When New Carbon Markets and New Technologies Meet

NASA CMS Applications Policy Speaker Series
April 15, 2015

Blue Source

Overview

- Who is Blue Source?

- Global carbon offset markets
- Forestry's role in carbon markets
- Carbon project requirements, dynamics/economics
- Carbon measurement requirements, processes, costs
- Barriers to adoption of remote sensing solutions
- Speeding adoption

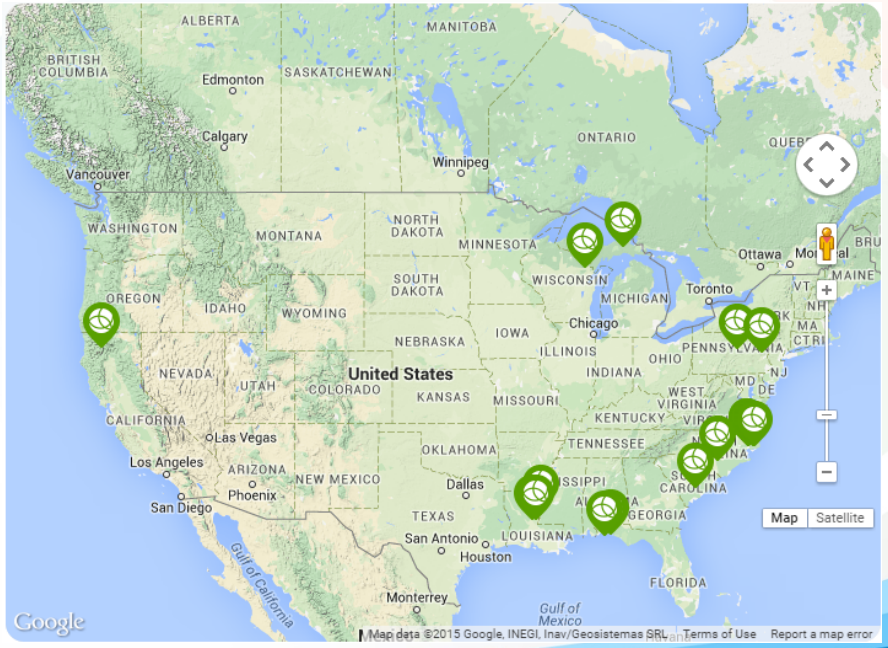
- Q&A

Who is Blue Source?

Founded in 2001, Blue Source is the oldest and largest offset project developer in North America

- **200+ Projects**
- **100,000,000 offsets created**
- **Offset projects in nearly all 50 states and most Canadian provinces**
- **Most forest offsets generated**

- **Emphasis**
  - Generating high quality, high volume GHG emission reductions
  - Motivating industry to action through leveraging carbon markets to provide financial incentives to reduce emissions
  - Simplifying carbon markets for those companies that wish to or are forced to address their carbon footprints



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Global Carbon Offset Markets

A Carbon Offset is a reduction of greenhouse gases, measured in metric tonnes of CO_2 equivalent ($mtC0_2e$), meeting the following criteria, that is created by one entity, transferred to another, and ultimately retired.

- **Offset Criteria**

Real	Verifiable
Permanent	Surplus
Measurable	Additional

A carbon market is a group of companies and individuals looking for cost-effective means for reducing their environmental impacts, out of either internal motivations or regulatory requirements.

Voluntary, Compliance, Pre-Compliance Carbon Markets

- **North America**
  - Voluntary (VCS, ACR, CAR)
    - Internal Sustainability, CSR
    - Carbon Neutral Product or Supply Chain
  - Compliance
    - California, Quebec (Ontario?)
    - RGGI
    - Alberta
    - British Columbia
  - Pre-Compliance

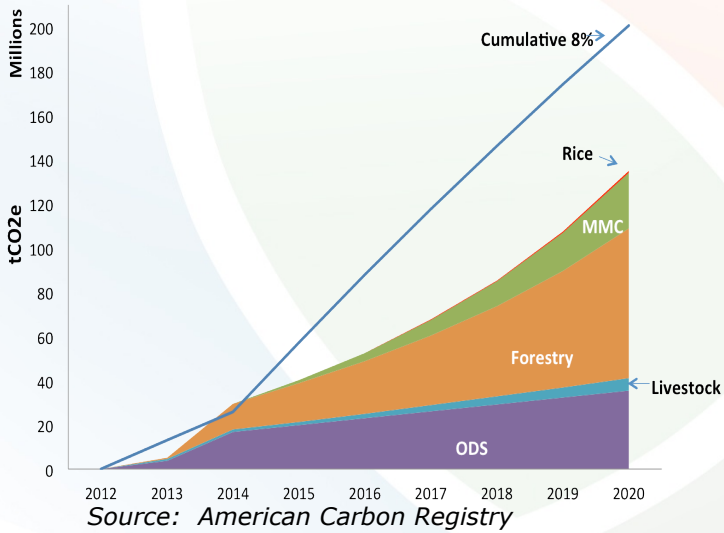
- **International**
  - Voluntary
  - Kyoto Protocol Driven (EUETS, CDM, JI)

Forestry's Role in Carbon Market

- **Voluntary Benefits**
  - Co-benefits
    - Biodiversity
    - Local water quality
    - Community
    - Community-economic

- **California Compliance Benefits**
  - High volume projects
  - Large potential reductions across industry
  - EHS Regulatory conformance

- **Disadvantages**
  - High cost of development
  - High degree of difficulty, long path to market
  - Complexity for buyers
  - 100-year landowner commitments
  - Monitoring Challenges



Source: American Carbon Registry

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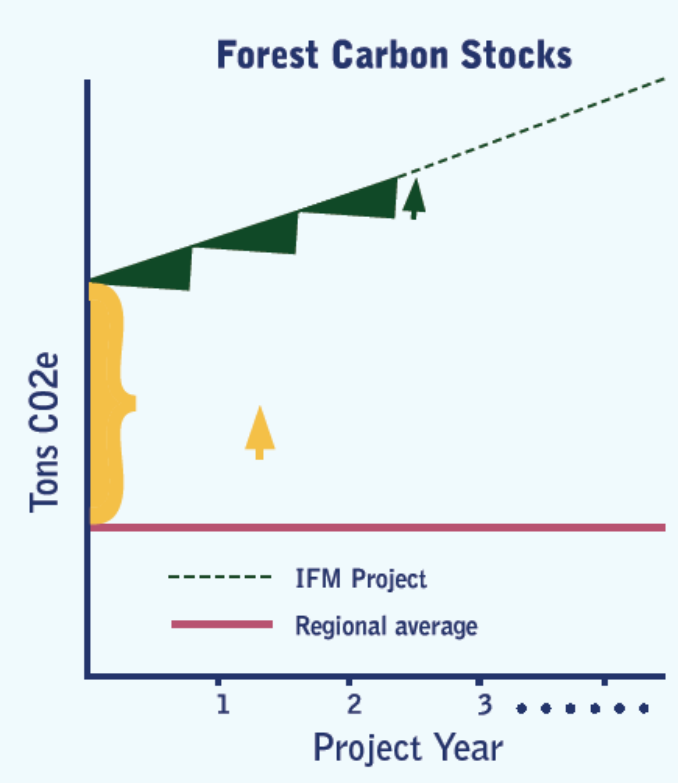
Forest Offset Project Requirements (California Cap and Trade)

- A/Reforestation (AR), Avoided Conversion (AC), Improved Forest Management (IFM)
- Lower 48 states and Alaska
- Natural forest management, sustainable harvesting (e.g. SFI, FSC, Tree Farm)
- Clear title/ownership of carbon credits, eased or un-eased
- ~100 year commitments: measurement, verification, reversals
  - Resample every 12 years, verify every 6 years, model and report annually
  - Compensate for intentional reversals (i.e. harvests)
  - Similar to a conservation easement with a termination option
    - Can subdivide and sell, but commitment transfers w/ownership
    - Can exit at any time if pay back all credits issued (+ 0-40% penalty)
  - Endowment may be set aside in first years to cover 100-year expenses
  - Also: 3-8 year invalidation risk (offset buyer is liable)
- See also VCS, ACR, CAR forest carbon project protocols

= Minimum Practical Size = 1,000 ac Avoided Conversion / 3,000 ac Improved Forest Mgt

Project Dynamics/Economics: Improved Forest Management (IFM)



	Pacific Northwest Fir	Northern Mixed Hardwood	Southern Pine
Credits at project initiation	190,000	120,000	115,000
Revenue at project initiation	$1.9	$1.2	$1.2
Annual credit generation from continued CO2 stock accumulation	8,000	5,000	7,000
Gross revenue in first project decade	$2.7	$1.7	$1.9
Gross revenue per acre in first project decade	$270	$170	$185

Assumes

- 10,000 acres
- Carbon stocks 20% over average stock
- 50% annual growth harvested
- $10/ton carbon price
- 10 year crediting (25-100 year possible)

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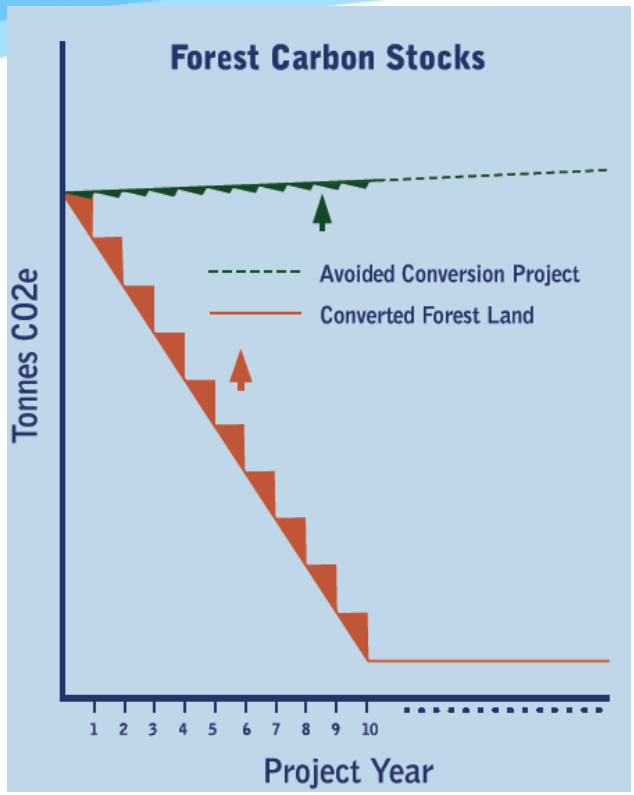
Project Dynamics/Economics: Avoided Conversion (AC)



	Pacific Northwest Fir	Northern Mixed Hardwood	Southern Pine
Annual Credits generated from conversion avoidance	28,000	18,000	16,000
Annual credit generation from continued CO2 stock accumulation	2,200	1,400	2,800
Gross revenue in first project decade ($ millions)	$3.0	$1.9	$1.9
Gross revenue per acre in first project decade	$1,208	$776	$752

Assumes:

- 2,500 acres
- 3 acre residential development avoided
- Carbon stocks 20% over average stock
- 50% annual growth harvested
- $10/ton carbon price
- 10 year crediting (25-100 year possible)

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Carbon Measurement Requirements, Costs, Potential Savings

	Estimated Costs			
	Initial	**Ongoing**	**Frequency**	**Potential Savings**
1 Feasibility Assessment (eligibility, volume)	$5-$15k	$0	one time	**
Legal (AC Only)	$0-20k	$0	one time	
Appraisal (AC Only)	$5-30k	$0	one time	*
2 Forest Carbon Inventory				
Inventory Methodology and Design	Varies	Varies	~one time	*
Inventory Sampling / Field Work	$30-75k	$20-$100k	12 years (6?)	**
3 Calculation of Carbon Benefits				
Project Growth & Yield models	$15-$80k	$0-20k	6 years/harvests	*
Baseline Scenario Harvest Model (legal, economic)	$5-$50k	$0	one time	*
Conversion of "Gross" to "Net" Carbon Benefits (credits)	$5-20k	$0-10k	annual	
▪Inventory confidence				**
▪Leakage				*
▪Wood products				
▪Reversal risk, e.g. fire, wind				*
4 Project Design and Documentation	$10-100k	$0	one time	
5 Third-party Verification				
Full (Site) Verification	$30-75k	~80% Initial	6 years	**
Desk Verification	$0	$7-10k	when crediting	*
6 Registration	~$0.20/credit	~$0.20/credit	when crediting	
7 Marketing, Sales, Contracting	Varies	Varies	when crediting	
8 Annual Monitoring and Reporting	n.a.	$0-5k	annual	*
9 Project Finance	Varies	Varies	Varies	

- 12 month process
- Upfront Inventory, Verification Costs: $60-150k In Year 1
- 100 Year Monitoring, Verification, Inventory Costs: $100-200k Endowment

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Barriers to Adoption

- Strong support “as long as the science is there”
- Differing prospects for inventory, monitoring, verification; pre/post-crediting
- Specific protocol requirements would need modification
  - Plot sampling parameters including dbh, height for volumetric equations
  - Sampling Error <5%-20% of mean at 90% confidence
  - Required pools, verification protocols, modeling requirements

Table A.1. Requirements of carbon pool categories and determination of value for pool

Category	Carbon Pool	Improved Forest Management	Reforestation	Avoided Conversion	Determination of Value
Living biomass	Standing Live	Required	Required*	Required	Sampled in Project
	Shrubs and Herbaceous Understory	Excluded	Required	Excluded	Sampled in Project
Onsite dead biomass	Standing Dead	Required	Required	Required	Sampled in Project
Soil	Soil**	Required/ Excluded**	Required/ Excluded**	Required/ Excluded**	Sampled in project

* Pre-existing trees must be distinguished from planted trees. Since pre-existing and new trees are easy to distinguish for several decades after tree planting, pre-existing trees do not need to be inventoried until the offset project first seeks verification of GHG reductions and GHG removal enhancements.
** Soil carbon is not anticipated to change significantly as a result of most Forest Project activities. Soil carbon is excluded except when specified in Section 5.

a. Standard procedures for the collecting of field measurements. These procedures must be detailed enough so that any qualified forester would be able to accurately repeat the previous measurements. These procedures must include a description of the types of sample plots, location of plots, and frequency for updating or replacing sample plots as well as the forest carbon inventory as a whole;
b. Standard procedures for where and how to measure parameters used in biomass calculations such as dbh and height (including for irregular trees), how to classify dead wood, and for any other aspects of sampling where a consistent method needs to be documented; and

The following growth models have been approved:

- CACTOS: California Conifer Timber Output Simulator
- CRYPTOS: Cooperative Redwood Yield and Timber Output Simulator
- FVS: Forest Vegetation Simulator
- SPS: Stand Projection System
- FPS: Forest Projection System
- FREIGHTS: Forest Resource Inventory, Growth, and Harvest Tracking System
- CRYPTOS Emulator
- FORESEE

Table 10.1. Minimum number of sample plots in sequence, as a function of project size.

Test	Number of Strata Verified	Project Acres				
		<100	100 - 500	501 - 5,000	5,000 - 10,000	> 10,000
Paired/Unpaired	3	2	3	4	5	6
	2	4	6	8	10	12
	1	8	12	16	20	24

CA Air Resources Board:
Compliance Offset Protocol U.S. Forest Projects
Section 10, Appendix A, Appendix B

Other Potential Barriers / Questions

- Single tree selection yields uniform ht/canopy, yet carbon varies w/basal area?
- 2-3 age classes - ability to penetrate the canopy/measure understory?
- Differentiate between e.g. hard maple and soft maple?
- Mixed old and second growth have similar ht/canopy, very different dbh/carbon?
- What's realistic expected reduction in plots (inv, verif)?
- Tradeoff in sampling uncertainty

Speeding Adoption

- Engage ARB to modify protocol; ACR/VCS/CAR to approve new protocol or module
  - Emphasize potential to reach small landowners, dramatically increase market potentialj
  - Post-crediting monitoring
- Use existing/ongoing project data for ground truthing (Hurtt-03)
- Just Do it: start using to support inventory, demonstrate benefits (# plots, frequency)
  - Inventory likely easiest initial path; verification provides ground-truthing / safety-net
- Identify areas of (relative) high stocking and potential new projects
  - Proof of concept, ground-truthing, revenue generation
  - Blue Source provides free eligibility assessments and revenue projection

Working hard to bring projects to market…

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