

Mitigation Strategies for the Forest Sector

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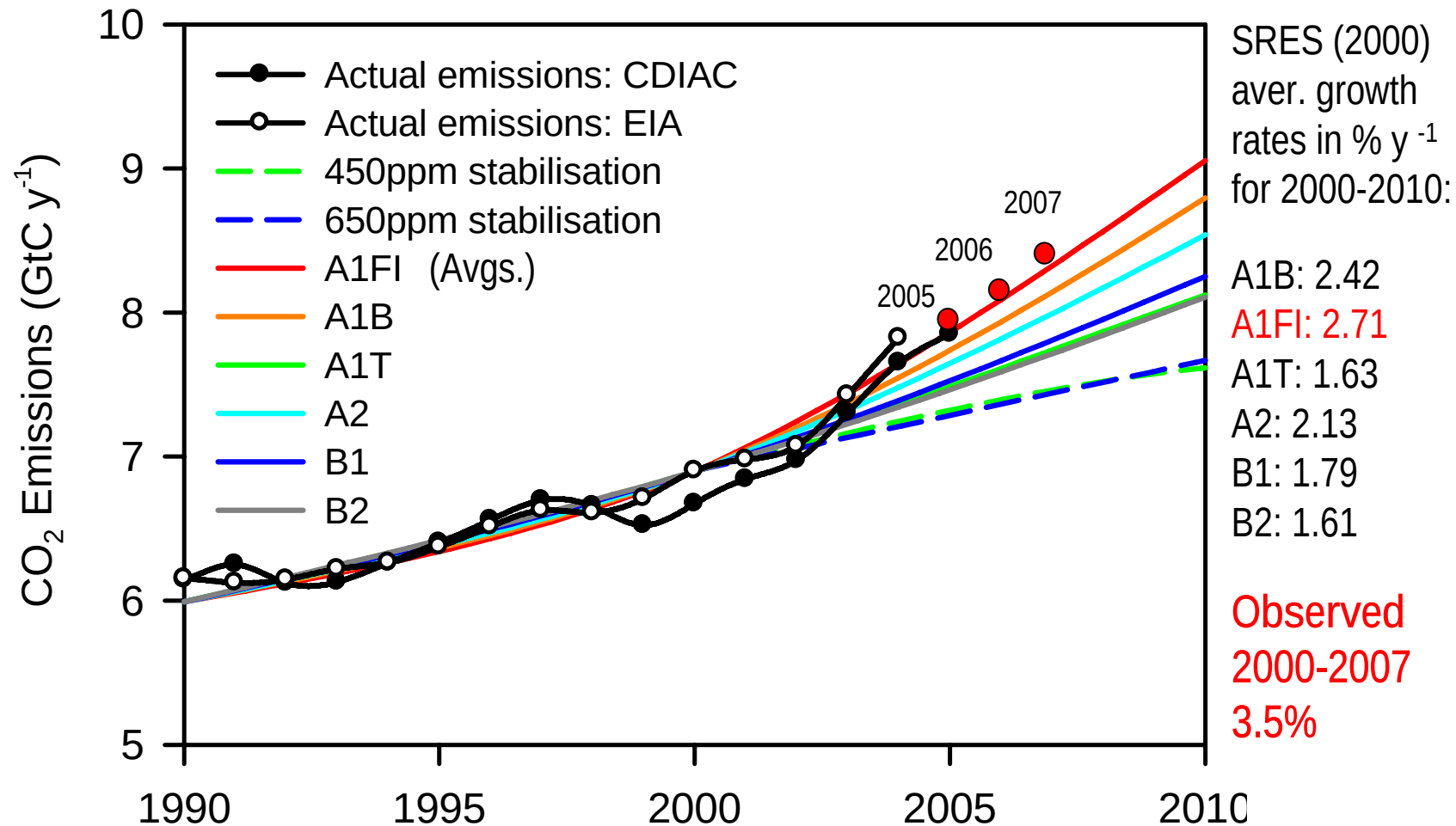
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Outline

- Background
- Forest Mitigation Options
- “Robbing the Carbon Bank” or
“Tackle Climate Change: Use Wood”
- Climate Change Impacts and Salvage
- Conclusions



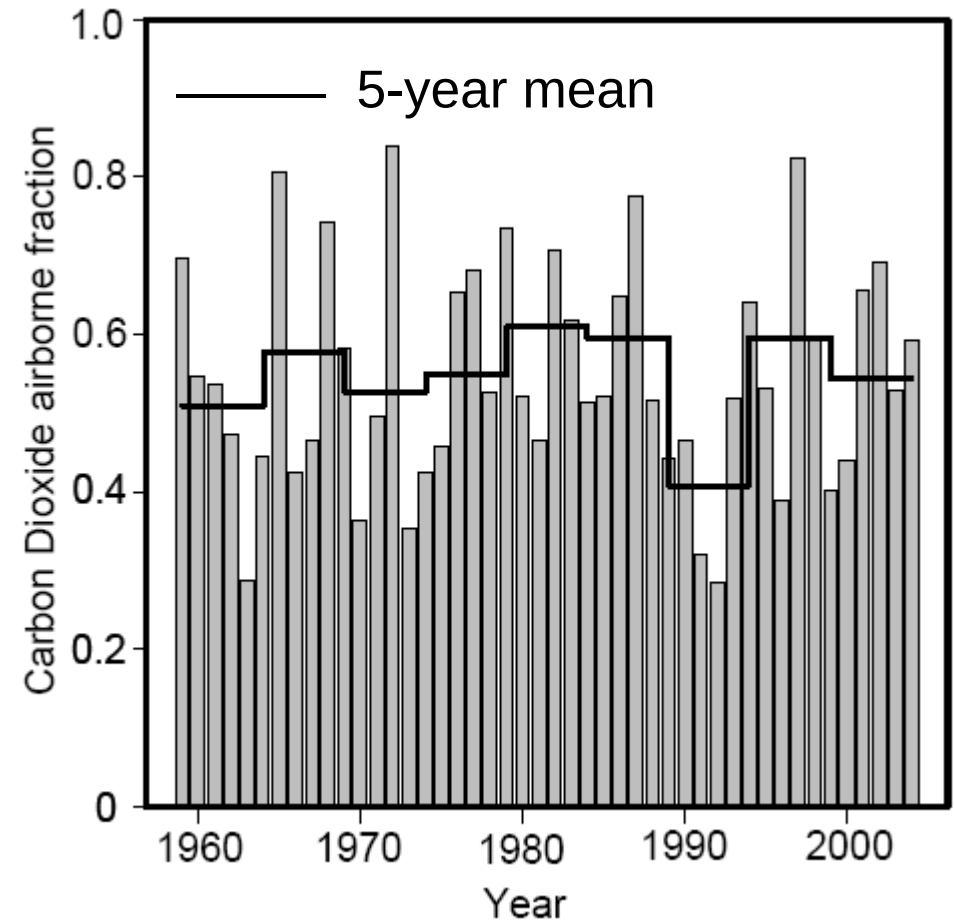
2000-2006 CO₂ emissions growth rate exceeds all IPCC scenarios



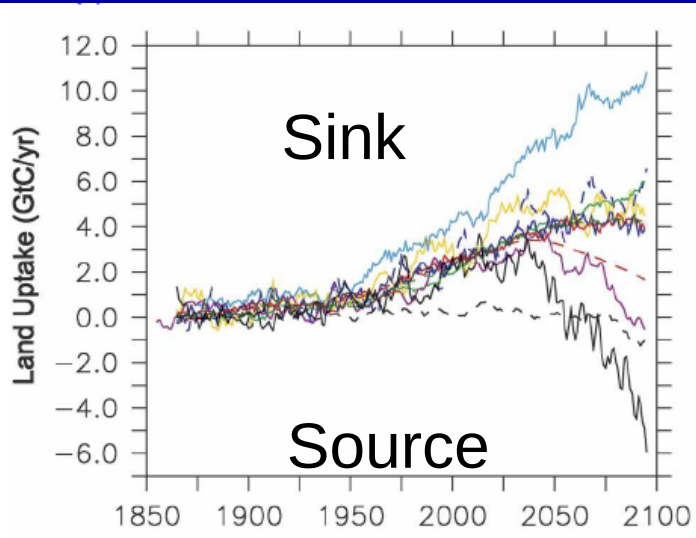
Annual Variation in Airborne Fraction

The proportion of fossil CO₂ emissions remaining in the atmosphere varies over time.

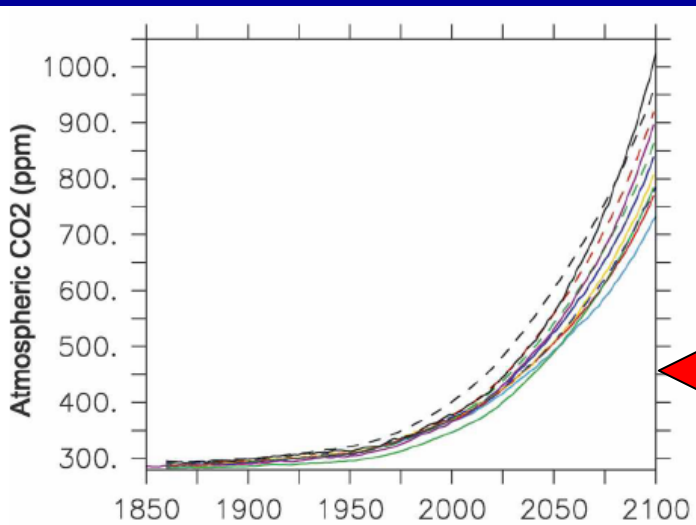
It is affected by the uptake by terrestrial ecosystems.



Climate Change impacts on forest carbon balance will affect the required level of mitigation efforts



Uncertainty among 11 global models on future C balance of terrestrial ecosystems in 2100: $\sim 16 \text{ Gt C yr}^{-1}$



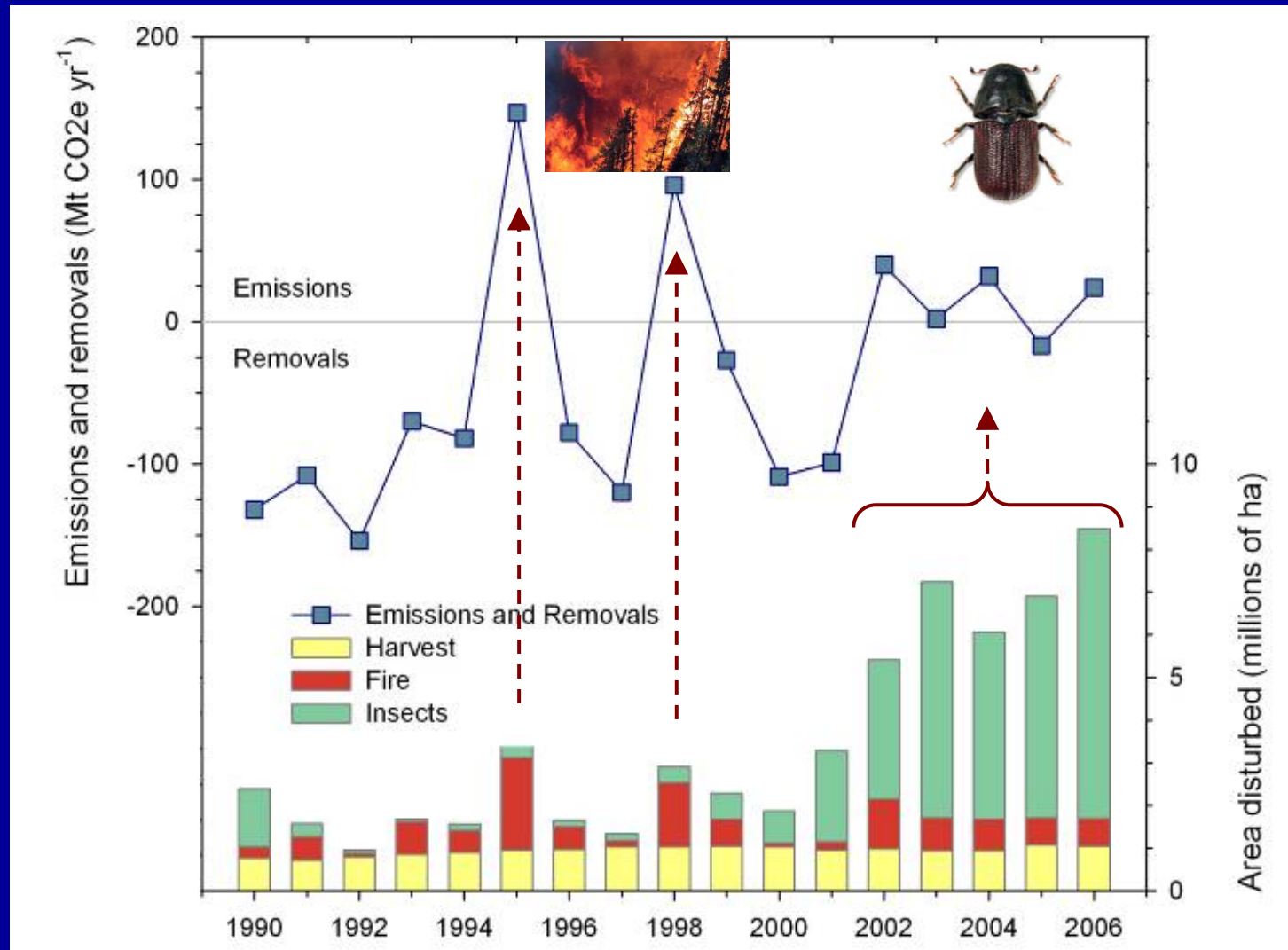
Contributes to uncertainties about future CO_2 concentration....

Stabilization Target ~ e.g. 450 ppm

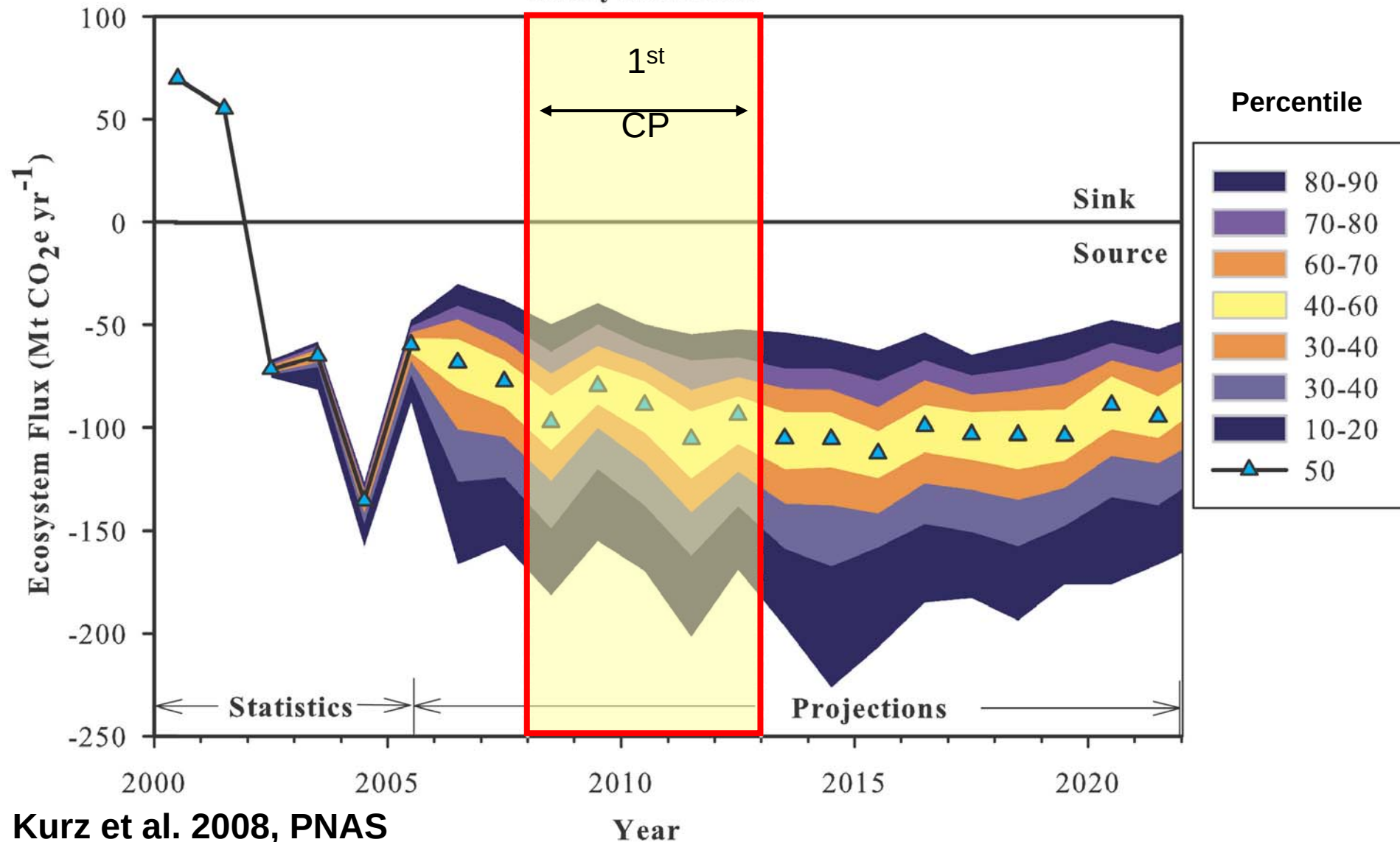
... and uncertainties about required level of mitigation efforts.

Managed forest GHG emissions and removals

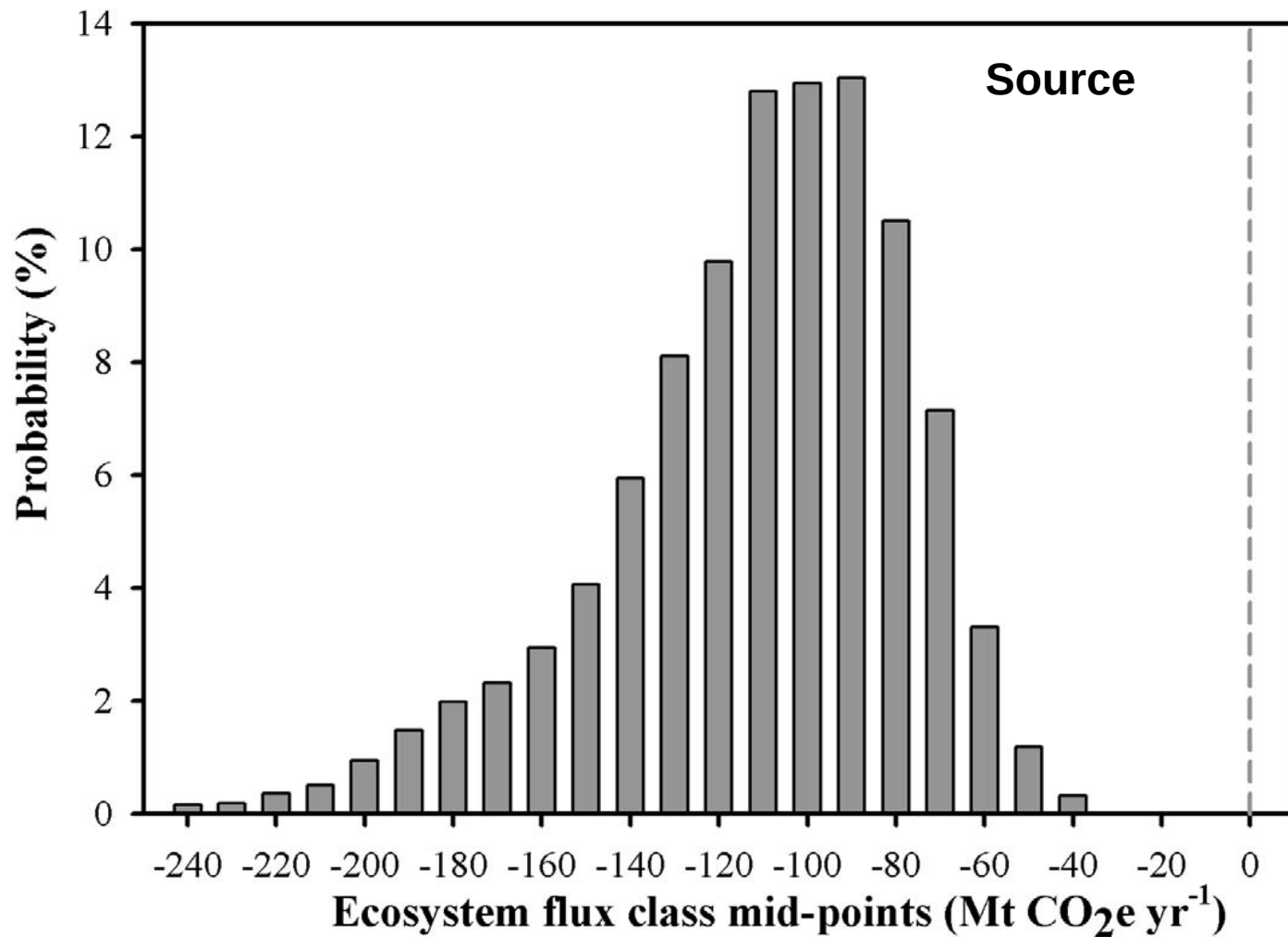
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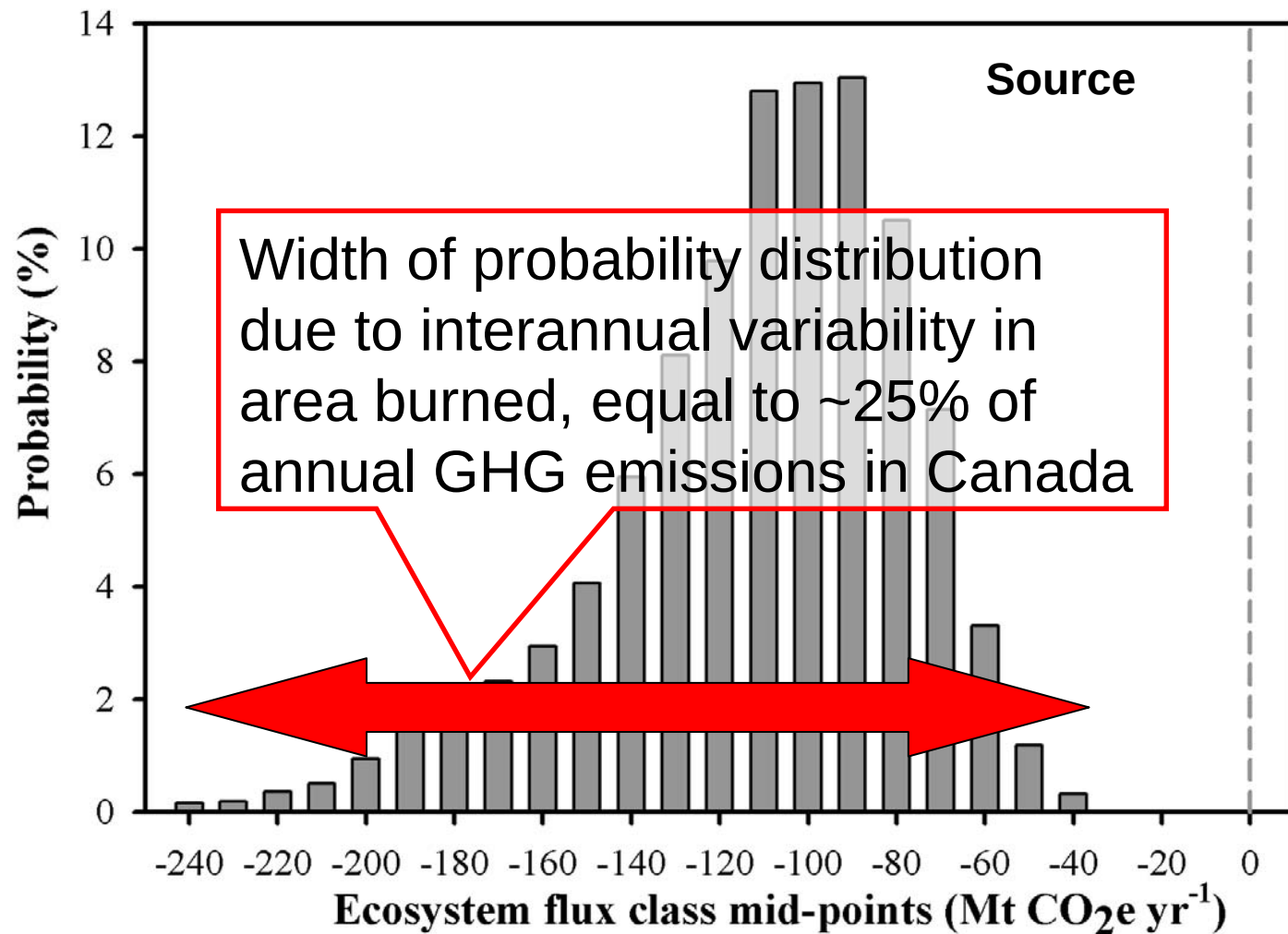
Canada's Managed Forest is Predicted to be a C Source in the Near Future



Probability Distribution of 5-yr average CO₂e Balance (2008 – 2012)



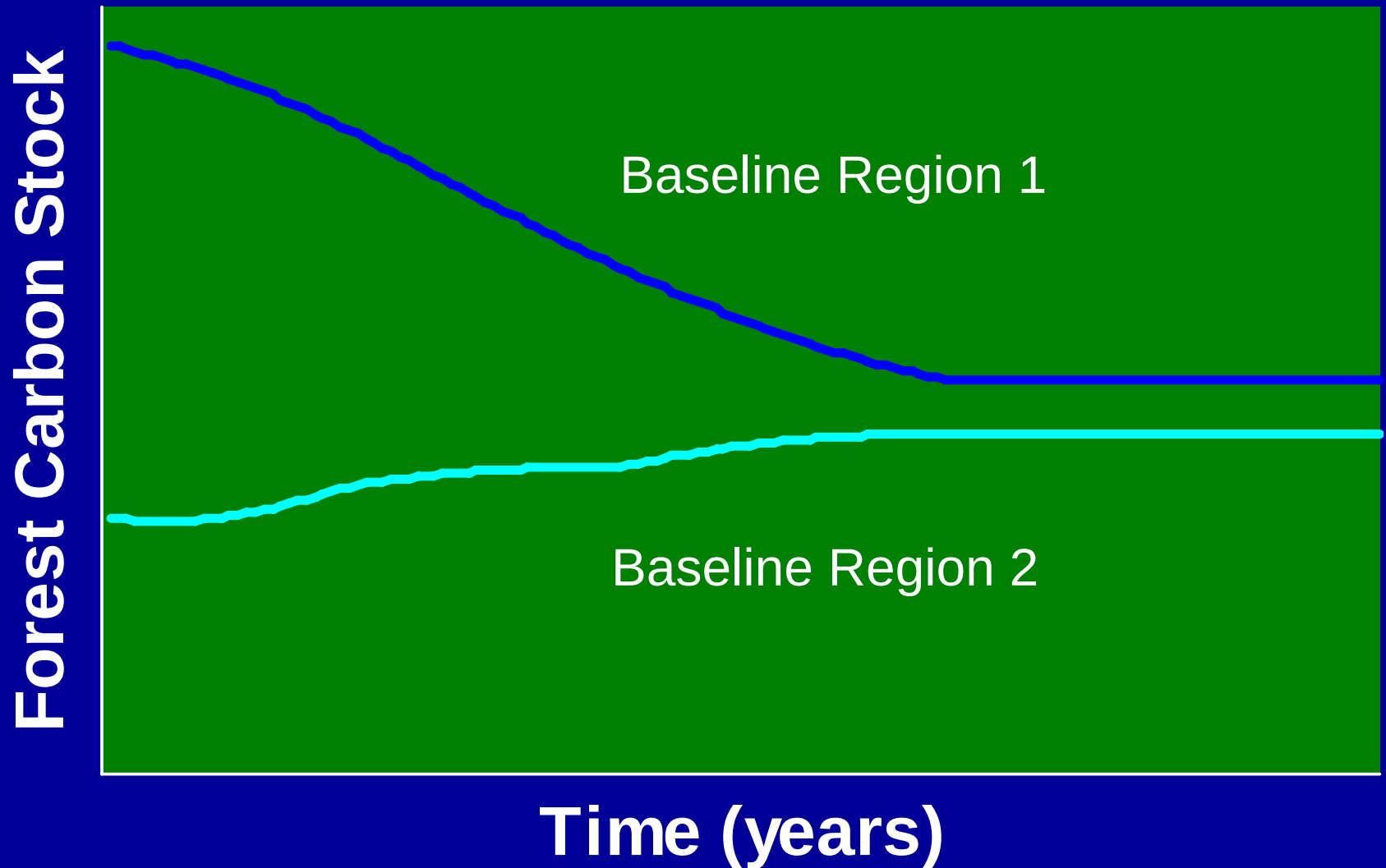
Probability Distribution of 5-yr average CO₂e Balance (2008 – 2012)



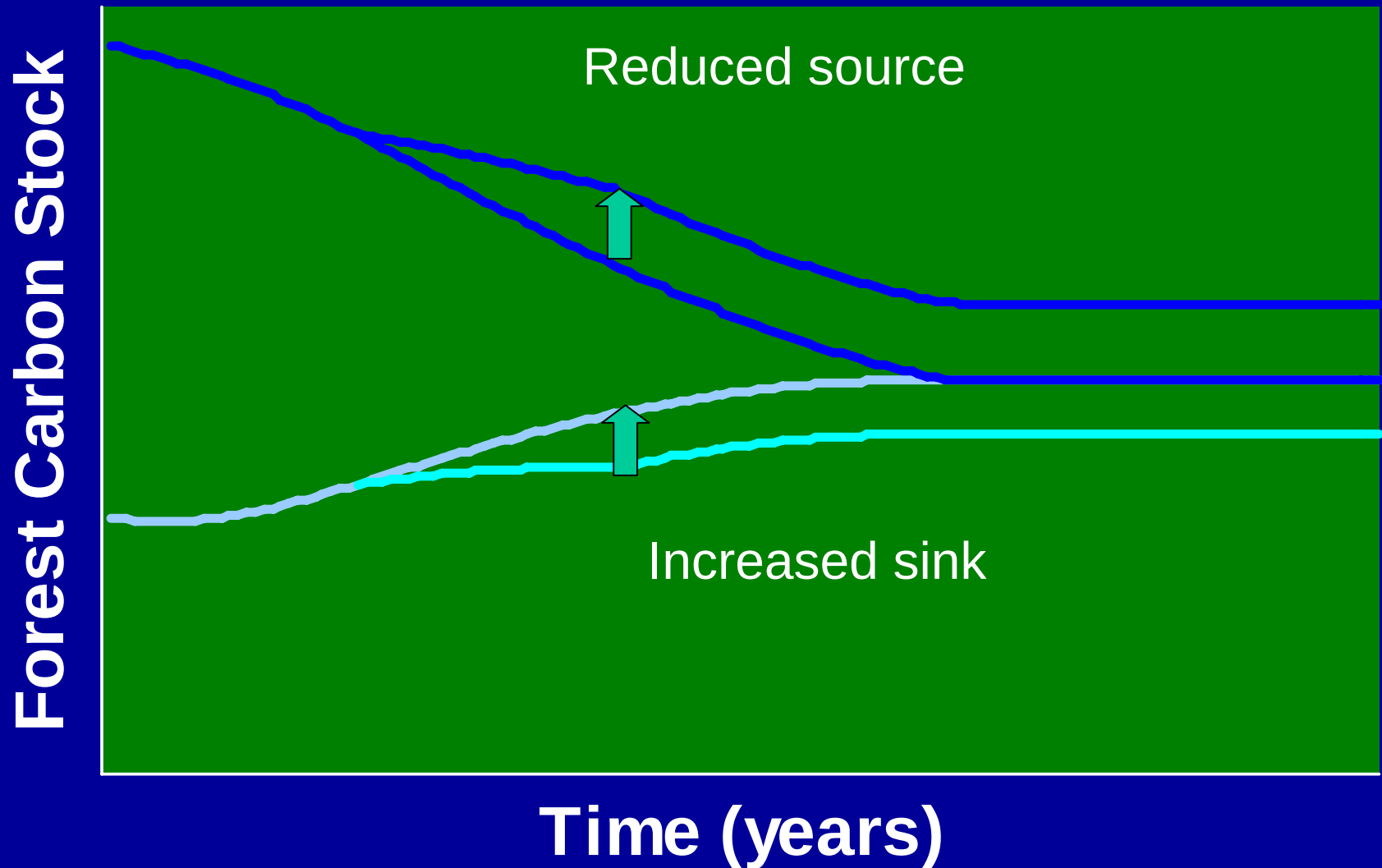
Does the Forest Sector have a Role in a Mitigation Portfolio?

- Mitigation objectives are achieved when changes in human activities result in
 - a reduction of emissions or
 - an increase in removals of GHG from the atmosphere relative to a projected business-as-usual baseline.
- Climate change will increase the area annually affected by fires, drought, and insects and could have negative impacts on forest carbon stocks.
- Nevertheless, forest management options are available to improve the net GHG balance of the forest sector relative to a baseline.

Increased Sink or Reduced Source both benefit the Atmosphere



Increased Sink or Reduced Source both benefit the Atmosphere



Mitigation Options in the Forest Sector

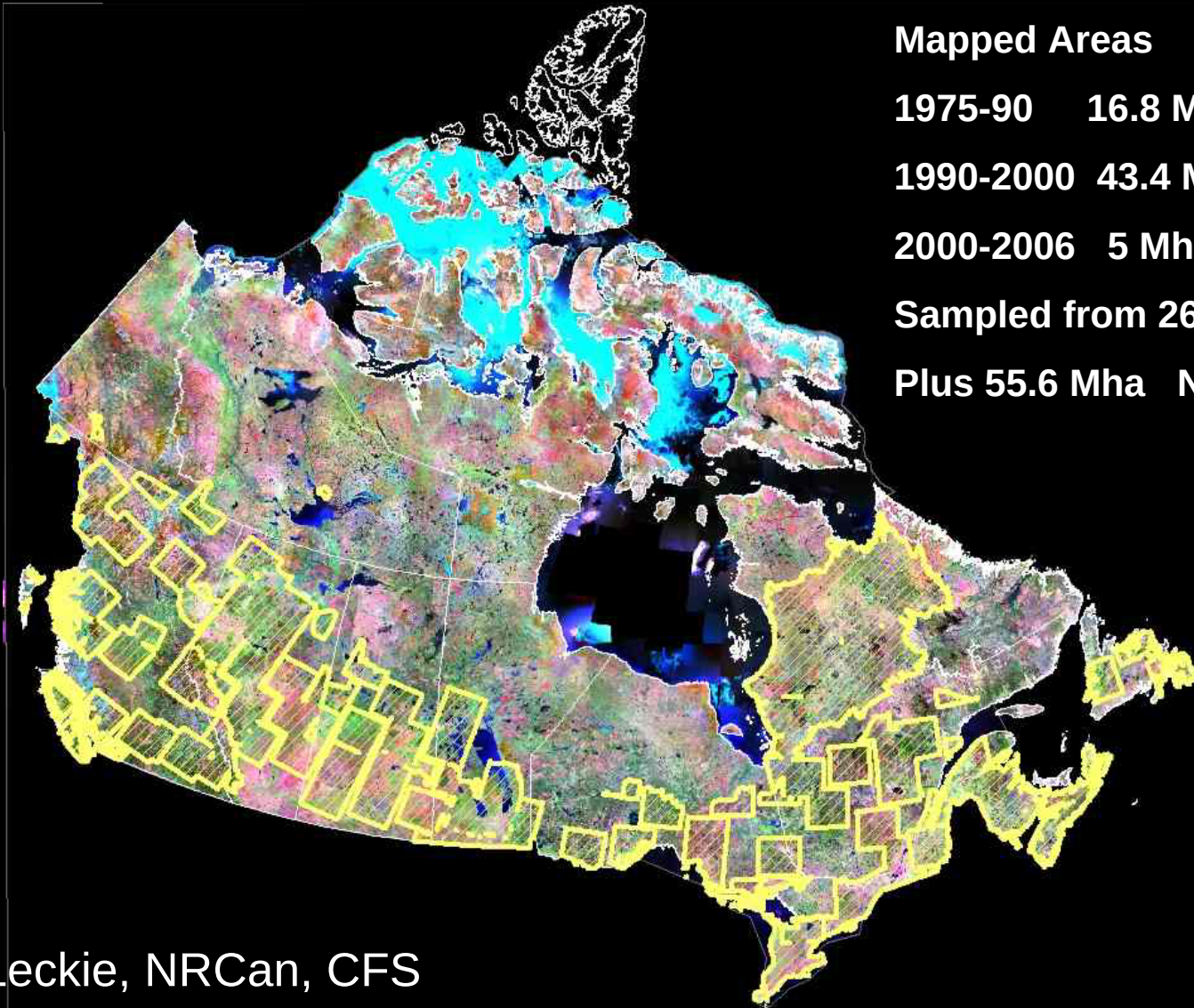
- What are possible elements of a forest sector mitigation portfolio?



Mitigation Options in the Forest Sector

1. Increase (or maintain) forest area

CFS Deforestation Monitoring Program



Source: D. Leckie, NRCan, CFS

Deforestation

Definition: the direct human-induced [non-temporary] conversion of forested land to non-forested land (UNFCCC)

2005 deforestation in developed countries

	<u>Mt CO₂e</u>	<u>%*</u>
Australia	74.1	14
Canada	19.9	3
EU15	7.3	0.2
Japan	-0.6	0
New Zealand	0.8	1
Russia	?	
United States	?	

* % of total emissions excl. LULUCF

Source: UNFCCC



Reducing Deforestation

- Government of BC has declared intent to introduce legislation in 2010 to achieve zero net deforestation by 2015.
- Where does deforestation occur, in what sectors, and at what rates?
- Where are areas for future afforestation to off-set unavoidable deforestation?
- Net zero deforestation in terms of area does not imply net zero carbon stock change!

Mitigation Options in the Forest Sector

1. Increase (or maintain) forest area
2. **Increase stand-level carbon density**
3. **Increase landscape-level carbon density**

Forest Management Activities

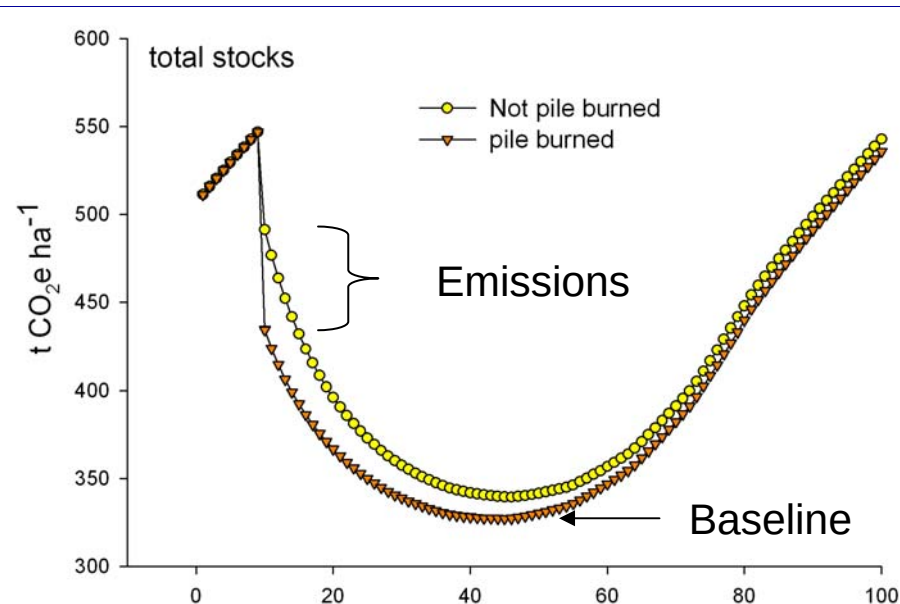
- Increase stand-level carbon density
 - Silviculture, harvest systems with partial cover, avoid slashburning, reduced regeneration delays, species selection, fertilization, tree improvement programs
- Increase landscape-level carbon density
 - Longer rotations, conservation areas, protection against fire and insects
- Forest management technologies for mitigation portfolios exist and are implemented operationally.

Stand-level Example 1: Avoided Slashburning

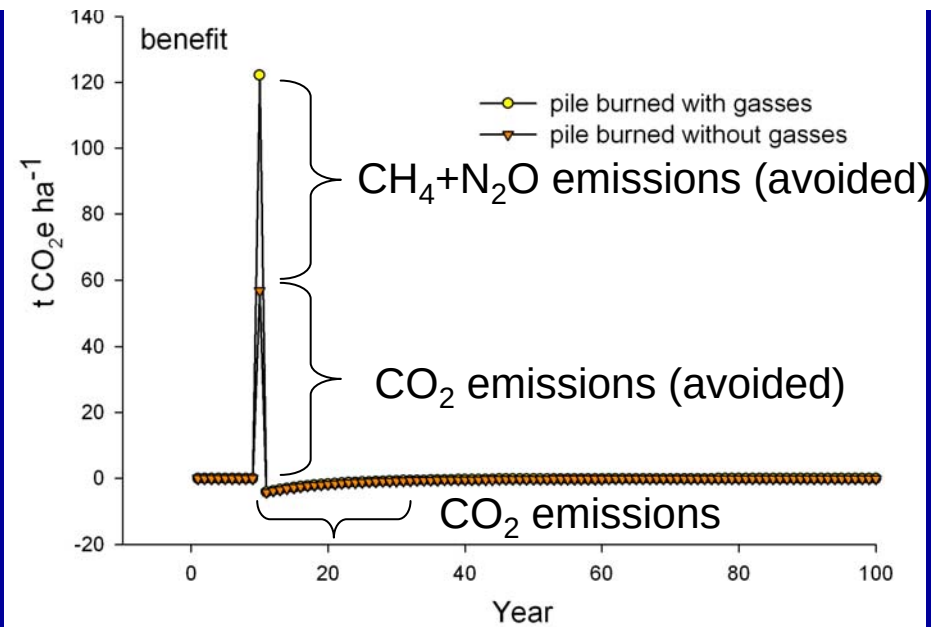
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- Burning of harvest residues (slashburning, pile and burn, windrowing, etc.) to reduce fire hazard or to improve site conditions for planting.
- Burning releases CO_2 , CH_4 and N_2O .
- Non- CO_2 emissions are avoided but some of the avoided CO_2 emissions occur in later years due to decomposition.

Stand-level Carbon Dynamics
(with and without burn)



Carbon and non- CO_2 benefits
(difference between with and without burn)

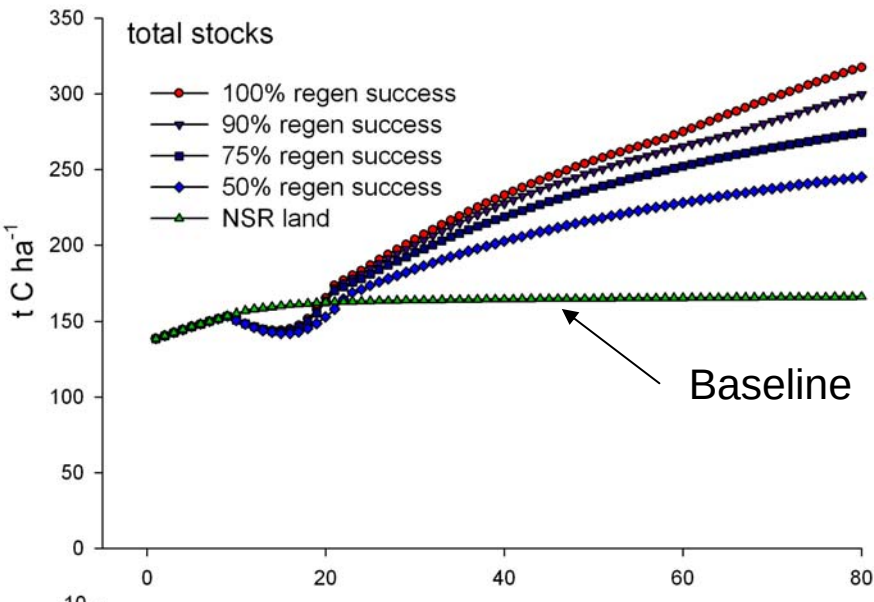


Stand-level Example 2: Replant NSR land

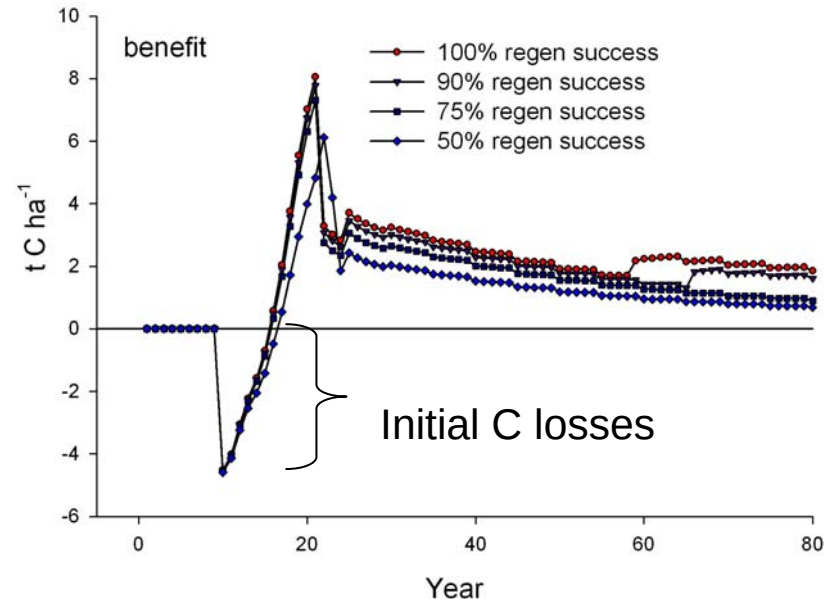
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- Not sufficiently stocked (NSR) land occurs for various reason. It often contains some vegetation.
- Planting on NSR land has initial C costs.
- Carbon benefits increase over time.

Stand-level Carbon Dynamics
(no action and planting)



Carbon benefits
(difference with and without planting)



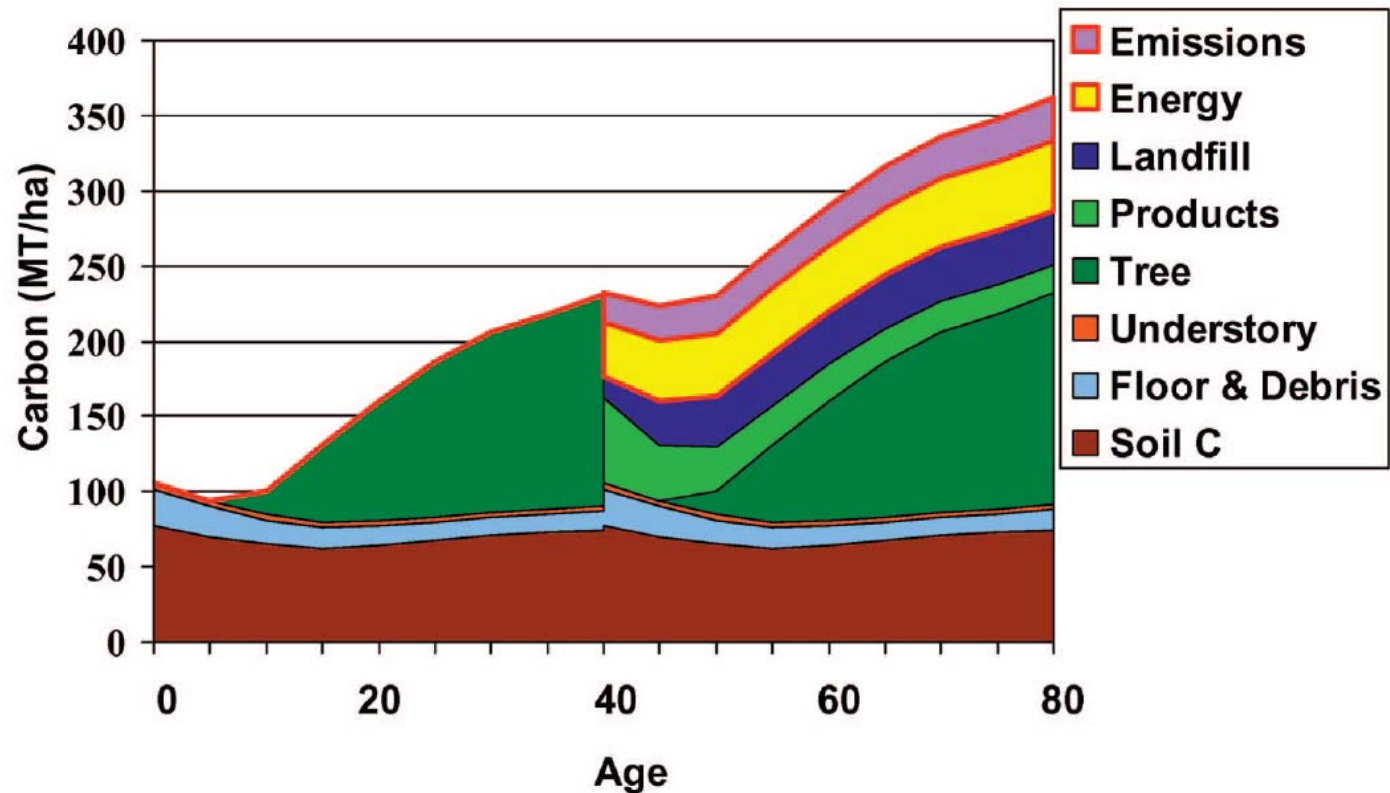
Portfolio Design: combining activities

- By combining activities with immediate benefits
 - e.g. avoided slashburning, avoided deforestation, reduced harvestwith activities for which benefits increase over time
 - e.g. conversion of understocked land, tree breeding, afforestationit is possible to meet mitigation objectives on a sustained basis.
- Work is ongoing to quantify:
 - per ha benefits of alternative mitigation options,
 - “scalability” of each option,
 - Stands and landscapes appropriate for mitigation activities (initial conditions, age-class structure, risk of disturbance), and
 - economic and ecological costs and benefits.

Mitigation Options in the Forest Sector

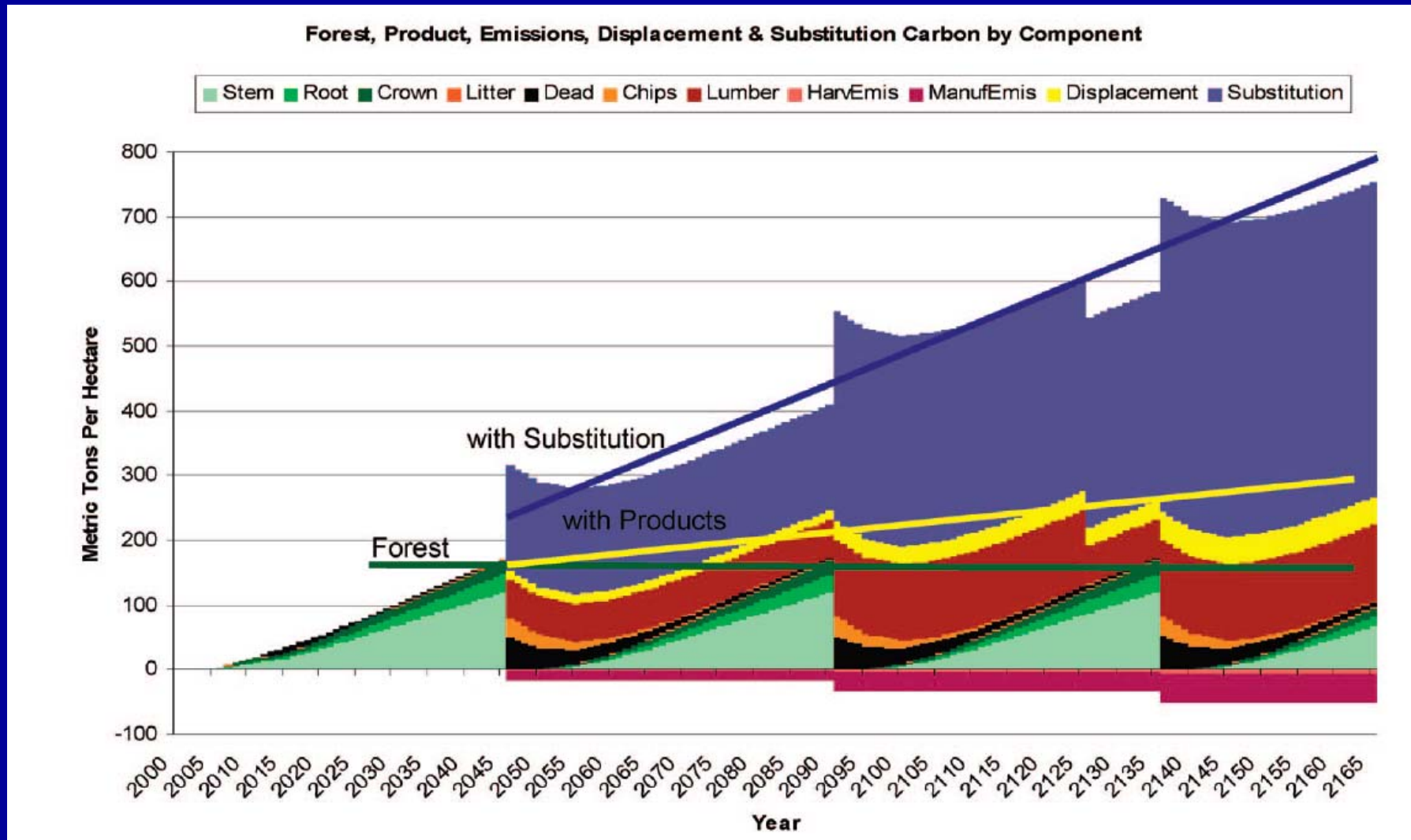
1. Increase (or maintain) forest area
2. Increase stand-level carbon density
3. Increase landscape-level carbon density
4. **Increase C stored in products, reduce fossil emissions through product substitution and through bioenergy use**

C Accounting in Forest Sector

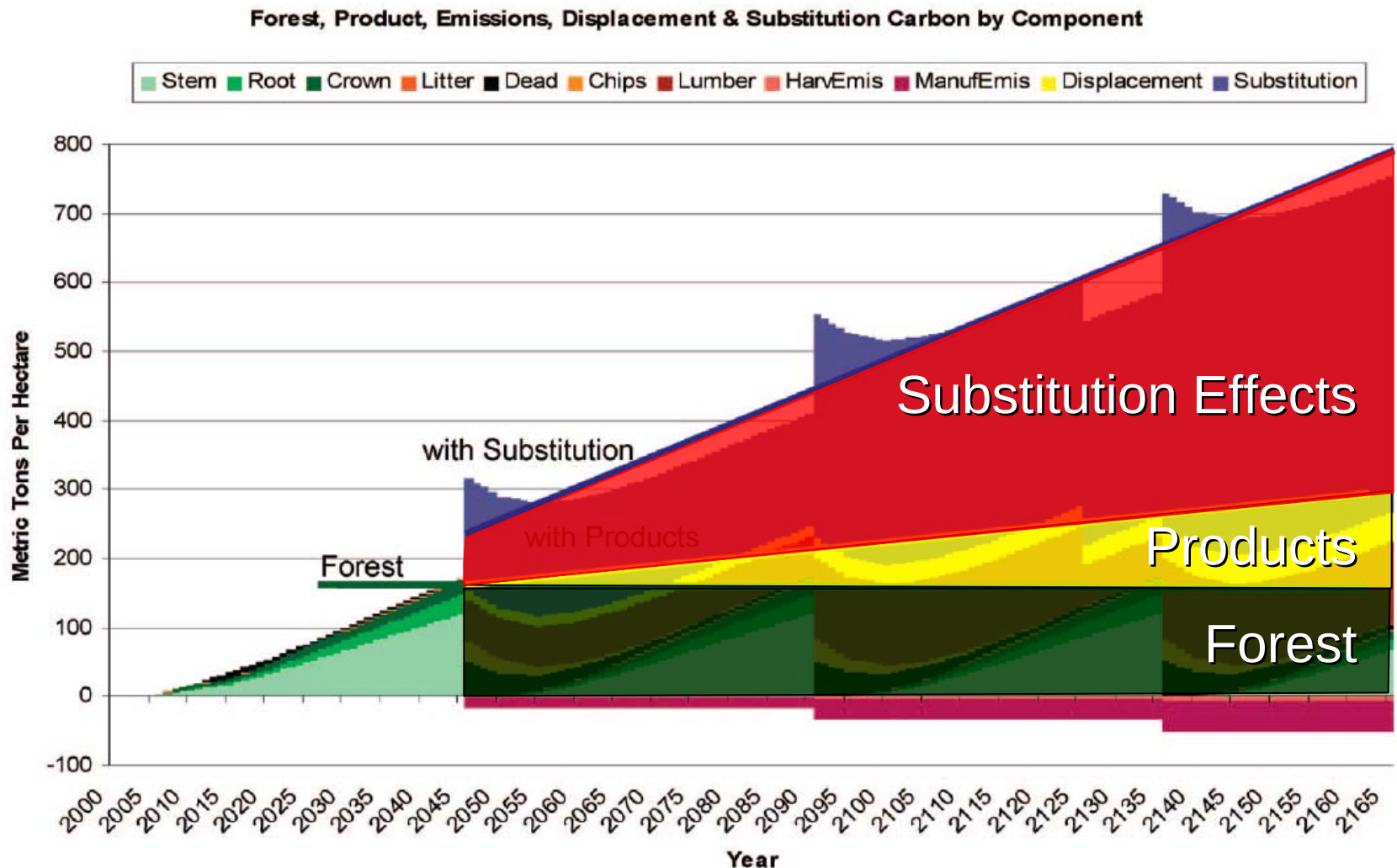


Source: Birdsey and Lewis, 2002; J.Forestry 2008

C Accounting in Forest Sector



C Accounting in Forest Sector



C Mitigation in Forest Sector

- Forest Carbon stocks will eventually saturate or release C through disturbances.
- Harvested wood products – unless accumulating in anaerobic landfills, will also saturate.
- Substitution effects through product use or bioenergy use will accumulate indefinitely.
- Analyses very sensitive to:
 - assumptions about HWP storage (e.g. landfills)
 - magnitude of substitution effects
 - time horizon of analysis , and
 - system boundaries.

Forest Mitigation Strategies: What to Optimise?

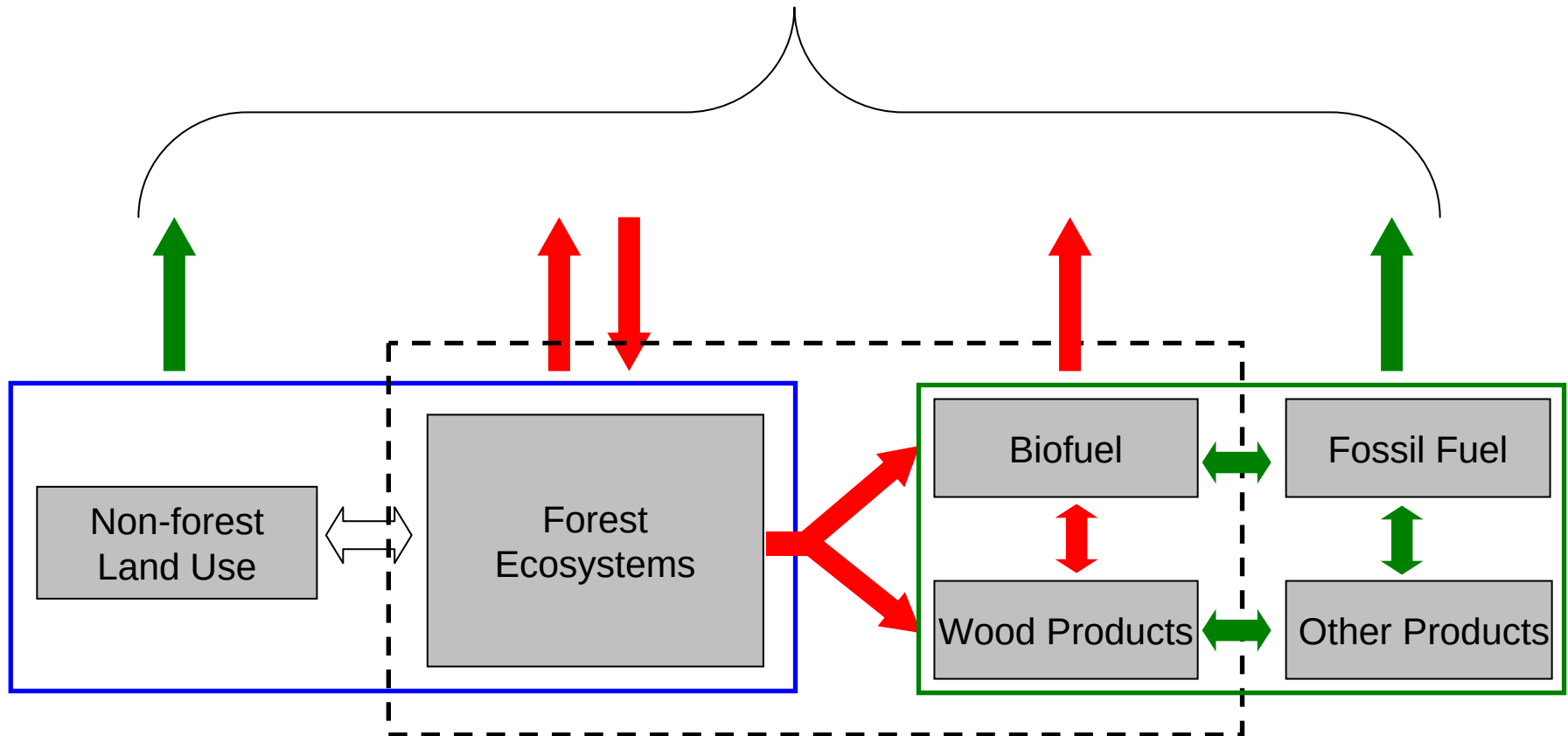
Maximise Carbon Stocks



Forest
Ecosystems

Forest Mitigation Strategies: What to Optimise?

Minimise net Emissions to the Atmosphere



Land-use Sector

Forest Sector

Services used by Society

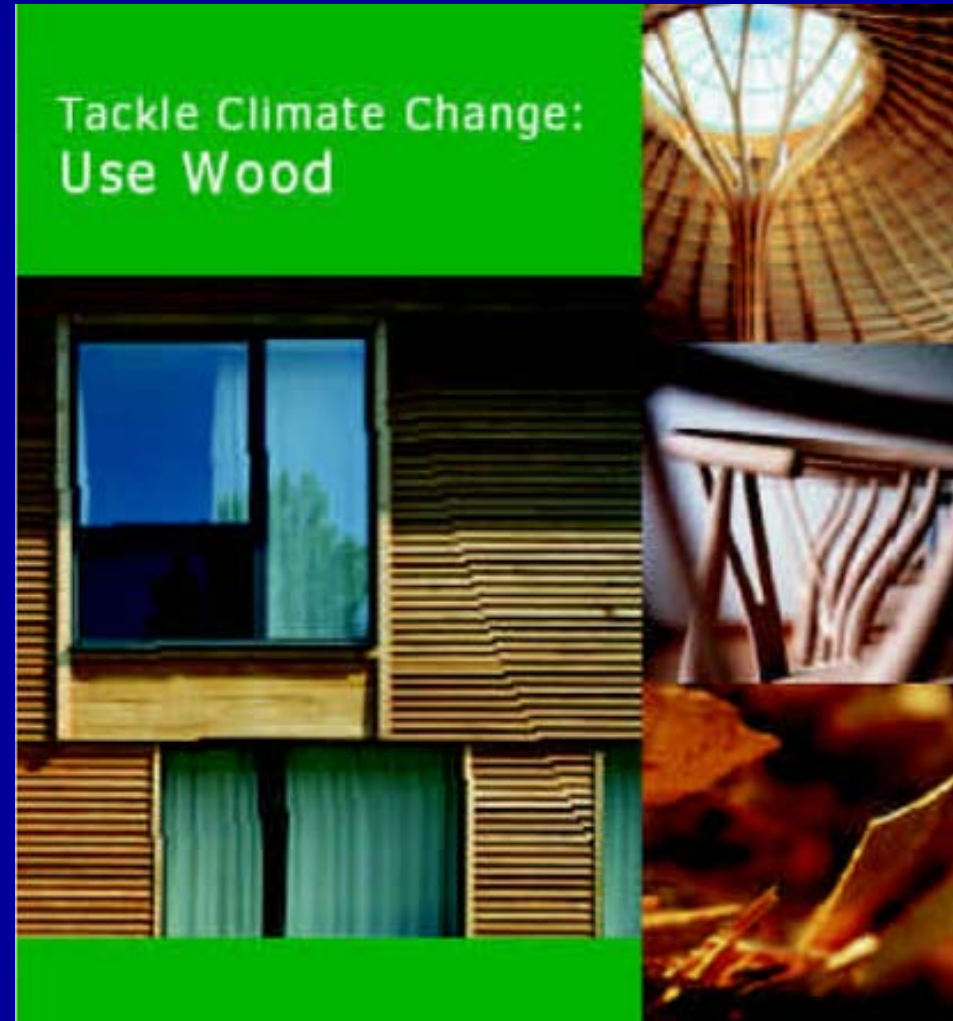
Source: IPCC 2007, AR4 WG III, Forestry

Forest Mitigation Strategies: Two competing positions

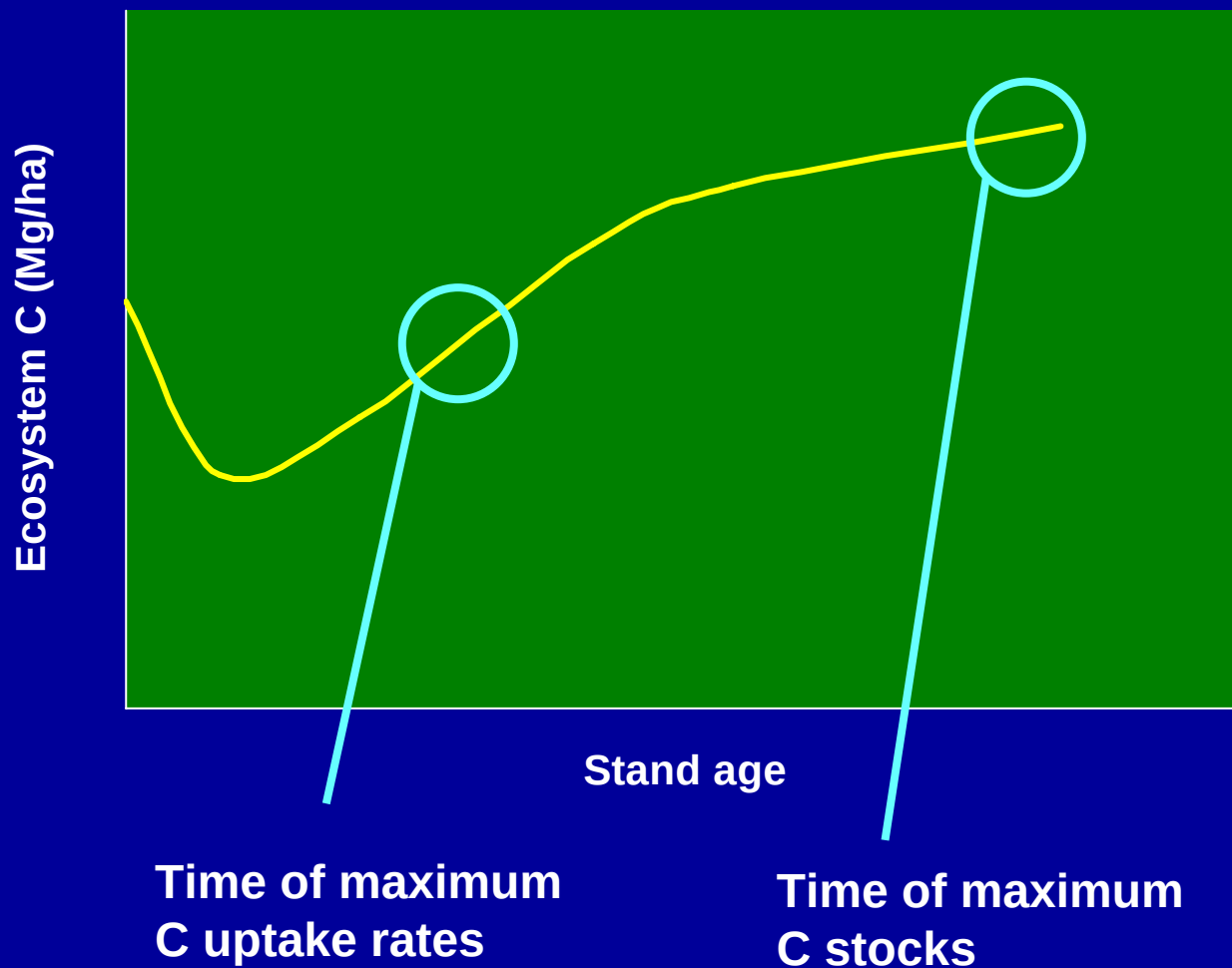
Stop logging



... or use wood?

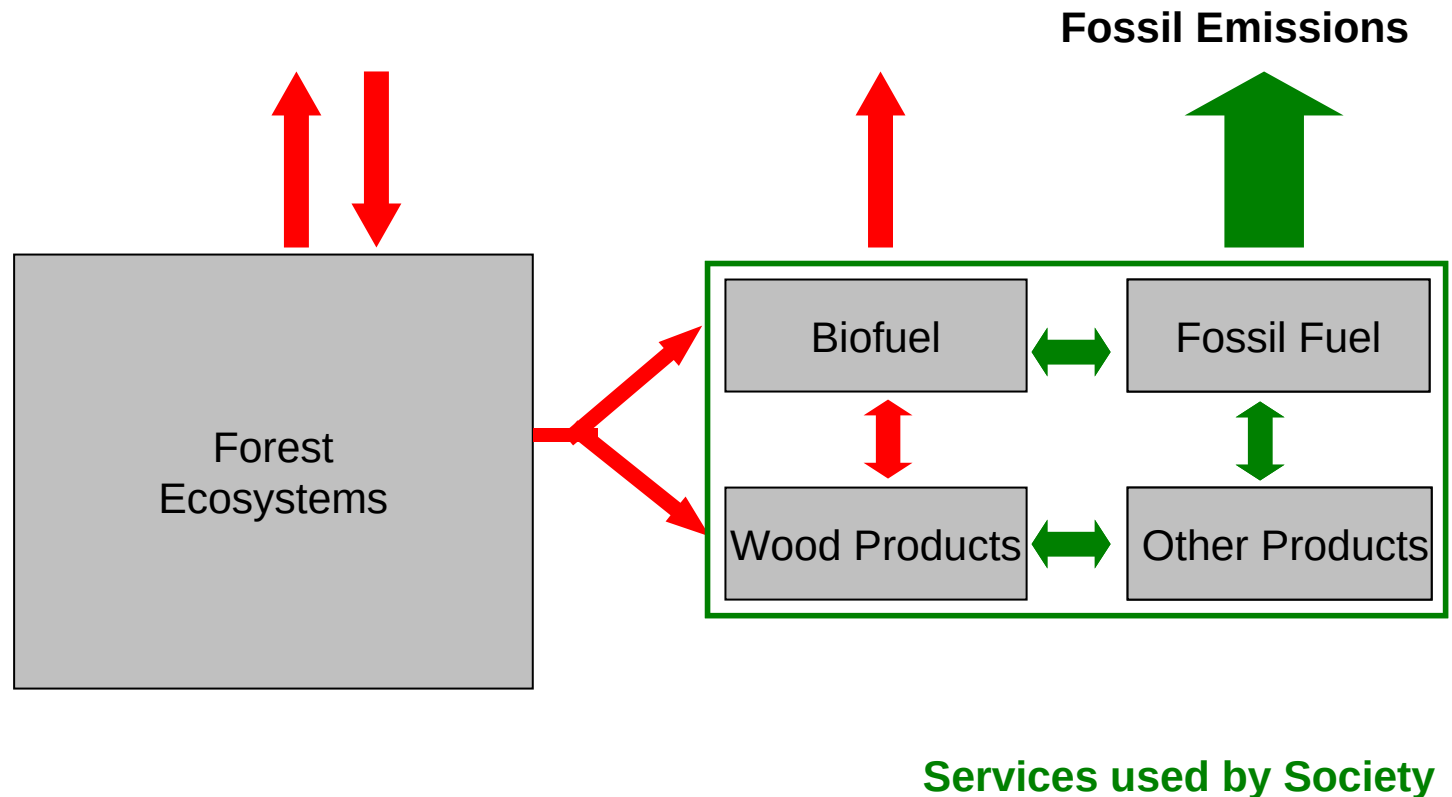


Stand-level C dynamics



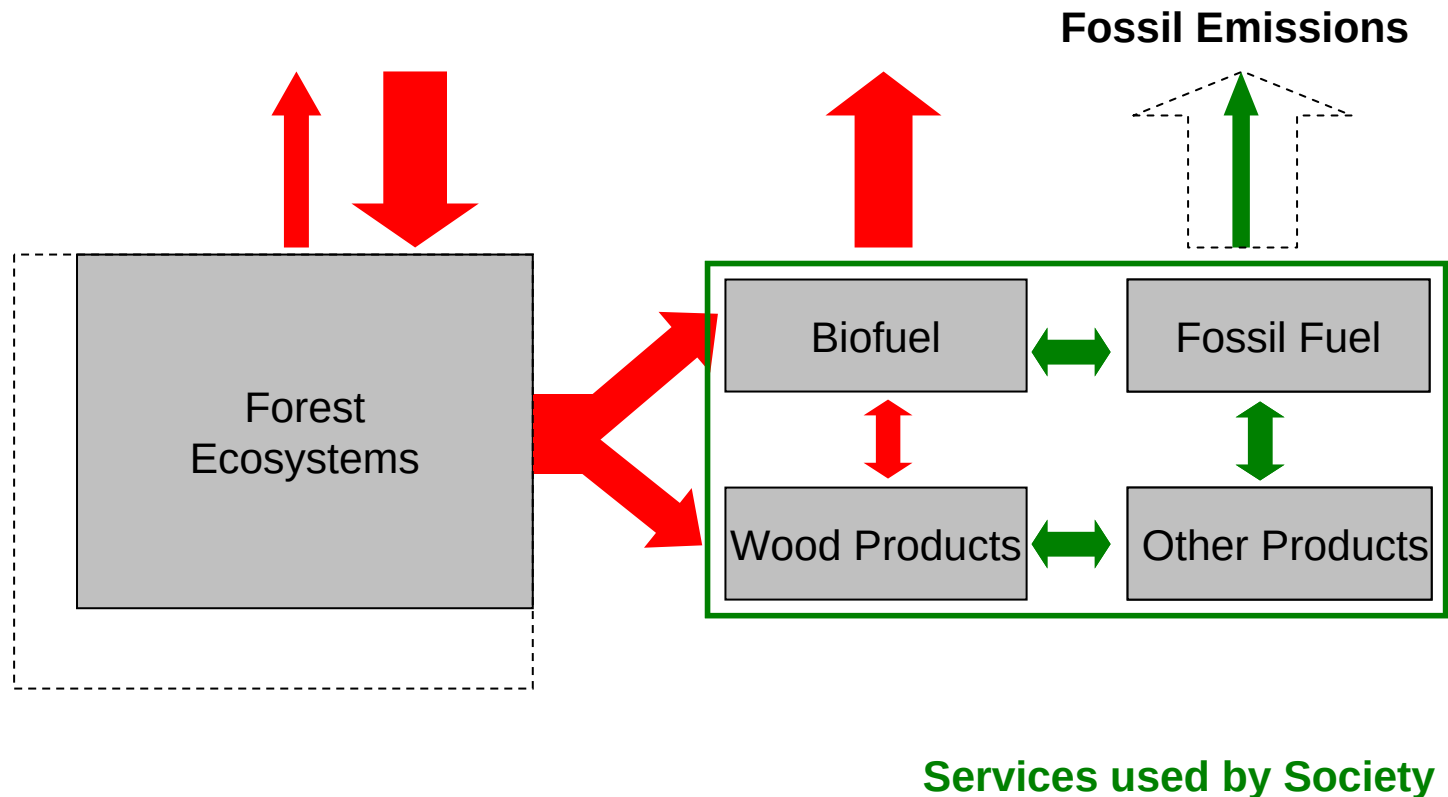
Forest Mitigation Strategies: Two competing positions

Maximise Carbon stocks



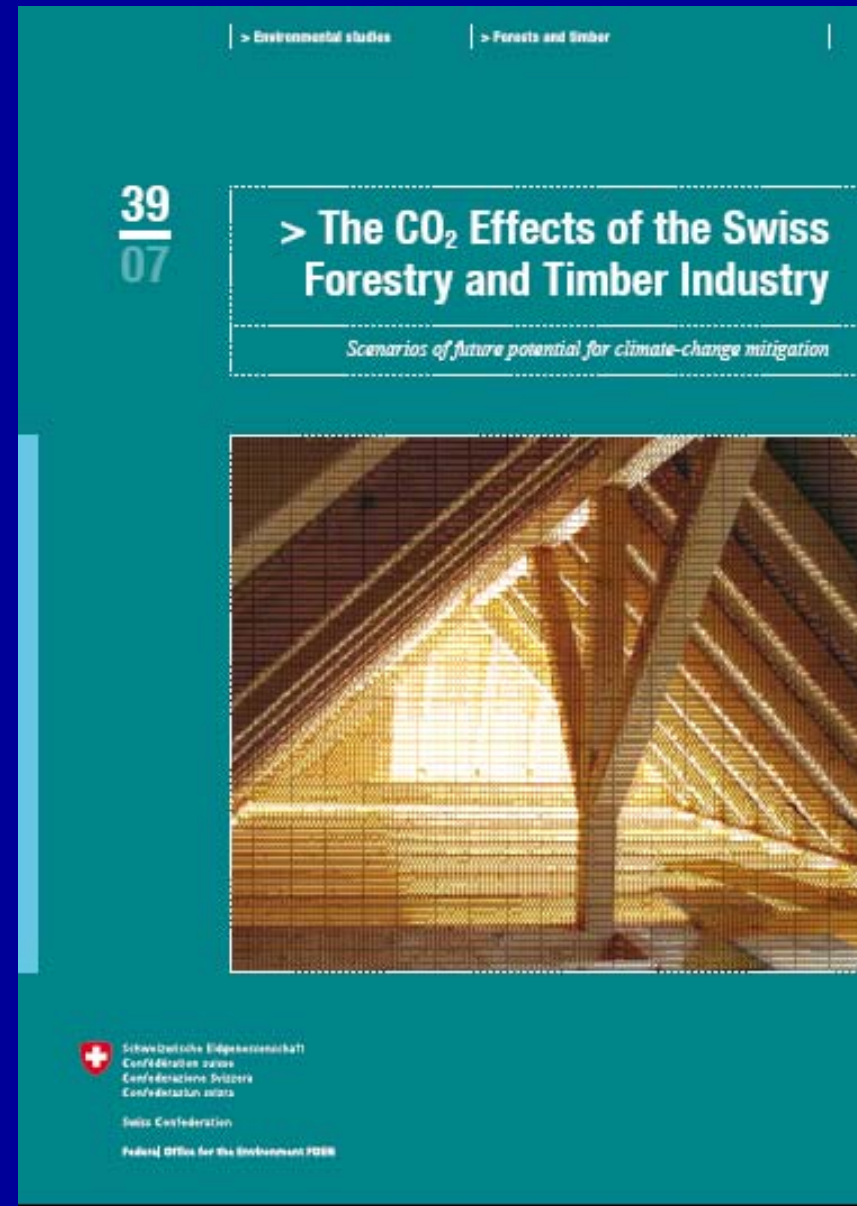
Forest Mitigation Strategies: Two competing positions

... or maximise Carbon uptake?



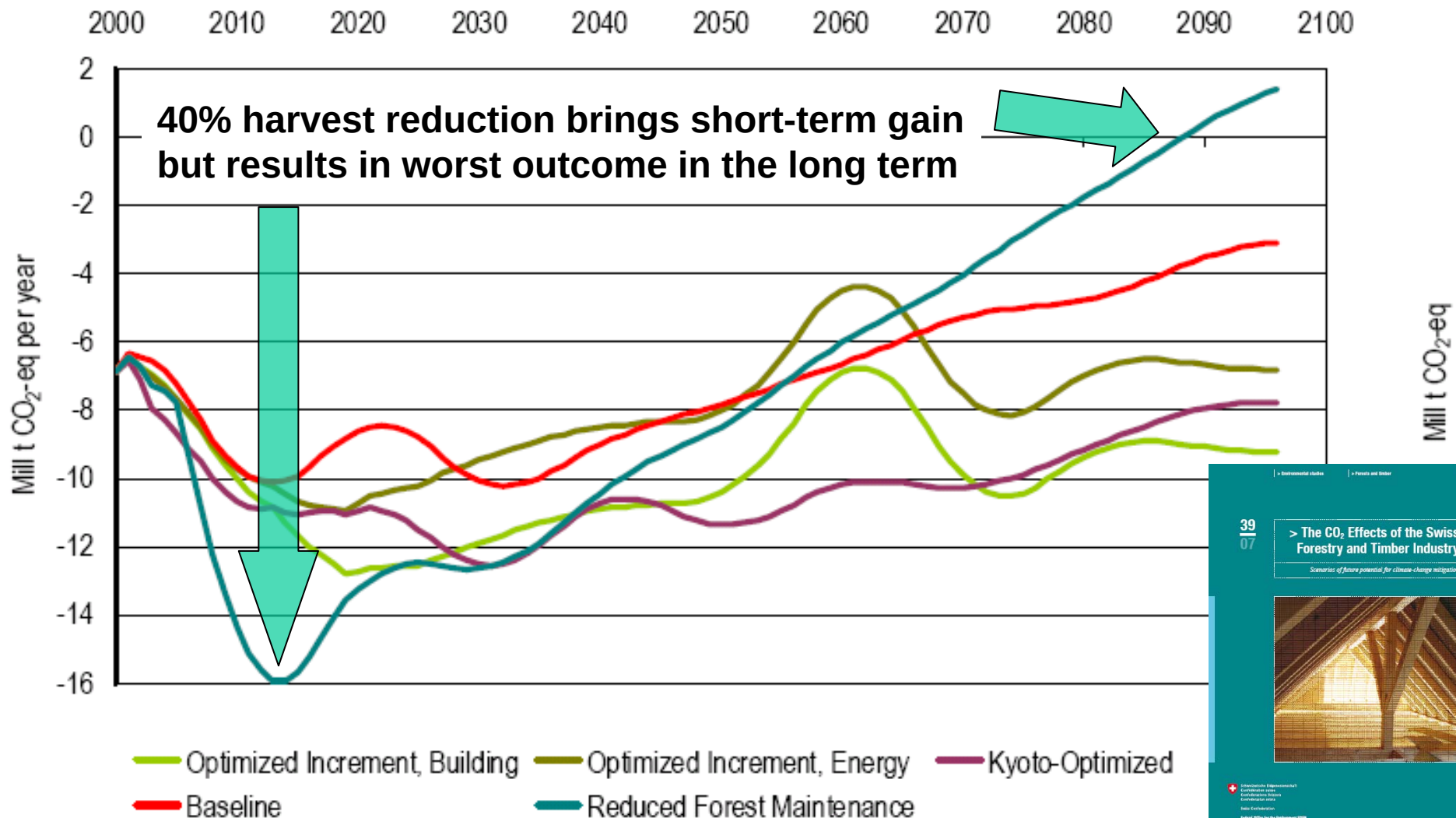
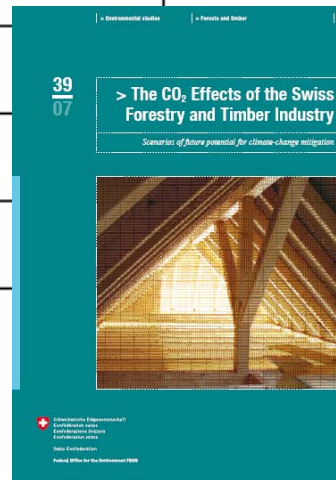
Analyses that consider substitution effects

- Schlamadinger and Marland 1999
- NCASI Footprint of Canadian forest product sector
- Taverna et al. 2007 quantified increased emissions in other sectors if wood harvest is reduced in Switzerland.
- Same model applied to Sweden (unpublished)
- Hennigar et al. 2008 for NB.



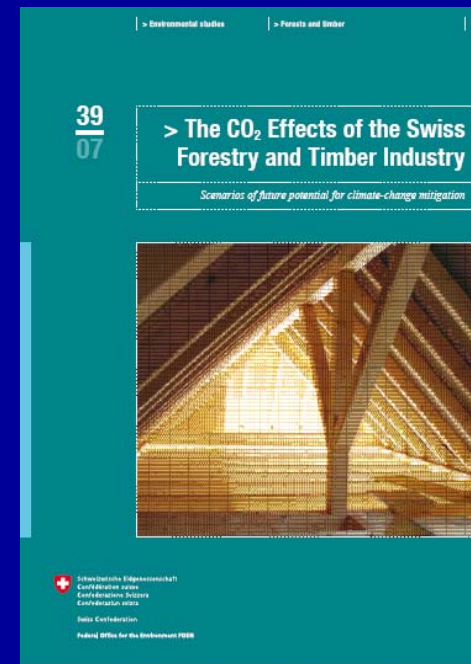
Results from Swiss study

Taverna et al. 2007



Recommendations from Swiss study

- the maximum possible increment that is also sustainable should be generated in the forest;
- this increment should be exploited through wood harvesting;
- the harvested wood should be processed in accordance with the principle of cascade use;
- waste wood that is not suitable for further use should be used to generate energy.



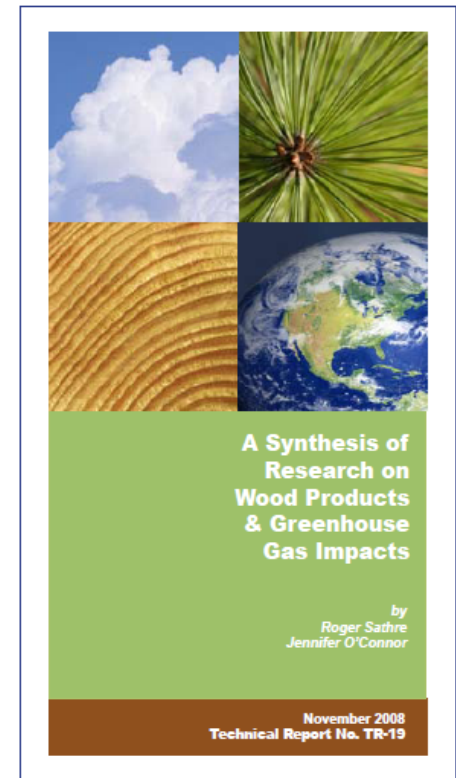
Optimum Carbon Management Strategy

- Used LP to develop management plans with different carbon maximisation objectives, over 200 year analysis.
- Important to include forest product and substitution effects in design of management plan with carbon objectives.

	Forest	Products	F+P	F+P+S	Harvest
Maximise C in:	C/ha/yr	C/ha/yr	C/ha/yr	C/ha/yr	m3/ha/yr
Forest	0.164	0.064	0.228	0.277	0.98
Products	-0.035	0.183	0.148	0.287	3.13
Forest+Products	0.155	0.110	0.265	0.351	1.71
F+P+substitution	0.114	0.138	0.252	0.361	2.15

Meta-analysis of Displacement Factors

- Displacement factor (DF) quantifies the amount of emission reduction achieved per unit of wood used in products (i.e. substitution)
- Note that this is not per unit of wood harvested.
- In 48 studies reviewed, the calculated DF ranged from a low of -2.3 to a high of 15.0.
- Most DF in the range of 1.0 to 3.0.
- The average DF was 2.0.



Forest Mitigation Strategies: Climate Change Impacts?

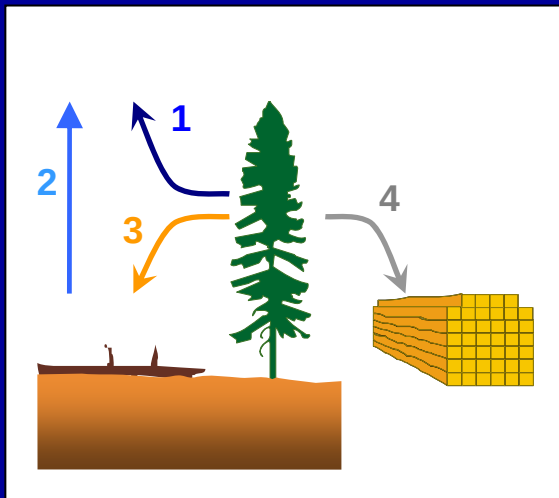
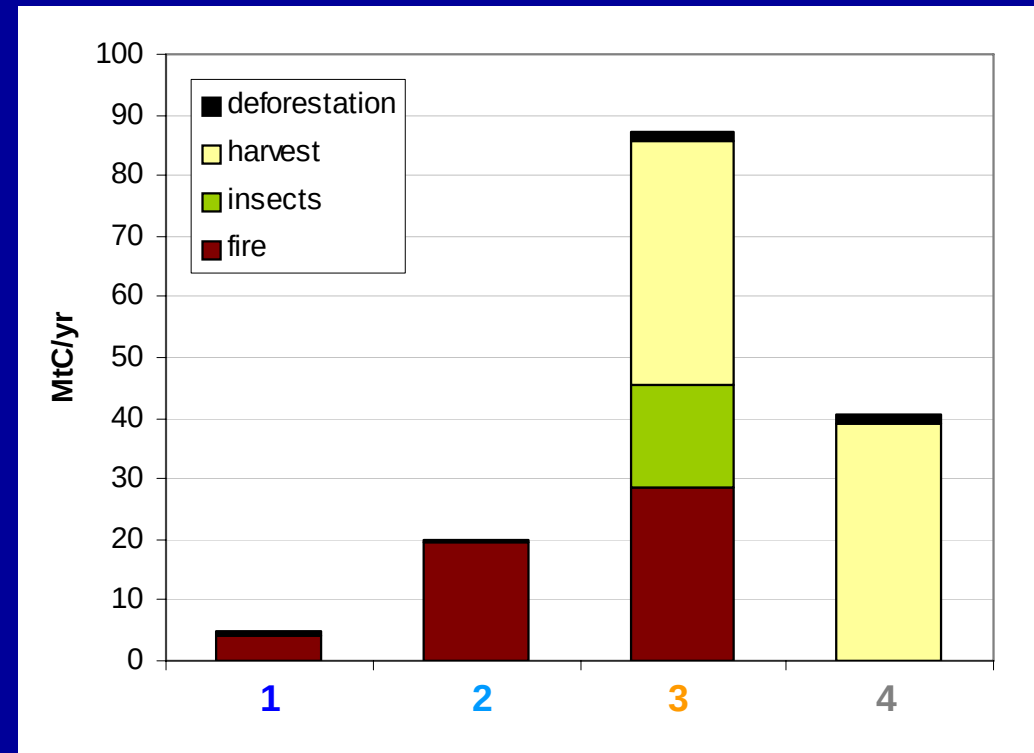
- Climate change is likely to affect the forest sector's mitigation potential
 - Changes in forest growth rates
 - Increased natural disturbances
 - Species maladapted to shifting climate zones
 - Changes in ecological processes (drought, decomposition, permafrost melting)
 - May create opportunities in some regions
- Increased natural disturbances (fire, insects, windthrow), drought and climate-induced species mortality will create millions of cubic meters of dead wood.
- Need discussion before these events about the appropriate forest management response(s).

Disturbance Impacts

1990-2006

- Largest C transfers are within the ecosystem (3)
- Direct emissions from fire also large (1 & 2)
- Substantial transfers from ecosystem to forest products (4)
(*default IPCC accounting method treats these as emissions*)

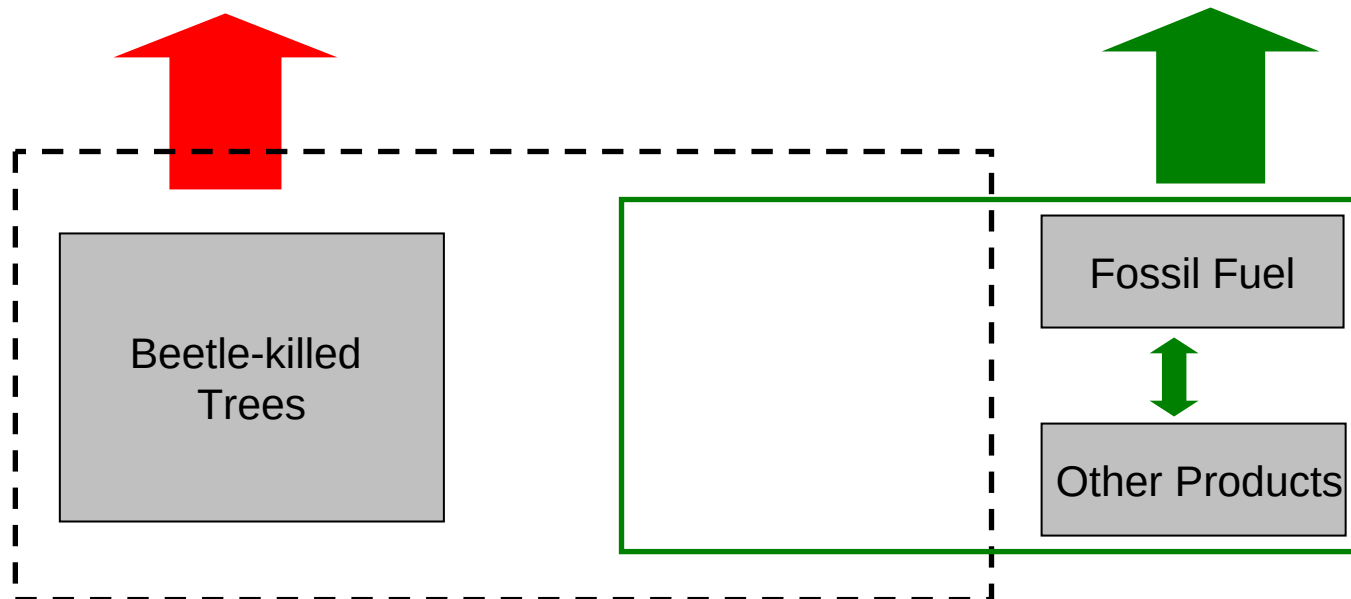
Totals for Canada's managed forest



Beetle-killed trees: No salvage

Emissions from Decomposition

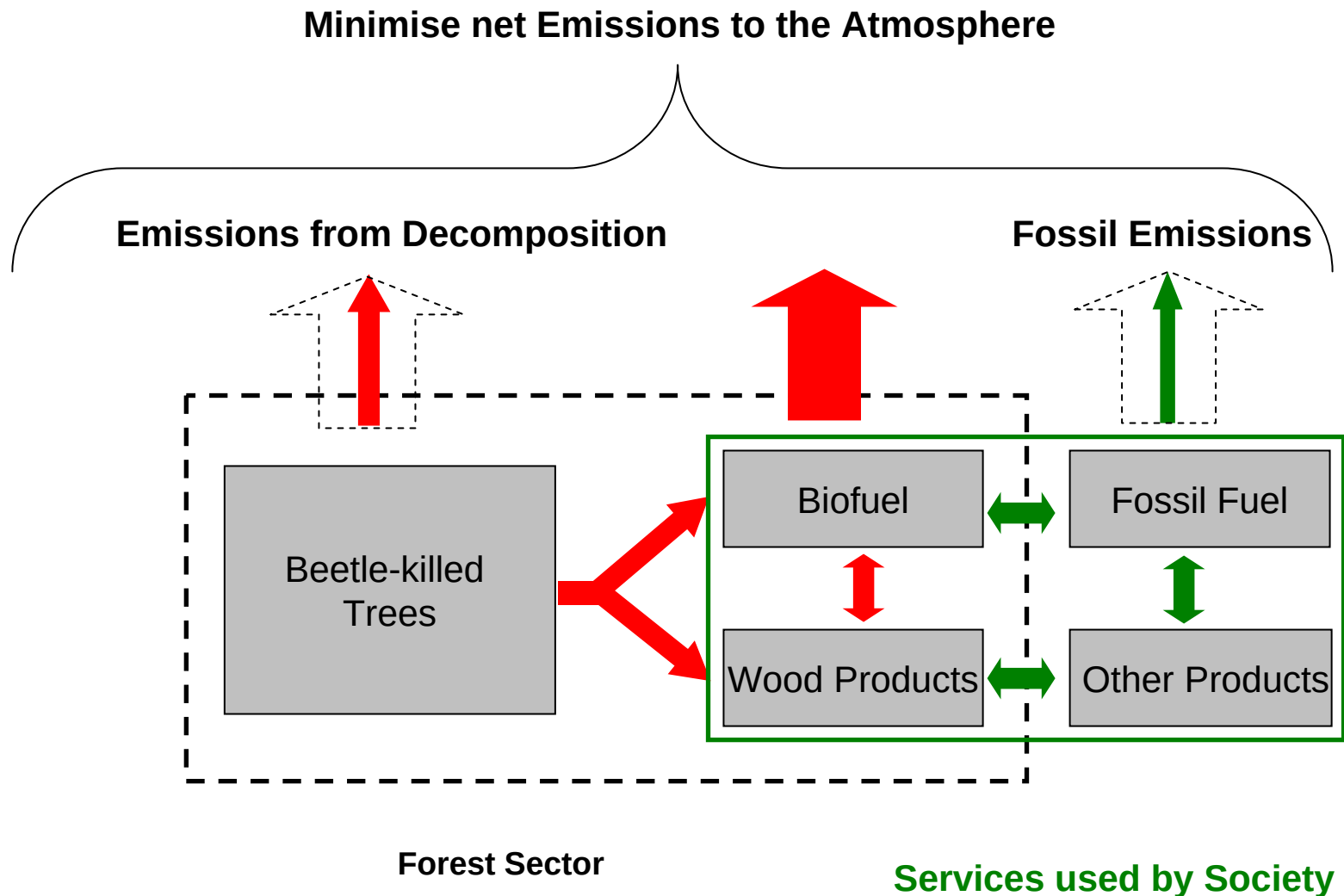
Fossil Emissions



Forest Sector

Services used by Society

Beetle-killed trees: Salvage and Biofuels



Conclusions

- Mitigation opportunities – i.e. reducing sources and increasing sinks relative to a baseline – exist in both forest management and the forest product sector.
- Research is ongoing to assess mitigation options:
 - carbon (and non-CO₂) cost and benefits,
 - costs and barriers to implementation,
 - magnitude of their potential contribution, and
 - risks / probability of success.
- 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

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



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Thank you very much!



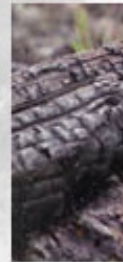
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Forest Carbon Accounting Comptabilisation du Carbone Forestier

Canadian Forest Service
Service canadien des forêts



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