

Standing trees for energy applications: Impact on GHG balance



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Outline

- Introduction
- Methods
 - Life cycle assessment of wood pellet production from standing trees
 - Electricity generation pathways studied: reference (coal, natural gas); wood pellet co-firing and 100% pellet
- Results for pathways studied
- Insights and conclusions

Study motivation

- Utilizing forest biofuels in place of fossil fuels has the potential to make progress in addressing concerns over climate change, nonrenewable resource use, air pollution, and energy security
- Government of Ontario policy goals
 - Increase electricity generated from renewables
 - Eliminate use of coal for electricity generation by end of 2014
 - Reduce greenhouse gas (GHG) emissions
 - Economic development
 - Sustainable forest management

Study motivation

- Standing trees as a biomass source
 - Decline in forest sector provides merchantable but not marketable trees available for new applications
 - New markets provide economic benefits for forestry-dependent communities
 - Expand on limited supply of 'waste' sources of biomass
- Wood pellets as a fuel
 - More easily transported
 - Preferable combustion characteristics
 - Standardized fuel/feedstock
- How does fuel use and associated emissions from forest operations and pelletization impact GHG balance of wood pellet production and use for electricity generation?

Pathways investigated

- **Reference Coal Pathways:** Nanticoke and Atikokan Generating Stations (GS)
- **Reference Natural Gas Pathways:** hypothetical natural gas boiler and combined cycle facilities
- **Wood Pellet Co-firing Pathways:** Co-firing rates of 10%, 20%, 30% of energy input at Nanticoke and Atikokan GS
- **Wood Pellet Pathways:** Wood pellets utilized at 100% in one unit at Nanticoke and sole unit at Atikokan GS

Biofibre in the Great Lakes - St. Lawrence Forest Region

- Sustainably harvested biofibre supplied from forest management units
 - Allowable annual harvest (determined through sustainable forest management planning techniques, public consultation, environmental assessment)
 - ~7.5 million m³ maximum yield; avg. last 8 yrs ~4.3 million m³
- Harvest volume available from GLSL forest for pellets is ~1.475 million oven dry tonnes (ODT)/yr
- Would create a market for available merchantable logs no longer marketable
 - no competition with other uses



Source: OMNR

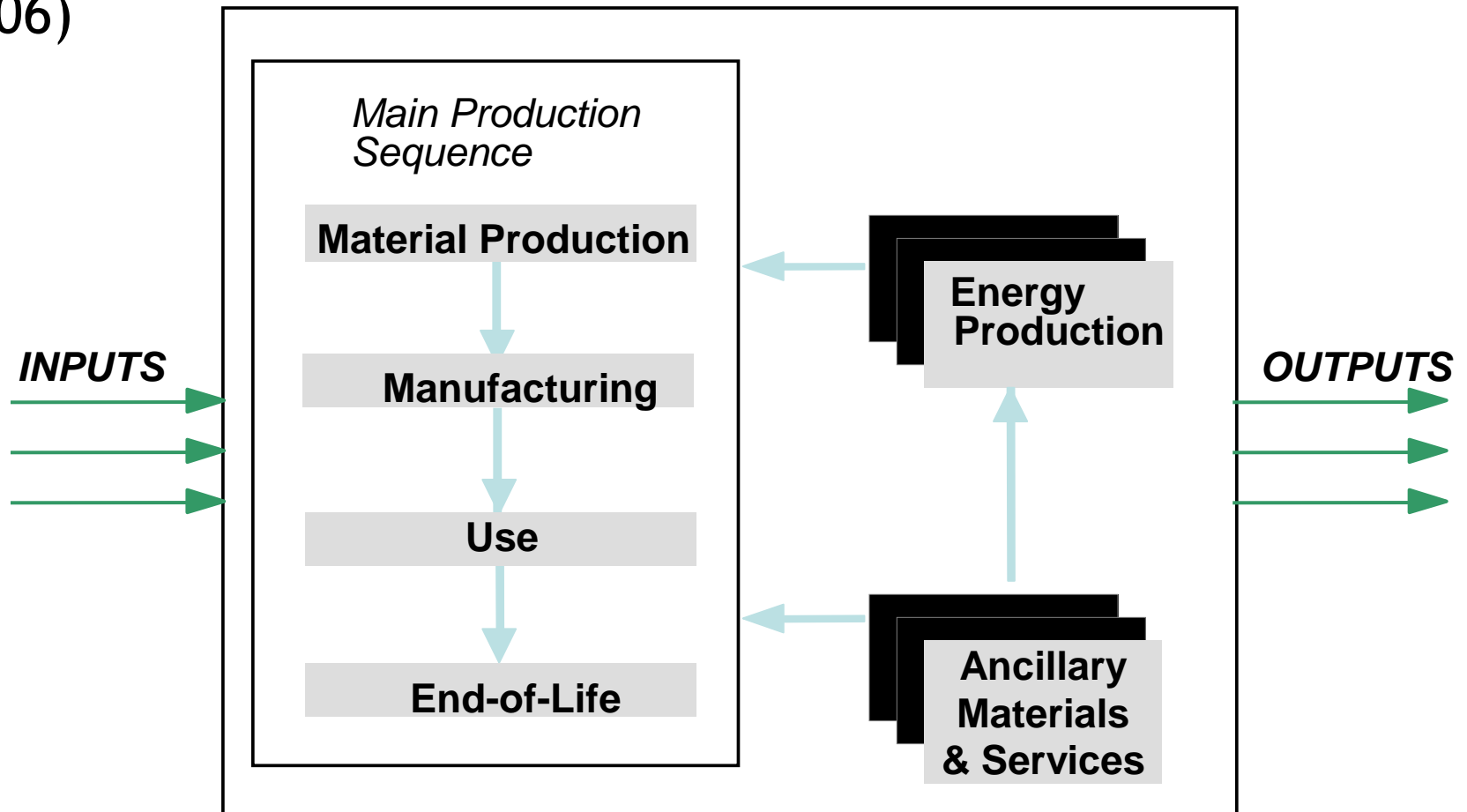
Life cycle GHG emissions of harvested wood pellet production and use



from: www.totalenergygroup.com

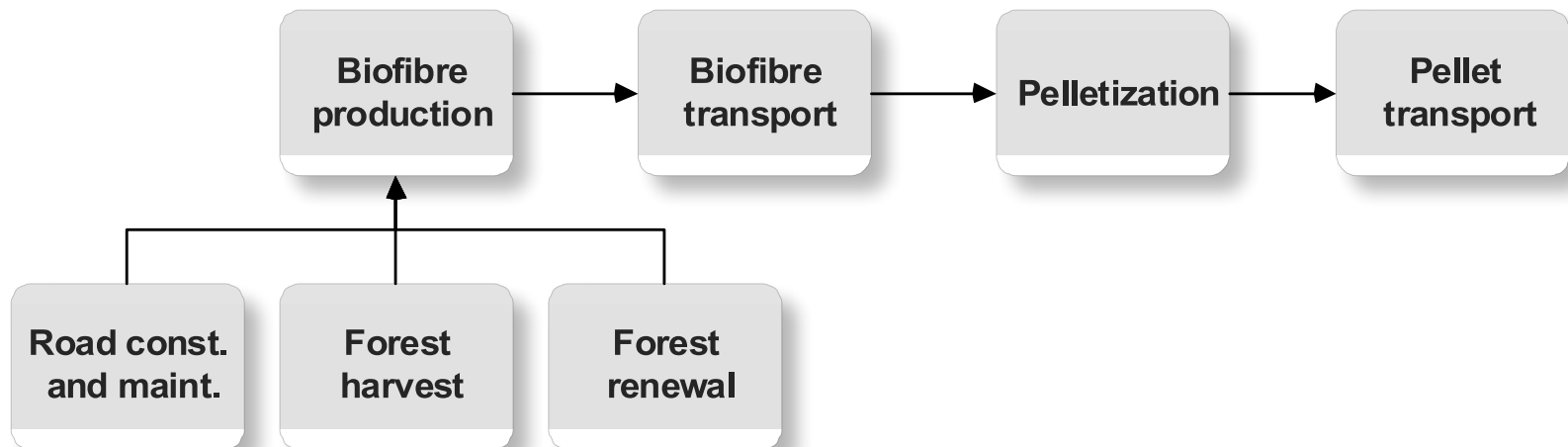
Life cycle assessment (LCA)

Provides a systematic assessment of the *environmental* implications of a product throughout its life cycle (ISO 2006)



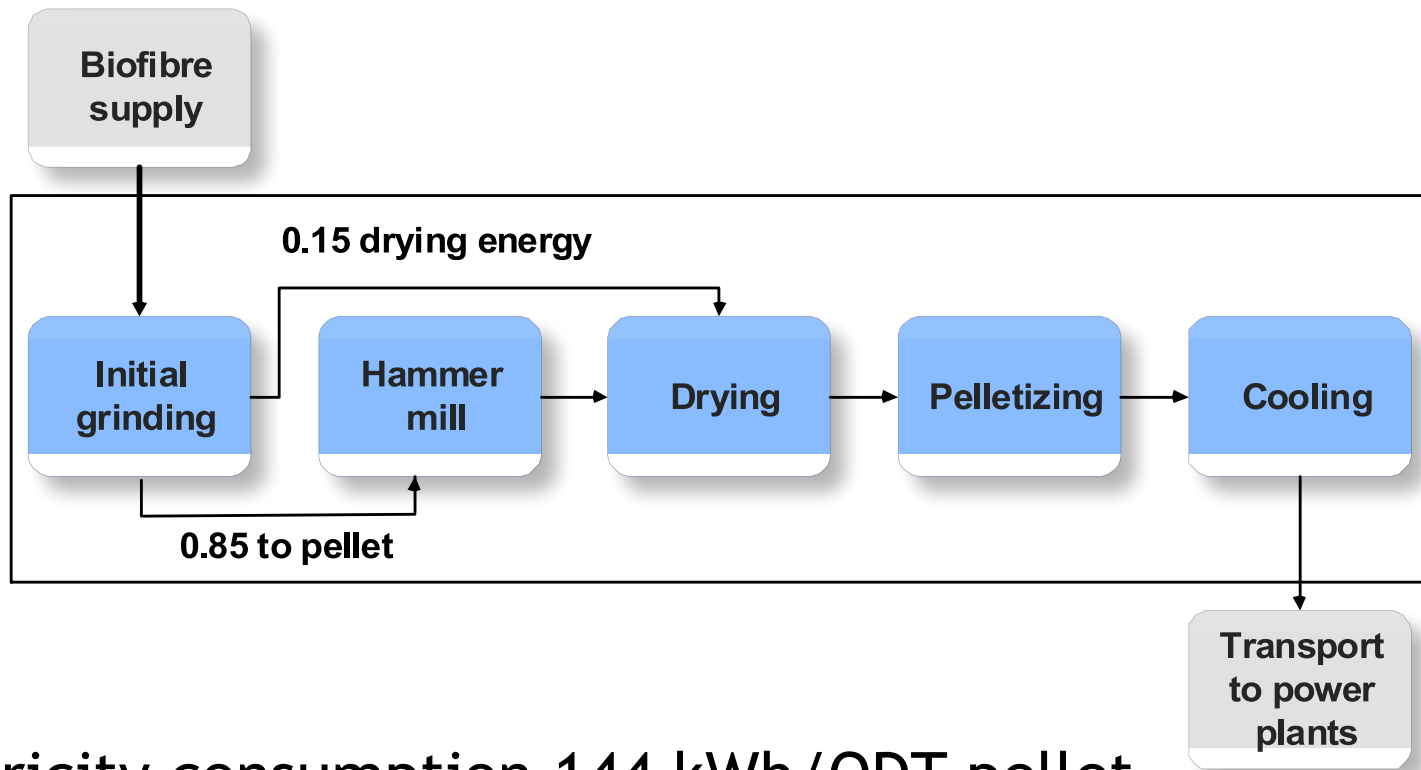
Wood pellet production

- Canada, Sweden, and US are leaders in production
 - Canada produced 1.2 million tonnes in 2006
- For this study, forest biofibre harvesting data obtained primarily from OMNR, FPInnovations-Feric and NRCan
- Harvest methods (selection 25%, shelterwood 25%, clearcut 50%), equipment and fuel use, and associated emissions (tops, branches left in forest)



Pelletization process

Data from Northeastern U.S. state-of-the-art pellet producer, capacity of 12 ODT/hr



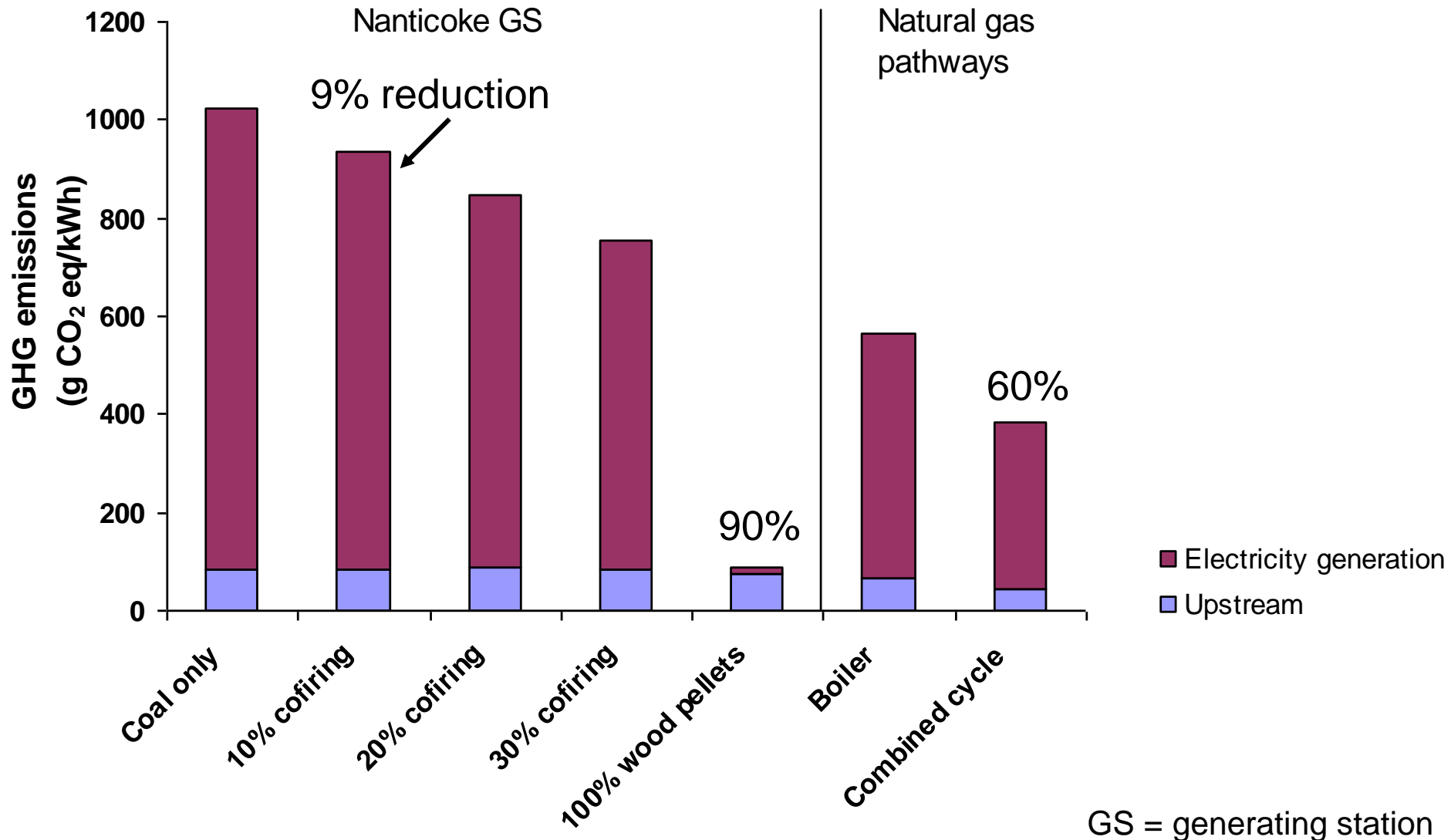
Electricity consumption 144 kWh/ODT pellet

Pellet production and transportation

~ 0.133 tonnes CO₂ eq. are associated with the production and transportation of 1 ODT of pellets

Activity	To Nanticoke (g CO ₂ eq./ODT pellet)	To Atikokan (g CO ₂ eq./ODT pellet)
Forest harvest	39,190	39,190
Forest road construction and maintenance	1,840	1,840
Forest renewal	1,380	1,380
Transportation to pellet facility	31,330	31,330
Pelletization	39,530	39,530
Transportation to generating stations	20,180	19,410
Total: pellet production and transportation	133,440	132,670

Life cycle GHG emissions



Harvested wood pellets in the Ontario generation mix

Metric (annual basis)	All Pellets Used (13% co-firing)
Pellet production (million ODT)	1.25
Renewable electricity (TWh)	2.5
Renewable electricity as; % of Province's electricity generation	1.6
Coal displacement (million tonnes)	0.9
Reduction in GHG emissions (million tonnes CO₂ eq.)	2.1
% Reduction in GHGs resulting from Province's electricity generation	7

Insights and conclusions



From: www.goforwood.info

Key messages

- Pellet production/use would;
 - Reduce GHG emissions from coal GS
 - Decrease fossil fuel use/ increase renewable electricity production
 - Make progress toward full implementation of sustainable forest management plan
- Overall GHG balance should be informed by the effect of increased harvest on forest carbon stocks (ongoing)
- This study examined only selected emissions and energy use
 - Other environmental, economic and social aspects need to be considered
- Would benefit from additional investigation of alternative uses of the GL-SL forest

Acknowledgements

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Questions?