



Role of Forest Ecosystems in Climate Change Mitigation and Adaptation

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Key Points

- Promote conservation of carbon storage in forests
- Natural disturbance (fire, insects) has small impact on forest carbon compared to intensive harvest
- Thinning does not reduce emissions and fire occurrence





Role of Forests:

More Carbon in Forests = Less Carbon in the Atmosphere

- **Old forests store up to ~10 times more carbon per unit ground area than young forests**
- **Old forests store carbon for hundreds of years**
- **Low hanging fruit: Allow existing forests to continue to store and accumulate carbon**

Old (>200)



Young (0<80)



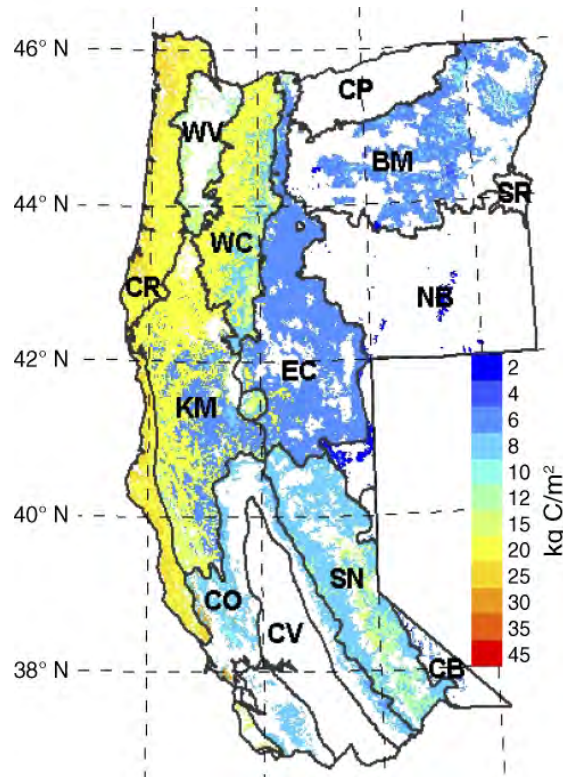


Regional Potential to Store More Biomass Carbon

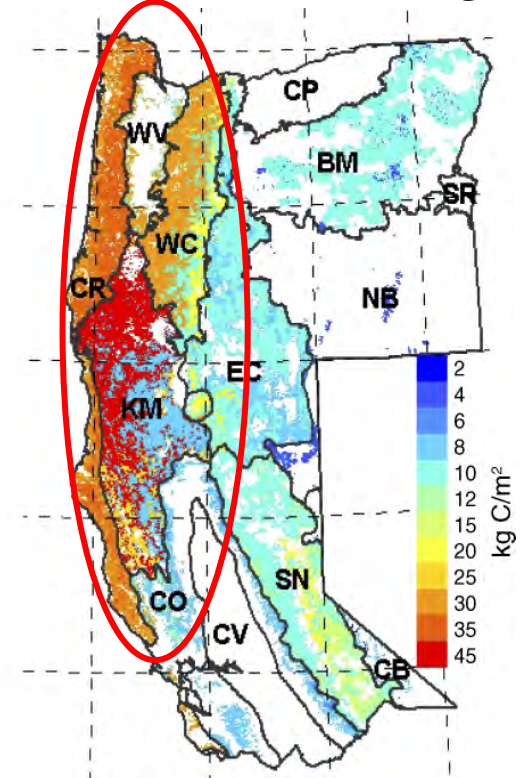
- Mesic temperate forests in PNW among highest biomass in the world
- Centuries to make up for carbon lost



Current 3.2 Pg C



Potential 5.9 Pg C





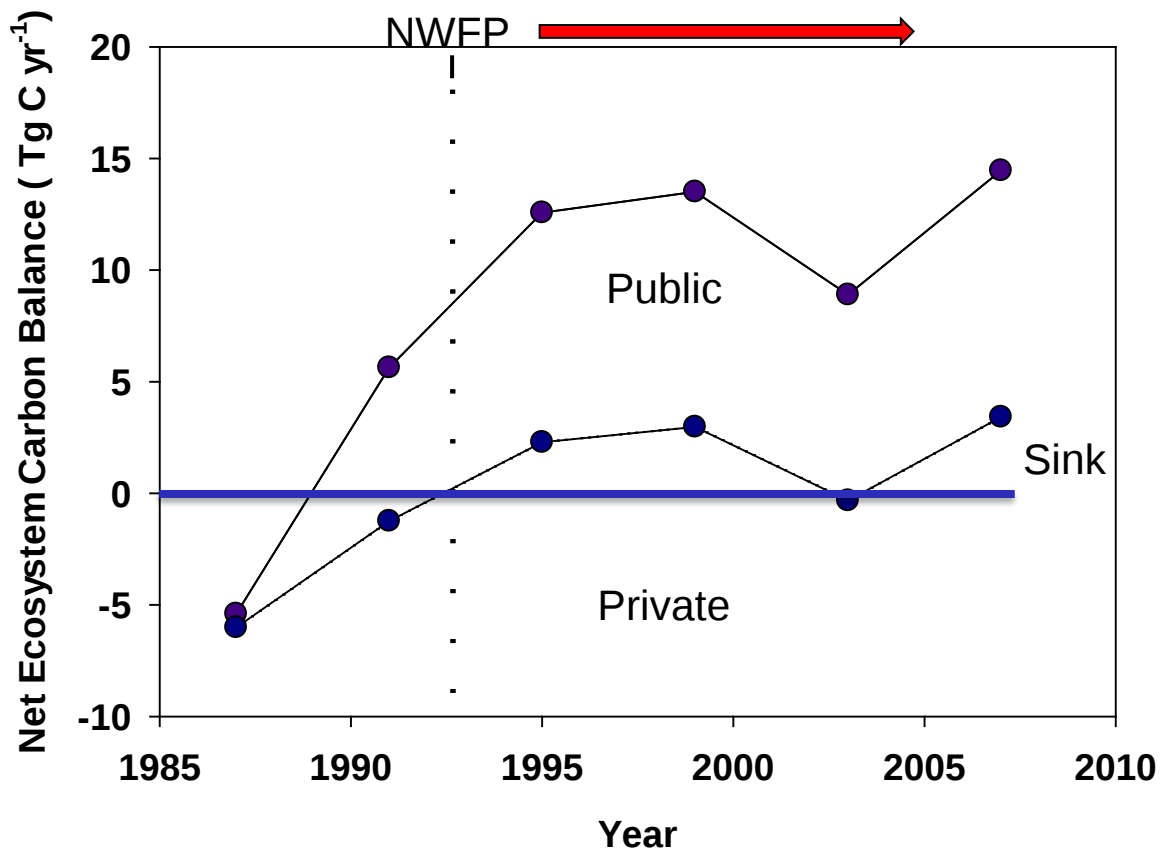
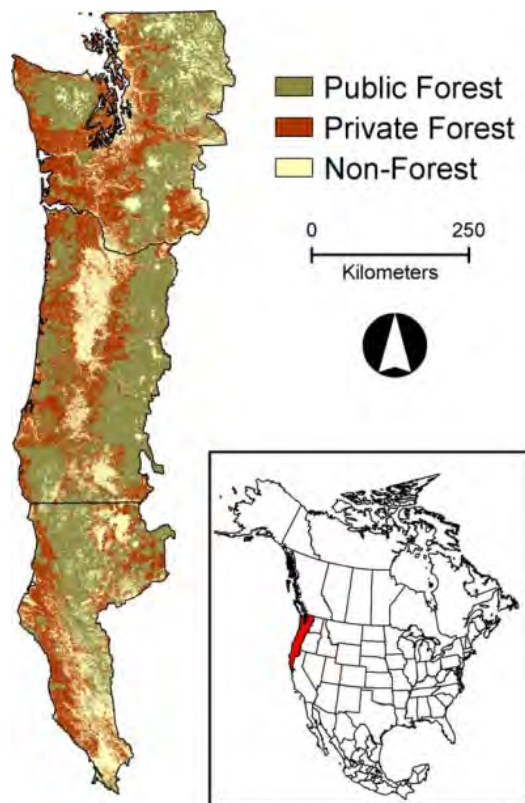
Potential for Reforestation, Regrowth Improve Connectivity for Migration





Decreasing Harvest Intensity Increases Carbon Sequestration: NW Forest Plan

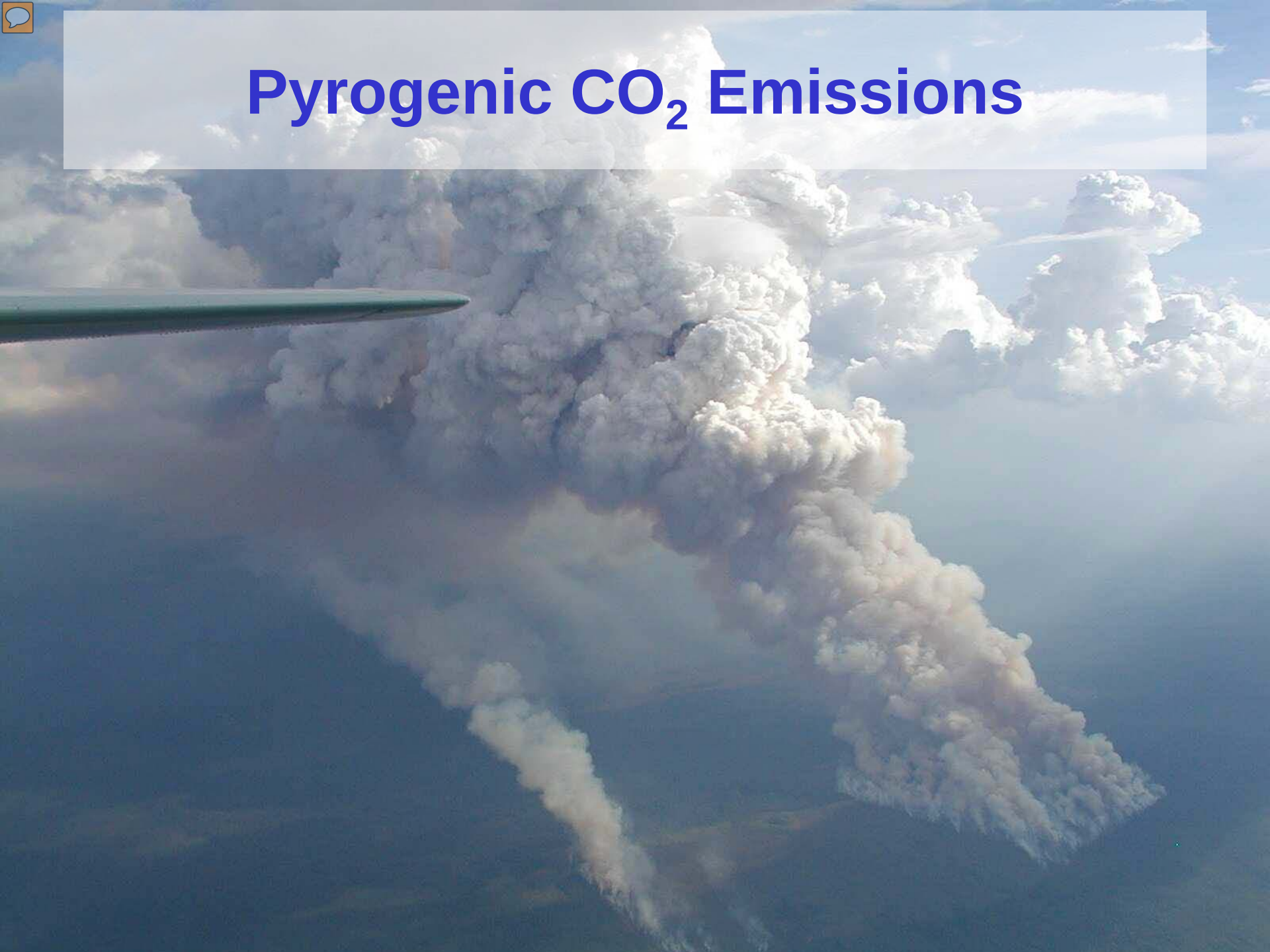
- Public lands were source of carbon before NWFP, changed to a sink in the decades after ~80% reduction harvest rate



Source: Turner et al. 2011, Law et al. 2013



Pyrogenic CO₂ Emissions



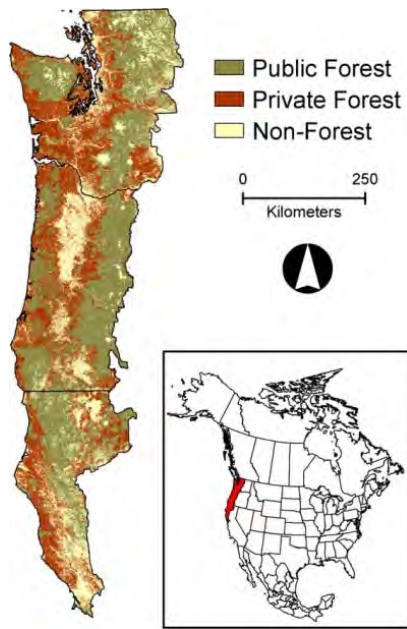


Fire has Small Effect on Forest Carbon Compared to Intensive Harvest

- Decomposition after fire takes decades to centuries
- ~Half of fire-produced carbon in soil remains ~90 yrs, other half >1000 yrs
- If fire doesn't significantly reduce carbon stored in forests, it isn't going to materially worsen climate change

Harvest Removals

Fire
Emissions

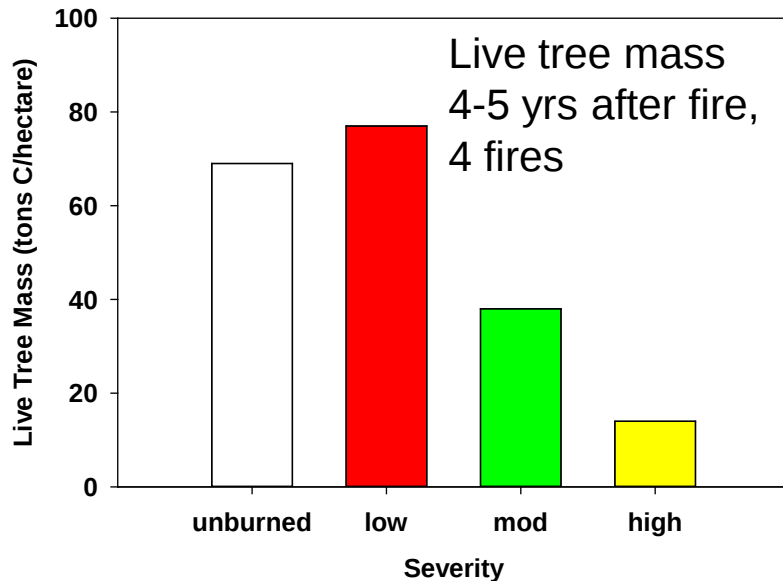


Removals: 17
Removals: 351

**1985-2007 cumulative effects on
forest carbon in NWFP area**

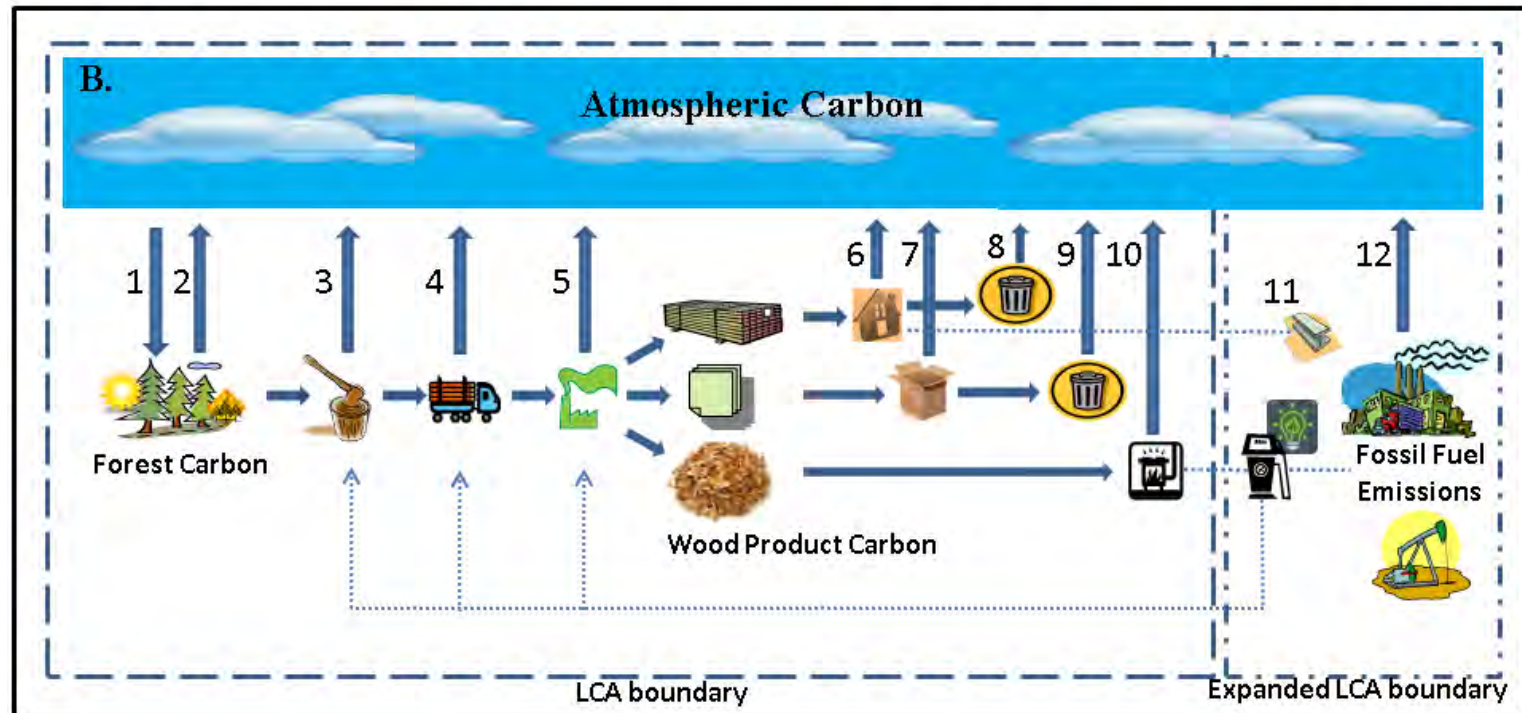
Source: Turner et al. 2011

Survivors are Still Productive – C Sequestration & Seed Source



- **~50 to 75% of live biomass survives moderate + low severity fire which accounts for 80% of burn area in PNW**
- **Removing surviving trees will reduce carbon storage, and in many cases sequestration and regeneration**

Full Life Cycle Assessment to Account for Carbon Losses

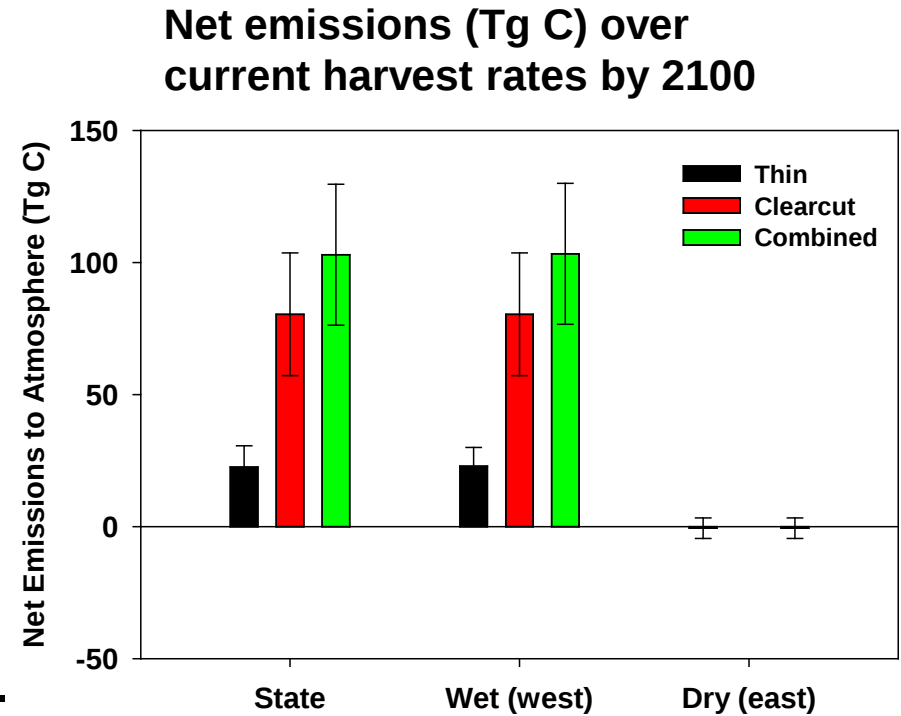


- Changes in carbon on land
- Emissions associated with harvest, production, transport, usage of wood
- Substitution and displacement of fossil fuel emissions associated with extraction and use



Regional Analysis: Effects of Harvest Strategies, Future Climate, CO₂

- Over next 20 yrs, thinning forests of WA, OR, CA for crown fire risk reduction & bioenergy production increases net C emissions
- By 2100, enhanced productivity from CO₂ fertilization & warming overshadows increased fire emissions at current harvest rates
- Harvest strategies lead to long-term increased C emissions, semi-arid region contributes little



Earth System Modeling, inventories,
Life Cycle Assessment



Repeated Thinning for Bioenergy Production Can Impact Soil Fertility

- Shorter rotations (30-50 yr) increase nutrient removal, decrease productivity
- Residue removal increases soil nitrogen losses
- Depleted soil fertility would require fertilization, which increases GHG emissions (N_2O)





Thinning Does Not Necessarily Reduce Fire Occurrence



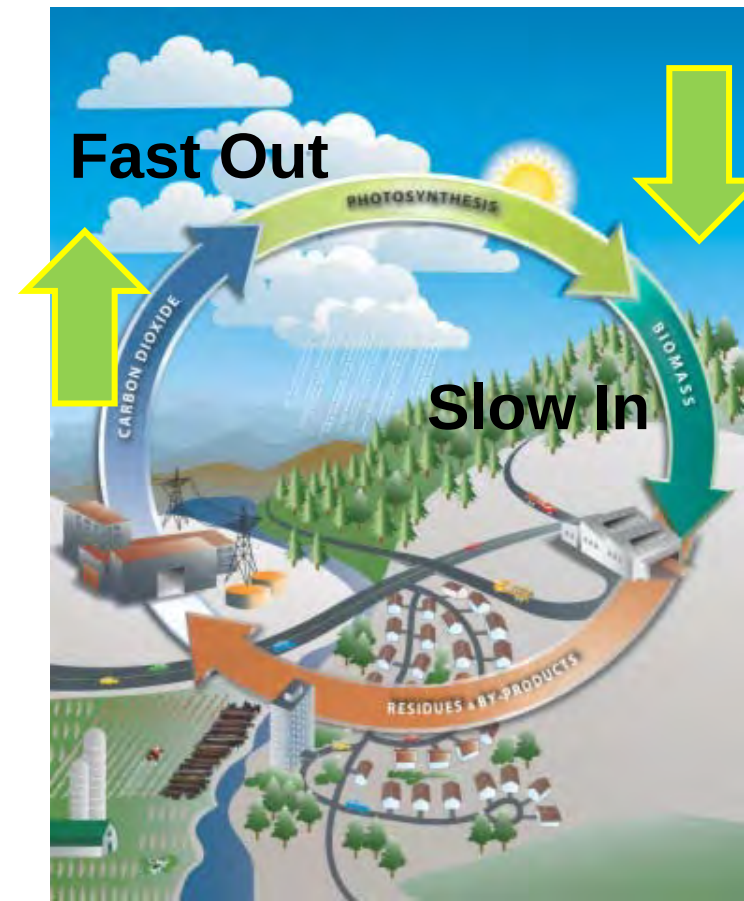
- **Fuel treatments may do little to mitigate fire spread or severity in extreme weather conditions (drought, high winds)**
- **Removal of small diameter trees can reduce crown fire hazard, reduce severity (if treated within 10-20 yrs of fire)**



Slow In, Fast Out – Opportunity Cost



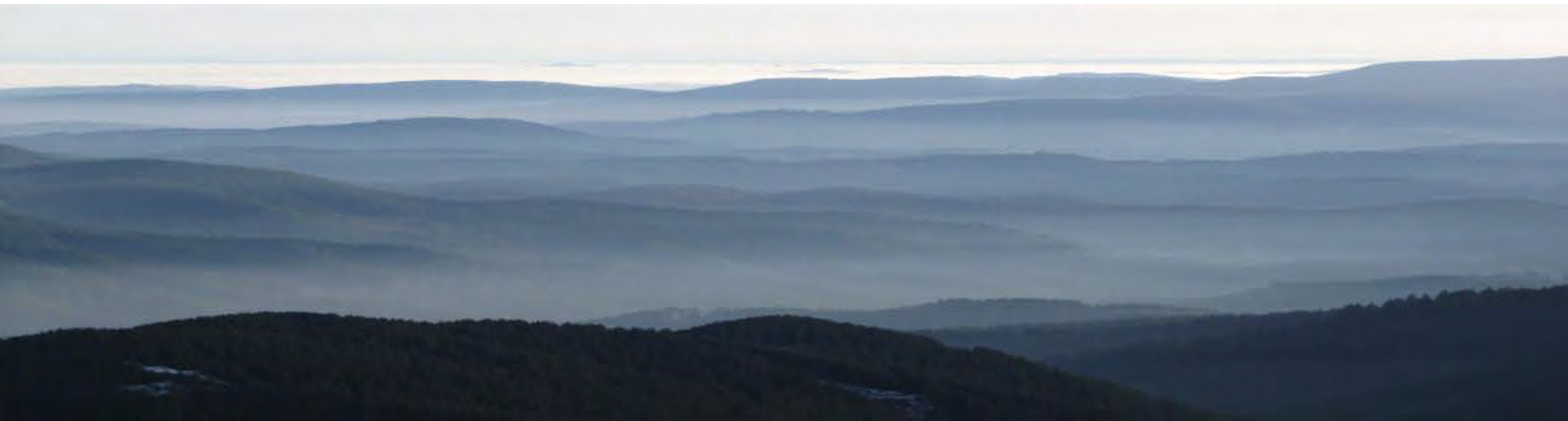
- Today's harvest took decades to centuries to accumulate
- Returns to atmosphere quickly via bioenergy use
- Increased GHG emissions mostly due to:
 - Consumption of current forest carbon
 - Long-term reduction of C stock





Summary

- **Activities that promote conservation of carbon storage in forests**
 - allowing existing forests to accumulate carbon
 - forestation of lands that once carried forests
- **Natural disturbance has small impact on forest carbon stores compared to intensive harvest regime**
- **Full accounting shows thinning results in increased carbon emissions to the atmosphere for at least many decades**



Extras

Fossil Fuel Displacement

Assumption behind expected GHG benefits of bioenergy:

- **A unit of energy supplied by bioenergy takes the place of a unit of energy supplied by fossil fuel sources**

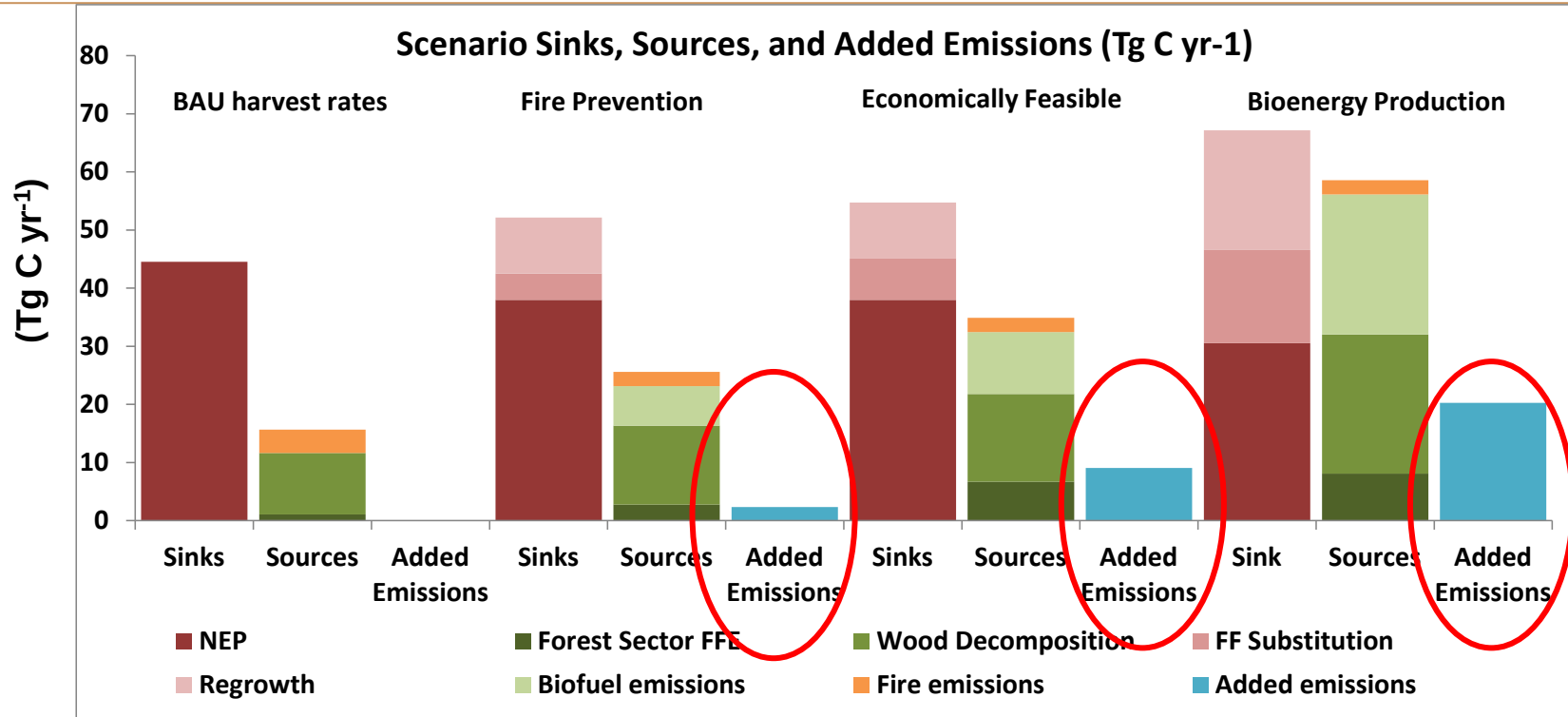
Finding: Not true.

- **Non-hydro renewables do not displace, and may do the opposite**
- **Per unit of energy, the amount of CO₂ released from biomass combustion is ~ as high as coal and substantially larger than oil, natural gas**



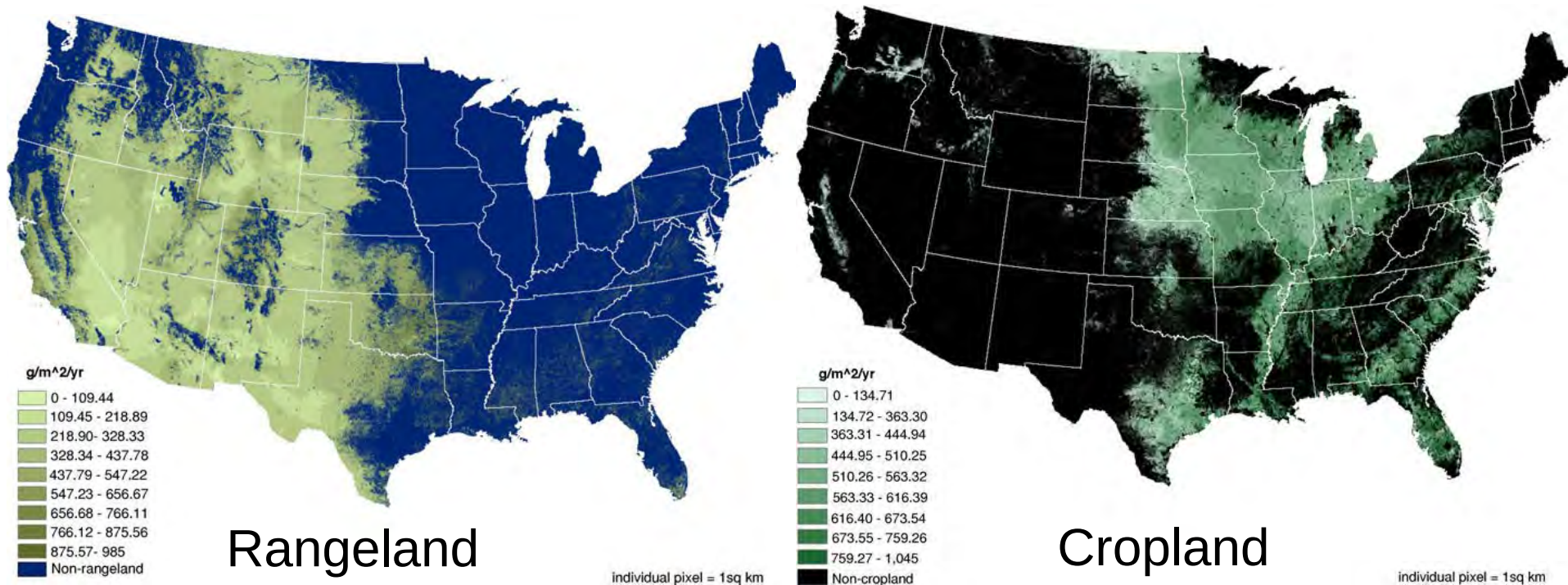


PNW Region: None of Harvest Scenarios Reduce GHG Emissions



- Regional analysis of PNW forests, observation-based
- 20 year timeframe, three harvest scenarios
- Increase emissions relative to BAU harvest rates

Potential Forestation Carbon Gains



Forestation of 25% of relatively low-production crop or rangeland has capacity to offset ~20% of annual fossil fuel emissions