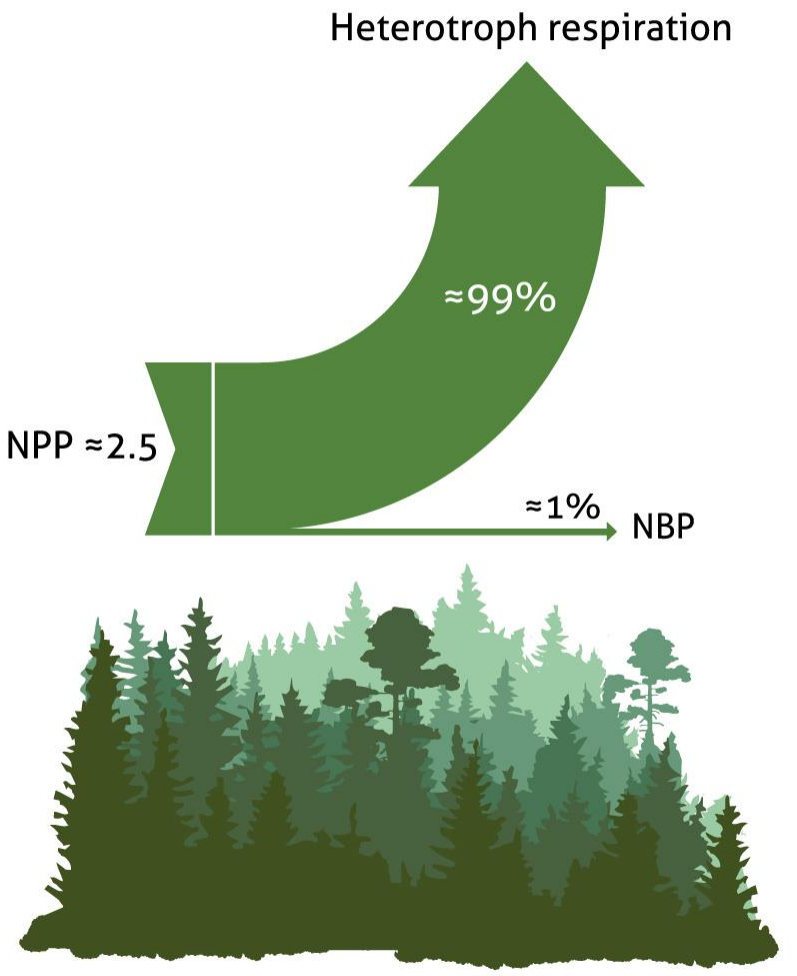
Broader insights on forest management in relation to carbon balance?

Managed forests or unmanaged forests

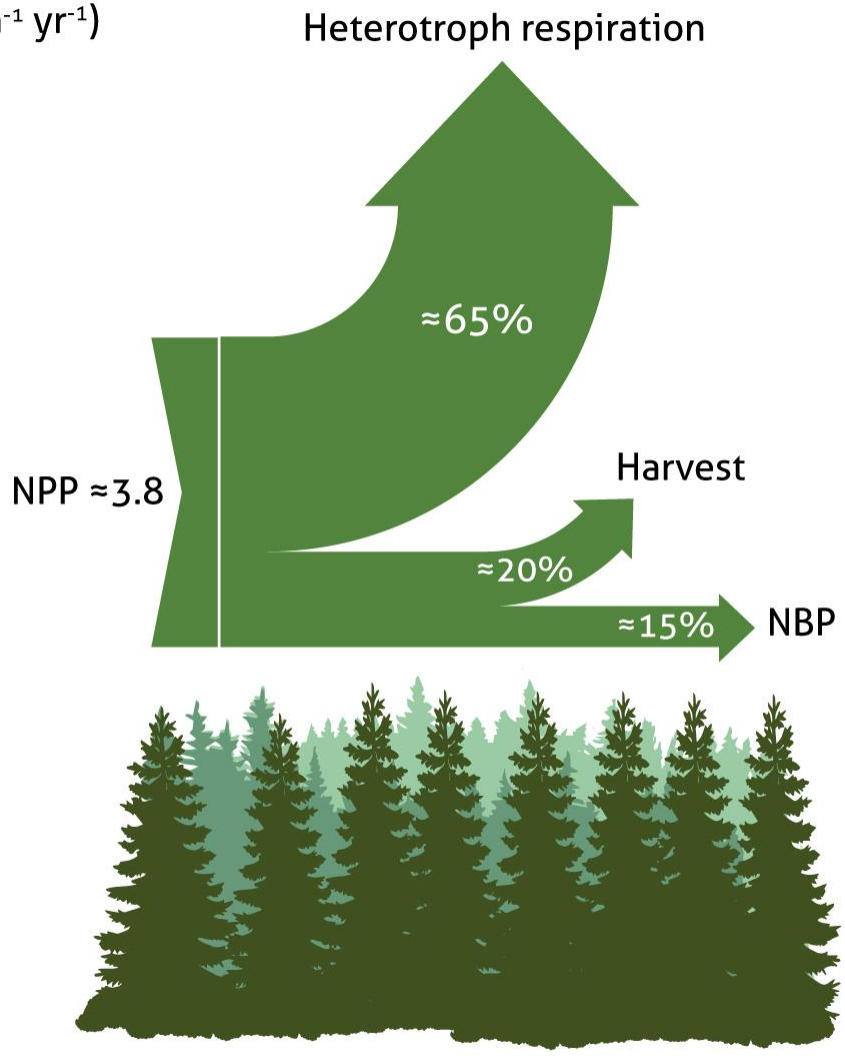
Unmanaged	Managed
Heterogeneous structure	Even-aged stands
Old-growth	Even age class distribution
Natural disturbances	Rotations adapted to ”maximize” mean annual production
Lots of dead wood	
Natural regeneration	Silviculture

Fate of NPP

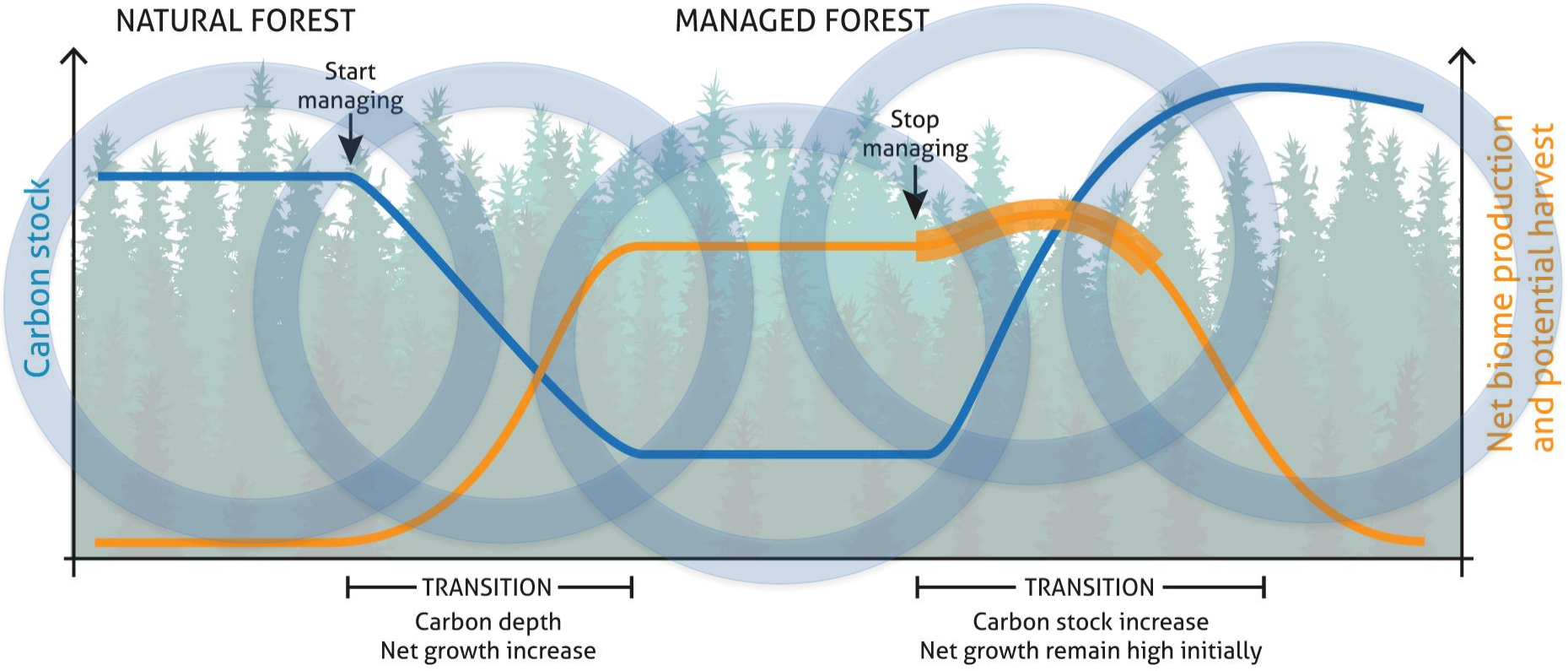
(Mg ha^{-1} yr^{-1})

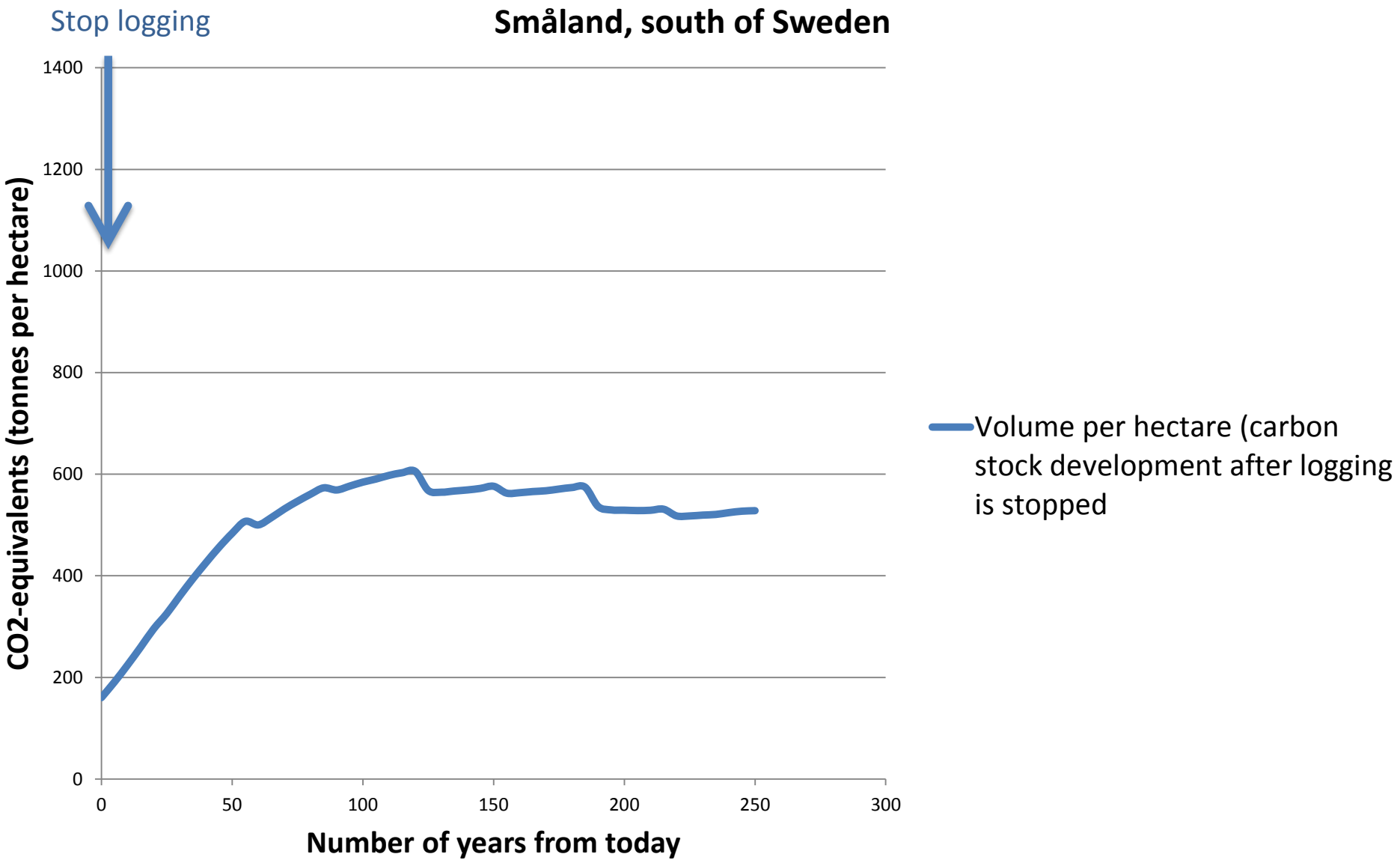


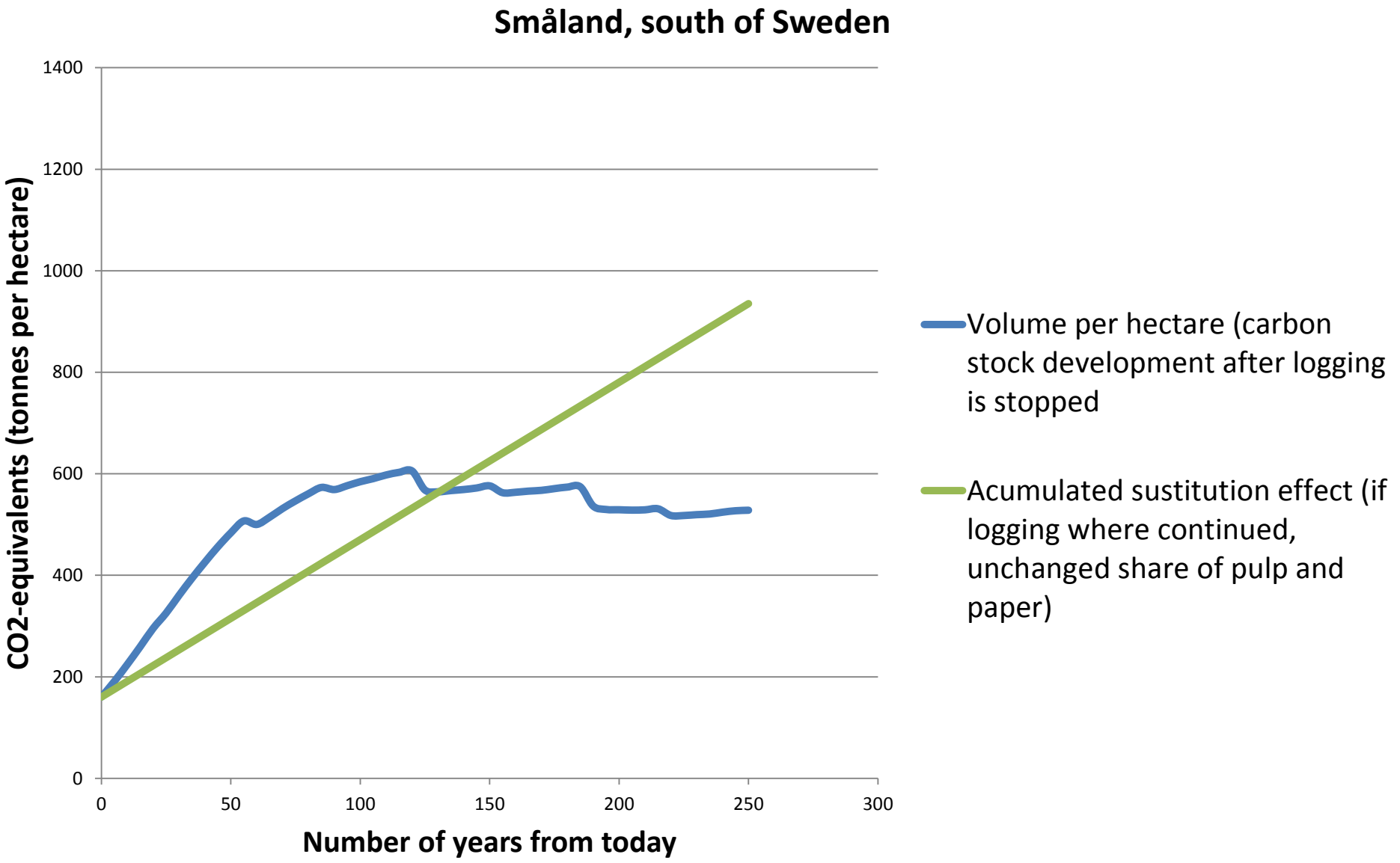
UNMANAGED NATURAL FOREST



MANAGED FOREST


NATURAL FOREST
MANAGED FOREST
Start managing
Stop managing
Carbon stock
Net biome production and potential harvest
TRANSITION
Carbon depth
Net growth increase
TRANSITION
Carbon stock increase
Net growth remain high initially


Stop logging
Småland, south of Sweden
1400
1200
1000
800
600
400
200
0
CO2-equivalents (tonnes per hectare)
0
50
100
150
200
250
300
Number of years from today
Volume per hectare (carbon stock development after logging is stopped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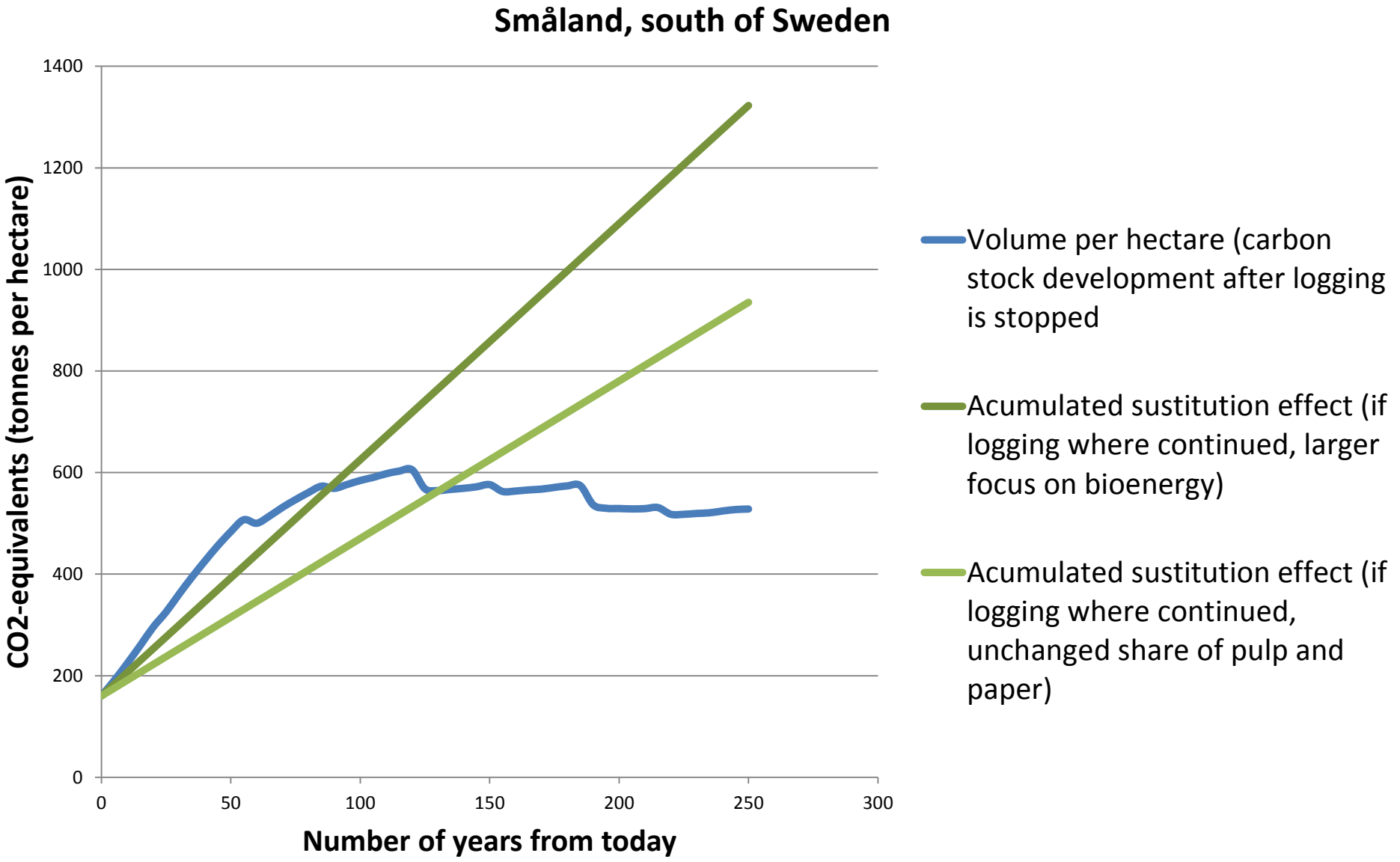
Number of years from today
Volume per hectare (carbon stock development after logging is stopped
Acumulated sustitution effect (if logging where continued, unchanged share of pulp and paper)


Småland, south of Sweden
CO2-equivalents (tonnes per hectare)
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100
150
200
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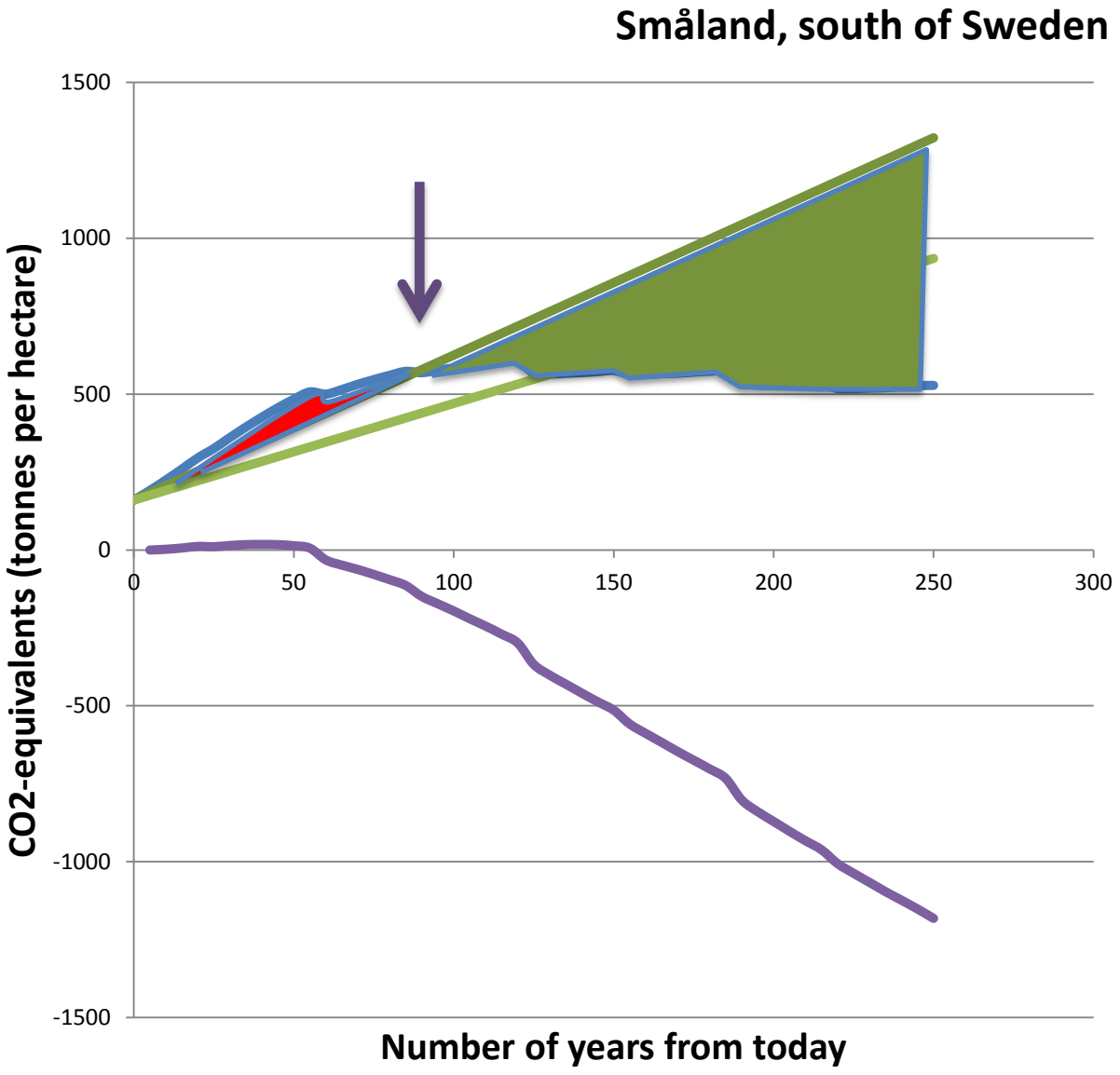
300
Number of years from today
Volume per hectare (carbon stock development after logging is stopped
Acumulated sustitution effect (if logging where continued, larger focus on bioenergy)
Acumulated sustitution effect (if logging where continued, unchanged share of pulp and paper)



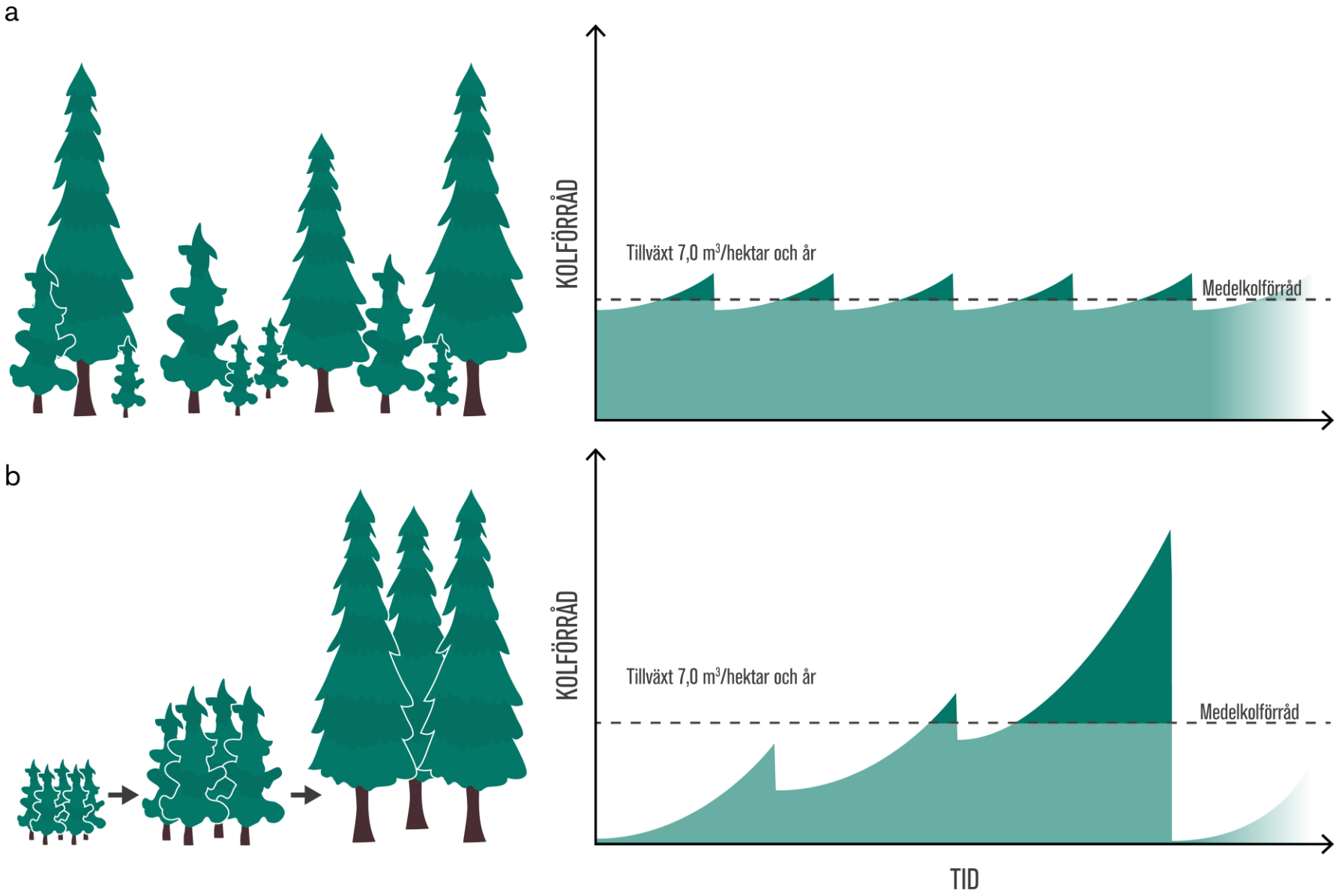
Volume per hectare (carbon stock development after logging is stopped

Acumulated sustitution effect (if logging where continued, larger focus on bioenergy)

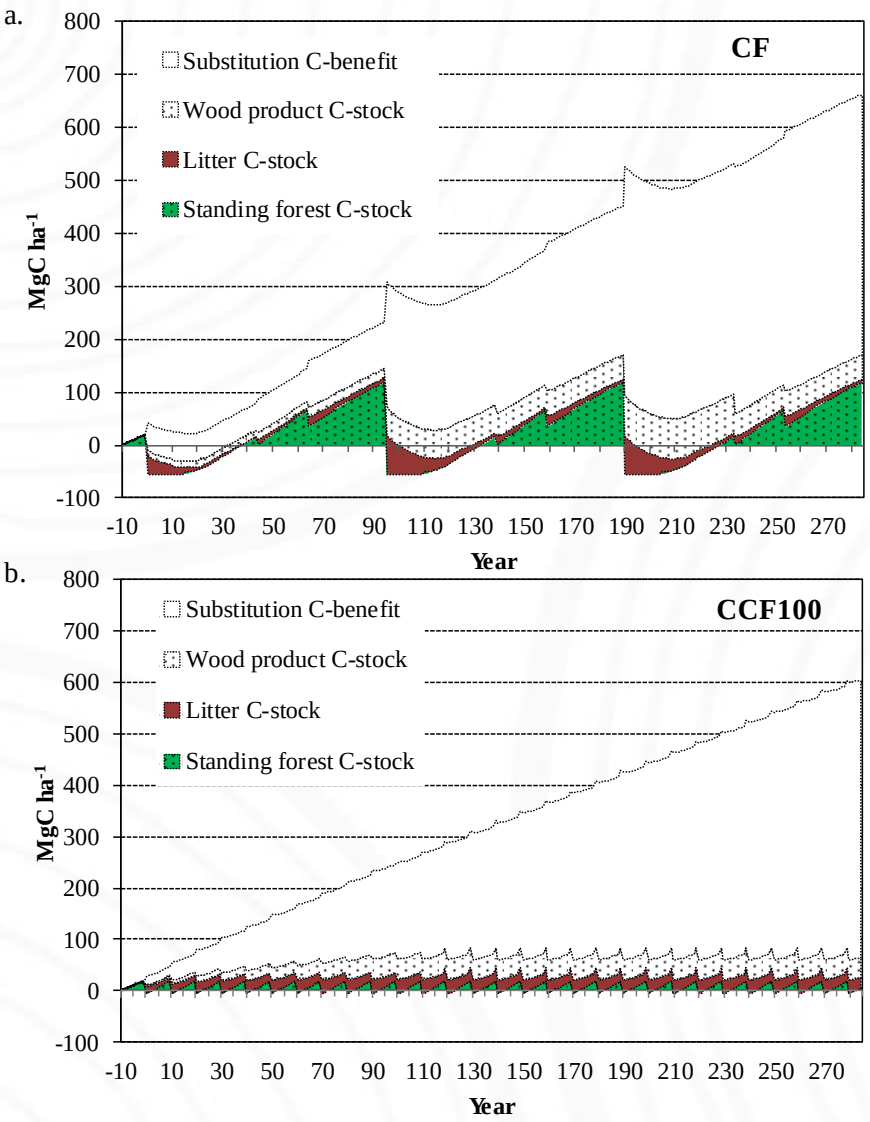
Acumulated sustitution effect (if logging where continued, unchanged share of pulp and paper)

"Growth depth" (acumulated difference between actual annual growth and potential annual growth if forests where managed)

Uneven-aged vs. even-aged systems



Carbon balance CF vs CCF



Lundmark et al. 2016

Climate benefit - T_{ake}H_{ome}M_{essages}

- Forest growth is more important than the choice of silvicultural system *per se*.

Climate benefit - T_{ake}H_{ome}M_{essages}

- The effect is of temporary character.
- Cost per “climate benefit” can be considerable

Conclusions

- Design of climate change mitigation portfolios in the forest sector should account for changes in C in **forest ecosystems,** in **harvested wood products**, and for **substitution benefits**, relative to a base case.
- Climate change mitigation efficiency varies among silvicultural activities, product use strategies and by region, and no single strategy is best everywhere.
- Time perspective is crucial.
- A forest that is not growing more than today can not make further climate benefit.