

New Markets for Northeastern Forest Owners?

An intro to Ecosystem Markets

John S. Gunn, Ph.D.

Research Assistant Professor of Forest Management

Dept. of Natural Resources and the Environment

NH Agriculture Experiment Station

UNH Cooperative Extension



Northeast Silviculture
Institute for Foresters
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Portsmouth, NH

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Outline

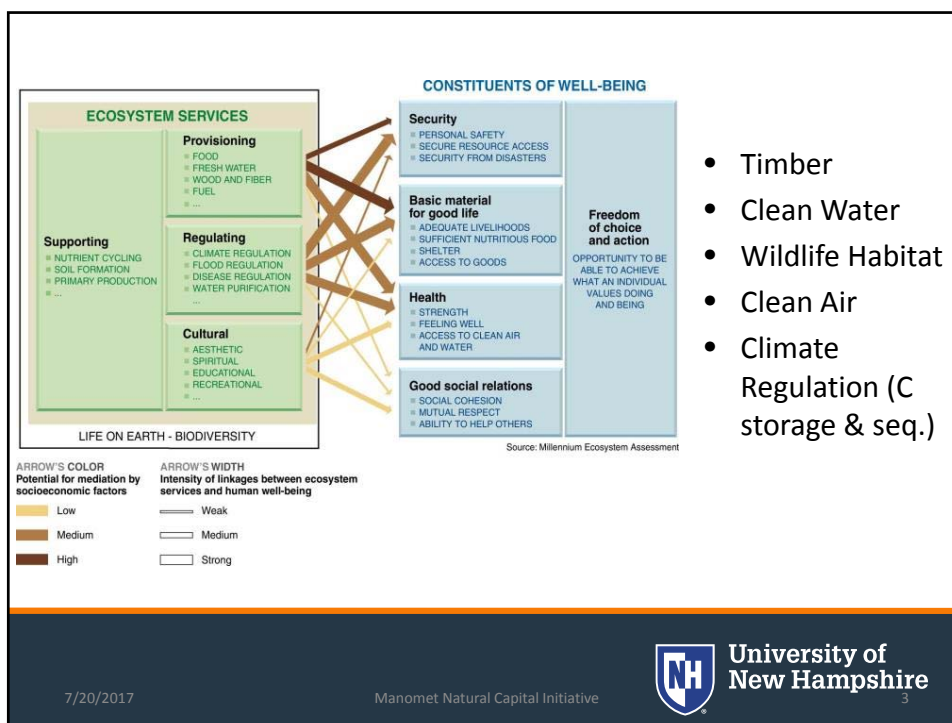
- What are Ecosystem Services
- Ecosystem Markets
 - What needs to be in place?
 - What markets are there?
 - Water, Carbon (but really just carbon)
- Carbon Markets 101
- Pro forma tool

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- Timber
- Clean Water
- Wildlife Habitat
- Clean Air
- Climate Regulation (C storage & seq.)



Elements of Ecosystem Service Markets

- Clear identification of a “**beneficiary**” (buyer)
- Clear Drivers create “**demand**”
- Clear identification of a “**seller**”

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Manomet Natural Capital Initiative

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Types of Watershed Markets



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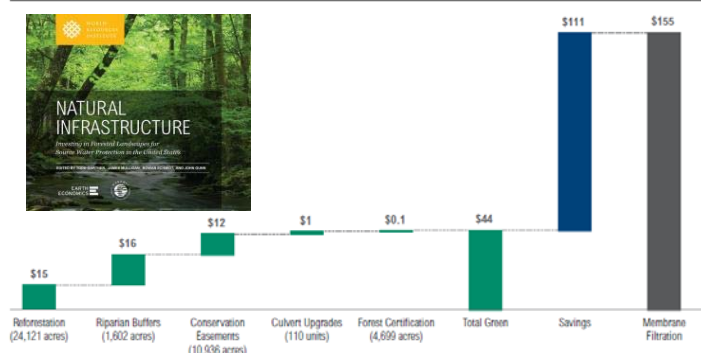
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Green vs. Gray Investments

Figure 3 | Preliminary Analysis for Portland, Maine—Optimistic Scenario (\$ millions)



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Water Quality ES Marketplace

Sellers



Users

- Water District/Utility
- Rate Payers
- PWD Stewardship Incentive Fund
- Recreation
- Industry
- Ground Water Users

NRCS

- EQIP
- Dedicated Pool

State/Town

- Current Use Tax
- Zoning/TDR

Mitigation Funds

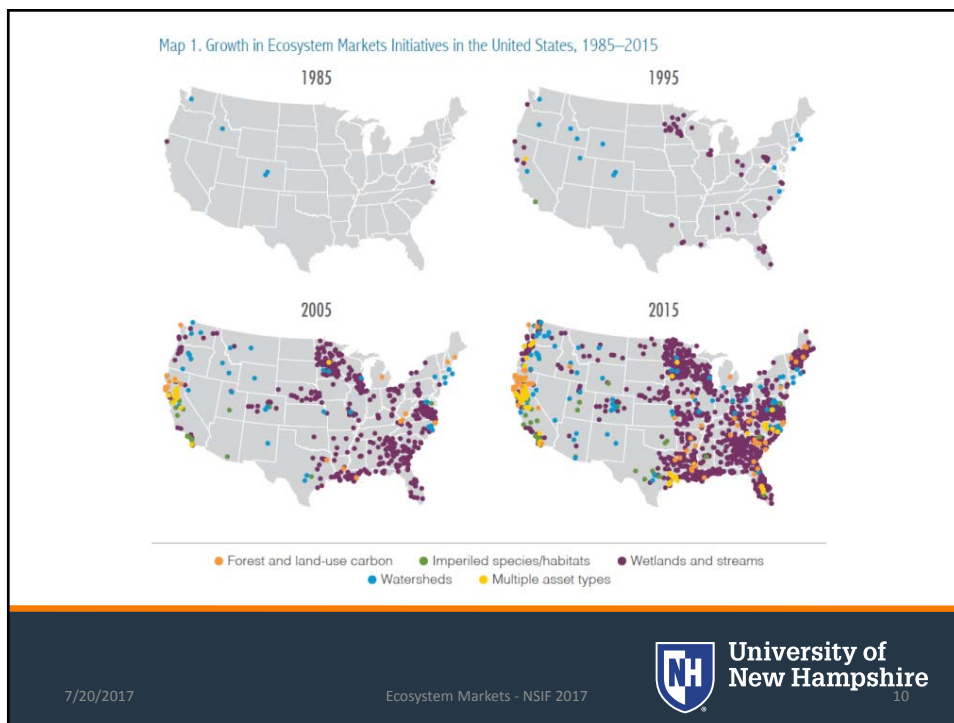
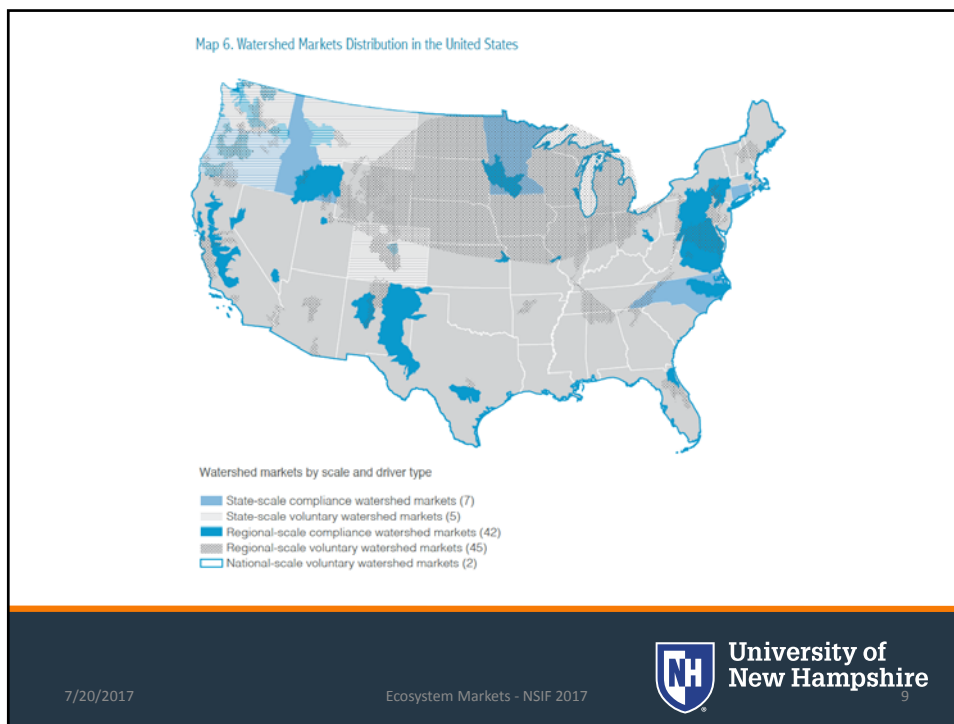
- In-Lieu Fee Compensation Program (ME DEP/TNC)

Buyers

1. Failure: 200,000 free riding consumers (also the beneficiaries)
2. Demand Drivers: Safe Drinking Water Act, EPA filtration exemption
3. Market Challenge: 190 mi²; 82% forested (mostly private FF owners)



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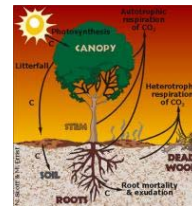


Carbon Offsets

- “real, verifiable, additional, and permanent”
- Voluntary Markets
- Compliance Markets

What Is A Carbon Offset?

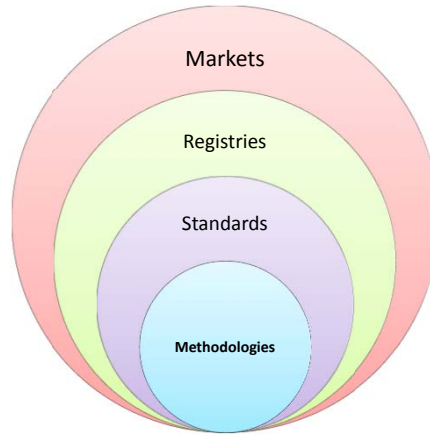
A carbon offset is a reduction in greenhouse gas emissions, or an increase in carbon sequestration, used to neutralize or cancel out an equivalent amount of emissions. Offsets are a tradable commodity generated by one party and sold to another party looking to offset its emissions. One offset is equal to one metric ton of carbon dioxide equivalent—the amount of carbon dioxide emitted by consuming 112 gallons of gasoline.



Navigating the Carbon Offset World

Relevant US Standards

1. Verified Carbon Standard (**VCS**)
2. California Air Resources Board (**ARB**)
3. American Carbon Registry (**ACR**)
4. Climate Action Reserve (**CAR**)



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Some Notes On Units

- Green Tons (green cord = 3,000 – 5,500 lbs)
- Dry Tons = $\frac{1}{2}$ green ton weight
- Carbon (C) = $\frac{1}{2}$ dry ton weight (or $\frac{1}{4}$ green ton weight)
- Metric Tons (MT) = 2,204 lbs
- Metric Tons Carbon Equivalent (MTCO_{2e}) = MTC X 44/12 (3.667) - **Credits based on this #**
- Biomass volume generally calculated using allometric scaling equation

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Stocks and Flows

- Stocks – how much C is stored in a given acre of forest?
- Flow – what is the rate of accumulation?
- Depends on: Site Class; Forest Type; Development Stage; Current Management; Mgmt & Disturbance History



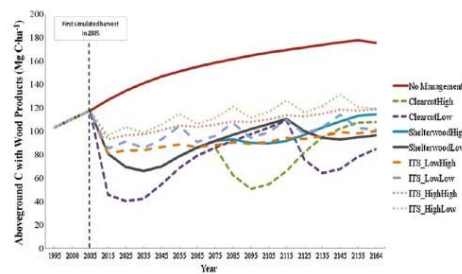
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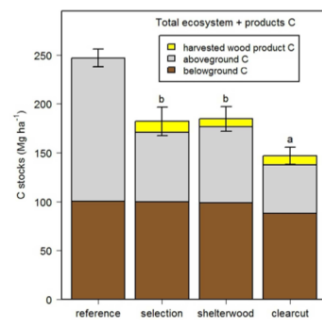
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Forest Management & C



Nunery & Keeton, 2010. Forest carbon storage in the northeastern United States: net effects of harvesting frequency, post-harvest retention, and wood products. Forest Ecology & Mgmt.



Puhlick, J.J. et al., 2016. Long-term influence of alternative forest management treatments on total ecosystem and wood product carbon storage. Canadian Journal of Forest Research

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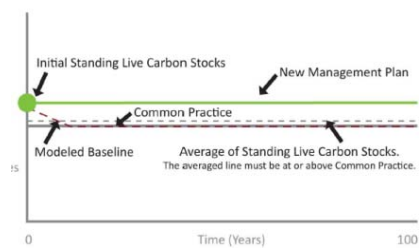
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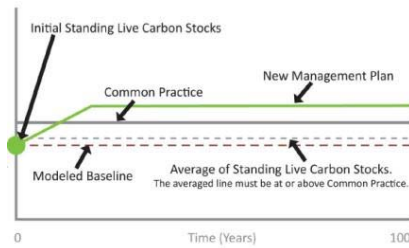
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Baselines and Additionality

Above Common Practices



Below Common Practices



Source: Finite Carbon CAR presentation

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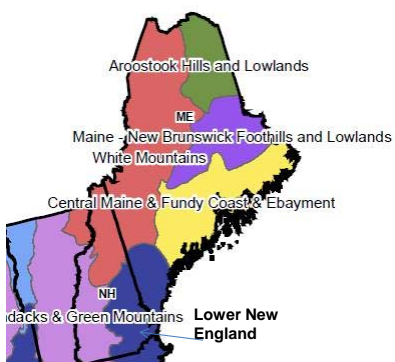
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Stocks in Context



Ecoregional Supersection	Common Practice - Above Ground Carbon Mean in Metric Tonnes/acre (BA)	Range (depends on site class, forest type)
Lower New England - Northern Appalachia	25 (111)	16-32
Maine - New Brunswick Foothills and Lowlands	14 (97)	7-22
Central Maine & Fundy Coast & Ebbayment	16 (103)	11-23
Aroostook Hills and Lowlands	16 (107)	7-45
White Mountains	16 (100)	11-23

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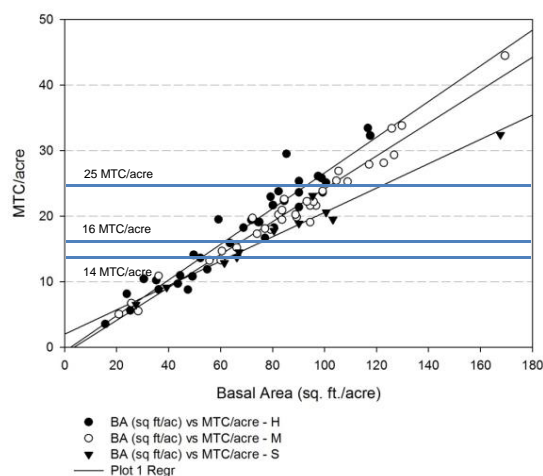
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Basal Area - Aboveground Live Carbon Relationship
(Western and Central Maine, Hardwood, Softwood, and Mixed Wood Stands)



Lower New England - Northern Appalachia	25 (111)	16-32
Maine - New Brunswick Foothills and Lowlands	14 (97)	7-22
Central Maine & Fundy Coast & Ebayment	16 (103)	11-23
Aroostook Hills and Lowlands	16 (107)	7-45
White Mountains	16 (100)	11-23

Maine Family Forest Carbon Project Data (12 landowners, 82 stands)

Western, Central, & Eastern Maine
Carbon Stocks in "Typical" Stands

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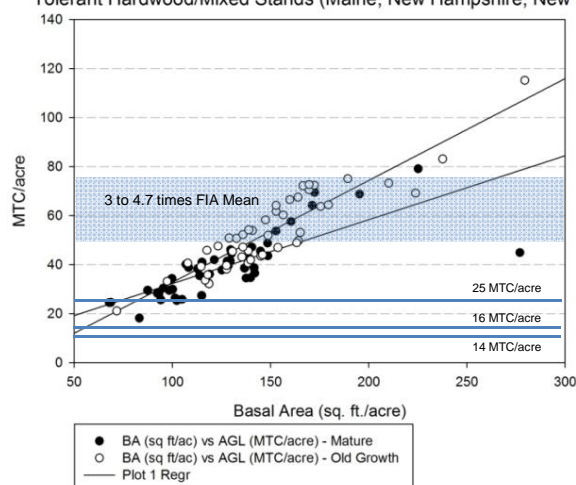
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Basal Area - Aboveground Live Carbon Relationship in
Tolerant Hardwood/Mixed Stands (Maine, New Hampshire, New York)



Lower New England - Northern Appalachia	25 (111)	16-32
Maine - New Brunswick Foothills and Lowlands	14 (97)	7-22
Central Maine & Fundy Coast & Eabayment	16 (103)	11-23
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White Mountains	16 (100)	11-23

Data from: Keeton, W.S., A. A. Whitman, G.G. McGee, and C.L. Goodale. *Forest Science* December 2011. Late-successional biomass development in northern hardwood-conifer forests of the northeastern United States. *Forest Science*. Mature = 80-150 yrs; Old Growth = >150 yrs n=94

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Study	Mean AGL (MTC/ac/yr) ¹	Range
Brownfield OCSWCD	0.30 (100 yr mean)	0.08 - 1.10
Maine FF Data	0.62 (50 yr mean)	0.31 – 0.71 (range of means)
Smith et al. 2006 ² (Tol HW)	0.53 (125 yr mean)	0.23 (120-125 yrs) to 0.99 (5-15 yrs)
Smith et al. 2006 (Spr/Fir)	0.41 (125 yr mean)	0.26 (120-125 yrs) to 0.56 (5-15 yrs)
Smith et al. 2006 (Oak-Pine)	0.52 (125 yr mean)	0.23 (120-125 yrs) to 0.88 (15-25 yrs)

Maine C Accumulation Rates



¹ Multiply by 3.667 for MTCO₂e
² USDA Forest Service GTR-343

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Moving C Stocks and Flows to the Offset Marketplace



View from the Understory
State of Forest Carbon Finance 2016

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Sponsors:     

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California Air Resources Board (ARB)

- state agency charged with implementing California's cap-and-trade program (AB 32) since 2012
- A 100 year commitment from the date of the last credit issuance
- annual monitoring and verification at least once every 6 years.
- % of buffer credits based on risk evaluation and is reduced by the use of a qualified easement

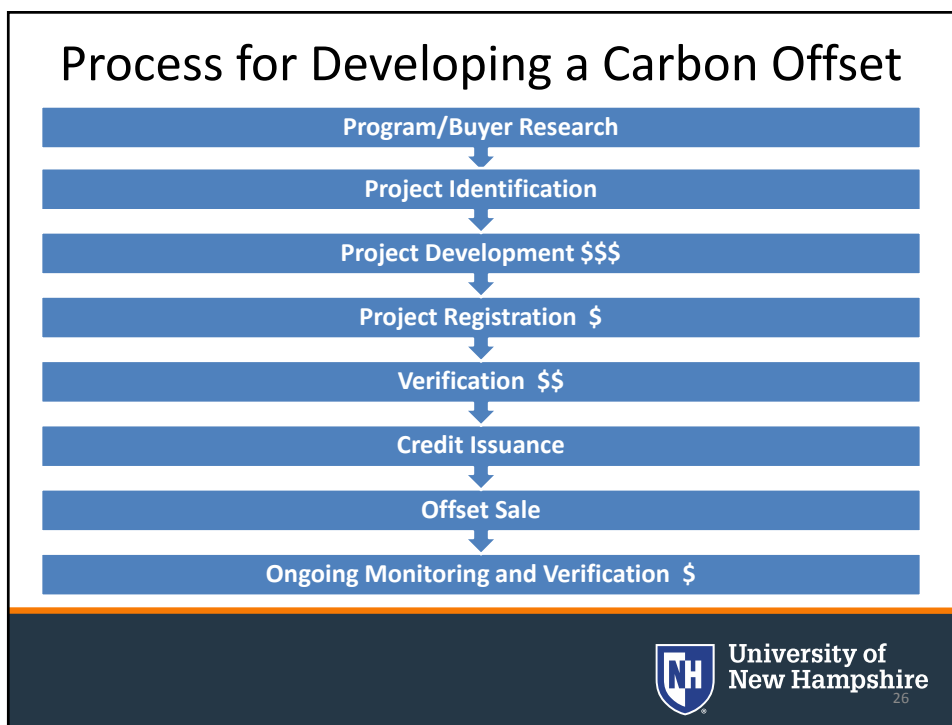
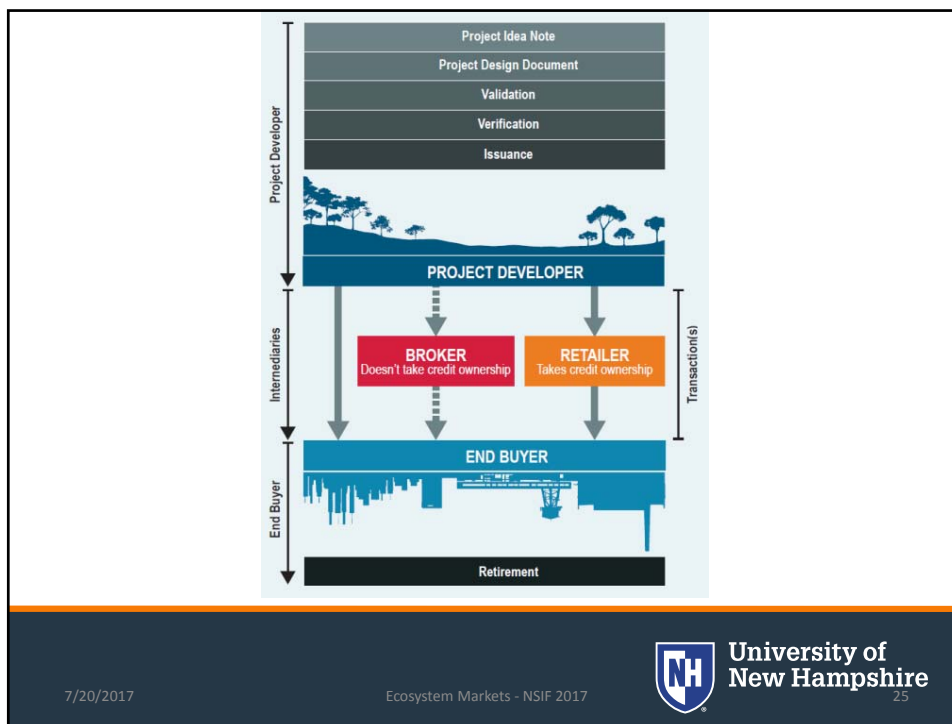


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	American Carbon Registry (ACR) v2.1	Climate Action Reserve (CAR) v3.3	Verified Carbon Standard (VCS)
Description	<p>ACR is a non-profit U.S. carbon market registry operated by Winrock International.</p> <p>Eligible forest offsets include:</p> <ul style="list-style-type: none"> • Afforestation/Reforestation • Improved Forest Management • Reducing Emissions from Deforestation and Degradation <p>*40 year commitment period</p>	<p>CAR is a voluntary carbon offset standard that grew out of the California Climate Action Registry, a voluntary carbon market created by the State of California in 2001.</p> <p>Eligible forest offsets include:</p> <ul style="list-style-type: none"> • Improved Forest Management • Reforestation • Avoided Conversion <p>Currently, projects must be located in the U.S. but changes are being drafted to expand eligibility internationally.</p> <p>*100 year commitment period</p>	<p>VCS was established in 2005 and offers standards and a registry system for creating verified carbon credits throughout the world.</p> <p>Eligible forest offsets include:</p> <ul style="list-style-type: none"> • Afforestation, Reforestation & Re-vegetation • Improved Forest Management • Reduced Emissions from Deforestation and Degradation <p>*20 year commitment period</p>



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Transaction Costs

- It is not cheap to get a project to market
- Economy of scale
- Project developers/brokers willing to “front” transaction costs
- Make forest offsets expensive relative to other categories

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Transaction Costs

Category	Description/examples
Transaction Costs Associated with Credits Traded	
Credit Transaction Costs	<i>cost per verified tonne associated with the issuance and transaction costs at the registry</i>
Brokerage Fee	<i>cost per verified tonne associated with finding a buyer using a brokerage service</i>
Insurance Cost	<i>insurance premium in lieu of a buffer pool for first verification (periodic as well)</i>

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Transaction Costs

Category	Description/examples
Annual Costs	
Annual Reporting Costs	<i>internal time and registry fees</i>
Annual Membership Fee	<i>registry fees</i>
Post-Project Monitoring Costs Associated with Monitoring Cycle	
Periodic Monitoring Cost	<i>internal field and office time</i>
Post-Project Periodic Monitoring Costs	<i>Internal field and office time</i>
Other Costs/Deductions	
Project Ending Costs	<i>account closing fees</i>
Inventory Deduction	<i>e.g., if > ±10% of the mean at 90% confidence interval</i>
Buffer Pool	<i>generally 20% of project credits</i>

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Revenue

- \$/Credit
 - Ecosystem Marketplace Summary
 - Compliance vs. Voluntary
- Credit Volume
 - Summary of transactions in forest sector

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Market Volume and Prices

Table 2: Overview of Market-based Payments for Emissions Reductions in 2013, 2014, and 2015

		Volume (tCO ₂ e)			Value (\$ M)			Average Price (\$/tonne)		
		2013	2014	2015	2013	2014	2015	2013	2014	2015
Voluntary markets		21 M	23.7 M	18.2 M	\$100 M	\$128 M	\$88 M	\$4.7	\$5.4	\$4.9
Compliance markets	California-Quebec cap-and-trade	1.7 M	6.1 M	6.5 M	\$16 M	\$55 M	\$63 M	\$9.4	\$8.9	\$9.7
	Australia carbon tax/ERF*	1.5 M	4 M	60.7 M	\$32 M	\$71 M	\$588 M	\$20.8	\$17.7	\$9.7
	New Zealand ETS	–	–	1.3 M	–	–	\$10 M	–	–	\$3.1
	Other	0.4 M	0.5 M	1.3 M	\$3.9 M	\$4 M	\$11 M	–	–	–
Total		24.7 M	34.3 M	87.9 M	\$151.9 M	\$257 M	\$762 M	\$35	\$32	\$27.4

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Volume Trends (voluntary)



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Transaction Volume Examples

Market	State	Acres	Registered Tons	Tons/acre	Notes
Voluntary (CAR)	NH	2,141	69,051	32	NEFF (Hersey Mtn)
Voluntary (CAR)	NH	141,000	1,442,576	10	TFG (CT Lakes)
Compliance (ARB)	WI	29,087	852,630	29	
Voluntary (VCS)	PA	17,591	21,770	1	annually (100 year project)
Voluntary (VCS)	PA	4,905	6,384	1	ex ante 6,384 VCUs annually and 370,301 VCUs total, after deduction of the 10% buffer.
Compliance (ARB)	ME	19,118	284,043	15	Downeast Lakes Land Trust (Grand Lake Str.)
Compliance (ARB)	ME	1,460	36,596	25	Northeast Wilderness Trust (Alder Stream)

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Making Sense of Costs and Revenue

Understanding the amount and timing of transaction costs and potential revenue is fundamental to making the decision to engage in the marketplace.

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Pro Forma Tool

WHAT DOES THE TOOL DO?

- The tool is intended to provide a first estimation of carbon market opportunities and the ability to test alternate scenarios to determine the conditions where carbon market entry may be possible.

HOW DOES THE TOOL WORK?

- A landowner or forest manager is walked through a series of questions about a forest property to determine eligibility, costs, and potential benefits under current carbon standards and protocols

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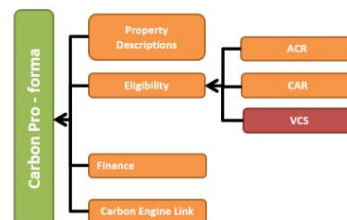
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Tool Components

1. Property Description and Composition
2. Carbon Standard Definition & Requirements (Climate Action Reserve, American Carbon Registry)
3. Additionality, Legal Requirements, & Performance Test
4. Carbon Eligibility Worksheet
5. Transaction Costs Worksheet
6. Summary Analytics (pro forma)

The tool resides in a Microsoft Excel spreadsheet (Version 2010).



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Who should use the tool?

- Primary users are forestry and natural resource professionals and carbon project developers.
- Landowners with some knowledge of forest management and carbon markets will also find the tool useful.

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What do you need to know to use it?

- Basic knowledge of a forest parcel's acreage and forest cover types is necessary.
- Many default values are provided for transaction costs, but a working knowledge of forest inventory and management costs will help.
- It is also helpful to have some basic understanding of the possible verified carbon reductions that could be generated from the project.

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Finance Assumptions:									
Values	ALL			ACR			CAR		
	Total	Fixed Cost	Per Acre Cost	Total	Fixed Cost	Per Acre Cost	Total	Variable Cost	Per Acre Cost
IFM									
Initial Costs									
Project Startup Costs (\$)	\$ 5,000.00			\$ 5,000.00			\$ 1,000.00		
Inventory Cost (\$/ac)	#DIV/0!	\$ -	\$ 8.00	#DIV/0!	\$ -	\$ 8.00	#DIV/0!	\$ 1,000.00	\$ 20.00
Inventory Deduction (%)	0%			0%			0%		
Buffer Pool (%)	20%			20%			20%		
Forest Analysis (\$/ac)	#DIV/0!	\$ 15,000.00	\$ -	#DIV/0!	\$ 15,000.00	\$ -	#DIV/0!	\$ 4,000.00	\$ 5.00
Forest Certification Cost (\$/ac)	#DIV/0!	\$ -	\$ -	#DIV/0!	\$ -	\$ -	#DIV/0!	\$ 10,000.00	\$ 4.00
Legal Expenses (\$/ac)	#DIV/0!	\$ 10,000.00	\$ -	#DIV/0!	\$ 10,000.00	\$ -	#DIV/0!	\$ 10,000.00	\$ 1.00
Verification Cost (\$/ac)	\$ 10.00			\$ 10.00			\$ 9.00		
Compliance Market Costs (\$/ac)	\$ -			\$ -			\$ -		
Aggregator Initial Cost (\$/ac)	#DIV/0!			#DIV/0!			#DIV/0!		
Initial Costs (\$)	#DIV/0!			#DIV/0!			#DIV/0!		
Periodic Costs Associated with Verification Cycle									
Verification Period (years)	#DIV/0!	\$ -	\$ 2.50	#DIV/0!	\$ -	\$ 2.50	#DIV/0!	\$ 1,000.00	\$ 20.00
Periodic Inventory Cost (\$/ac)	0%			0%			0%		
Periodic Inventory Deduction (%)	20%			20%			20%		
Future Forest Analysis (\$/ac)	#DIV/0!	\$ 10,000.00	\$ -	#DIV/0!	\$ 10,000.00	\$ -	#DIV/0!	\$ 4,000.00	\$ 5.00
Periodic Certification Cost (\$/ac)	#DIV/0!	\$ -	\$ -	#DIV/0!	\$ -	\$ -	#DIV/0!	\$ 8,000.00	\$ 4.00
Periodic Legal Expenses (\$/ac)	#DIV/0!	\$ 5,000.00	\$ -	#DIV/0!	\$ 5,000.00	\$ -	#DIV/0!	\$ 2,000.00	\$ 0.25
Periodic Verification Cost (\$/ac)	\$ 0.50			\$ 0.50			\$ 9.00		
Periodic Compliance Market Costs (\$/ac)	\$ -			\$ -			\$ -		
Periodic Aggregator Cost (\$/ac)	#DIV/0!			#DIV/0!			#DIV/0!		
Future Periodic Costs (\$/ac)	#DIV/0!			#DIV/0!			#DIV/0!		
Total Future Periodic Costs (\$)	#DIV/0!			#DIV/0!			#DIV/0!		
Annual Costs									
Annual Reporting Costs (\$)	\$ 5,000.00			\$ 5,000.00			\$ 5,000.00		
Annual Membership Fee (\$)	\$ 500.00			\$ 500.00			\$ 500.00		
Annual Costs Subtotal (\$)	\$ 5,500.00			\$ 5,500.00			\$ 5,500.00		
Post-Project Monitoring Costs Associated with Monitoring Cycle									
Post-Project Monitoring Length (years)	10			10			0		
Monitoring Period (years)	10			10			0		
Periodic Monitoring Cost (\$/ac)	\$ -			\$ -			\$ -		
Post-Project Periodic Monitoring Costs (\$/ac)	\$ -			\$ -			\$ -		
Total Post-Project Periodic Monitoring Costs (\$)	\$ -			\$ -			\$ -		

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Summary Alternative Pro-Forma:

Alternative	1	2	3	4	5	6
Eligibility	PROJECT ELIGIBLE	PROJECT ELIGIBLE	PROJECT ELIGIBLE	PROJECT ELIGIBLE	PROJECT ELIGIBLE	PROJECT ELIGIBLE
Project Acres:						
Start Year:	2012	2012	2012	2012	2012	2012
End Year:	2051	2051	2111	2111	2111	2111
Project Length (yrs):	40	40	100	100	100	100
Project Type:	IFM	IFM	IFM	IFM	IFM	IFM
Program:	ACR	ACR	CAR	CAR	CAR	ACR
Revenues						
Carbon Price (\$/t):	\$ 10.00	\$ 15.00	\$ 15.00	\$ 20.00	\$ 15.00	\$ 15.00
Net Timber Price (\$/MBF):	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Costs						
Verification Cycle (yrs):	5	5	6	6	6	5
Initial Project Costs (\$):	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Costs per Verification Cycle (\$/cycle):	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Monitoring Length (yrs):	0	0	0	0	0	0
Monitoring Cycle (yrs):	40	40	100	100	100	40
Post-Project Monitoring Costs (\$/cycle):	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project End Costs (\$):	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Initial Transaction Costs (\$/t):	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Future Transaction Costs (\$/t):	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Economic Valuation						
Discount Rate (annual, include both inflation rate and investor hurdle rate):	6.0%	6.0%	8.0%	8.0%	8.0%	8.0%
Reinvestment Rate (annual, used in modified IRR calculation):	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Carbon Results						
Nominal Revenues:	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Nominal Costs:	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Present Value of Revenues (using Discount Rate):	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Present Value of Costs (using Discount Rate):	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net Present Value (using Discount Rate):	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Modified IRR:	NA	NA	NA	NA	NA	NA
Benefit/Cost Ratio:	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Payback Period (years):	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Number of Years with Negative Cash Flow:	0	0	0	0	0	0
About 1. Property Description 2. CAR ELIGIBILITY 3. ACR ELIGIBILITY 4. FINANCE ASSUMPTIONS 5. CARBON ENGINE LINK 6. Carbon Pro-Forma						

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CREDITS

- Tool developed by Dr. David Saah, Dr. Timothy Robards, and Dr. Thomas Buchholz of the Spatial Informatics Group (www.sig-gis.com) and Dr. John Gunn with funding from the US Endowment for Forestry and Communities (in association with the Northern Forest Center and the Northern Forest Investment Zone).
- Download at: <https://silvicultureinstitute.org/>

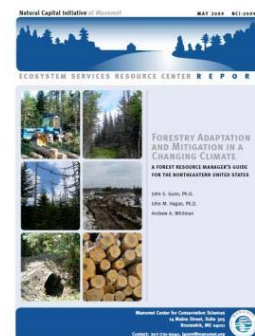
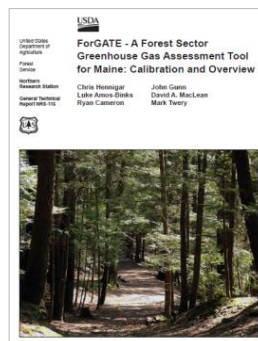
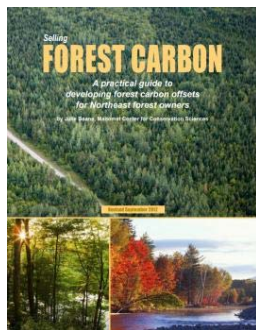
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Forest Carbon Resources




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John S. Gunn, Ph.D.
john.gunn@unh.edu
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43