

Building with Biomass (Wood)



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Outline

- Key points
- Forest carbon
- Harvested wood products
- Forest carbon pools
- Harvested wood product carbon flow
 - Long-term products
 - Short-term products
- GHG mitigation
- Life-cycle assessment
- Carbon impacts of wood
- Results
- Conclusions



Key points

- Wood is the primary biomass building material
- Wood can be used for products and for energy
- Wood used in construction, manufacturing, and shipping
- Wood baskets are the southeast and the PNW
- Forests cover 30% of U.S.
- Nearly all single-family houses in U.S. built with wood (US Census Bureau, 2018)
- Nearly all pallets in U.S. built with wood
- Life cycle assessment supports wood as a green building material (Ritter et al., 2013)

Why is forest carbon important?

- 4th most common element
- Trees are ~50% carbon (oven dry weight)
- Trees consume ~1.83 kg CO₂ to produce 1 kg of wood or 0.5 kg carbon

U.S. Housing

- Housing statistics
 - ~126 million households (US Census Bureau 2018)
 - Single-family units
 - 90% made from wood
 - Built annually, ~1 million units (Buehlmann and Alderman, 2018)
 - Half-life of 80 years (Skog, 2018)
 - Multi-family units
 - ~0.4 million units built annually ((Buehlmann and Alderman, 2018)
- Wood houses are about 5% cheaper than concrete or steel houses

Non-structural usage: Pallets

- Most wide-spread packaging system
- ~1.8 billion wood pallets in circulation in U.S.
 - 508 million new (Gerber et al. 2018)
 - 341 million recovered (Gerber et al. 2018)
 - 18.3 million pallets were landfilled (Shiner et al. 2018)
- 90% are wood in the United States (Bhattacharjya & Walters 2012)

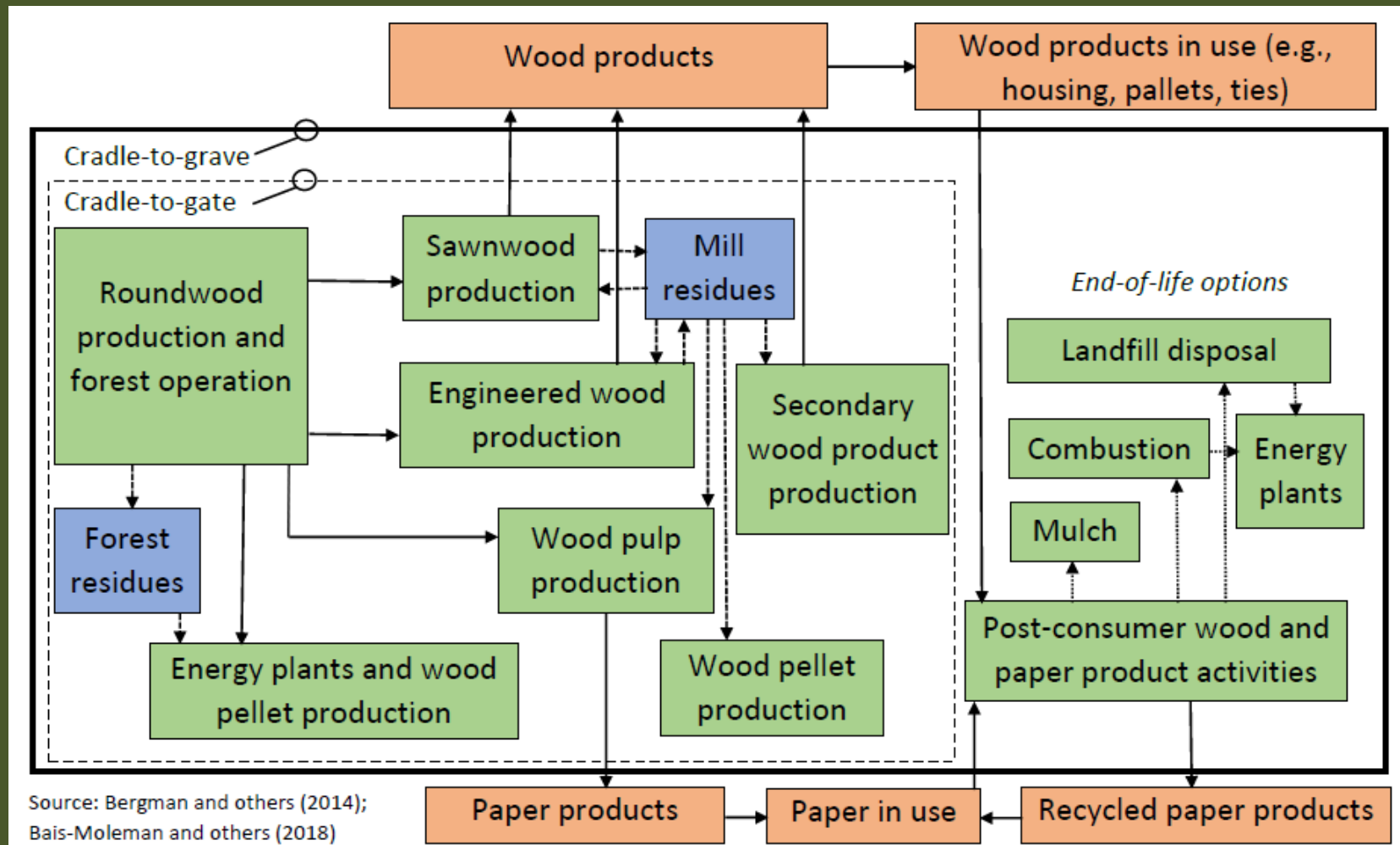
Forest carbon pools

- Forest stock carbon
 - Lower 48 states: ~41,000 Tg C (Wear and Coulston 2015; McKinley et al. 2011)
 - Net forest C sequestration rate (Wear and Coulston (2015))
 - 173 Tg C for 2013
 - Average is 216-313 Tg C/yr
 - Equivalent to 10-20% of US fossil fuel GHG emissions (USEPA 2010)
 - Rate varies by region

Forest carbon pools (cont.)

- Harvested wood product carbon
 - Wood in housing
 - Wood pallets
- Wood at end-of-life carbon
 - Landfilled
 - Gas flared into CO₂
 - Gas captured or not
 - Burned for energy
 - Mulched
 - Recovered for re-use (pallets)

Harvested wood product C flow



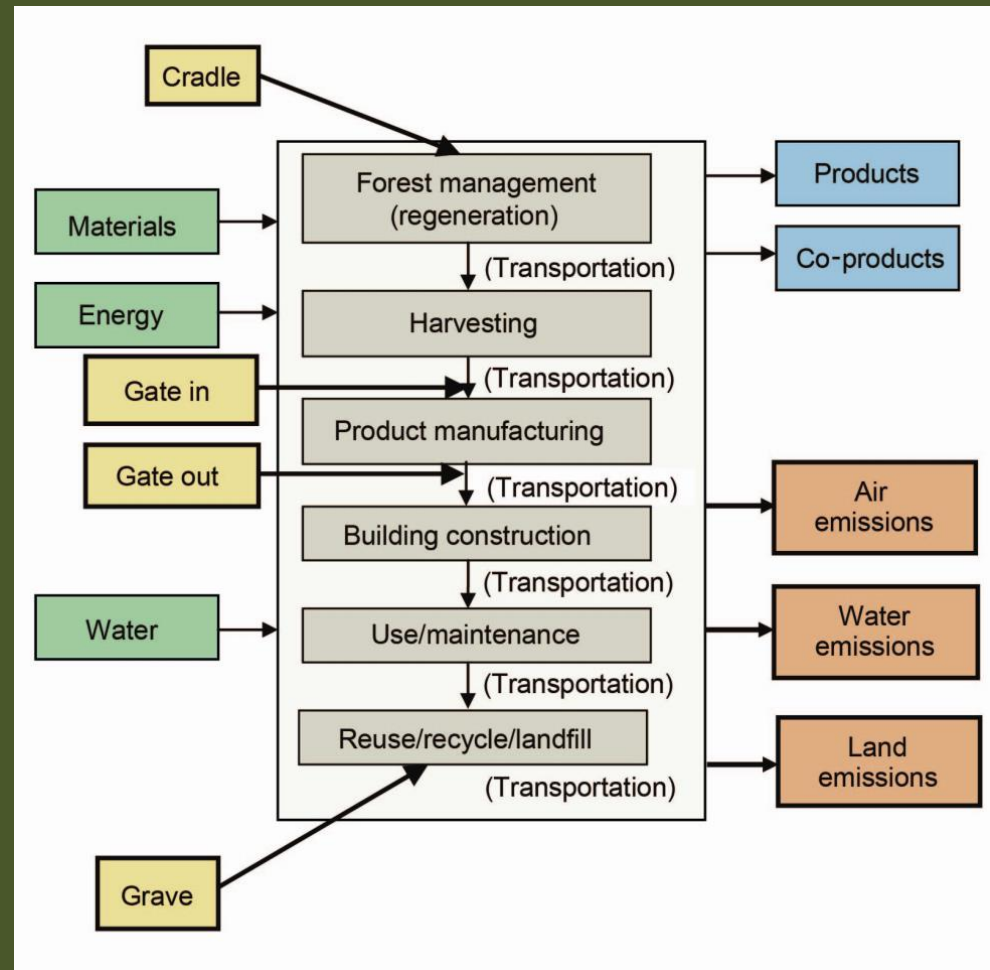
GHG Mitigation

- Forests/trees sequester carbon
- Growing trees actively pull CO₂ from air
- Paper and wood products store carbon in use
 - Long-term products
 - Wood building products (huge market)
 - Bioproducts (small market)
 - Short-term products
 - Pulp and paper products (huge markets)
 - Bioenergy products (huge markets)
- Substitute for fossil-fuel intensive products
 - 1 ton of wood building product saves ~4 tons CO₂
- Post-recovery activities (cascading/recycling)
- Life-cycle assessment can cover all stages

Life-cycle assessment (LCA)

Can cover parts or all of the life-cycle from cradle-to-grave (nature-to-nature)

>>>LCA tracks GHG (carbon) emissions of product production

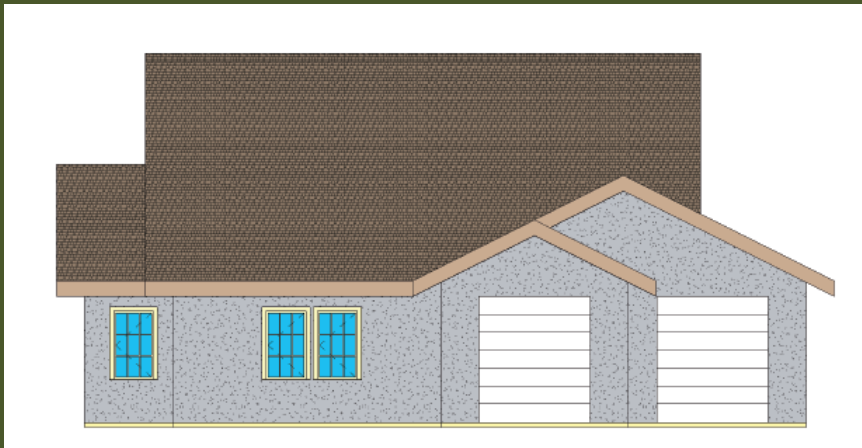


CORRIM LCA Project Goal

Objective: Examine the environmental performance on structural components in residential housing

Atlanta

(wood- vs concrete-framed)



Minneapolis

(wood- vs steel-framed)



CORRIM: Consortium for Research on Renewable Industrial Materials
(www.corrim.org): Lippke et al. 2004

Carbon impacts of wood products

Objective:

State how wood products can **mitigate carbon emissions** through **carbon storage, product substitution, and carbon sequestration**

The Wood Product
Carbon Impact Equation

$$A - B - C - D = E$$

Bergman et al. (2014)

Results

- Wood housing
 - Stores ~725 Tg tonnes carbon (+/-20%)
 - Delays carbon emissions to atmosphere
- Wood pallets
 - Stores 16 Tg carbon
 - Less and less pallets to landfill
- Build more with wood (Nepal et al. 2016)
 - In low-rise non-residential construction
 - 7,707 thousand cubic meter of wood used to build
 - GHG emissions reduction of 240 Tg C over 50 years
 - Market-induced effects
 - Increased forest C stocks in the south

Things to Consider for Future

- Reforestation
 - Safeguards soil organic carbon
 - Provides a renewable carbon resources
- Afforestation
 - Increase forest carbon stocks
- Avoid deforestation
 - Replant
- Build more with wood in non-residential construction
 - Product substitution
 - GHG emission reduction strategy
 - Increase value of forests
- Cascading use of wood products
 - GHG emission mitigation strategy

Questions?

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