Inland West Carbon Accounting: fire, climate, product substitution, & policy are all important

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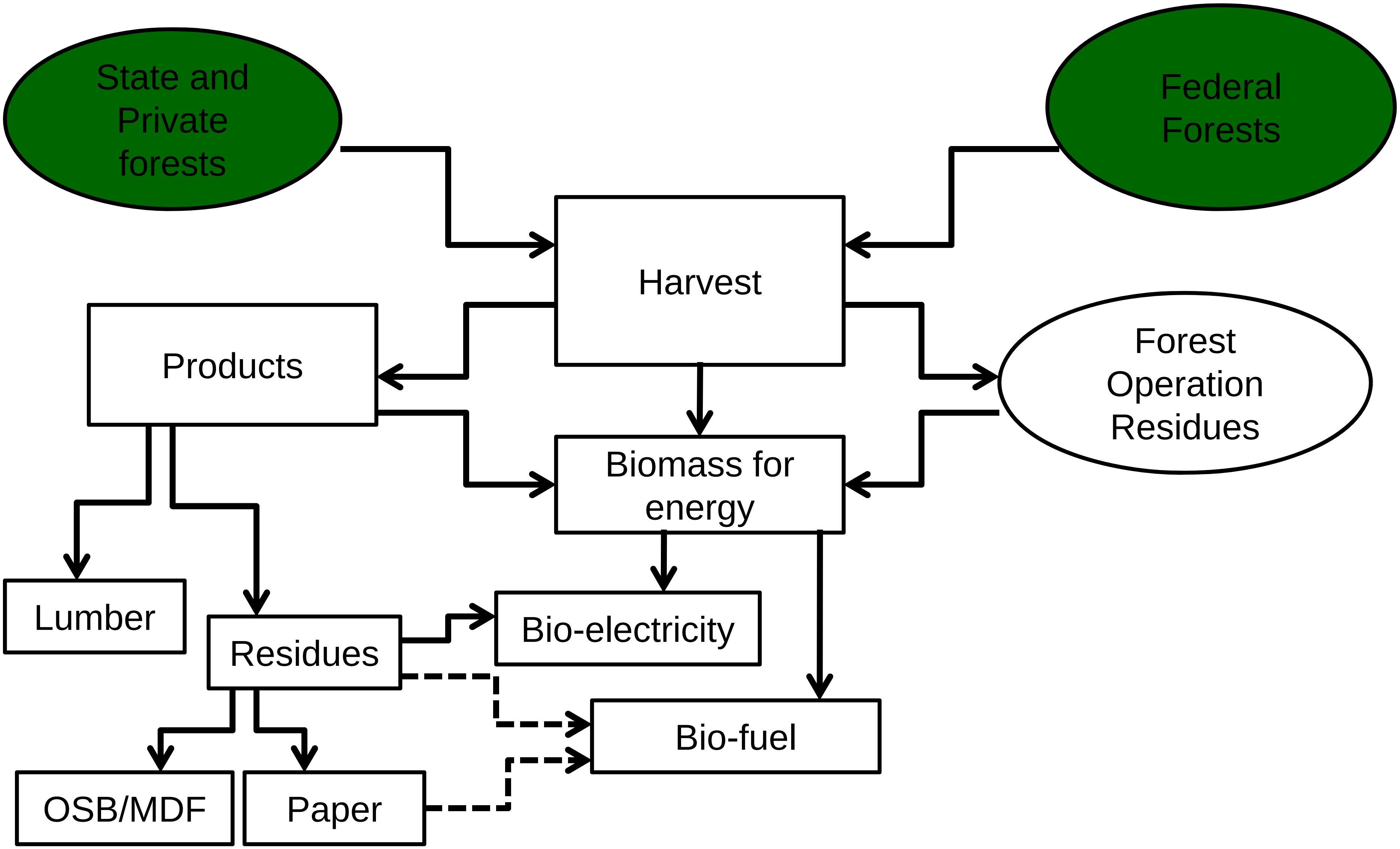
CORRIM

Consortium for Research on Renewable Industrial Materials
A non-profit corporation formed by 15 research institutions to conduct cradle to grave environmental studies of wood products

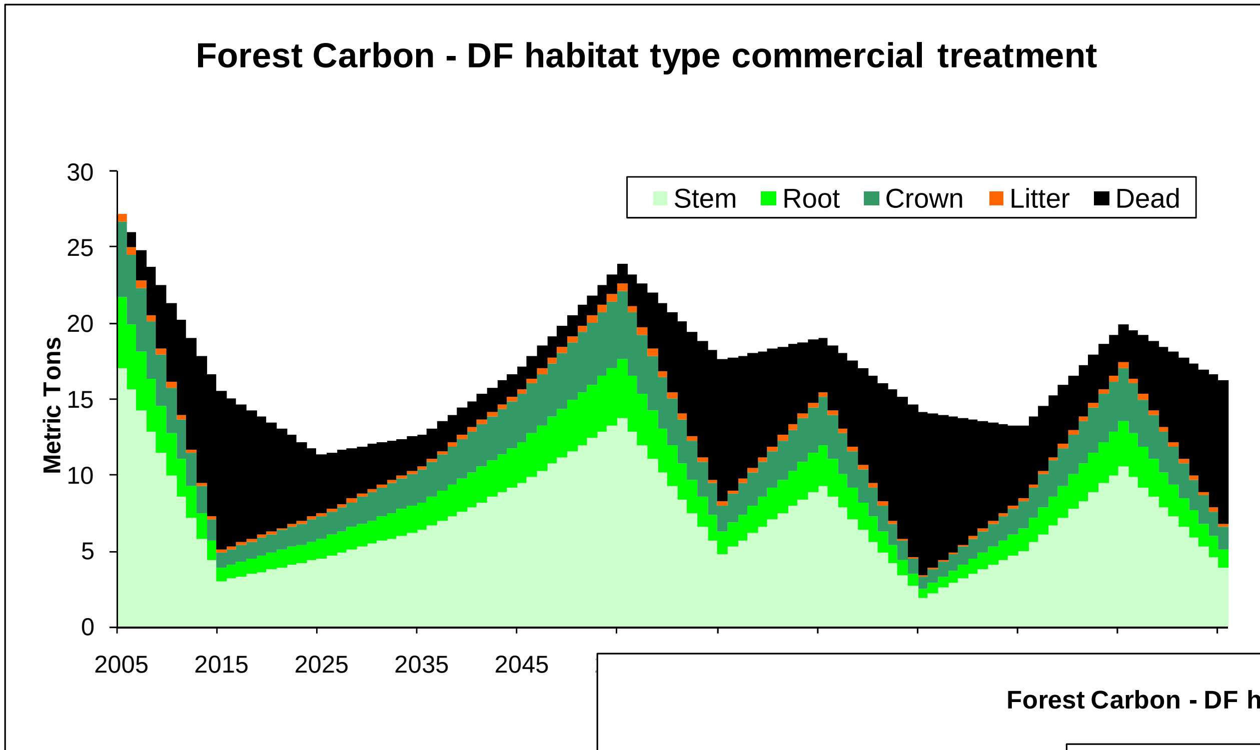
Objective

- Conduct a life cycle assessment (LCA) of wood products of the Inland West supply region including a life cycle inventory (LCI) for forest harvest, regeneration and growth.
- Use methods developed by CORRIM to link forest carbon, processing emissions, product storage and substitution for fossil intensive products for the supply region

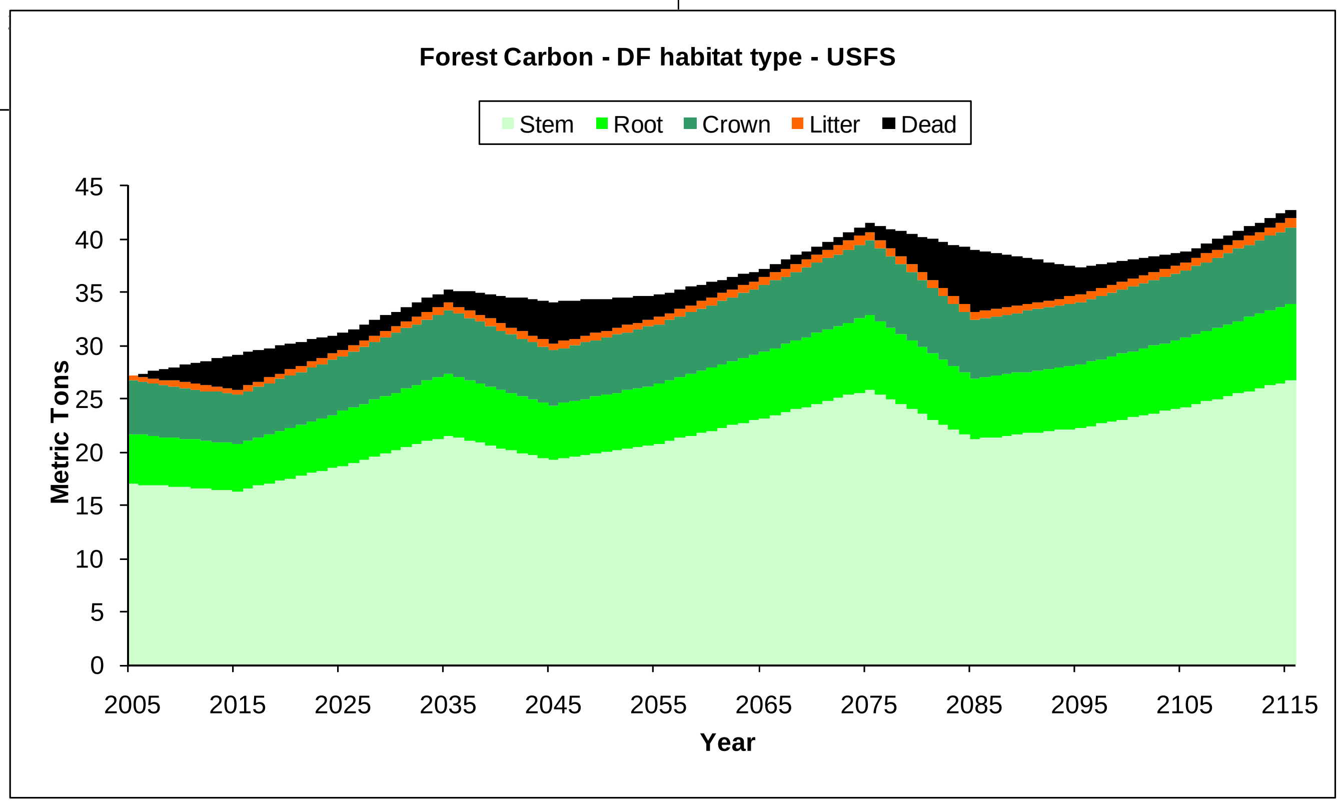

State and Private forests
Federal Forests
Harvest
Products
Forest Operation Residues
Biomass for energy
Lumber
Residues
Bio-electricity
Bio-fuel
OSB/MDF
Paper

Forest Carbon

- ✓ Categorize the forest by habitat type (site quality), forest type, owner group, and management regime and identify representative forest stands from inventory covering WA, OR, MT, ID weighted by area of each habitat type
- ✓ Estimate tree growth and its allocation to carbon pools (roots, stem, crown, litter, dead wood) using the landscape management system and the FVS growth model.
- ✓ Measuring carbon (stock) for each process linked by time & interacting with other processes (forest growth, management, harvest, decomposition)

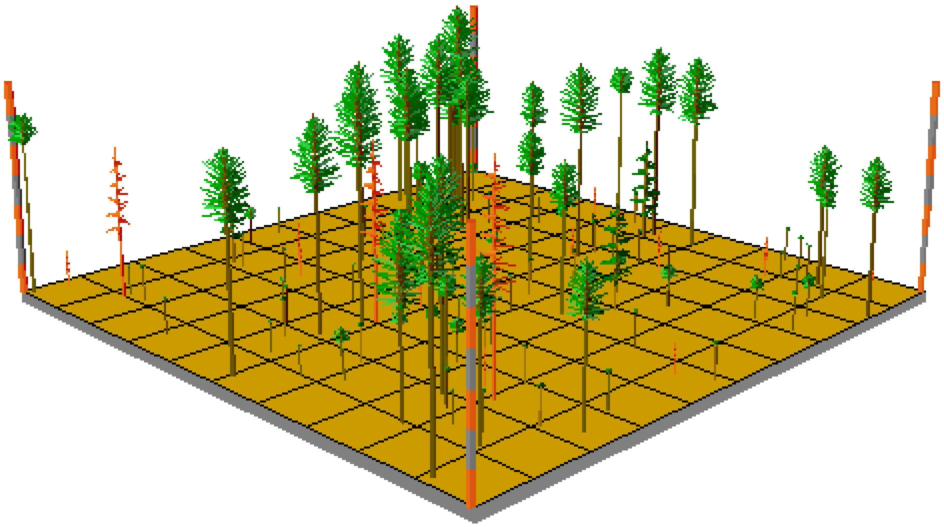


Average 17 MT/ac of Carbon over the 110 years

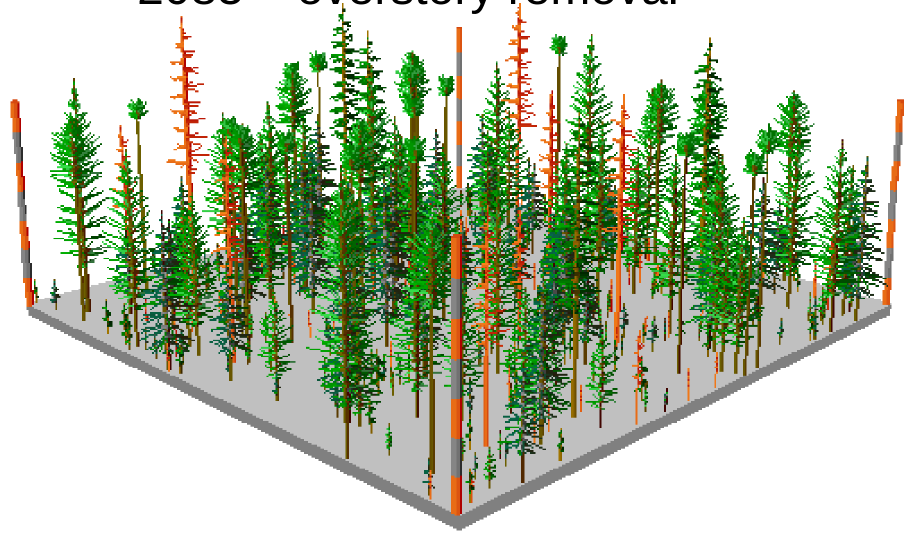


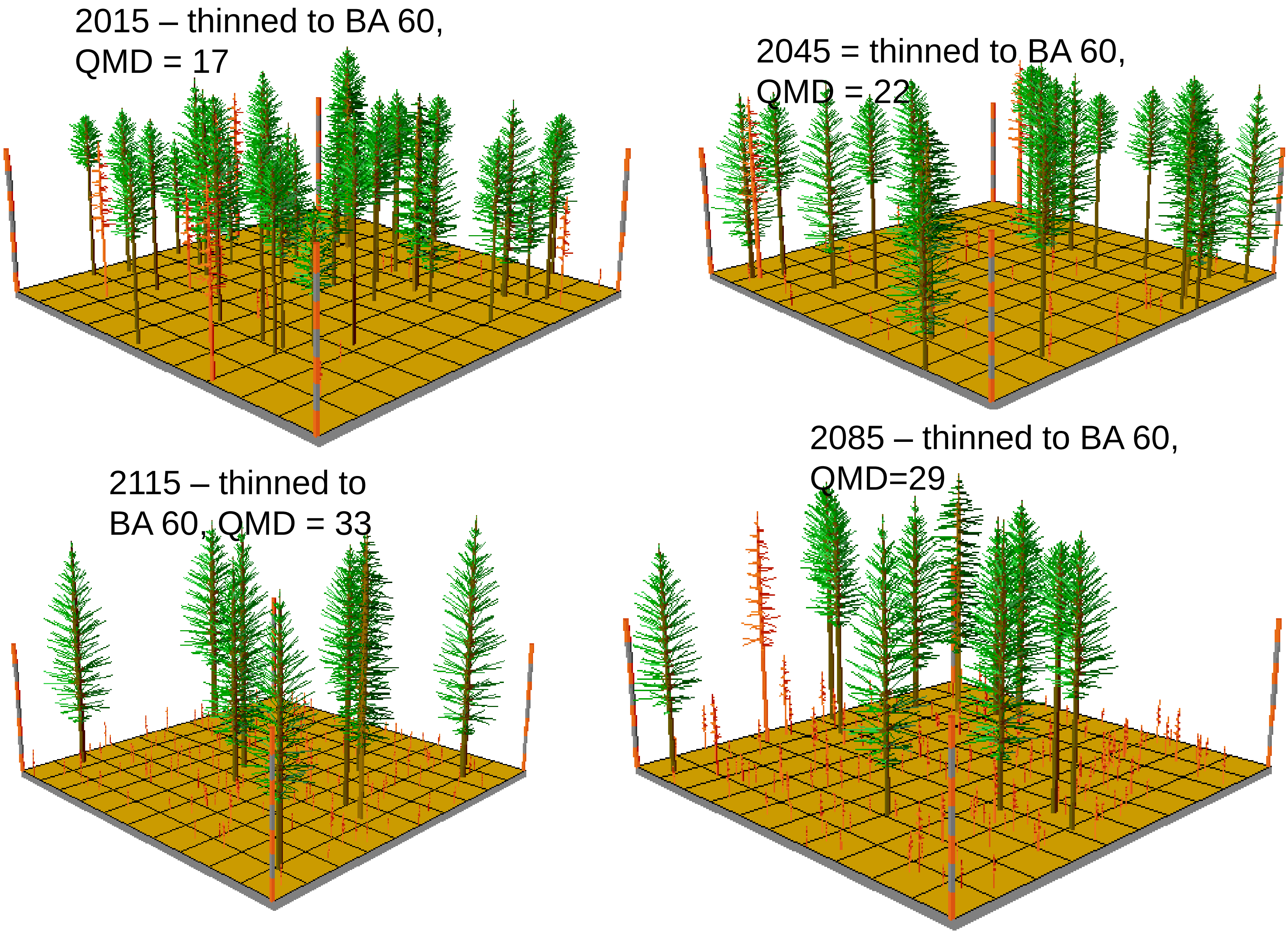
Average 36 MT/ac of Carbon over the 110 years

2015 with commercial harvest



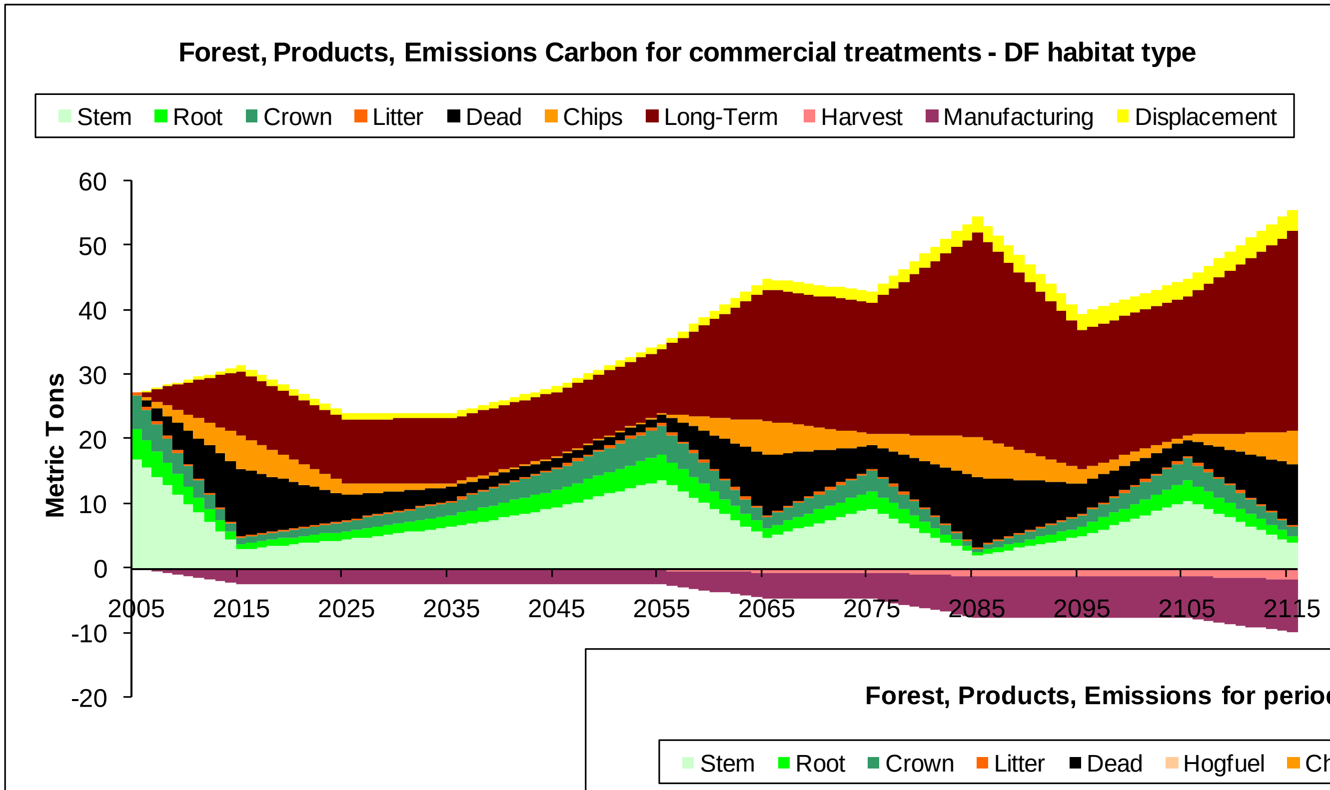
2085 – overstory removal




2015 – thinned to BA 60,
QMD = 17
2045 = thinned to BA 60,
QMD = 22
2085 – thinned to BA 60,
QMD=29
2115 – thinned to
BA 60, QMD = 33

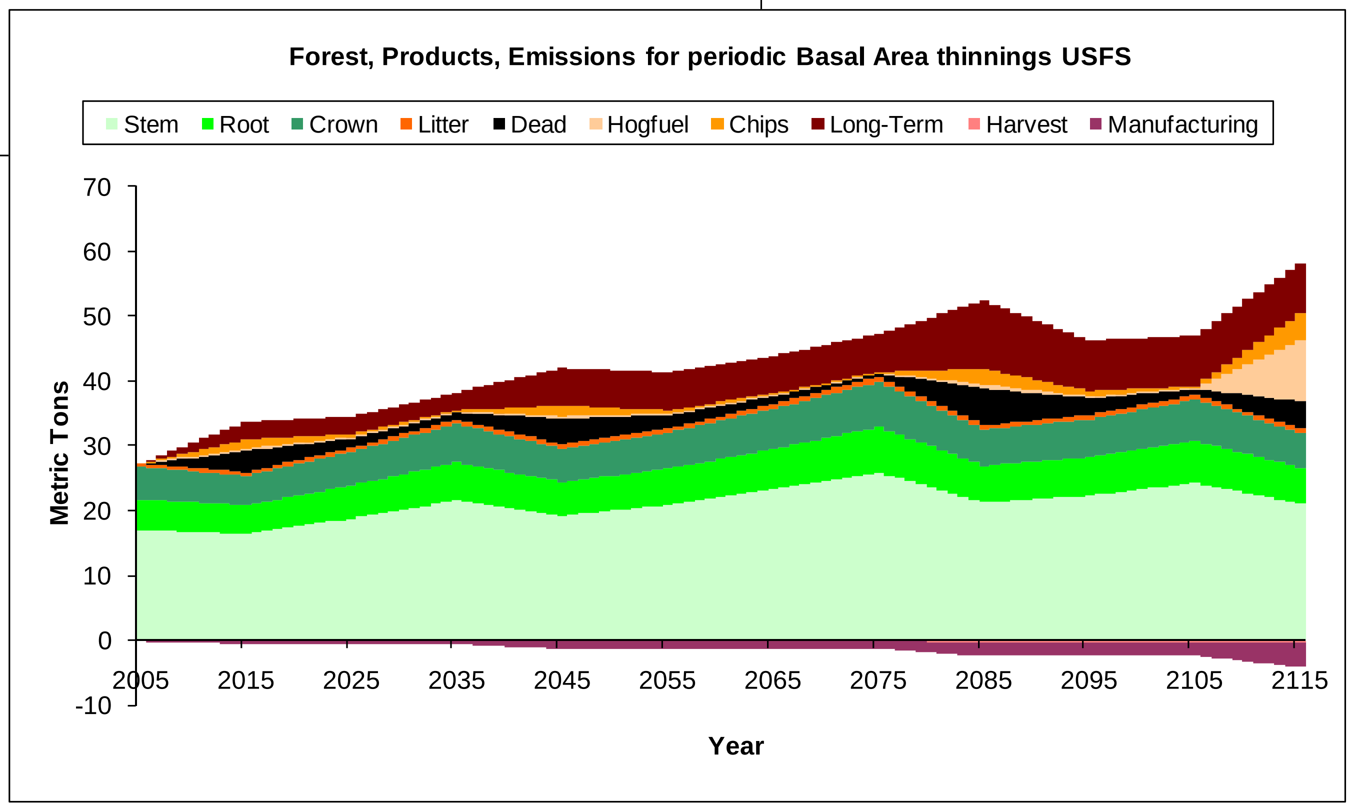
Products

- ✓ The distribution of harvested log volume (& carbon) into short and long lived products
- ✓ The energy & emissions from management, log, haul & producing lumber (or other products)



Average 15 MT/ac of Carbon over the 110 years in product pools net of energy

Average 5 MT/ac of Carbon over the 110 years in product pools net of energy

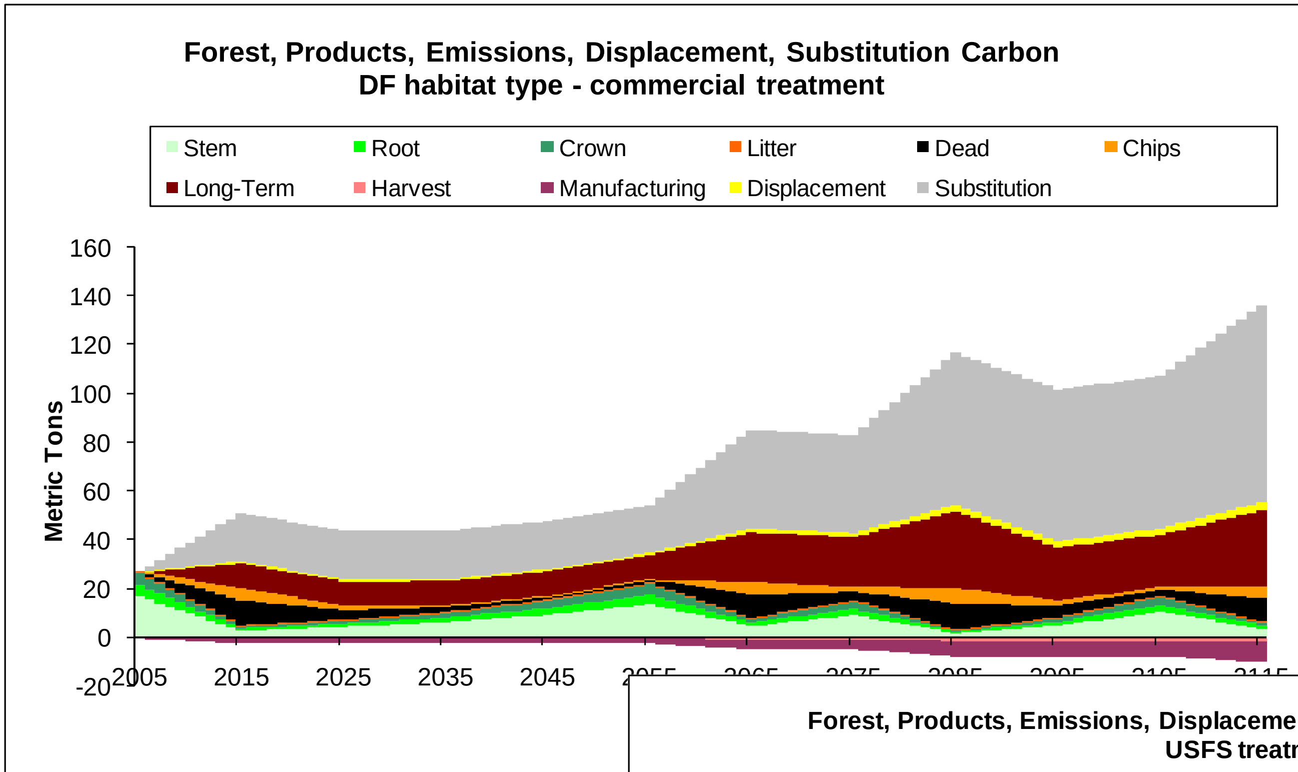


Displacement of fuels

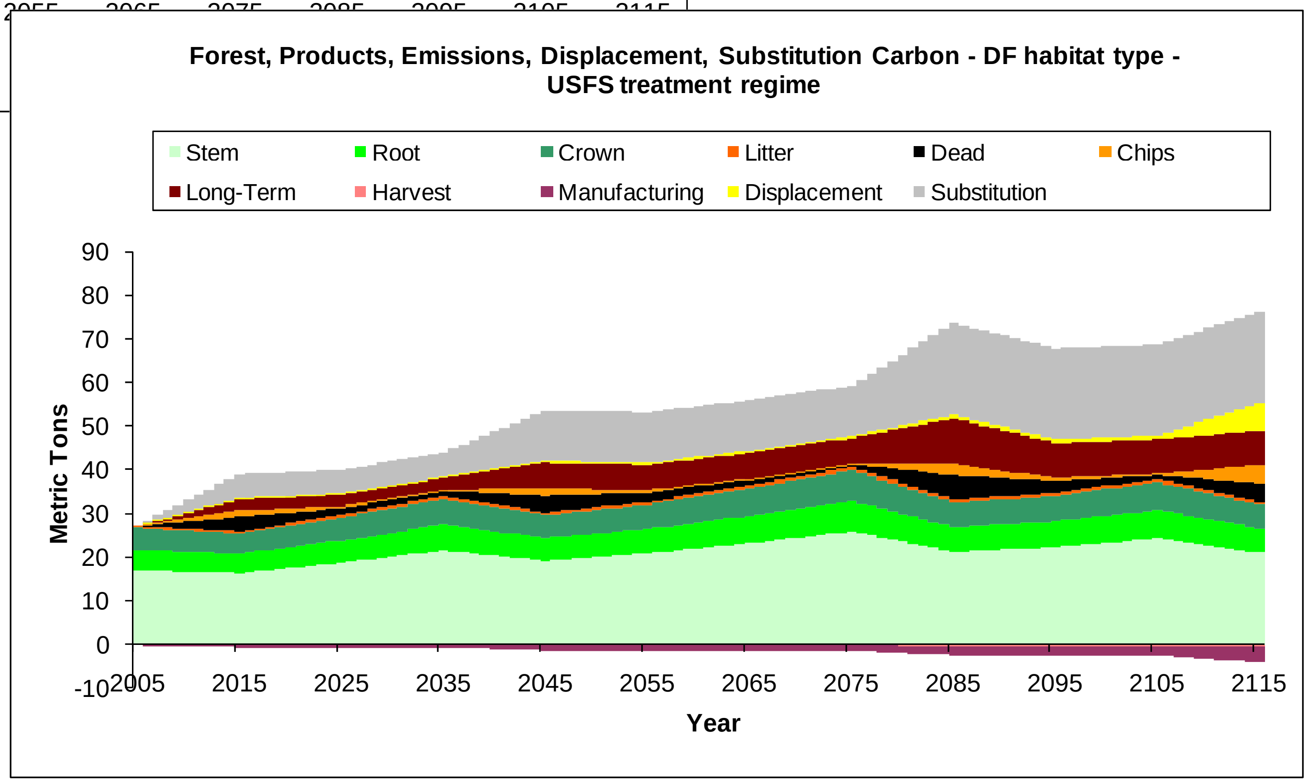
- The use of renewal biofuels (carbon neutral) to displace fossil fuel emissions in product manufacturing

Substitution of products

- Using a wood product that replaces a non-wood product (or any product mix) identifying the carbon store or emissions offset



Average 70 MT/ac of Carbon over the 110 years in all pools



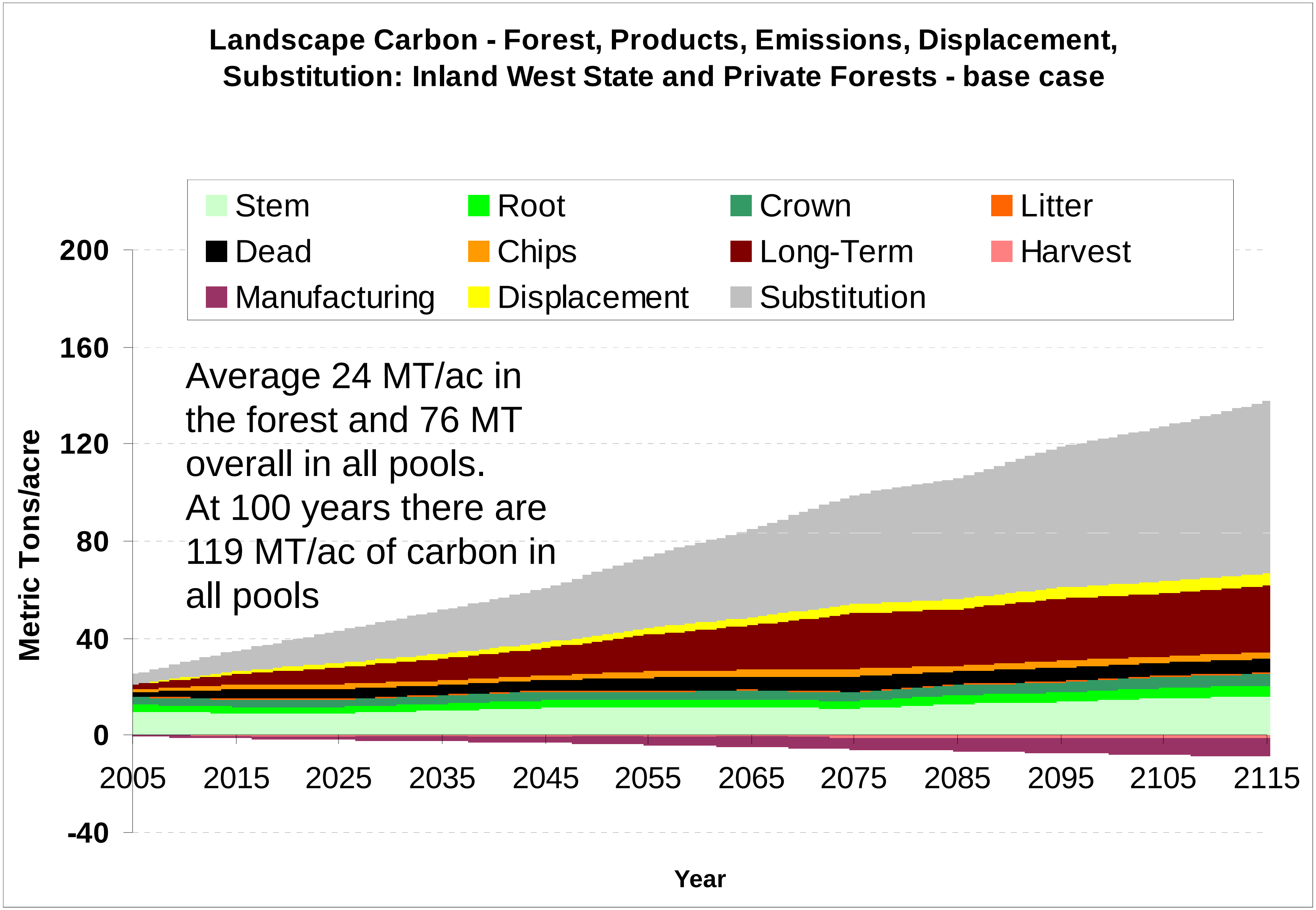
Average 53MT/ac of Carbon over the 110 years in all pools

Single Acre Example Summary

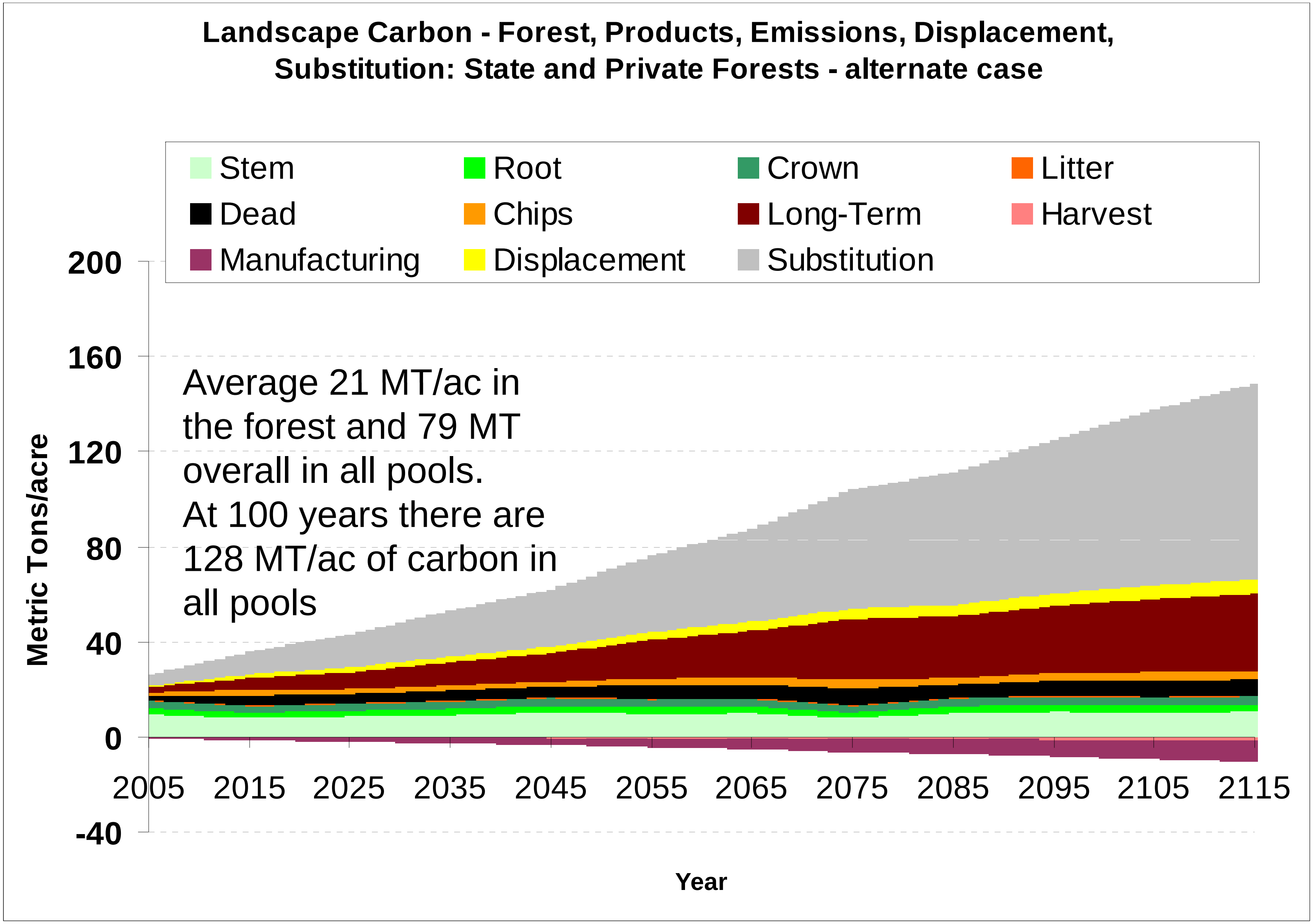
- after 100 years there are 33 more MT/ac under commercial management than under a strategy aimed at thinning from below to a basal area target designed to create historic stocking conditions or 2.7 MT less than the average standing carbon in the federal forest for the 110 year period.

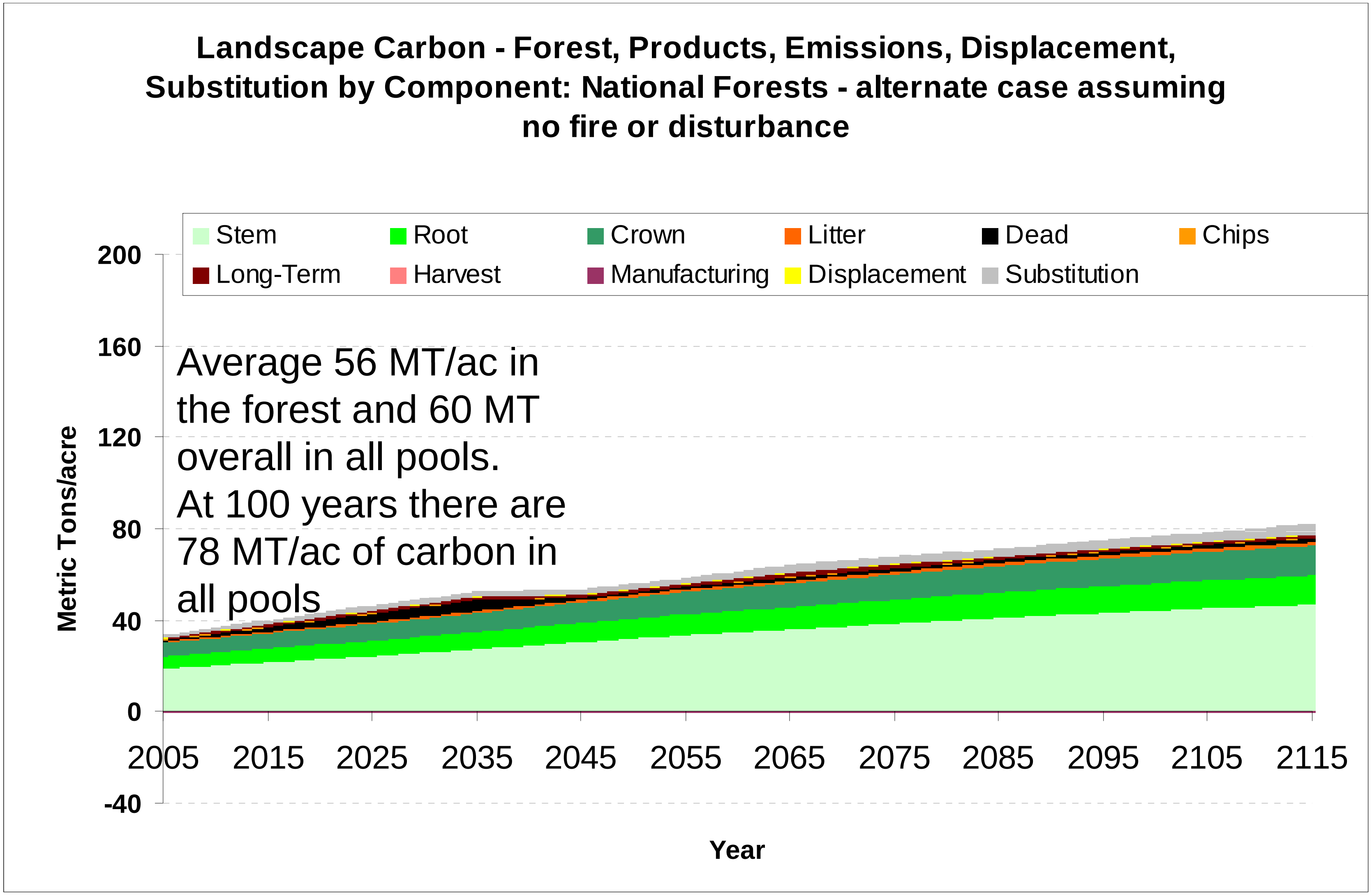
Single Acre to Landscape Level

- Average acre by owner group assuming current harvest rates are maintained and the profile of forest types that are treated remains the same

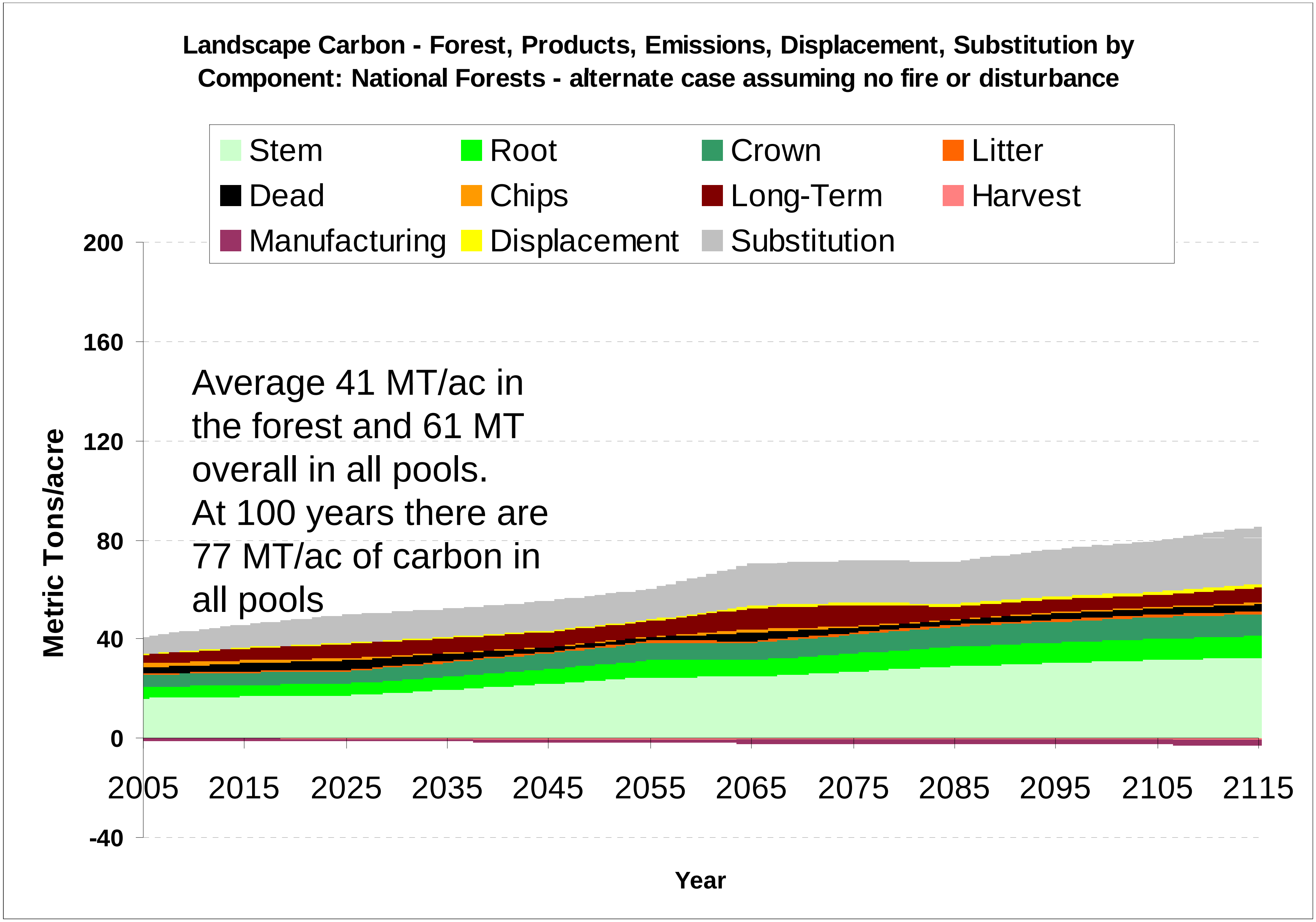


Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution: Inland West State and Private Forests - base case
Stem
Root
Crown
Litter
Dead
Chips
Long-Term
Harvest
Manufacturing
Displacement
Substitution
Average 24 MT/ac in the forest and 76 MT overall in all pools.
At 100 years there are 119 MT/ac of carbon in all pools
Metric Tons/acre
200
160
120
80
40
0
-40
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
2105
2115
Year

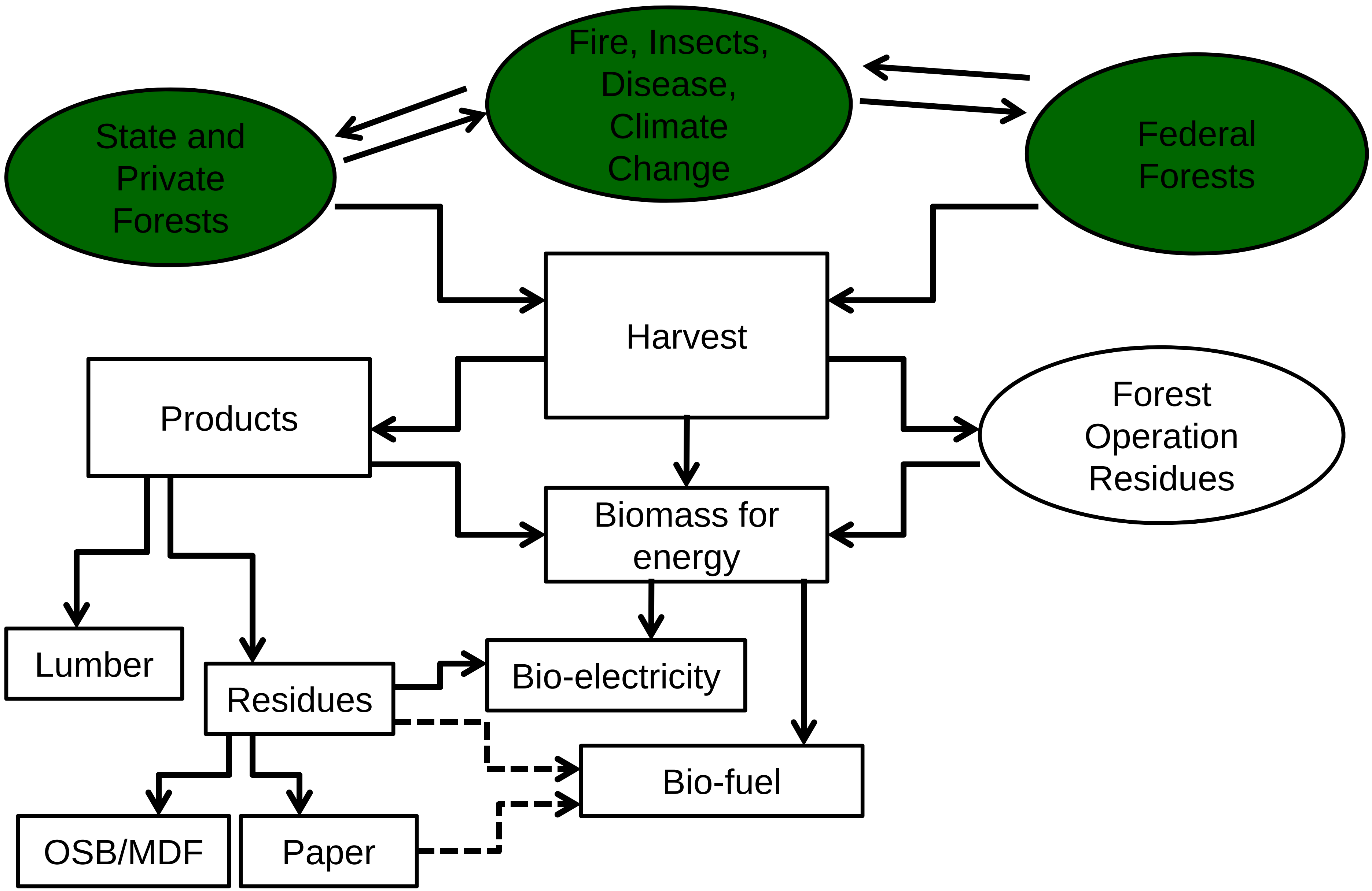

Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution: State and Private Forests - alternate case
Stem
Root
Crown
Litter
Dead
Chips
Long-Term
Harvest
Manufacturing
Displacement
Substitution
Average 21 MT/ac in the forest and 79 MT overall in all pools.
At 100 years there are 128 MT/ac of carbon in all pools
Metric Tons/acre
200
160
120
80
40
0
-40
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
2105
2115
Year



Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution by Component: National Forests - alternate case assuming no fire or disturbance
Stem
Root
Crown
Litter
Dead
Chips
Long-Term
Harvest
Manufacturing
Displacement
Substitution
Average 56 MT/ac in the forest and 60 MT overall in all pools.
At 100 years there are 78 MT/ac of carbon in all pools
Metric Tons/acre
200
160
120
80
40
0
-40
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
2105
2115
Year



Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution by Component: National Forests - alternate case assuming no fire or disturbance
Stem
Root
Crown
Litter
Dead
Chips
Long-Term
Harvest
Manufacturing
Displacement
Substitution
Average 41 MT/ac in the forest and 61 MT overall in all pools.
At 100 years there are 77 MT/ac of carbon in all pools
Metric Tons/acre
200
160
120
80
40
0
-40
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
2105
2115
Year



Fire, Insects, Disease, Climate Change
State and Private Forests
Federal Forests
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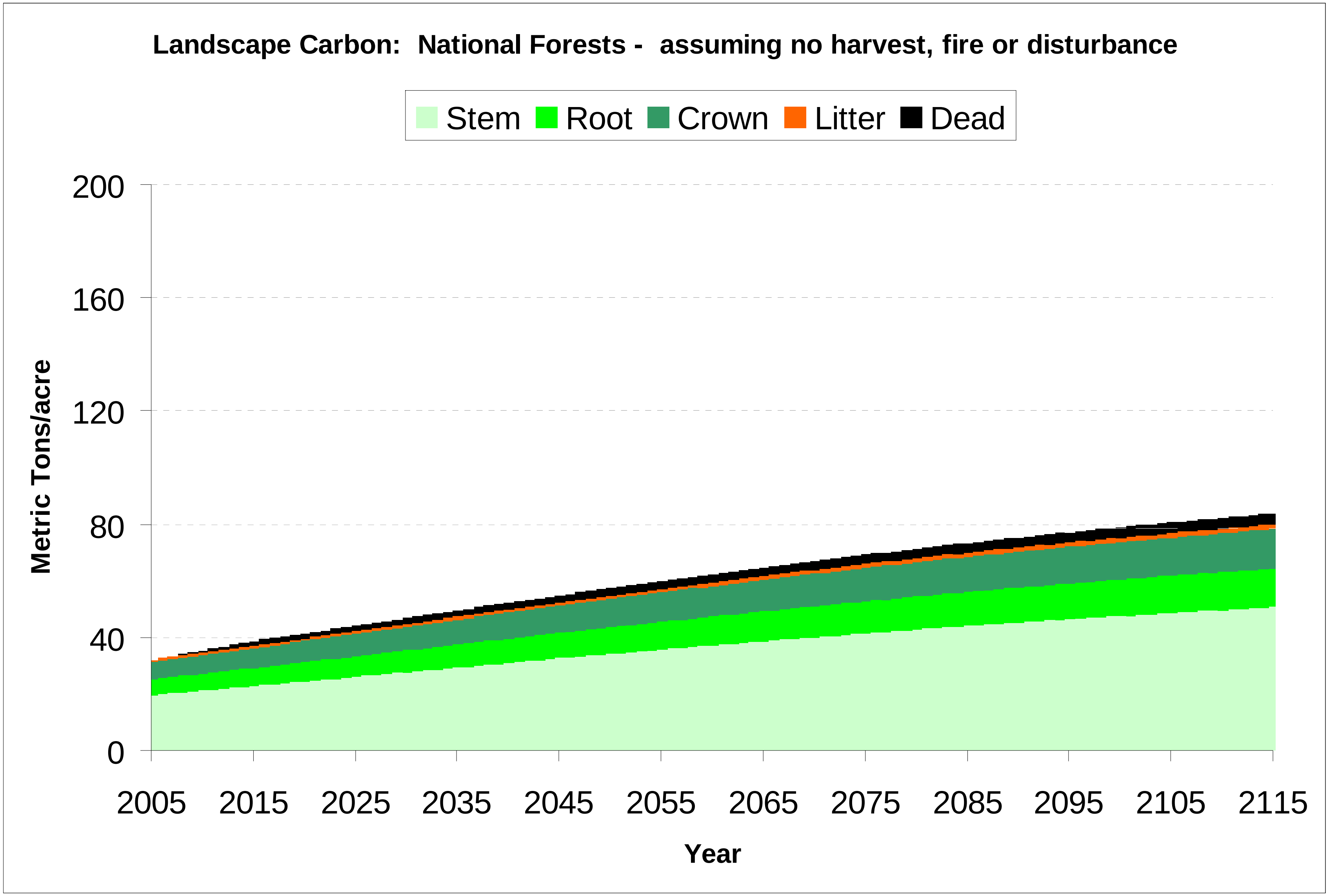
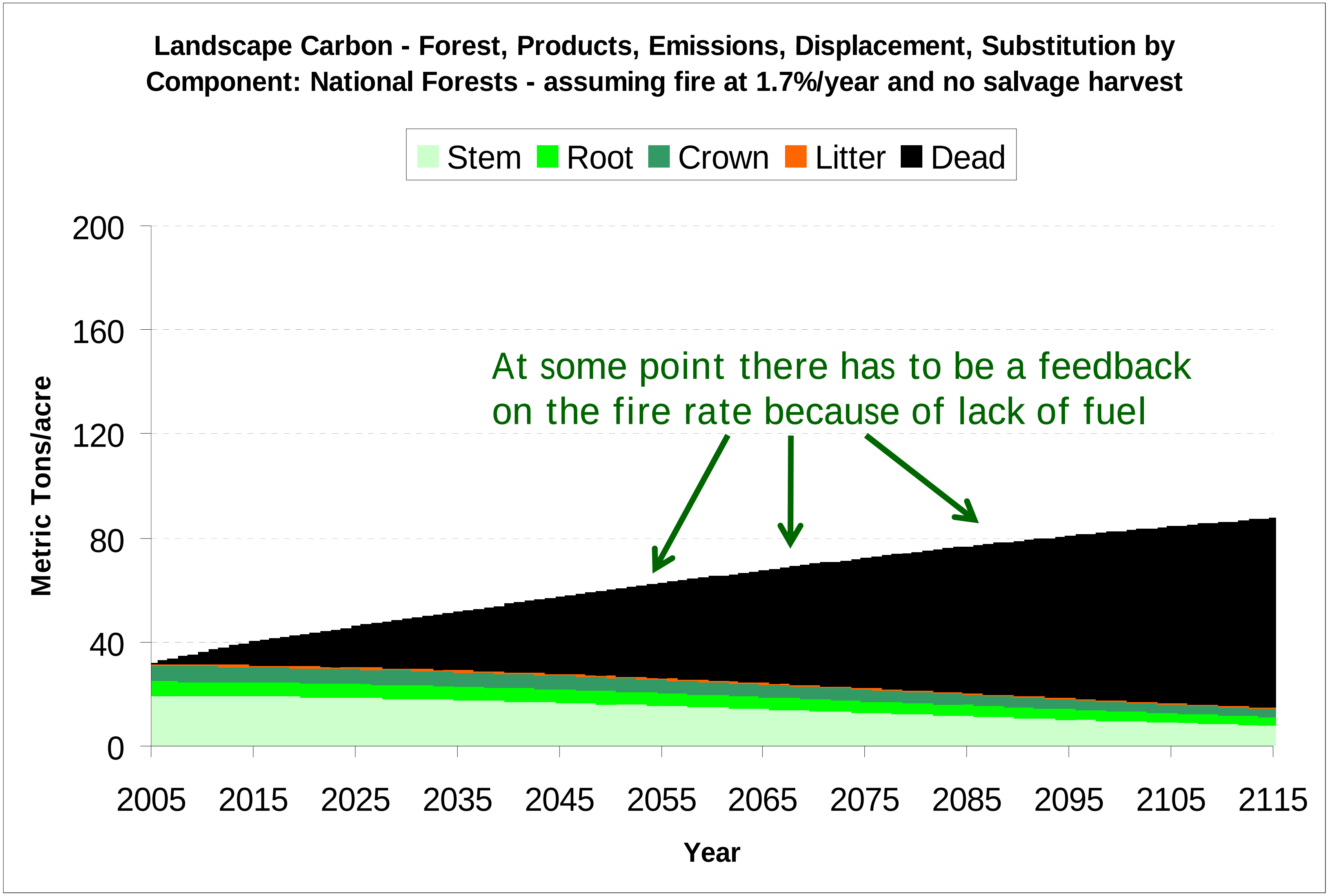
Predicted outcomes from climate change

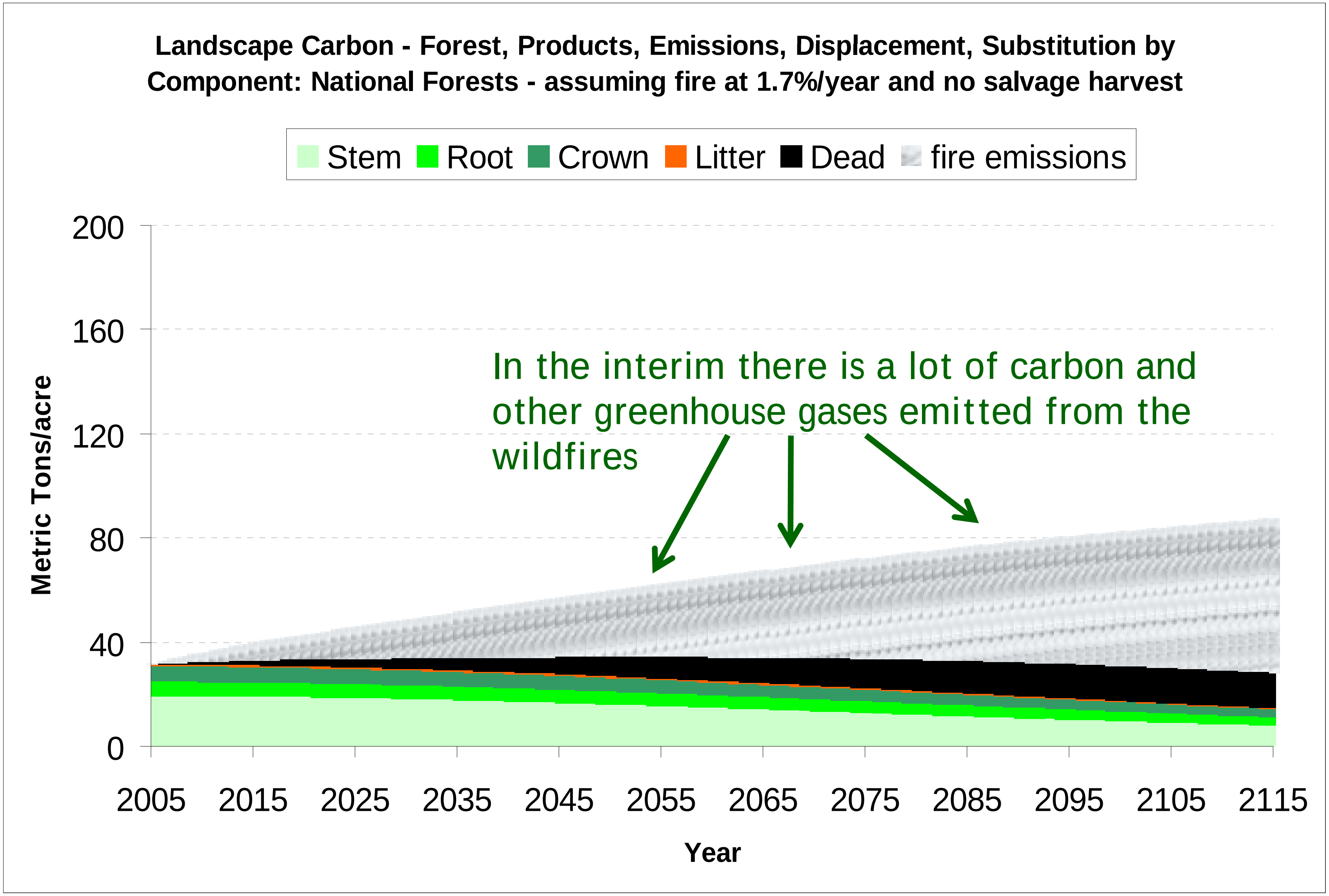
- Multi year droughts
- Intensification of insect outbreaks (Logan et al 2006)
- Range expansion of MPB (Logan and Powell, 2006, Carroll et al 2003)
- Earlier snowmelt and higher summer temperatures creating greater cumulative summer moisture deficits, a longer fire season, expansion of high fire risk areas into high elevation sites earlier in the year and in more years (Running 2006, Westerling et al 2006)
- 2-3x increase in fire extent in PNW (McKenzie et al 2003)
- Doubling of the number of years where wildfire burns more than 1 million acres (Littell et al. 2009)

The FVS growth model prediction of carbon in the trees on National Forests



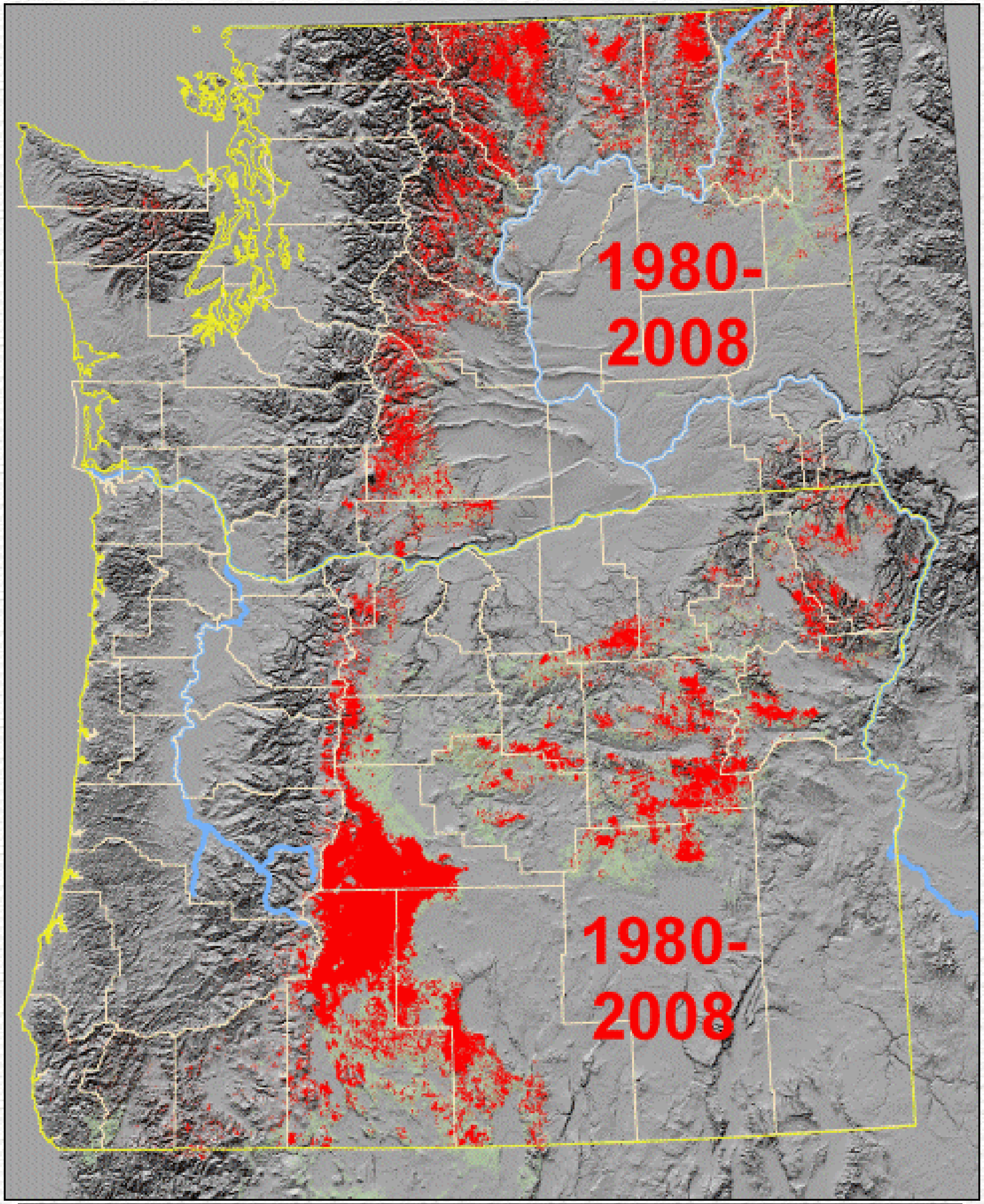
A doubling of fire rate for E WA might look like this as a worst case scenario




Landscape Carbon - Forest, Products, Emissions, Displacement, Substitution by Component: National Forests - assuming fire at 1.7%/year and no salvage harvest
Stem
Root
Crown
Litter
Dead
fire emissions
200
160
120
80
40
0
Metric Tons/acre
2005
2015
2025
2035
2045
2055
2065
2075
2085
2095
2105
2115
Year
In the interim there is a lot of carbon and other greenhouse gases emitted from the wildfires

Adding Insects to the models

Mountain Pine Beetle Attacks in Washington and Oregon 1980-2008



http://www.fs.fed.us/r6/nr/fid/as/mpb-r6-slow.shtml



J. Hicke


- Used average pine stand
- Simulated MPB outbreak using the FVS keyword file
  - took 7% of the basal area and 21% of the trees in the first decade
    - conservative relative to what we have been seeing in the Inland West

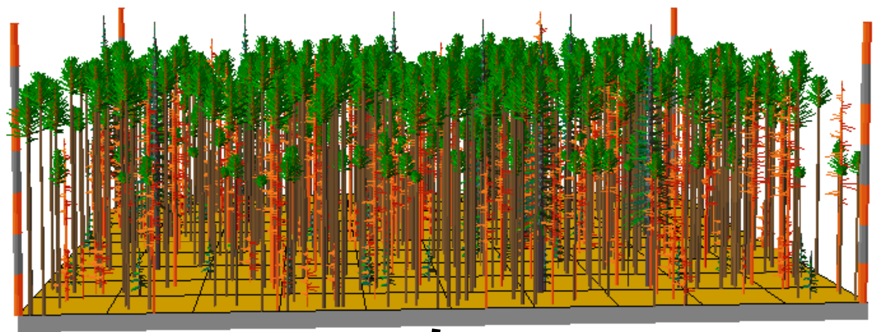
Lodgepole Pine, Mountain Pine Beetle, and carbon

Lodgepole Pine – initial inventory without MPB outbreak

8 year outbreak

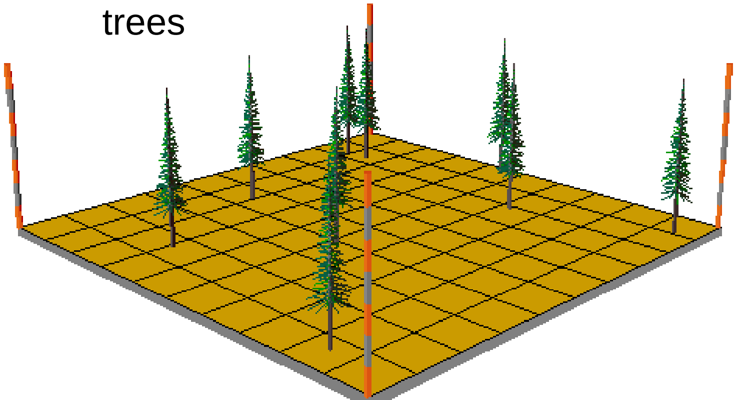
Lodgepole Pine – after simulated MPB attack

26 MT carbon/acre



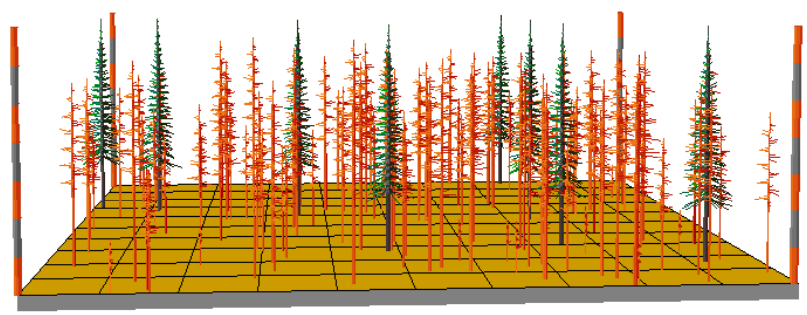
28 MT carbon/acre

Harvest all < 12” diameter trees



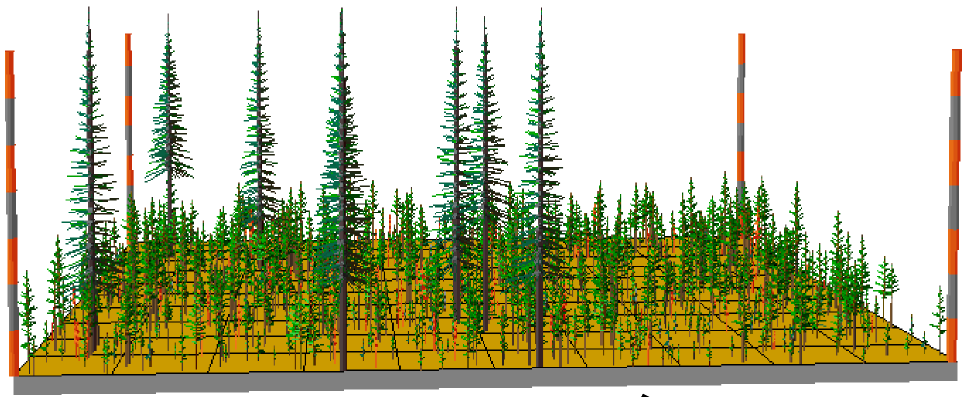
8 MT carbon/acre

Harvest all < 12” diameter trees and leave MPB snags

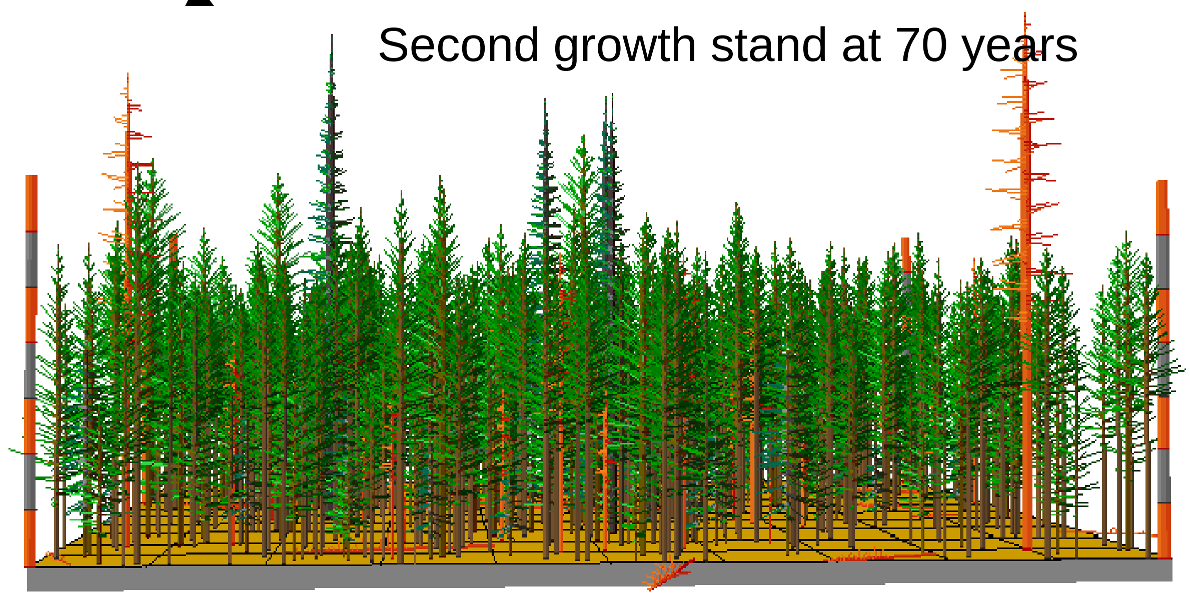


15 MT carbon/acre

Regeneration at 1200 TPA
after 20 years

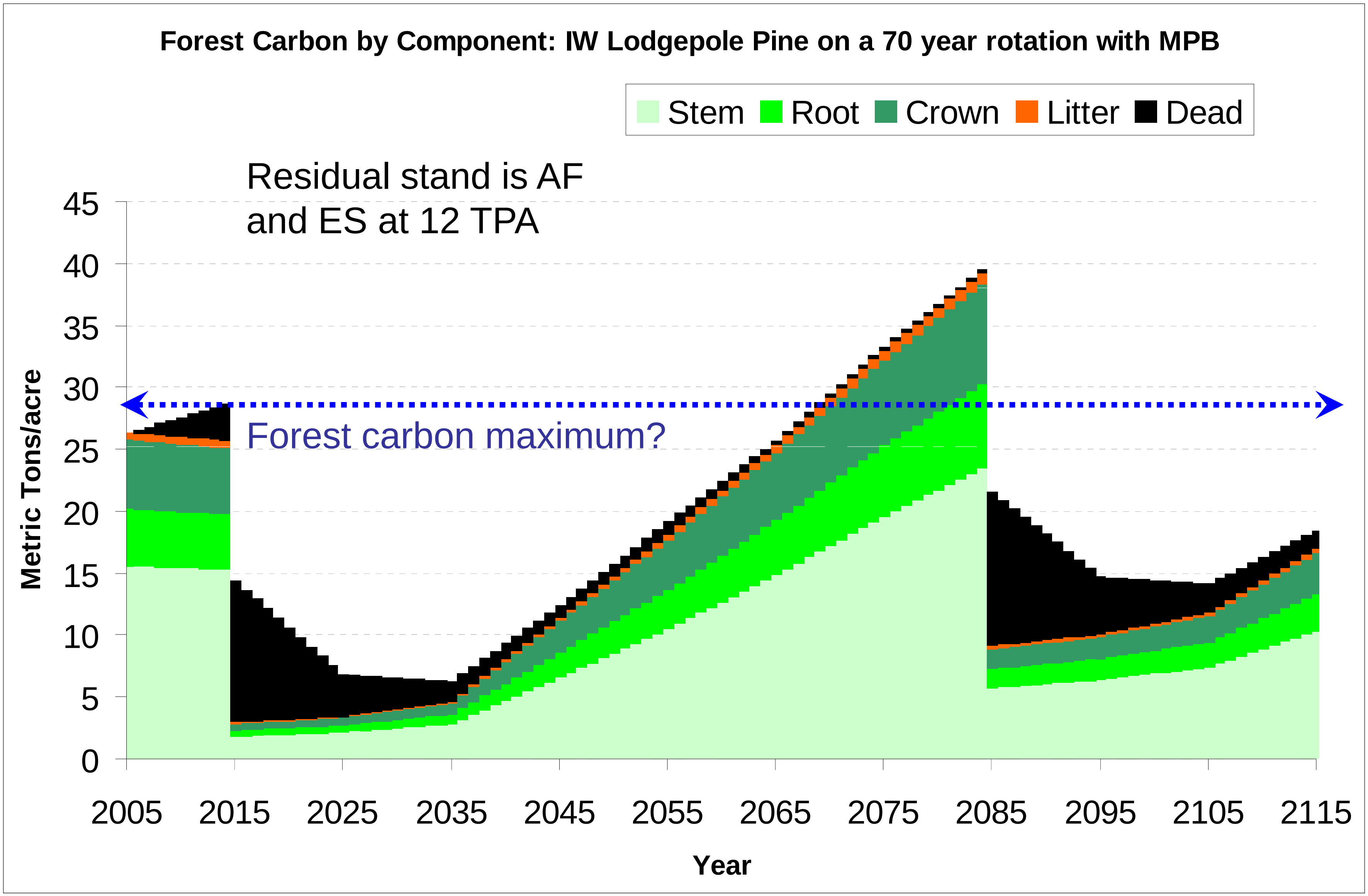


Second growth stand at 70 years

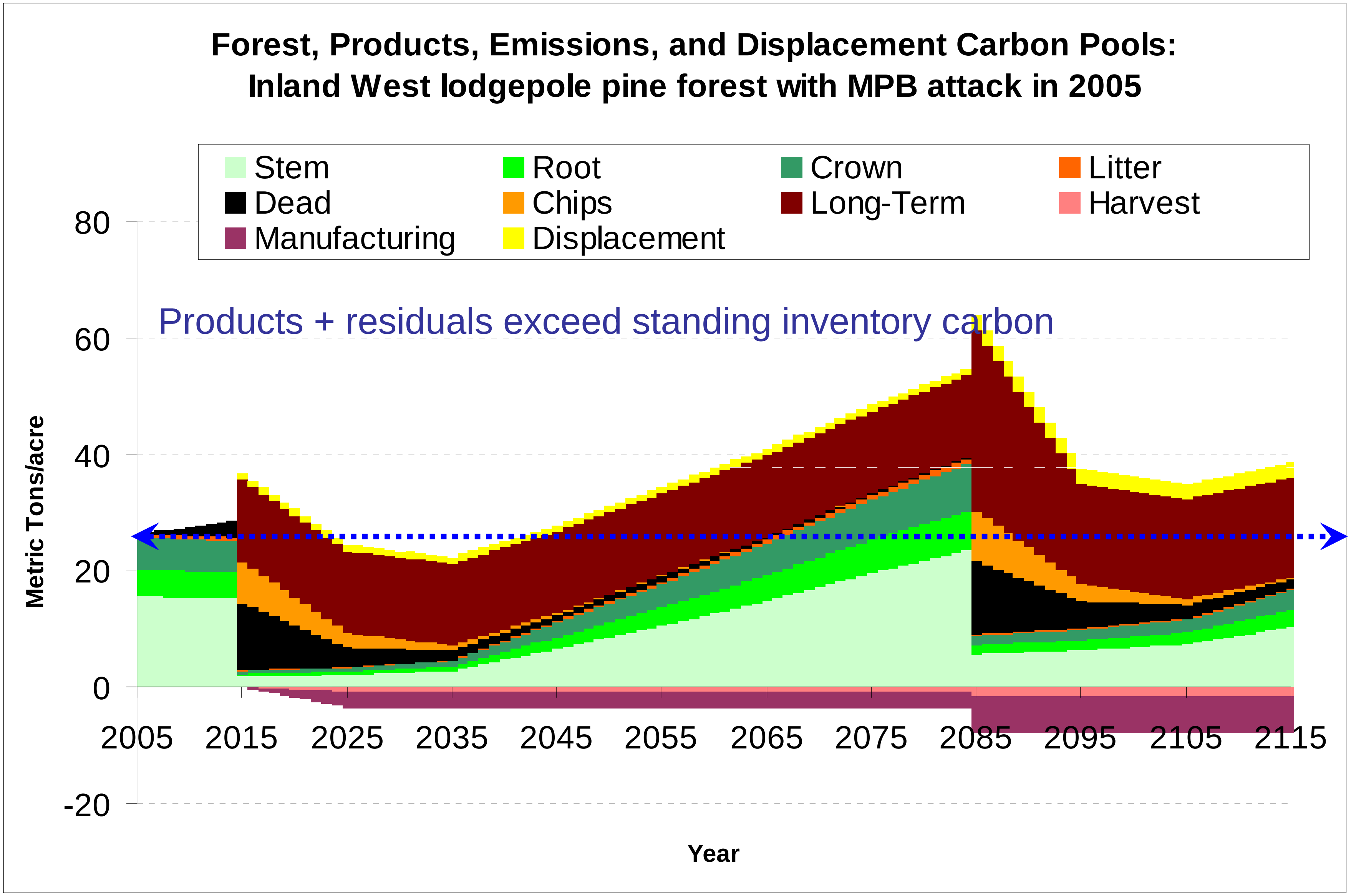


Maybe

Lodgepole forests on a 70 year rotation harvesting all trees < 12 inch DBH

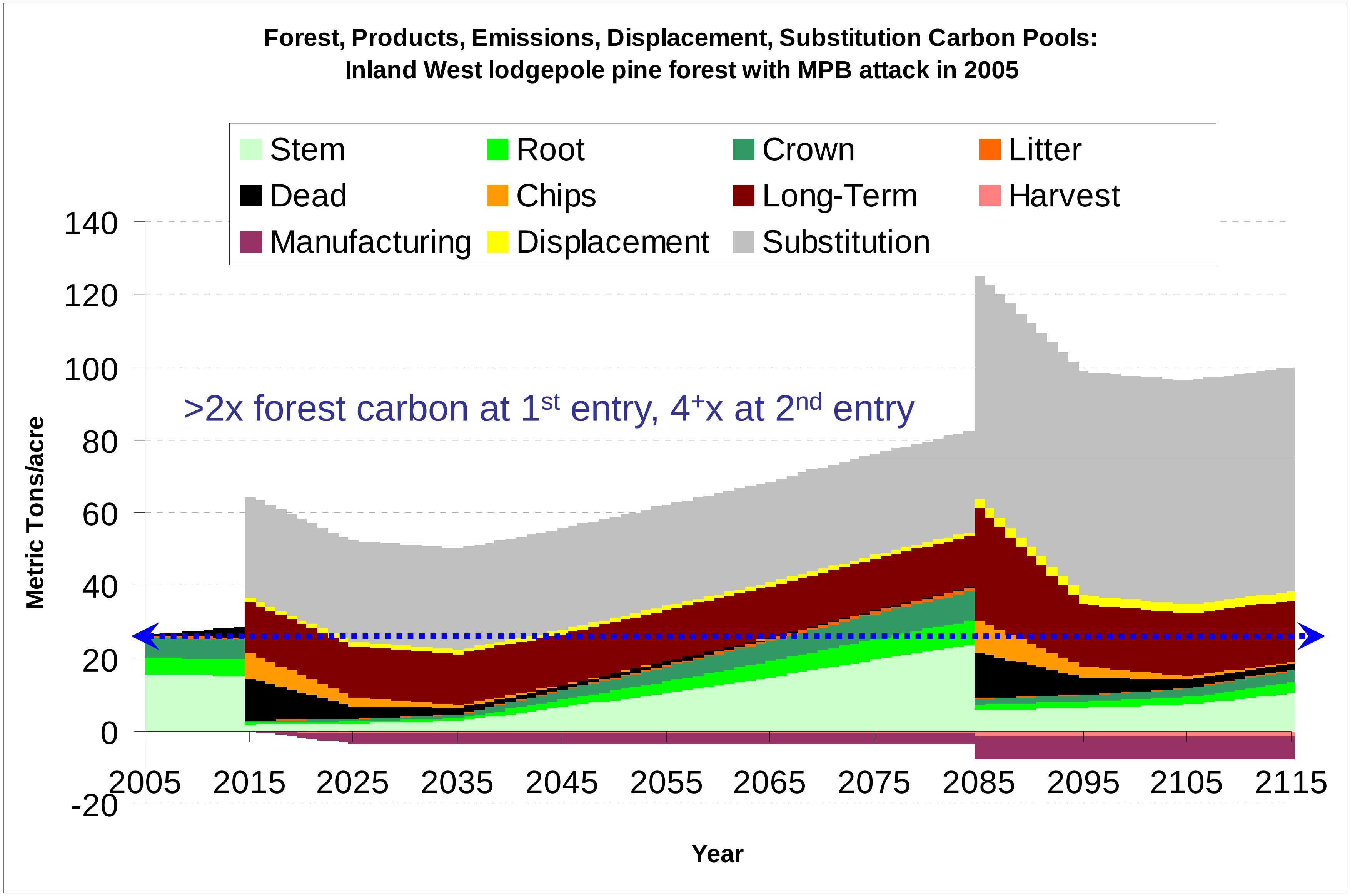


Considering Product Pools



Product Substitution

using substitution rate from Sathre and O'Connor (2007) meta-analysis



Summary Findings

- ✓ Wood used in long-lived products provides the greatest reduction in fossil fuel use & emissions.
- ✓ Thin from below strategies on USFS lands reduce the leverage of the product pools as less of the wood volume is available for long lived products (more into displacement and/or left on the landing as slash).
- ✓ Wood residuals used in biofuels could reduce emissions further
  - But prospective policy incentives may displace products with greater GHG leverage and be partially counterproductive.
  - Energy for heat production remains the driving factor in wood processing energy, but could be bioenergy (if fuel costs or incentives were higher).

Important But Complex Issues/Opportunities

- ✓ Tree growth and carbon modeling need calibration to account for insects, disease and fire occurrence based on climate change predictions
- ✓ Finding the carbon 'carrying capacity' of different forest types and identifying the thresholds beyond which maintaining carbon on site is too risky or unsustainable
- ✓ Policies can easily be counter-productive
  - Incentives for carbon stored in forest rather than for increased growth rates and early harvest
  - Incentives for biofuels that divert fiber from higher leveraged substitution
  - Incentives that promote small scale activity that diverts supply from more efficient scale transport fuels

Summary Findings

- ✓ State and Private
- ✓ National Forest

- ✓ Built in conservatisms
  - End of house life burned: no recycling, no energy recapture, no landfill
  - Forest residuals not collected for biofuel

- ✓ Not so conservative
  - No accounting for fire, insect, and disease impacts
  - Growth rates may be over-stated on the drier habitat types because of climate change

- ✓ Less certainty
  - Variability in substitution: will increase with price of carbon

Impact of Higher Fossil Fuel/Carbon Prices

- ✓ Pay to collect forest residuals & waste
- ✓ Pay to use more wood in construction or other fossil substitutes (furniture etc.)
  - Where the carbon displacement leverage is highest
- ✓ Use more biofuels (*but solid wood prices must rise more than biofuel feedstock to avoid counter productive result)*
- ✓ Should pay to grow it faster & use it sooner, not grow it longer *(with correct accounting)*

Future Analysis

- Collect biofuels and displace fossil energy
- Non-structural product substitution (furniture)
- More site-specific decay rates
- Impact of more recycling or land fill or energy recovery at end of product life
- Fire risk disturbance impact on both forest carbon and product use
- MPB salvage, recovery, & restoration
- Liquid fuel bio-processing alternatives – greatest shortage