

Carbon Reservoirs in Wood Products- in-use in Finland: Current Sinks and Scenarios until 2050

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Outline

1. The main interests and questions
2. Literature
3. Methods and results
4. Conclusions

1. The main interests and questions

Motivation: Storing of carbon to wood products can be used to mitigate the climate change

Objective: To estimate carbon reservoirs of wood products-in-use (WPIU) in the coming decades in Finland

- The decay rate of WPIU in Finland
- The estimation of future domestic consumption of wood products
- To discuss on long term level and balance of those reservoirs, while the sawnwood consumption has increased rapidly during last decades
- Monetary valuation of wood-products carbon reservoirs

2. Literature

IPCC. 2006. Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use.

Pingoud, K. & Perälä, A.-L. 2000. Studies on Greenhouse Impacts of Wood Construction. 1. Scenario Analysis of Potential Wood Utilisation in Finnish New Construction in 1990 and 1994. 2. Inventory of Carbon Stock of Wood Products in the Finnish Building Stock in 1980, 1990 and 1995 .VTT Julkaisuja– Publikationer 840.

Pingoud, K., Perälä, A.-L., Soimakallio, S., and Pussinen, A. 2003. Greenhouse gas impacts of harvested wood products. Evaluation and development of methods. VTT Tiedotteita - Research Notes : 2189.

National level studies e.g.

Apps, M.J., Kurz,W.A., Beukema, S.J. & Bhatti, J.S. 1999. Carbon budget of the Canadian forest product sector. Environmental Science and Policy 2: 25–41.

EPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2005.
<http://epa.gov/climatechange/emissions/usinventoryreport.html>

Karjalainen, T., Kellomäki, S. & Pussinen, A. 1994. Role of wood-based products in absorbing atmospheric carbon. Silva Fennica 28(2):67–80.

3. Methods

Decay rate= share of WPUI, which is rejected annually

1. Decay rate of WPIU (1955-2000)

- carbon contents of WP
- construction losses
- import and export of the WP
- carbon reservoirs in sector(s) at 2000
- share of WP consumption in the different sector(s)
- initial carbon reservoirs in sector(s)

3. Methods

2. Forecast of domestic consumption of WP
 - used time series analysis
 - scenarios
3. Forecast of carbon reservoirs in WPIU in Finland
 - scenarios
4. Valuation of carbon reservoirs
 - interest rate
 - shape of the decay function
5. Sensitivity analysis
 - with above assumptions

3.1 Results:

The decay rate

- The estimated decays between years 1955-2000
- 1.75 % for sawnwood
- 2.89 % for wood based panels

3.1 Results:

Carbon reservoirs at 2004

Table 1. Carbon reservoirs WPIU in Finland at 2004.

	2004 (Mt C)
Sawnwood products	23.51
Wood-based panel products	3.05
plywood products	0.05
particle board products	1.55
fibre board products	1.45
All wood products	26.55

3.2 Results:

The forecast of wood product consumptions (2005-2050)

Forecasts are medians of VAR, VARX,VECM and RWD model forecasts

Series	Estimation sample	Volume 2004 (1000 units)	Volume 2050 (1000 units)	Annual growth rate	Total Growth
Sawnwood	1956-2004	5575 m ³	10135 m ³	+1.31%	+81.80%
Plywood	1962-2004	191 m ³	336 m ³	+1.23%	+75.60%
Particle board	1971-2004	259 m ³	27 m ³	-4.79%	-89.55%
Fibre board	1962-2004	215 t	379 t	+1.24%	+76.39%

3.2 Results:

Alternative scenarios

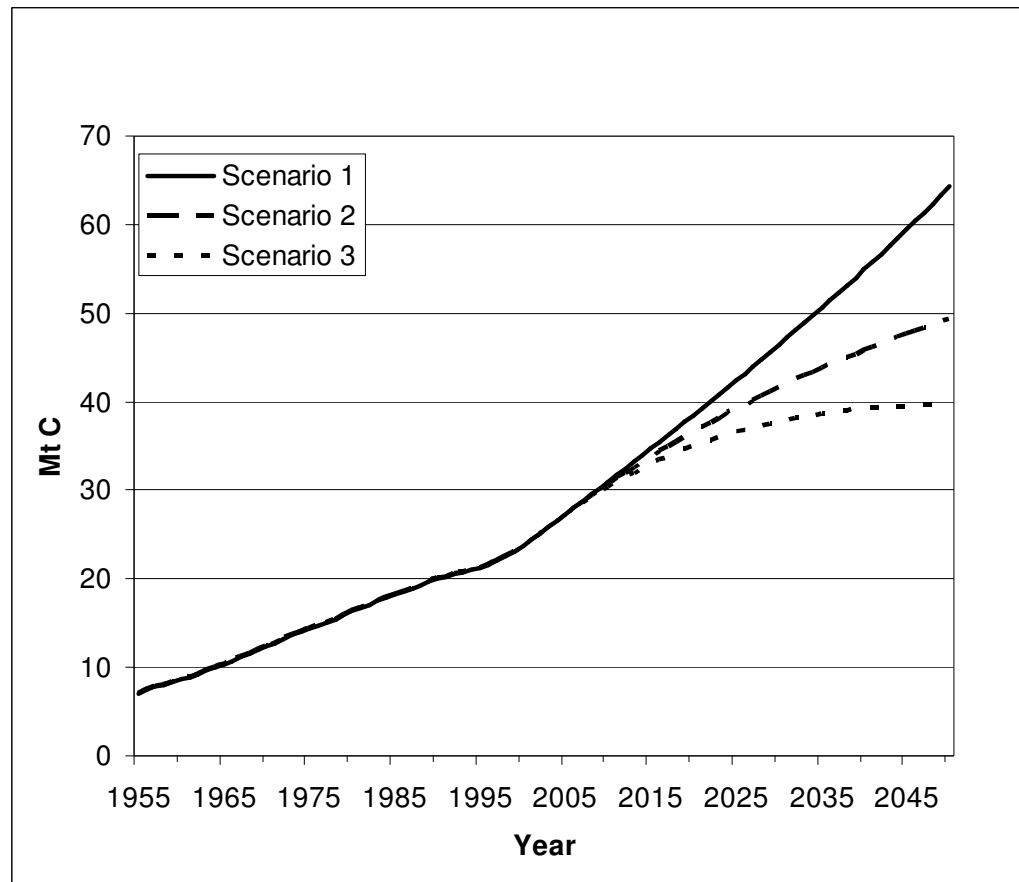
- Sawnwood consumption

	Scenario 1		Scenario 2		Scenario 3		
Volume 2004 (1000)	Annual growth rate	Volume 2050 (1000)	Annual growth rate	Volume 2050 (1000)	Annual growth rate	Volume 2050 (1000)	
Sawnwood	5575 m ³	+1.31%	10135 m ³	0 %	5575 m ³	-1.31%	3040 m ³



3.3 Results:

Carbon reservoirs in WPIU in Finland in scenarios 1955-2050



3.3 Results:

Carbon reservoirs in WPIU in Finland in three scenarios 1955-2050

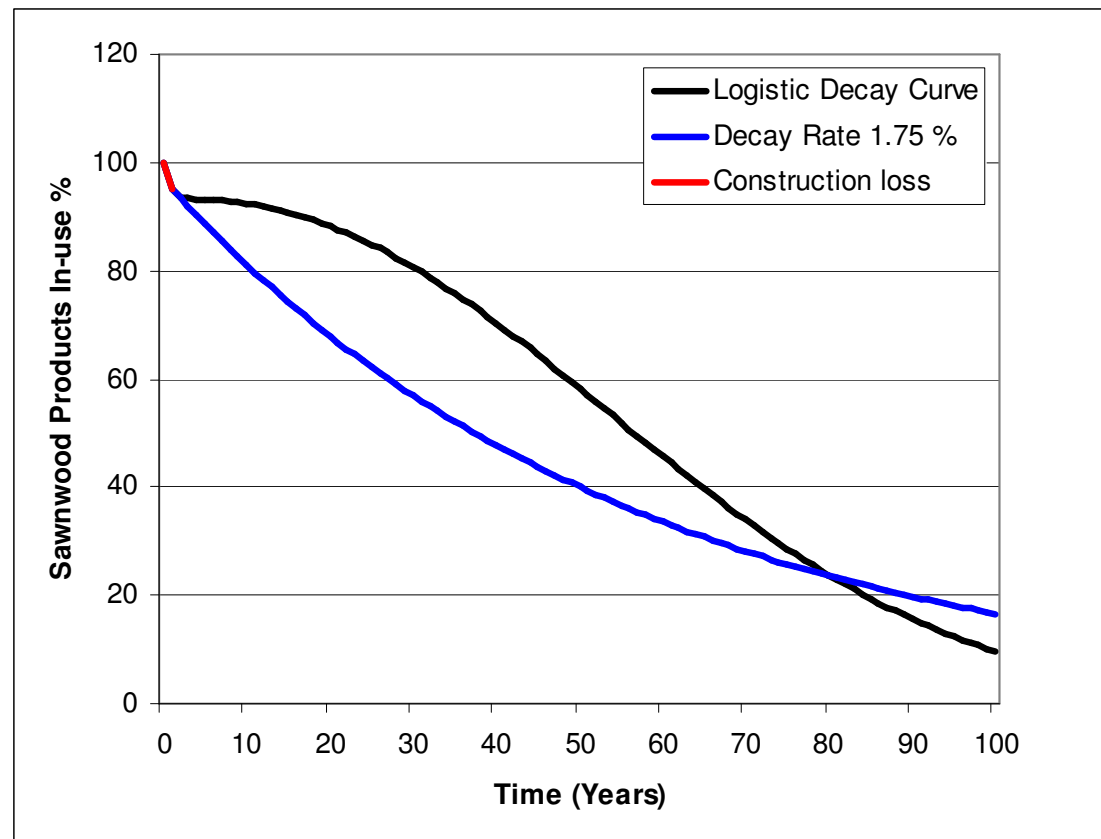
	2000 (Mt C)	2004 (Mt C)	Growth
Sawnwood products	20.87	23.51	13%
Wood-based panel products	2.86	3.05	6%
plywood products	0.044	0.050	15%
particle board products	1.51	1.55	2%
fibre board products	1.31	1.45	11%
All wood products	23.73	26.55	12%

3.4 Results:

Valuation of carbon reservoirs

Shape of the decay functions

Example:
Sawnwood



3.4 Results:

The effects of a decay function on the present value of carbon reservoirs in WPIU in Finland

- Three scenarios for sawnwood consumption 2005-2050

	Decay function					
	Geometric (€ million)			Logistic (€ million)		
Scenario 1: sawnwood products	861			1292		
Scenario 2: sawnwood products	593			983		
Scenario 3: sawnwood products	402			761		
Wood-based panels products	41	41	41	86	86	86
All wood products	902	634	443	1378	1069	847

Conclusions

- The increase in the carbon reservoirs in WP-in-use seems to continue in the coming decades in Finland
- There is need for the further research on the end use wood products



Takk!

		Decay percent (%)	Change to decay percent (%)	C stock in 2004 (Mt C)	Change to 2004 Stock (%)	C stock in 2050 Scenario 1 (Mt C)	Change to C stock 2050 Scenario 1 (%)	C stock in 2050 Scenario 2 (Mt C)	Change to C stock 2050 Scenario 2 (%)	C stock in 2050 Scenario 3 (Mt C)	Change to C stock 2050 Scenario 3 (%)
Results of the study	All	1.75		23.51		59.67		44.79		35.00	
	Non CCE sector	1.75		5.88		14.92		11.20		8.75	
The approximated volume of net export of wood products	Net export of wood houses ^{a)}	1.70	-3	23.45	0	60.31	+1	44.54	-1	34.16	-2
	Net export of wood products sector ^{b)}	1.64	-6	23.35	-1	59.95	0	44.07	-2	33.61	-4
Decay percent doubled in Non CCE sector. Initial carbon stock in Non CCE sector as main results (1,66 mill m ³)	All			21.65	-8	54.30	-9	40.26	-10	31.08	-11
	Non CCE sector	3.5		3.98	-32	9.54	-36	6.67	-40	4.83	-45
Decay percent doubled in Non CCE sector. Initial carbon stock in Non CCE sector 1 mill m ³	All			21.50	-9	54.27	-9	40.24	-10	31.05	-11
	Non CCE sector	3.5		3.87	-34	9.52	-36	6.65	-41	4.80	-45

^{a)} Approximated from euro valued foreign trade statistics for years 1990, 1996–2004 (Finnish Forest Research Institute 2006, Vallin 2007a, 2007b), for years 2004–2050 trade is assumed to be as in the 2004. Used conversion factor for statistics euro values to sawn wood volumes is 1 m³/ 333 € (Luoman konsemi 2007), and construction losses is assumed to be as in domestic use of sawn wood.

^{b)} The wood products sector consist on wood houses, door, windows, parquets, furniture, etc. Approximated from euro valued foreign trade statistics for years 1996–2004 (Finnish Forest Research Institute 2006, Vallin 2007a, 2007b), for years 2004–2050 trade is assumed to be as in the 2004. Used conversion factor for statistics euro values to sawn wood volumes is 1 m³/ 500 €, and construction losses is assumed to be as in domestic use of sawn wood.

		Decay percent (%)	Change to decay percent (%)	C stock in 2004 (Mt C)	Change to 2004 Stock (%)	C stock in 2050 Scenario 1 (Mt C)	Change to C stock 2050 Scenario 1 (%)	C stock in 2050 Scenario 2 (Mt C)	Change to C stock 2050 Scenario 2 (%)	C stock in 2050 Scenario 3 (Mt C)	Change to C stock 2050 Scenario 3 (%)
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Results of the study (Sawn wood)		1.75		23.51		59.67		44.79		35.00	
Sawnwood consumption in CCE sector (75%)	67.5%	1.35	-23	26.04	+11	66.76	+12	51.11	+14	40.76	+16
	82.5%	2.14	+22	21.44	-9	53.94	-10	39.75	-11	30.48	-13
Initial carbon stock in CCE sector at 1955 (5 mill. t)	4 mill. t ^{a)}	1.61	-8	23.62	0	61.65	+3	46.50	+4	36.52	+4
	6.2 mill. t ^{a)}	1.88	+7	23.40	0	57.93	-3	43.28	-3	33.67	-4
Carbon content of sawnwood (0.204 t C/m ³)	0.184 t/m ³	1.28	-27	23.50	0	61.25	+3	47.02	+5	37.60	+7
	0.224 t/m ³	2.20	+26	23.53	0	58.59	-2	43.09	-4	32.97	-6
Construction loss (5%)	2.5% ^{b)}	1.85	+6	23.52	0	59.58	0	44.50	-1	34.60	-1
	10% ^{b)}	1.54	-12	23.47	0	59.88	0	45.40	+1	35.86	+2

^{a)} Using higher change (20%) in the initial carbon stock because uncertainty of initial carbon stock is higher than others

^{b)} Using double (half) value, while the change with 10% increase (decrease) is less than 3 units

^{a)} Approximated from euro valued foreign trade statistics for years 1990, 1996–2004 (Finnish Forest Research Institute 2006, Vallin 2007a, 2007b), for years 2004–2050 trade is assumed to be as in the 2004. Used conversion factor for statistics euro values to sawn wood volumes is 1 m³/333 € (Luoman konsemi 2007), and construction losses is assumed to be as in domestic use of sawn wood.

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