Harvested Wood Products and Bioenergy for Climate Change Mitigation: Competing Services?

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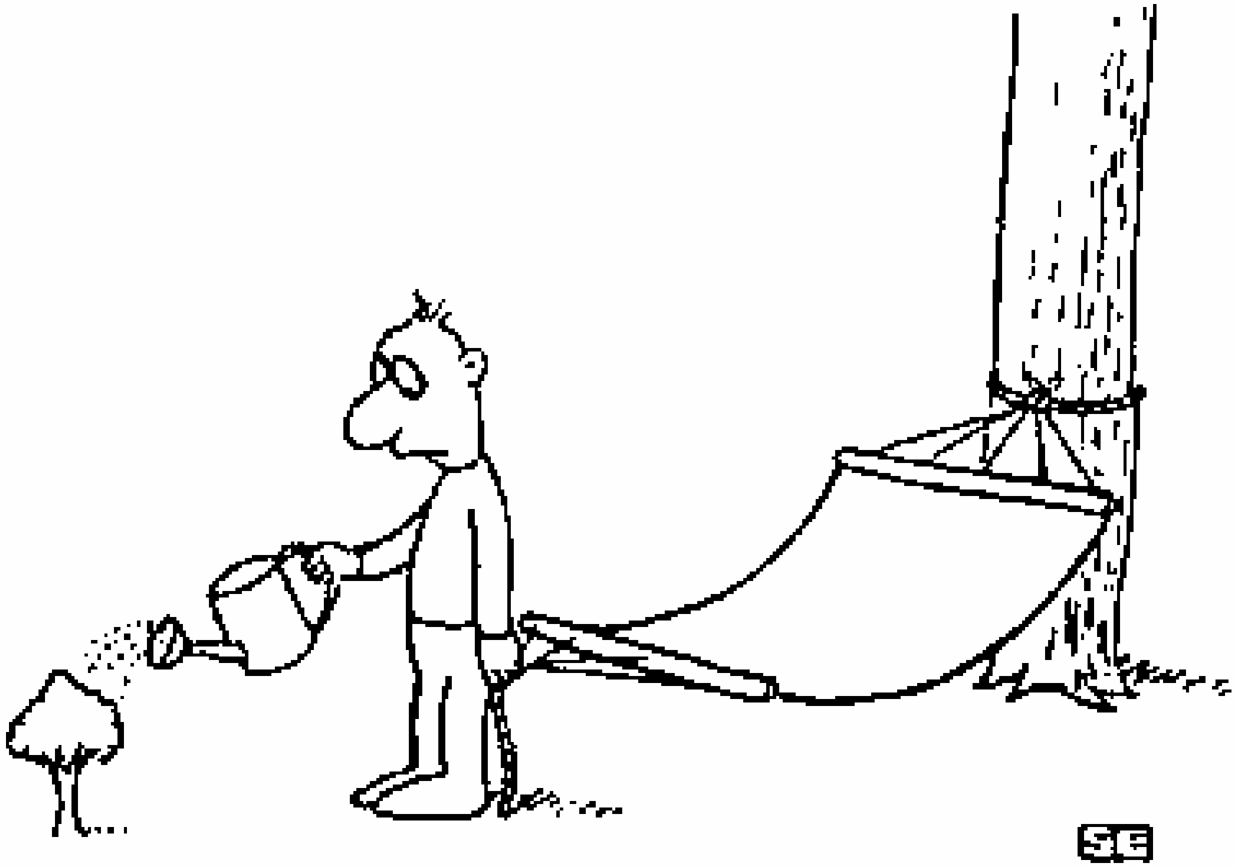
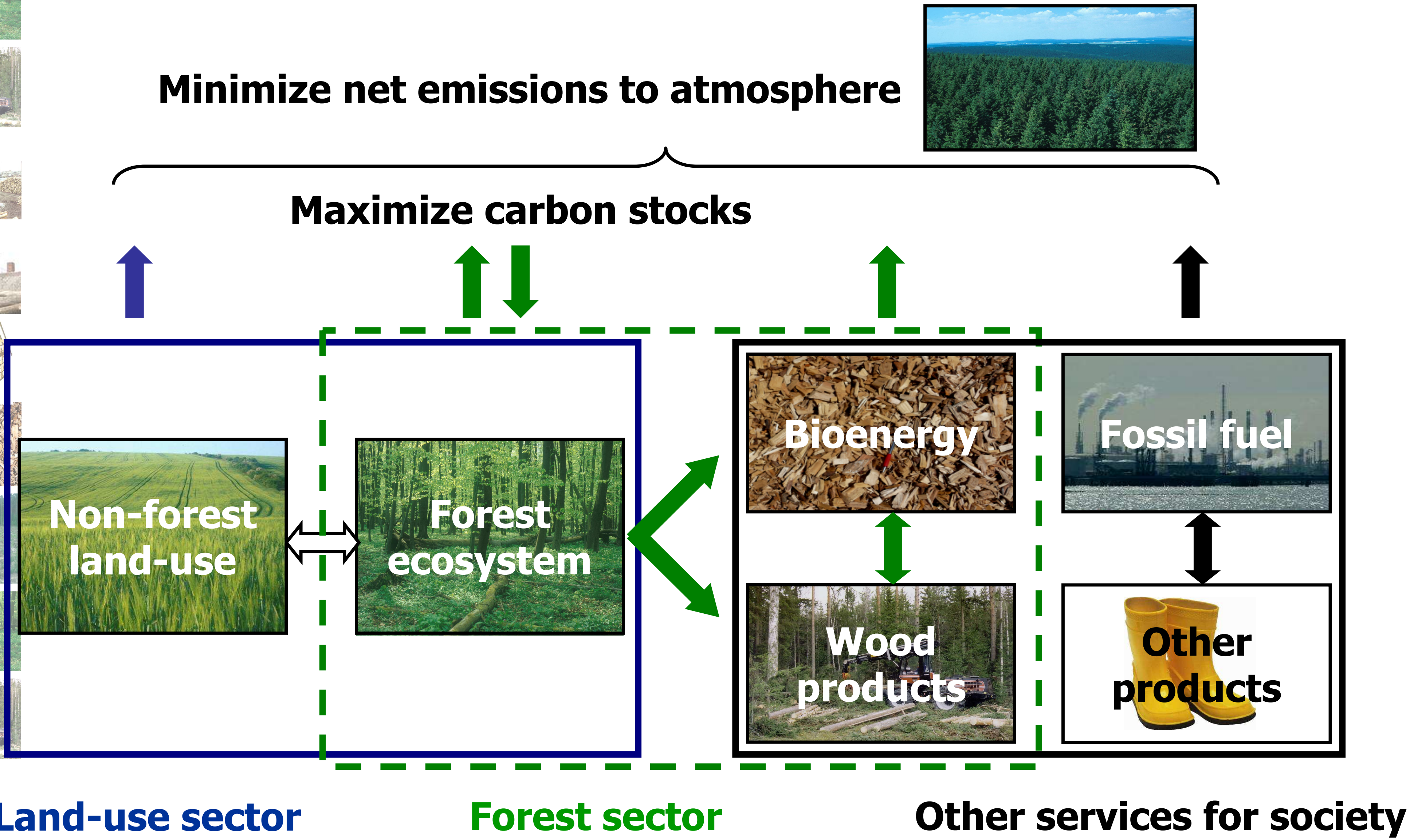
High hopes in trees



What is climate effective?



IPCC AR4, 2007

Climate effectiveness of bioenergy

- Conversion losses of biomass in heat and electricity production: 10-20%
- Conversion losses of biomass in biofuel production: 30-65%
- Cellulose fibers much higher energy efficiency compared to conventional agricultural feedstocks
- Aggregated environment impacts of biofuels:
  - Organic waste (recycled plant oil, bio-waste, etc.)
  - Ligno cellulosic fibers

Cellulosic pathways offer effective climate mitigation options of biofuels

Fuel (feedstock)	**Fossil energy balance**
Cellulosic ethanol	10
Biodiesel (palm oil)	9
Ethanol (sugar cane)	8
Biodiesel (waste)	5-6
Biodiesel (soybeans)	3
Ethanol (corn)	1.5

Zah et al., 2007

Farrell et al., 2006

Poly-production for competitiveness

- Example from Austria
- Ethanol production from wood
- Excess heat used for district heating

Use of waste heat makes ethanol from wood competitive with gasoline

Feedstock	Technology	Costs (% of gasoline costs, 1 liter=0.55 Euro)	
	Scenario	*Heat*	*No heat*
Forest residues	Gasification	140%	151%
	Fermentation	85%	140%
Poplar plantation	Gasification	115%	127%
	Fermentation	47%	89%

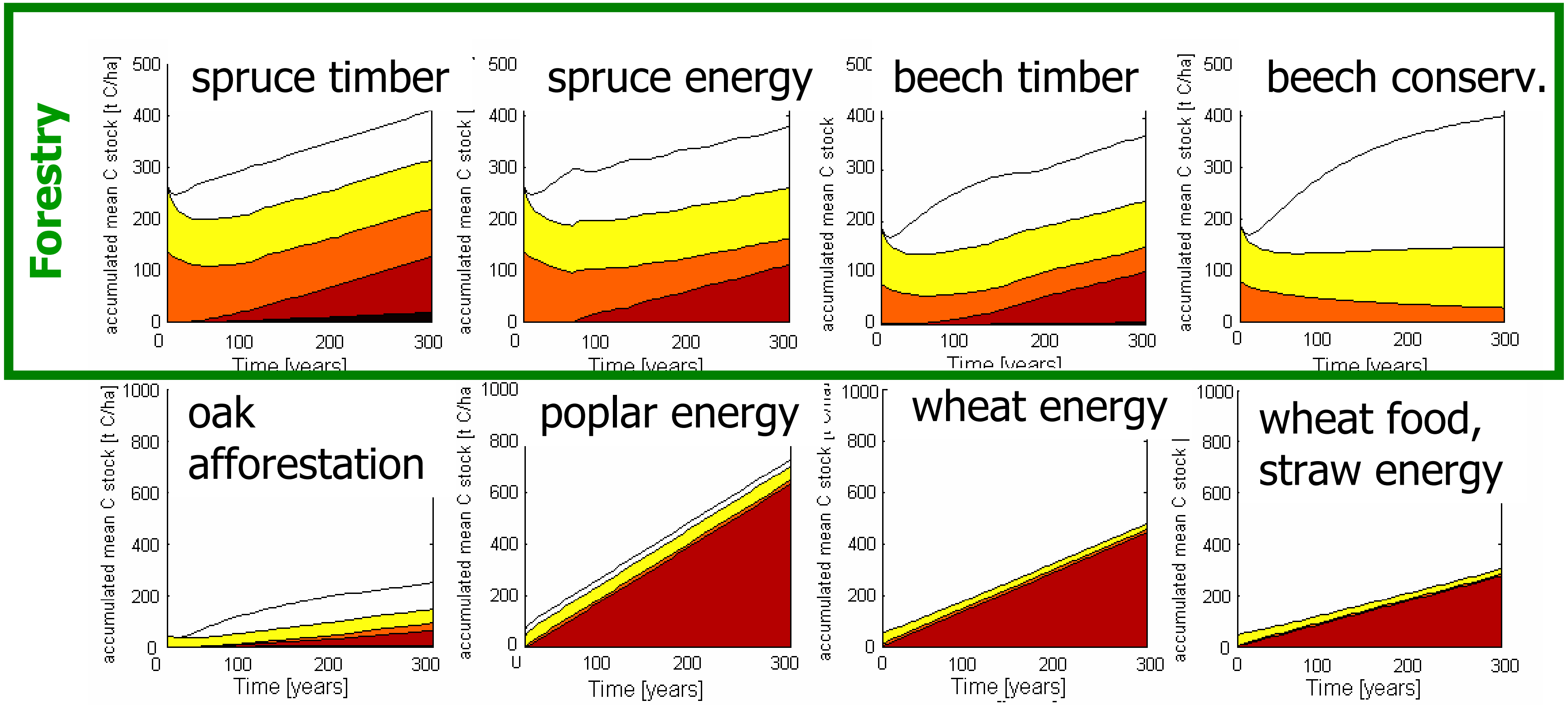
IIASA: Schmidt and Leduc, 2008

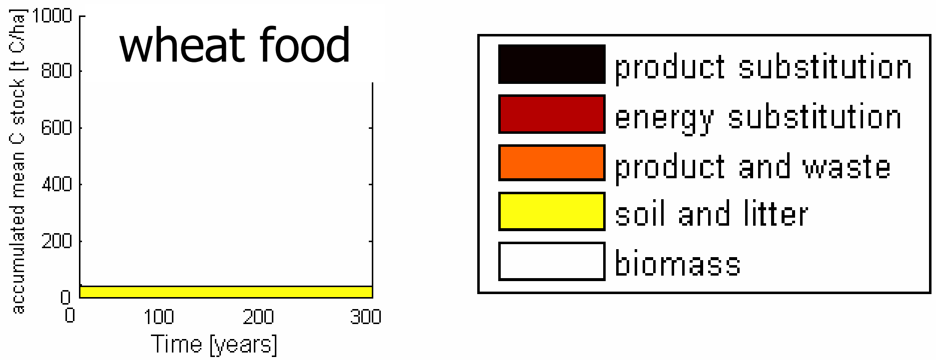
Case study: A hectare of beech or spruce

- Data from Thuringia (Germany)
- Reference: Timber production
- Conservation: Sequester carbon on-site
- Bioenergy: Switch to short-rotation
- Product use: No organic material in landfills: waste incineration (assumed: 80%)

- Compared to agricultural options (no land use change)

Case study: Full C budget



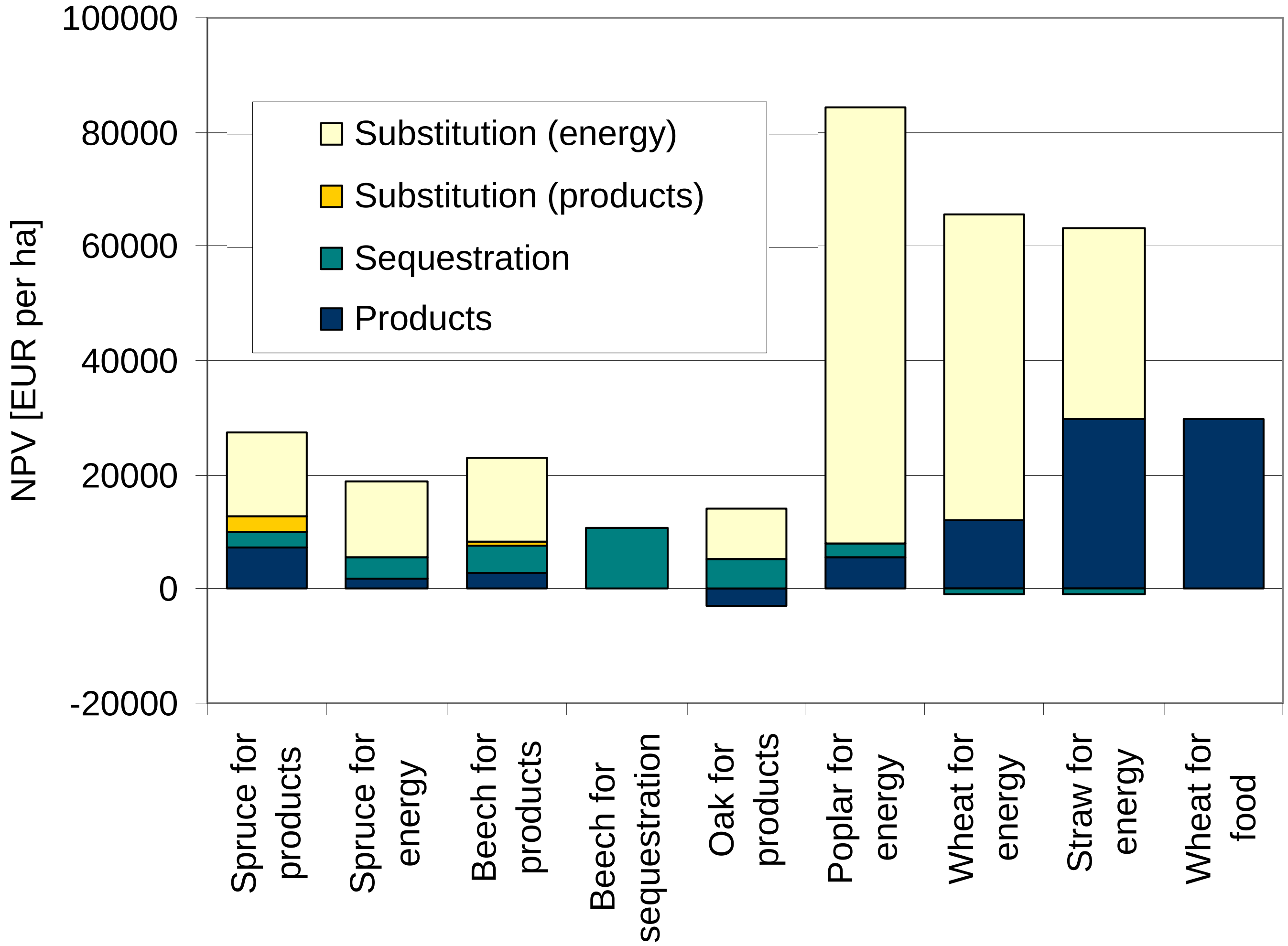


Accumulated means over 300 year simulation period

IIASA/MPI-BGC: Freibauer et al., 2008

Case study: Rewarded carbon services

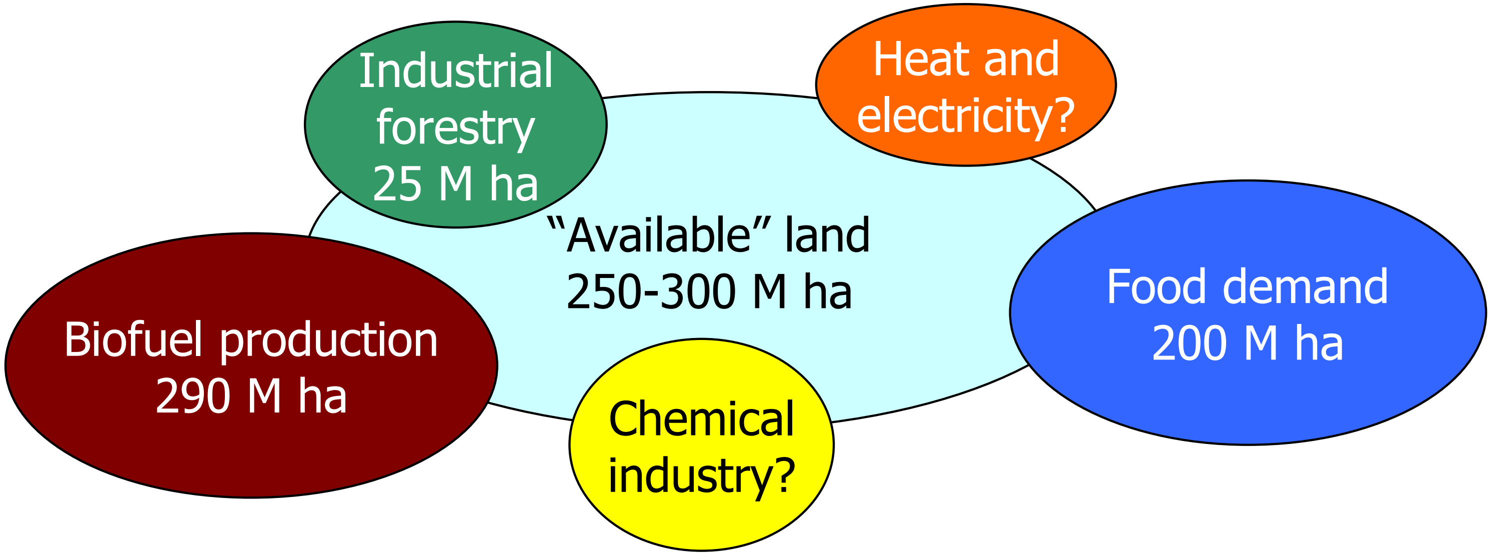
Contribution of services to NPV at a C price of 60 € t-1 C



IIASA/MPI-BGC: Freibauer et al., 2008

Potential put into area perspective

Land availability and demand in 2030



- Potential **additional** area for biomass production competing with cropland and grassland and threat of deforestation!
- Potential area for sustainable timber production (and potential wood product recovery for energetic use):
  - 1,350 M ha of forest managed for production
  - 1,800 M m^3 removals as Industrial Roundwood

IIASA: Nilsson, 2007

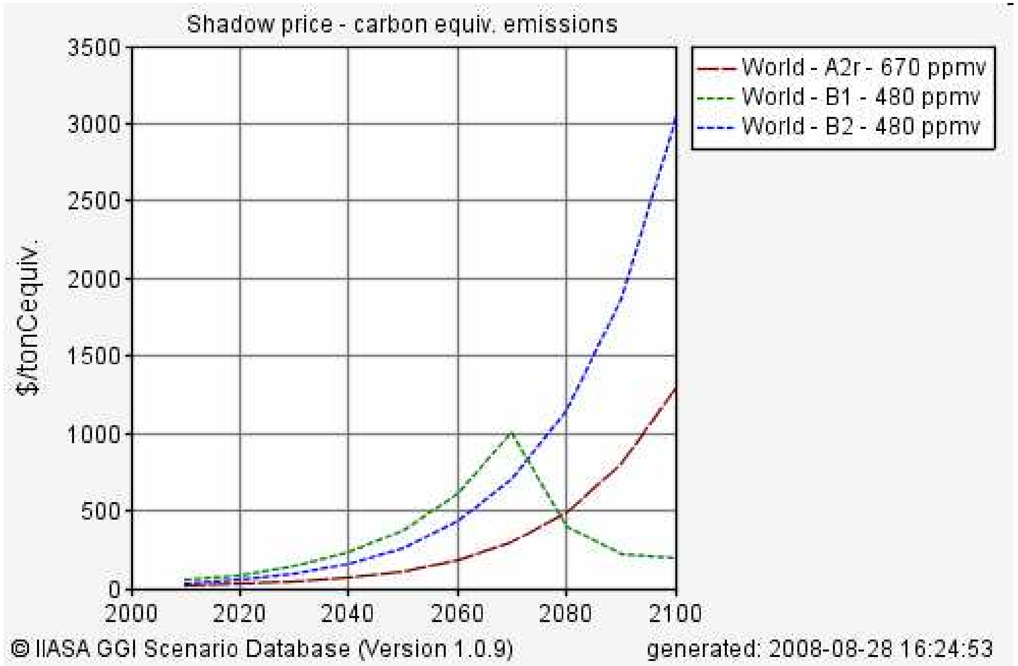
HWPs and biofuels for C mitigation

- Climate effectiveness of HWPs and biofuels depends on
  - the lifetime of products
  - the efficiency of the bioenergy chain
  - reference system to be substituted
- Cascaded use of HWPs with energy as end use offers potential without requesting additional land
- Potentials in wood fuel use (accounting for one third of global removals) through increased efficiency

IIASA: Chladna, 2007

Discussion

- Carbon price projected to rise considerably
- HWPs in: A high incentive for increased recycling and wood recovery in a integrated carbon market
- HWPs out: Feedbacks might induce shorter optimal forest rotations, assuming
  - full liability to carbon stocks
  - constant wood price and
  - increasing C price



merci!
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Abstract:

HWPs and and biofuels impact the carbon cycle of the land-use sector in similar ways. HWPs postpone emissions of carbon after biomass harvest by building up a product carbon stock. When burned for energy generation, both offer substitution services that can lead to a slower depletion of fossil carbon stocks due to less fossil fuels burned. This requires a cascaded use of HWPs in a tight recycling chain with final bioenergy use.

The effectiveness of climate services of HWPs and biofuels depends on a) the efficiency of the bioenergy chain, b) reference system to be substituted and c) the lifetime of products.

While direct wood production for biofuel use is usually the more efficient carbon mitigation option compared to HWPs, mitigation potential of HWPs emerges from the mere extent of forests available for timber production.

In a future integrated carbon market an inclusion of HWPs would offer incentives for mitigation options in the entire forestry sector. Long-lasting HWPs and an efficient recycling cascade would buffer emissions from harvest and avoid additional costs for forest owners.