

Carbon Impacts of Forest Bioenergy in Minnesota

Forest Biomass and its Role in a National Renewable Electricity Standard

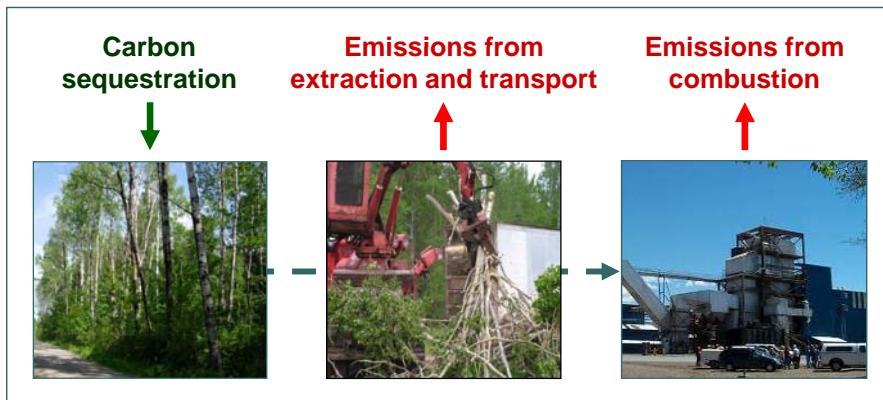


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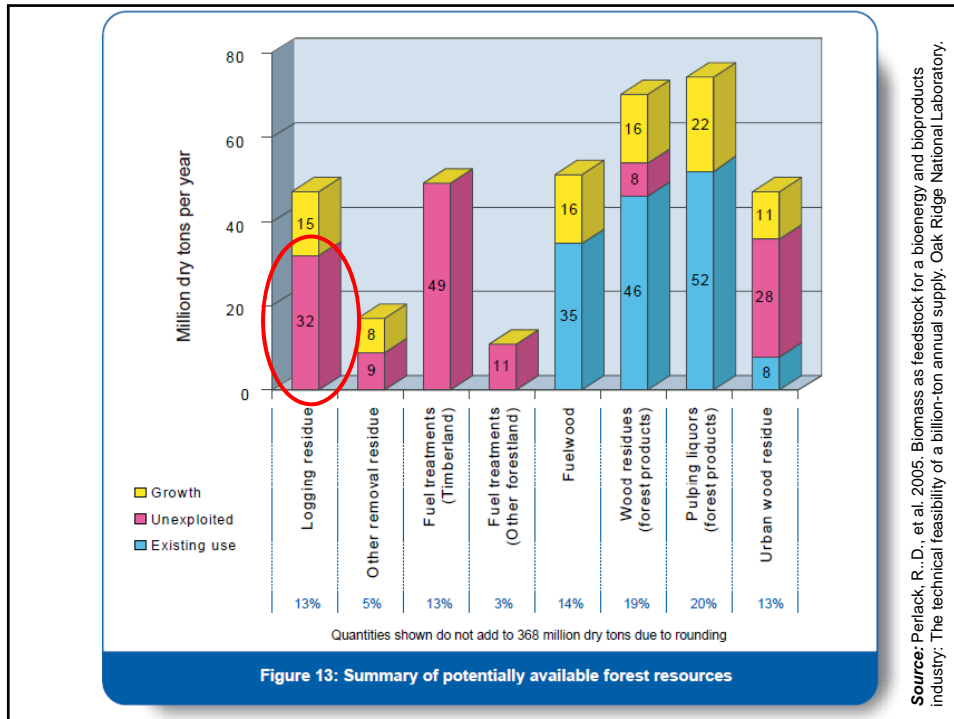
Environmental and Energy
Study Institute

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Carbon Inputs and Outputs



100-year Planning Period (26 megawatt facility)

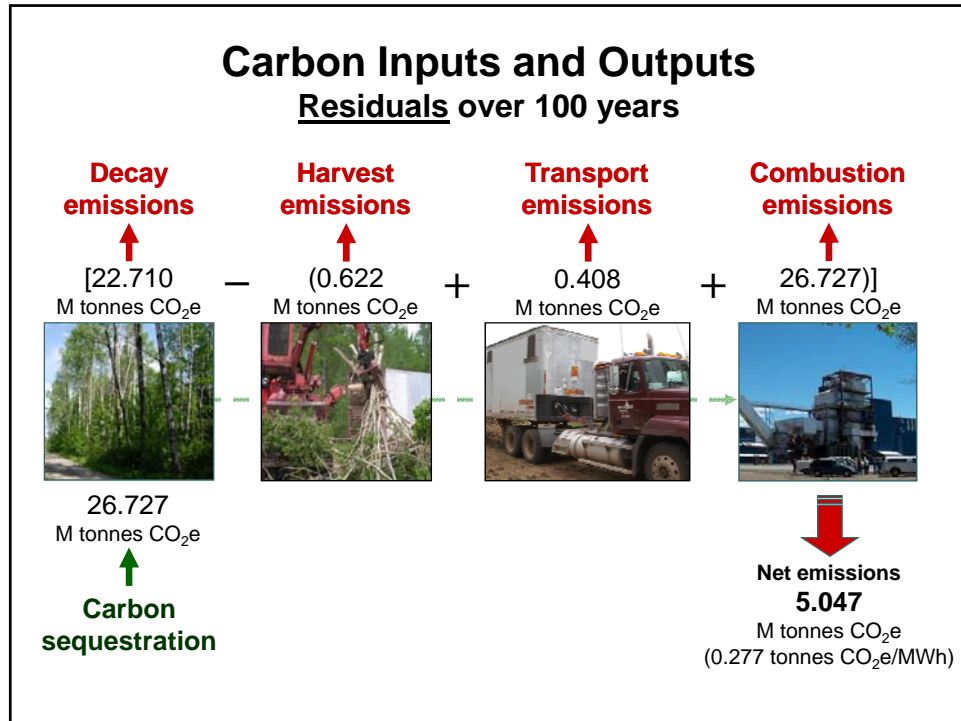


Biomass Availability

- Annual biomass use (145,652 dry tonnes; 26 megawatts)
- Proportion of residuals by forest type (volume per acre)
- Harvest rotation length (short versus long-lived species)
- Residual biomass extracted (approx 50%; harvest guidelines)
- Site productivity
- Species mortality
- Timberland area
- Annual timber harvest

Aspen Forest Type

Age Class	2008	2058	2108
5	600000	550000	500000
15	450000	550000	500000
25	350000	500000	450000
35	300000	450000	400000
45	400000	350000	300000
55	400000	200000	250000
65	350000	100000	150000
75	200000	100000	100000
85	100000	100000	100000
95	50000	100000	100000
105	50000	150000	100000



Study Observations

- 85% of biomass is emitted as CO₂ within a 100-year period; additional 5-10% emitted in the 20-years following
- Complete biomass decay within 250-350 years
- Carbon balance changes by species, fuel efficiency (Btu content, processing)
- Early thinning of forests could substantially increase yields of residual biomass



Comparison of CO₂ Emissions

Electricity Generation Type		CO ₂ Emissions (tonnes per MWh)
Biomass Direct Emissions (conventional reporting)		1.5
Conventional Coal*		1.0
Natural Gas Combustion Turbine*		0.6
Natural Gas Combined Cycle*		0.4
Minnesota Woody Biomass (in-forest residues)	100-yr outlook	0.28
	20-yrs post plant	0.07
Hydro, Wind, Solar		0

*Direct CO₂ emissions reported by the Energy Information Administration
http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html



Forest Bioenergy and a Renewable Electricity Standard

- Forest bioenergy is “carbon-friendly”
- Need all viable sources to reach renewable energy goals
- Minnesota renewable portfolio standard drives investment (25 x 25)
- Baseload energy is critical for industrial users
- Safeguards exist for forest sustainability (e.g., biomass harvest guidelines)

For a copy of the report (staff paper 198):

<http://www.forestry.umn.edu/publications/staffpapers/index.html>

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