



Sustainability Assessment of Two Alternative Bio-energy Forest Wood Chains with ToSIA

by

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The story and methodology

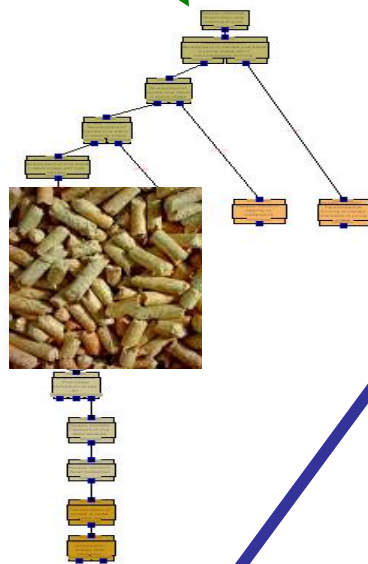
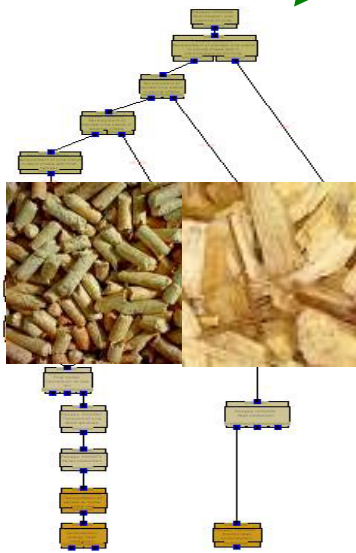


- equation of the presentation:

1. The story and methodology

Pellet & Chipping Chain
(P&C Chain)

Pellet Chain
(P Chain)



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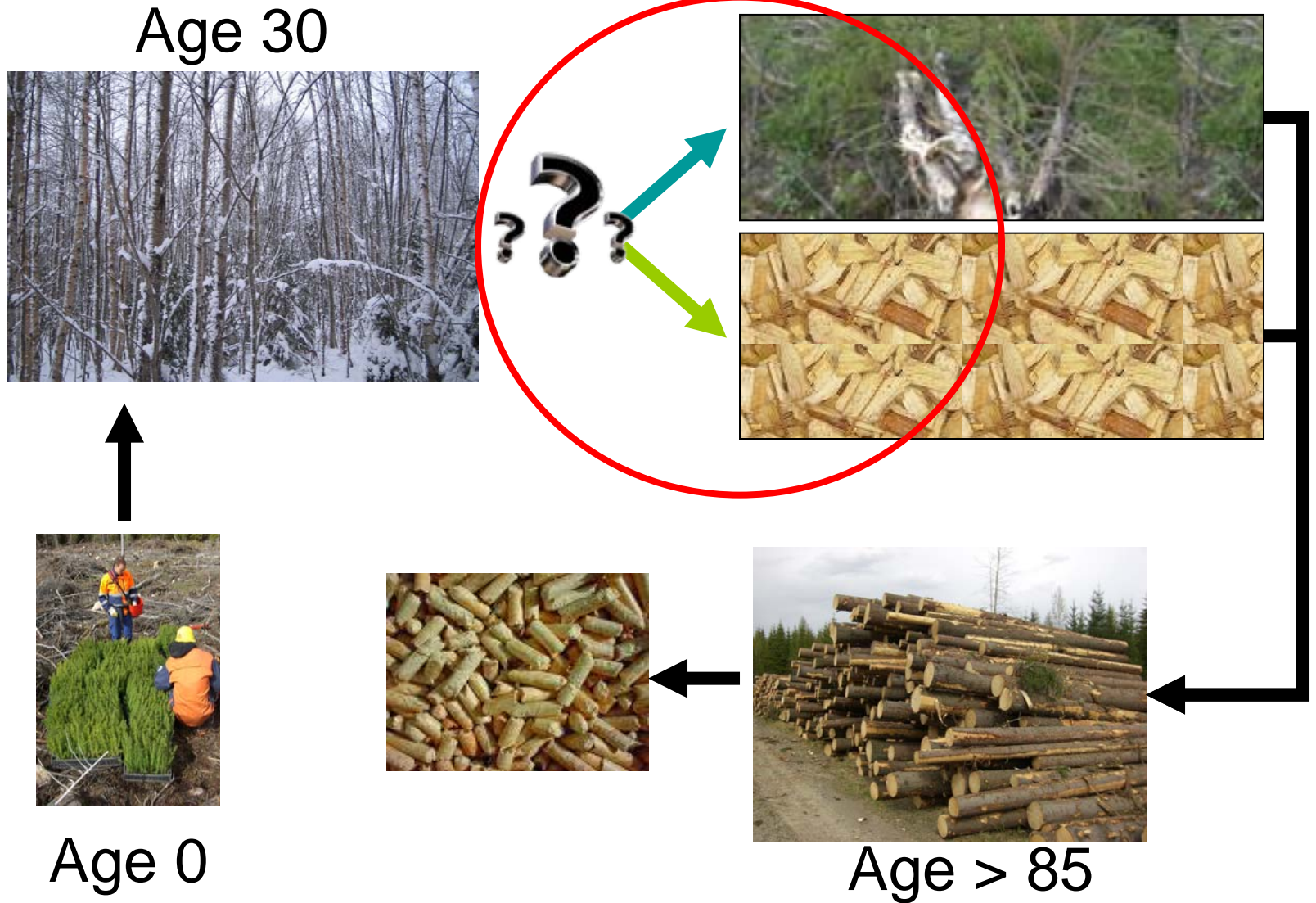


2. Results of comparison

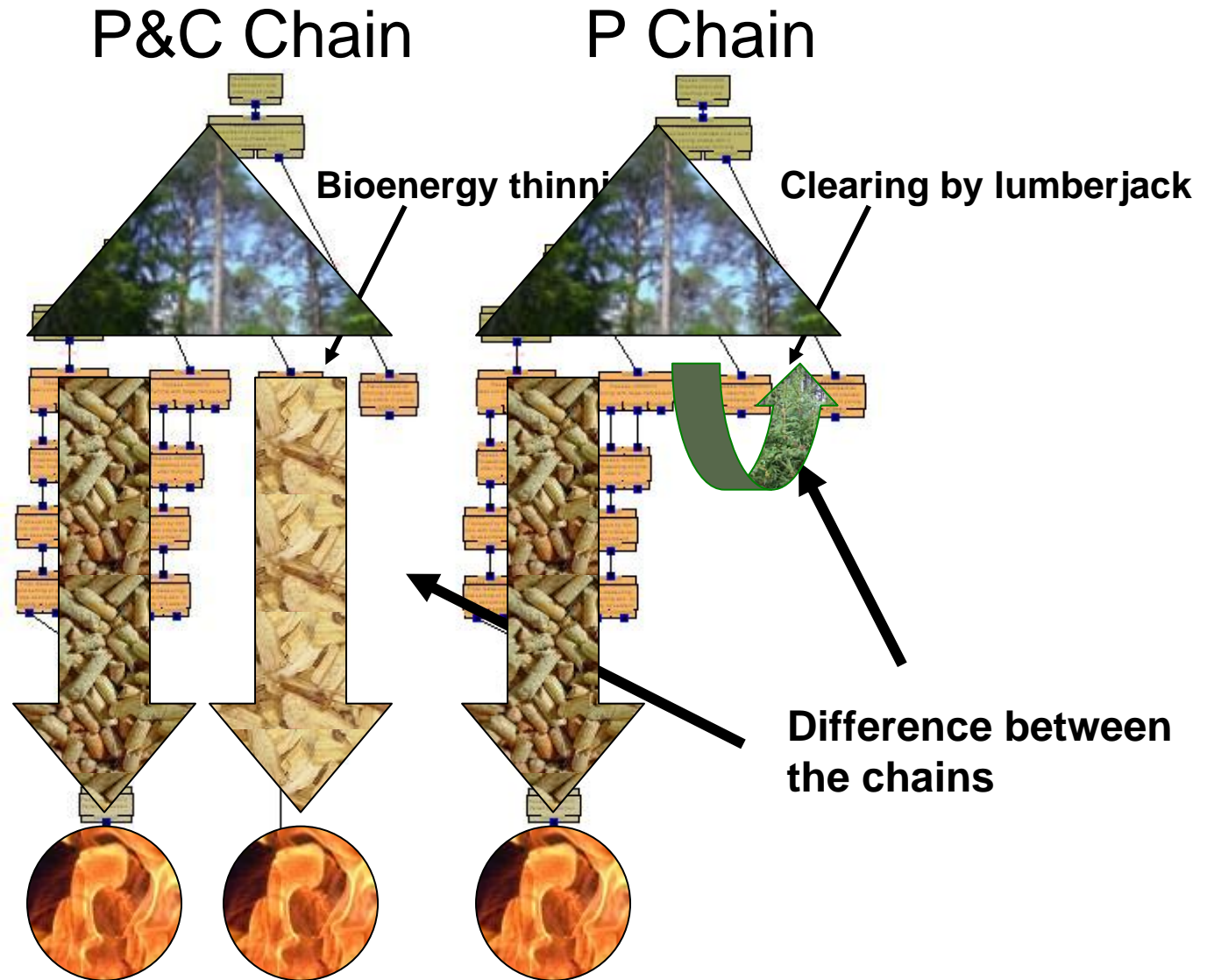
3. Discussion of results



The story and methodology



The story and methodology



The story and methodology



- Research objective
 - a) effects of additional extraction of forest biomass for energy purposes on sustainability
 - b) greenhouse gas balance
 - c) social and economic aspects
 - d) potential environmental trade-offs



The story and methodology



- Indicator set



Indicators		Units
1. Production costs		euro
2. Resource / Material use		m ³
3. Total heat consumption		MJ
4. Employment	4.1 male	person a
	4.2 female	person a
5. Wages and Salaries	5.1 male	euro
	5.2 female	euro
6. Safety and Health	6.1 Occupational accidents non-fatal	accidents
	6.1 Occupational accidents fatal	accidents
7. Greenhouse Gas Emissions		tons CO ₂ eqv.
8. Maintenance of soil quality		kg
9. Transport (road)	9.1 transport distance road	tkm
	9.2 freight volume	tons
10. Energy	10.1 renewable energy use	MJ
	10.2 non renewable energy use	MJ
	10.3 electricity from the grid use	MJ
	10.4 generation from renewables	MJ
11. Average carbon storage in cut biomass		tons



Results of the comparison



a) effects of additional extraction of forest biomass on sustainability

Indicator		P Chain	P&C Chain	increase in %	Unit
1. Production costs		318 737	595 078	87	euro
3. Total heat consumption		5 604 318	1 6491 609	194	MJ
4. Employment		0,99	2,18	120	person a
7. Greenhouse Gas Emissions		63	126	101	tons CO2 eqv.
8. Maintenance of soil quality		0	5 382	n.a.	kg
9. Transport	9.1 transport distance	272 416	363 846	34	tkm
	9.2 freight transported	1 679	2 822	68	tons
10. Energy	10.1 energy use	1 942 126	2 348 295	21	MJ
	10.2 heat generation	6 404 935	20 725 555	224	MJ

Based on:

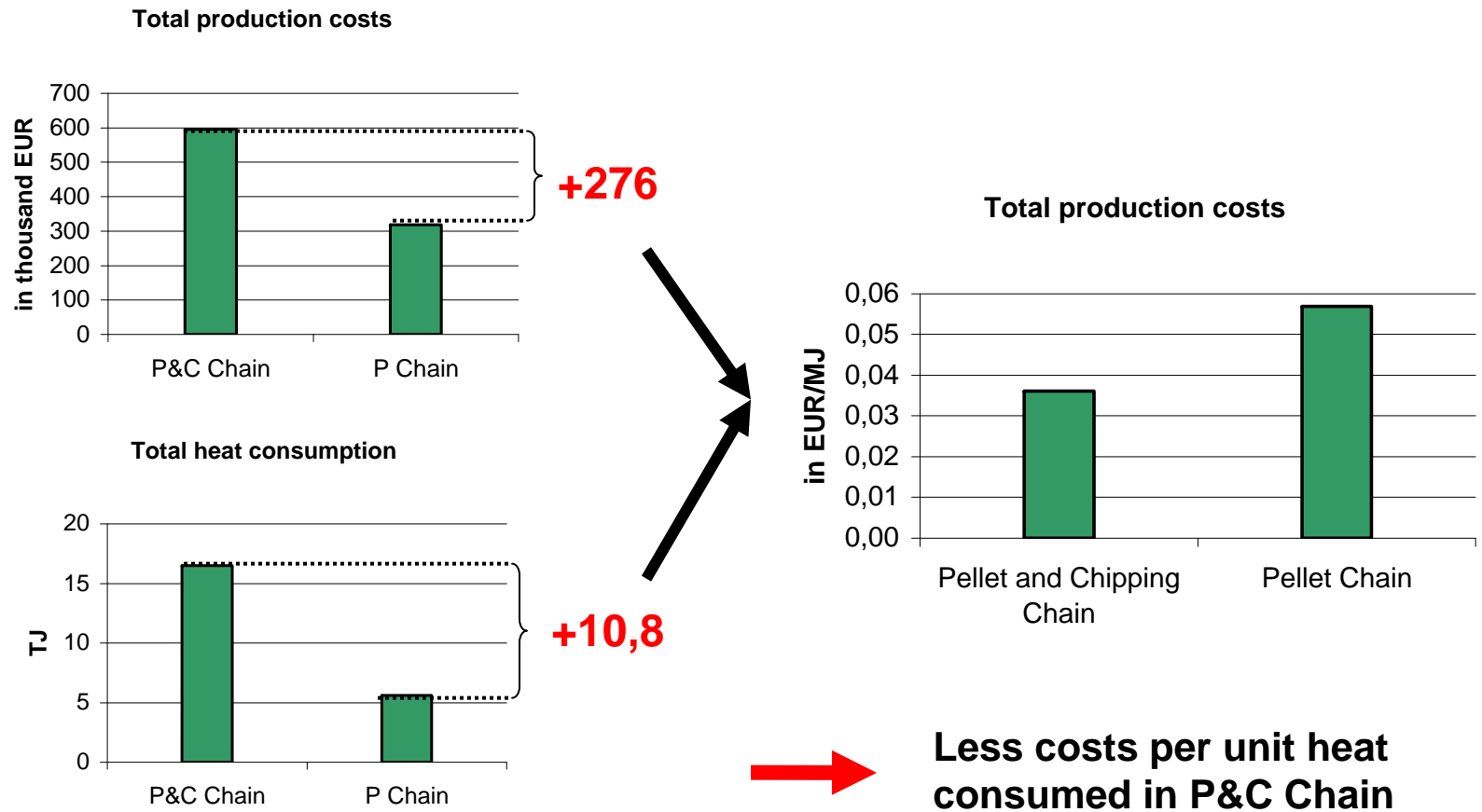
- one reference year (2007)
- a certain land area (1803 ha)



Results of the comparison



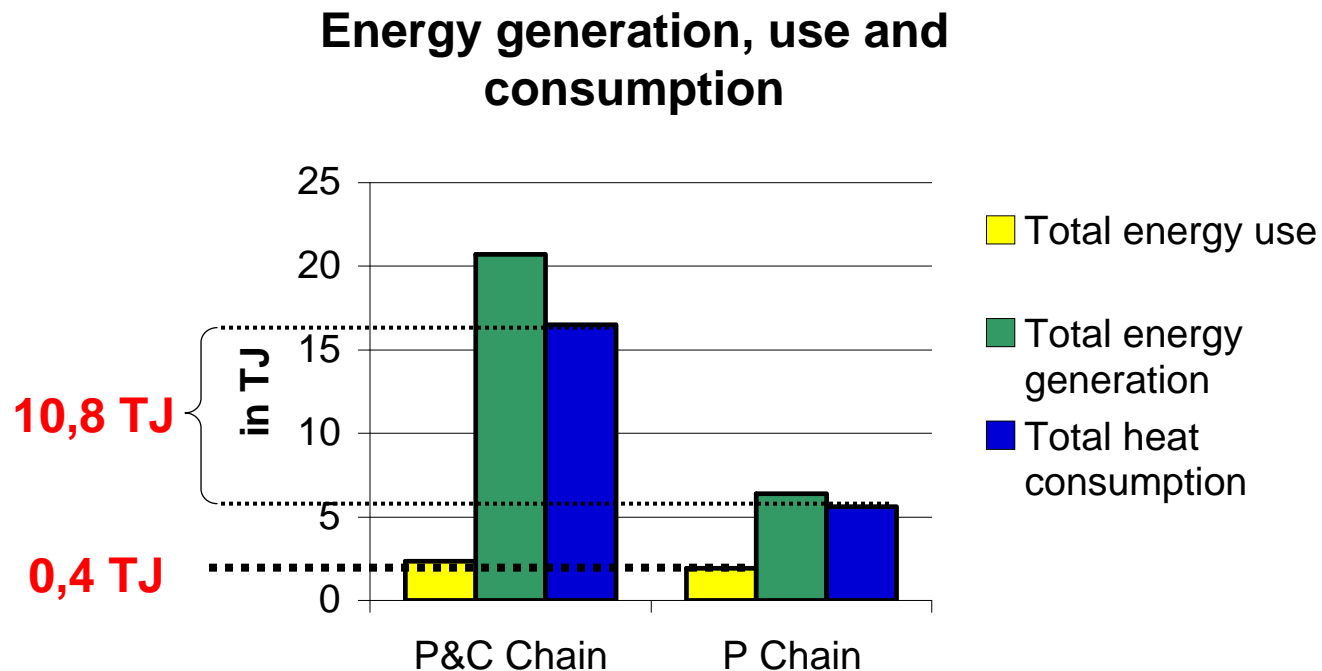
a) effects of additional extraction of forest biomass on sustainability



Results of the comparison



a) effects of additional extraction of forest biomass on sustainability



- ➔ Chipping strongly increases the heat generation, > 3 times**
- ➔ Similar energy use in both chains**
- ➔ Pellet Chain more efficient, (0,80 vs. 0,88)**

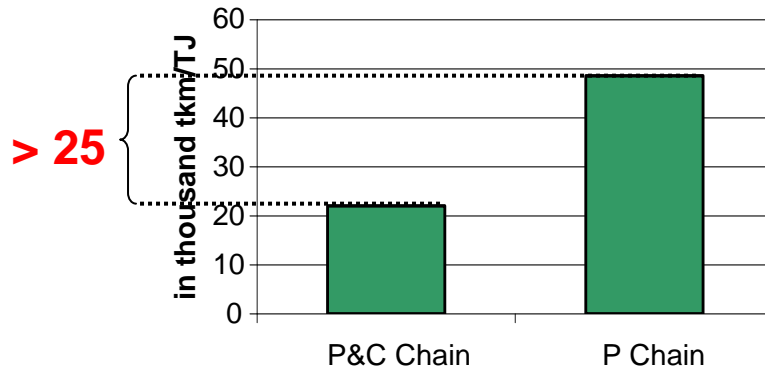


Results of the comparison

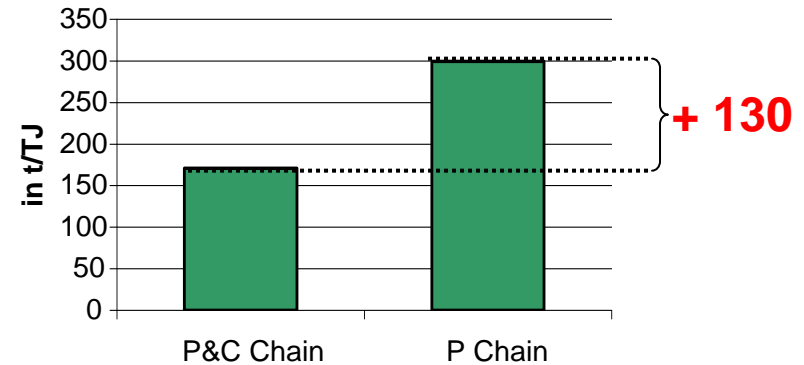


a), b) & c) greenhouse gas balance and social aspects

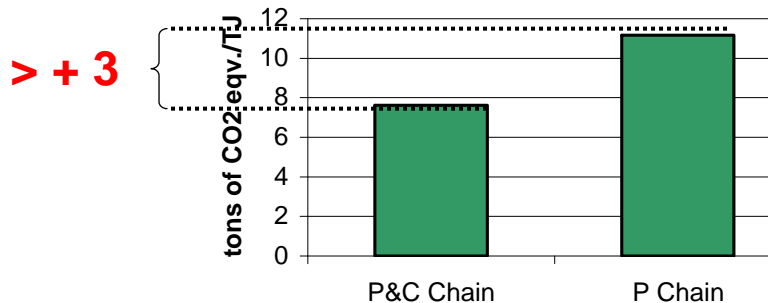
Total transport distance



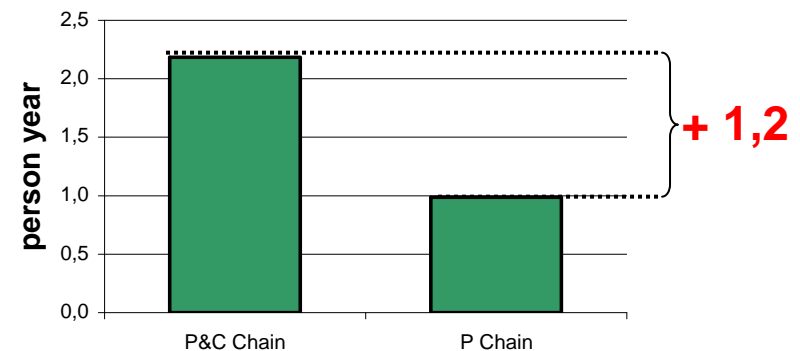
Total freight transported



Total greenhouse gas emissions



Total employment

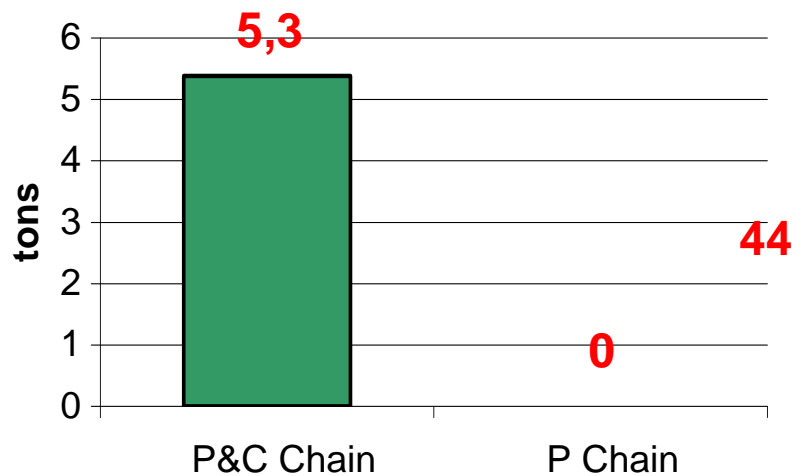


Results of the comparison

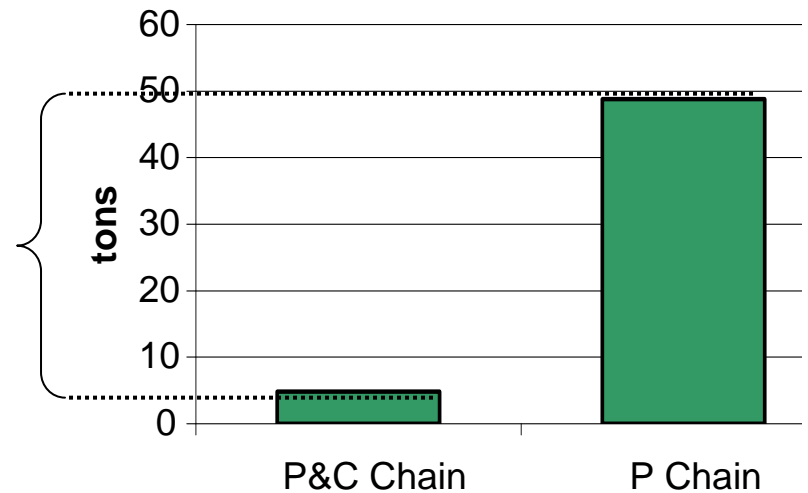


d) The potential trade-offs

Total nutrients extraction



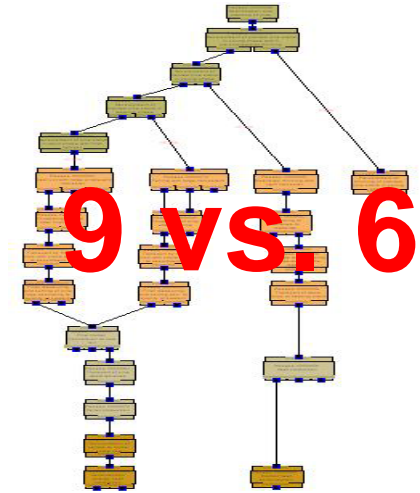
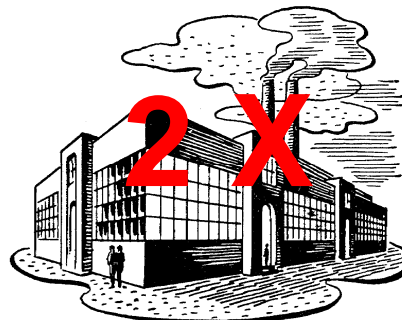
Average carbon storage in cut biomass



Discussion of results



- Constraints of the pellet production
 - High energy use
 - High transport distance, freight volume
 - Greenhouse gas balance



→ pellets high energy density





Summary of results

Indicator	P & C Chain	P Chain
GHG bal.	↑	→
Employment	↗	→
Energy bal.	↑	↓
Costs	↑	→
Soil maint.	↓ ↑	↑



Conclusion & achievements



- Chipping adds socio-economic advantages on sustainability
- Nutrient extraction possible constraint
- Basis for evaluation methods e.g. MCA
- Proved unique energy efficiency ratio





Thank you for your attention

