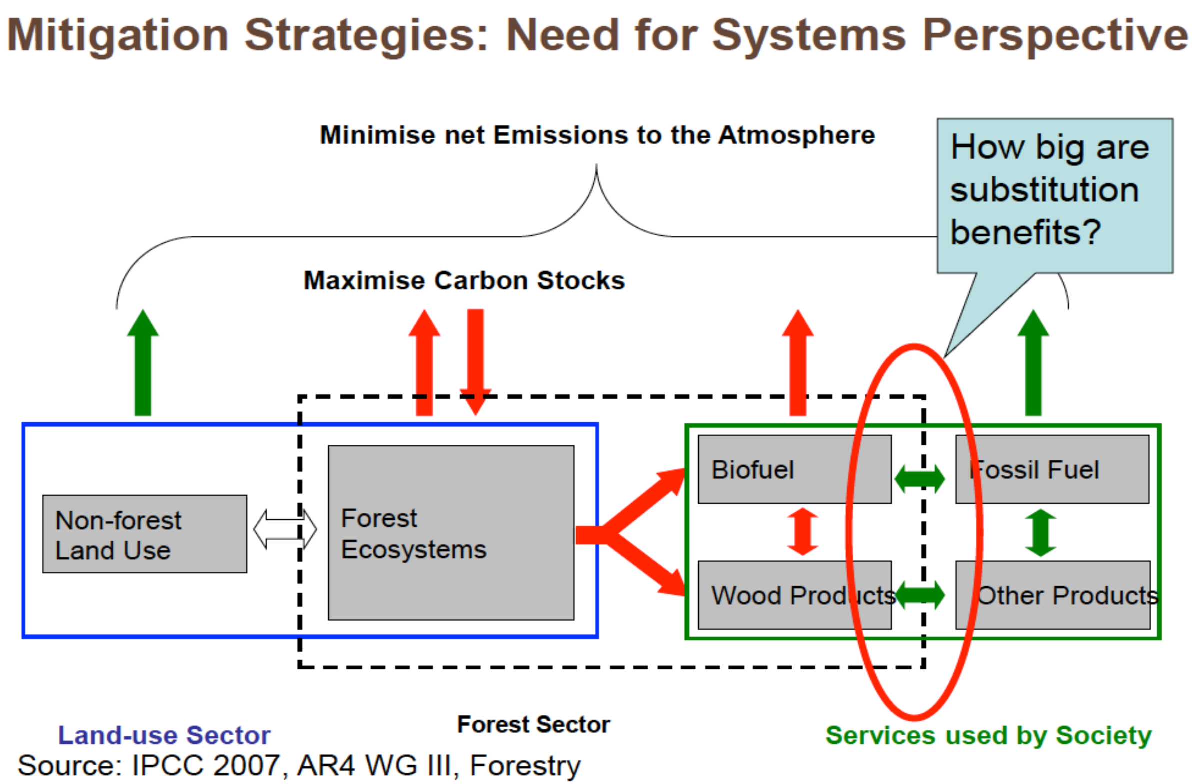
Can Forest Health Restoration be Successful for California? A 40 Year BioSum Scenario That Could Work

Jeremy Fried: USFS-PNW-FIA Portland
Sara Loreno: Portland State University
Benktesh Sharma: UC Berkeley
Carlin Starrs: UC Berkeley
Bill Stewart: UC Berkeley

for the Western Forest Economist Meeting – May 2016
Gratitude to: California Energy Commission, JFSP, PNW FIA

Forests and Forest Products have roles in all six goals
But only one uses a tree as the icon
Ecosystem Carbon is only a subset of Global Carbon

Reducing overall economy-wide and landscape-wide emissions is how IPCC framed the goal, but many researchers and agencies ignore the green box



Source: Kurz presentation at CalEPA (Dec 2015) and 2007 IPCC report . But in the USFS Forest Carbon Accounting Framework – "Harvested wood products were not included in this forest ecosystem carbon assessment" (Woodall et al. 2016, p5)

CA – We make Teslas but still have high elec. costs, medium emissions, some hydro (it dwarfs biomass)

State	Key fuel	retail price cents/kwh	tCO2/Mwh	Hydro T Mwh
OR	Hydro	8.7	0.14	35,262
WA	Hydro	7.1	0.11	79,463
ID	Hydro	7.9	0.10	9,002
CA	Natural Gas	15.2	0.29	16,571
MT	Coal	8.6	0.58	11,483
WY	Coal	7.8	0.95	869
UT	Coal	8.4	0.80	633
CO	Coal	10	0.71	1,770

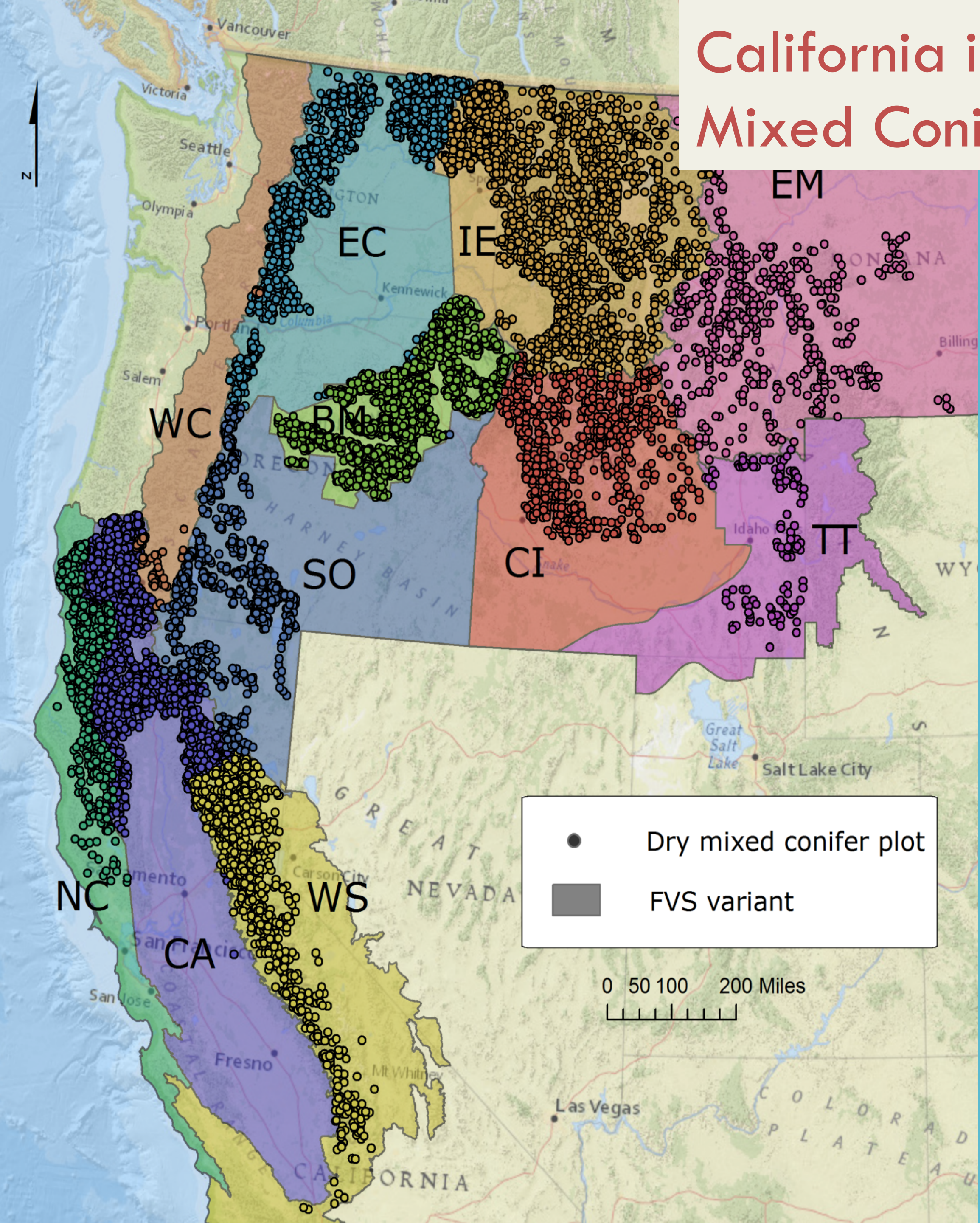
California is spending $100 million per year to develop and deploy low carbon transportation fuels

- Forest ‘residues’ are plentiful but not just ‘waste’
- Challenge - determine whether forest residues could be environmentally utilized for transportation fuels
- UC/PNW FIA applied a systems perspective to the whole state –
  - all forests acres,
  - wildfires,
  - economics of forest products and fire suppression
  - Model out private and public benefits/costs

CEC project components

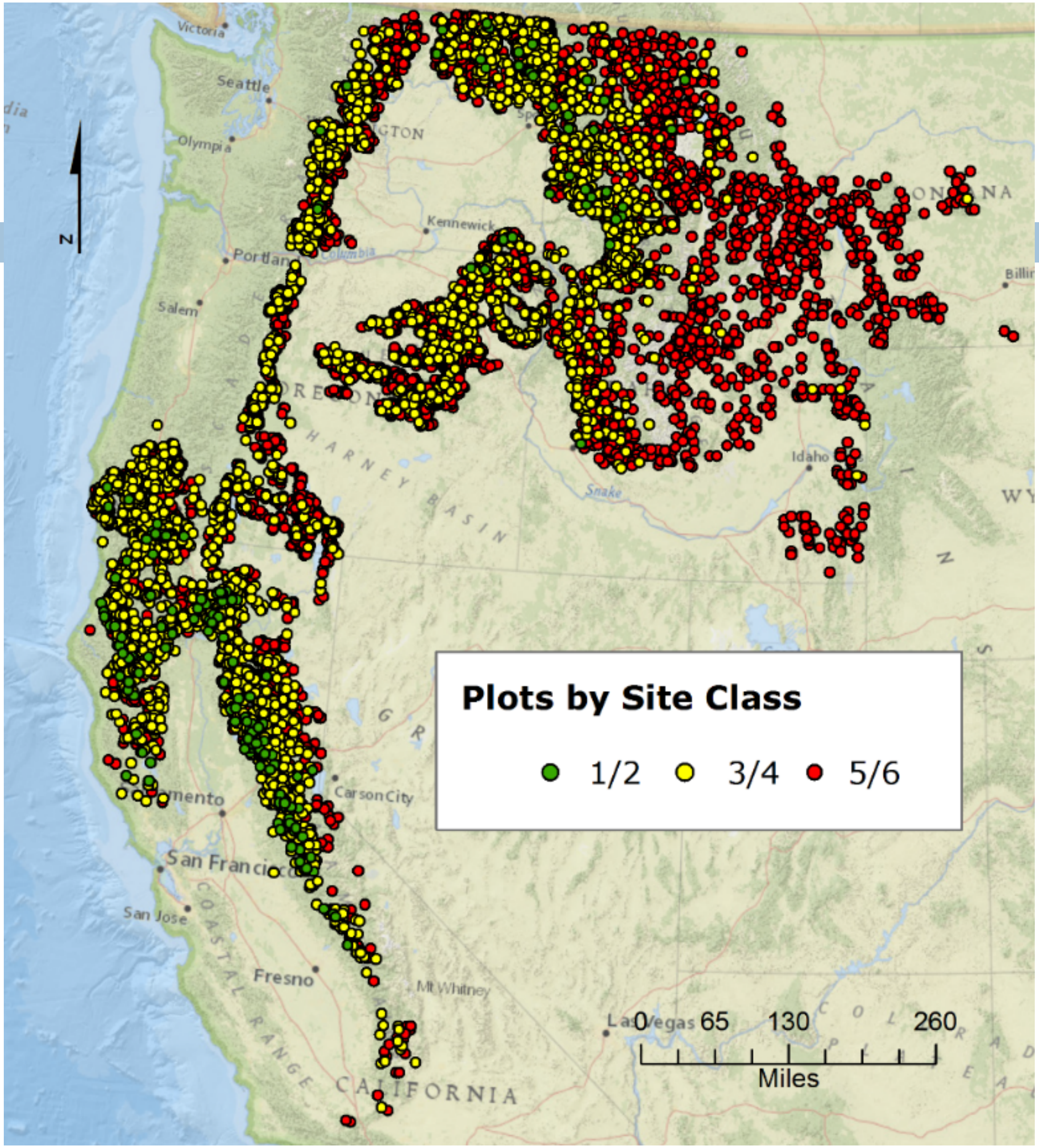
- Sustainable supply of feedstocks
- Environmental sustainability
  - Land-Forest-Forest Products carbon flux
  - Addressing trend of increasing wildfires
  - Ensuring wildlife population viabilities in treated sites
- Economic sustainability of forest management units – market prices for products, cost share for public benefits,
  - Corporate ownerships
  - Family ownerships
  - Federal ownerships

California is mainly a subset of Dry Mixed Conifer Forests in the West



By the Numbers - Westwide

- FIA sample contains
  - 7713 “conditions”
    - Full or partial plots
  - Represents 29 million ac.
  - Field visited
    - 2003-2013
- BioSum model
  - 11 FVS variants
  - 10 treatments
  - 283 sawmills, etc.
  - 58 Bioenergy sites



CA has generally higher site lands that are in lower elevations where ET is moderate

California is steep but well roaded – no wonder we have too much silt for our salmon

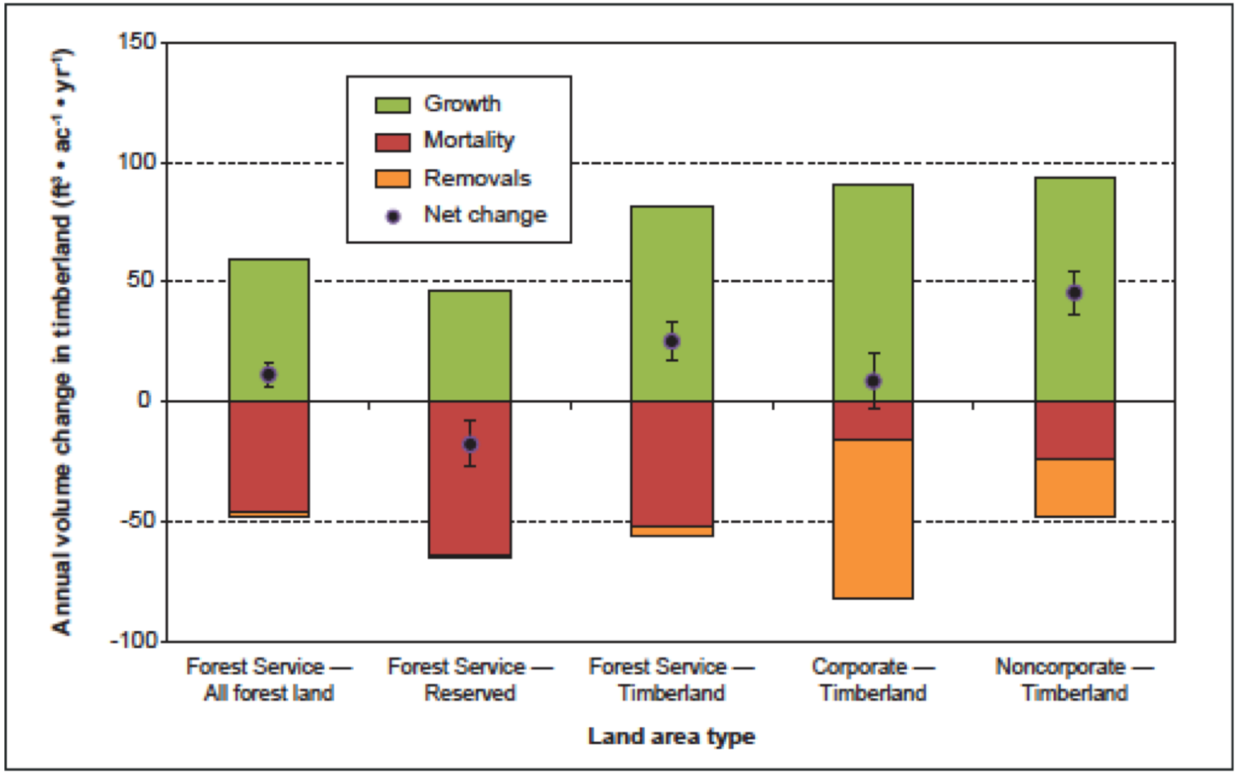
<2/3 of acres are on "easy" ground,on average, but varies

	Slope Class	
Variant	≤ 40 Percent	>40 Percent
SO	94%	6%
BM	80%	20%
WC	76%	24%
EC	73%	27%
EM	71%	29%
WS	69%	31%
TT	69%	31%
Variant Mean	63%	37%
IE	57%	43%
CA	49%	51%
NC	46%	54%
CI	44%	56%

Road access varies

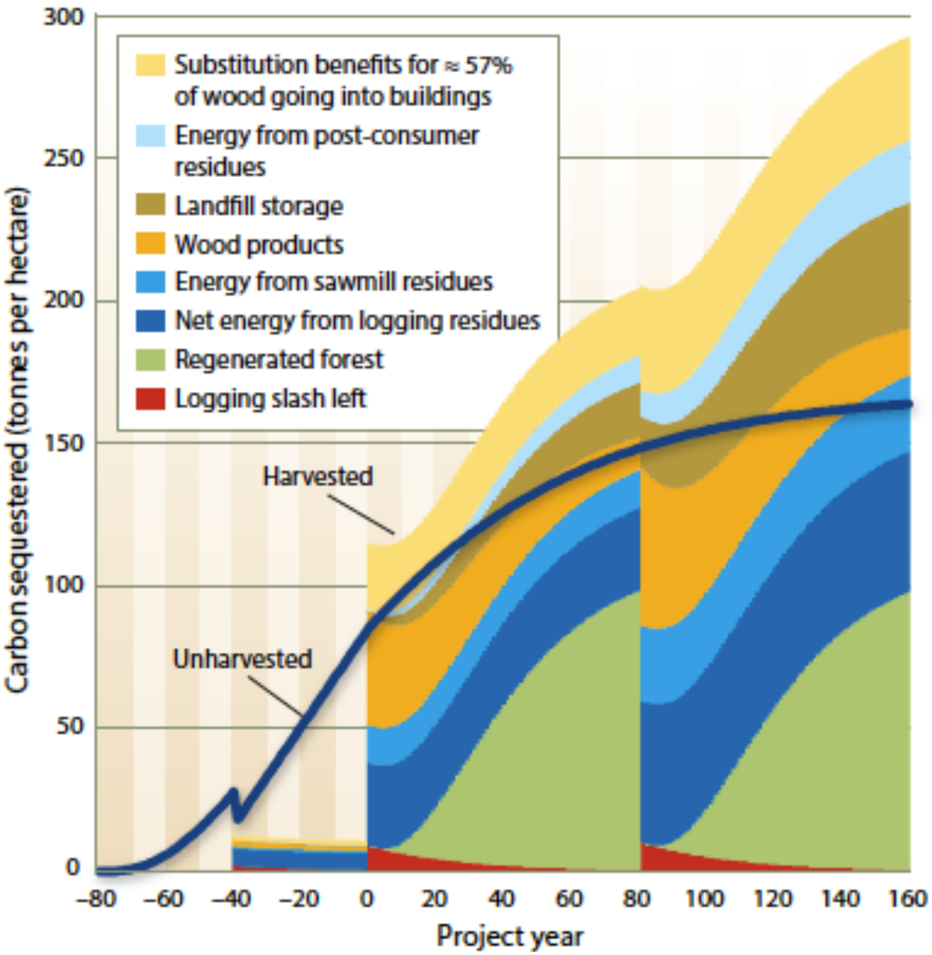
	Yarding Distance		
Variant	< ¼ mile	¼ to ½ mile	> ½ mile
WC	93%	1%	5%
SO	93%	6%	2%
BM	90%	6%	3%
WS	84%	11%	5%
CA	84%	11%	5%
NC	79%	16%	5%
Variant Mean	78%	12%	10%
EC	78%	11%	10%
IE	74%	12%	14%
EM	63%	16%	21%
CI	60%	15%	24%
TT	55%	17%	28%

Empirical data suggests poor conversion of photosynthesis in some forests



Combined average annual change in volume (cubic feet) growth, removals, and mortality per acre year on national forest land between 2001-2006 and 2006-2010 by land status compared to privately owned timberland between 1991-1994 and 2007-2010 in California (error bars represent sampling error). Although volume changes are on an annual per-acre basis, it is important to note that Forest Service estimates of change cover a different timeframe than private timberland. Credit: *Christensen, G., K. Waddell, S. Stanton and O. Kuegler (2016). California's Forest Resources: Forest Inventory and Analysis, 2001-2010. Portland, OR, U.S. Forest Service, Pacific Northwest Research Station. PNW-GTR-913. http://www.treesearch.fs.fed.us/pubs/31452 . Page 33.*

We did not change the product mix, but assume efficient life cycle use



- Sawlogs mainly for building products
- Assumed chips used for carbon neutral energy
- Reasonably efficient waste management systems are the law but often not modeled

Published estimates of usable carbon in harvested wood products over 100 years

Author Year	What Products	Estimated 100 year climate benefits of harvest wood products a fraction of initial removal
Luyssaert 2010	Explicitly ignored	0
Hayes 2012	All	0
Naudts 2016	Explicitly ignored	0
Wear 2015	Explicitly ignored	0
Coulston 2015	Estimated	.17 - .25
Executive Office of the President 2015	Focus only on land carbon sinks and sources	0
Woodall 2016	Products ignored, to be included in later reports	0
Smyth 2014	Building products	>2
Smyth 2014	Paper products	.2
Lu 2015	Paper products	0.05
Lu 2015	Building products	0.5
Bergmann 2014	By building product	1.9-3.5
Sathre and O'Connor 2010	For wide range of building products	1.0-3.0 (median 2.1)
IPCC (Smith 2014)	All, highlight greater benefits of long lived building products	Reference Sathre 2010
Stewart and Nakamura 2012	w/ bioenergy – pre 2006 USFS documents	0.66
Stewart and Nakamura 2012	w/ bioenergy – post 2006 USFS documents	1.23

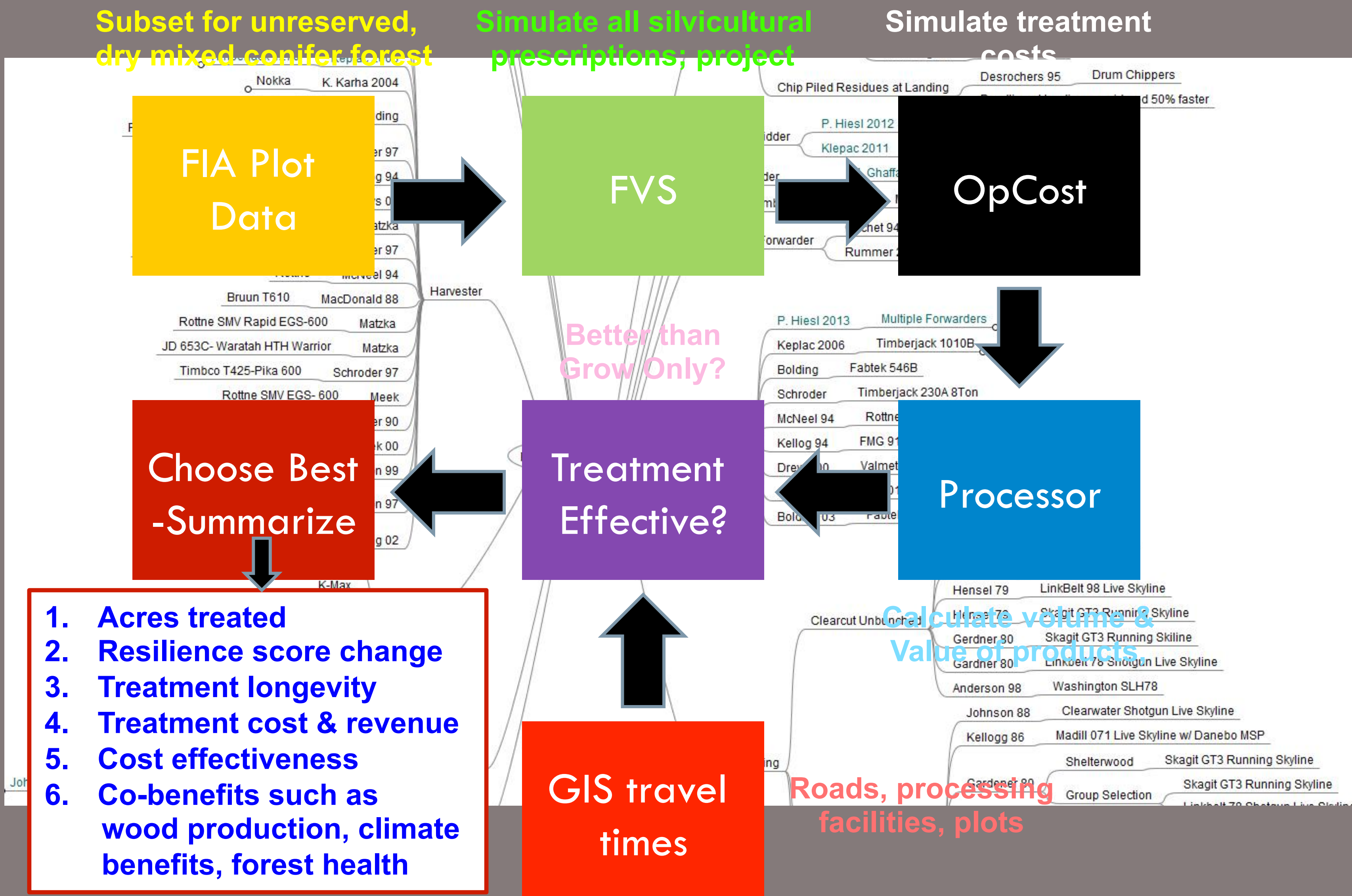
Attributes of tools needed to address the problem – integrate into BioSum

- Differentiate forest by different owners
- Track forest growth, removals and mortality over decades with multiple treatments
- Track forest stand attributes that can be correlated to fire hazard, habitat, financial value attributes
- Track benefits and costs based on market or cost-share prices
- Present results in a manner that inform policy makers – (no lectures on elasticities)

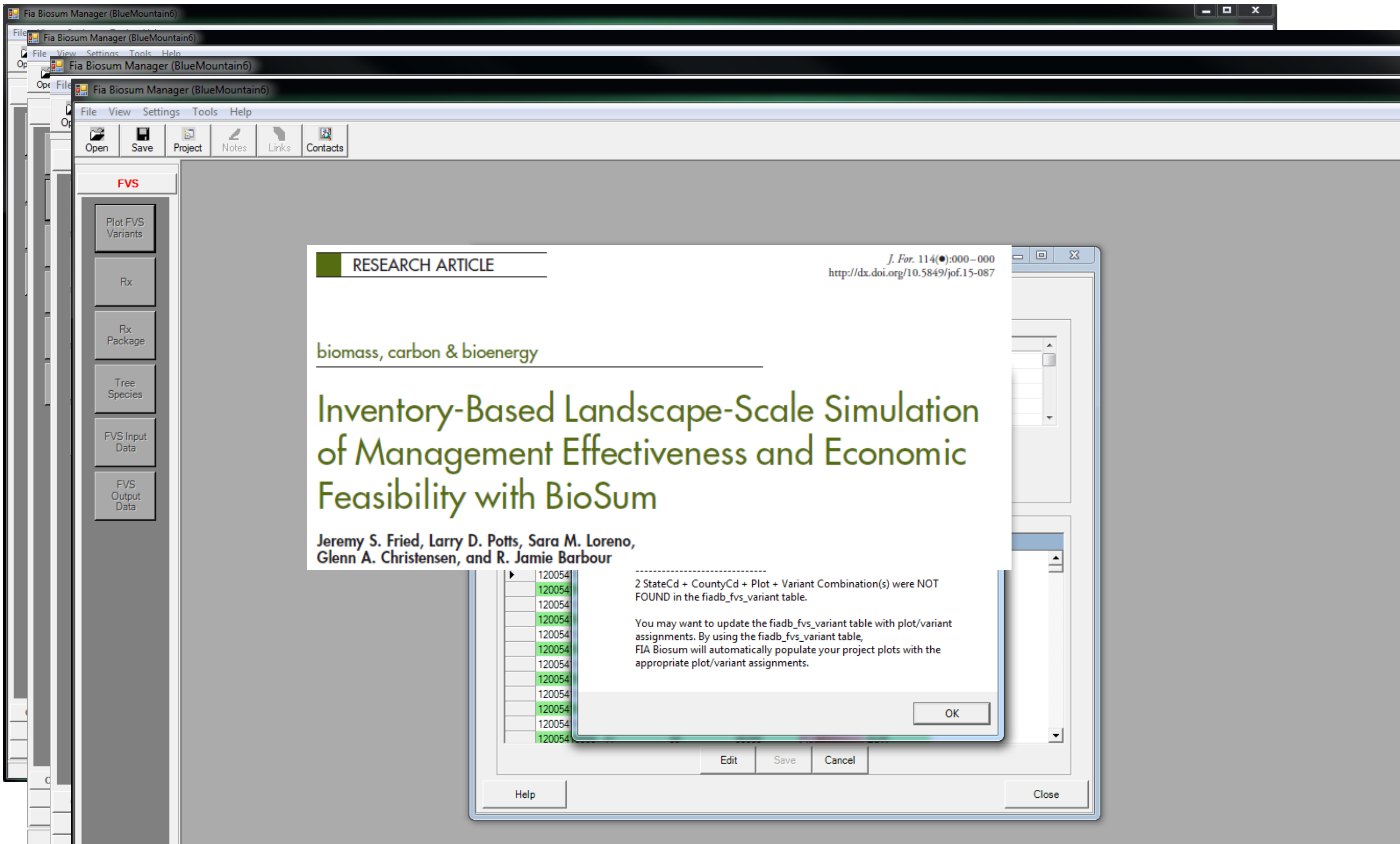
Bioregional
Inventory
Originated
Simulation
Under
Management

- A software supported analytic framework that builds on FIA's representative sample of all forests
- Simulates unlimited # of alternative silvicultural sequences applied over 40 years
- Tracks:
  - effectiveness by user-defined criteria
  - wood produced, revenues generated, treatment and haul costs incurred, and status of any forest attribute that can be computed & tracked in FVS
- Summarizes by owner-class, forest type, ecoregion, wood processing facility, tree size class, species group, and so on…
- Evaluates Rx "popularity" – on how many acres is each sequence "best"?

BioSum Model Framework



Bioregional Inventory Originated Simulation Under Management



Forest landowners and analysts face multiple market prices for biomass

Merch Logs $/mbf	Merch. Logs or Bioenergy (green) $/Green Ton	Bioenergy (dried) $/Bone Dry Ton	Carbon Offset $ $/tCO2e*	Examples of Products at this Price Point in California
60	10	20	12	Landfill wood diversions, SE US pulpwood
90	15	30	18	Sawmill residues, Orchard waste
120	20	40	24	Logging residues; Fir, non-competitive
125	21	42	25	Pine, non-competitive
150	25	50	30	
200	33	67	40	Fir, competitive
250	42	83	50	Pine, competitive
300	50	100	60	Douglas-fir, competitive
350	58	117	70	
400	67	133	80	
450	75	150	90	
500	83	167	100	Redwood, non-competitive
550	92	183	110	Redwood, competitive

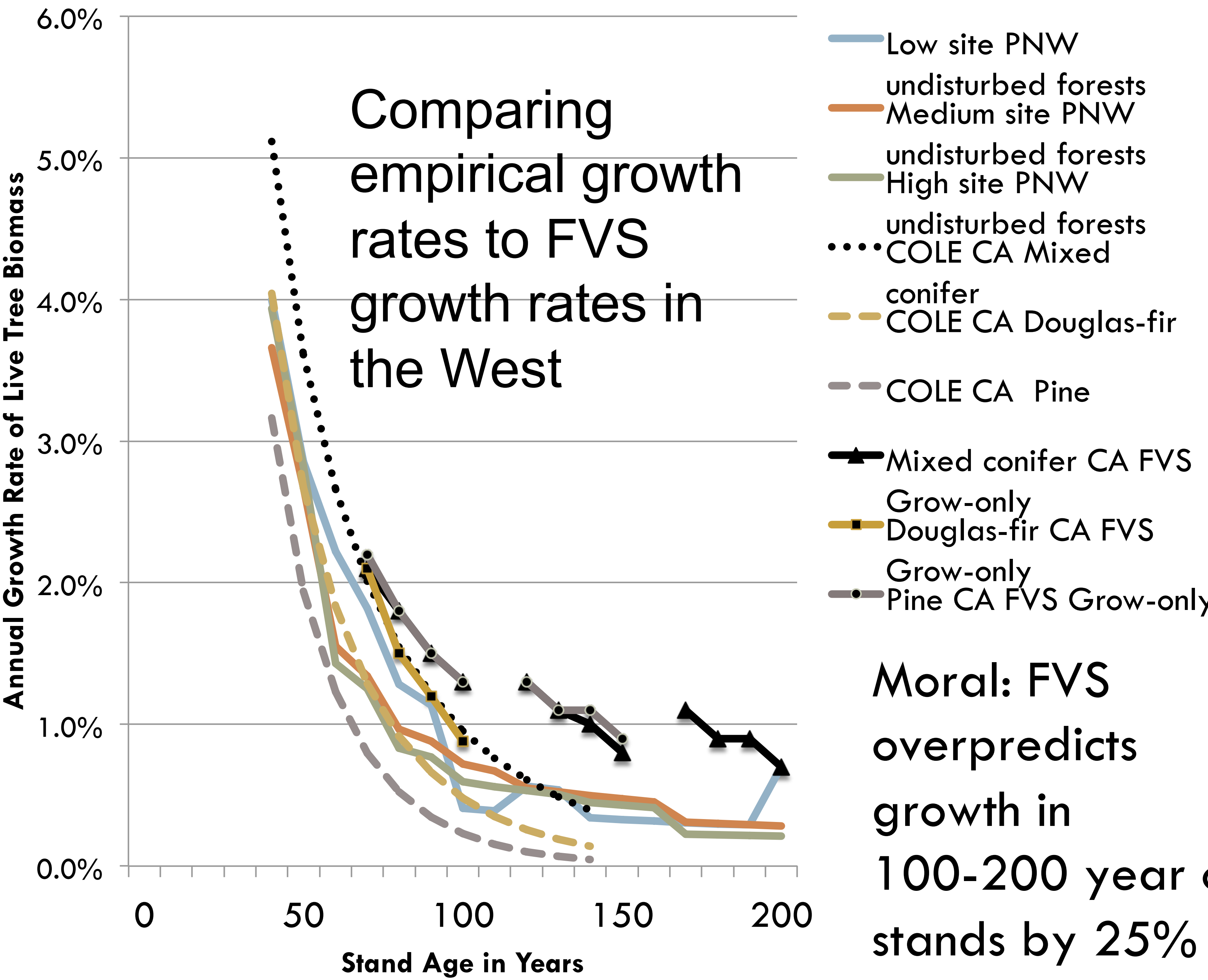
But a lot of forests can not be economically thinned now – too little volume, rules based on basal area

Basal Area Class (ft^2)	**Corporate**	**Family**	**NFS**	**All**
0-50	16%	6%	14%	13%
50-100	17%	19%	16%	17%
100-150	22%	23%	19%	21%
150-200	16%	22%	19%	19%
200-250	15%	13%	14%	14%
250-300	6%	8%	9%	8%
300-350	3%	3%	5%	4%
> 350	4%	6%	3%	4%

Test a range of plausible treatments

- Selection thinning v Clearcut/Reforest v Grow only
- Different residual volumes
- Thin from below or Thin evenly across diameters
- Different surface fuel treatments
- Different levels of removal of low value biomass
- Treat stands with net profit or net risk reduction

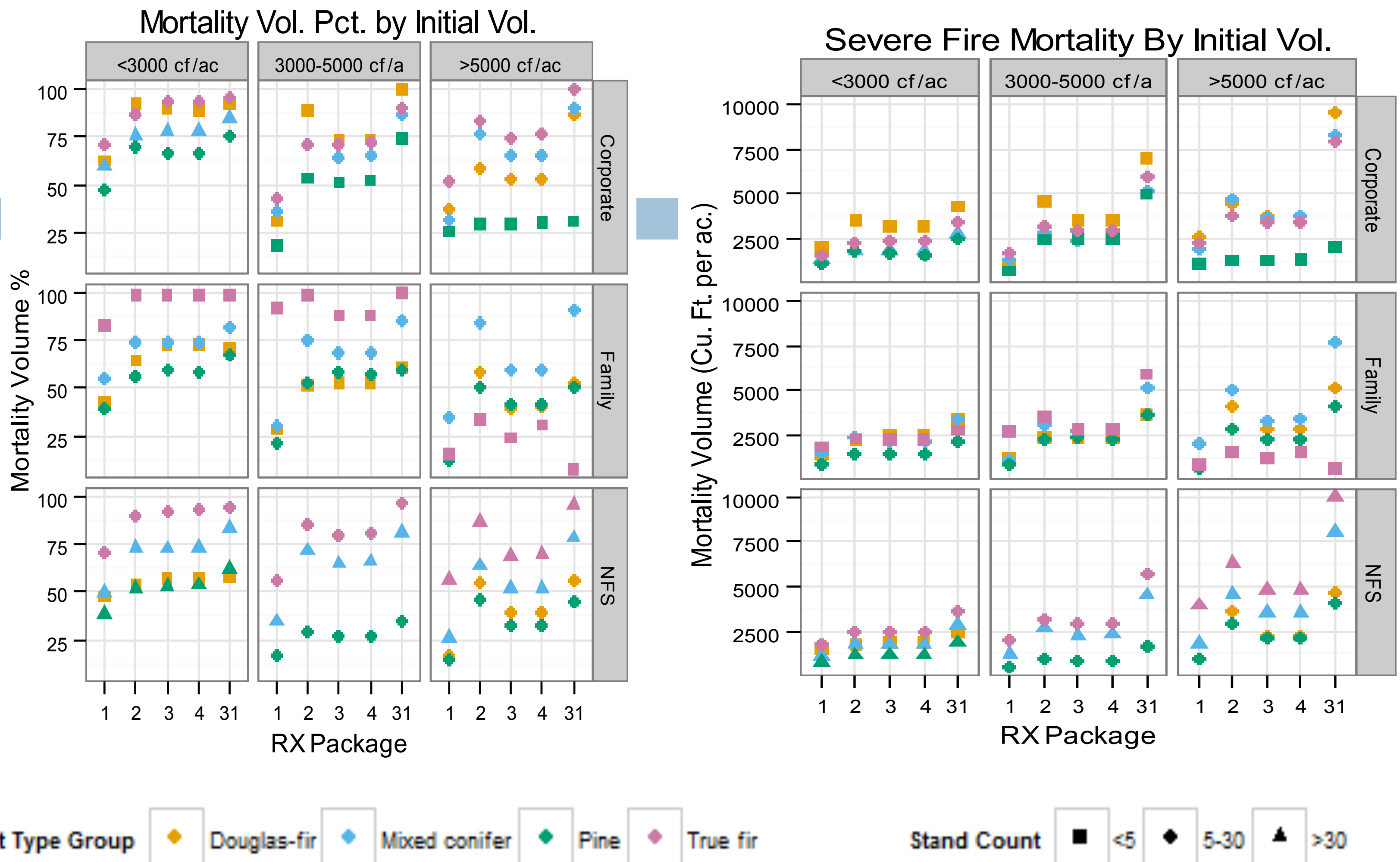
Comparing empirical growth rates to FVS growth rates in the West



Moral: FVS overpredicts growth in 100-200 year old stands by 25%

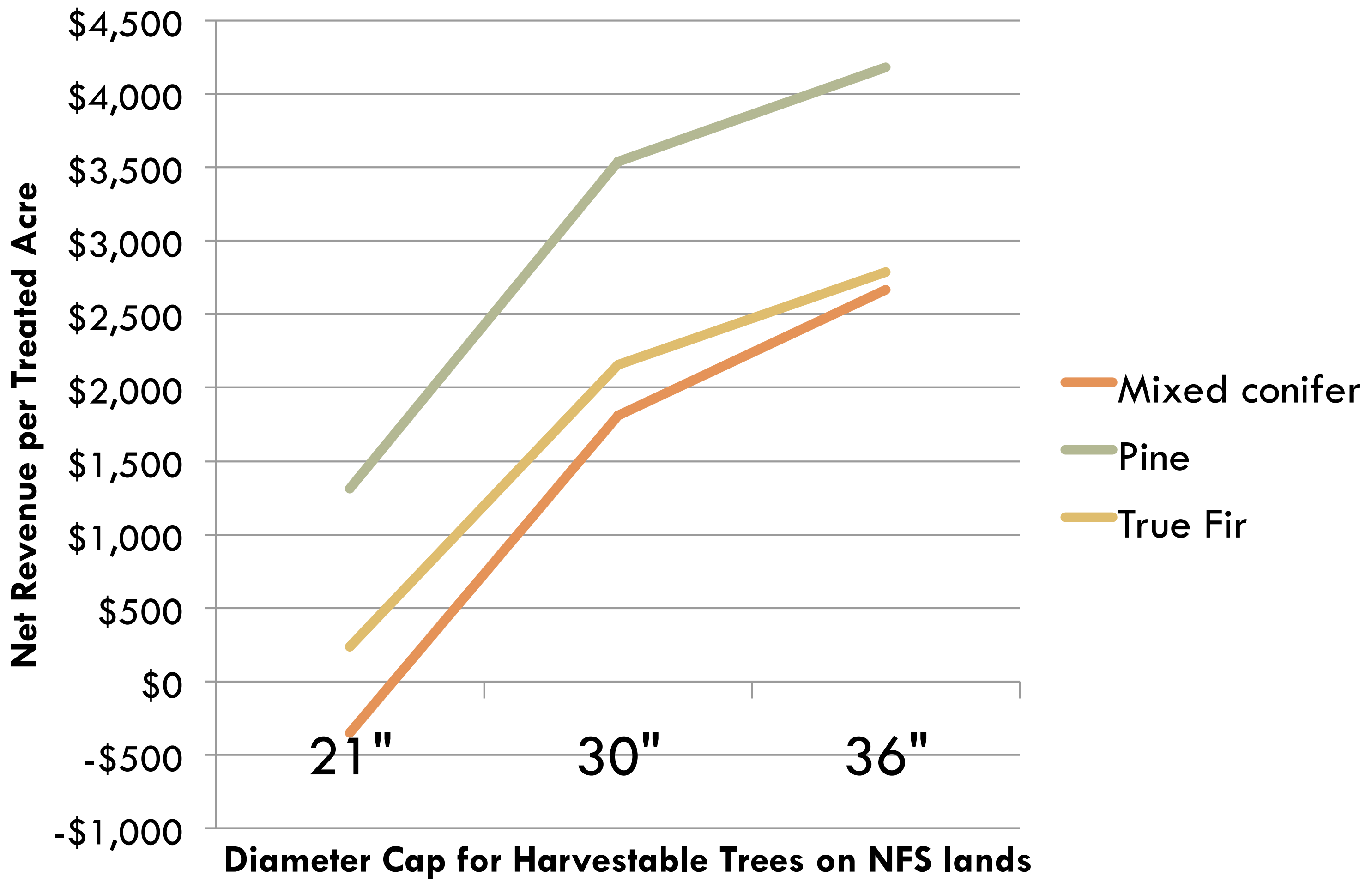
Modeling fire hazard and mortality

- Surface fuel models are key to suppression uses but are a poor match to post-fire forest conditions
- Forest mortality from non-fire vectors is much greater than from fire mortality
- Most forest growth models use external add-ons to model mortality, so plain vanilla runs are always wrong
- We tracked many fire hazard metrics, all costs of treatments, but need to improve models with systematically collected empirical forest data



- Whole tree logging followed by Rx fire significantly reduces fire hazard
- Same rank order by forest type, but initial inventory and history matter
- Illustrates risk of deciding state policy from any small subset of combos

Impact of lower diameter caps



Steep slopes are very challenging

	Mixed Conifer 29% area is steep Mortality %	Mixed Conifer 29% area is steep Net Rev/ Acre	Douglas fir 55% of area is steep Mortality %	Douglas fir 55% of area is steep Net Rev/ Acre
< 40% slope	39	$2950	36	$4233
> 40% slope	43	$1951	52	$963

Steep slopes significantly reduce treatment effectiveness and net revenues

Pre-optimization - compare options

	Mixed Conifer	**Mixed Conifer**	**Douglas fir**	**Douglas fir**
	Mortality %	Net Rev/ Acre	Mortality %	Net Rev/ Acre
Thin, Rx fire	37	2375	39	2487
Thin, Lop scatter	70	1838	72	1027
Clear cut, replant	74	4496	77	4621
Grow only	86	0	88	0

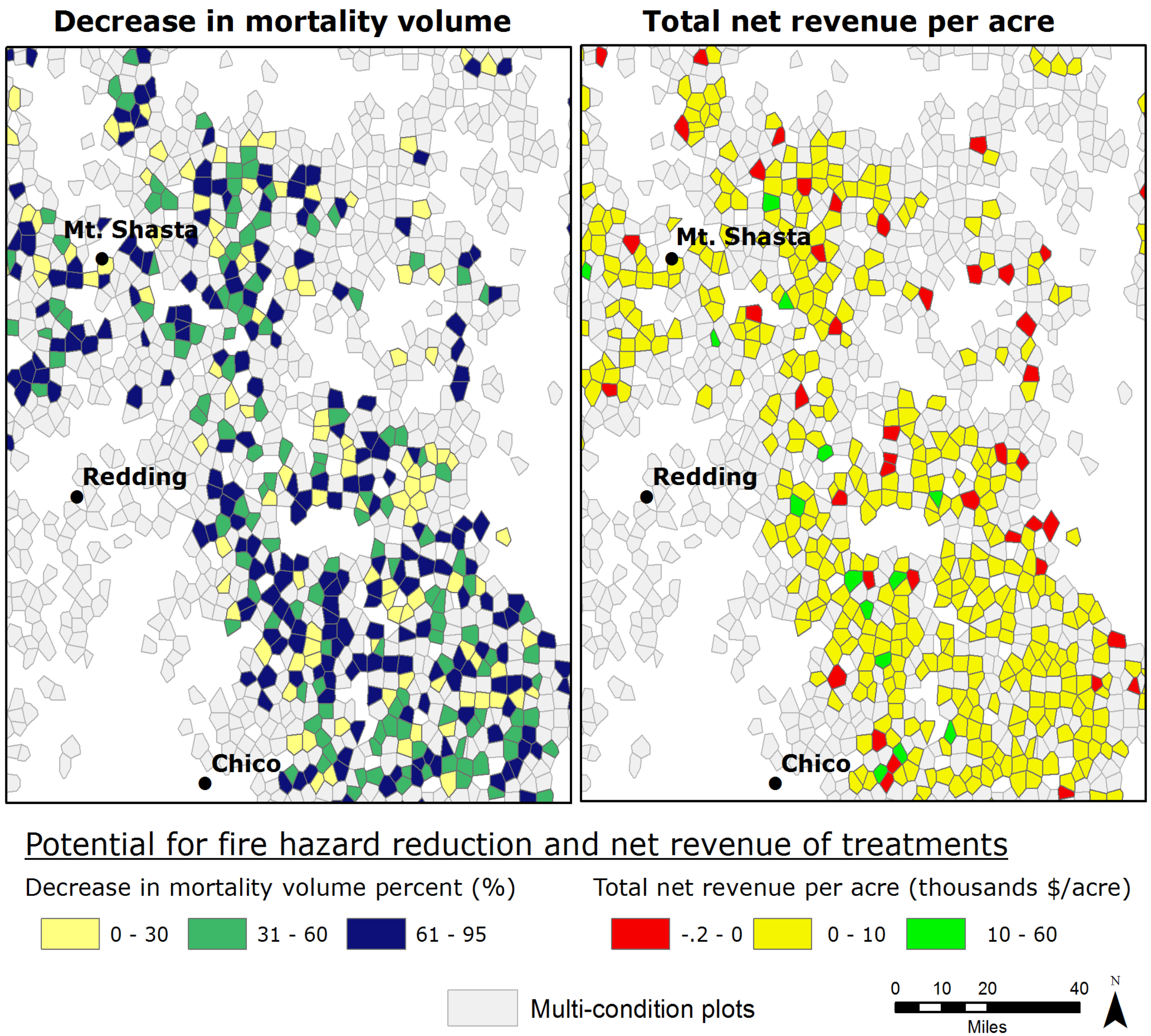
Considering optimal statewide policy/strategies

- Don't waste money on nearly impossible to improve sites
- Allow some investment in fuels reduction per project to prevent leaving 'holes in the fence' – when some spatially key units are left untreated.
- Stage forest fuels hazard actions as stands develop commercially harvestable volumes

Which treatments chosen – treatments with best average value not always chosen

- 47% thin from below (average benefit over ‘across’)
- 44% thin across diameters (significant net rev. adv)
- 9% regeneration harvest
- 70% prescribed burn is best surface fuels treatment but other treatments are better elsewhere

Primary Goal – Reduce Fire Hazards
Use Net Revenue to break ties



Estimates of optimal management depend strongly on counting products and future fire probability estimates

	1/120 fire probability	1/120 fire probability	0/120 fire probability	0/120 Fire probability
	Optimal	Grow Only	Optimal	Grow Only
40 year Net Growth + Harvest with 25% discount applied to FVS grow only	2612	943	3129	2790
Optimal Advantge	1669		339	

Maintain Pvt Forest Management and increase National Forest Mgt

Timberland Owner	Annual Acres Treated	Annual Energy Wood in BDT	Annual Merchantable Wood in BDT
Private Timberlands	171,000	2,300,000	2,900,000
National Forest System Timberlands	242,000	6,700,000	8,400,000
All Timberlands	412,000	9,000,000	11,300,000

Can Forest Health Restoration be Successful for California?

- "Toto, I have a feeling we're not in Kansas anymore" – The Wizard of Oz, 1939
- More parks, less intensive management, spend more on fire suppression – these themes have dominated 100 years of forest policy discussions in California
- But restoring health will require more management
- Approaches that define specific goals and model out innovative approaches are needed

Potential Next Steps for California

- Defining a forward-looking resilience strategy that is different than backward looking restoration strategies or preservation strategies is needed
- Governor Brown's budget is proposing more carbon offset $$ to be spent on working forests California rather than mainly on forest preservation elsewhere
- The many agencies with a finger in the forest*climate pie need to agree on a common process for analyzing different strategies

QUESTIONS WELCOME