WESTCARB Phase I Results Review

Terrestrial Supply Curves for CA, OR, and WA

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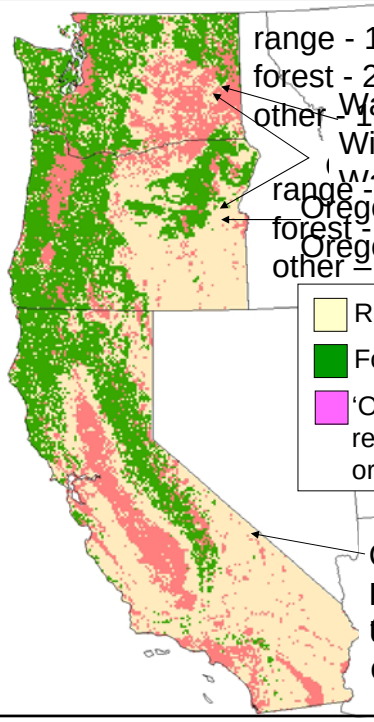
Overview

- Terrestrial sequestration opportunities quantified for California, Oregon, and Washington
  - Area, tons, cost
  - Largest terrestrial sequestration opportunity in each state is afforestation

Terrestrial Sequestration Opportunities

- Largest terrestrial sequestration opportunity in each state is afforestation
- Changing forest management has limited potential
- Fire appears to be the most important management issue to address
- Forest conservation limited but some important opportunities
- Negligible opportunity for terrestrial sequestration from changing ag management

Land cover ~1995



range - 12M acres
forest - 20M acres
other - 11M acres

Washington Cooperative Fish and Wildlife Research Unit, University of Washington

range - 27M acres
forest - 26M acres
other – 8M acres

Oregon Natural Heritage Program, Oregon State University

Rangelands
Forest
'Other' (agriculture, residential, water bodies or barren lands)

CDF-FRAP, CA Rangelands Research and Information Center, U.C. Davis

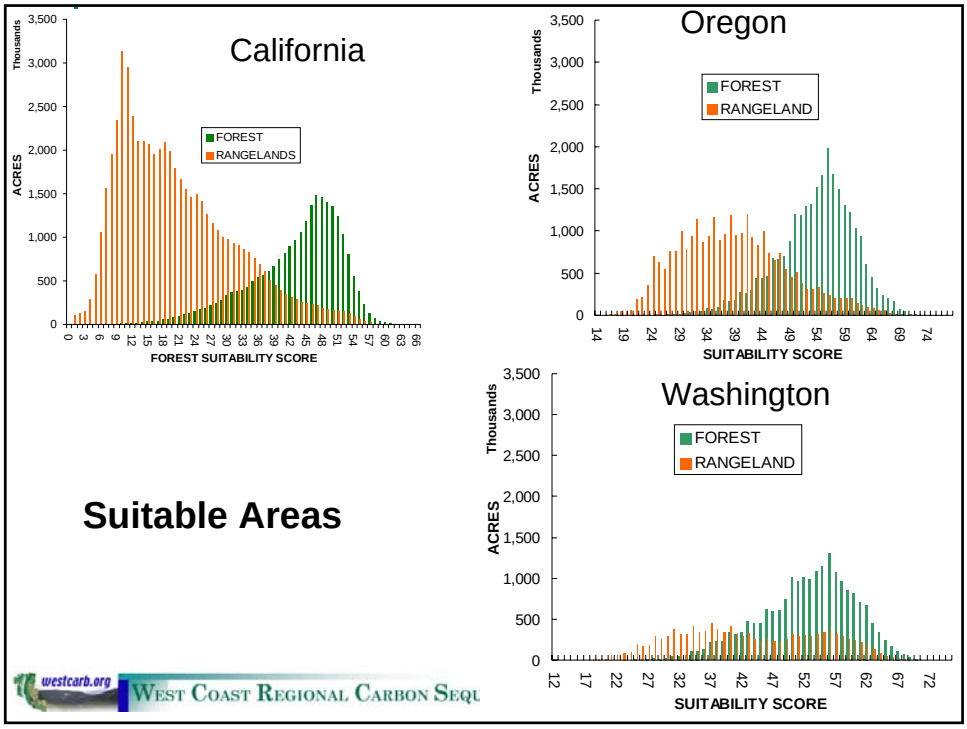
range – 56M acres
forest - 23M acres
other - 20M acres

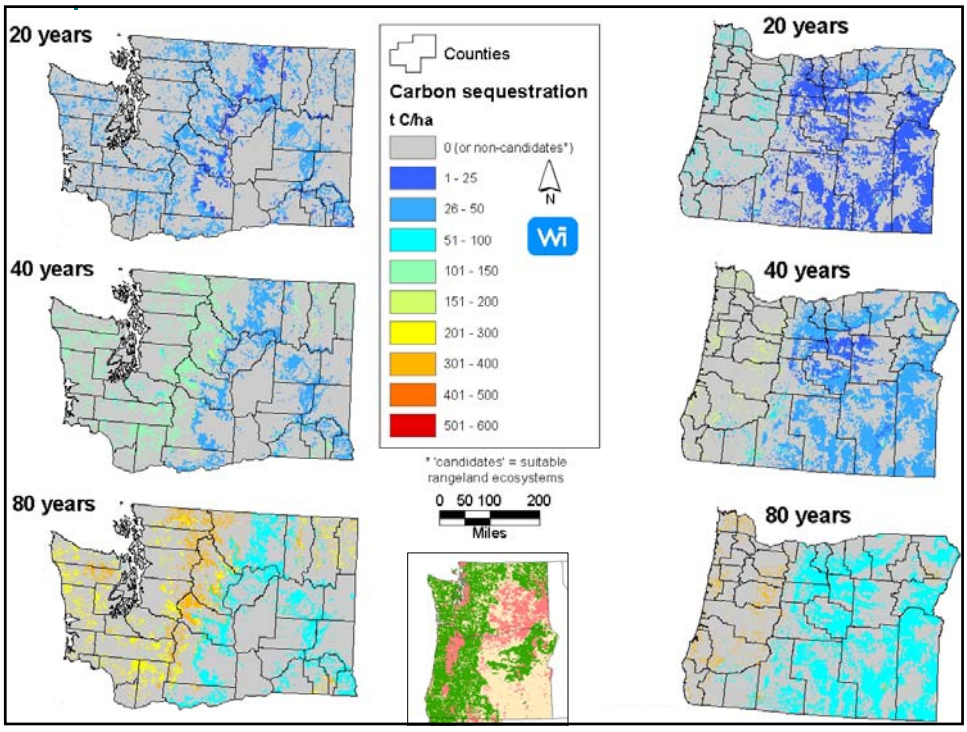
Results after 40 Years

	California		Oregon		Washington	
	Area	Quantity	Area	Quantity	Area	Quantity
Grazing Lands—Afforestation	million acres	MMT CO_2	million acres	MMT CO_2	million acres	MMT CO_2
< \$2.40/metric ton CO_2	**3.61**	**1138**	**0.16**	**37.5**	**0.06**	**14.8**
< \$10/metric ton CO_2	**17.1**	**3228**	**10.5**	**1007**	**6.17**	**1031**
< \$20/metric ton CO_2	**20.1**	**3347**	**17.4**	**1420**	**9.07**	**1219**
Crop Lands—Afforestation						
< \$2.40/metric ton CO_2			**0**	**0**	**0**	**0**
< \$10/metric ton CO_2			**1.91**	**458**	**0.26**	**57.2**
< \$20/metric ton CO_2			**3.33**	**560**	**3.32**	**271**
Forests—Rotation Extension 5 yr extension, 20 yr contract						
< \$2.40/metric ton CO_2		**0**		**0**		**6.08**
< \$10/metric ton CO_2		**0**		**0.37**		**7.17**
< \$20/metric ton CO_2		**7.25**		**1.80**		**13.55**

Afforestation of Rangelands Methods

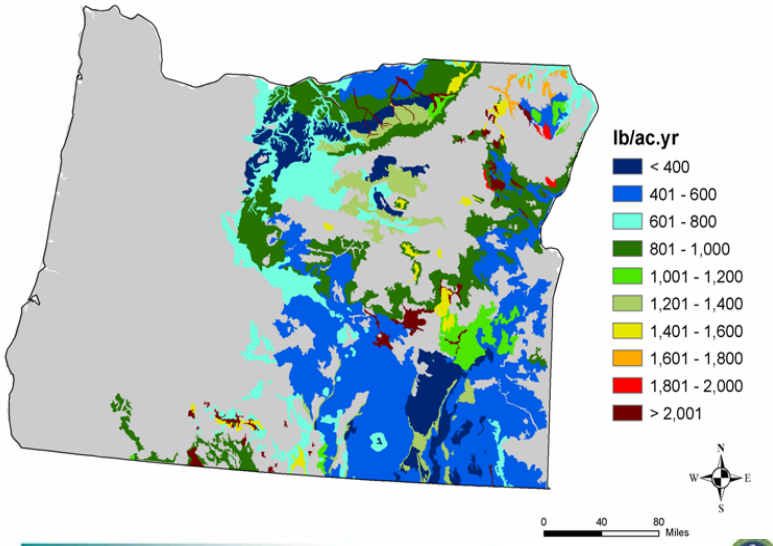
- ID suitable areas
- Determine carbon sequestration potential
- Determine cost of afforestation
  - – Opportunity costs
  - – Other

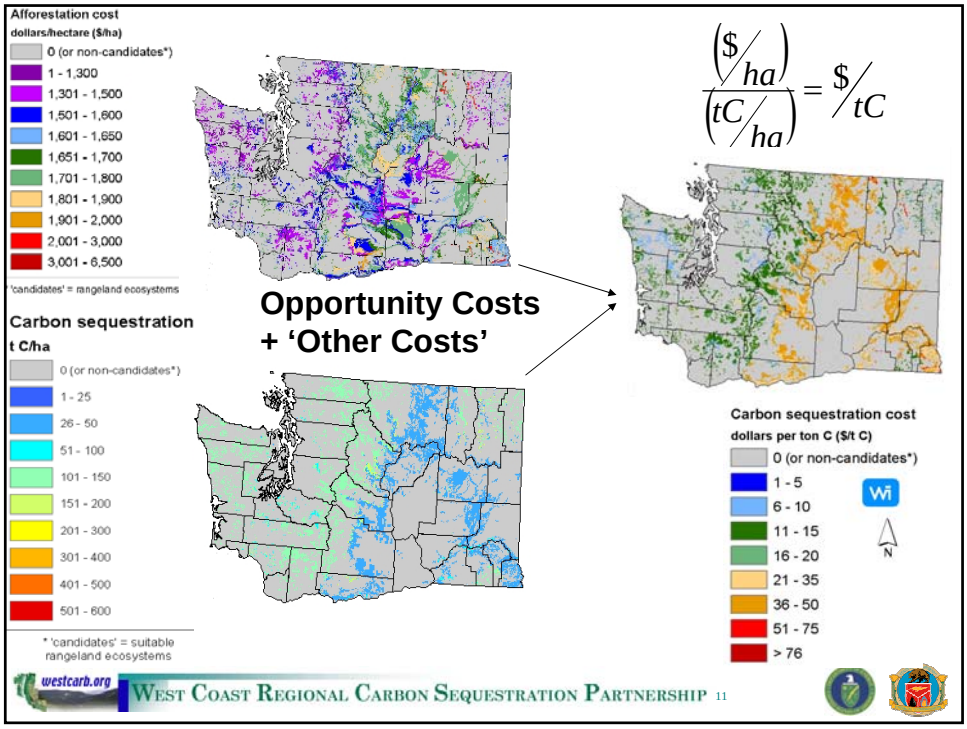

California
Thousands
ACRES
FOREST
RANGELANDS
FOREST SUITABILITY SCORE
Oregon
FOREST
RANGELAND
SUITABILITY SCORE
Washington
FOREST
RANGELAND
SUITABILITY SCORE
Suitable Areas
westcarb.org
West Coast Regional Carbon Sequ

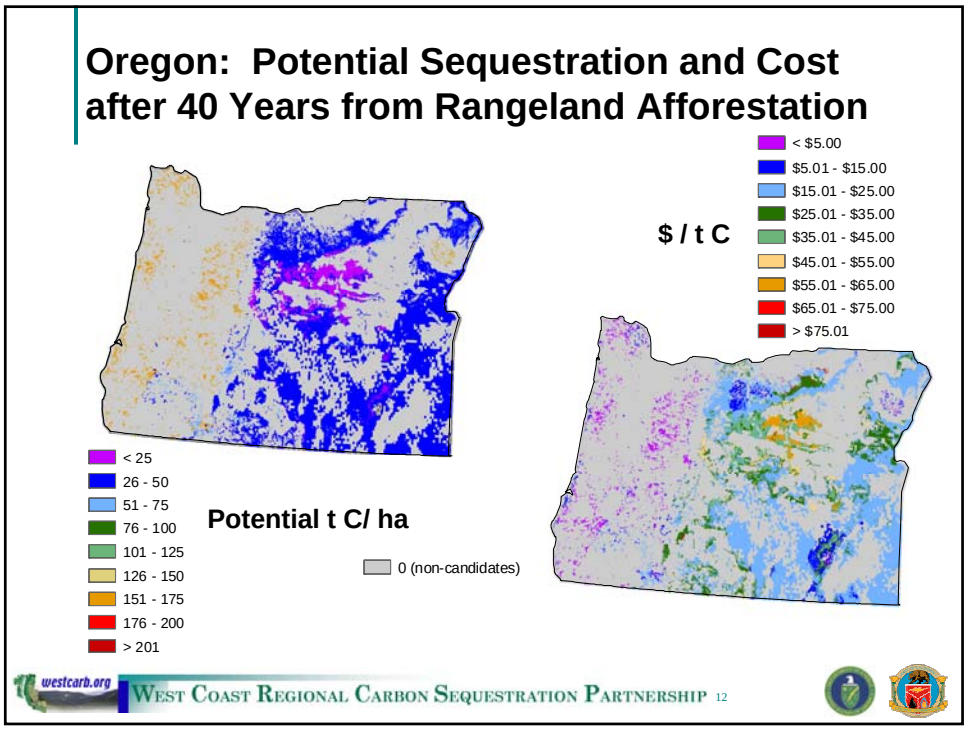

20 years
40 years
80 years
Counties
Carbon sequestration
t C/ha
0 (or non-candidates*)
1 - 25
26 - 50
51 - 100
101 - 150
151 - 200
201 - 300
301 - 400
401 - 500
501 - 600
N
* 'candidates' = suitable rangeland ecosystems
0 50 100 200
Miles
20 years
40 years
80 years

Opportunity Costs Analysis

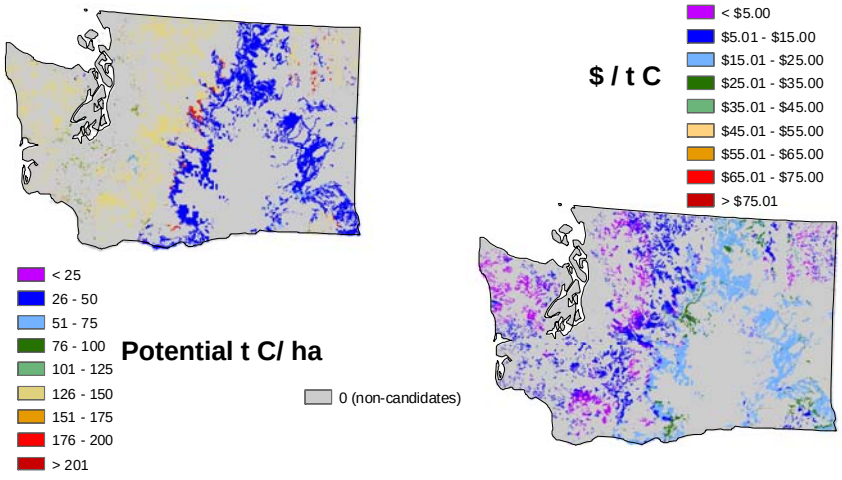
Available STATSGO Forage Production Data—Oregon



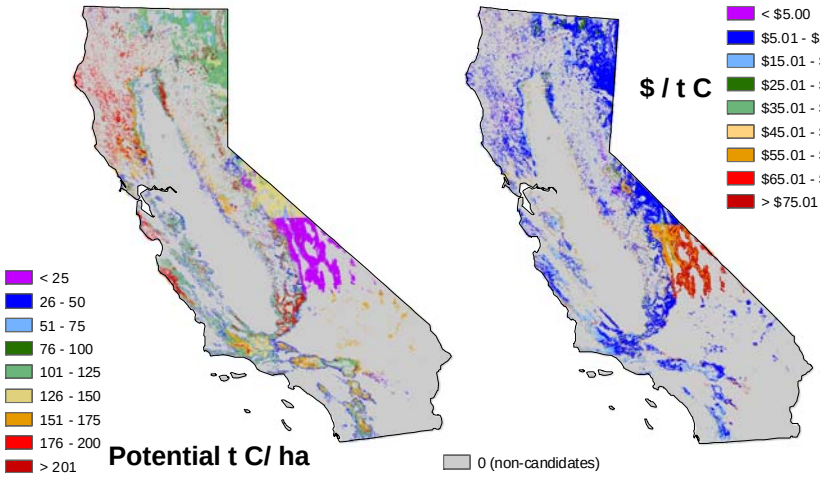

Afforestation cost
dollars/hectare ($/ha)
0 (or non-candidates*)
1 - 1,300
1,301 - 1,500
1,501 - 1,600
1,601 - 1,650
1,651 - 1,700
1,701 - 1,800
1,801 - 1,900
1,901 - 2,000
2,001 - 3,000
3,001 - 6,500
'candidates' = rangeland ecosystems
Carbon sequestration
t C/ha
0 (or non-candidates*)
1 - 25
26 - 50
51 - 100
101 - 150
151 - 200
201 - 300
301 - 400
401 - 500
501 - 600
* 'candidates' = suitable rangeland ecosystems
Opportunity Costs
+ 'Other Costs'
$\frac{(\$/ha)}{(tC/ha)} = \$/tC$
Carbon sequestration cost
dollars per ton C ($/t C)
0 (or non-candidates*)
1 - 5
6 - 10
11 - 15
16 - 20
21 - 35
36 - 50
51 - 75
> 76
Wi
N
westcarb.org
West Coast Regional Carbon Sequestration Partnership 11

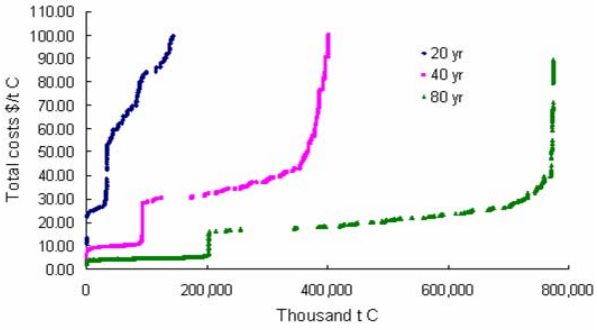

Oregon: Potential Sequestration and Cost after 40 Years from Rangeland Afforestation
$ / t C
< $5.00
$5.01 - $15.00
$15.01 - $25.00
$25.01 - $35.00
$35.01 - $45.00
$45.01 - $55.00
$55.01 - $65.00
$65.01 - $75.00
> $75.01
Potential t C/ ha
< 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 175
176 - 200
> 201
0 (non-candidates)
westcarb.org
West Coast Regional Carbon Sequestration Partnership 12

Potential Sequestration and Cost after 40 Years from Rangeland Afforestation for Washington

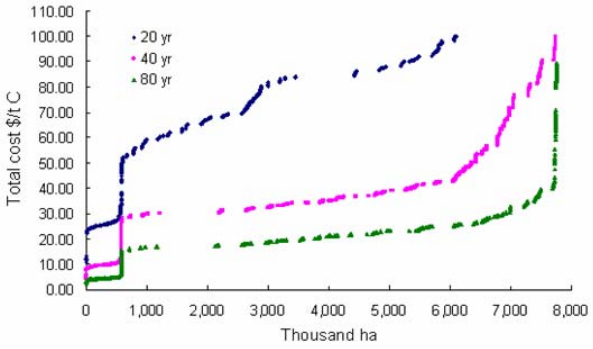


Potential Sequestration and Cost after 40 Years from Rangeland Afforestation for California





Oregon C-supply Curves



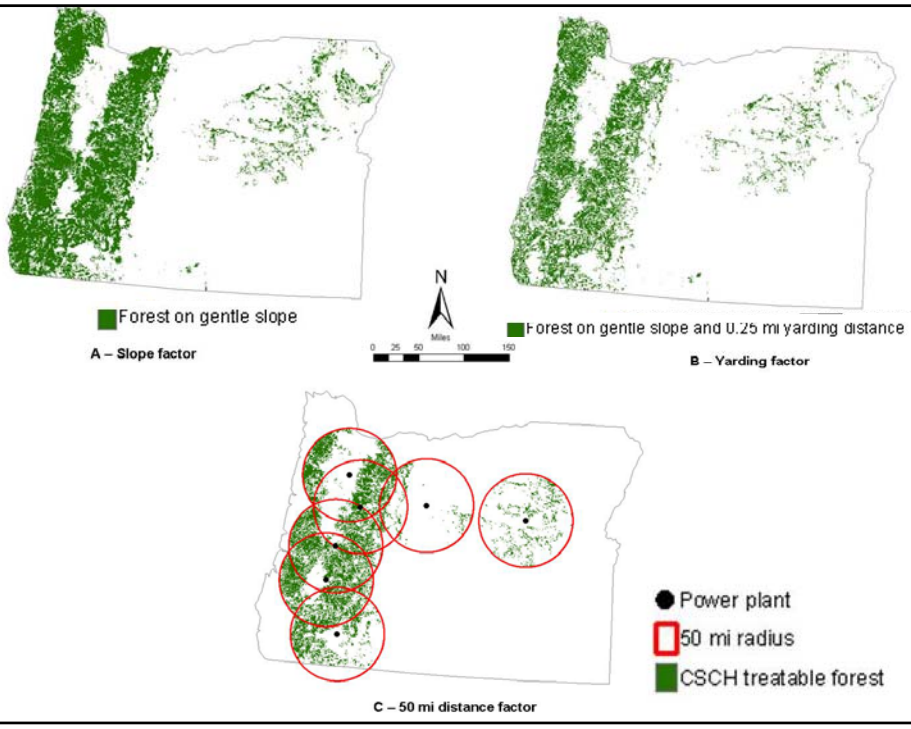
Forest Management Options to Increase Sequestration

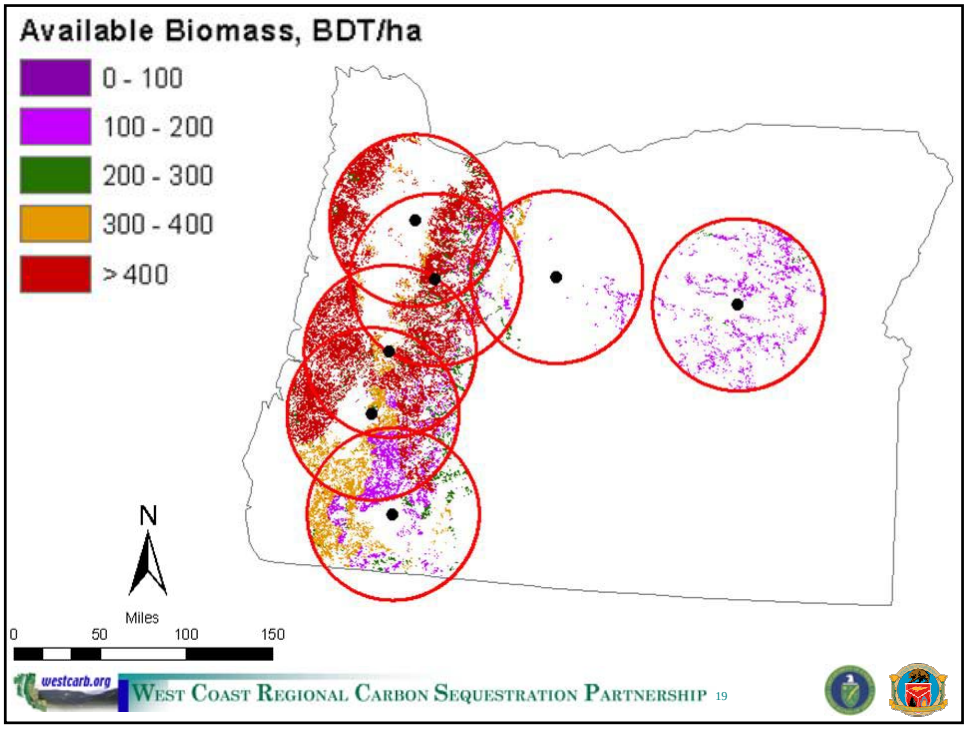
- Allow timber to age before harvest (i.e., lengthen rotation time)
  - On all ownership classes, all project durations, >$30/t CO_2
- Increase the riparian buffer zone by an additional 200 feet
  - Cost >$20/t CO_2 (CA), >$30/t CO_2 (OR and WA)
- Reduce forest fuel load to reduce risk of uncharacteristically severe fires, with subsequent use of biomass in power plants

Potential Sequestration Benefits from Improved Fire Management

Source: Dr. Sam Sandberg, USDA Forest Service Pacific Wildland Fire Sciences Laboratory

- Reduce net GHG emissions from combustion
- Reduce loss of carbon stocks from large trees
- Reduce loss of carbon stocks from duff
- Maintain carbon accumulation rates during recovery
- Avoid ecosystem-changing fires



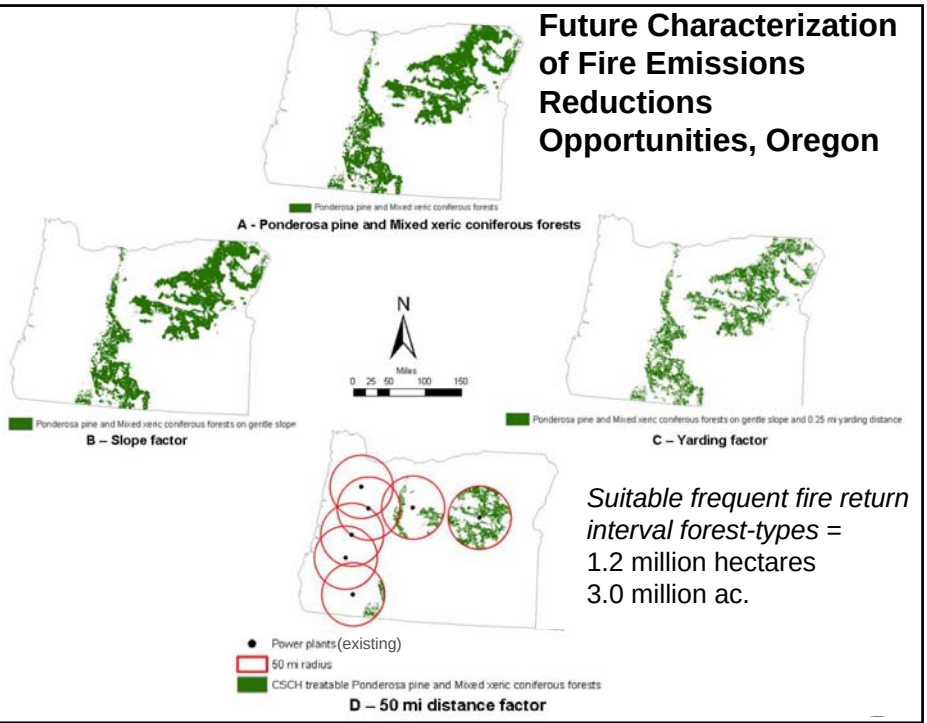


Emissions Reductions by Changing Fire Management

	California	Oregon	Washington
Treatable Area (million acres)	**2.2 (1.51)**	**6.47**	**5.76**
Biomass (millions tons carbon)	**81 (54)**	**413**	**376**
Emissions assuming 10% loss (million tons CO_2e)	**30 (19.8)**	**151.6**	**138.0**
Emissions assuming 70% loss (million tons CO_2e)	**208 (138.7)**	**1,061**	**969**

Potential reductions in emissions from fire estimated by looking at forest lands with moderate to high ***fuel load*** conditions on lands with <40% slope within 400 meters of existing roads and within 50 miles of biomass energy facility

Future Characterization of Fire Emissions Reductions Opportunities, Oregon



Suitable frequent fire return interval forest-types =
1.2 million hectares
3.0 million ac.

Conclusions

- Largest terrestrial sequestration opportunity in each state is afforestation
- Fire appears to be the most important management issue to address
- Further characterization needed
  - Fire
  - Fast-growing species
  - Riparian zone restoration
  - Baselines for conservation
  - Identify additional pilots for Washington and Arizona

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