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Public Land, Timber Harvests and Climate Mitigation: Quantifying Carbon Sequestration Potential on U.S. Public Timberlands

Brian C. Murray, Nicholas Institute, Duke University

Forestry and Agriculture Greenhouse Gas Modeling Forum
Shepherdstown, WV
March 6, 2007

Funding and collaborators

- Funding: US EPA Climate Change Division to RTI International
  - Ken Andrasko

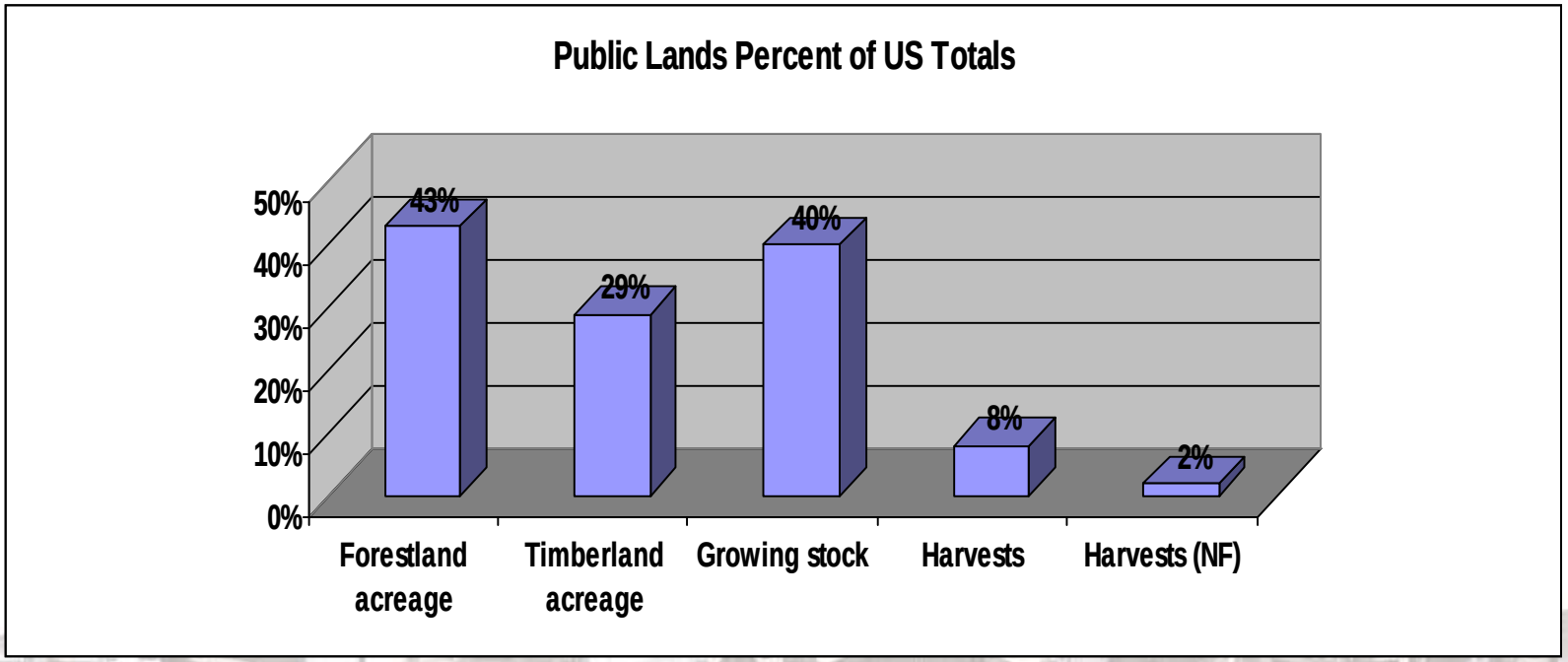
- Co-authors:
  - Brooks Depro, RTI International
  - Ralph Alig, USDA Forest Service
  - Alyssa Shanks, Oregon State University
- Collaborators
  - Jim Smith, USDA Forest Service
  - Darius Adams, Oregon State University
  - Bruce McCarl, Texas A&M

Background

- Much work has looked at private land mitigation opportunities
  - EPA 2005 (Murray et al), USDA 2004 (Lewandrowski et al), Richards and Stokes, 2004; McCarl and Schneider, 2001; Adams et al., 1999; Stavins, 1999; Plantinga et al., 1999
- Baseline C stock projections on public lands (Smith and Heath, 2004)
  - Proportion of total US forest C stock rising over time (35 to 37% from 1950s to now)
- Little work on C stock effects from changes in public land management
  - Not a profit-maximizing response like private sector
  - Management is determined exogenously by administrative decree
  - Ability to access carbon markets is unclear
  - Managing for public goods (like carbon) is core to the mission
- Q: What is the potential, when and where?

Public Forest Lands

- Ownership: National Forest, BLM, Other Federal, State, and Local
- Public Forest Percent of National:



Public & Private Forest by Region

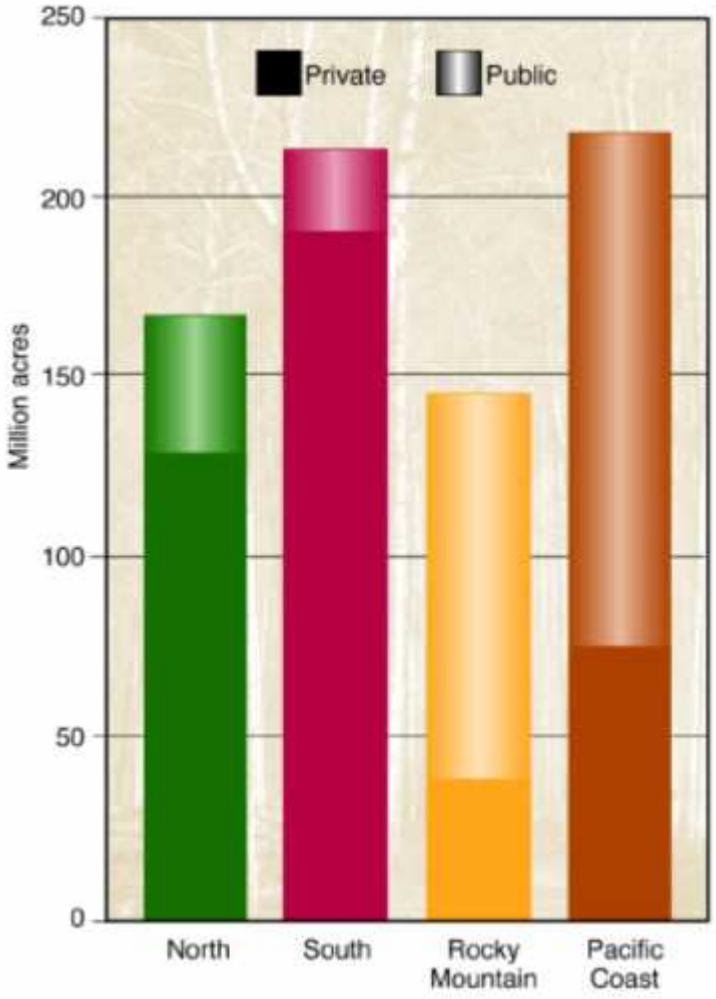


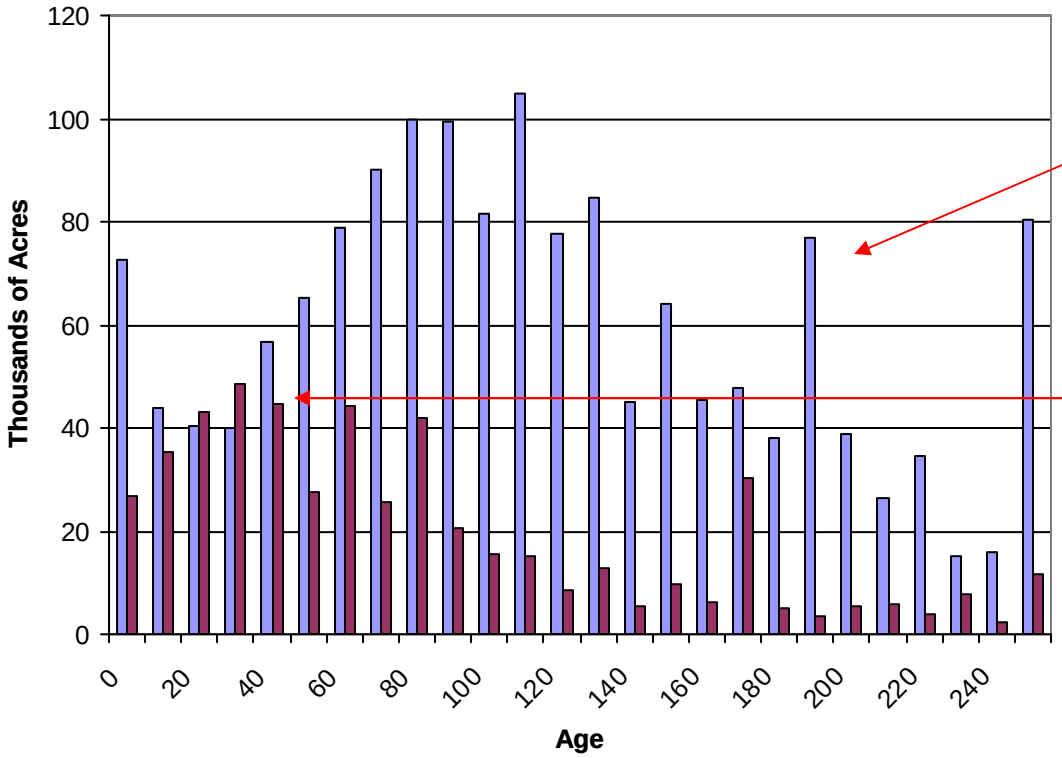
Figure 5—*Distribution of forest land by major region and ownership group.*

Most public forest land is in West

Source: Smith, W.B, P.D. Miles, J.S. Vissage, and S.A. Pugh. 2004. *Forest Resources of the United States, 2002*. General Technical Report NC-241.

Age class distribution differs by ownership class

Distribution of National Forests and Other Public Lands Acres by Age Class: 2000



National Forests managed for older age classes

Other public forests are much younger (more commercial)

General Approach

Public Land Harvest Scenarios (2010-2050)
- BAU (RPA)
- No Harvest
- Pre-1989 levels

Timber harvest levels

Forest Inventory Projection Model

ATLAS

Growing stock projections

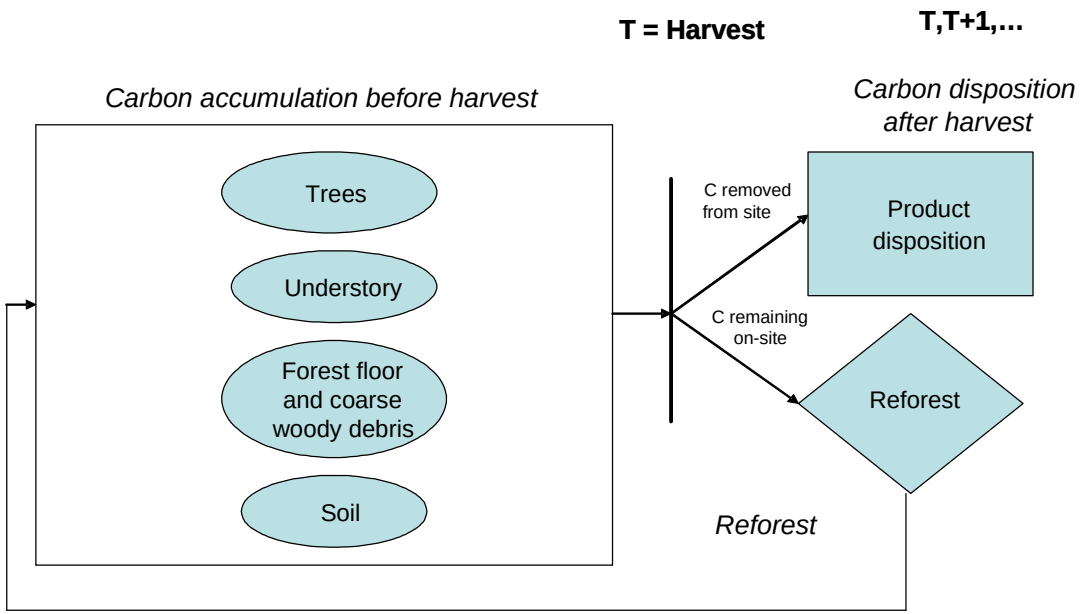
Carbon Accounting Model

Carbon Stock Projections: 2010-2050
- *Forest Carbon*
- *Wood Products*

Carbon Accounting Model

Follows FORCARB2 methods (USDA Forest Service)

Carbon Accounting Framework



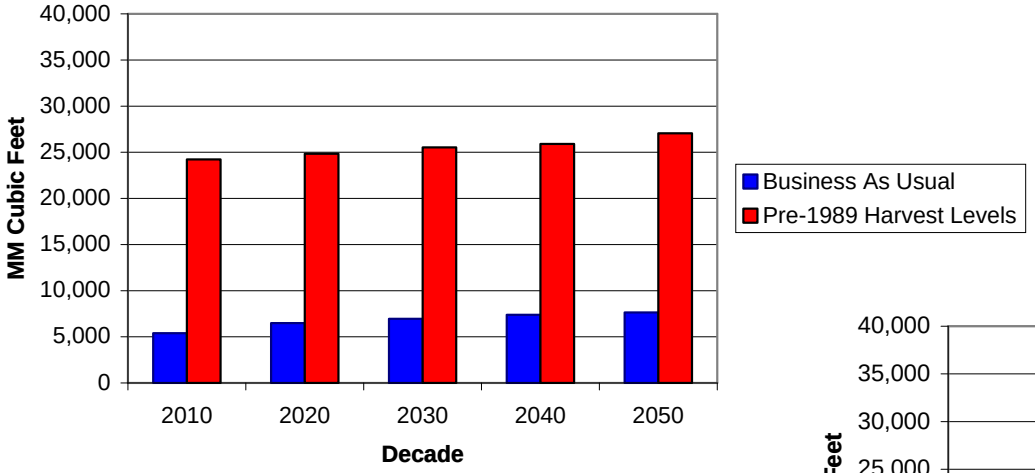
Details on carbon accounting appended at end of slide show

Public Land Harvest Scenarios

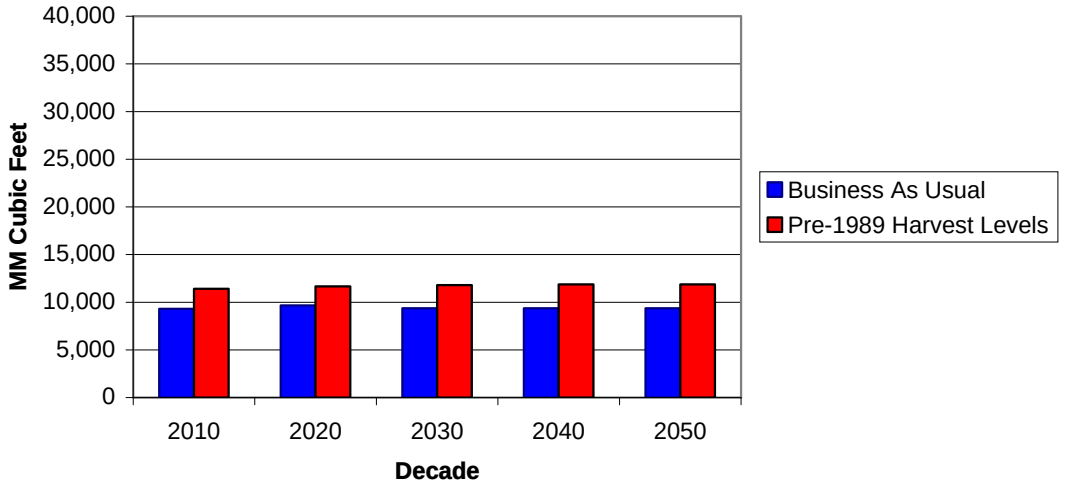
1. **Business-As-Usual:** Public land harvests match latest RPA projections for next 50 years
2. **No-harvest:** All harvests on public lands are halted
3. **Pre-1989 harvest levels:** Return public land harvests to the same levels they were prior to the sharp post-1989 drop in federal allowable harvests (spotted owl-related)

Timber Harvests: Pre-1989 Levels vs BAU

National Forests:
Decade Harvests by Scenario 2010 to 2050

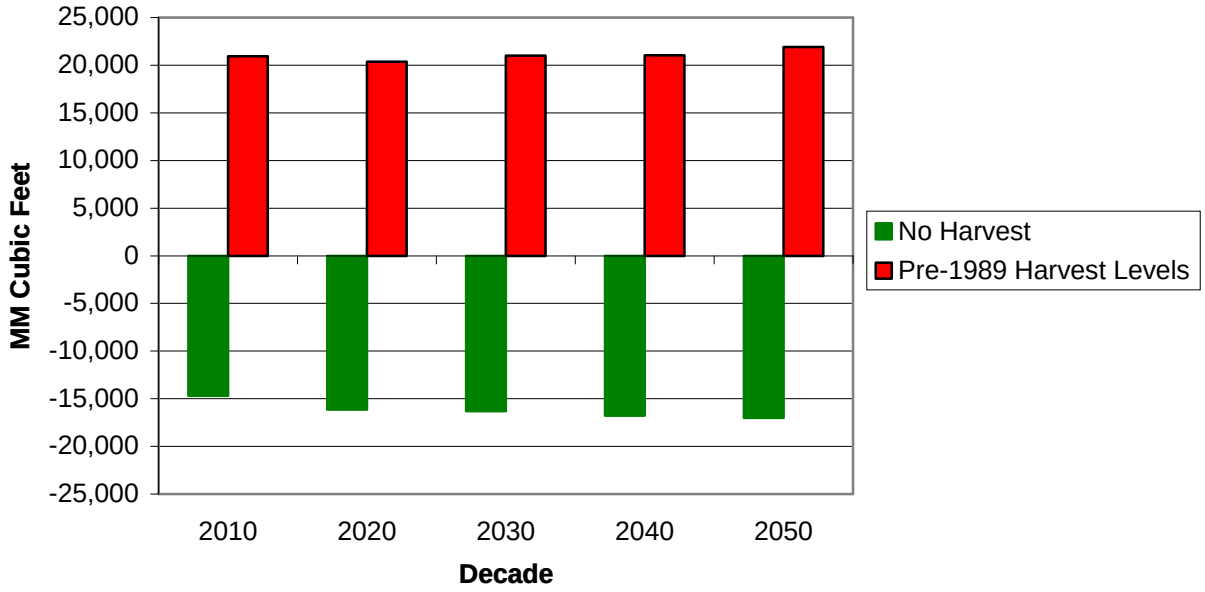


Other Public Lands:
Decade Harvests by Scenario 2010 to 2050



Harvests: Alternative Scenarios vs BAU

National Forests and Other Public Lands: Changes from BAU Harvest Volume by Scenario



Results

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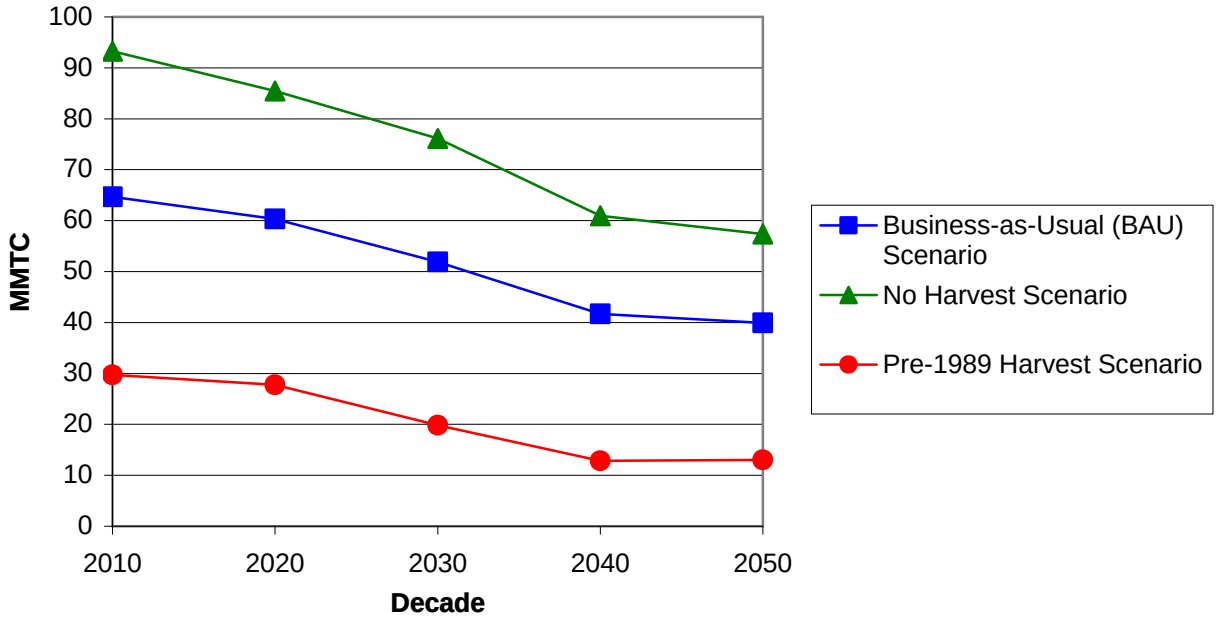
BAU Carbon Projection

	Forest Carbon			Disposition of Wood Product Carbon					Total in Wood Products		Total C Stock Change	
Decade	Existing	Regen-erated	Total in Forest	Cumulative Harvest Volume Since 2000 (MM cf)[a]	Decade Harvest (MM cf)	Prod-ucts	Land-fills	Energy	Without Energy Credit	With Energy Credit	Without Energy Credit	With Energy Credit
All Public Lands												
2010	55.1	4.5	59.7	28,009	14,695	2.5	2.5	2.5	5.0	7.5	64.6	67.1
2020	45.2	10.1	55.3	44,159	16,150	2.5	2.5	2.5	5.0	7.5	60.3	62.8
2030	34.0	13.5	47.5	60,477	16,318	2.2	2.2	2.2	4.3	6.5	51.9	54.0
2040	20.1	17.5	37.5	77,236	16,759	2.1	2.1	2.1	4.1	6.2	41.7	43.7
2050	15.7	20.4	36.2	94,239	17,003	1.9	1.9	1.9	3.8	5.6	39.9	41.8
National Forests												
2010	50.0	1.2	51.2	9,424	5,394	1.2	1.2	1.2	2.5	3.7	53.7	54.9
2020	35.3	2.9	38.2	15,912	6,488	1.4	1.4	1.4	2.7	4.1	40.9	42.3
2030	28.6	4.1	32.8	22,862	6,950	1.3	1.3	1.3	2.6	3.9	35.4	36.6
2040	22.1	5.6	27.6	30,253	7,391	1.3	1.3	1.3	2.5	3.8	30.2	31.4
2050	17.6	7.1	24.7	37,888	7,635	1.2	1.2	1.2	2.4	3.5	27.0	28.2

C Projections over Time by Scenario

Figure 6. Annual Carbon Sequestration in All Public Lands by Scenario



Annual C Stock Change vs BAU

Figure 8. Comparison of Annual Carbon Stock Changes with Business-as-Usual Scenario

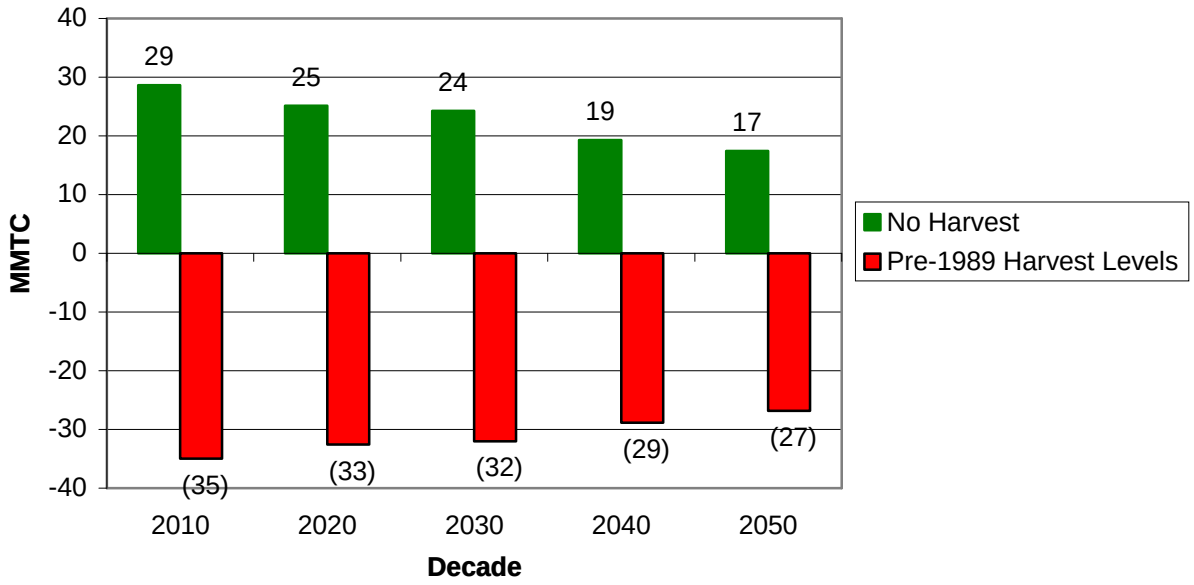
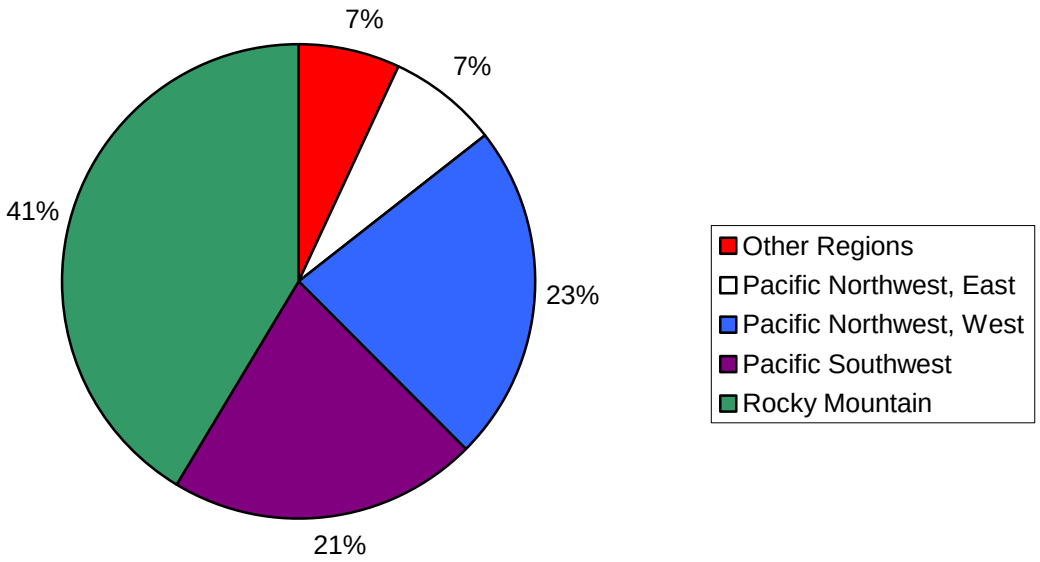


Figure 7. Distribution of Annual NF Carbon Stock Changes by Region: BAU Scenario (2030)



Paying for the Carbon

- Private carbon markets
  - Voluntary (e.g., CCX)
  - Mandatory
- Federal appropriations

Relative Monetary Value: Carbon and Timber

- Carbon Revenue
  - Assume CO_2 eq price of $15-30/ton
  - Payment for additional carbon only
  - Revenue effects
    - No harvest scenario: +$0.9-3.2 billion
    - Pre-1989 harvest scenario: -$1.5-3.9 billion
- Current timber harvest revenues ~ $900 million

Other forms of pubic forest management with GHG effects

- Fire suppression
- Regeneration practices/species selection
- Salvage logging/Thinning
- Biofuel production

Conclusions

- Focus has been on mitigation reponses in private forests and ag lands
- Public forest holdings are highly stocked, vast stores of carbon, and high sequestration volumes
  - Relative to rest of forest base
  - Relative to national emissions
- Deviations from BAU harvesting could have substantial (+/-) effects on
  - Carbon storage
  - Timber markets
  - Other ecosystem services provided by forests
- Other management actions effects could be larger and need to be examined more carefully
- Will private markets be a source of carbon revenue for public lands or must we rely on traditional budgetary outlays to pay for carbon practices?

Carbon Accounting Details

Tree Carbon (Smith et al 2003)

Tree Carbon Equations

$C^R = (D^L + D^D)/U^B \times 0.5,$ [1]

where live and dead tree biomass are computed as

$D^L = F^w \times (G^{vbw} + (1–\exp(–V^T)/H^{vbw}))$ [2]

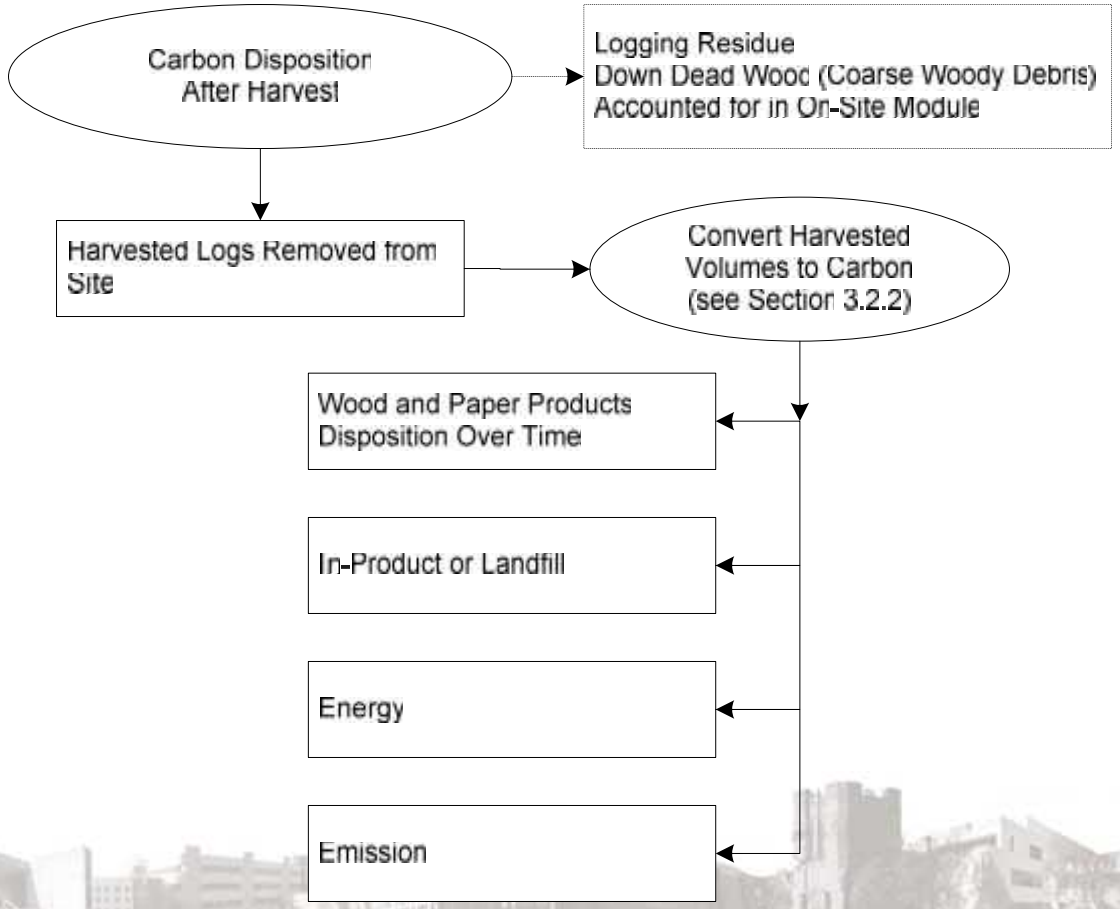
$D^D = D^L \times A^{vbw} \times \exp(–((V^T/B^w)\text{^}C^{vbw}))$. [3]

Symbol	Description	Units	Source
D^L	Live tree mass density (above and below ground)	Mg C/ha	Calculated
D^D	Dead tree mass density (above and below ground)	Mg C/ha	Calculated
C^R	Total tree carbon	Mg C/ac	Calculated
V^T	Total timber volume	m^3/ha	See Eq. [1]
F^{vbw}, G^{vbw}, H^{vbw}	Weighted live tree density parameters from volume-to-biomass equations	—	Smith, Health, and Jenkins (2003) Table 3 weighted by forestland area data from RPA (Miles, 2003) Tables 5 and 6
A^{vbw}, B^{vbw}, C^{vbw}	Weighted dead tree mass density parameters from volume-to-biomass equations	—	Smith, Health, and Jenkins (2003) Table 4 weighted by forestland area data from RPA (Miles, 2003) Tables 5 and 6
U^B	Units conversion factor	1 hectare (ha) = 2.471 acres	—

Other Forest Carbon Pools

- Understory: fixed fraction of live tree C (EPA 2003)
- Forest Floor: Smith and Heath (2002)
- Coarse Woody Debris: fixed fraction of total tree C (EPA 2003)
- Soil: large stock, but flux assumed fixed after regeneration (Heath, Birdsey and Williams 2002)

How Products are Handled



Wood product disposition over time

Example of Disposition Patterns of Harvested Wood by Region and Harvest Type, 100-Year Period: Southeast

				Years after Harvest										
Region	**Type**	**Product**	**Disposition**	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Southeast	Softwood	Pulpwood	Products	0.30	0.07	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02
Southeast	Softwood	Pulpwood	Landfills	0.00	0.16	0.16	0.16	0.10	0.14	0.14	0.13	0.12	0.11	0.11
Southeast	Softwood	Pulpwood	Energy	0.44	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Southeast	Softwood	Pulpwood	Emissions	0.26	0.32	0.34	0.35	0.41	0.37	0.38	0.39	0.40	0.41	0.41
Southeast	Softwood	Sawtimber	Products	0.47	0.28	0.24	0.21	0.18	0.17	0.15	0.14	0.13	0.13	0.12
Southeast	Softwood	Sawtimber	Landfills	—	0.13	0.16	0.17	0.18	0.19	0.19	0.19	0.18	0.18	0.18
Southeast	Softwood	Sawtimber	Energy	0.38	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41
Southeast	Softwood	Sawtimber	Emissions	0.15	0.19	0.20	0.22	0.24	0.24	0.25	0.26	0.28	0.28	0.29
Southeast	Hardwood	Pulpwood	Products	0.30	0.07	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Southeast	Hardwood	Pulpwood	Landfills	—	0.16	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10
Southeast	Hardwood	Pulpwood	Energy	0.39	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Southeast	Hardwood	Pulpwood	Emissions	0.31	0.37	0.38	0.40	0.40	0.42	0.43	0.44	0.44	0.45	0.46
Southeast	Hardwood	Sawtimber	Products	0.27	0.12	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.04
Southeast	Hardwood	Sawtimber	Landfills	—	0.11	0.13	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12
Southeast	Hardwood	Sawtimber	Energy	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Southeast	Hardwood	Sawtimber	Emissions	0.31	0.34	0.36	0.35	0.36	0.37	0.38	0.39	0.39	0.39	0.40

Disposition adds up To1.0 in any period

Amount remaining in products declines over time – rest is landfilled or emitted