Developing a dynamic life cycle GHG emission inventory for wood construction for two different end-of-life scenarios

Dynamic LCA: Service life and indicators

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Premises

- Wood-framed structures make up more than 90% of residential housing
- Estimate ~67 million cubic meter softwood framing lumber to be produced in 2012
- GHG emissions occur over time
- Standard life-cycle assessment practice is static view
- What happens in the forest is important

Goal

- Develop a dynamic GHG inventory
  - US Forest Service data
  - Cradle-to-gate life-cycle emissions
    - New softwood framing lumber
    - Recovered softwood framing lumber
  - Estimate GHG emissions for construction wood for two scenarios

Scope

- Scenarios
  1. Making new construction wood
     1. Landfilling old wood
     2. Logging forests
  2. Reusing old construction wood
     1. No disposal
     2. No logging
- Single harvest cycle
  - Pacific Northwest (PNW) - Douglas-fir
  - Southeast (SE) - Southern pine

GHG emissions covered a 100-year time-period and all were allocated to 1.0 m^3 of softwood lumber

Forest Modeling

- High-intensity managed, high productivity
  - PNW (45-year harvesting cycle)
  - SE (25-year harvesting cycle)
- Logging slash
  - New wood construction
    - Harvest occurred
      - PNW (82.6 ton carbon/ha)
      - SE (22.2 ton carbon/ha)
  - Recovered wood construction
    - No harvest occurred >>> emissions set to zero

Other emissions

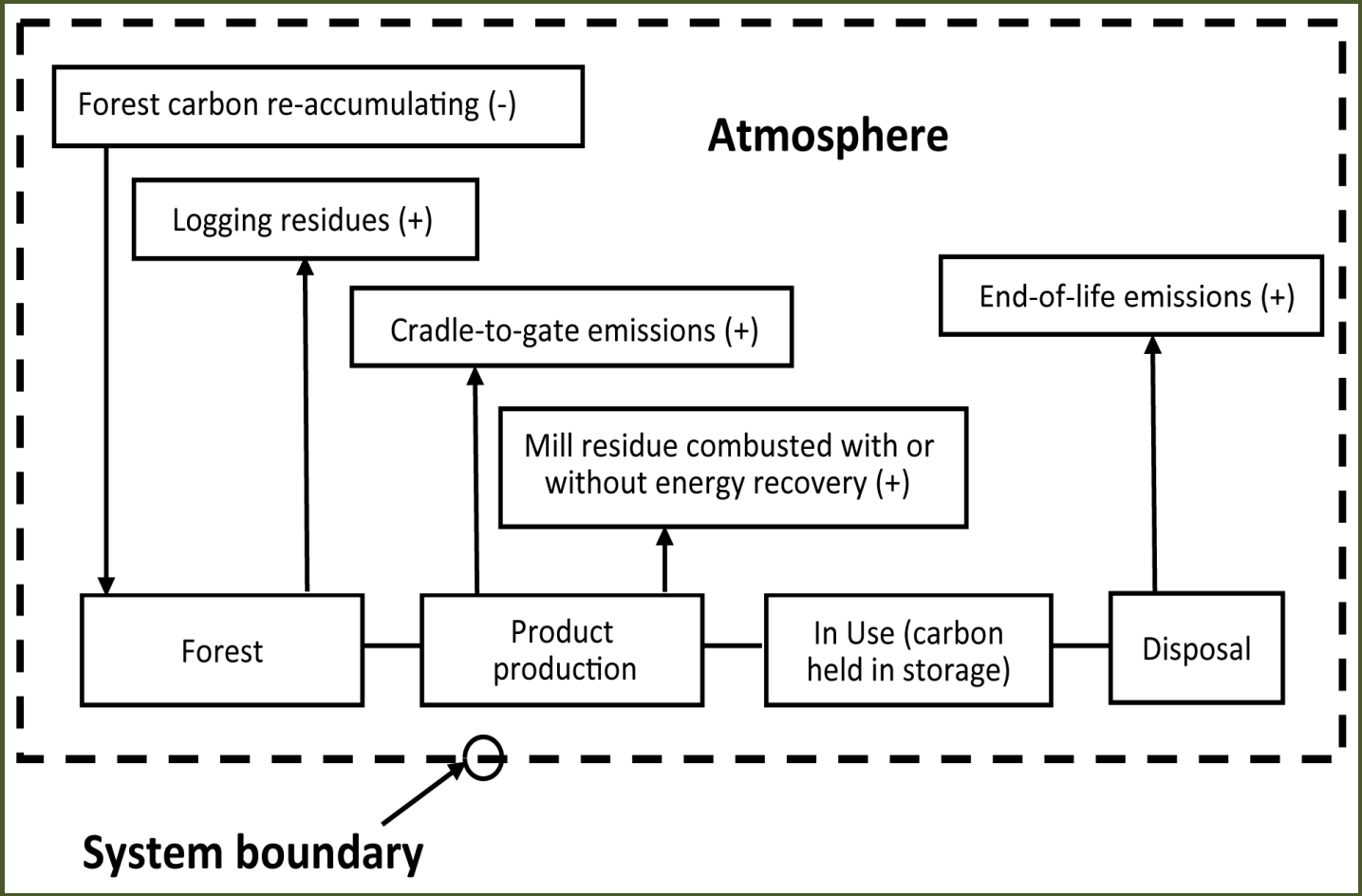
- Cradle-to-gate manufacturing
  - New wood – 118 kg fossil CO_2/m^3
  - Recovered wood – 76.4 kg fossil CO_2/m^3
- Product decay in landfill
  - 23% decomposition rate
  - 45% CH_4/55% CO_2 at surface
- Biomass CO_2 emissions accounted for

GHG emissions sources (+ or -)

- Forest carbon re-accumulating (-)
- Logging slash (+)
- Softwood lumber manufacturing (+)
- Residue decay and combustion (+)
  - Energy recovery
  - No energy recovery
- Product decay in landfill (+)
  - Energy recovery
  - No energy recovery

(-) carbon uptake from atmosphere (+) GHGs emitted to atmosphere

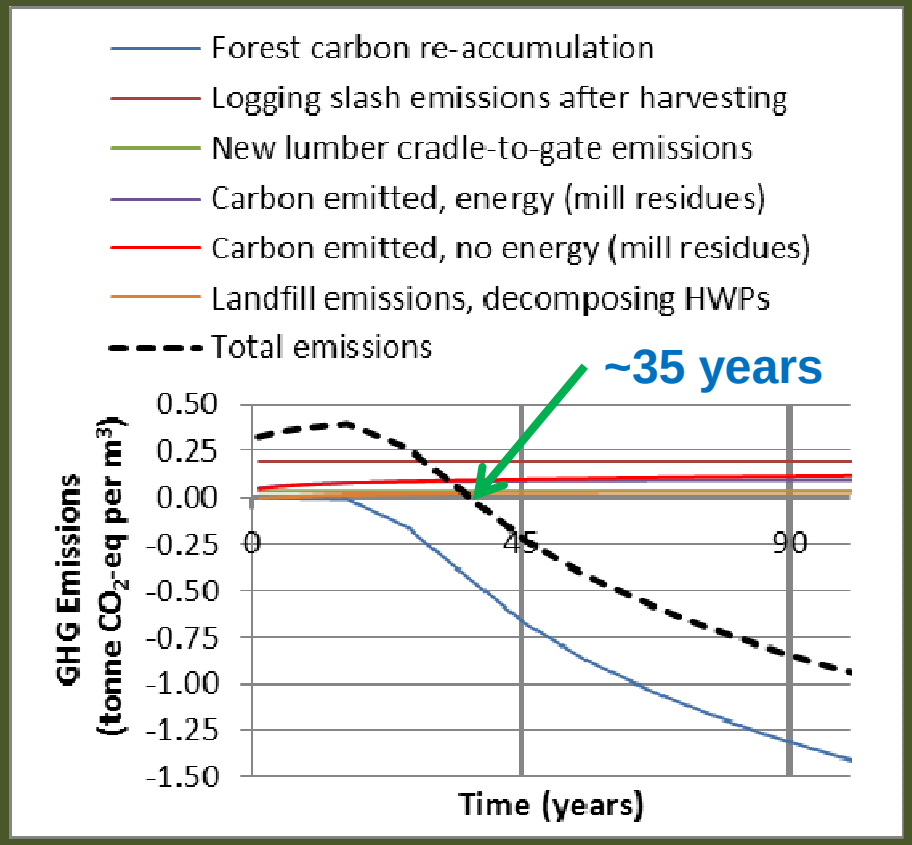
Total GHG emissions = Logging residues + Cradle-to-gate manufacturing + Mill residues + EOL – Forest re-accumulating



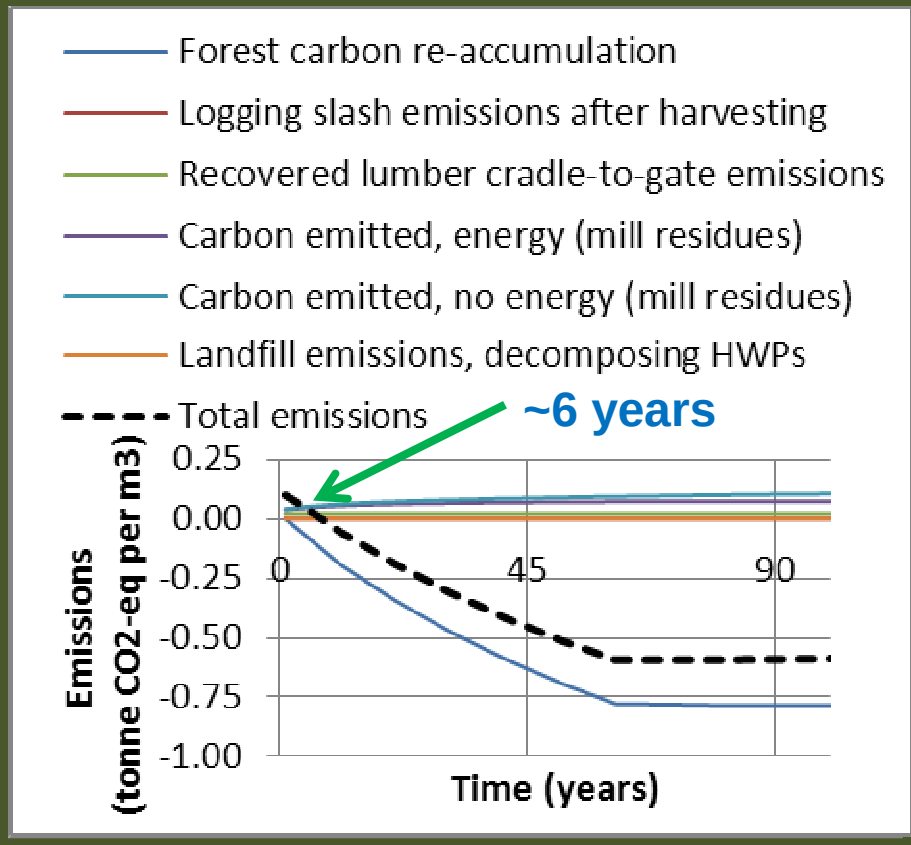
SYSTEM BOUNDARY FOR GHG POOLS

Results for Pacific Northwest

GHG emissions for new wood scenario for PNW stand



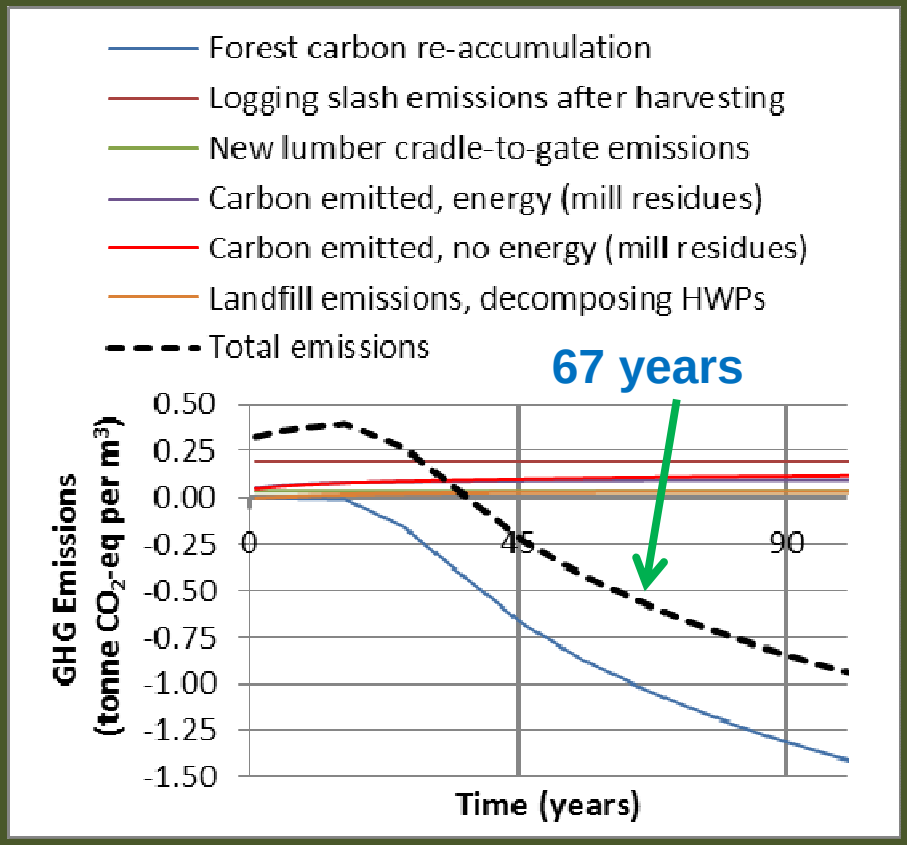
GHG emissions for recovered wood scenario for PNW stand



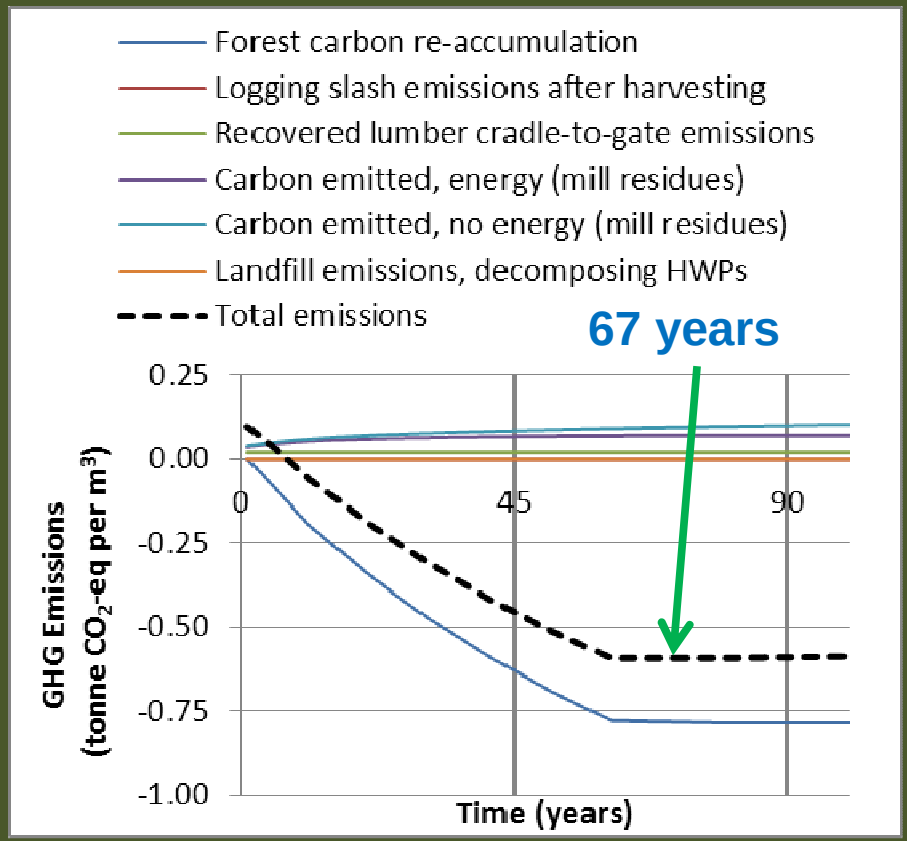
Time for total GHG emissions to go below zero

Results (con.)

GHG emissions for new wood scenario for PNW stand



GHG emissions for recovered wood scenario for PNW stand



Time when the two scenarios are equal

Results summary

Forest region	Time when total GHG emissions to go below zero	Time when the two scenarios are equal
Pacific Northwest	New (~35 years) Old (~6 years)	67 years
Southeast	New (~18 years) Old (∞)	17 years

Discussion

- Reusing old wood scenario short term
- New wood scenario long term
  - Initial carbon losses
    - Logging slash
    - Mill residues
  - Harvested forests generates new tree growth
  - Logged forests regrow and absorb carbon faster and for a longer time than unlogged forests

Conclusion

- Harvesting new wood
  - Time delay in forest carbon re-accumulating
  - Long-term climate change benefits
  - Growing trees are an excellent way to sequester carbon
- No harvesting
  - Forests reach equilibrium earlier
  - May not provide maximum carbon benefits.
- Low-productivity stands may not have the same long-term carbon benefit

Future work

- Review Smith et al. 2005 numbers on southern pine (update if necessary)
- Replace static IPCC 100-year measures
  - Timing effect on GHG emissions
  - PAS 2050 values
- Incorporate additional harvests
- Evaluate low-productivity stands

Citations

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Questions?

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