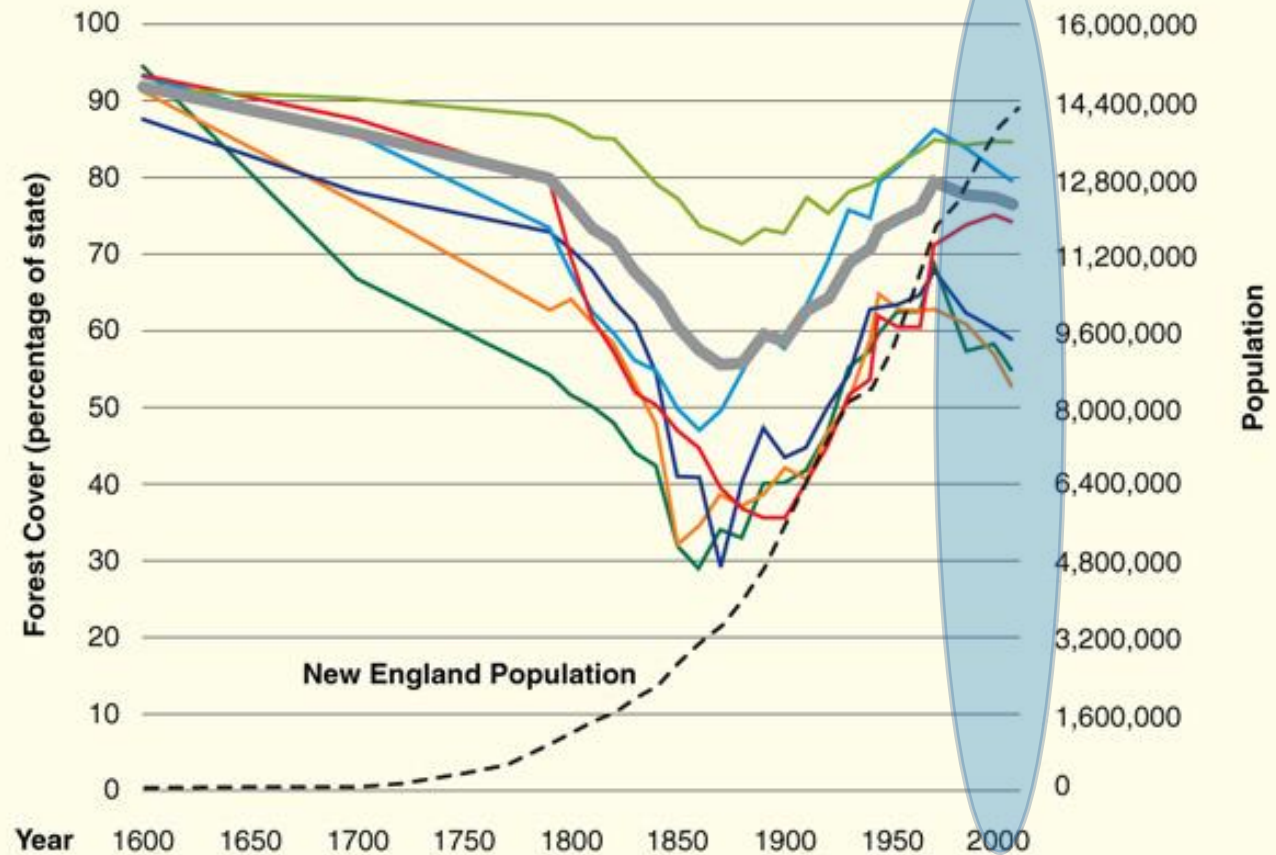


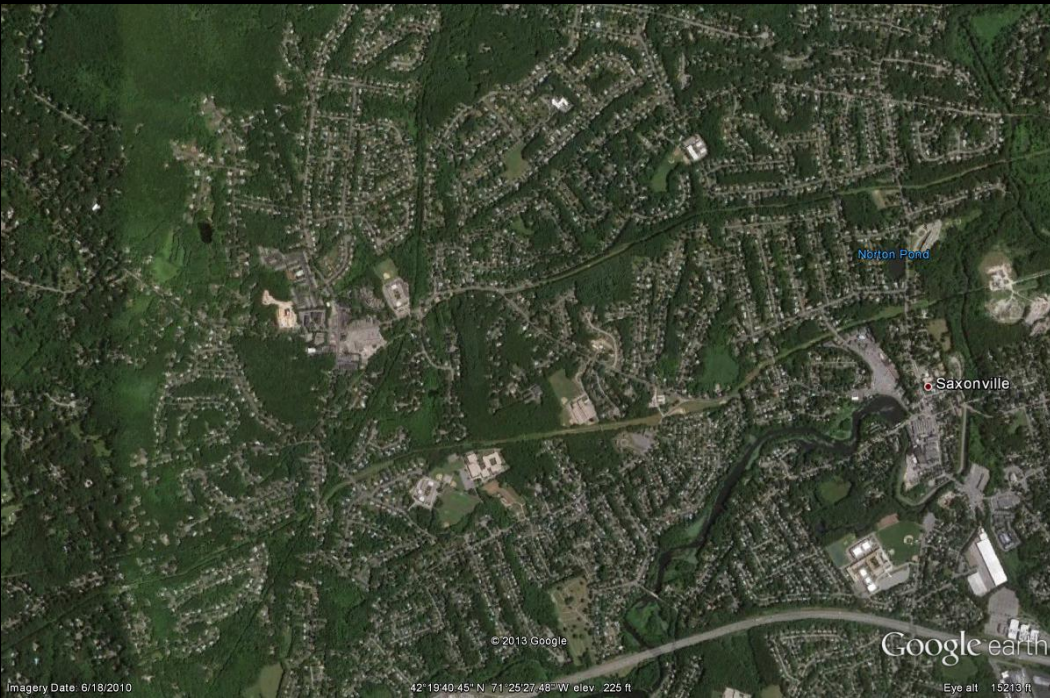
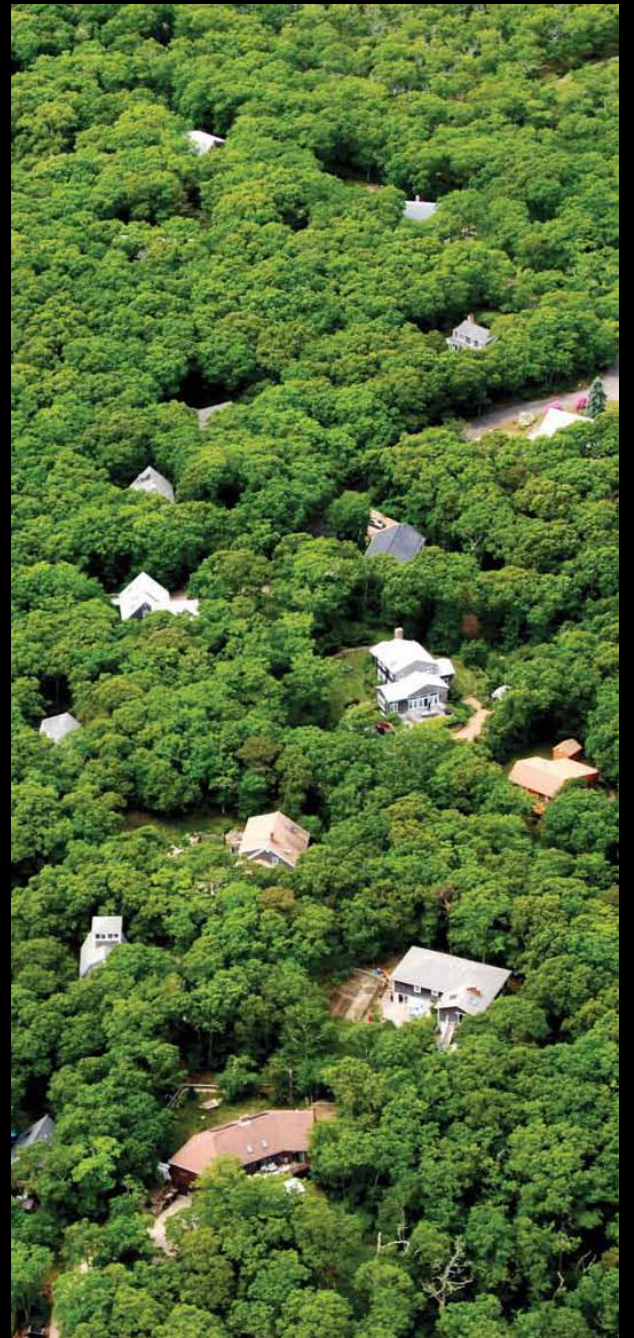
- Deforestation → ~15% of annual global GHG emissions
- World forests are a net C sink, sequestering 2.3 Pg/yr
- U.S. forests sequester ~12% of annual U.S. GHG emissions

Why conserve and manage forests for carbon?



Forest cover change in New England since the early 1600s





How do we encourage conservation of working forests?

Exploit available opportunities

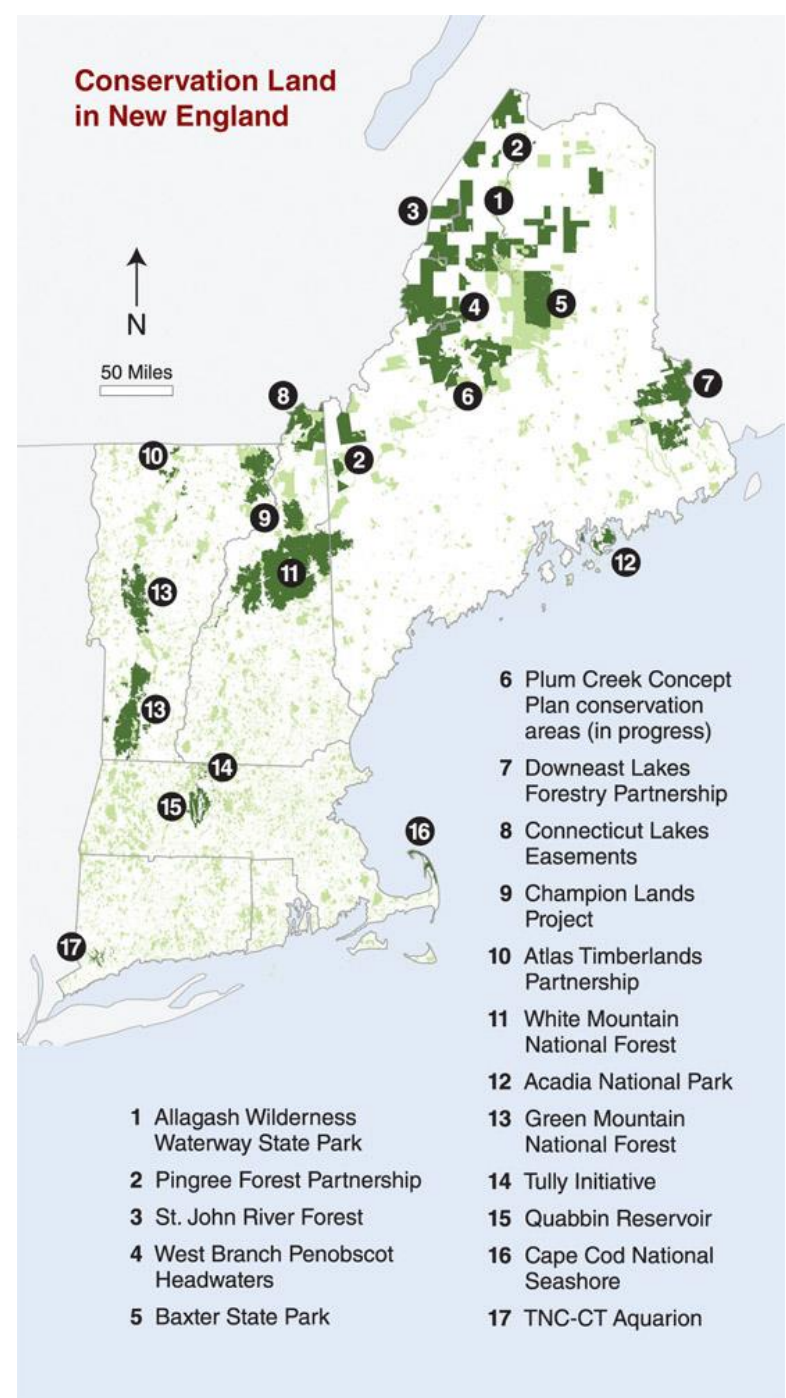
For example:

- Conservation of former industrial timber lands through tenure transfer and easements
- Expansion of existing open space programs

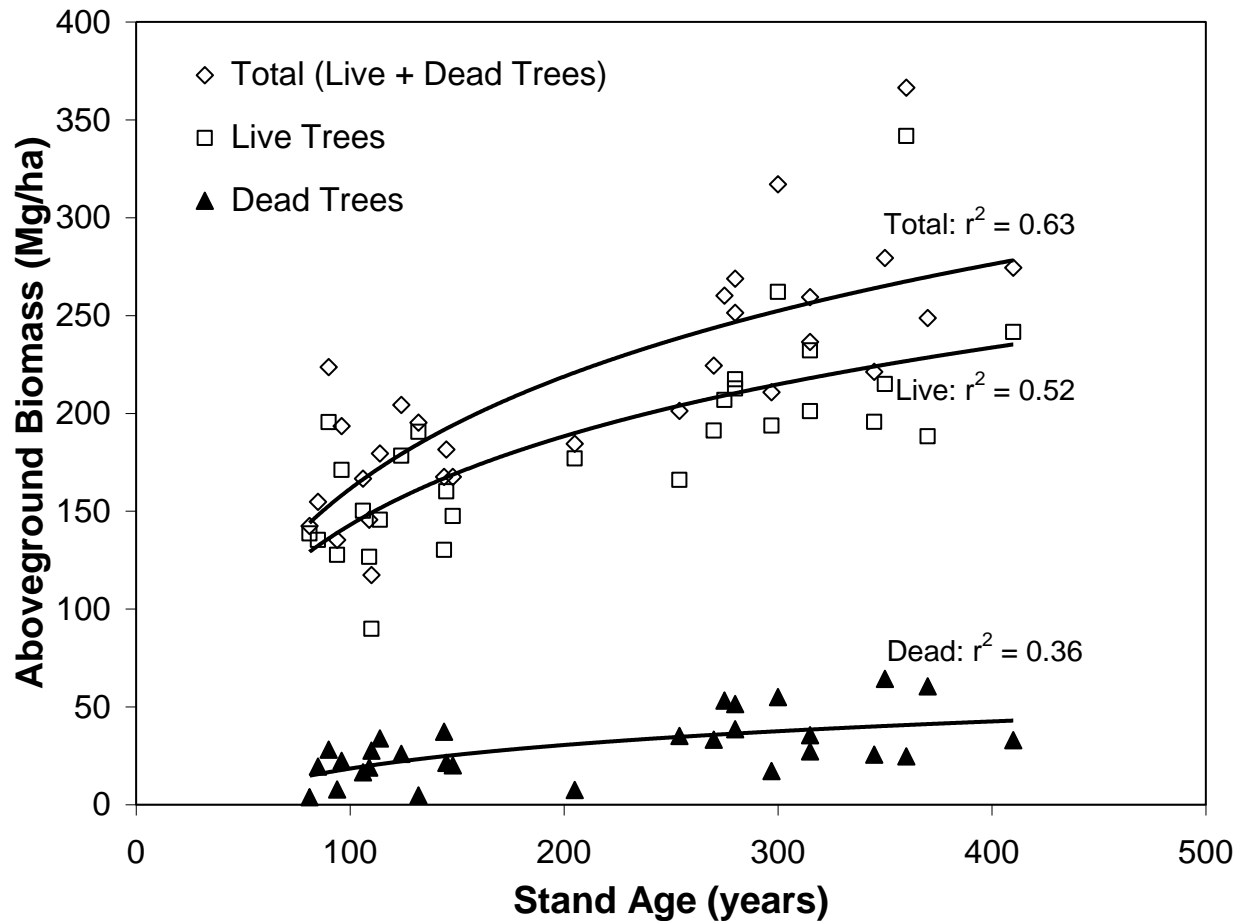
Implementation recommendations

For example:

- Tax incentives
- Public-private funding mechanisms
- Facilitation of carbon market participation
- Market cooperatives



Carbon is an umbrella for many ecosystem services people care about



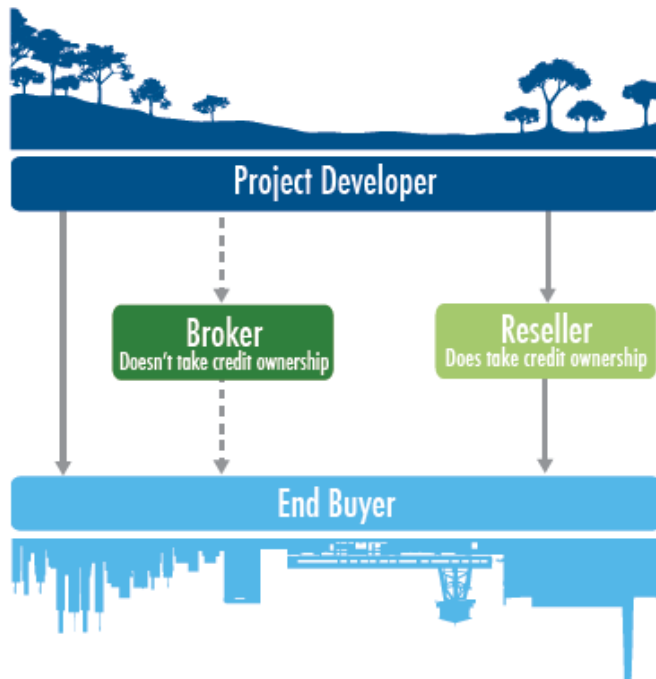
From: Keeton, Whitman, McGee, and Goodale. 2011. Forest Science

Voluntary Market ("Over the Counter")

Compliance Market (Regulated or "Cap and Trade")

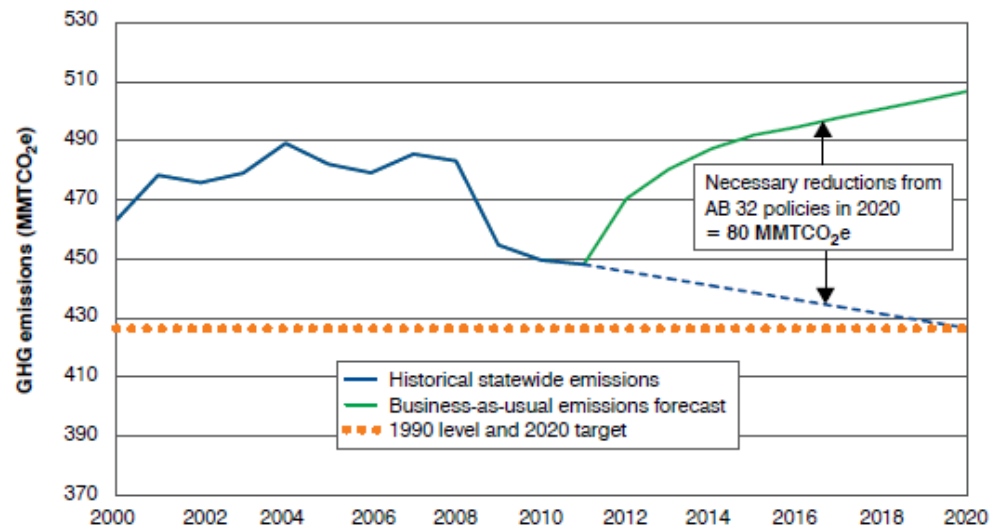
Vs.

Voluntary Carbon Markets Value Chain



Source: Forest Trends' Ecosystem Marketplace.
State of the Voluntary Carbon Markets 2013.

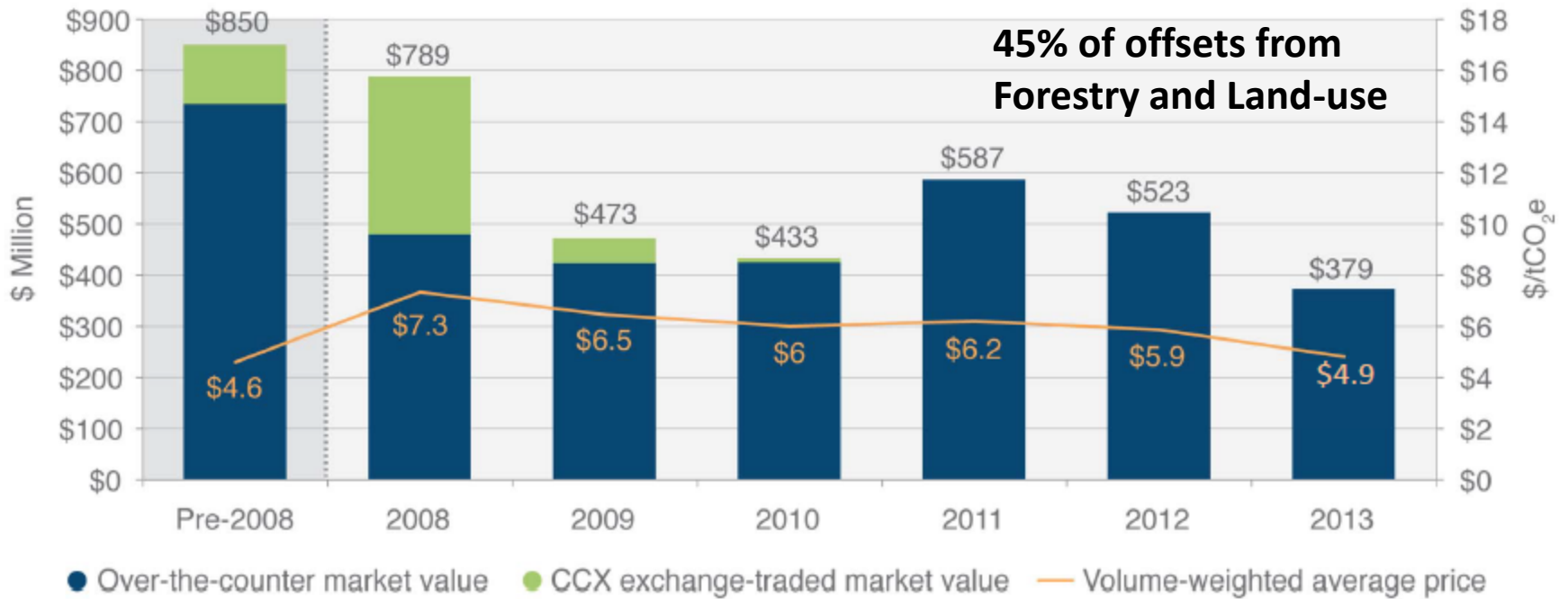
AB 32 emissions reduction target compared to the business-as-usual scenario



Source: Historical 2000 to 2011 GHG Emissions Data⁹ and Emissions Forecast¹⁰ from California Air Resources Board

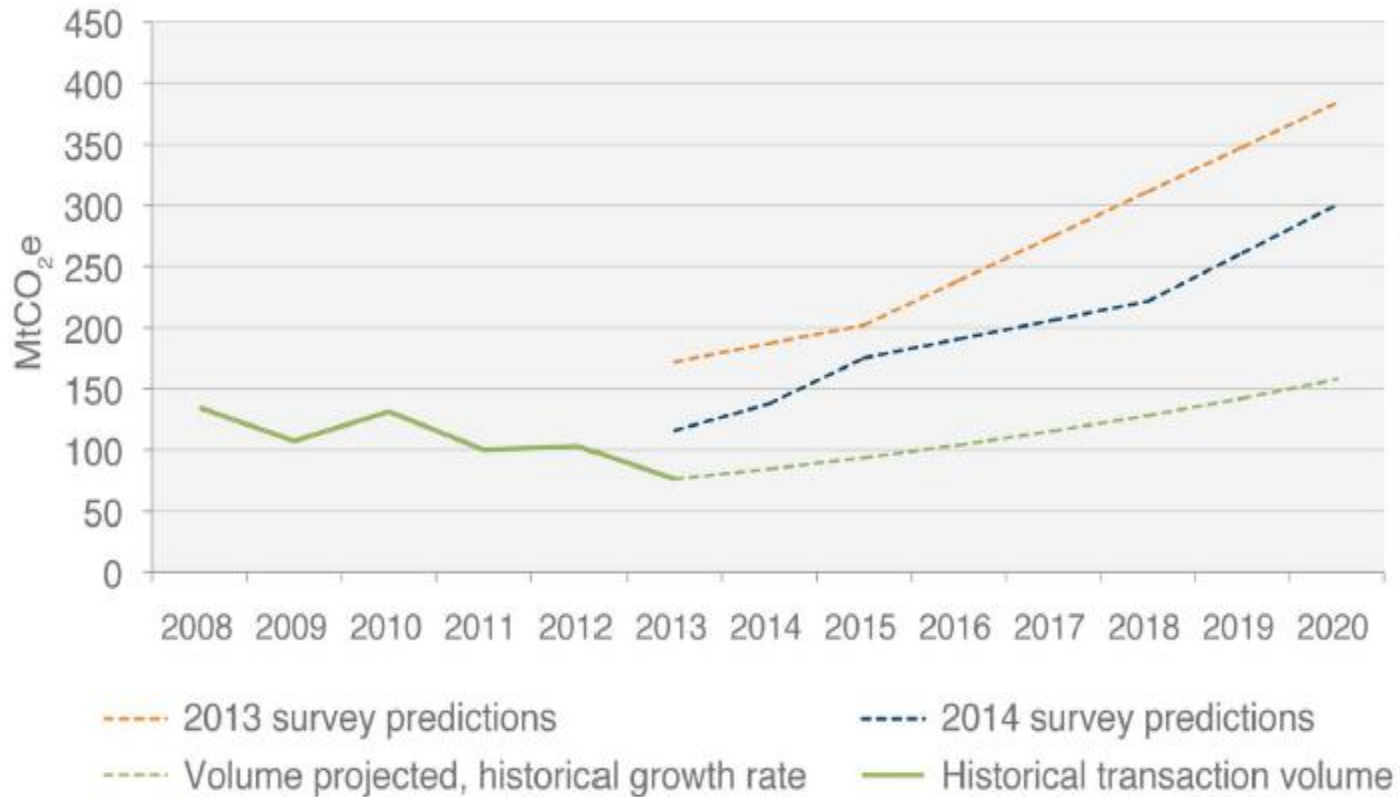
From: Hsia-Kiung et al. 2014.
Environmental Defense Fund

Historical Offset Demand by Market Value, All Voluntary Carbon Markets



SOURCE: Forest Trends' Ecosystem Marketplace. State of the Voluntary Carbon Markets 2014.

Historic and projected trends in the voluntary carbon offset markets



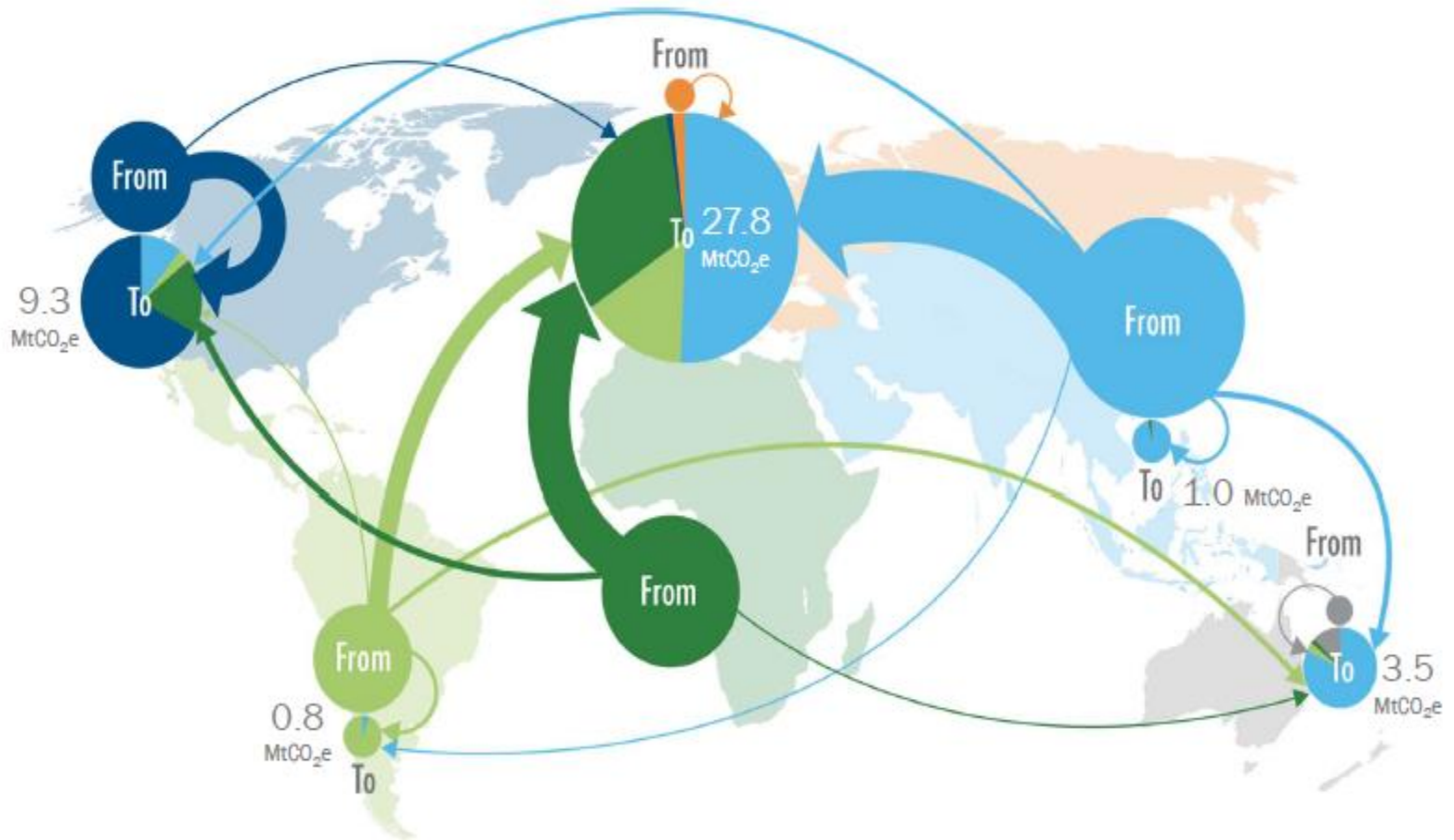
Projected Value
in 2020
PREDICTED RATES
\$1.8 bn

Projected Value
in 2020
HISTORICAL RATES
\$0.9 bn

SOURCE: Forest Trends' Ecosystem Marketplace. State of the Voluntary Carbon Markets 2014.

FLOW OF TRANSACTED OFFSET VOLUMES FROM SUPPLIER TO BUYER REGION, 2013

% share and Sized by Volume



SOURCE: Forest Trends' Ecosystem Marketplace. State of the Voluntary Carbon Markets 2014.

California Compliance Market (ARB):

- Took effect Jan 1, 2014
- 8% of cap for regulated emitters can be met through offsets
- Harmonized with Quebec market (currently no forest C offsets)
- >\$1.3 billion in allowance auctions
- Offsets now trading at about \$12 per metric ton CO₂ equivalent → forestry offset prices usually discounted by 20%

Five offset sectors:

- U.S. Forest Projects
- Urban Forestry
- Ozone Depleting Substances (ODS)
- Mine Methane Capture
- Livestock projects

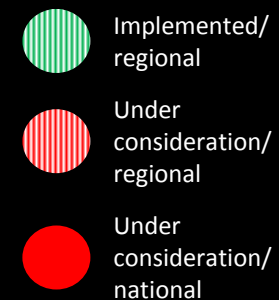
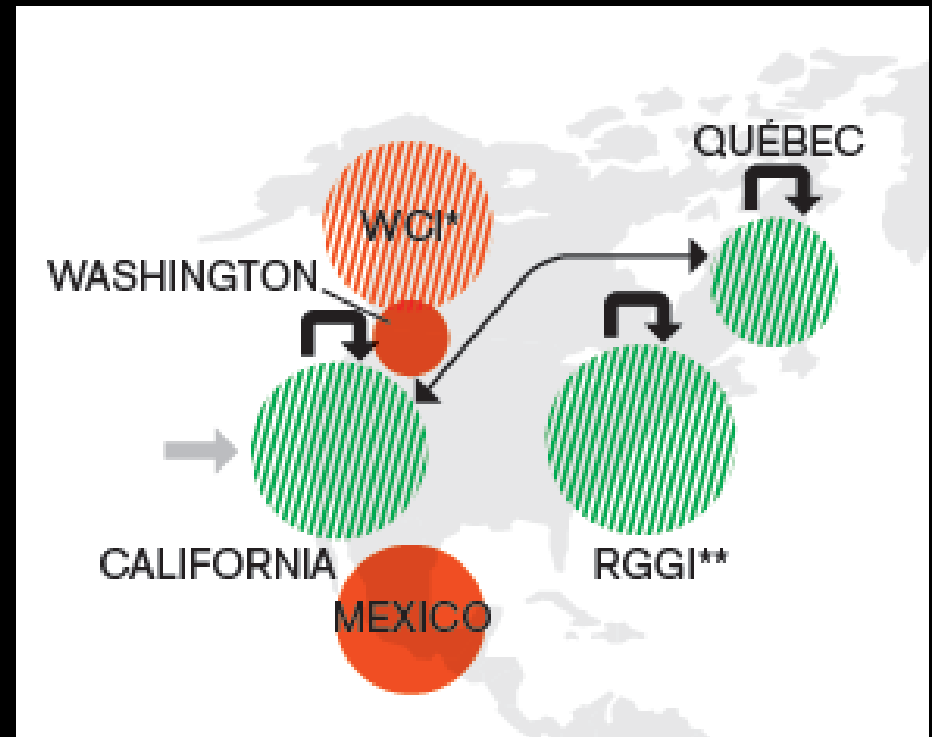


Figure from: World Bank. 2014. Status and Trends of Carbon Pricing.

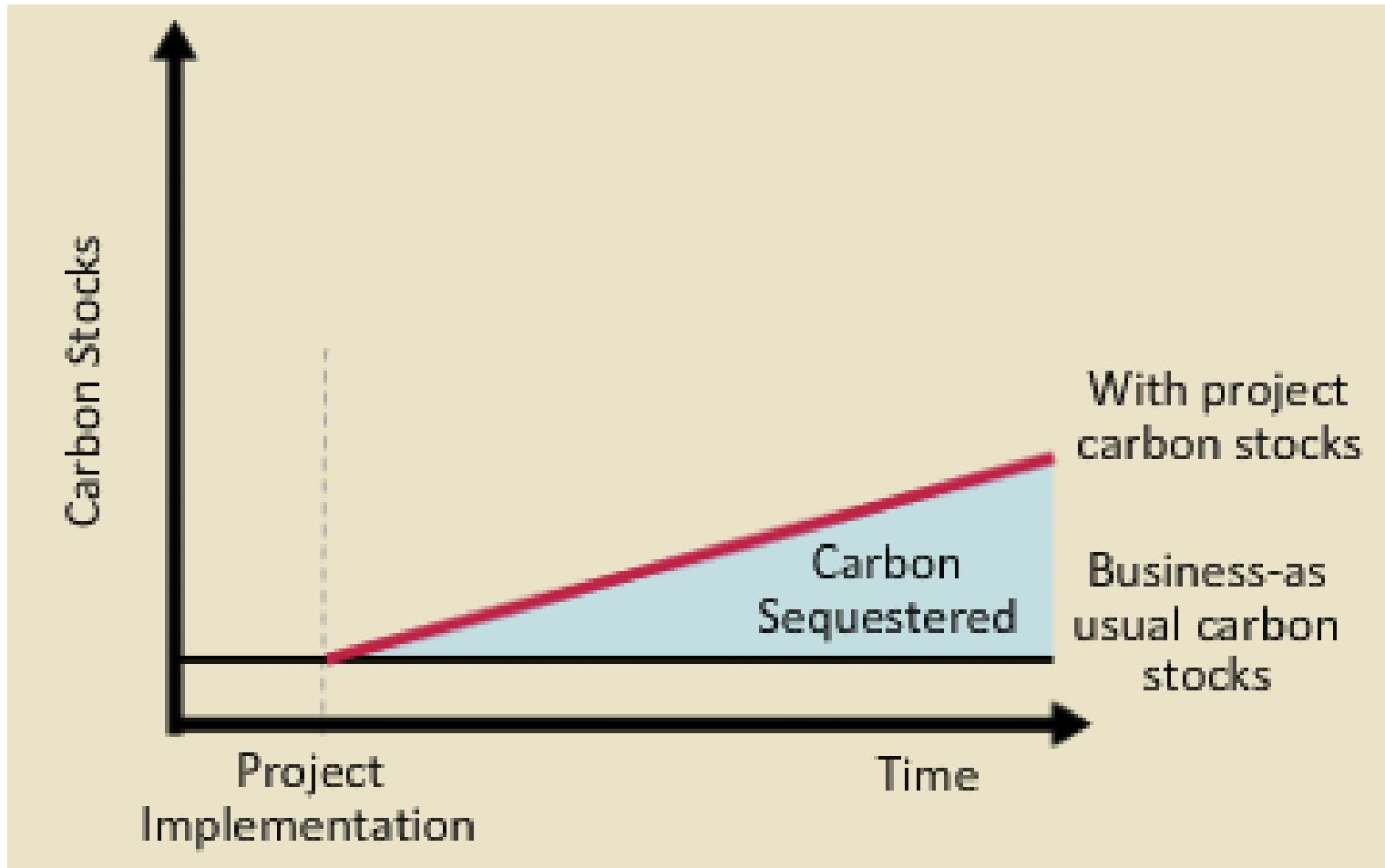
“Best” Carbon Market Options for the Forest Sector in the Northeast

- Reforestation/afforestation
- Avoided Conversion/ REDD
- Improved Forest Management

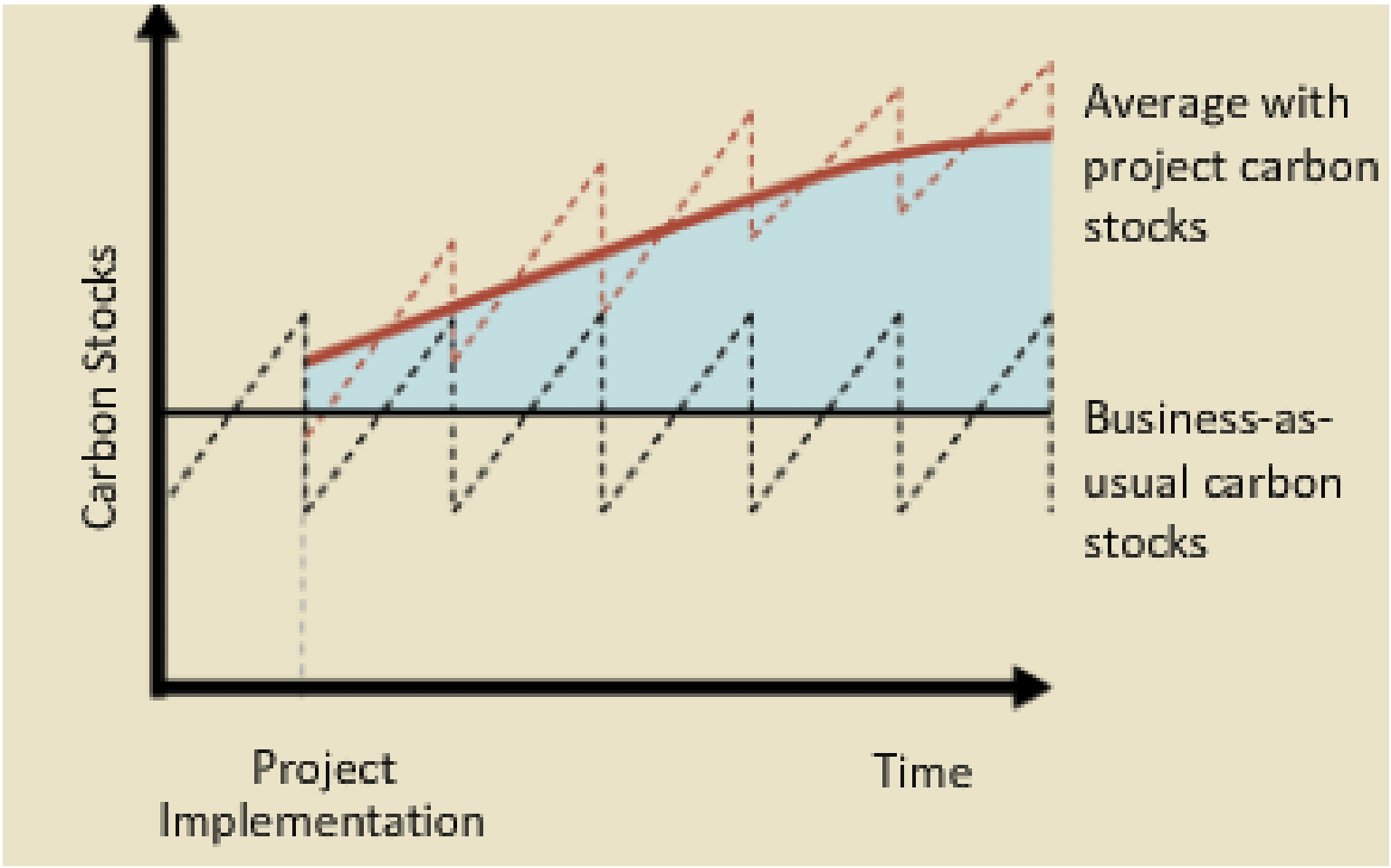
* Key is “additionality”



“Improved Forest Management”



Forest carbon management can be integrated with timber management

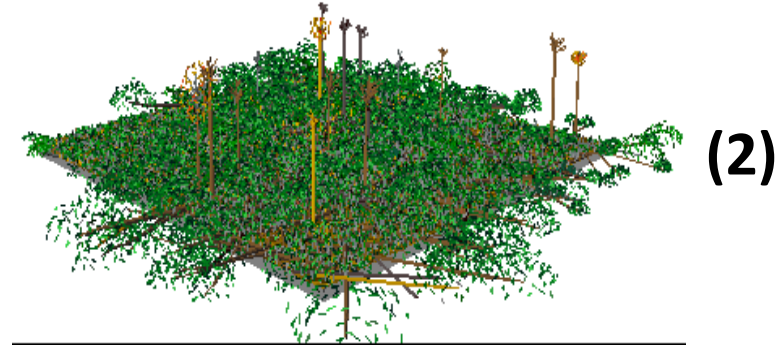


Management scenarios

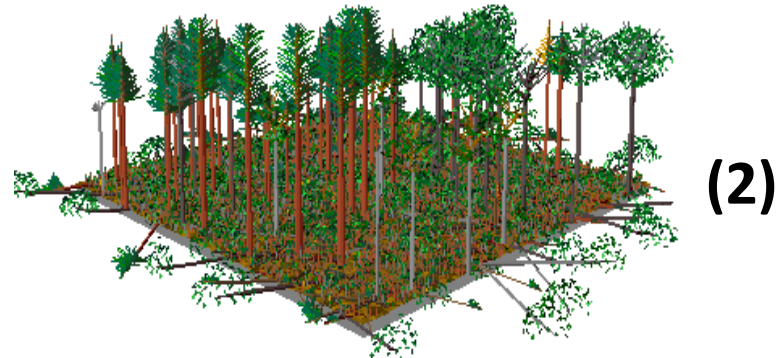


8 active management scenarios, varying harvesting intensity and frequency

Clearcut
Variants



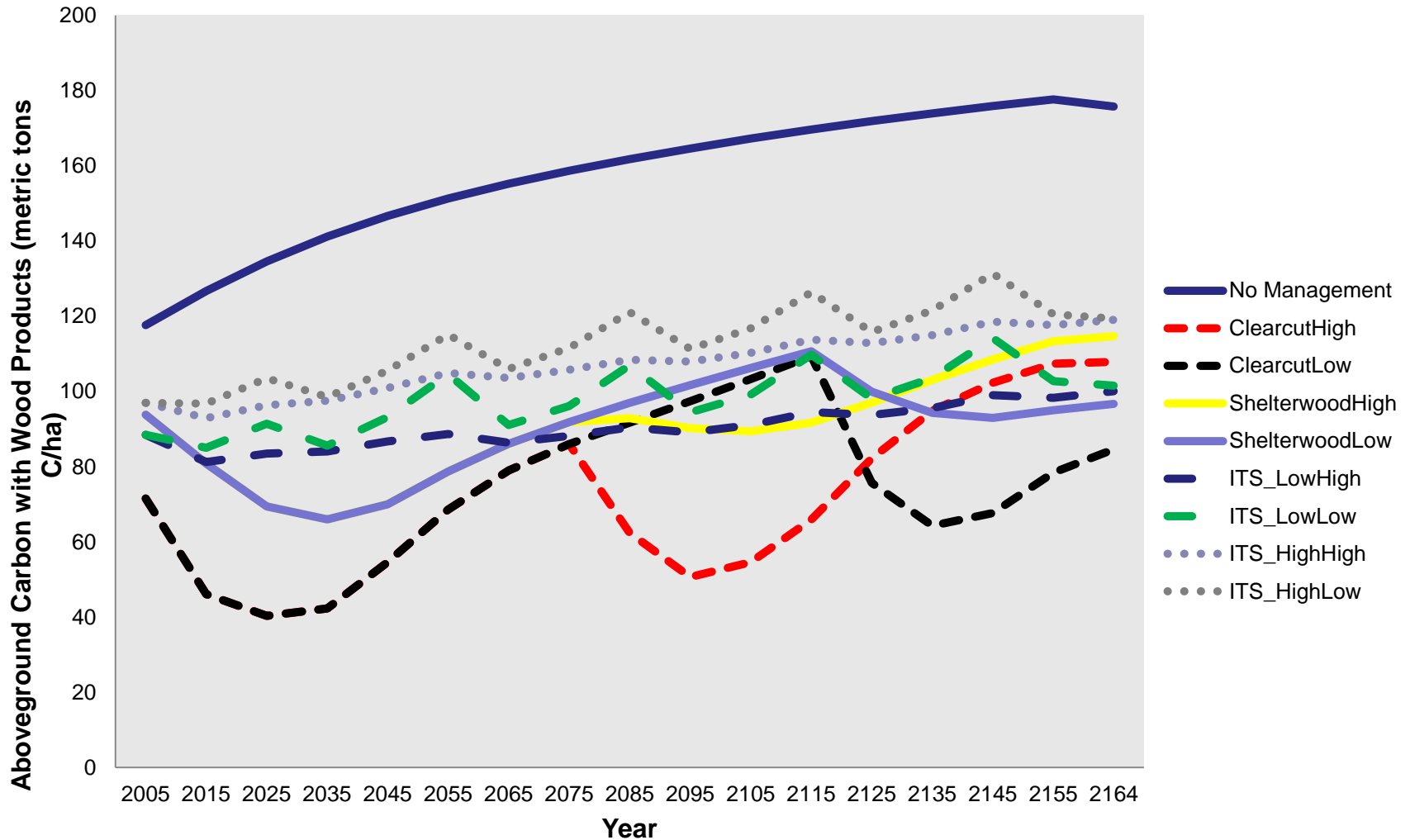
Shelterwood
Variants



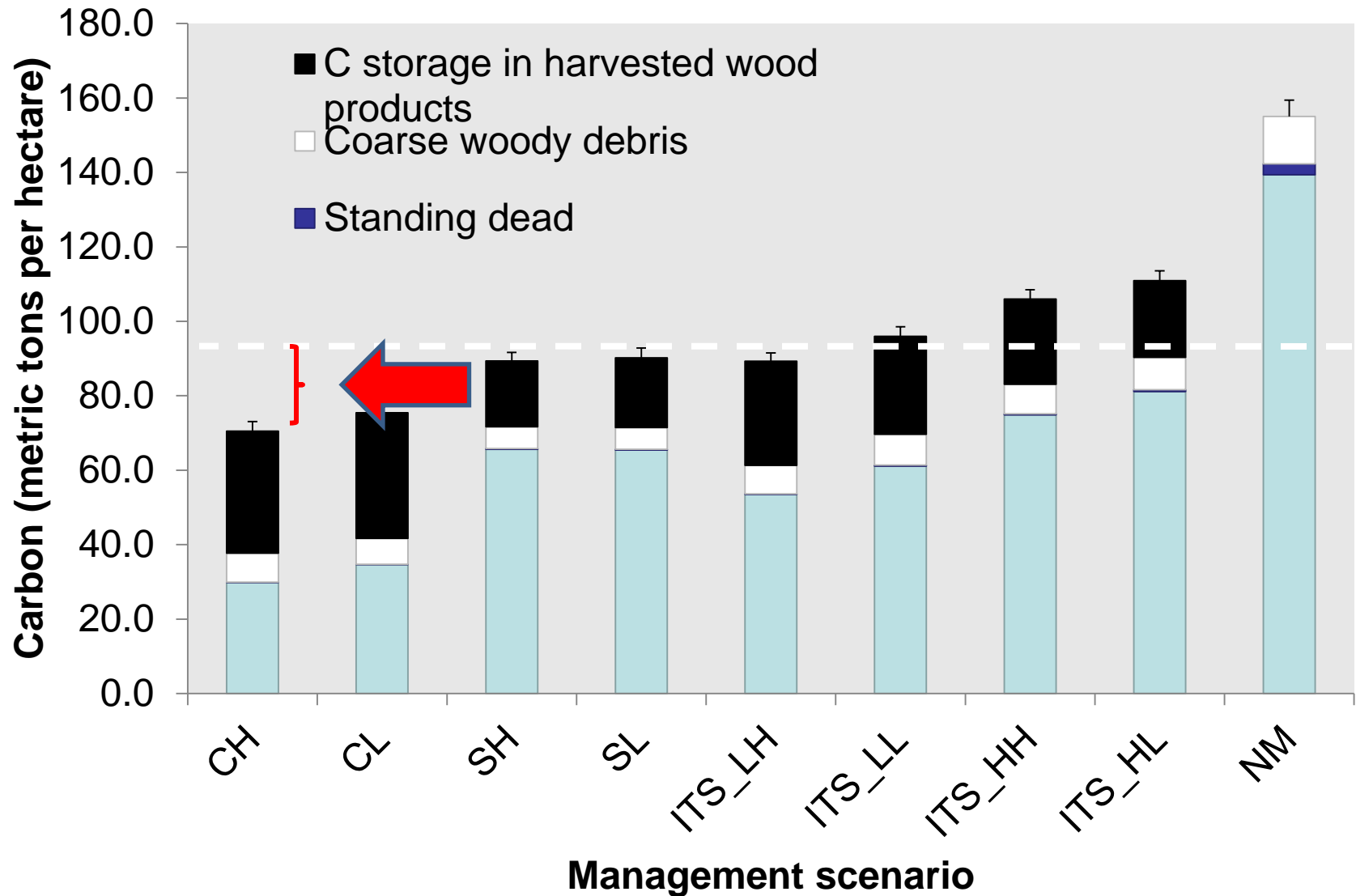
Selection System
Variants



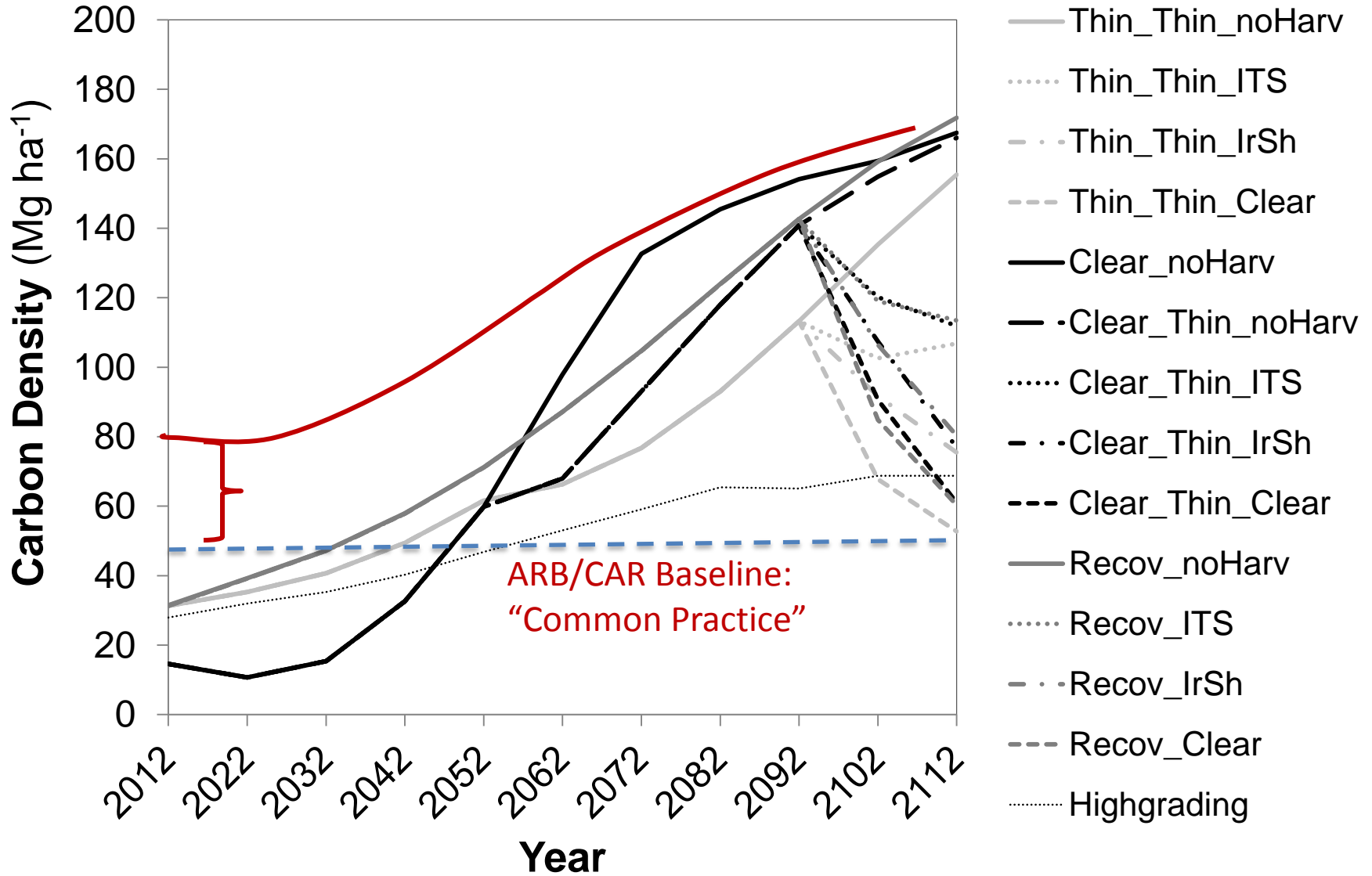
Model Predictions



Model Predictions

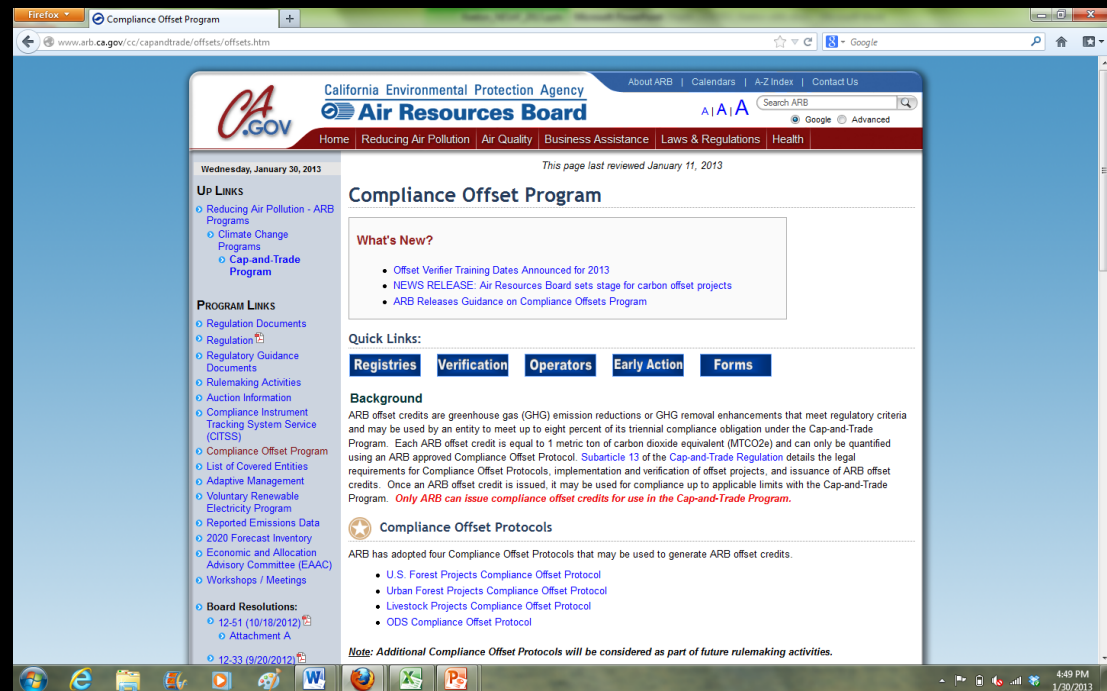


Carbon Stock Accumulation



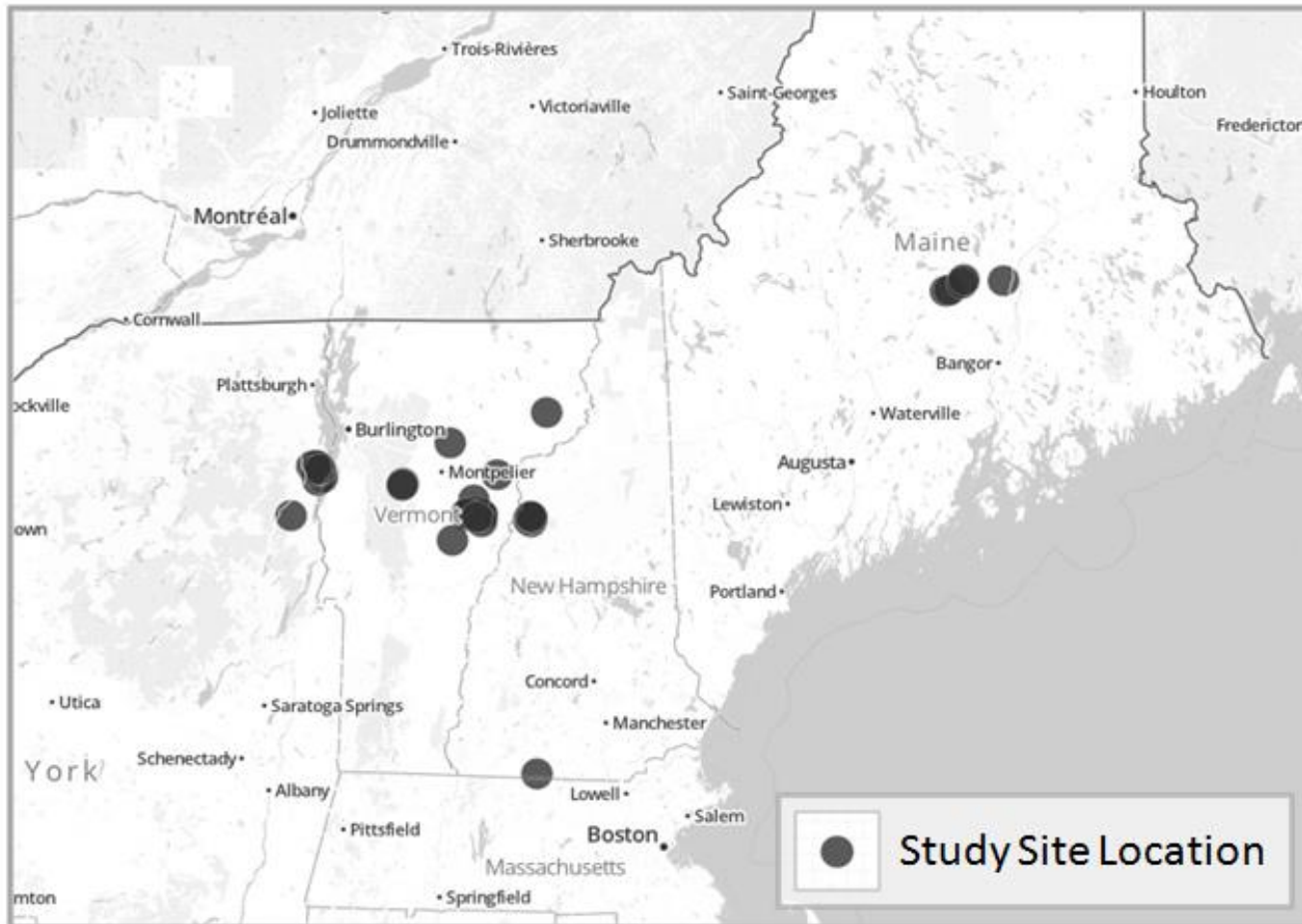
Financial Viability of Forest Carbon Projects in the Northeast

- Market price points
- Transaction Costs
- Policy Assumptions
- Economies of Scale/Property Size
- Carbon Stocking
- Other Site Characteristics

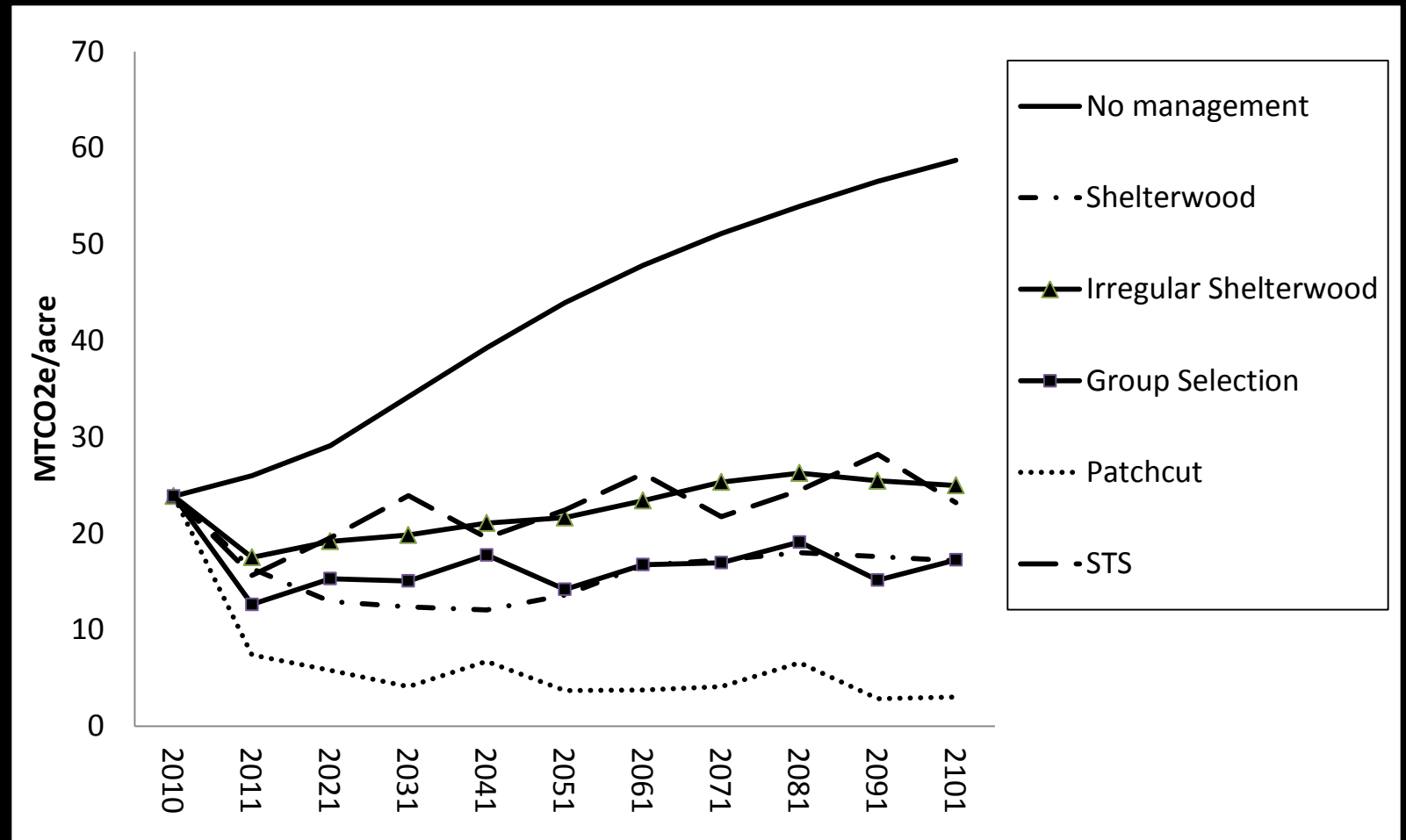


The screenshot displays the California Air Resources Board (ARB) website, specifically the Compliance Offset Program page. The page is viewed in a Firefox browser window. The header includes the ARB logo and navigation links such as Home, Reducing Air Pollution, Air Quality, Business Assistance, Laws & Regulations, and Health. The main content area is titled "Compliance Offset Program" and features a "What's New" section with recent updates, a "Quick Links" section with buttons for Registries, Verification, Operators, Early Action, and Forms, and a "Background" section explaining ARB offset credits. A "Compliance Offset Protocols" section lists four protocols: U.S. Forest Projects, Urban Forest Projects, Livestock Projects, and ODS. A note at the bottom states that additional protocols will be considered for future rulemaking activities. The footer shows the date and time as 4:49 PM on 1/30/2013.

Study Sites: 25 Properties, Diverse Ownership, Size, and Management



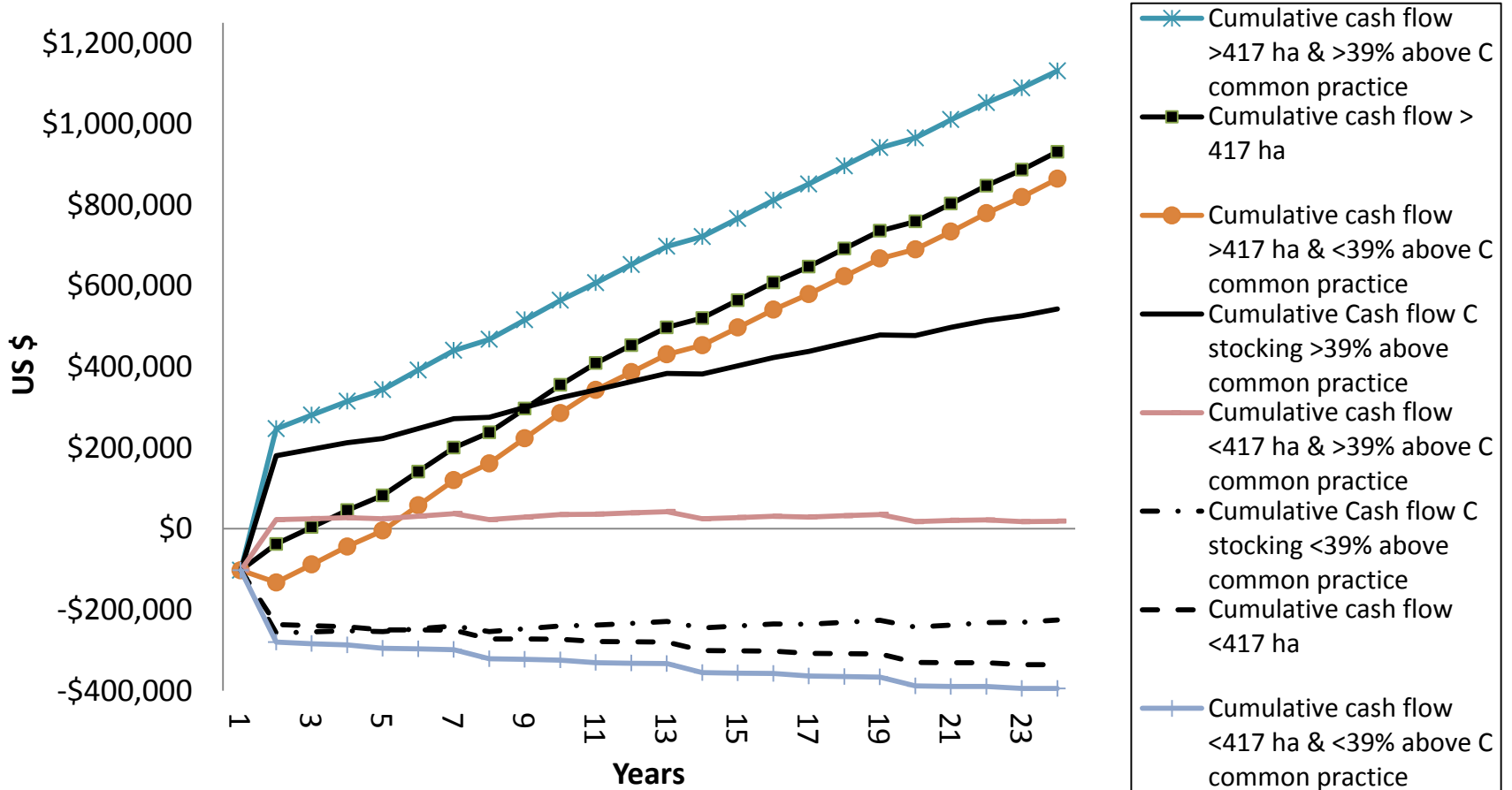
Carbon Projections Using the Forest Vegetation Simulator: Forest C + Wood Products as per the ARB Protocol



Modeled Transaction Costs

Initial development costs	Cost	Frequency
Registry opening account fee	\$500	Once
Registry project listing fee	\$500	Once
Labor for account opening and project listing	\$1,500	Once
GIS stratification & inventory	\$15,000	Once
Growth and yield modeling and C quantification	\$30,000	Once
Travels costs and lodging for inventory	\$3,500	Once
Project Reporting Document	\$29,000	Once
Third-party verification and verification management	\$25,000	Once
Total initial development costs	\$105,000	Once
Monitoring Costs		
Desk review verification	\$3,000	Annual
Registry fee	\$500	Annual
Annual carbon accounting, modeling, monitoring & reporting	\$5,000	Annual
Inventory	\$12,000	Every 12 years
Onsite third-party verification	\$15,000	Every six years
<u>Other fees</u>		
Brokerage fee	3%	
Registry credit issuance fee (cents/credit)	0.02	

Cash Flows by Predictor of Financial Attractiveness



Policy Scenario Legend:

Policy A: AB 32 is renewed past 2020 & 100 year monitoring is required.

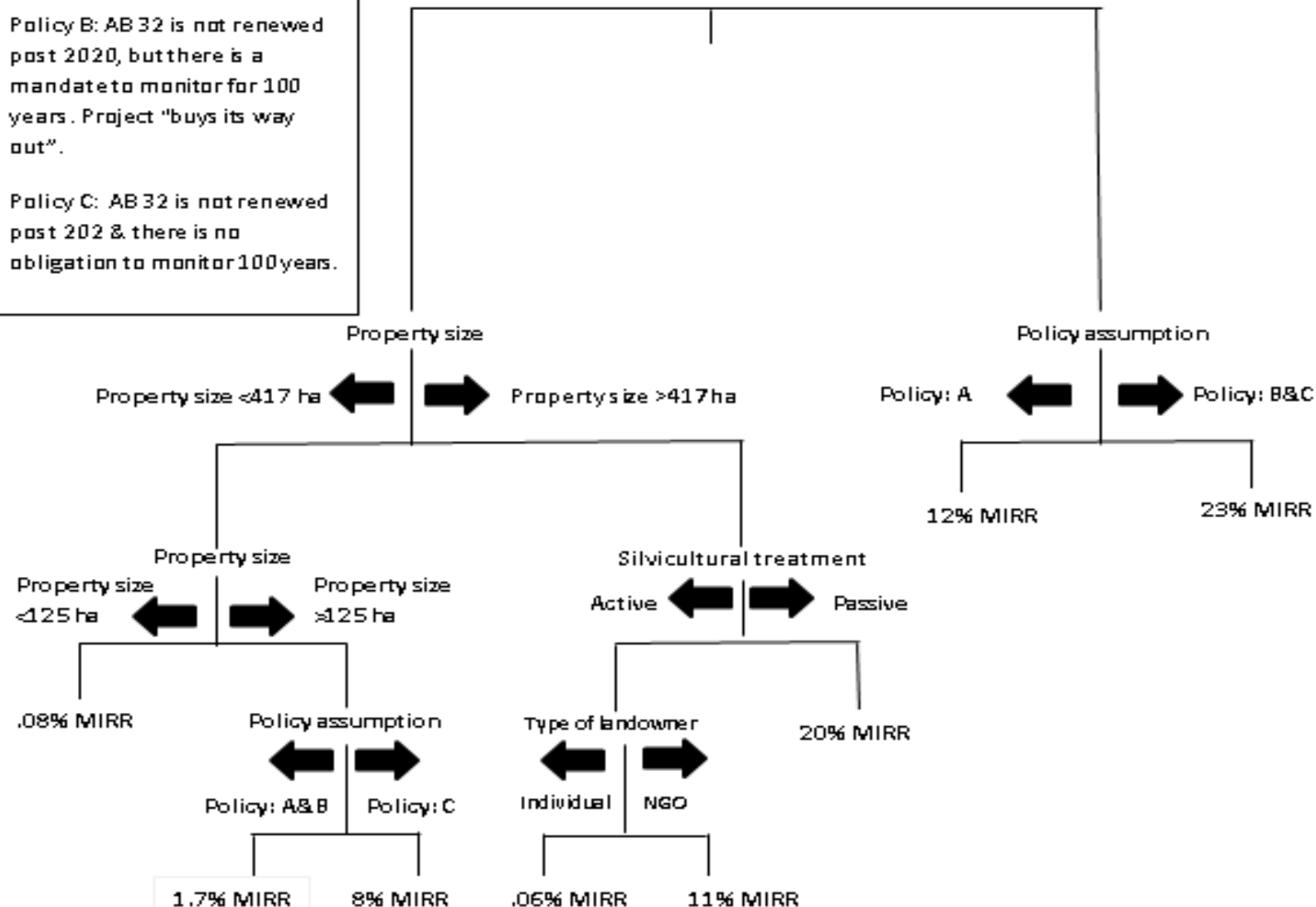
Policy B: AB 32 is not renewed past 2020, but there is a mandate to monitor for 100 years. Project "buys its way out".

Policy C: AB 32 is not renewed past 202 & there is no obligation to monitor 100 years.

Percent standing live carbon stock above regional average standing live C stock (C common practice)

C stock < 39% common practice C

C stock > 39% common practice C



Project Viability Assessment Tool: Shelterwood Harvesting Example

Scenario	Hectares				
	200	600	1200	2400	4800
Stocking: below Common Practice Policy A	-\$324,863	-\$123,851	\$55,277	\$511,482	\$1,423,815
MIRR	-3%	5%	8%	11%	14%
Stocking: >20% above common practice Policy A	-\$245,642	\$64,633	\$530,040	\$1,460,853	\$3,322,480
MIRR	-100%	9%	12%	15%	18%
Stocking: >40% above common practice Policy A	-\$258,153	\$27,108	\$454,989	\$1,310,756	\$3,022,278
MIRR	-100%	8%	12%	15%	18%
Stocking: below Common Practice Policy B	-\$120,724	-\$26,331	\$57,750	\$271,908	\$700,219
MIRR	-16%	5%	10%	14%	16%
Stocking: >20% above Common Practice Policy B	-\$58,883	\$136,075	\$428,508	\$1,013,375	\$2,183,108
MIRR	2%	15%	25%	37%	48%
Stocking: >40% above Common Practice Policy B	-\$67,286	\$110,865	\$378,089	\$912,537	\$1,981,424
MIRR	3%	16%	26%	36%	47%

NPV to
2020

MIRR to
2020

Concluding Thoughts



- Voluntary and compliance market options
- Carbon forestry practices are well established
 - > Lots of flexibility for landowners
- Carbon projects will not work for everyone in the Northeast
 - Transaction costs are high
 - Long term commitment may be burdensome
 - Not always financially viable
 - Not always consistent with landowner objectives
- Carbon projects will work best:
 - On larger ownerships, e.g. > 1,400 acres
 - Well stocked forests above “Common Practice”
 - With project aggregation
 - Under current and increasing offset prices
- Integration with other objectives key
- Layer carbon with multiple timber and non-timber revenue streams
- Potential to yield financial, climate, and land conservation benefits
- Role for state policies: e.g. technical assistance, Current Use, incentives for landowners and service providers

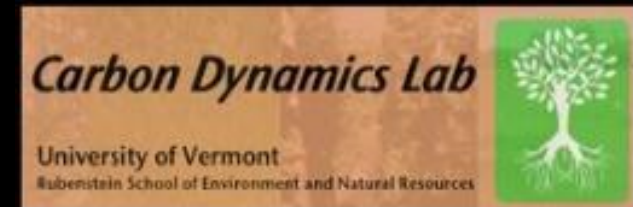
H. 372



- H. 372 sends a strong message that Vermont takes forest sector contribution to climate change mitigation seriously
- Feasibility study will provide an important springboard for forest carbon projects in Vermont
- Key will be determination of viability on state lands
- Potential for project aggregation on private lands will be critical under the California Compliance Market

Acknowledgements

- Northeastern States Research Cooperative
- USDA McIntire-Stennis Forest Research Program
- NRCS Conservation Innovation Grant



Questions?

