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Forest bioenergy and GHG: an overview

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Forest bioenergy and GHG

- Great GHG mitigation potential
- Biomass is a **renewable energy**
- … But not automatically carbon neutral!
- Changing forest practices to harvest and use more wood **reduce forest carbon**
- Carbon debt (payback/parity time)

Living biomass

CO_2 recapture is not instantaneous

Dead biomass

CO_2 released slowly during decomposition

Confusion about C neutrality

- Renewable energy:
  - If produced sustainably, CO2 released is captured back, unlike fossil
- International reporting:
  - Emissions for biomass burning not reported in the energy sector

Energy sector
(emissions=zero)

Land sector (AFOLU)
(reported here!)

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The carbon debt

- Varies according to characteristics of the studied system/project/scenario:
  - Carbon debt from 0 to >1000 yrs (Buchholz et al, 2015)
  - Biomass source, application, transport, energy substituted, efficiency, climate, forest dynamics, forest management, etc..

- A complete analysis takes into account all parameters, from supply to forest dynamics (fossil + biogenic emissions), and compare it to a reference scenario (counterfactual / *BAU*)

" Bioenergy GHG Model " (LCA-based)

BIOENERGY SYSTEM

Supply chain & use

Forest C dynamics

Living biomass

Deadwood

No accounting needed

FOSSIL SYSTEM

Supply chain & use

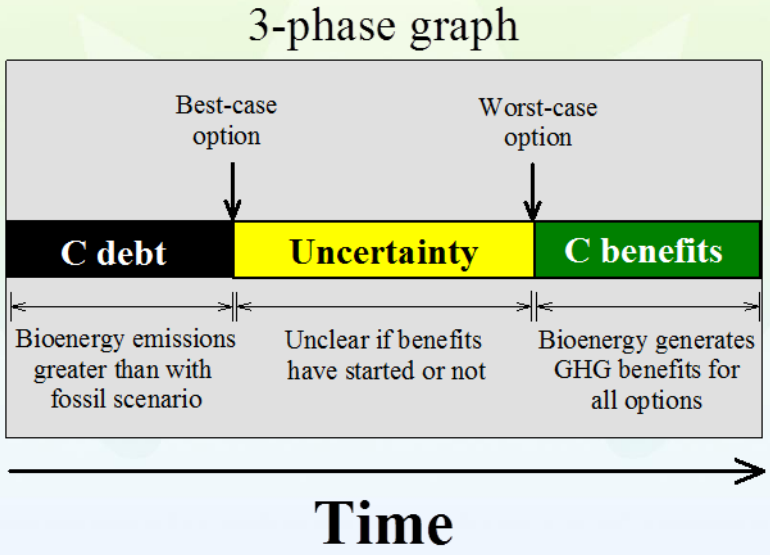
Forest C dynamics

Living biomass

Deadwood

CO2 released slowly (decay) or fast (burning)

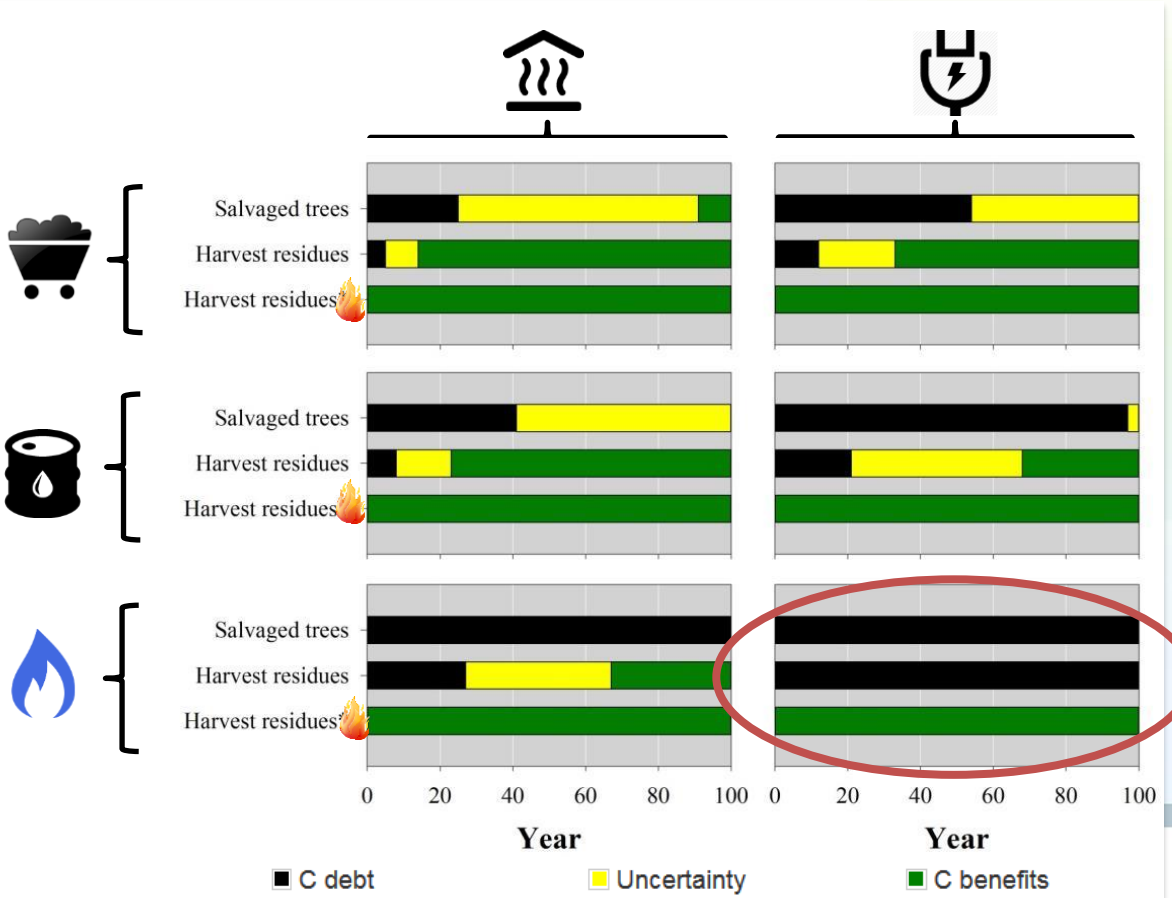
How the results are presented



GLOBAL CHANGE BIOLOGY
BIOENERGY
GCB Bioenergy (2017) 9, 358–369, doi: 10.1111/gcbb.12327

Range and unc
greenhouse ga
sourced from C

JÉRÔME LAGANIÈRE[1],
[1]Natural Resources Canada, Can
des sciences du bois et de la forêt



Time to reach benefits is highly variable!

Renewable natural gas (RNG)

Contents lists available at ScienceDirect

Biomass and Bioenergy

journal homepage: http://www.elsevier.com/locate/biombioe

Research paper

From conventional to renewable natural gas: can we expect GHG savings in the near term?

Rut Serra [a], Iman Niknia [b], David Paré [a], Brian Titus [b], Bruno Gagnon [c], Jérôme Laganière [a,*]

Study area location for BC (red), AB (green), and ON (blue) with the total biomass available at a 75-km radial distance from major gas compressor stations.

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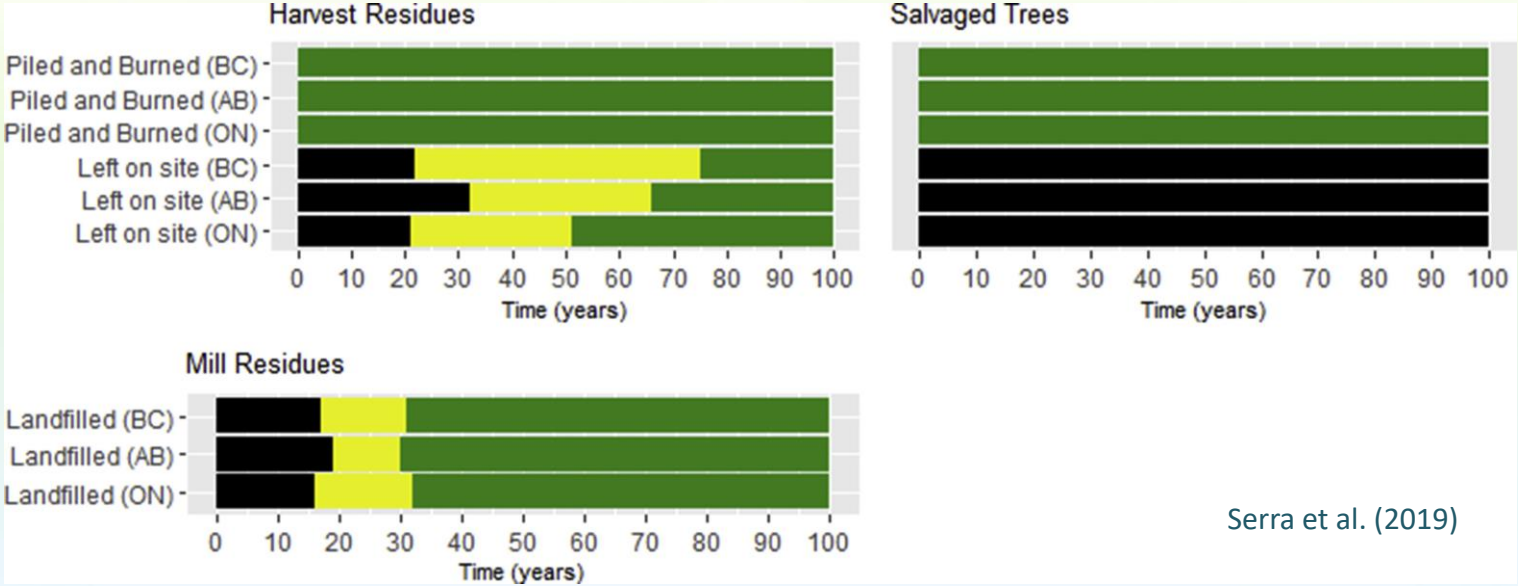
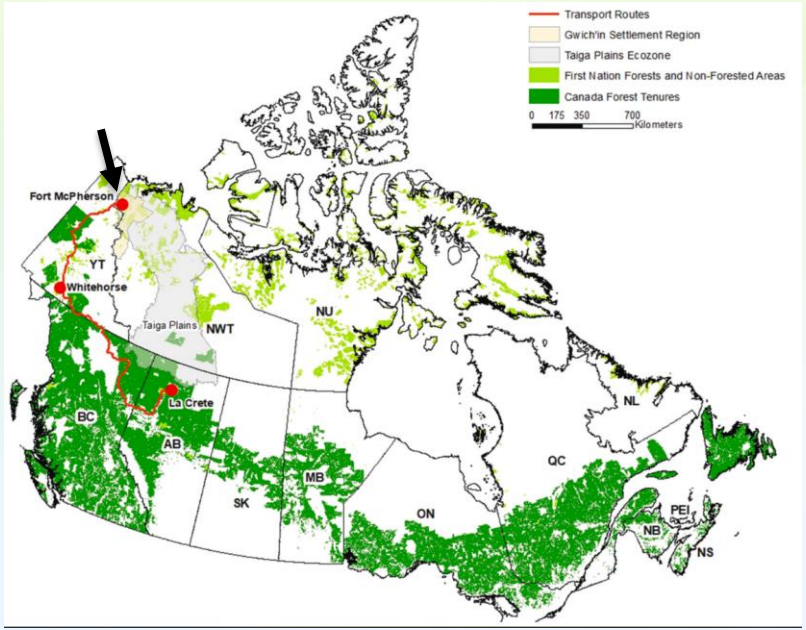
What mitigation potential for RNG?



Serra et al. (2019)

- The thermochemical process captures on average 60% of the biomass energy content..
- Potentiel net GHG savings of **52 to 78 Mt CO2eq/yr**

Case study – Arctic remote community



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Biomass and Bioenergy

journal homepage: www.elsevier.com/locate/biombioe

Greenhouse gas mitigation potential of replacing diesel fuel with wood-based bioenergy in an artic Indigenous community: A pilot study in Fort McPherson, Canada

Jennifer Buss [a], Nicolas Mansuy [a,*], Jérôme Laganière [b], Daniel Persson [c]

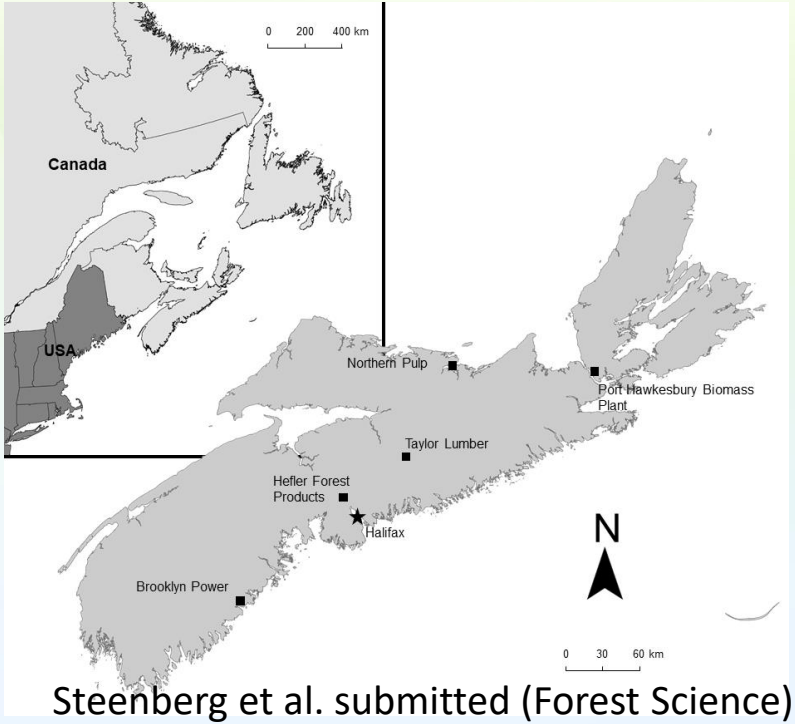
Time to GHG benefits

1. Pellets from Yukon or AB → 2-37 yrs
2. Local willow biomass → 0-20 yrs

Case study – Nova Scotia

- 5 CHP systems (1.15 to 60 MW)
- Coal and natural gas substitution
- Bioenergy GHG model coupled with CBM-CFS3 for forest C dynamics

- *the use of forest biomass in local CHP facilities can deliver GHG benefits in the short term, but careful attention must be given to avoid or minimize the use of additional primary biomass.*



Steenberg et al. submitted (Forest Science)

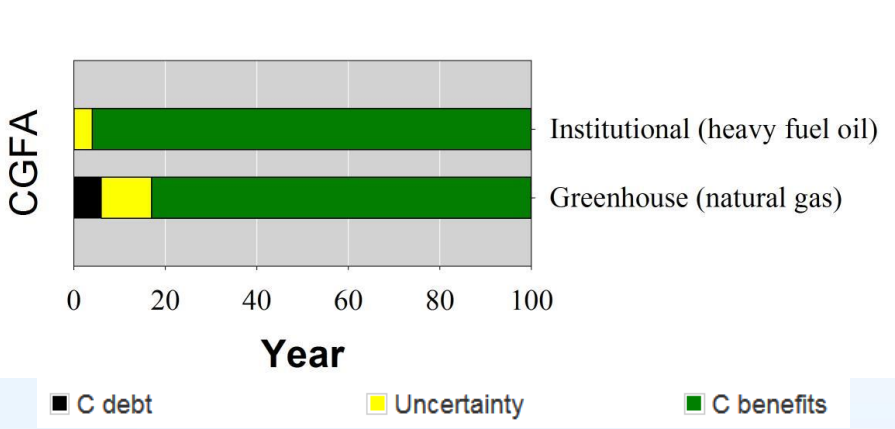
Case study - Québec Forest Coops

- GHG mitigation analysis - 4 Forest Coops
- Local biomass heating projects
- Different clients / different project specs

Serra et al. (2017)

Example: Forest Coop CGFA

Distance from forest to client :
1- Institutional heating → 78km
2- Greenhouse heating → 148km



Serra et al. (2017)

Summary

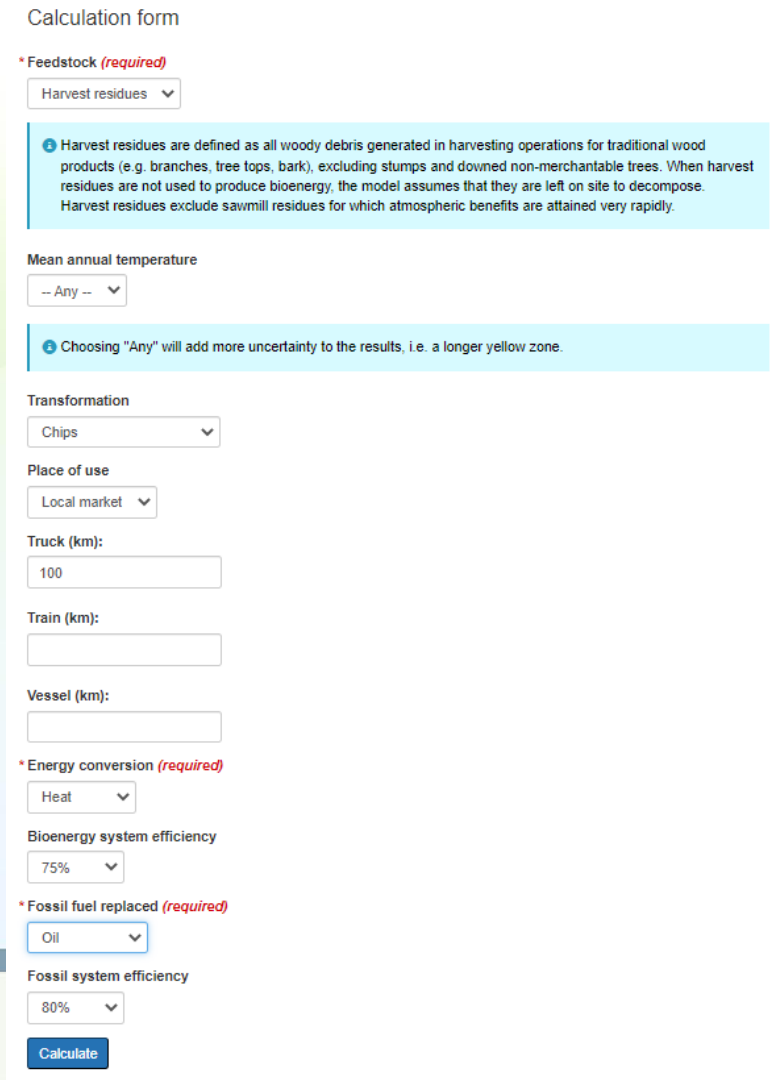
- Forest biomass generates GHG reduction when substituting fossil fuel, but large variability in the timing
- Uncertainty may lead to different outcomes → important to consider
- Residual biomass, local use in high efficiency applications (heat or CHP) to replace coal/oil usually provide the fastest GHG benefits BUT…
- Short payback times are better but longer ones can also help fighting climate change
- Multiple forest products are generated by forestry → assessing the contribution of the « forest sector » as a whole, not just bioenergy

Bioenergy GHG calculator

- Simple web tool to rank scenarios based on their anticipated GHG emission profiles
- Not suited to assess the GHG benefits of policies or projects with specific/complex assumptions

- Build your own scenario!

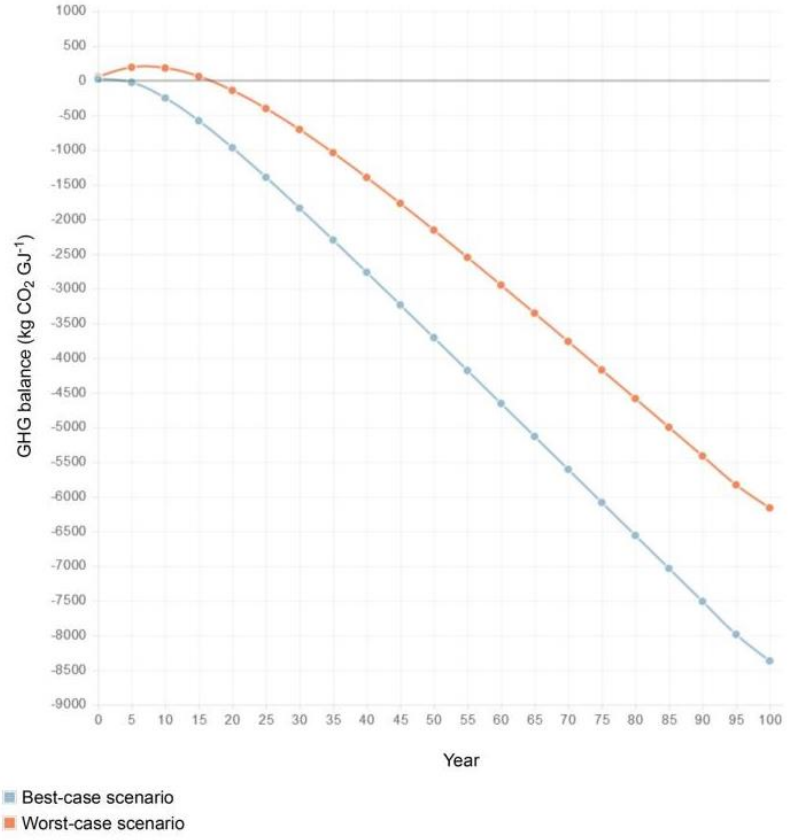
https://apps-scf-cfs.rncan.gc.ca/calc/en/bioenergy-calculator



Bioenergy GHG calculator

Results

Harvest residues intended for local market to be used in heat production (instead of using oil)



Harvest residues for local market to be used in heat production (instead of using oil) - Table

Harvest residues for local market to be used in heat production (instead of using oil)

Years	0	10	20	30	40	50	60	70	80	90	100
Best-case scenario	22	-250	-968	-1839	-2764	-3707	-4655	-5607	-6558	-7511	-8368
Worst-case scenario	51	182	-141	-705	-1396	-2154	-2949	-3762	-4585	-5413	-6161

A positive value represents a net source of CO_2 while a negative value represents a net benefit to the atmosphere.

C debt, uncertainty and C benefits

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Thank you

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