



# The Role of Forests in Carbon Sequestration and Storage

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**Werner A. Kurz**

**Natural Resources Canada  
Canadian Forest Service  
Victoria, BC, Canada**

Commission for Environmental Cooperation of North America  
Joint Public Advisory Committee  
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Natural Resources  
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# Outline

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- Contribution of forests to Carbon sequestration
- Mitigation options in the forest sector
- Conclusions





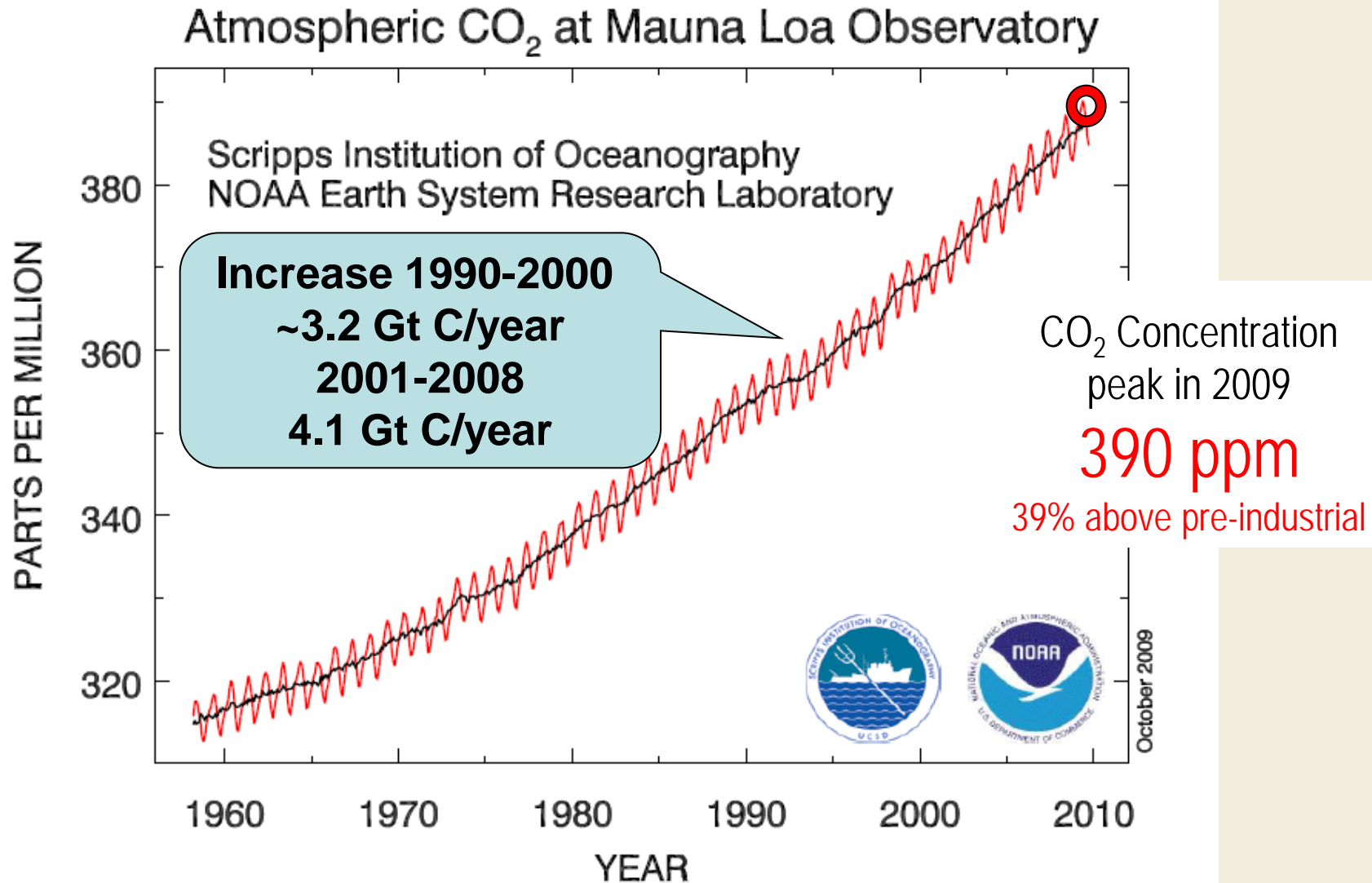
# Forest Carbon 101

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- 50% of the dry weight of wood is carbon.
- 1 m<sup>3</sup> of wood contains ~ 0.25 tons of carbon
- when burned releases ~ 1 ton of CO<sub>2</sub>
- C x 3.7 = CO<sub>2</sub>
- C in 1 m<sup>3</sup> of wood similar amount as in ~350 litres of gasoline.



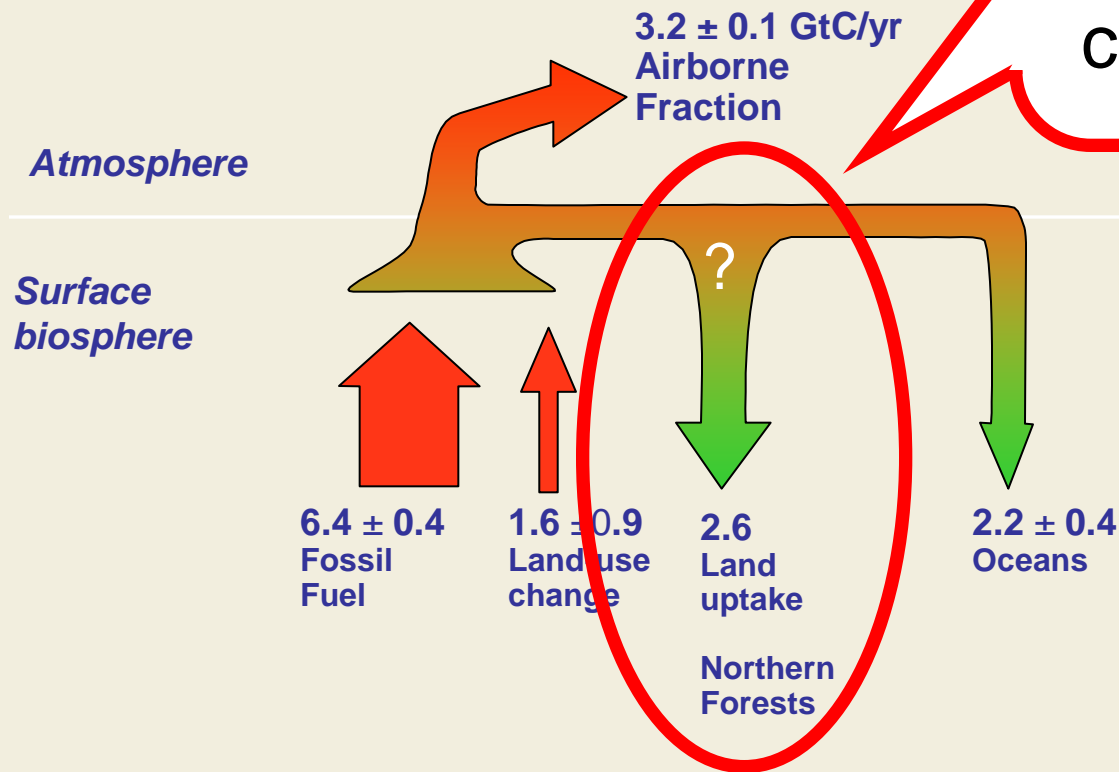
# Increase in Atmospheric CO<sub>2</sub> Concentration



# Human Perturbations to the Global C Cycle

Less than half of *human* emissions stay in the atmosphere:  
8.0 up but only 3.2 remains

Forests will affect the future CO<sub>2</sub> concentration.



Data for 1990s from IPCC 2007



# Forest Contribution to C Sequestration

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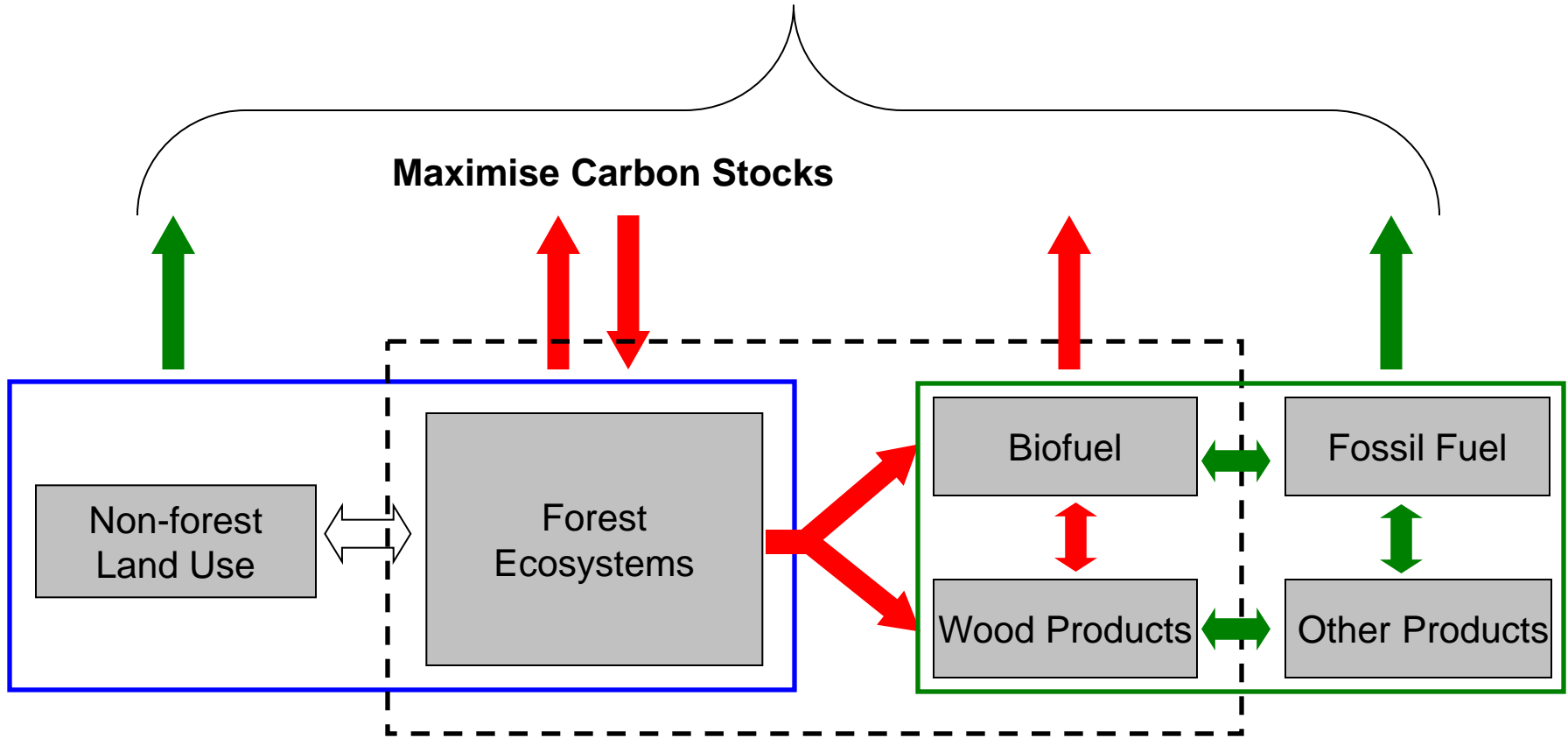
- Forests remove C from the atmosphere and store it in wood, dead organic matter and soils.
- Forests release C through decomposition and fire.
- The net C balance (sink or source) is the difference between large fluxes.
- Harvested wood products store C in use and in landfills.
- Harvested wood products can be used to substitute emissions-intensive materials (e.g. steel, concrete, plastic).
- Wood biomass can be used as renewable source of energy.



# Forest Mitigation Strategies: Systems Approach

Minimise net Emissions to the Atmosphere

Maximise Carbon Stocks



Land-use Sector

Forest Sector

Services used by Society

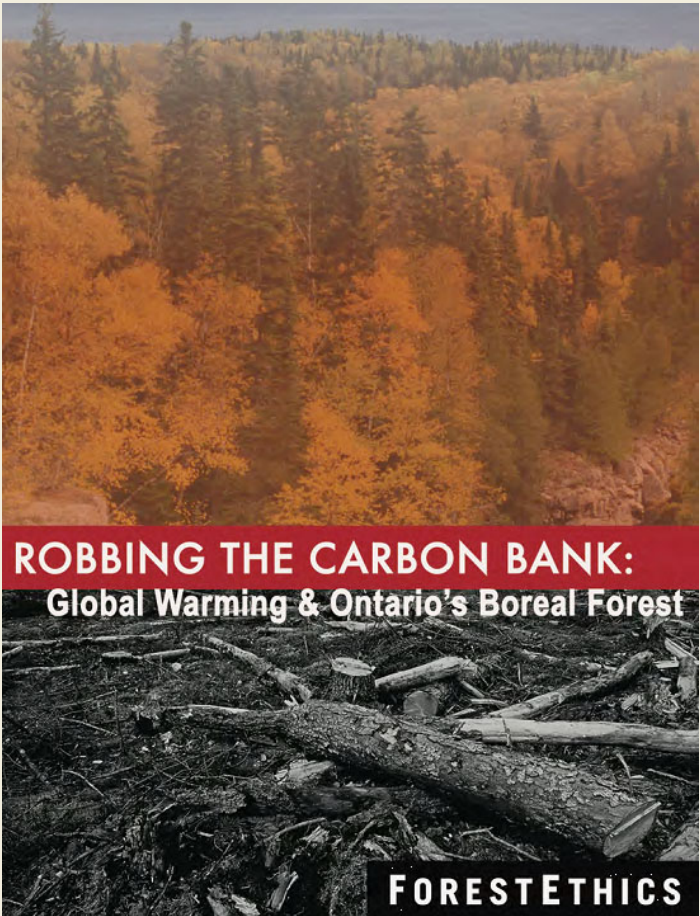
Source: IPCC 2007, AR4 WG III, Forestry



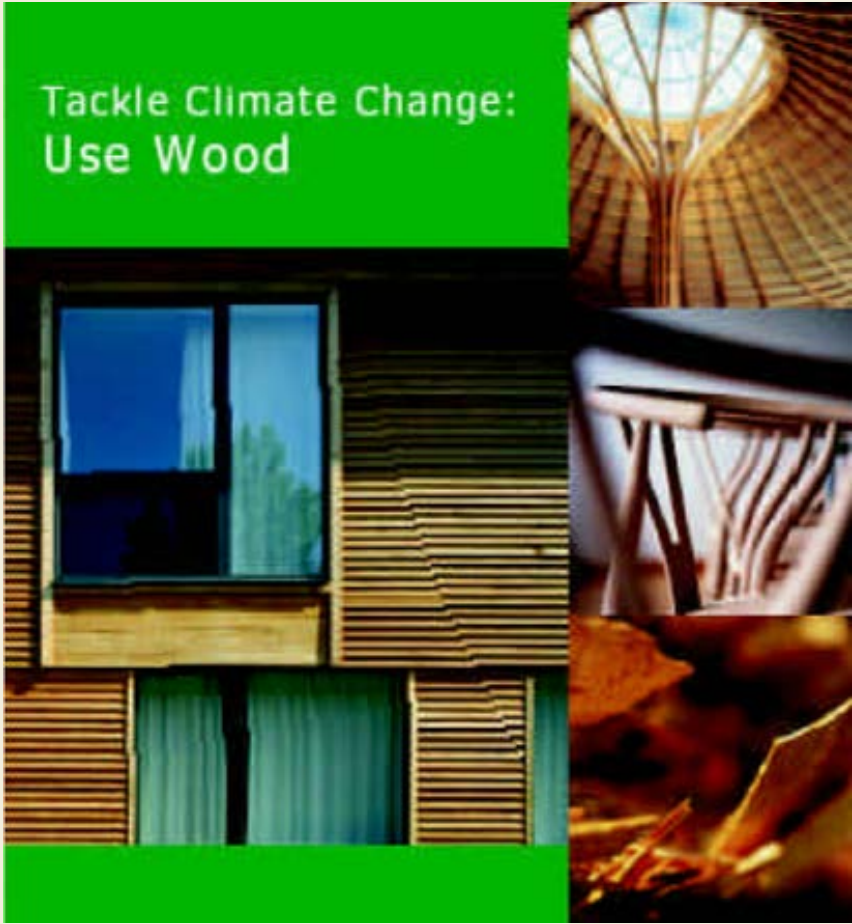


# Forest Mitigation Strategies: 2 competing positions

Stop logging .....

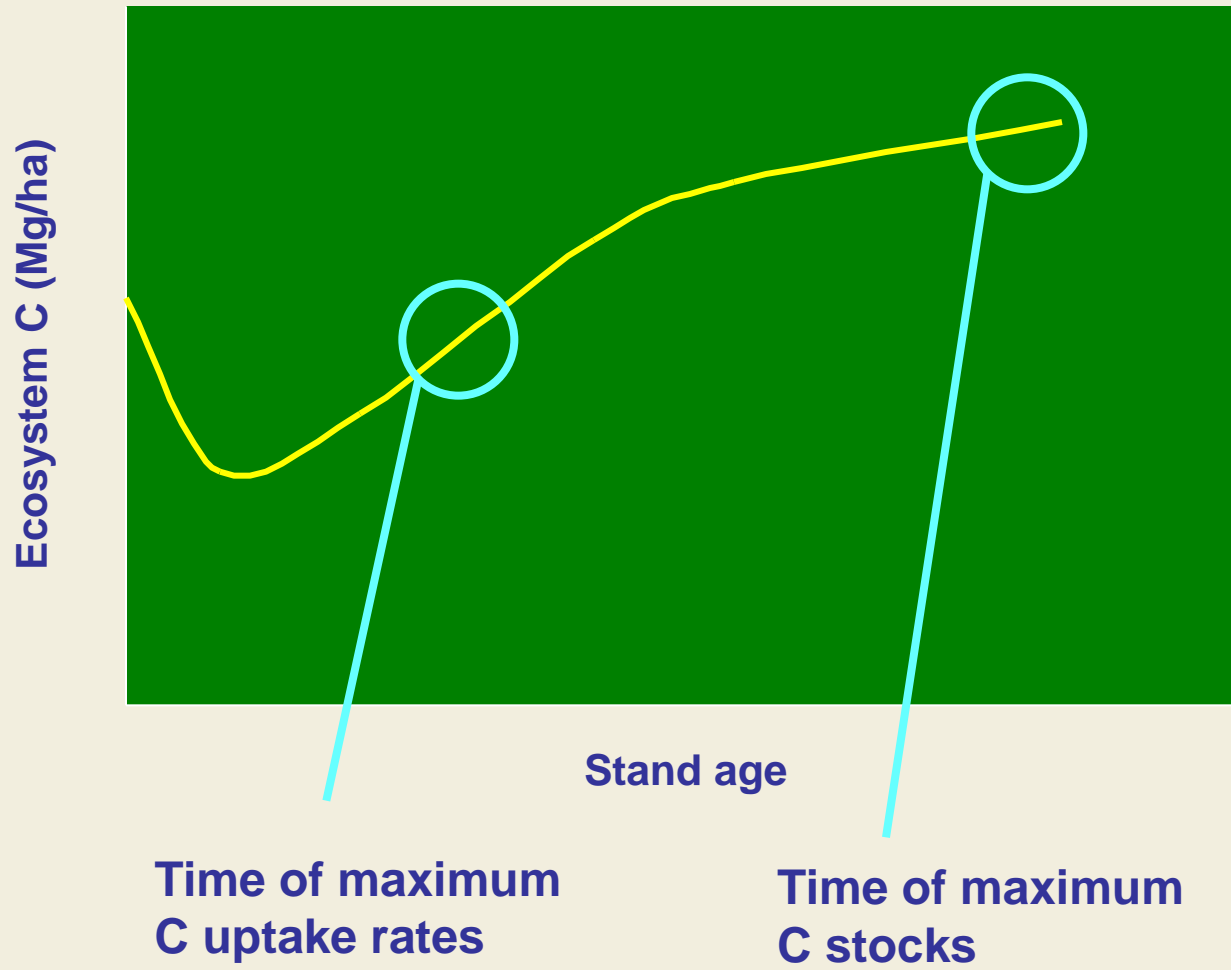


... or use wood?



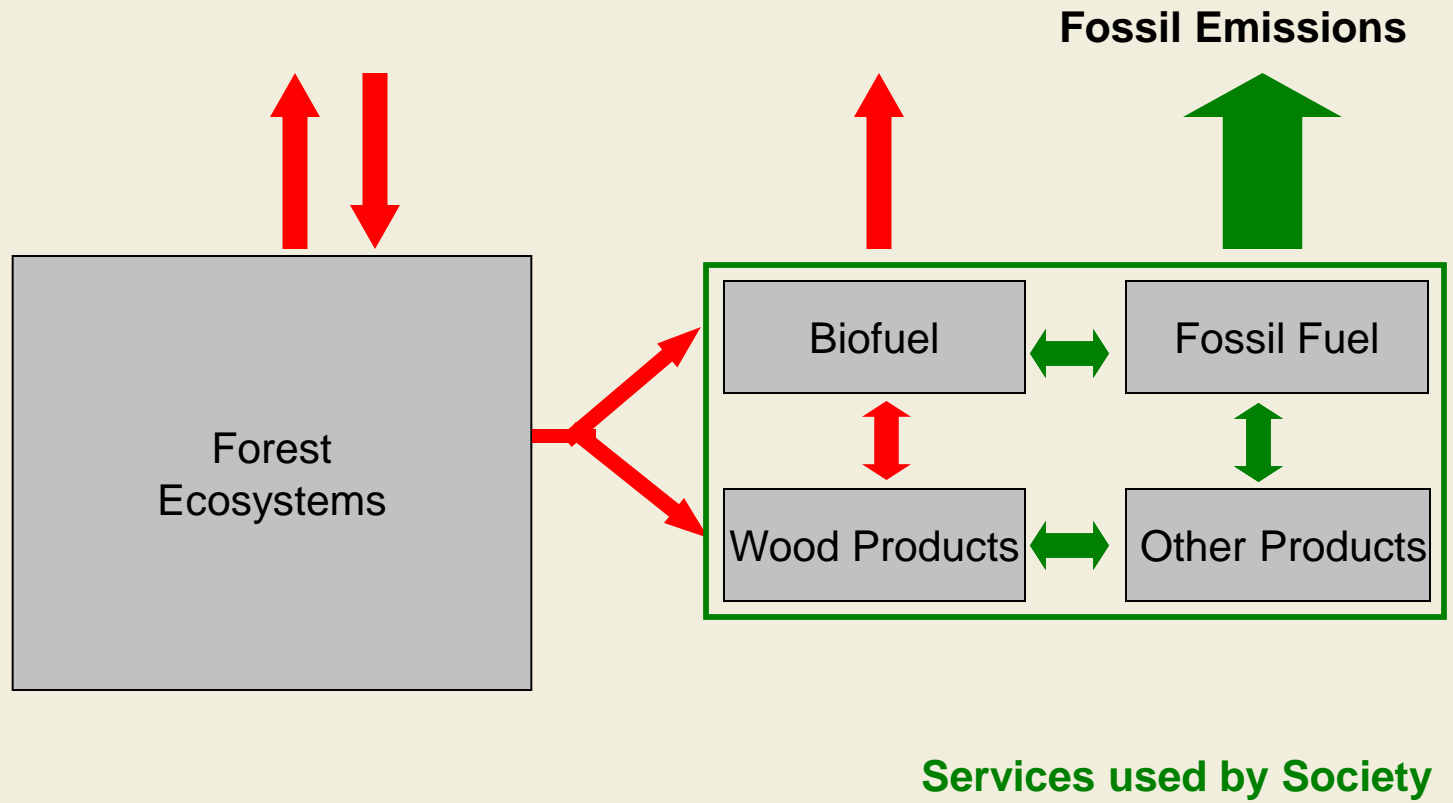


# Stand-level C dynamics



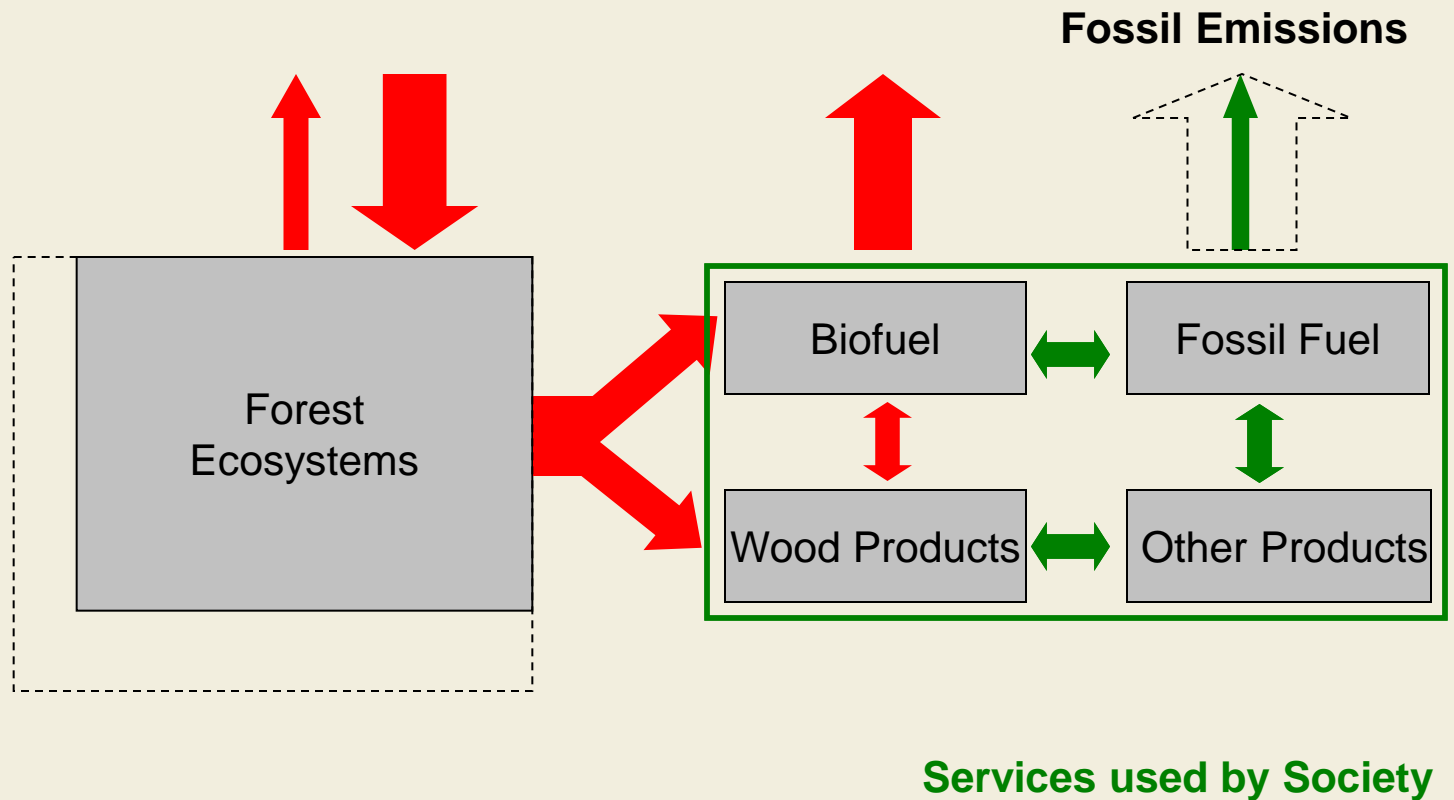
# Forest Mitigation Strategies: 2 competing positions

Maximise Carbon stocks ....



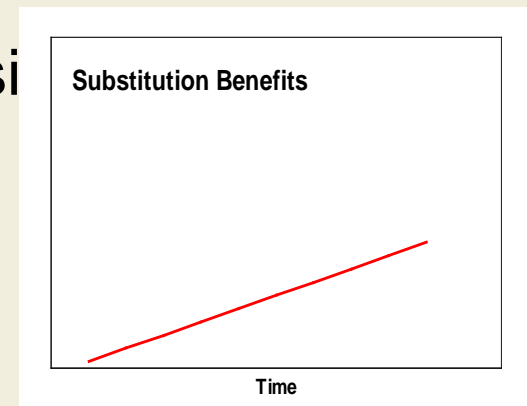
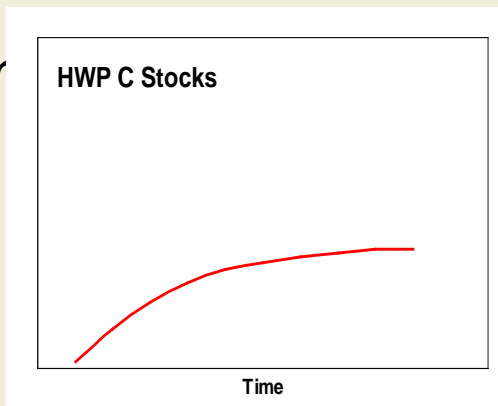
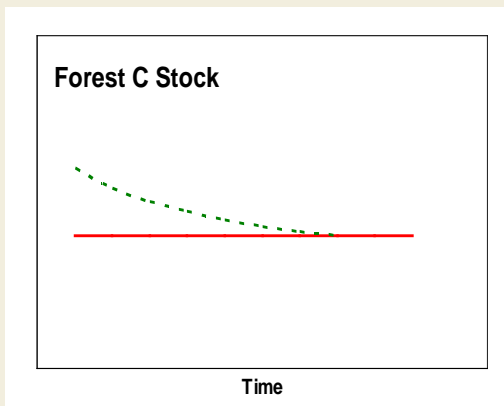
# Forest Mitigation Strategies: 2 competing positions

... or maximise Carbon uptake?



# Forest Sector C with Sustainable Forest Management

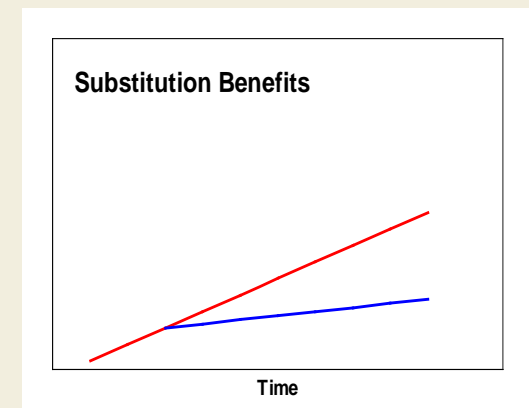
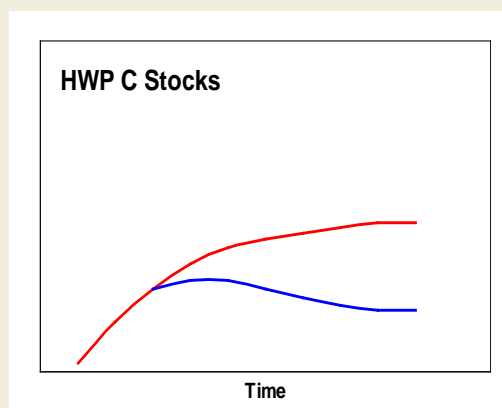
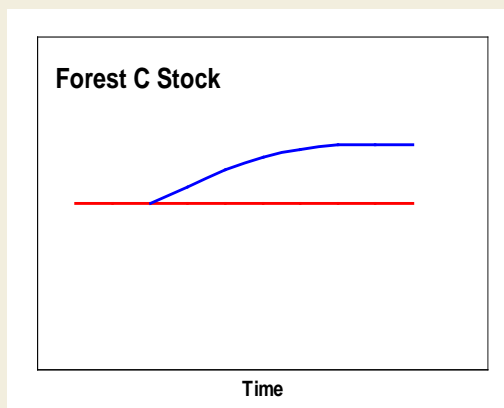
- With SFM C stocks can be maintained (once transition from natural to managed landscape completed)
- Harvested Wood Product C stocks eventually saturate continuous increases in landfills possible – but because of CH<sub>4</sub> emissions not desirable
- Substitution benefits accumulate over time





# Forest Sector Carbon with Conservation Strategy

- With conservation strategy forest C stocks can increase
- Harvested Wood Product C stocks decrease to lower level
- Substitution benefits accumulate at slower rate.
- Relative advantage of SFM vs conservation strategy depends on MANY factors and is not decided by carbon criteria alone.



# Mitigation Options in the Forest Sector

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1. Increase (or maintain) forest area
  - Reduce deforestation (REDD), increase afforestation
2. Increase stand-level carbon density
  - Silviculture, avoid slashburning, reduced regeneration delays, species selection, fertilization, tree improvement programs
3. Increase landscape-level carbon density
  - Longer rotations, conservation areas, protection against fire
4. Increase C stored in products, reduce fossil emissions through product substitution and through bioenergy use

Source: Nabuurs et al. 2007, IPCC AR4



# Carbon Neutral Bioenergy from Forests?

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*Two reasons why bioenergy is considered C neutral:*

1. Current accounting rules consider emission to occur when biomass is transferred out of forest
  - Emissions already accounted at time of harvest
  - Rules could change in future agreements
  
2. (Re) Growth removes emitted C from atmosphere
  - But over what time frame does this removal occur?
  - For agricultural residues – in previous year.
  - For short-rotation energy crops - in past 3 – 5 years
  - For forests – over past decades



# Bioenergy and Forest Carbon

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- Large-scale increases in demand for woody biomass could reduce forest C stocks or their rate of increase. Even if bioenergy is treated as C neutral, the impacts on forest C stocks must still be quantified (and reported).
- Sustainably managed bioenergy plantations (on land not used for food production) can remove large quantities of C per hectare from the atmosphere and provide feedstock for bioenergy production.
- Even if emissions per unit of energy from biomass are typically higher than those from fossil fuels – bioenergy is renewable (regrowth removes C from atmosphere) and can reduce the release of fossil C.





# Forest Management Mitigation Strategies

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- In a carbon-constrained world, every sector of society will be expected to contribute to climate mitigation activities.
- Forest sector well positioned: forests remove carbon from atmosphere and provide timber, fibre and energy.
- Forest mitigation strategies are compatible with sustainable management: from conservation to intensive management
- As the value of carbon increases, the number of forest management options, the area available for afforestation, and potential bioenergy options all increase.
- Mitigation activities require investment now to achieve future benefits.



# Conclusions

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- Mitigation opportunities – i.e. reducing sources and increasing sinks relative to a baseline – exist in both forest management and the forest product sector.
- Mitigation efforts – and the resulting economic values of carbon and energy contained in wood – may create new opportunities for forest sector, communities and economy.
- Limiting the impacts of climate change is one important step towards maintaining the mitigation potential of forests.
- Research is ongoing to assess mitigation options in forests:
  - carbon (and non-CO<sub>2</sub>) cost and benefits,
  - costs and barriers to implementation,
  - magnitude of their potential contribution, and
  - risks / probability of success.



# Conclusions

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- A sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit (IPCC AR4, Nabuurs et al. 2007).



# Conclusions

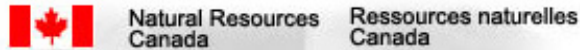
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- Forests and forestry cannot solve the problem of fossil C emissions, but they can contribute to the solution.





# Thank you very much!



Forest Carbon Accounting  
Comptabilisation du Carbone Forestier

Canadian Forest Service  
Service canadien des forêts



**Website:** [carbon.cfs.nrcan.gc.ca](http://carbon.cfs.nrcan.gc.ca)  
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