

The Impacts of Changes in Federal Timber Harvest on Forest Carbon Sequestration and Log Markets in Western Oregon

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NWFP & WOR Federal Forest

- Northwest Forest Plan
 - Federal forest management guidelines
 - Anticipated WOR cuts: 556 MMBF
 - Actual WOR harvests: 315 MMBF ('95-'99), 141 MMBF ('00-'04)
- Some debates on federal forest management and timber harvest
 - Increase cuts to NWFP levels for economic benefits and wildfire
 - Possible losses of ecosystem values



Carbon and Public Forests

- Possible carbon losses when old growth public forests cut (Harmon et al. 1990, Schulze et al. 2000)
- WOR, WWA federal timberlands sequestered 200Mt of carbon (1953-2000) (Smith & Heath, 2004)
- Future public carbon storage?



<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/index.htm>



Objectives

- Examine log market and carbon flux impacts of changes in WOR federal cuts up to maximum sustainable level
 - **Expanded federal harvest:** potential carbon flux and regional log supply changes due to increased federal timber harvests
 - **Carbon target:** potential harvests from private, federal, & state timberlands given regional carbon flux target that is achieved by joint efforts of all owners



Public Harvest Assumptions

■ Previous studies

- Ignore public inventories (Adams et al. 1999)
- Merge private and public inventories and harvest decisions (Sedjo & Lyons 1996, Sohngen & Mendelson 1998)
- Exogenous public harvest and management decisions (Adams & Latta 2005, Depro et al. 2006)

■ Our log market model includes public forests:

- Federal harvests set by agency policies (NWFP)
- Areas to be harvested and modes of management according to management costs and carbon impacts



Methods

- Inventory data
- Management intensity classes
- Timber & carbon yield projection
- Land area changes
- Market model

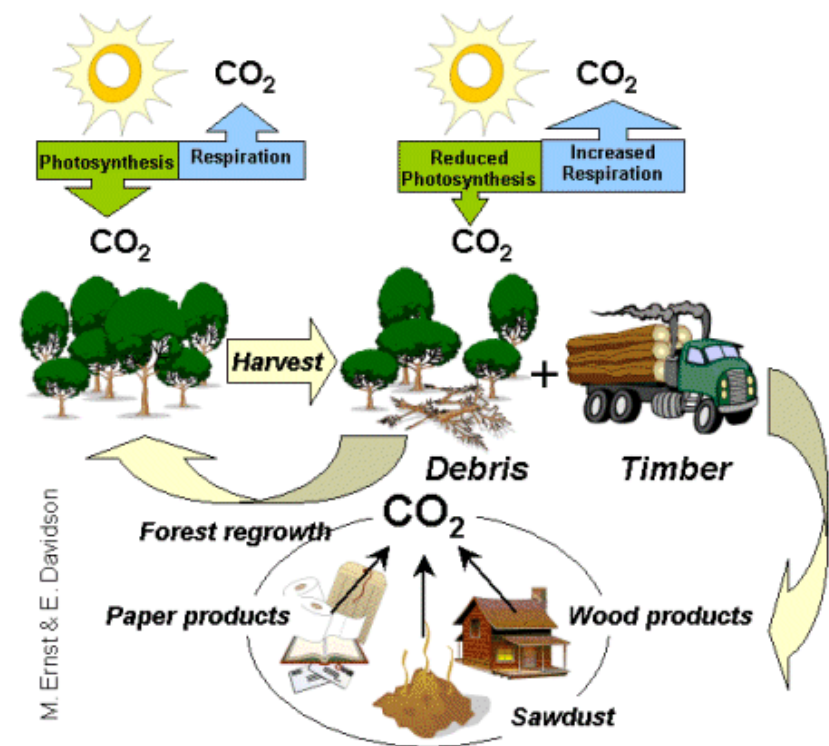


Methods: Inventory & MICs

- Private, federal, and state timber inventory derive from USFS FIA periodic forest survey
 - Inventories are updated based on actual harvest data by ODF
- MICs for private & state lands (Adams et al., 2002)
 - Existing stands: 7 MICs
 - New stands (natural or planted): 4 MICs
- Federal lands MICs based NWFP & its guidelines
 - Commercial thinning (CT) for LSR softwood stands
 - 3 thinning options for Matrix, AMA, and RR
 - Regeneration harvest for Matrix/AMA softwood stands
 - No additional silvicultural practices

Methods: Yield & Carbon Projections

- Yield projection using individual tree growth model
 - Private & state lands: ORGANON (Hann et al., 1997)
 - Federal lands: Forest Vegetation Simulator (Dixon, 2003)
- Carbon storage in forests & forest products
 - Live & dead trees, understory, forest floor, woody residue, soil
 - products and fuel substitution (Skog & Nicholson 2000)



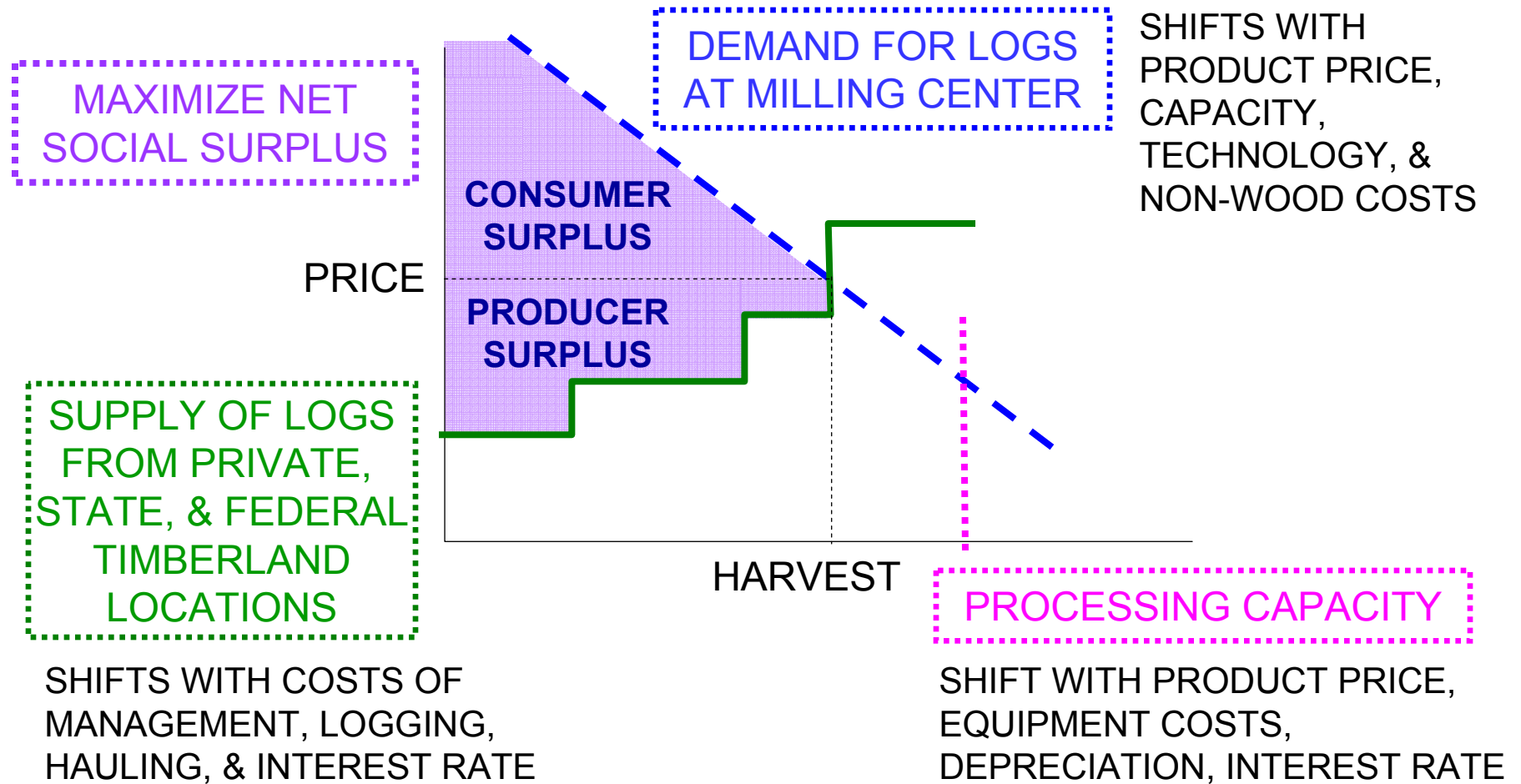
Source: <http://www.whrc.org/support/index.htm>
(The Woods Hole Research Center)

Methods: Federal LUA & KWS

LUA	Northwest Forest Plan		This Study	
	Key Watersheds		Key Watersheds	
	Tier1+2	non-Key	Tier1+2	non-Key
	<i>..... Thousand acres</i>			
CR/AW/ND	657	767	618	694
LSR	1,318	1,756	1,360	1,764
AMA	76	497	82	500
Matrix/RR	684	2,359	679	2,415

Note: Areas include forested and non-forested lands

Methods: Market Model



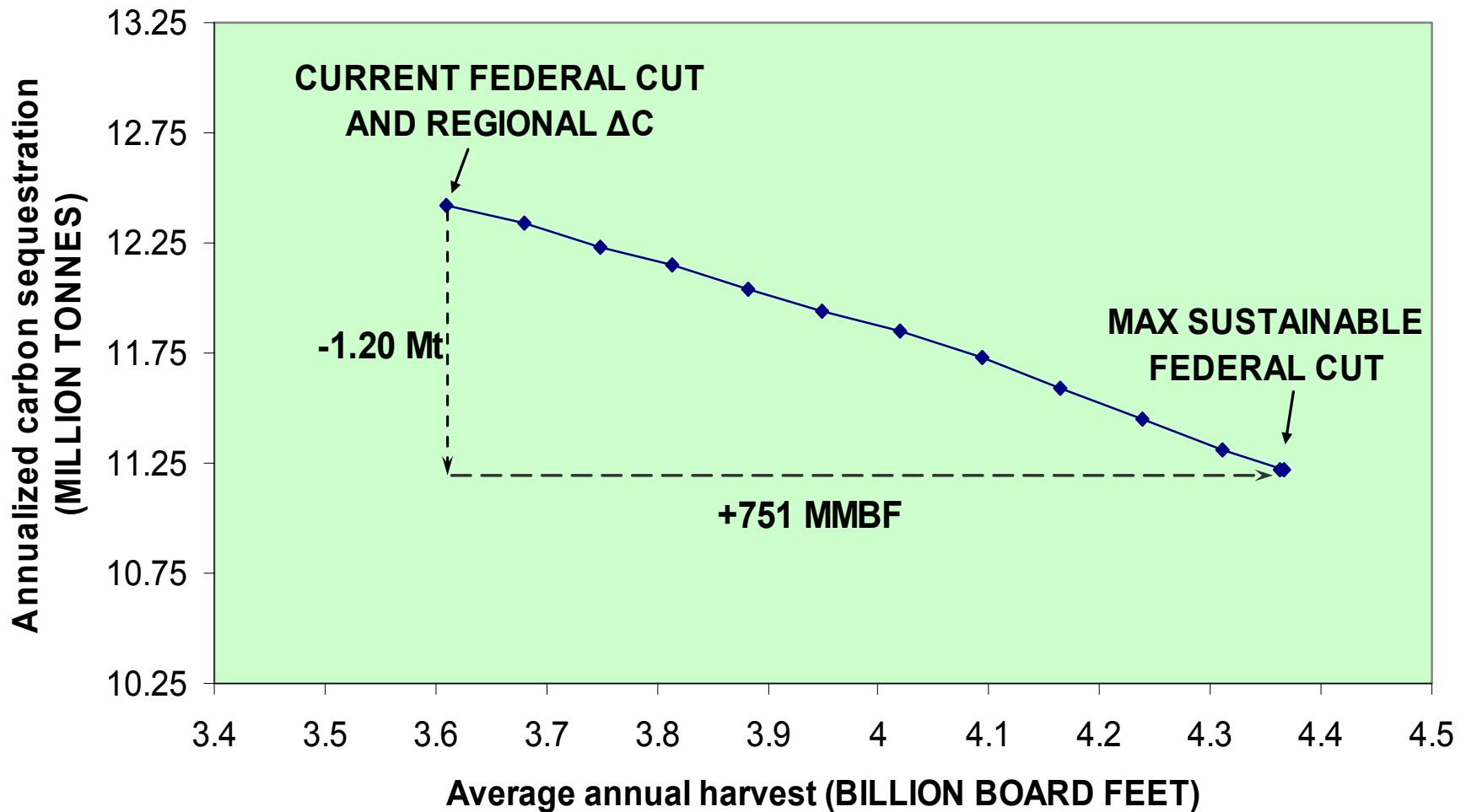
Results: Current Carbon Stock

□ Comparison of current carbon stock (tonnes/ha)

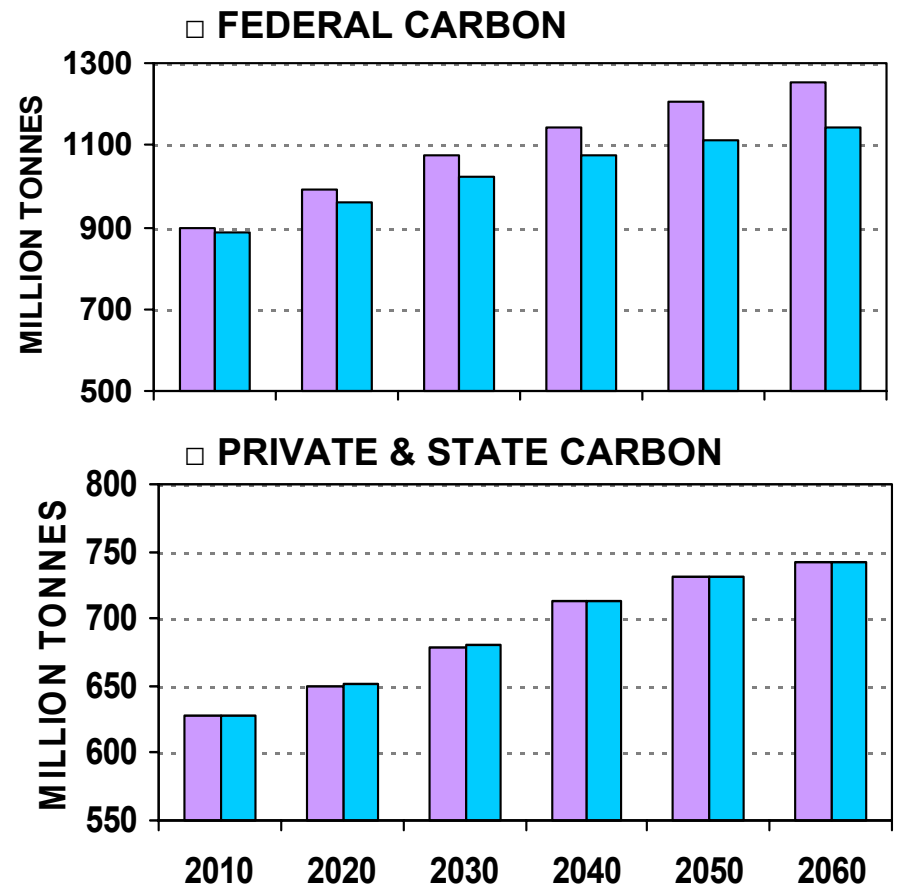
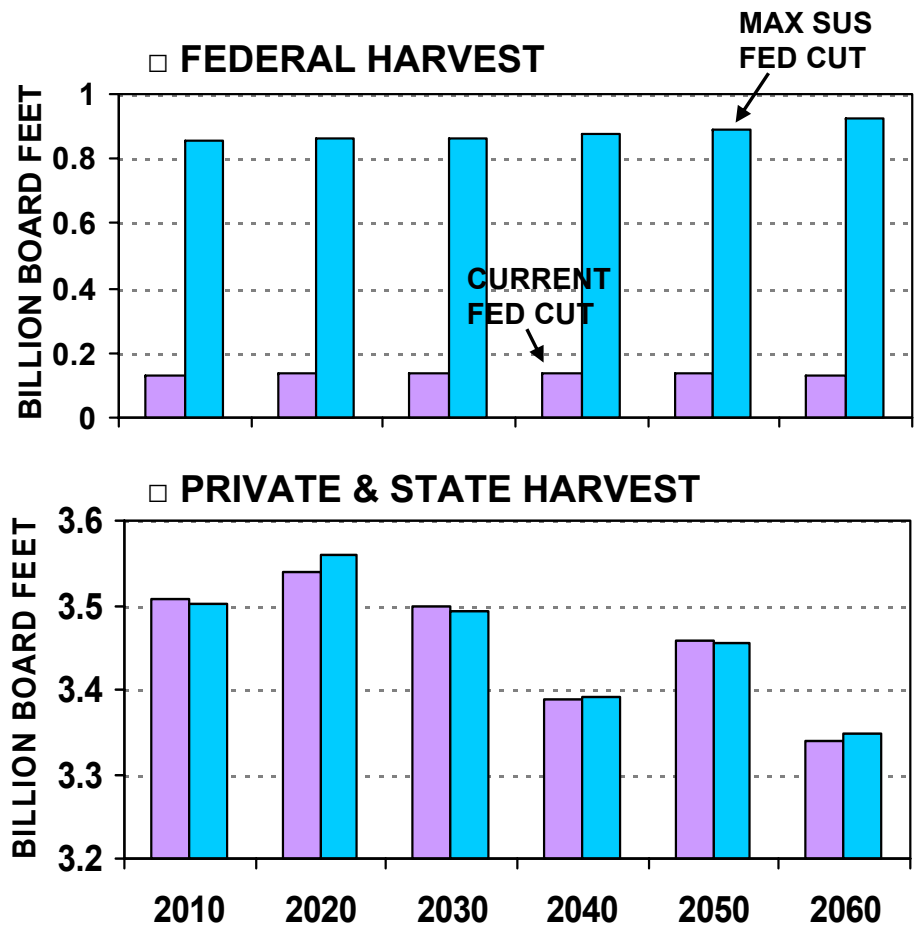
	Region/ owners	Live Carbon	Dead Carbon	Product Carbon
Heath et al. ('03)*	PNW/all	102.8	45.6	-
Birdsey&Lewis('03)*	OR/all	82.3	42.4	26.4
Law et al. ('04)†	WOR/all	128.6 - 196.8	38.4 - 49.5	-
This study †	WOR/all	144.2	39.5	38.2
	/Private	82.7	35.3	61.0
	/USFS	204.9	45.3	19.8
	/OPUB	161.4	34.1	21.9
	/State	176.2	48.3	26.5

Note: * Estimate of carbon stock in 1997; and † carbon stock in 2002.

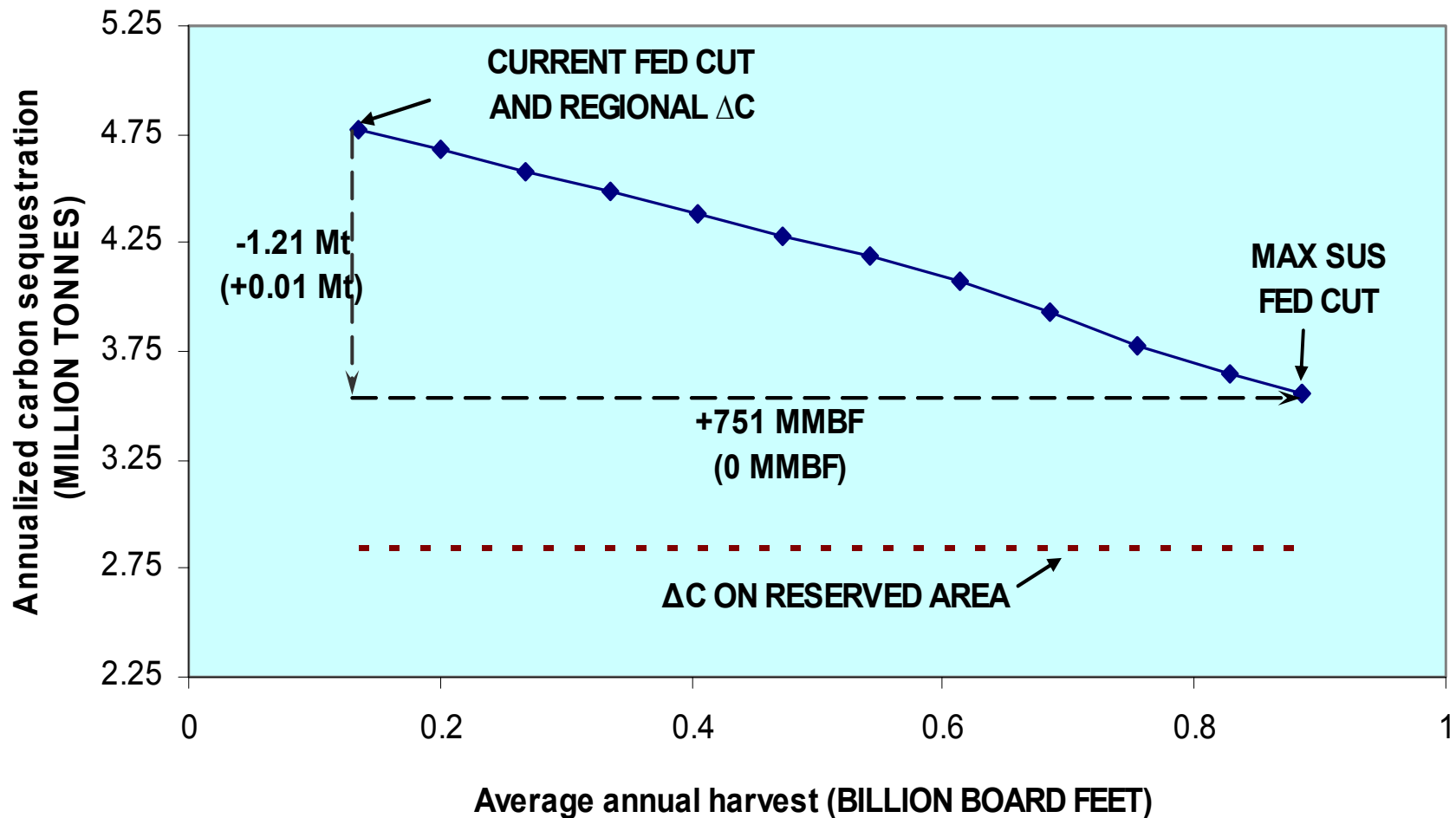
Results: Regional Carbon Flux & Harvest Impacts of Expanded Federal Harvest



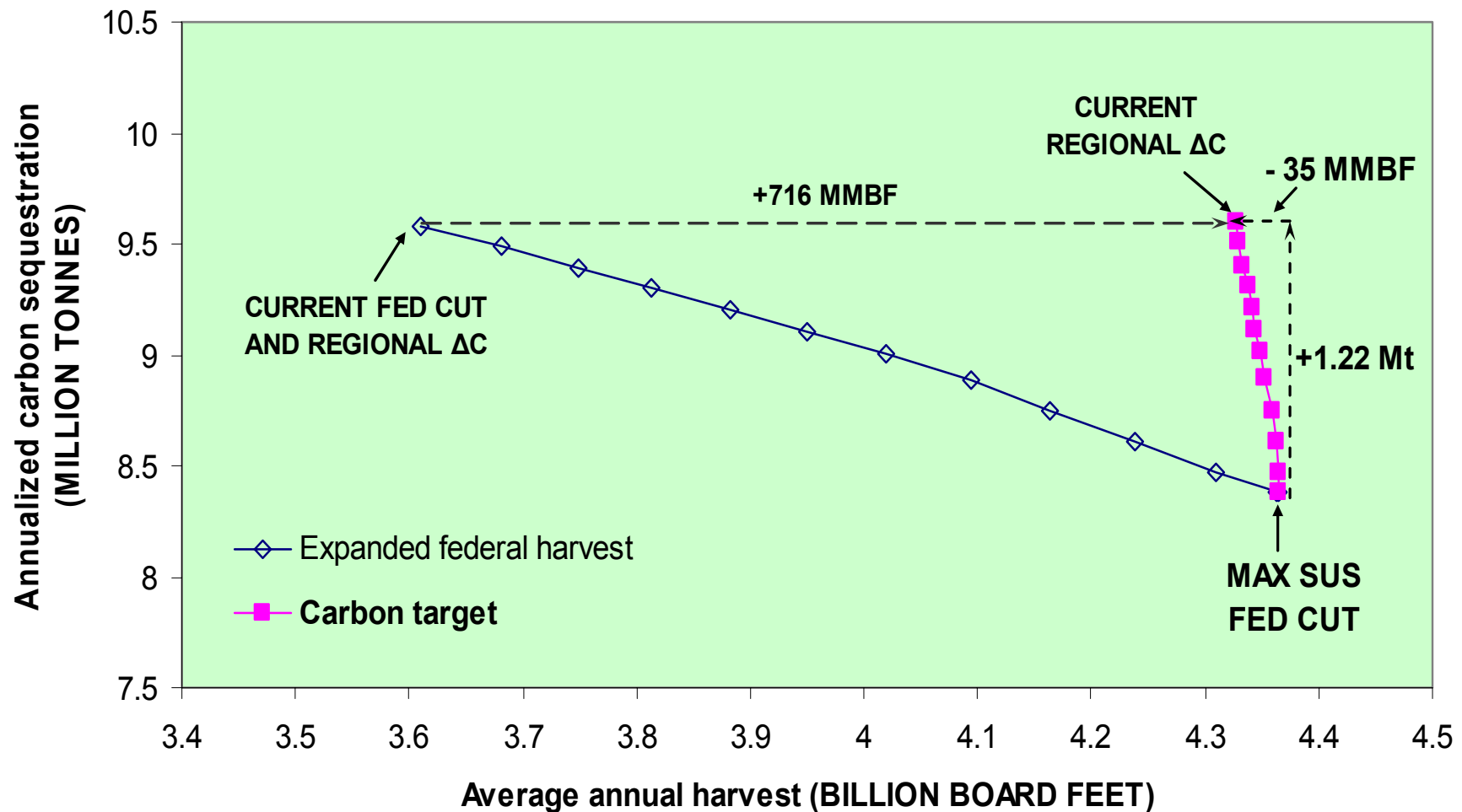
Results: Carbon & Harvest Projections (Current vs. Maximum Federal Harvest)



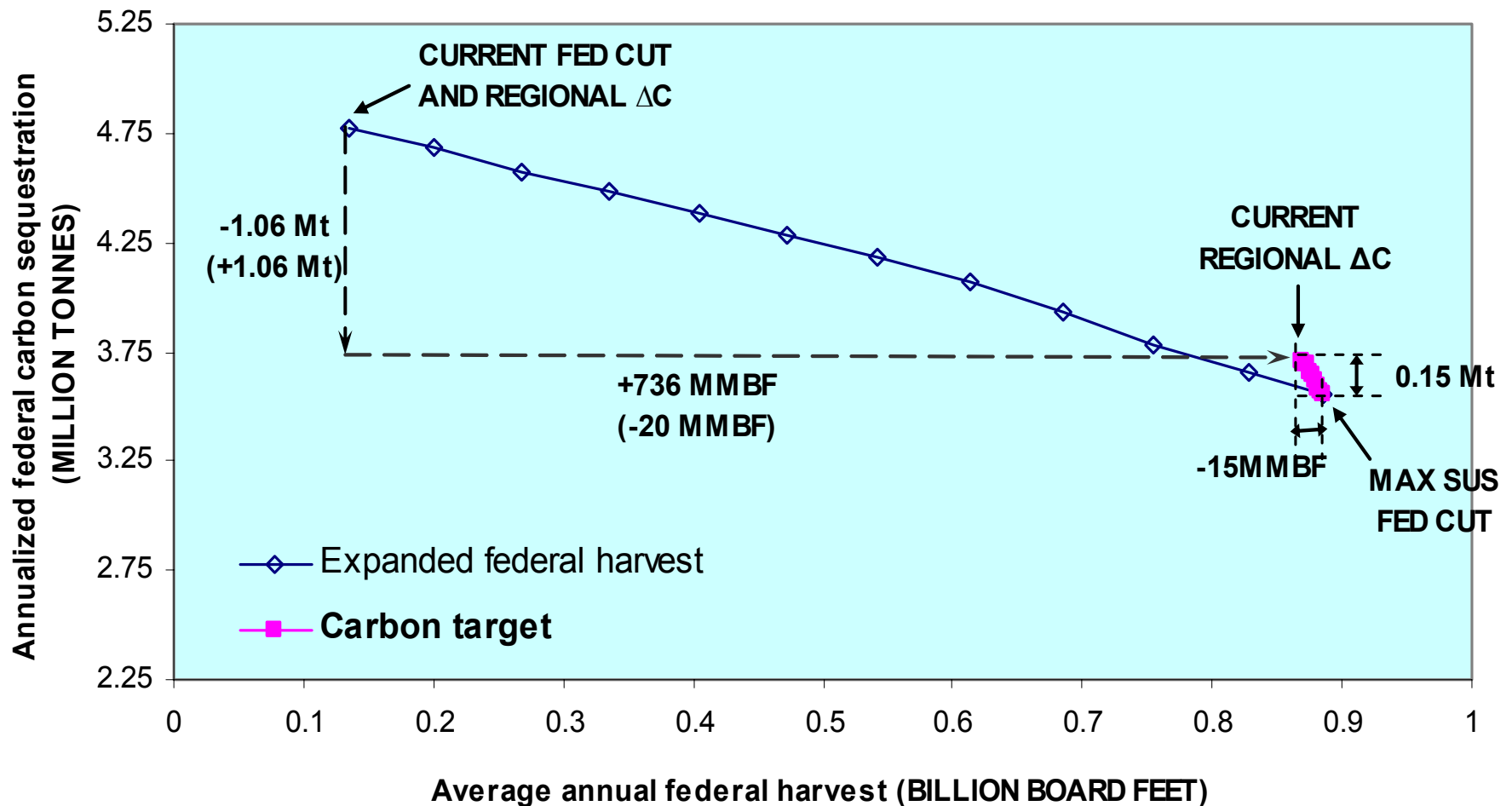
Results: Carbon Flux & Harvest Impacts of Expanded Federal Harvest on Federal lands



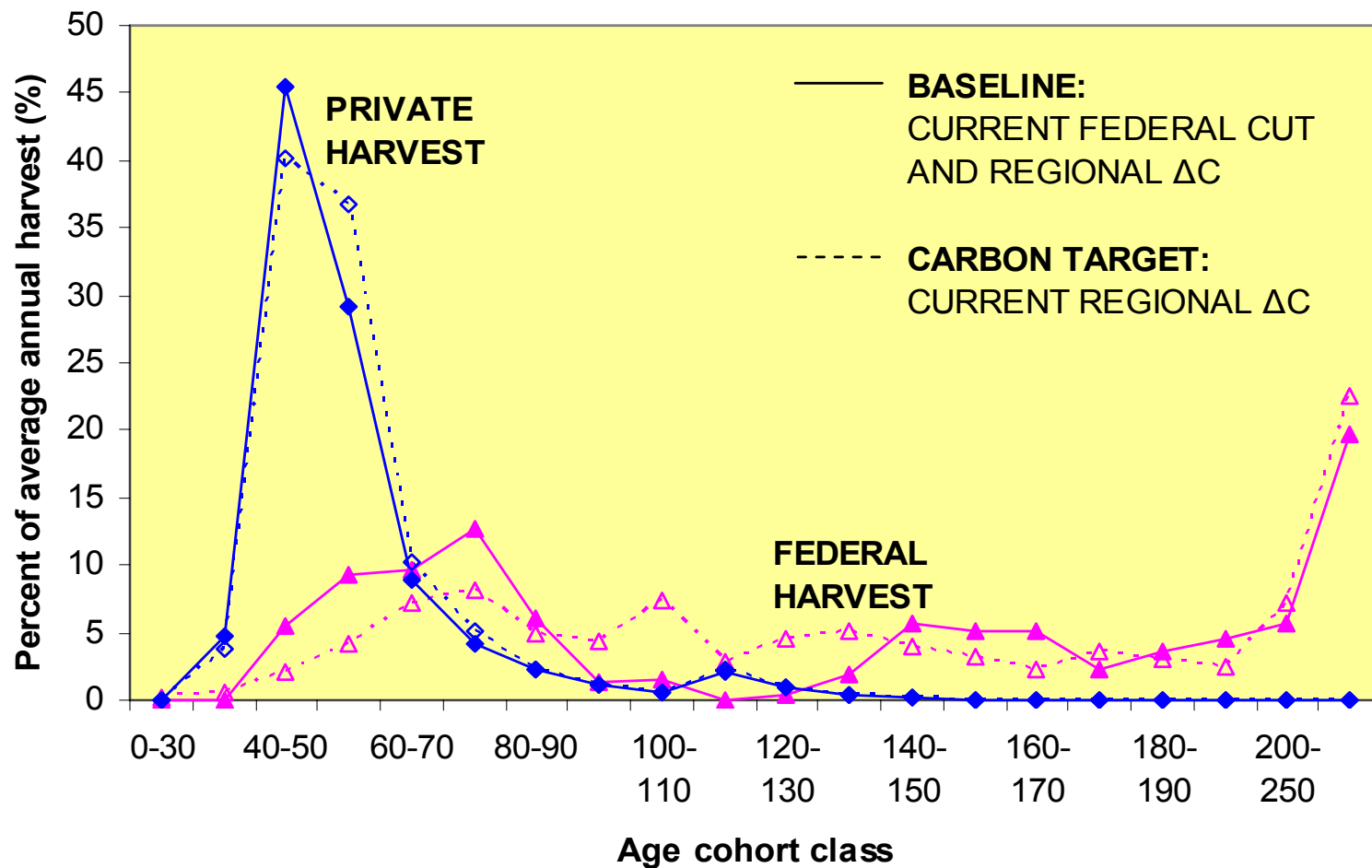
Results: Regional Carbon Flux & Harvest Changes with Carbon Target



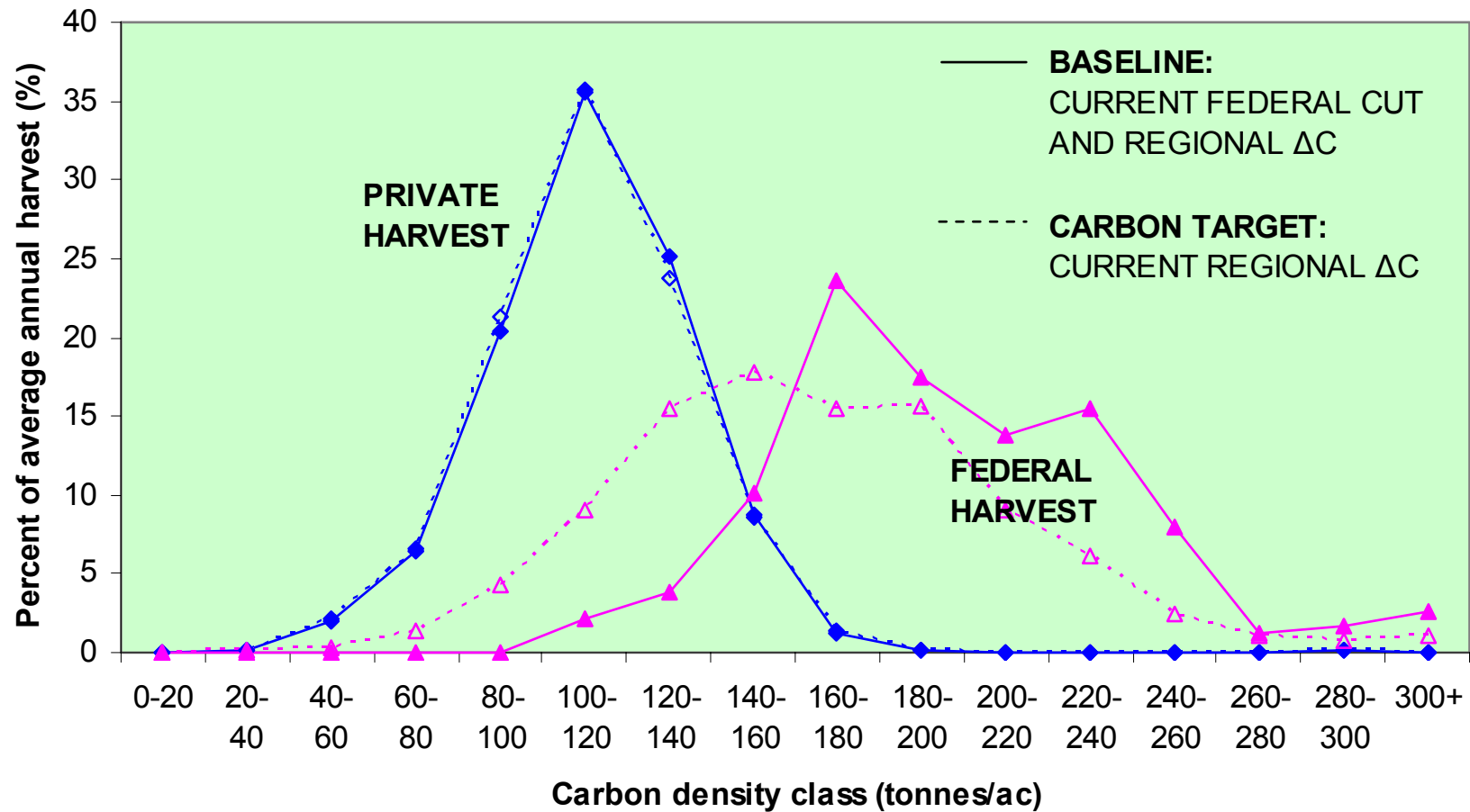
Results: Carbon Flux & Harvest Changes with Carbon Target on Federal lands



Results: Concentration of Cut by Age Class (Baseline vs. Carbon Target)



Results: Concentration of Cut by Carbon Density Class (Baseline vs. Carbon Target)



Results: Market Surplus Impacts

Policy scenarios	Consumer surplus	Producer surplus		Net social surplus
		Federal	PVT/State/Importer	
<i>..... Annualized 1992 \$US million</i>				
Baseline: Current federal cut & regional C flux	836.3	53.6	1,406.7	2,296.5
Carbon target: Regional C flux = baseline*	1,126.4	314.7 (80.3)	1,351.9 (72.2)	2,793.0 (152.5)
Max, Sustainable Federal cut, no C flux limits	1,144.6	317.5	1,359.8	2,821.8

Notes: 6% discount rate

*Parenthesis is carbon payments at a \$12.26 per tonne of carbon.



Summary & Conclusions

- Regional carbon flux declines as regional harvest rises
 - Max sustainable WOR federal cut: 885 MMBF
 - Market surplus rises 23% (consumer/federal gainer, others loser)
- Significant opportunities for substituting harvest and carbon flux between federal and private/state lands
 - Increase in federal harvest, but decrease in other harvests
 - Carbon loss in federal lands is offset by gain in other lands
- Carbon subsidy/tax can mimic carbon flux target
 - Baseline carbon target \approx C flux at \$12.3 tonne C
 - Carbon payment exceeds market surplus loss

Simplified Representation of Market Model

$$MAX \sum_t (1+i)^{-t} [\int P(C, K) dC - c_K \Delta K - M(E_P, R_P, I_P) - f(E_F, R_F, I_F)]$$

$$\text{s.t. } C - c_P(E_P, R_P, I_P) - c_F(E_F, R_F, I_F, pol) \leq 0$$

$$c_F(E_F, R_F, I_F, pol) \leq c_{F,MAX} \quad (*1)$$

$$P_P(E_P, R_P, I_P) \leq A_P, \quad P_F(E_F, R_F, I_F) \leq A_F$$

$$K_t - (1-\delta)K_{t-1} - \Delta K \leq 0$$

$$\sum_t (1+i)^{-t} [\Delta C_W(C) + \Delta C_P(E_P, R_P, I_P) + \Delta C_F(E_F, R_F, I_F)] \geq T_C \quad (*2)$$

(*1): Expanded federal harvest; and (*2): Carbon target