



WESTCARB Terrestrial Sequestration Results 2006

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*Regional Carbon Sequestration Partnerships
Initiative Review Meeting 2006,
Pittsburgh, Pennsylvania, October 3-4, 2006*



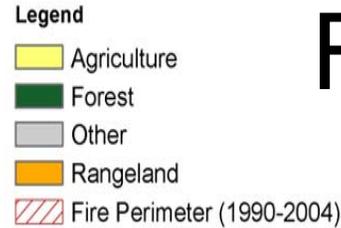
Summary

- Development of Fire Methodology
- Pilot Project Activities
 - Afforestation & Forest Management
 - Removing Hazardous Fuels from Forests to Reduce GHG Emissions from Uncharacteristically Severe Wildfires
- Biofuels Link with Geologic Sequestration

Development of Fire Methodology

- Expert panel identified to develop methodology
 - Completed initial round of interviews to identify critical issues
- Draft methodology prepared
- Review meeting scheduled October 24-25 in Redding, California

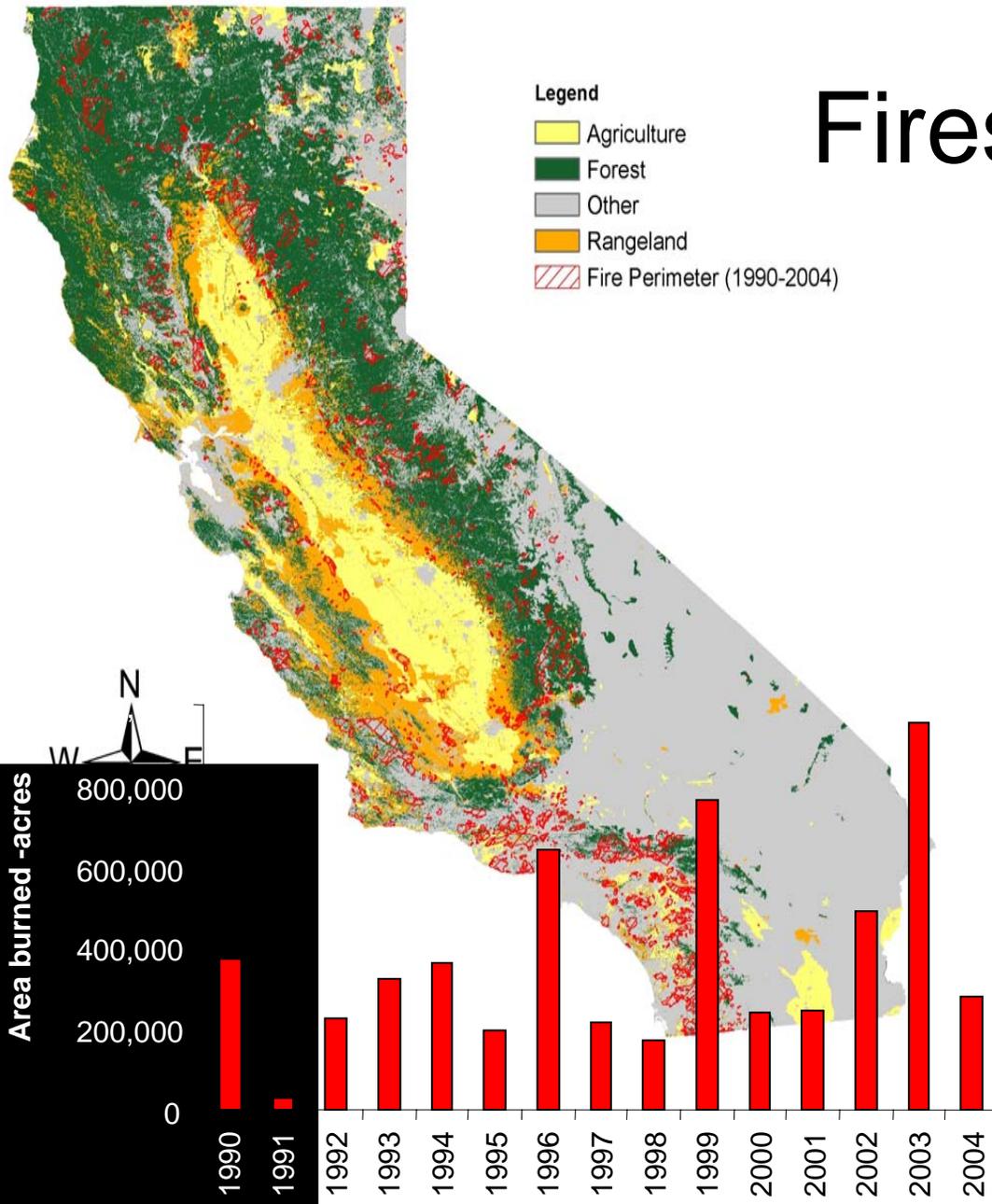
Fires in California



Total area burned
in 1990-2004
= 5.5 million acres

So far in 2006,
334,000 acres

Emissions from
fires during period
~ 26 MMT CO₂ plus
other GHGs





Not all forests
are the same

Photos: Dr. Sam Sandberg, USDA Forest Service

Not all forest fires
are the same



Potential Sequestration Benefits from Improved Fuel Management



Source: Sandberg, USDA Forest Service

- Bring fire to the ground
- Reduce fire severity
- Reduce GHG emissions from loss of carbon stocks
- Increase growth rates in residual stand

Methodology for Determining Emission Reductions from Reducing Fuel Loads

| Hazardous Fuel Load | Age Class | | | |
|---------------------|-----------|-----------|-----------|---------|
| | <10 yrs | 10-40 yrs | 40-80 yrs | >80 yrs |
| Low | | | | |
| Medium | | | | |
| High | | | | |

Assign emissions factors based on multi-criteria analysis. The objective of fuel treatments is to move from High to Medium to Low hazardous fuel factor.

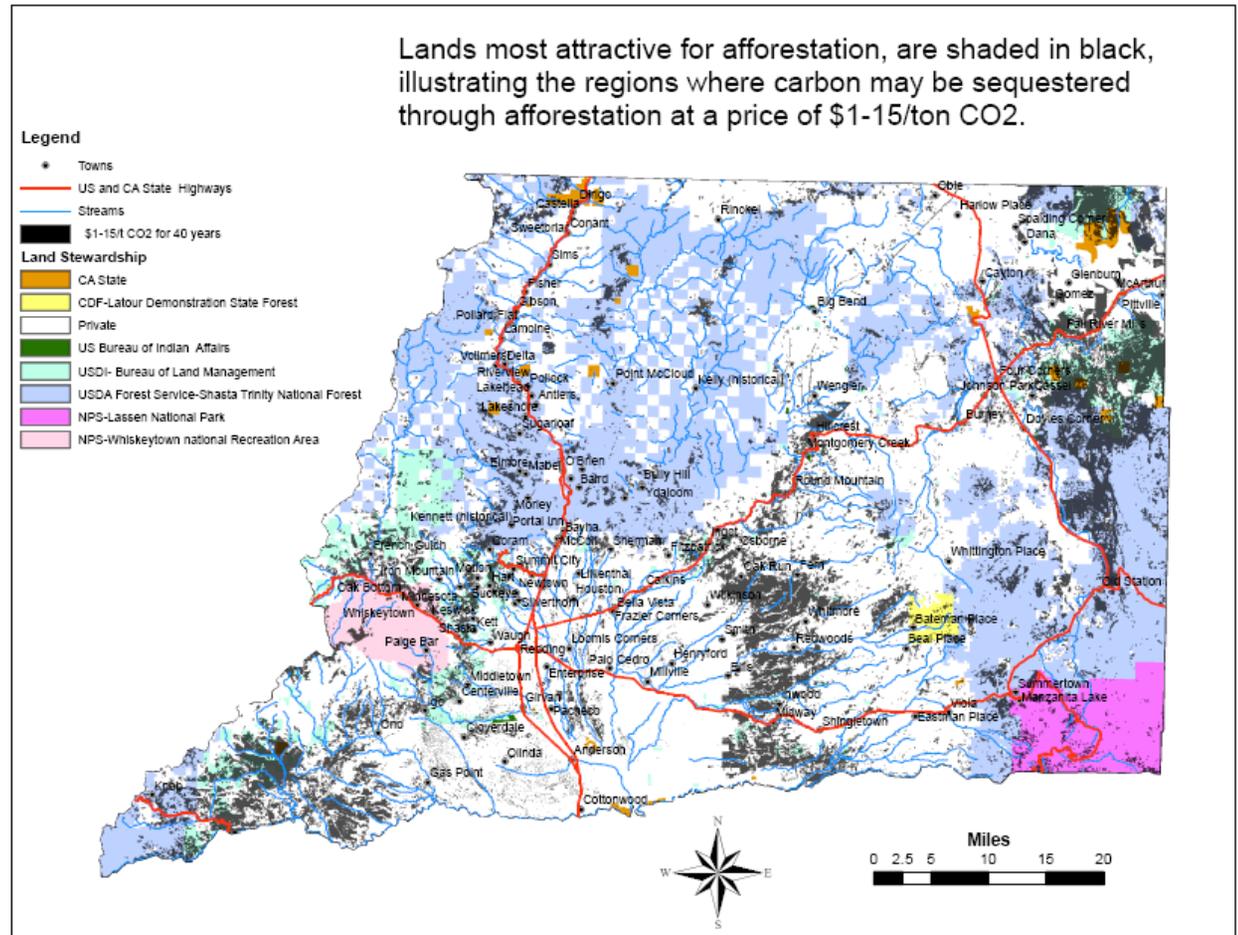
Methodology Panel meets in Redding October 24-25.

Pilot Projects in Shasta County – Afforestation and Forest Management

- Afforestation
 - Classify sites for planting
 - Identify landowners
 - Select species and varieties
- Forest Management
 - Develop easement
 - Estimate carbon benefits

Afforestation in Shasta County

- Candidate lands shaded in black
- Estimated cost for sequestration of \$1-15/ton CO₂
- Species options:
 - Mixed conifers
 - Oak
 - Grey pine



Conservation-Based Forest Management

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Changes in Practices on Bascom Pacific Lands

- Harvest 80% of growth until 25 mbf/acre is achieved, then harvest growth.
- Management in watercourse zones focuses on large trees and dense canopies.
- Ensure that all areas capable of sustaining forest vegetation are stocked appropriately.

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Pilot Projects in Shasta and Lake Counties -- Fire

- Identify candidate sites for measurement of changes in carbon stocks associated with treatments to reduce hazardous fuels
 - Collect data on carbon stocks before and after treatment and on the cost of treatment
- Identify candidate chronosequence sites for measurement of changes in carbon stocks associated with fire
 - Collect data on carbon stocks before and after fire and regrowth rates after fires of different severities

Example from Cone Fire -- 2002

- Treatments affect changes in carbon stocks attributable to fire



Area treated with thinning and prescribed burn prior to fire.

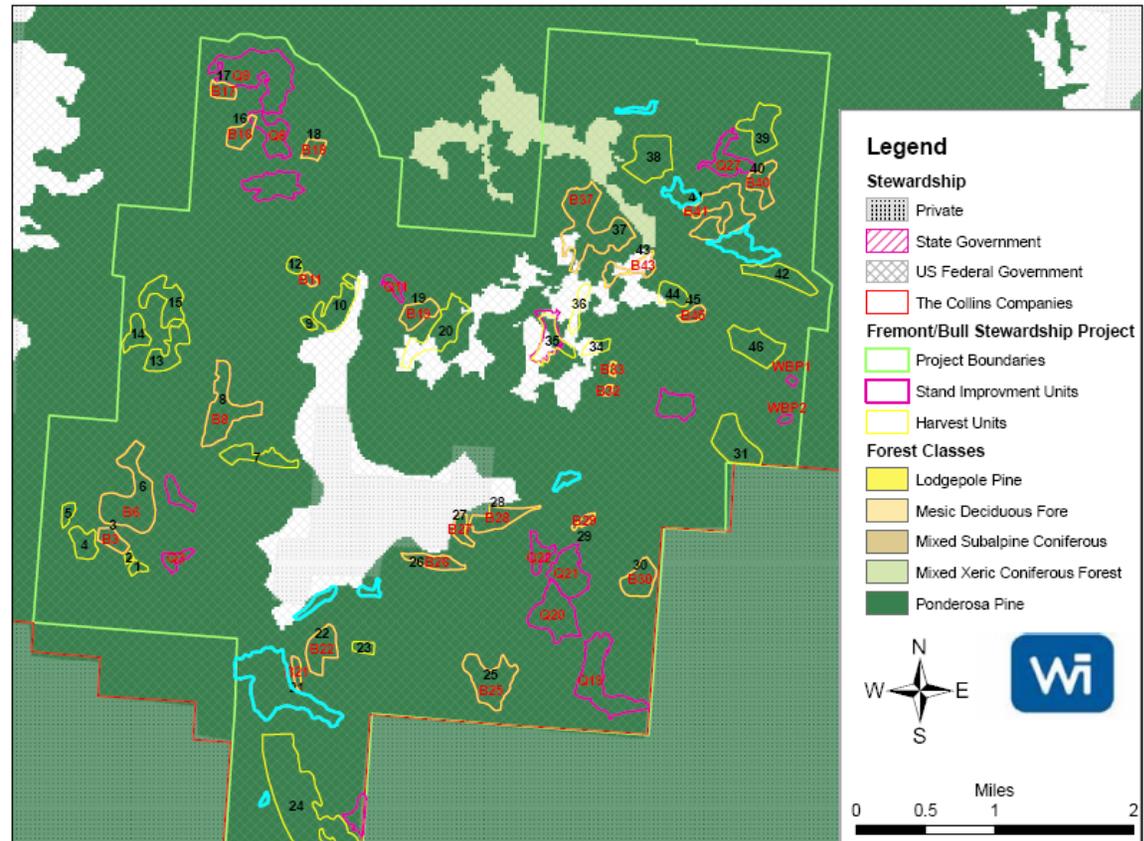


Area untreated prior to fire.

Source: "Cone Fire Tests Fuel Reduction Treatment Effectiveness," Gary Nakamura, UC Cooperative Extension, 2002. Photos: USFS PSW Research Station, Redding, CA.

Lake County Pilot Project

- First field data collected at the Bull Stewardship site in July 2006
- Collins Company carried out fuel removal and forest health treatments



Does hazardous fuel removal make economic sense?

- Quantifiable sources of revenue
 - Emissions credits for avoided GHG emissions
 - State and federal fire suppression costs
 - Bioenergy
- Prospective sources of revenue
 - Reduced emissions of other pollutants
 - Reduced insurance losses

Treatment Costs

| Treatment | Product yield | Representative Costs |
|-----------------------------|---------------|---|
| Prescribed fire | No | \$35-300/acre, average \$92/acre ¹ |
| Masticate and leave on site | No | \$100-1000/acre ² |
| Cut-pile-burn | No | \$100-750/acre ² |
| Cut-skid-chip-haul | Yes | \$560 – 1634/acre ³ or \$34-48/BDT + haul cost ³ |

1 USDA Forest Service R&D/Western Forestry Leadership Coalition, 2003.

2 Chalmers and Hartsough, no date

3 Fried et al. 2003

Carbon Credits for Shasta County

| Shasta County | |
|---|---|
| Forest land at high or very high risk of fire (acres) | 1,410,000 |
| High or very high fire risk land that satisfies constraints (acres) | 215,000 |
| Potential removable fuel based on field data (tons C/acre) | 9.3 |
| Total removable fuel from treatable land (BDT biomass) | 4 million |
| Potential emissions credits (\$/acre) | @\$10/tCO ₂ , \$350-700/acre |

Heat vs Power vs Liquid Fuels

- Heat for thermal applications
 - Each \$10 per ton fuel adds \$0.63/million BTUs
- Power generation
 - Each \$10 per ton fuel cost adds \$0.01/kWh
- Liquid fuels
 - Each \$10 per ton fuel cost adds \$0.10/gallon

Fire Benefits

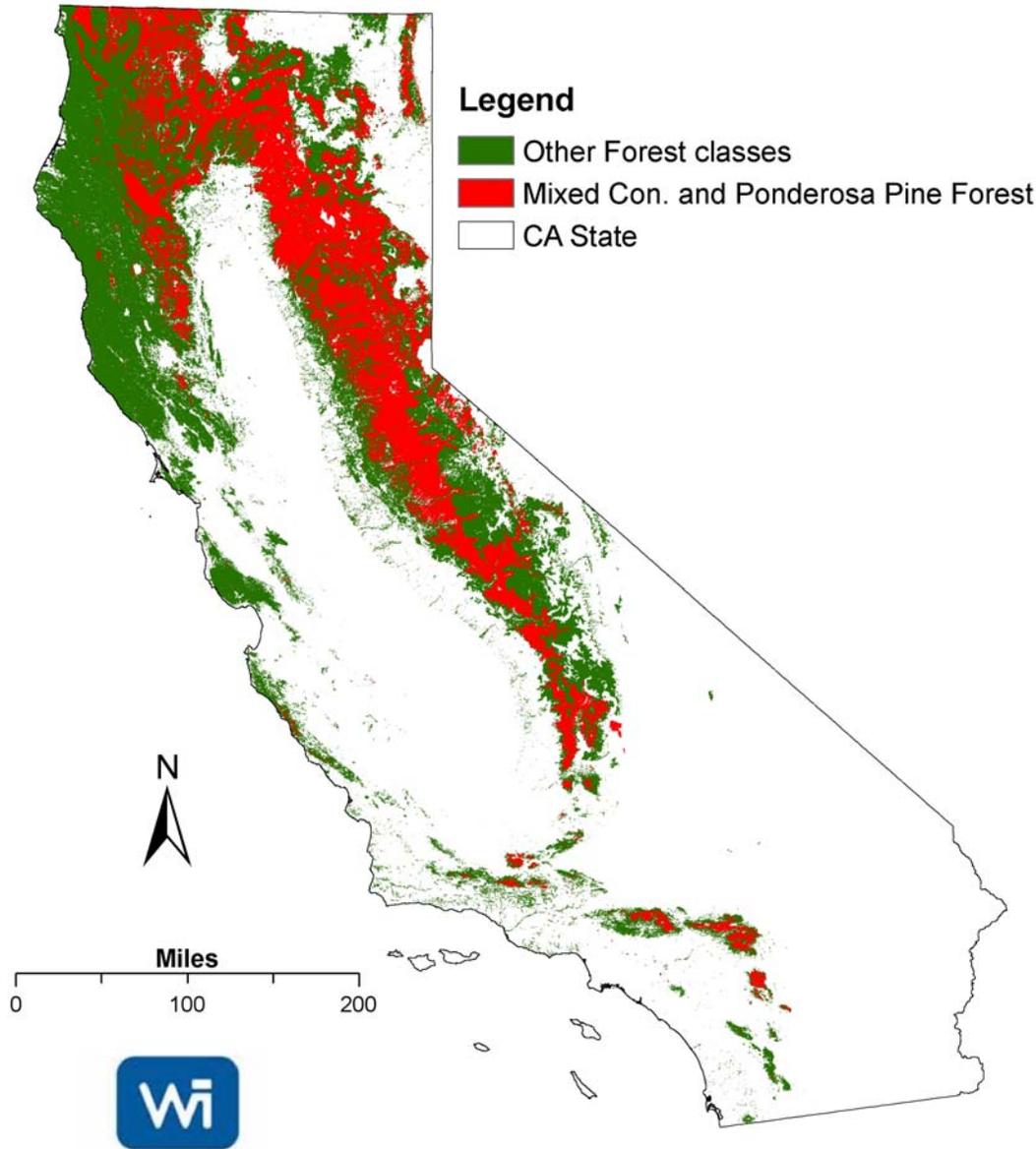
- Ten-year average (1996-2006) of 4.8 million acres per year
- Suppression costs to federal agencies for 1994-2004 period averaged \$830 million per year (\$1.2 billion per year for 2000-04)
- Average value per acre \$250/acre

Source: National Interagency Fire Center

California Air Emissions from Burning Biomass

| 10 year annual average (tons/day) | Reactive Organic Gases | CO | NOx | SOx | PM10 |
|-----------------------------------|------------------------|--------------|-------------|-------------|--------------|
| Agriculture | 19.3 | 216 | 5.6 | 0.2 | 25.6 |
| Range | 23.5 | 309 | 3.7 | | 45.3 |
| Forest | 28.4 | 720 | 6 | | 52.1 |
| Wildfire | 128.4 | 2,482 | 79.4 | 24.5 | 253.4 |
| Wood-Fired Boilers | 0.37 | 50 | 5.1 | 0.5 | 1.1 |

Source – California Air Resources Board Emissions Inventory 2004



CA forests at high/
very high risk of fire
that could benefit
from treatment = 16.2
million acres

About 2.2 million
acres meet constraints
for treatment used in
analysis

Constraints: Slope, yarding
distance, block size and
distance to biomass plant

Linking Terrestrial with Geologic Sequestration

