Nicholas Institute for Environmental Policy Solutions
Nicholas School of the Environment and Earth Sciences • Duke University

Duke Greenhouse Gas Gold Standard

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Agriculture Air Quality Task Force
Indianapolis -- October 2007

Outline

1. Why and how forest and farms are used for climate mitigation
2. What the Duke Std covers
3. How this book is useful for the policy and regulatory community

Why Forests & Farms

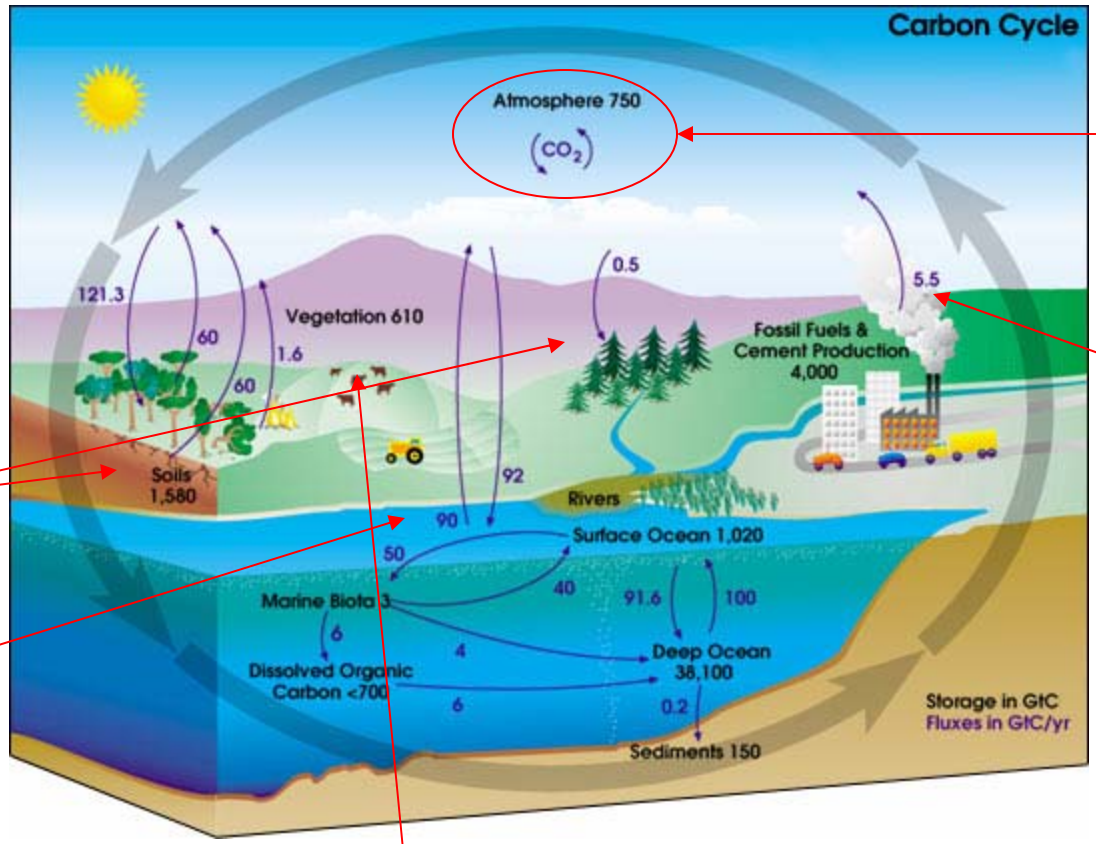
- Helps mitigate climate change
- Brings in an otherwise unutilized sector for reductions
- Opportunity for forest and ag sectors to balance other costs
- Reduces costs of mitigation to the economy

Re-manipulating the Global Carbon Cycle

Increase CO2 Stored in

Forests and Soils

Oceans



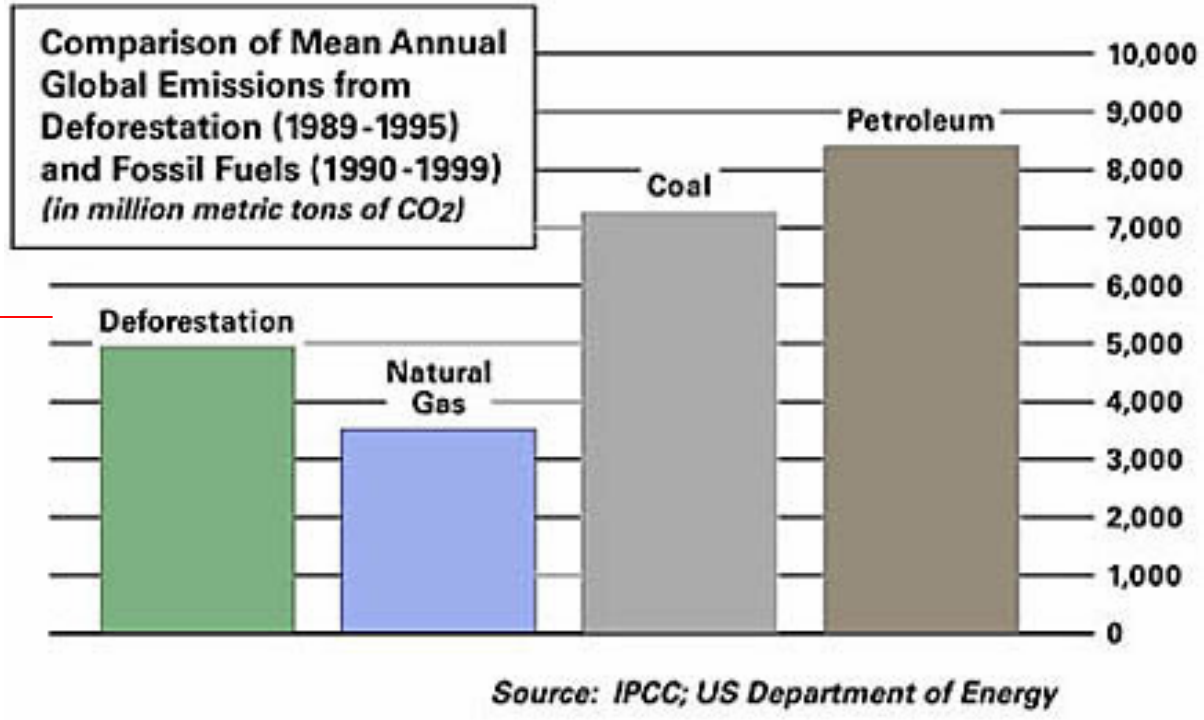
Goal is to reduce atmospheric concentration

Reduce Industrial emissions

Reduced emissions of CO_2 and Non-CO_2 greenhouse gases

Source: NASA

Global CO_2 Emissions Sources



~20% of Global emissions

From: Union of Concerned Scientists. *Recognizing Forest's Role in Climate Change.* http://www.ucsusa.org/global_warming/solutions/recognizing-forests-role-in-climate-change.htm
/

National GHG Balance of Forest and Agriculture

GHG Emissions Sources and Sinks in US: 2004

	Emissions (MMT CO2)	% of total
Electricity Generation	2,338	33.0%
Transportation	1,955	27.6%
Industry	1,377	19.5%
Agriculture (mostly methane and N_2O)	491	6.9%
Commercial Buildings	460	6.5%
Residential Buildings	391	5.5%
Other	62	1.0%
Gross emissions	7,074	100.0%
Forest/Ag Carbon Sinks	-780	-11.0%
Net emissions	6,294	89.0%

Source: US EPA GHG Inventory, 1990-2004

http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html

Opportunity for forest and ag sectors to balance other costs

Biophysical - Level and Variability of

- Temperature
- Precipitation
- CO_2 fertilization

→ May need adaptation (new technology and practices)

Economic – Policy will likely drive

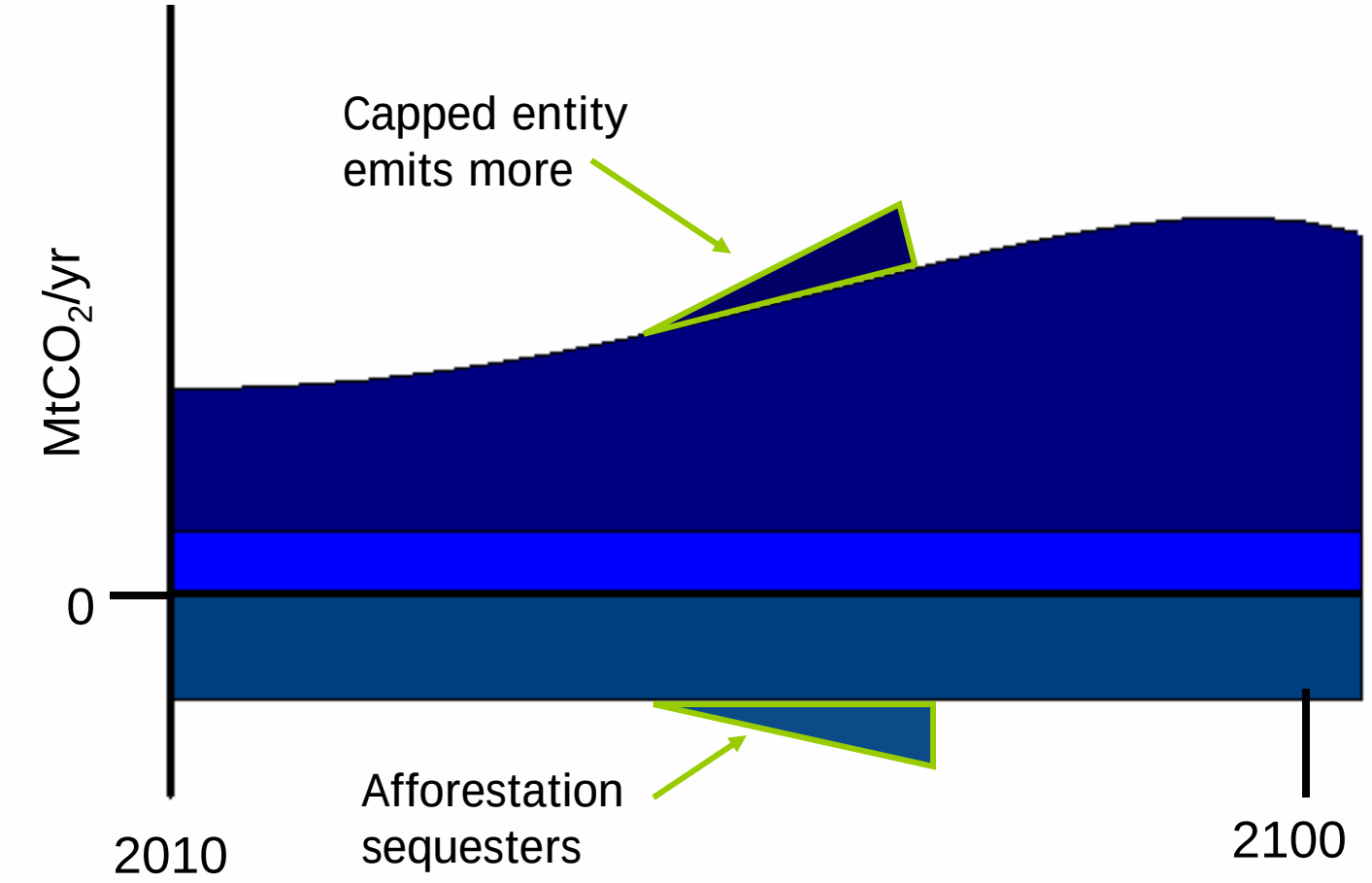
- Increased costs of energy-intensive inputs
- New opportunity for farmers/forest owners to provide a sink or mitigation to offset other emissions

What is an offset?

Offsets

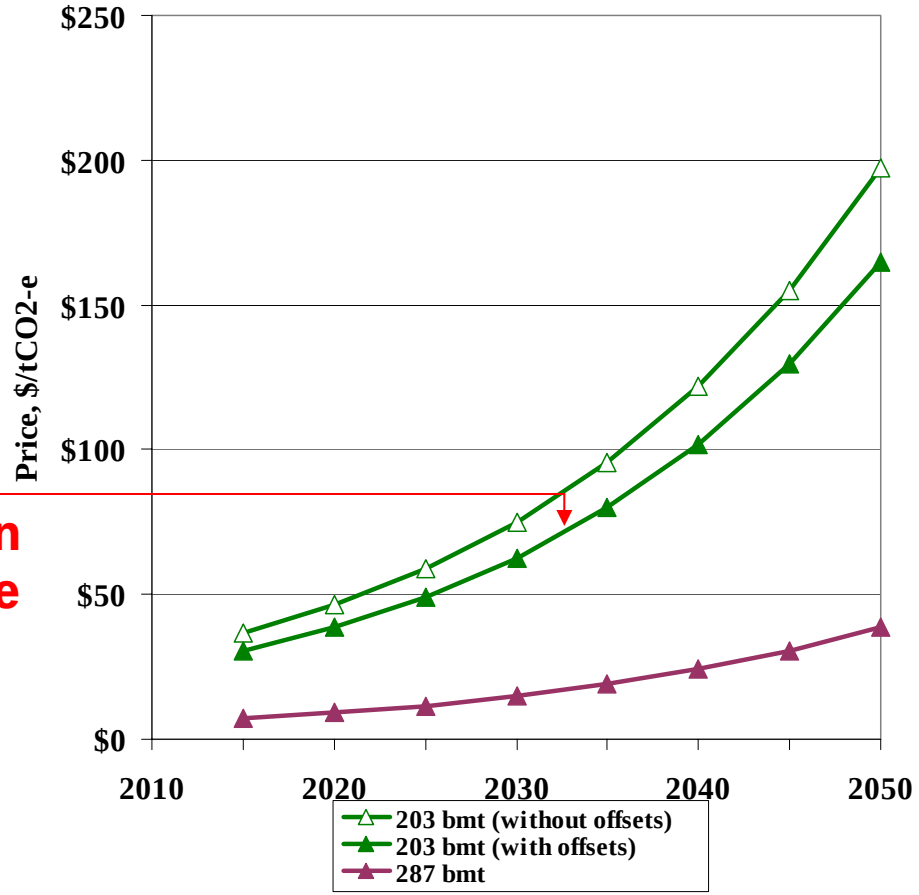
- **Some emissions sources are not subject to a cap**
  - Economic hardship (e.g.. developing countries)
  - Emissions too dispersed (e.g., agriculture)
- **Under some programs, uncapped sources can voluntarily reduce emission, verify them, and sell credits to capped sectors/sources**
  - Kyoto Protocol, Clean Development Mechanism – projects in developing countries
- **Benefits**
  - Reduce overall costs of mitigation target
  - Increases mitigation options

What is an offset?



Reduces costs of mitigation to the economy

Offsets Reduce Marginal Compliance Cost in Cap and Trade



15-20% reduction In allowance price With offsets

Martin Ross (RTI). ADAGE runs of Cap and Trade Targets with/without offsets. Presentation at Nicholas Institute Symposium, July 2007.

How F&A used for mitigation

- Numerous options for mitigation in F&A
- Growing market opportunities for F&A mitigation
- Measurement and accounting issues are a critical ‘sticking point’ going forward

Mitigation Options in Forestry and Agriculture

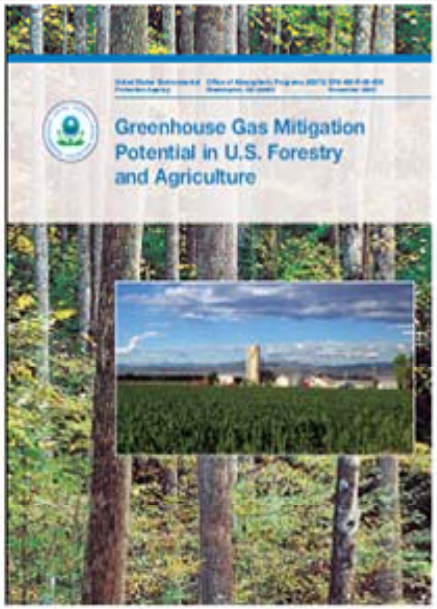
	Strategy	Mitigation Activities	Target GHG
Carbon Sequest-ration	**Afforestation**	Convert agricultural lands to forest	CO_2
	Forest management	Lengthen timber harvest rotation Increase forest management intensity Forest preservation Avoid deforestation	CO_2
	Agricultural soil carbon sequestration	Crop tillage change Crop mix change Crop fertilization change Grassland conversion	CO_2
Emissions reduction	**Fossil fuel mitigation from crop production**	Crop tillage change Crop mix change Crop input change Irrigated/dry land mix change	CO_2
	Agricultural CH4 and N2O mitigation	Crop tillage or mix change Fertilization change Irrigated/dry land mix change Enteric fermentation control Livestock herd size change Livestock system change Manure management Rice acreage change	CH_4 N_2O
Biofuels	**Biofuel offsets**	Produce crops for biofuel use	CO_2

Forestry and Agricultural GHG Mitigation Report

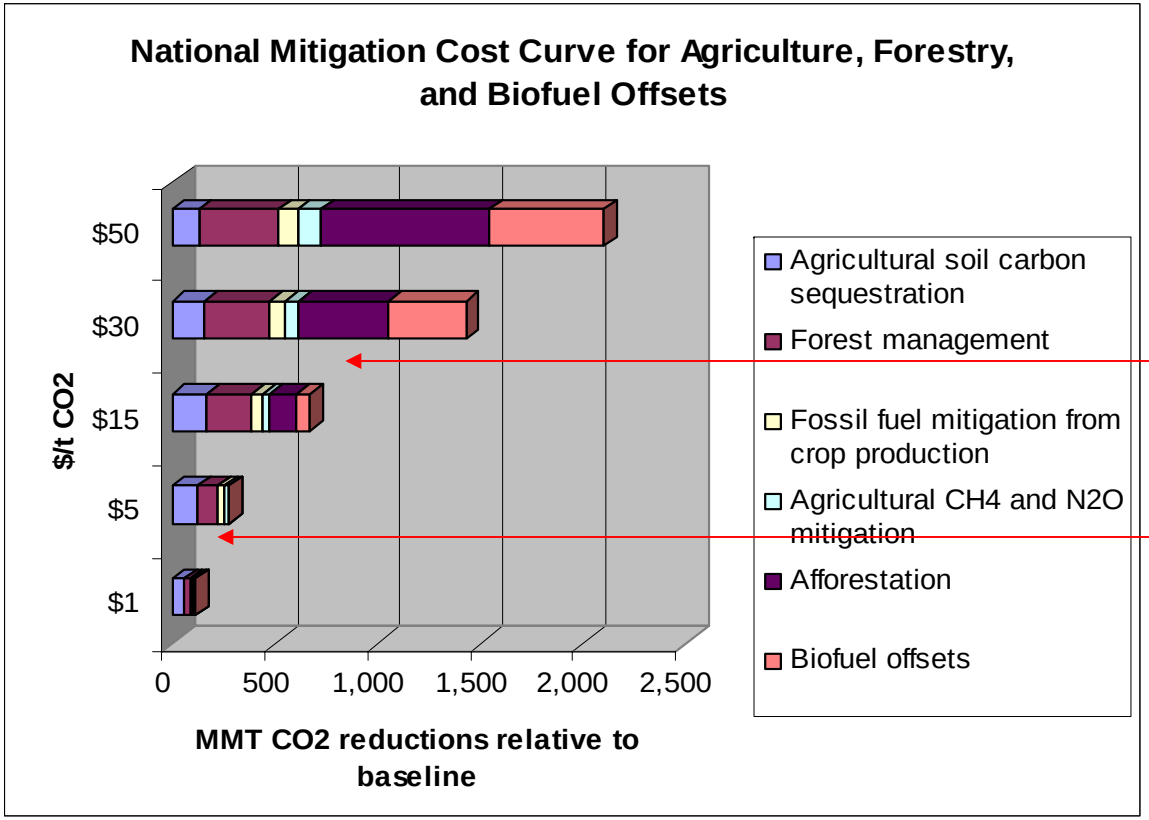
- **Funding Source: EPA**
- **Collaborators: RTI, Texas A&M, Ohio State**
- **<u>Objectives</u>**

✓ **Identify mitigation options in forestry and ag**
✓ **Estimate economic potential**
✓ **Examine policy design and implementation issues**
✓ **Assess environmental co-effects (water quality, biodiversity)**

- **Published 12/05. Posted at http://www.epa.gov/sequestration/greenhouse_gas.html**



Mitigation Potential in US: Agriculture, Forestry, and Biofuels



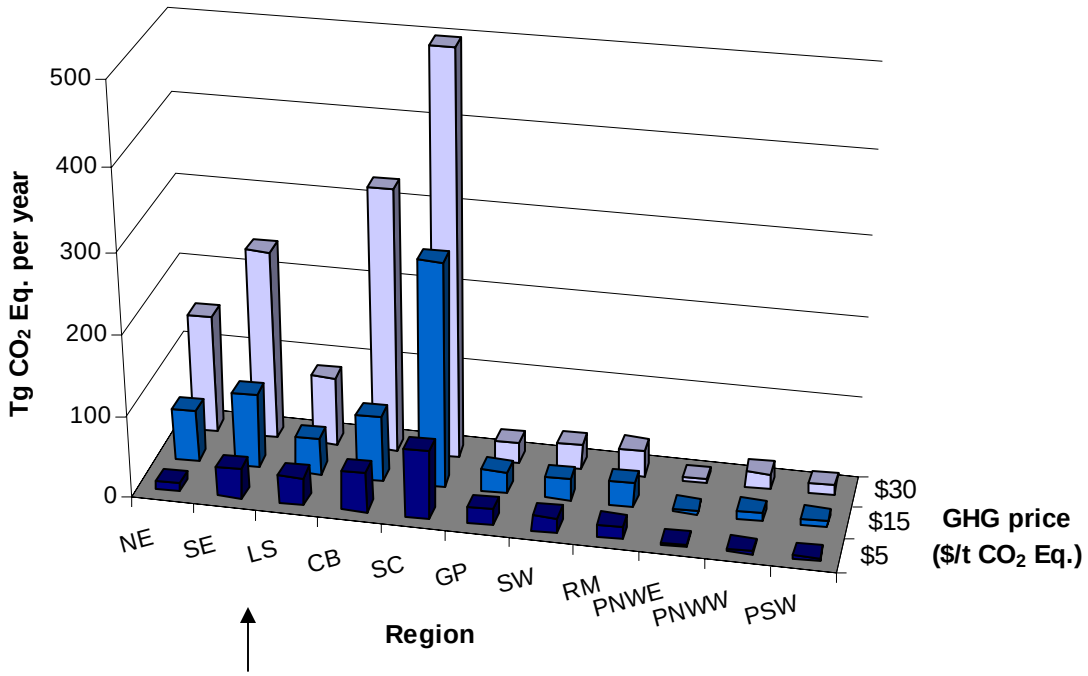
Afforestation and Biofuels at higher cost

Ag soils and Forest management At low cost

Source: US EPA. 2005. Greenhouse Gas Mitigation Potential in US Forestry And Agriculture. http://www.epa.gov/sequestration/greenhouse_gas.html

Potential not uniform across regions

Total Forest and Agriculture GHG Mitigation by Region
Quantities are Tg CO2 Eq. per year net emissions reduction below baseline, annualized over the time period 2010–2110.



Opportunities primarily in the eastern US

Growing opportunities

Voluntary offsets market

- Private trades (i.e. Environmental Resources Trust, Oregon Climate Trust)

Voluntary cap and trade in the U.S.

- Chicago Climate Exchange

International offsets for mandatory reductions

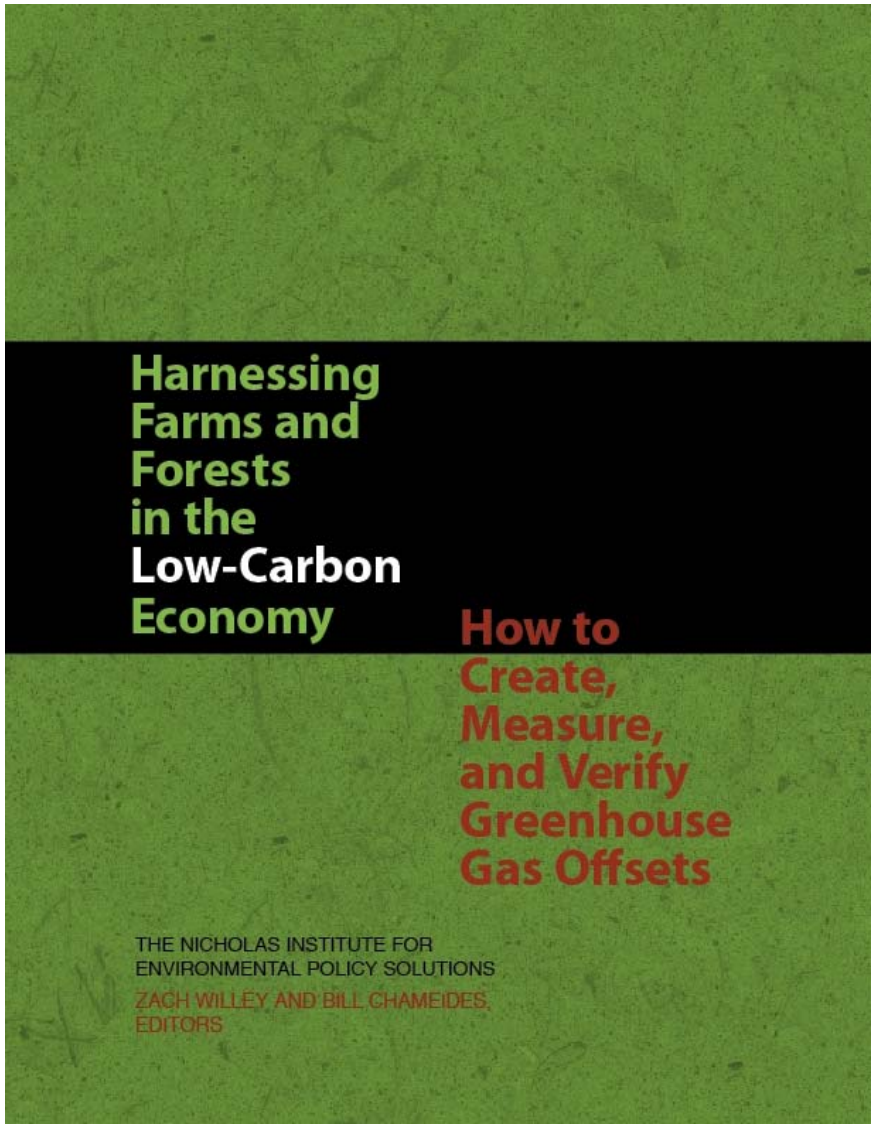
- Kyoto Protocol CDM market
- Discussing REDD market

Coming soon maybe – Mandatory US market

- Domestic F&A offsets
- International F&A offsets

Sticking points for offsets

- What activities are feasible?
- How can reductions/sequestration be measured?
- And verified?
- How can we insure that the reductions are additional and permanent?


Harnessing Farms and Forests in the Low-Carbon Economy
How to Create, Measure, and Verify Greenhouse Gas Offsets
THE NICHOLAS INSTITUTE FOR ENVIRONMENTAL POLICY SOLUTIONS
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What is in HFF?

- Why F&A important for climate mitigation
- How to create F&A offset projects – logistics, feasibility, contracts
- Critical issues for measuring and verifying reductions
  - Technical detail on measurement & accounting methods
  - A ‘gold standard’ – may not be what is applied

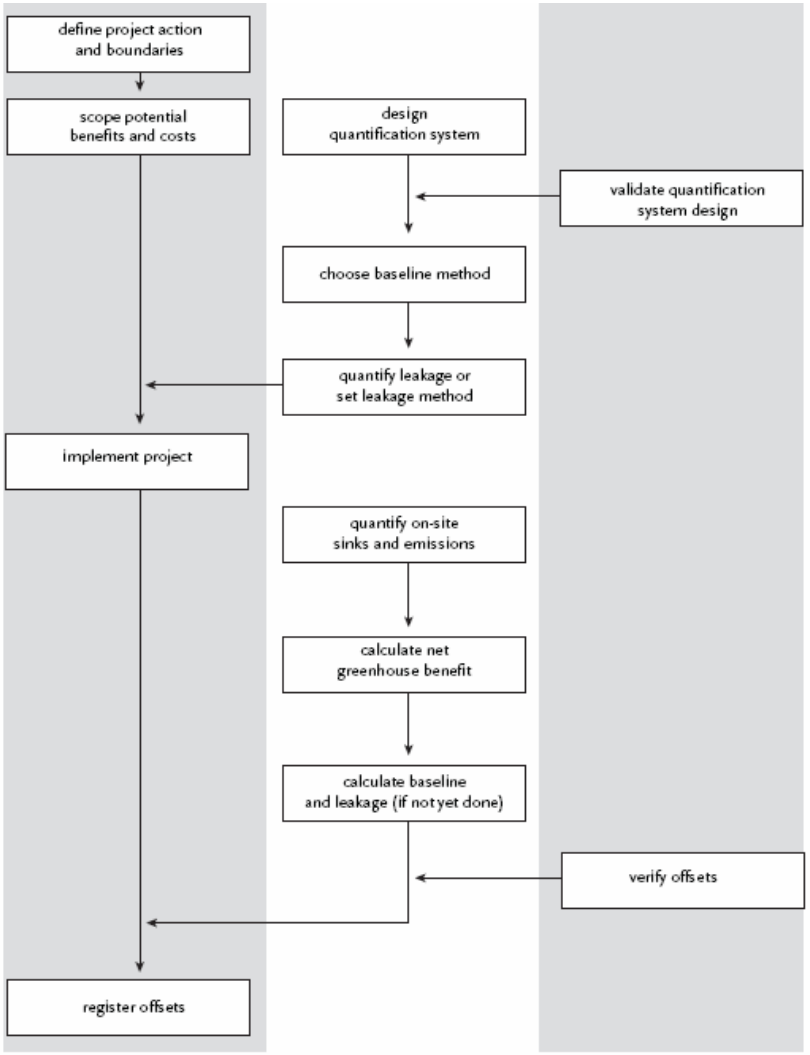


Figure 2.1 The process of producing offsets. Before committing to a project, landowners and buyers alike will want reasonable assurance that it will provide the offsets they seek. To obtain such assurance, participants must navigate a complex series of steps.

PROCESS

Activities for

- Project Developer
- Offset Quantifier
- Verifier

Such as

- Scope of costs and benefits
- Design of sampling
- Baseline determination
- Quantifying leakage
- Verifying methods and net reductions
- Registering offsets

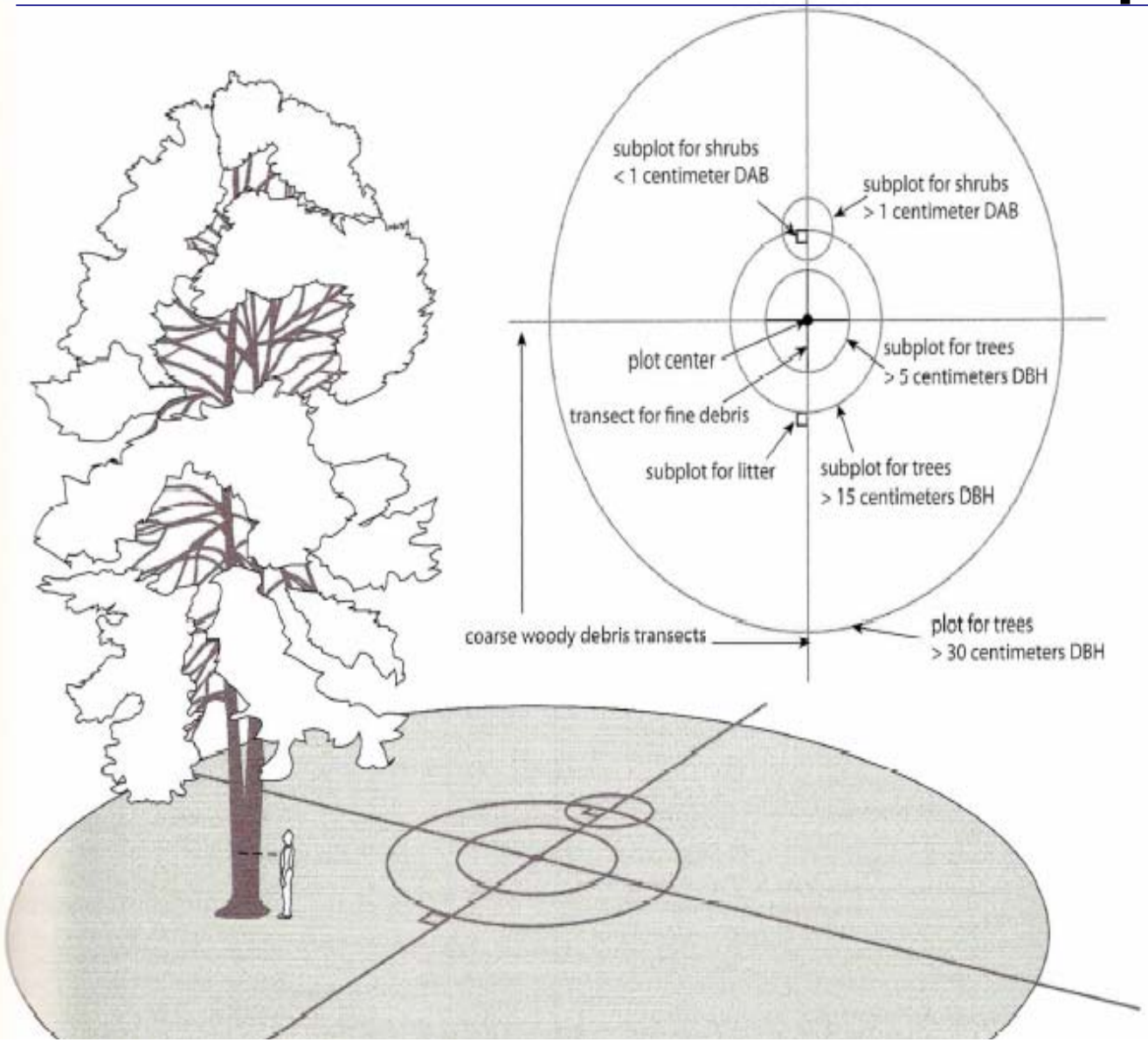
Types of mitigation activities covered

- Agricultural soil sequestration
- Sequestration from afforestation
  - Trees, debris, other vegetation, soils
- Reducing CH_4 and N_20 emissions by shifting agricultural practices
- Reducing CH_4 emissions from manure management operations

27 Technical Appendices

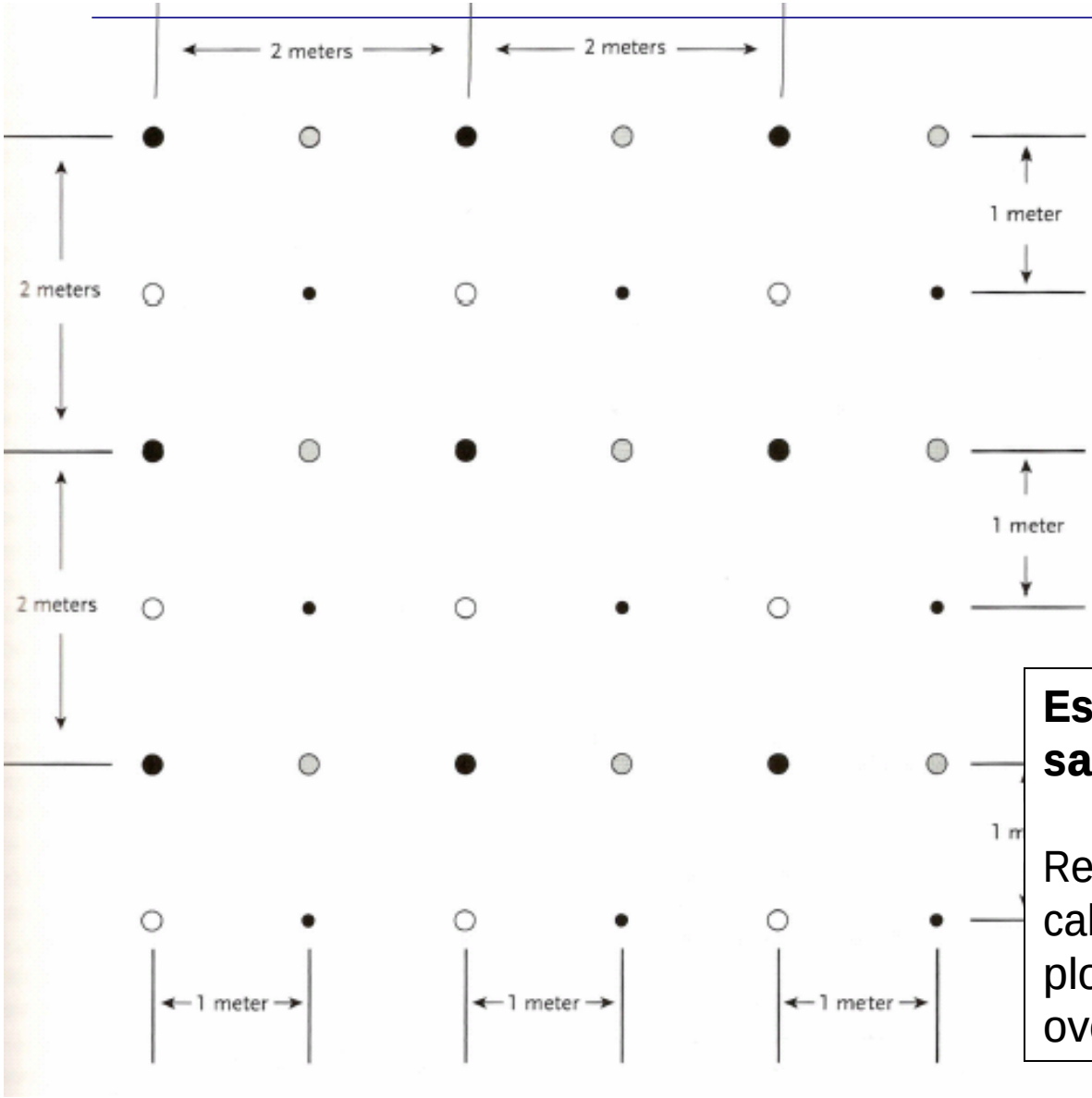
- Key Factors to Consider in Developing a Sampling Strategy
- Calculating Levelized Costs and Benefits
- Calculating Methane and Nitrous Oxide Emissions from Manure
- Addressing Leakage from Forestation Projects
- Choosing a Registry

Measurement Examples



Recommended design of a forest plot.

Measurement Examples

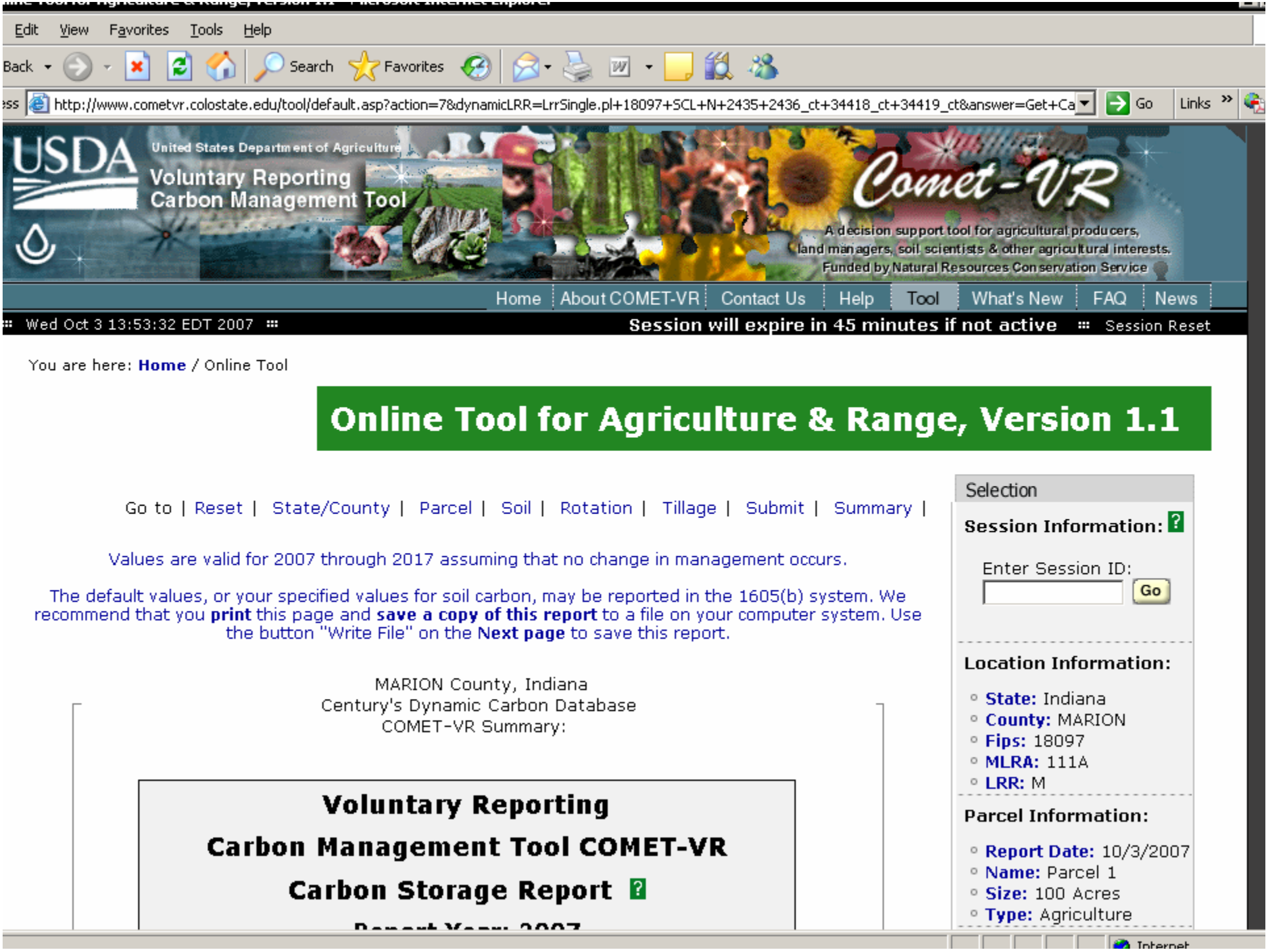


buried magnetic markers

- initial sampling
- first resampling
- second resampling
- third resampling

Establishing permanent core sampling plots

Re-measuring soil carbon and calculating the change on each plot gives statistical power to the overall results for the project.


Edit View Favorites Tools Help
Back Search Favorites
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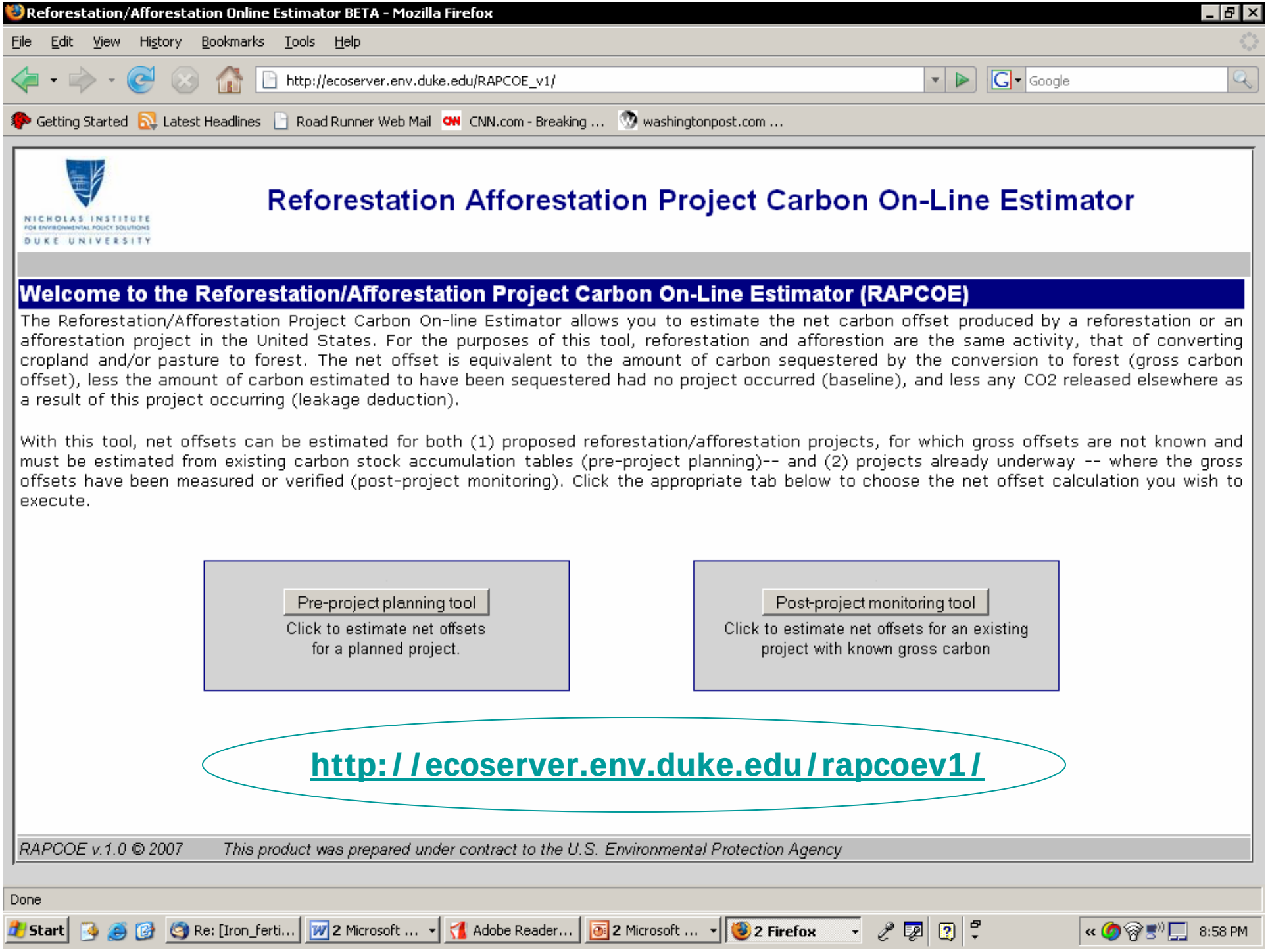
Go Links
USDA
United States Department of Agriculture
Voluntary Reporting
Carbon Management Tool
Comet-VR
A decision support tool for agricultural producers,
land managers, soil scientists & other agricultural interests.
Funded by Natural Resources Conservation Service
Home About COMET-VR Contact Us Help Tool What's New FAQ News
Wed Oct 3 13:53:32 EDT 2007
Session will expire in 45 minutes if not active
Session Reset
You are here: Home / Online Tool
Online Tool for Agriculture & Range, Version 1.1
Go to | Reset | State/County | Parcel | Soil | Rotation | Tillage | Submit | Summary |
Values are valid for 2007 through 2017 assuming that no change in management occurs.
The default values, or your specified values for soil carbon, may be reported in the 1605(b) system. We recommend that you print this page and save a copy of this report to a file on your computer system. Use the button "Write File" on the Next page to save this report.
MARION County, Indiana
Century's Dynamic Carbon Database
COMET-VR Summary:
Voluntary Reporting
Carbon Management Tool COMET-VR
Carbon Storage Report
Selection
Session Information:
Enter Session ID:
Go
Location Information:
State: Indiana
County: MARION
Fips: 18097
MLRA: 111A
LRR: M
Parcel Information:
Report Date: 10/3/2007
Name: Parcel 1
Size: 100 Acres
Type: Agriculture


Reforestation/Afforestation Online Estimator BETA - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://ecoserver.env.duke.edu/RAPCOE_v1/
Google
Getting Started
Latest Headlines
Road Runner Web Mail
CNN.com - Breaking ...
washingtonpost.com ...
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Reforestation Afforestation Project Carbon On-Line Estimator
Welcome to the Reforestation/Afforestation Project Carbon On-Line Estimator (RAPCOE)
The Reforestation/Afforestation Project Carbon On-line Estimator allows you to estimate the net carbon offset produced by a reforestation or an afforestation project in the United States. For the purposes of this tool, reforestation and afforestion are the same activity, that of converting cropland and/or pasture to forest. The net offset is equivalent to the amount of carbon sequestered by the conversion to forest (gross carbon offset), less the amount of carbon estimated to have been sequestered had no project occurred (baseline), and less any CO2 released elsewhere as a result of this project occurring (leakage deduction).
With this tool, net offsets can be estimated for both (1) proposed reforestation/afforestation projects, for which gross offsets are not known and must be estimated from existing carbon stock accumulation tables (pre-project planning)-- and (2) projects already underway -- where the gross offsets have been measured or verified (post-project monitoring). Click the appropriate tab below to choose the net offset calculation you wish to execute.
Pre-project planning tool
Click to estimate net offsets for a planned project.
Post-project monitoring tool
Click to estimate net offsets for an existing project with known gross carbon
http://ecoserver.env.duke.edu/rapcoev1/
RAPCOE v.1.0 © 2007 This product was prepared under contract to the U.S. Environmental Protection Agency
Done
Start
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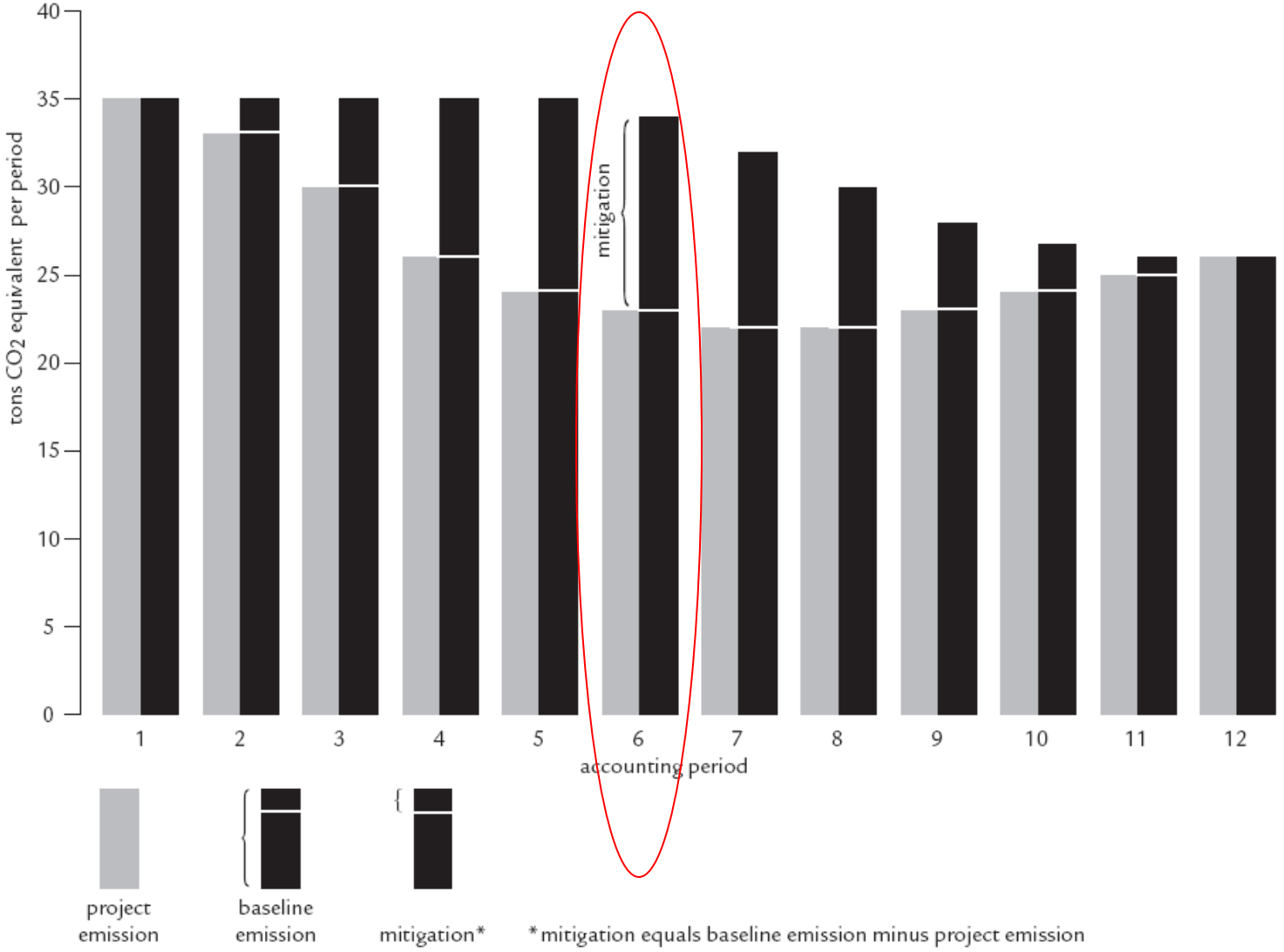
2 Microsoft ...
Adobe Reader...
2 Microsoft ...
2 Firefox
8:58 PM

Additionality/Baseline



Leakage

Table 6-2: Leakage Estimates by Mitigation Activity at a GHG Price of $15/t CO_2 Eq.
All quantities are on an annualized basis for the time period 2010–2110.

Selected Mitigation Activities	A GHG Effects of Targeted Payment (Tg CO_2 Eq.)	B Net GHG Effects of All Activities (Tg CO_2 Eq.)	C Indirect GHG Effects from Nontargeted Activity[a] (Tg CO_2 Eq.)	D Leakage Rate[b] (%)
Afforestation only	137	104	–33	24.0
Afforestation + forest management	338	348	10	–2.8
Biofuels	84	83	–1	0.2
Agricultural management	230	231	1	–0.1
Agricultural soil carbon	154	145	–9	5.7

[a] Indirect effects: C = (B – A).

[b] Leakage rate: D = –(C/A) x 100; rounding occurs in table.

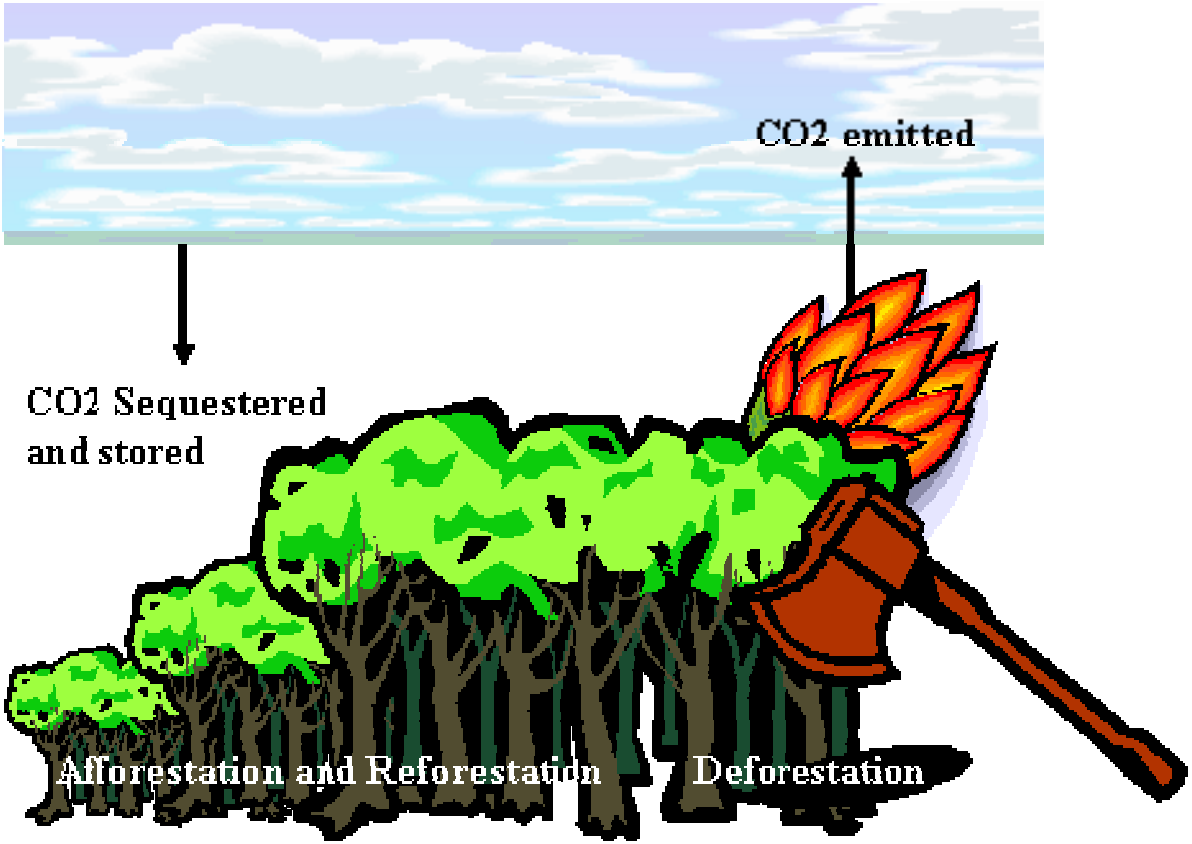
Note: Negative leakage rate in D refers to beneficial leakage (i.e., additional mitigation outside the selected activity region, also called positive leakage).

Leakage is caused by a partial system

More activities included = less leakage

Source: US EPA. 2005. Greenhouse Gas Mitigation Potential in US Forestry And Agriculture. http://www.epa.gov/sequestration/greenhouse_gas.html

Permanence


CO2 emitted
CO2 Sequestered
and stored
Afforestation and Reforestation
Deforestation

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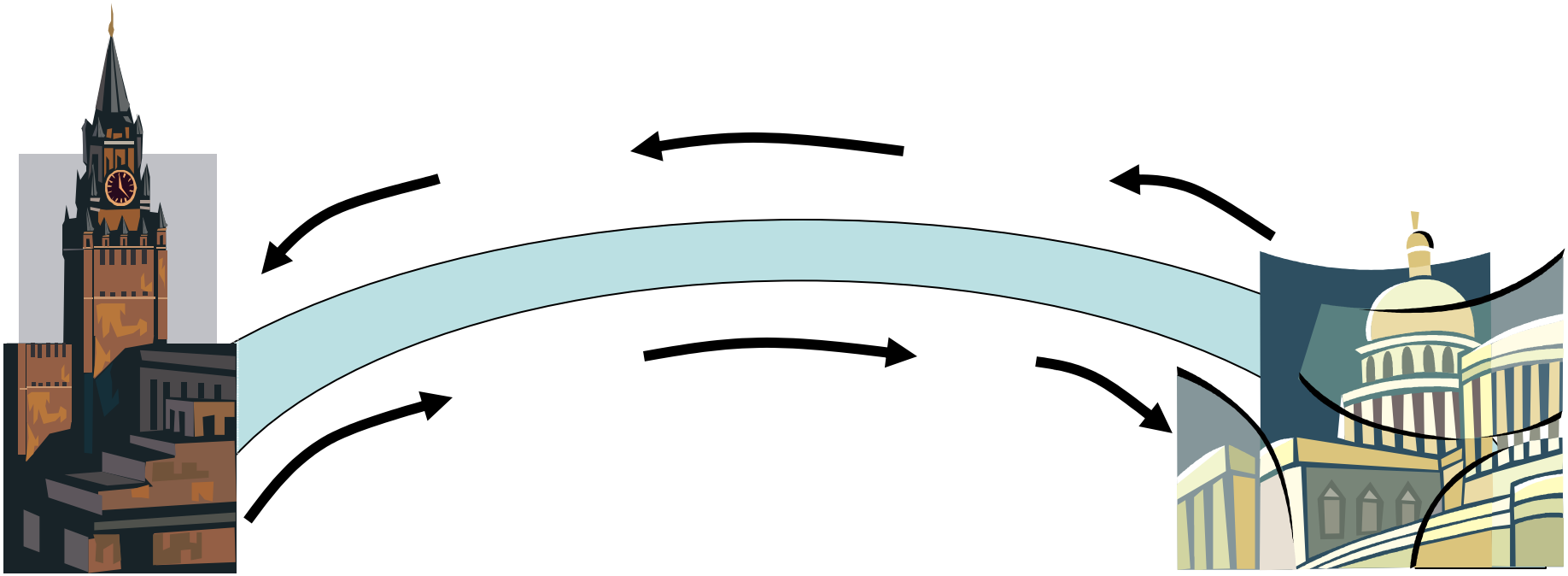
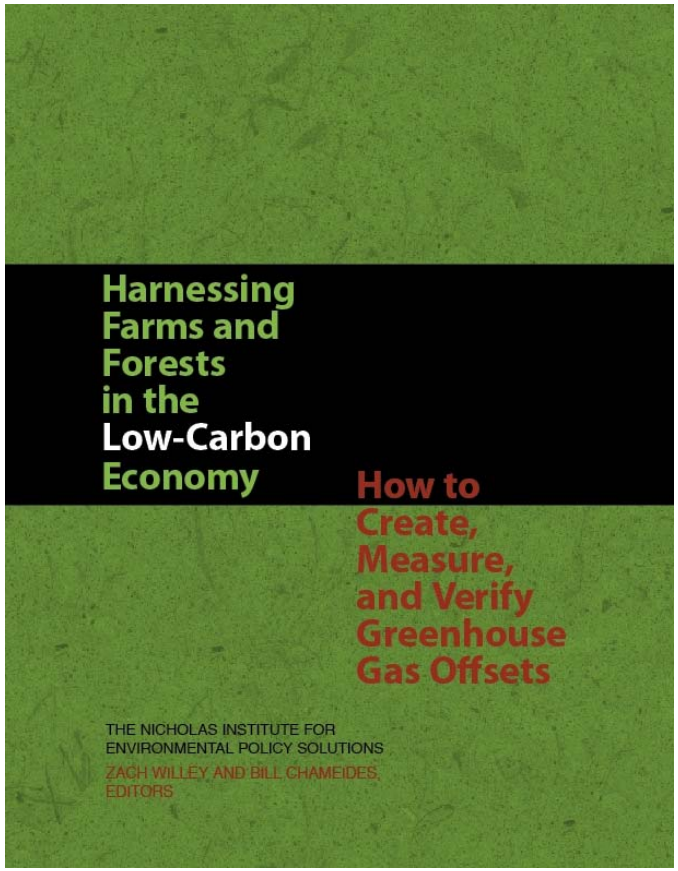
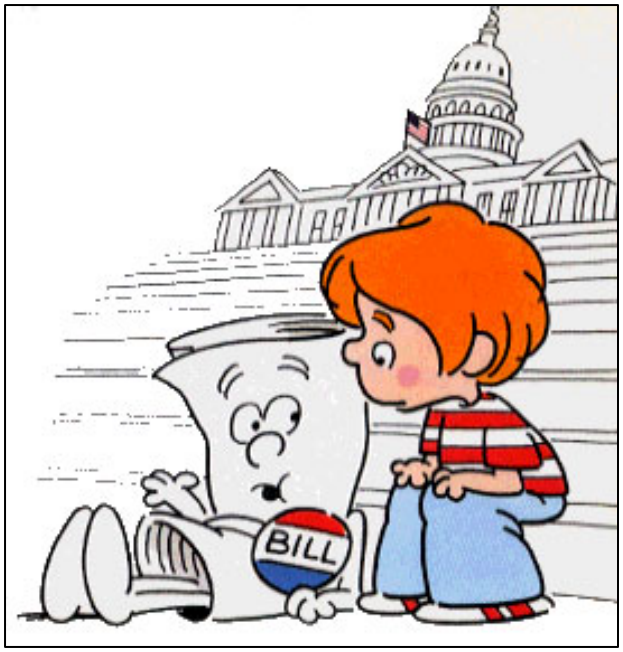
NI is a Bridge between Academia and Decision Makers

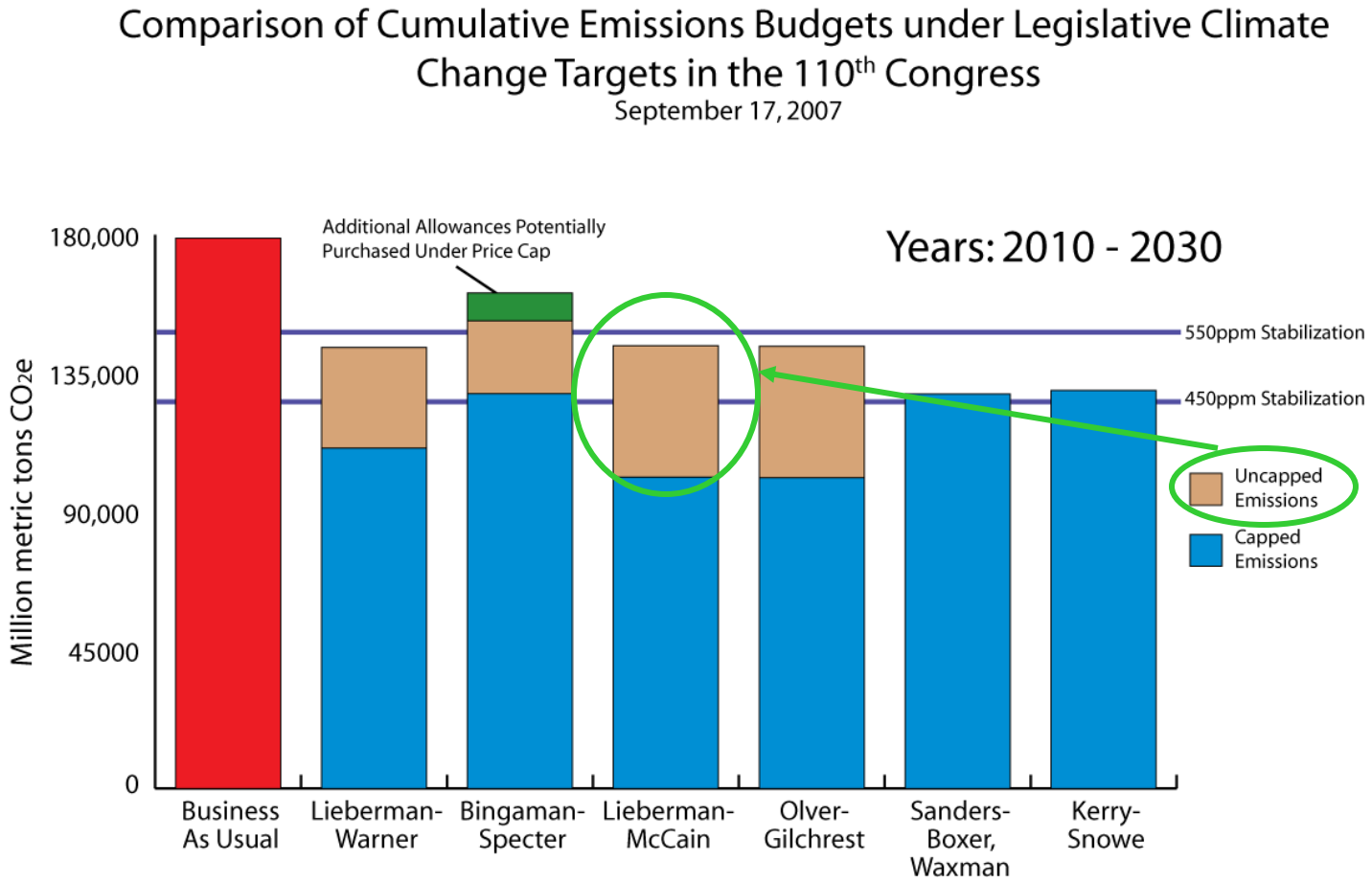






Schoolhouse Rock

Current Federal Climate Proposals



World Resources Institute (Sept 2007)

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Resulting Products

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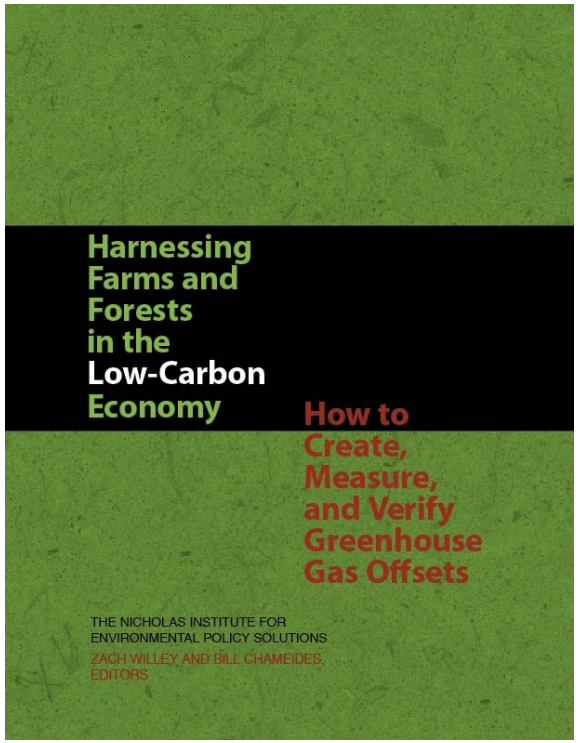

http://www.env.duke.edu/institute/ghgoffsetsguide/index.html

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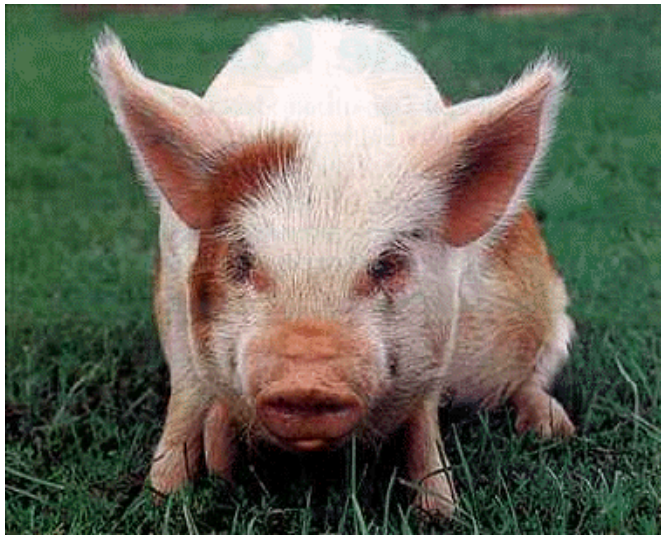
What we are Doing at the Nicholas Institute

Compensated Reductions: Tropical Deforestation

Partnership: Mobilizing the Greenhouse Gas Reduction Market to Improve Hog Waste Management in North Carolina



Duke Energy

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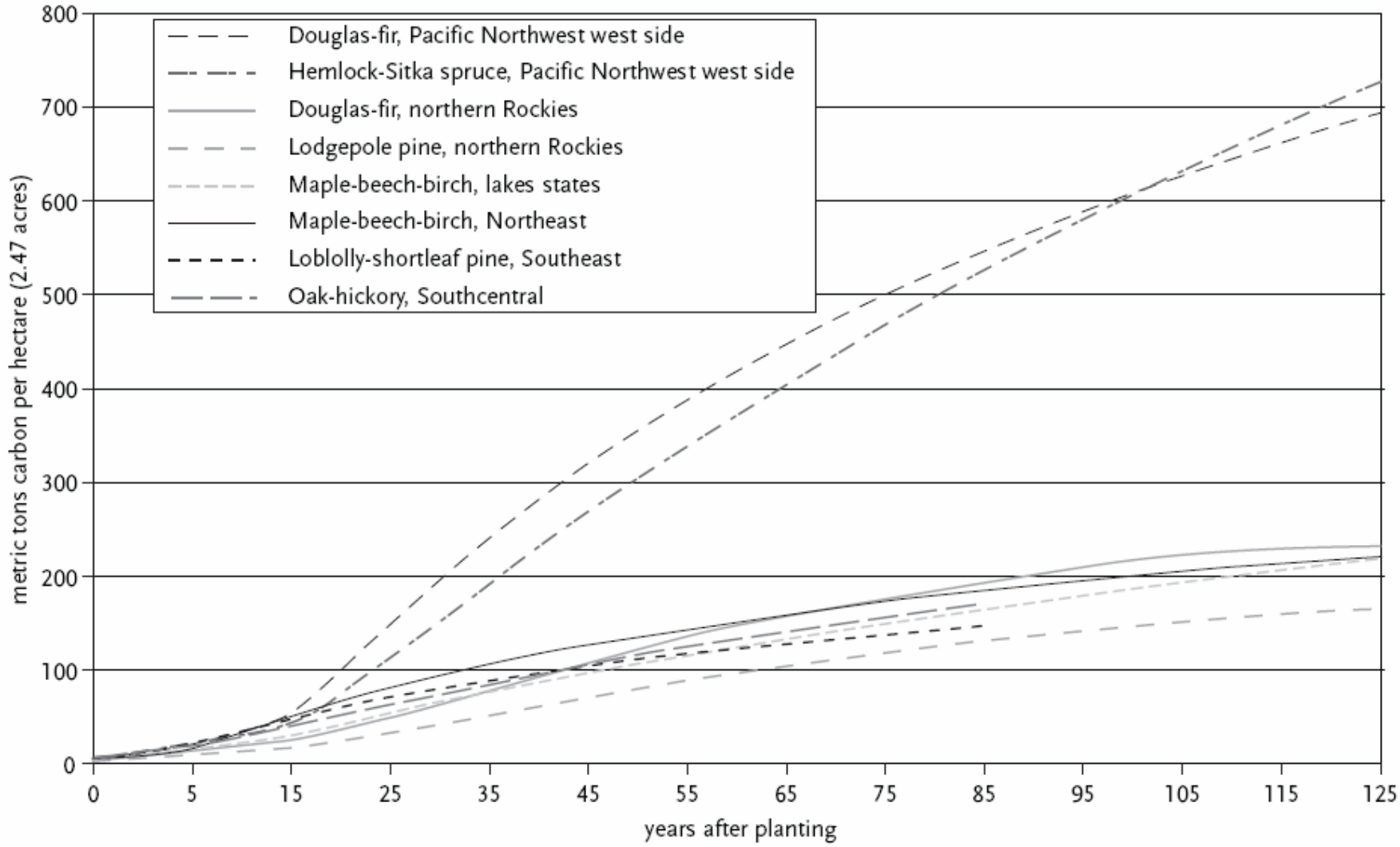
breaking down barriers to environmental progress

CAVANAUGH
Solutions through integrity and partnership


Douglas-fir, Pacific Northwest west side
Hemlock-Sitka spruce, Pacific Northwest west side
Douglas-fir, northern Rockies
Lodgepole pine, northern Rockies
Maple-beech-birch, lakes states
Maple-beech-birch, Northeast
Loblolly-shortleaf pine, Southeast
Oak-hickory, Southcentral
metric tons carbon per hectare (2.47 acres)
800
700
600
500
400
300
200
100
0
0
5
15
25
35
45
55
65
75
85
95
105
115
125
years after planting

Offset Project Implementation Issues:

Getting what you pay for (an emission ***offset***)

- **Permanence**
  - Carbon sinks can be reversed through harvesting or natural disturbance
- **Additionality**
  - Confining credits to reductions that would not otherwise have occurred
  - Requires a baseline
- **Leakage**
  - Accounting for emissions that are simply relocated outside an offset project's boundaries
- Accounting adjustments can be made for all of these
  - Protocols are being developed internationally, nationally, regionally