

Sustainability Impacts of bioenergy harvesting scenarios in European forests

Dr. Diana Tuomasjukka, EFI (INFRES)

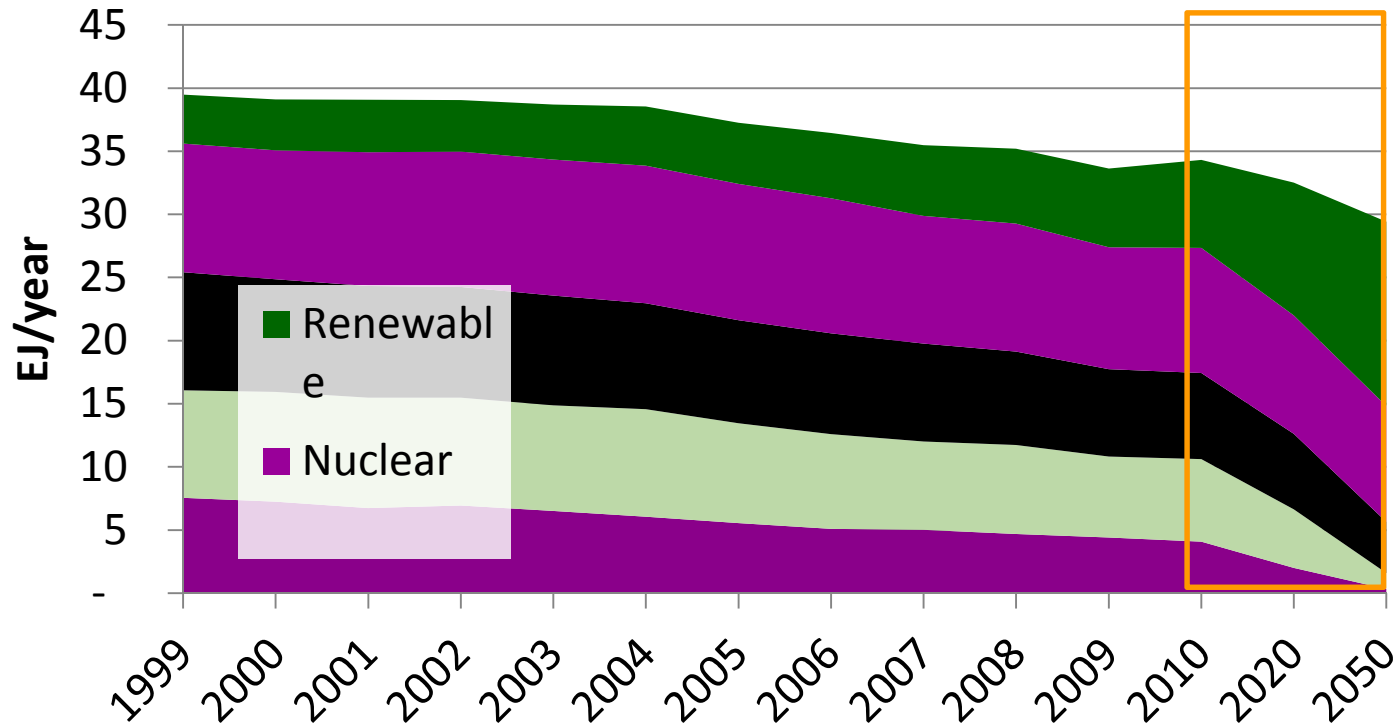
**Mobilization of woody biomass for energy and industrial
use -**

**Smart logistics for forest residues, prunings and
dedicated plantations**

19 May 2015, FAO Headquarters. Rome



The Challenge

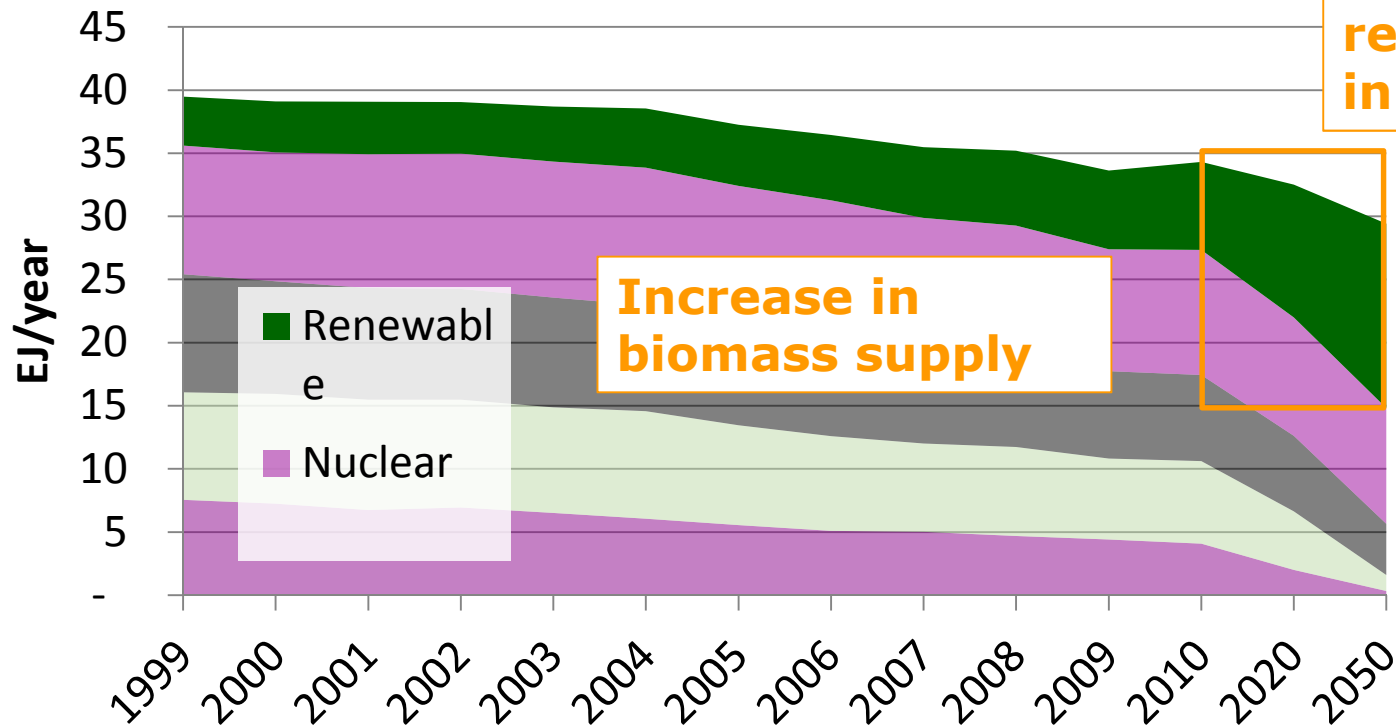


Total Production of Primary Energy, by Source, EU27, 1999-200, 2020, 2050

Source: The values from 1999 to 2010 are from Eurostat. The values for 2020 and 2050 are from the Energy Roadmap 2050, Impact Assessment and Scenario Analysis, Current Policy Initiative Scenario. (from INFRES D3.1)



The Challenge – and how can forests contribute?



Increase in efficiency/
reduction
in fuel use

Increase in
biomass supply

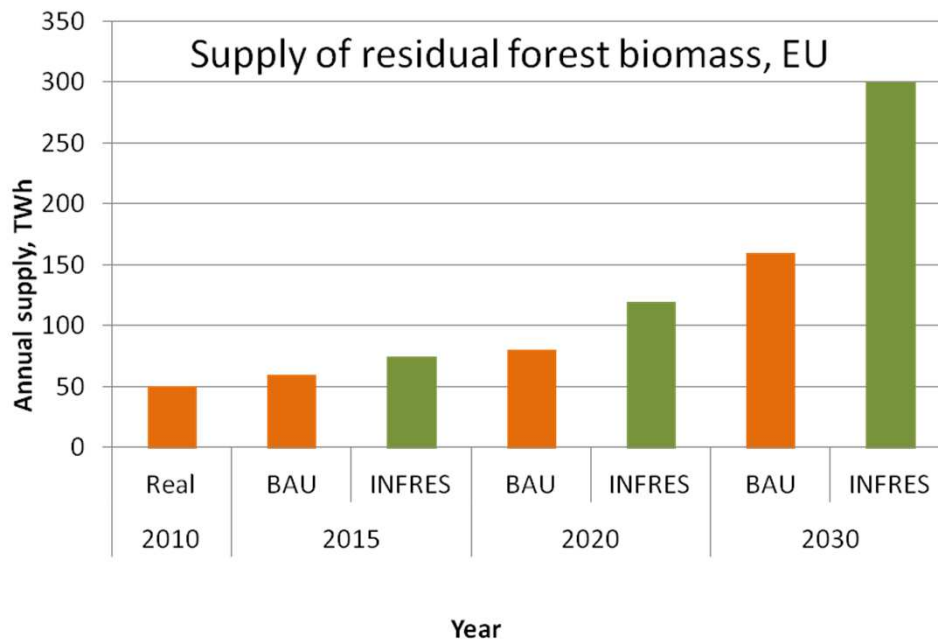
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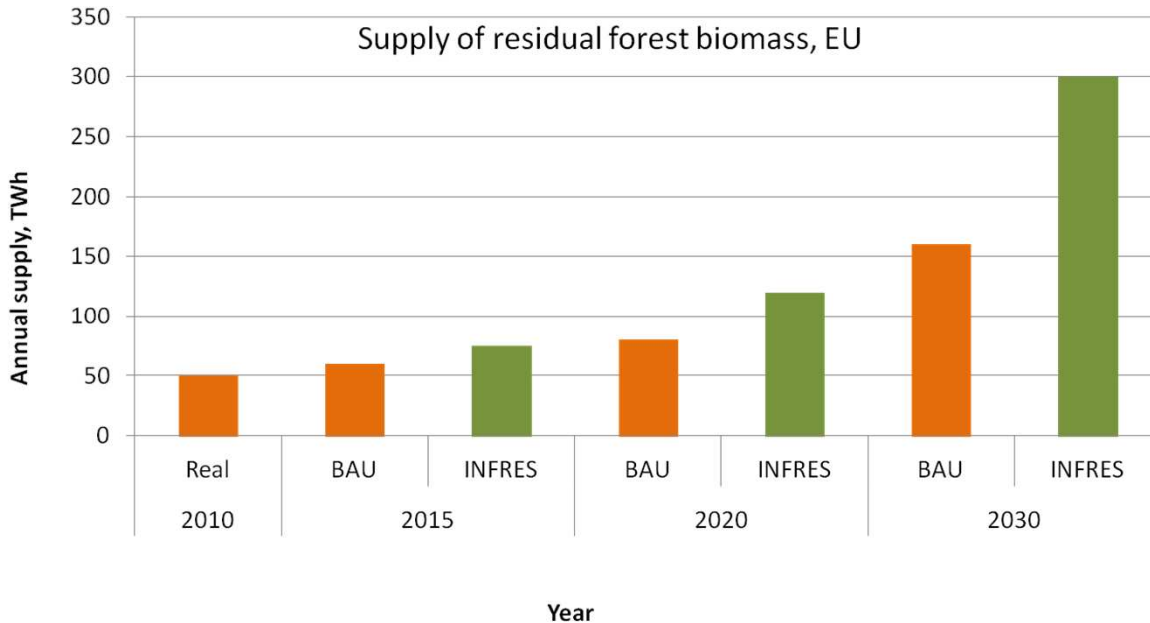
INFRES project goals

INFRES Goal	2010 (BAU)	2015	2020	2030
Annual supply of forest biomass	50 TWh	70 TWh +40%	120 TWh +140%	300 TWh +500%



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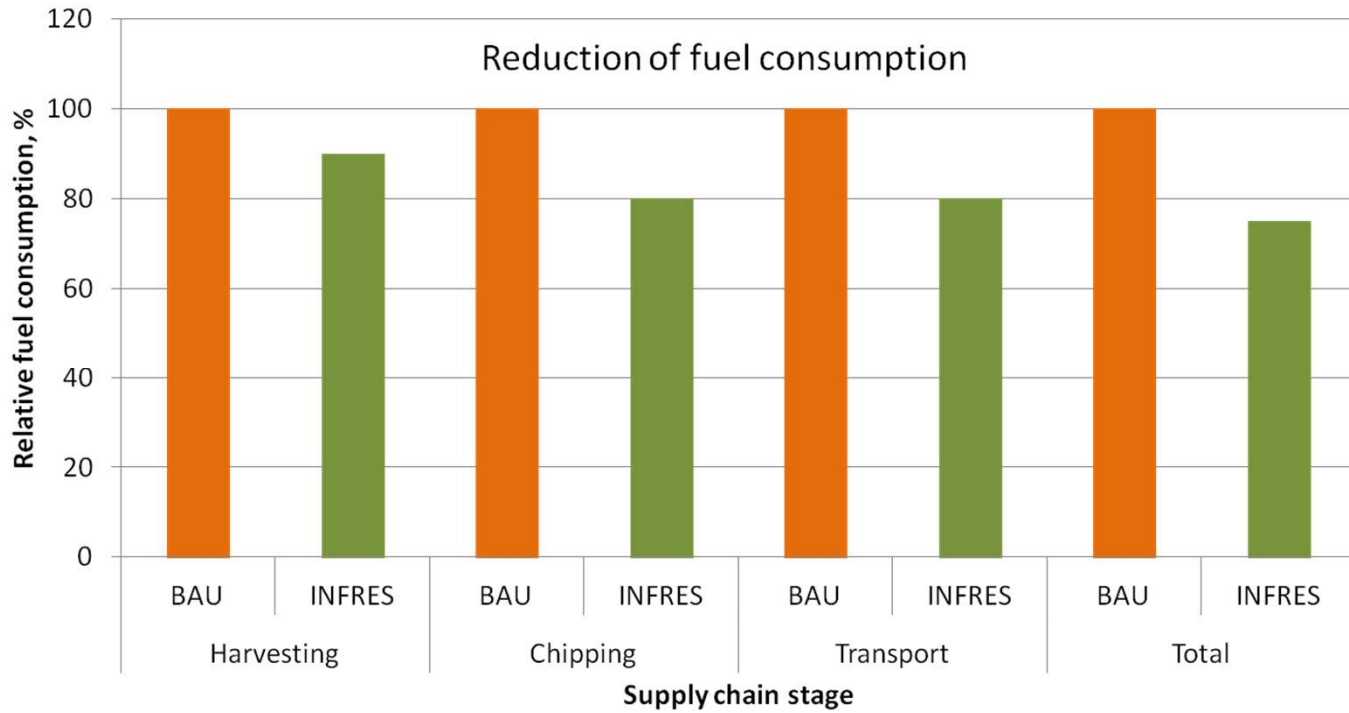


INFRES

INFRES Goal

Annual supply biomass

Turnover in fuel supply



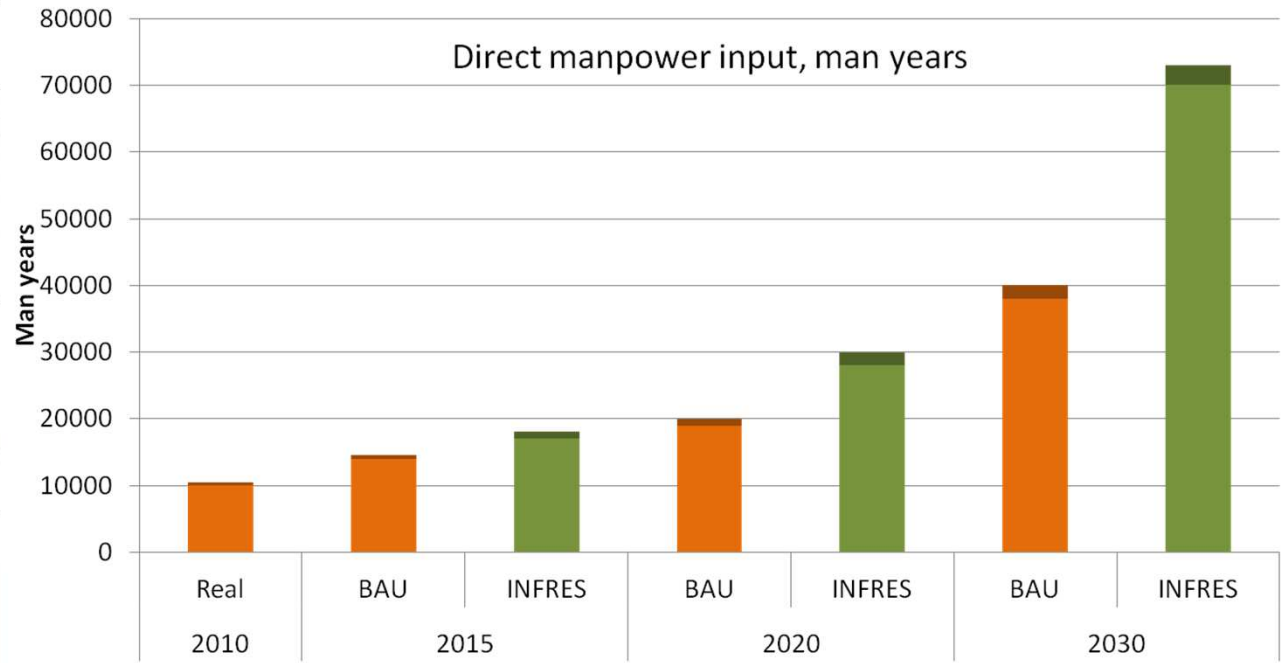
Reduction in fuel consumption

**-25% for whole value chain:
-10% in harvesting, -20% in chipping, -10% in transport**



INFRES project goals

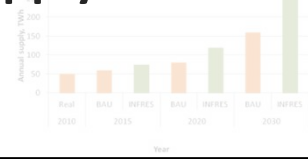
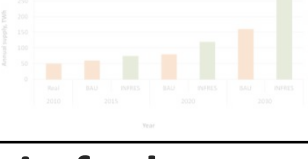
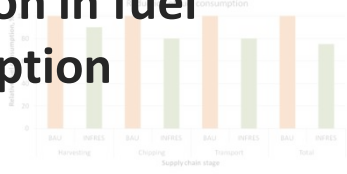
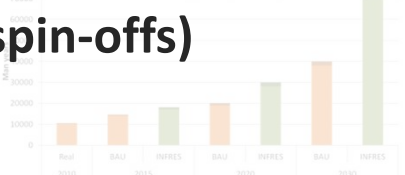
INFRES Goal
Annual supply biomass
Turnover in fe supply
Reduction in f consumption
Increase in manpower (incl spin-offs)



Increase in manpower (incl spin-offs)	11000 FTE	15000 FTE +36%	27000 FTE +145%	65000 FTE +490%
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Starting point: what was harvested in 2010?

- According to Eurostat (2011) for 2010:
- the net annual increment in EU28 was 779.15 Mio m³ o.b.,
- of which 489.27 Mio m³ u.b (62%) where harvested
- with 89.97 Mio m³ u.b. (11.5 % of fellings) destined for fuelwood.



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- INFRES focuses on small-dimensioned assortments which are not in conflict with other, higher value added wood products.
- We assumed that **25-30 Mio m³** come from forest wood chips (i.e. chips from small-dimensioned assortments such as harvest residues and stumps). Traditional firewood was excluded.



Starting point: how was harvested in 2010?

	CEU	SEU	EEU	NEU	EU
Roundwood [%]	93	94	94	93	94
Harvest residues [%]	7	6	6	5	6
Precom thin tree [%]	0	0	0	0	0
Stumps [%]	0	0	0	2	1
Motorsaw CTL [%]	7	36	15	7	12
Motorsaw WTS [%]	52	44	75	1	33
Harvester CTL [%]	41	21	9	91	55
Harvester WTS [%]	0	0	0	0	0
Forwarder CTL [%]	45	38	13	100	62
Skidding WTS [%]	47	55	85	0	35
Cable yarding [%]	8	8	1	0	3
Transport distance to incineration [km]	69	56	145	93	69

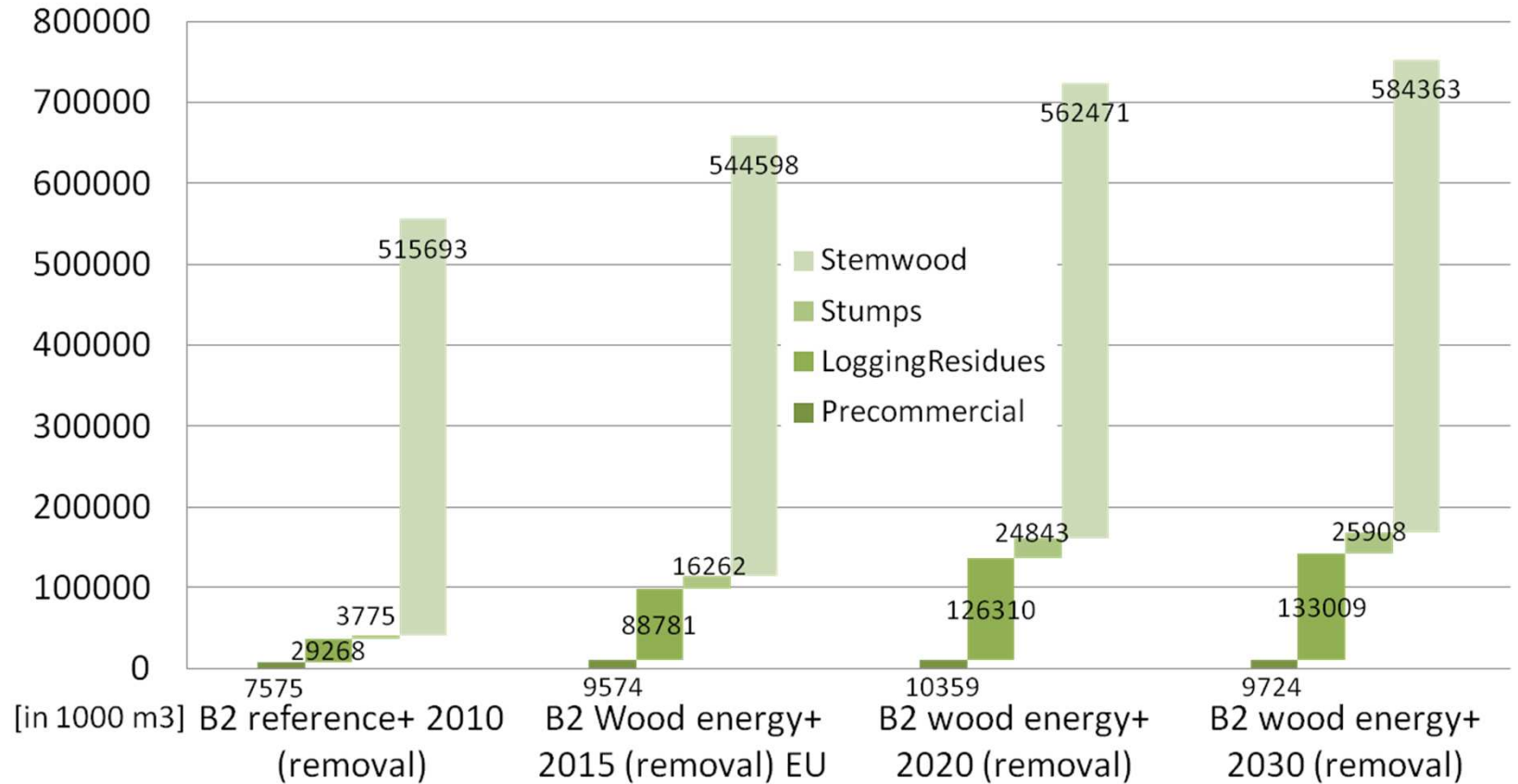


Chosen scenarios: technical innovations and higher level of mechanisation

Scenarios/machines	NEU	CEU	SEU	EEU
Narva multitree harvester head,	X	X	X	X
MAMA multistem harvesting head; MAMA forwarding	X	X	X	X
Press-collector:- due extended space forwarder.	X	X	X	X
Valentin cable yarder		X	X	X
Pezzolato (chipper)	X	X	X	X
Kesla hybrid chipper	X	X	X	X
Demonstrations of two-stage comminution of stumps	X	X	X	X
Antti Ranta, enlarged truck space	X	X		
Swedish big truck (Skogforsk)	X			



INFRES Goal: increase feedstock supply



INFRES Goal: increase feedstock supply

INFRES Goal [Mio m3]	INFRES Goal [TWh]	Small-dimensioned assortments [Mio m3]	Stemwood [Mio m3]	Total [Mio m3]	Scenario
27 [25-30]	50	41 [covers INFRES goal]	516 [for other uses]	557	B2 reference+ 2010 (removal)
37 [35-42]	70	115 [covers INFRES goal]	545 [for other uses]	660	B2 Wood energy+ 2015 (removal) EU
65 [60-72]	120	162 [covers INFRES goal]	563 [for other uses]	724	B2 wood energy+ 2020 (removal)
162 [150-180]	300	169 [covers INFRES goal]	585 [for other uses]	753	B2 wood energy+ 2030 (removal)



INFRES goal: increase turn over

**Turnover from feed stock supply =
value of the biomass**

supplied to the heat plant [assumption: energy price of
34 EUR/m³ in 2010 (EUROSTAT, weighted average)]

+

value of providing services

of the bioenergy supply chain [assumption: production
cost].



INFRES goal: increase turn over: value of services

Production cost for additional small-dimension timber	CEU	SEU	NEU	EEU	EU
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This service value was multiplied with the volumes provided, and yielded **0.9 Mio EUR in 2010 up to 3.4 Mio EUR in 2030.**

extra cost [EUR/m3]	44	0	0	15	22
stump extra cost [EUR/m3]			16		16



INFRES goal: increase turn over: value of services

Scenario	Small-dimensioned assortments [Mio m3]	Value raw material [Mio EUR]	Value services [Mio EUR]	Total value [Mio EUR]	INFRES goals [Mio EUR]
B2 reference+ 2010 (removal)	40.6	1379	0.9	1380	1000
B2 Wood energy+ 2015 (removal)	114.6	3892	2.5	3895	
B2 wood energy+ 2020 (removal)	161.5	5485	3.4	5488	2200
B2 wood energy+ 2030 (removal)	168.6	5727	3.6	5731	6000



INFRES Goal: reduce fuel consumption

The INFRES goals are to reduce fuel consumption

- in harvesting by 10%,
- in chipping and transport by 20% each.
- overall reduction (supply chain) -25%



INFRES Goal: reduce fuel consumption (in harvesting)

Process - BAU	Productivity m ³ /h	Process - Scenario	Productivity m ³ /h	%
Pre-commercial selective logging – not utilized (brushsaw vs harvester)	0.7-1.5 (manual)	Narva Multitree harvester head in geometric thinning	3.4-7.4	486-493
		MAMA felling head in geometric thinning	8.2	600-1171
Selective Logging: with motorsaw in CTL system	1.5-2	Selective logging: with medium harvester in CTL system	9	450-600
CEU Selective logging: with medium harvester in WTH system	6.5	Narva Multitree harvester head in geometric thinning	7.4	114
		MAMA felling head in geometric thinning	8.2	126



INFRES Goal: reduce fuel consumption (in chipping)

Process - BAU	Productivity	Process - Scenario	Productivity	%
CEU Chipping of logs with chipper at roadside or terminal	45	Pezzolato chipper	70.7	157
CEU Chipping of harvest residues with chipper at roadside or terminal	36	Kesla hybrid chipper	32.9	71-89
		Pezzolato chipper	32.9	

Hybrid chipper prototype trials:

The fuel consumption however reduced from 37.5 l/h (in CEU) and 22.5 l/h (in NEU) at general level to 34.9 l/h (in NEU) for pulpwood, and was around 39 l/h for harvest residues for both assortments.



INFRES Goal: reduce fuel consumption (in transport)

Transport calculations in D5.5,
as well as more extensive fuel reduction
calculations for whole supply chain.



Source: Fotolia



INFRES Goal: increase employment

Extra employment per region and assortment chain	Pre-commercial extra FTE [FTE/m3]	Harvest residue extra FTE [FTE/m3]	Stump extra cost FTE [FTE/m3]
CEU	0.00039	0.00033	
SEU	0.00017	0.00008	
NEU	0.00018	0.00009	0.00018
EEU	0.00024	0.00018	
EU	0.00098	0.00069	0.00018



INFRES Goal: increase employment

	2010 (BAU)	2015	2020	2030
INFRES Goal: Increase in manpower (incl spin-offs)	11000 FTE	15000 FTE +36%	27000 FTE +145%	65000 FTE +490%
Increased manpower from additional volumes and improved harvesting technology	+74938 FTE	+211461 FTE	+297980 FTE	+311132 FTE



Outlook, next steps:

- Results of this presentation are described in INFRES D5.3
- More economic calculations expected for June 2015, INFRES D5.4
- Additional sustainability impacts and comparative European level calculations expected in August 2015, INFRES D5.5

- Presented calculations are upscaled potential impacts for INFRES recommendations.
- For successful uptake of new technologies more training and knowledge dissemination is needed
- Further development and refinement of machines necessary in practice-engineering exchange.



Thanks a lot for your attention!

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