

BioBoost- Feedstock cost assessment

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Picture ©Krone

Determine price/supply of the
Agricultural residue straw
Forest residue wood chips
Organic municipal waste



Picture ©Krone

Agricultural residue straw- calculation



Residue from grain production:
→ no costs for harvesting (combine)

Cost items:

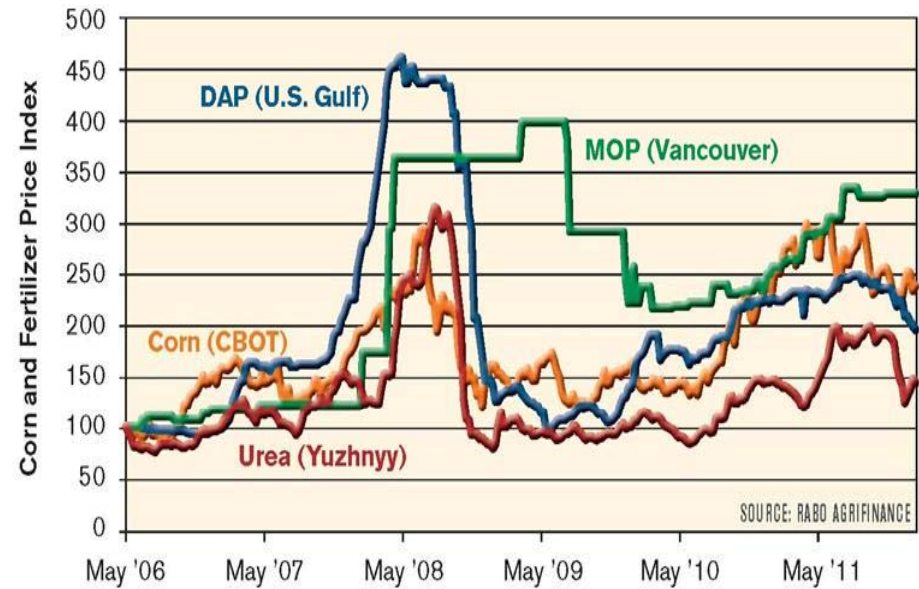
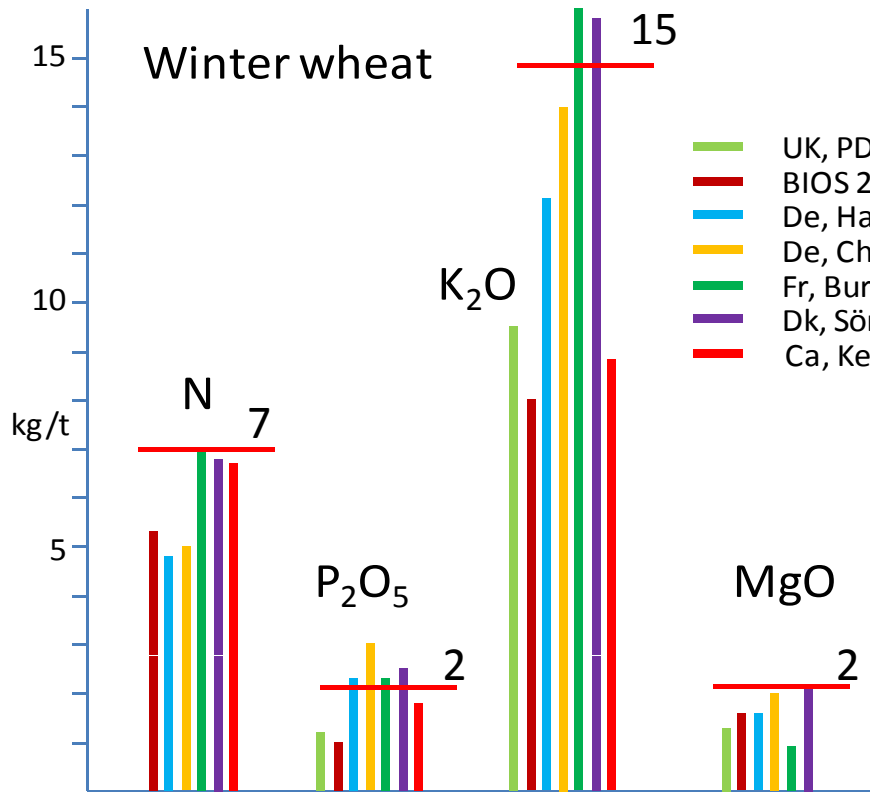
- Fertilizer replacement need ($\text{kg/t} * \text{€}/\text{kg}$) of N P K
- Cost for baling, bale collection & stacking on field side

Variables:

- Amount of straw per hectar
- Field size
- Labour cost

Picture ©Claas

Agricultural residue straw-Fertilizer



Agricultural residue straw- Fertilizer



Fertilizer element	N	P2O5	K2O
Straw content (kg/t)	7	2	15
Effective for following crop (%)	0	100	50-100
Assumed replacement need	3.5	2	12
Fertilizer price (EUR/kg)	0.95	1	0.72
Cost (EUR/t straw)	3.35	2	8.70
Total fertilizer costs:	14.05 EUR/t straw		

Agricultural residue straw- Large square balers

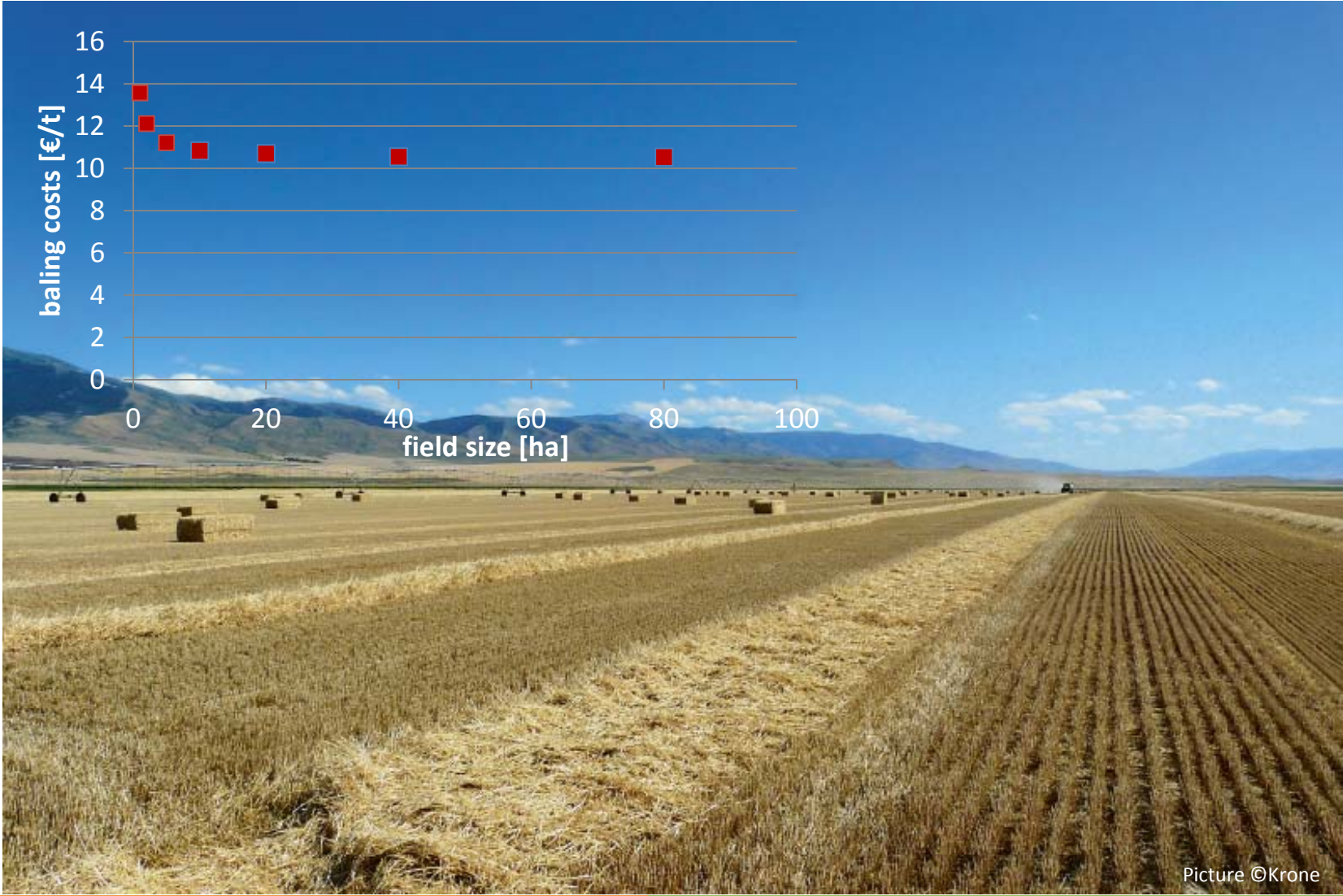


- Sold by all major OEMs
- Bale size HDP 90x120x240cm or 130x120x240cm
- Weight ~500 kg, density 150-220 kg/m³
- Tractor 150-220 kW
- 1 to 1.6 l fuel per tonne straw
- 50 bales per hour



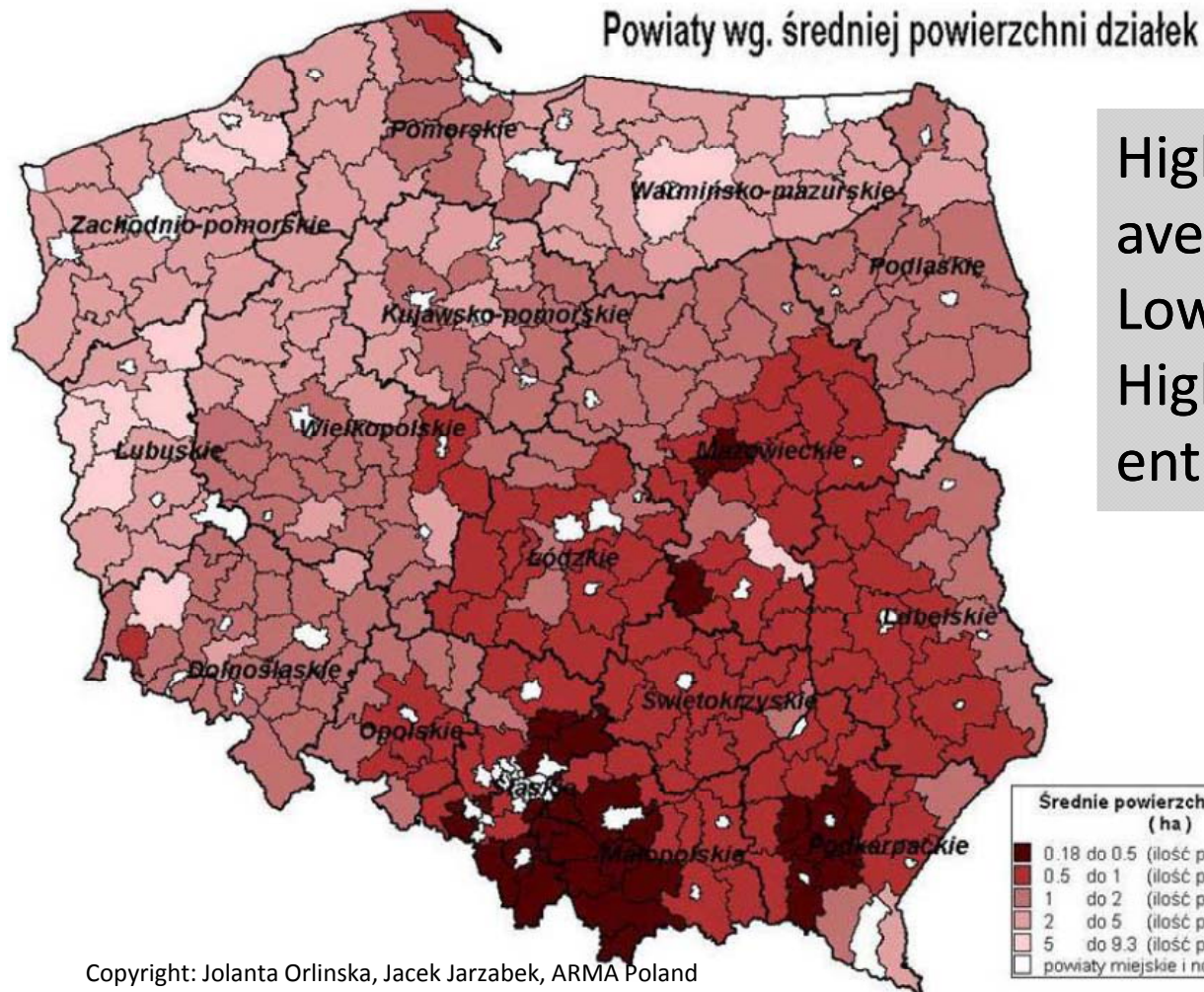
Picture ©Krone

Agricultural residue straw- Baling cost variable field size

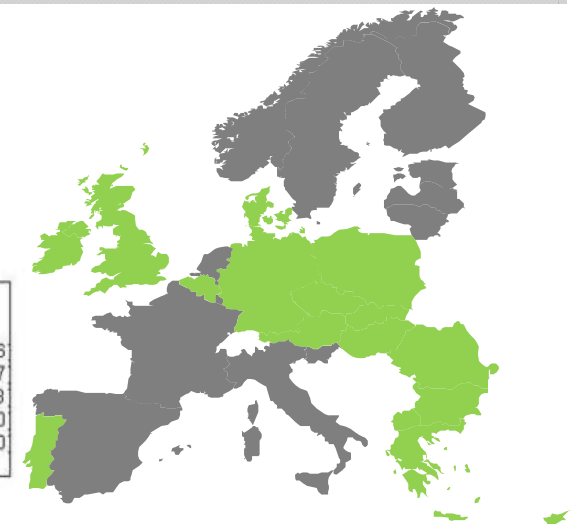


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Agricultural residue straw- Baling cost variable field size

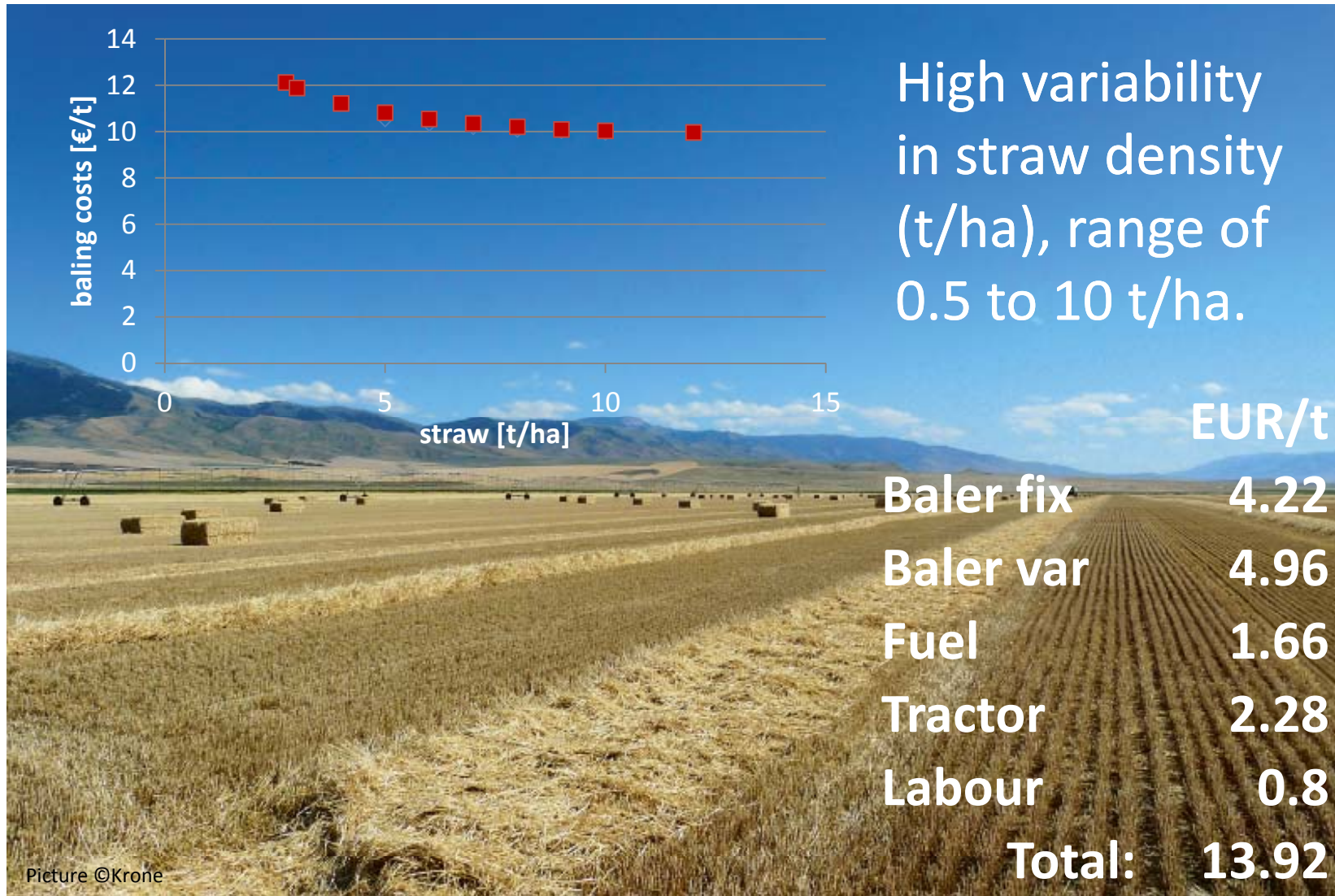


High variability in field size,
average field sizes:
Low: 0.18 ha, a Polish NUTS3
High: 30 ha Romanian legal
entity holdings



Copyright: Jolanta Orlinska, Jacek Jarzabek, ARMA Poland

Agricultural residue straw- Baling cost variable straw density



**Agricultural residue straw-
Bale chasing and stacking**

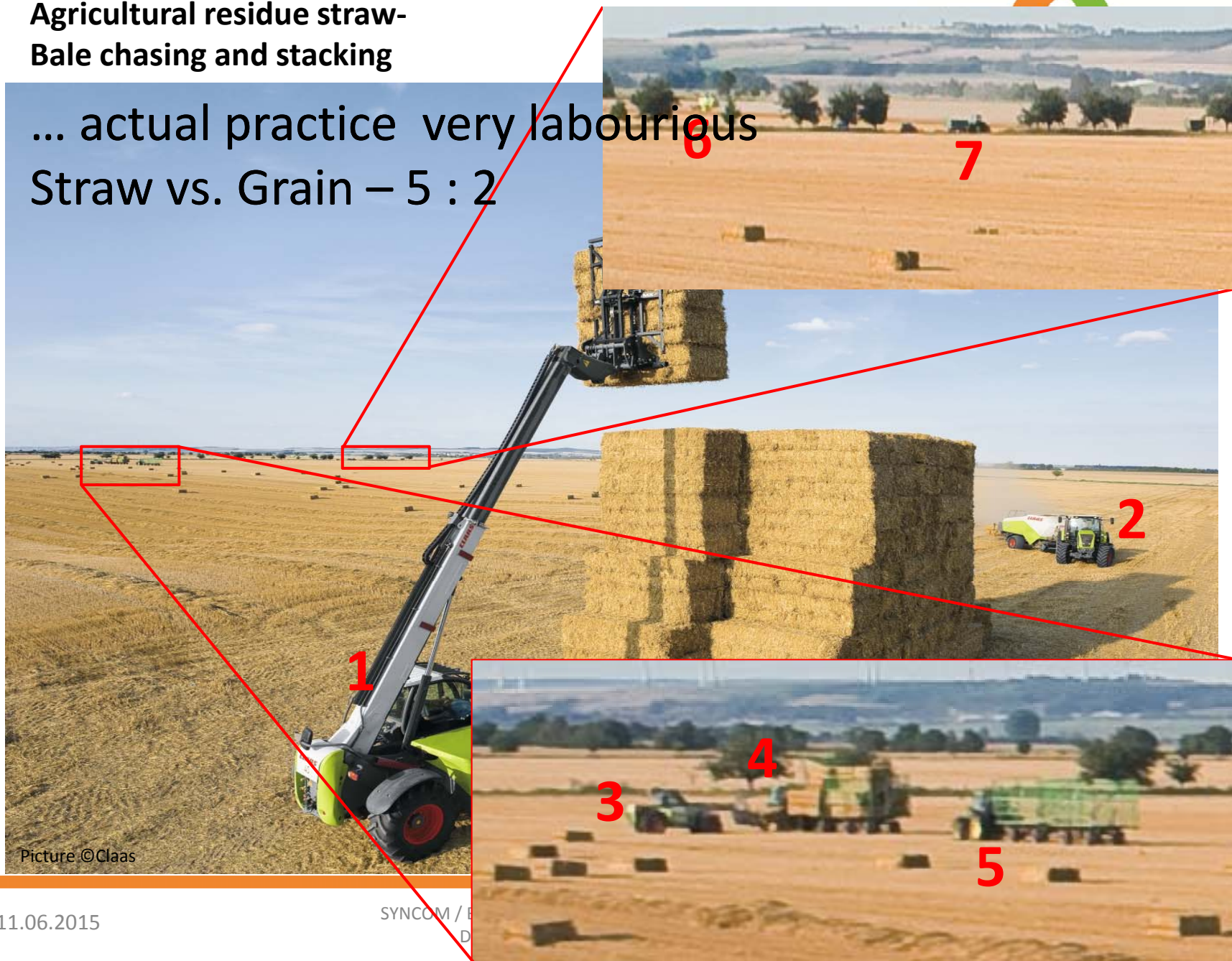
Various methods of
bale collection &
stacking...



Picture ©Krone

**Agricultural residue straw-
Bale chasing and stacking**

... actual practice very labourious
Straw vs. Grain – 5 : 2



Picture ©Claas

**Agricultural residue straw-
Dedicated equipment for bale chasing and stacking**

- Several OEMs
- 100 kW tractor
- 20 to 40 t/h depending on pile size
- ~0.35 l/t fuel



- Low soil compaction
- Rapid field clearance

Agricultural residue straw- Chaser costs



Calculation:

Chaser fix: € 1.21/t

Chaser var.: € 0.1/t

Fuel: € 0.32/t

Tractor: € 1.00/t

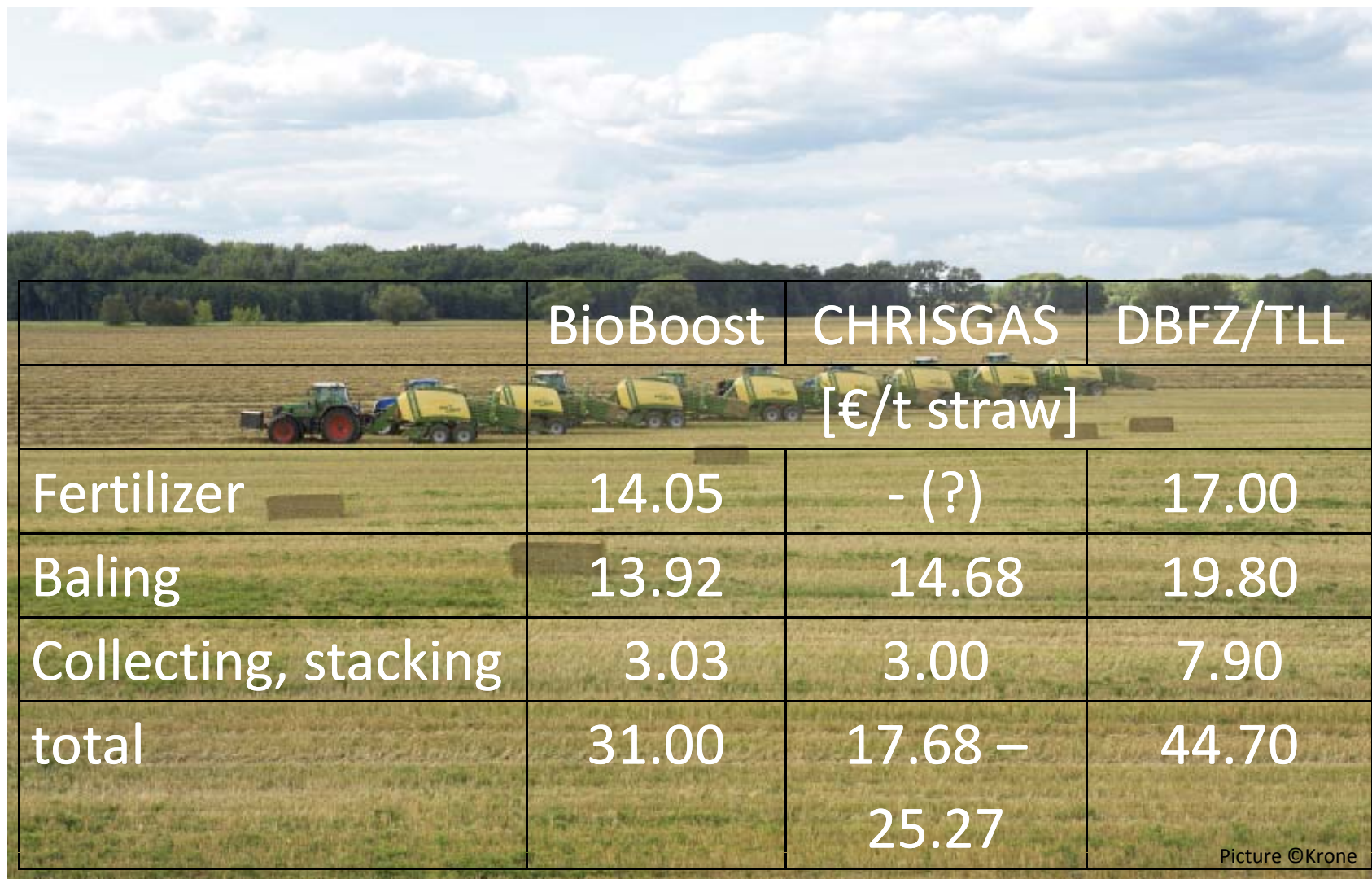
Labour: € 0.40/t

Total: € 3.03/t

@ 80 bales/h



Agricultural residue straw- Total costs

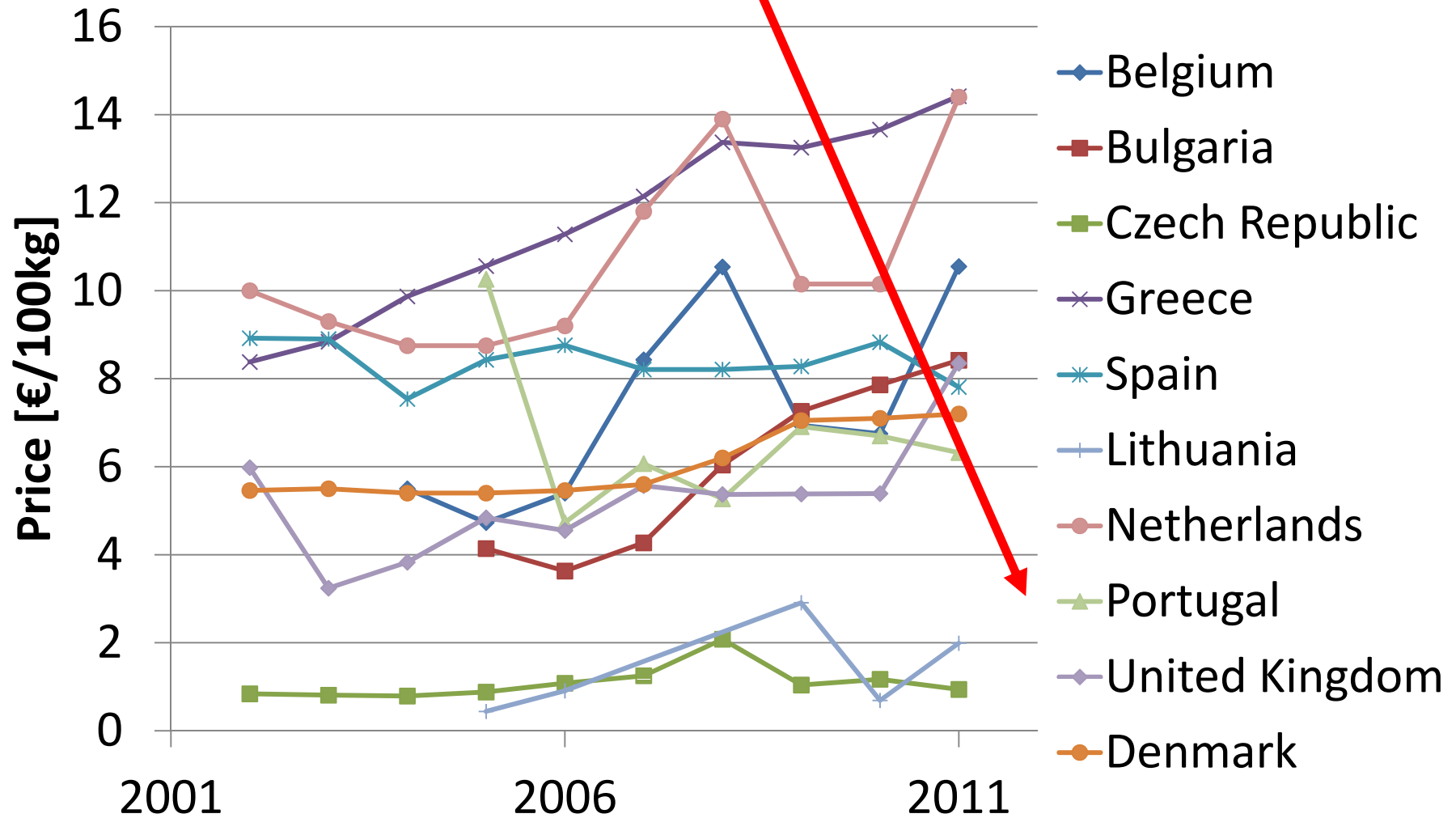



	BioBoost	CHRISGAS	DBFZ/TLL
	[€/t straw]		
Fertilizer	14.05	- (?)	17.00
Baling	13.92	14.68	19.80
Collecting, stacking	3.03	3.00	7.90
total	31.00	17.68 – 25.27	44.70

Picture ©Krone

**Agricultural residue straw-
Straw PRICE (EUROSTAT)**

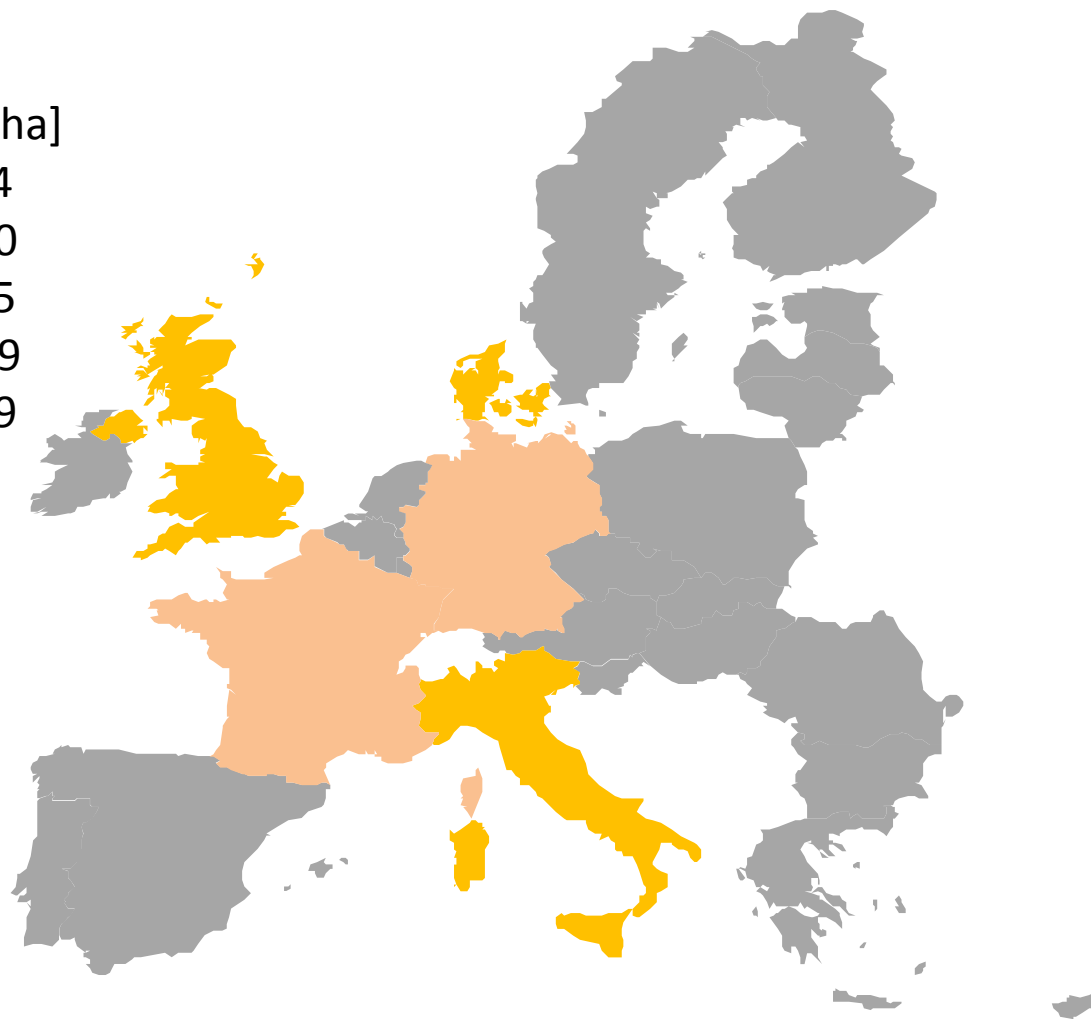
Straw COSTS free field side



Agricultural residue straw- Price / supply farm perspective



FADN cereal report 2011:
Receipts from straw selling [€/ha]
Denmark: 54
United Kingdom: 40
Italy: 25
Germany: 9
France: 9
remaining



Forestry residues - The example of Finland



Forestry residues are

- Small-diameter wood from stand thinning operations
- Tree tops and branches from final fellings
- Stumps from site preparation for planting of new stand (allowed only in some countries)



Forestry residues - The example of Finland



The example of Finland:

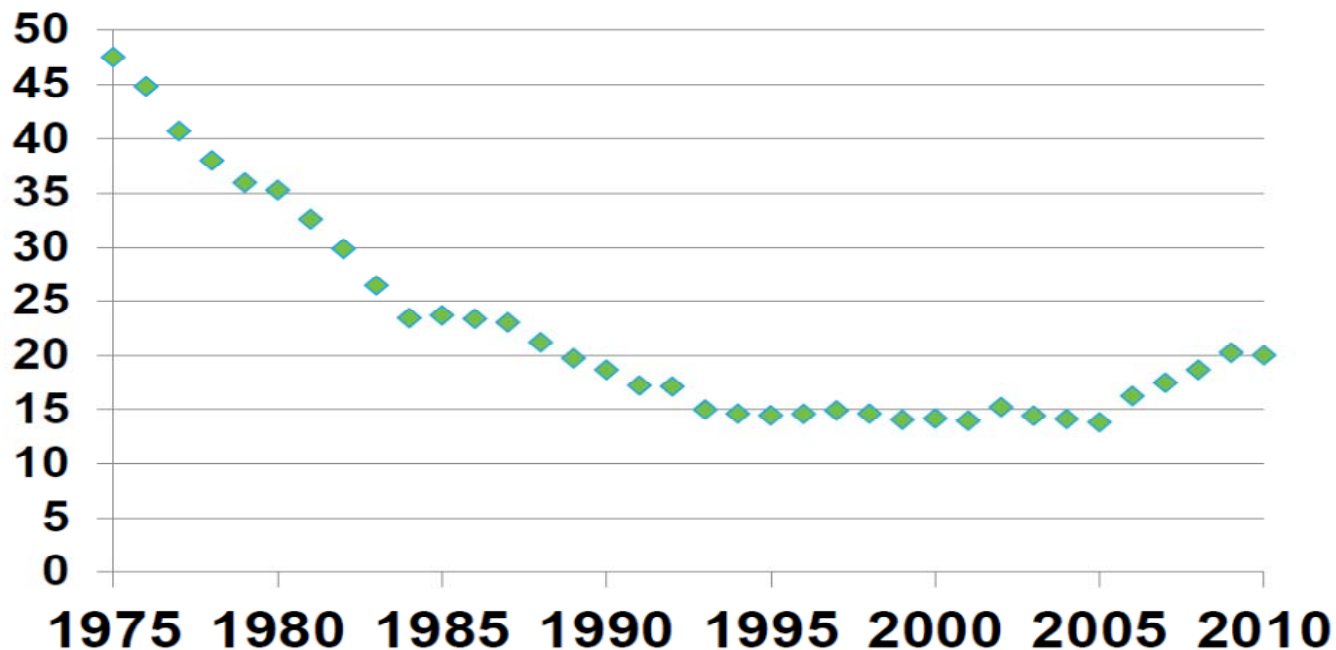
- Harvest of $\sim 70 \text{ Mm}^3/\text{a}$, or 70% of growth
- Forest farming: Even-aged stands, 71% timber from clearcuts, 97% mechanisation in felling, harvest at $>25\text{-}28 \text{ cm } \emptyset$
- 25 Mm^3 theoretical max. forest chip production
- $6,5 \text{ Mm}^3$ used in 2011
- 12.5 Mm^3 target 2020, techn/econ feasible???
- Logging residue volume about 20-30% of harvested roundwood volume
- 60% from logging residues; 40% thinning and stems

Forestry residues - achievements



Wood chip price free power plant (Sweden)
→ Strong learning curve in first 20 years;
→ Increasing prices due to competition for chips

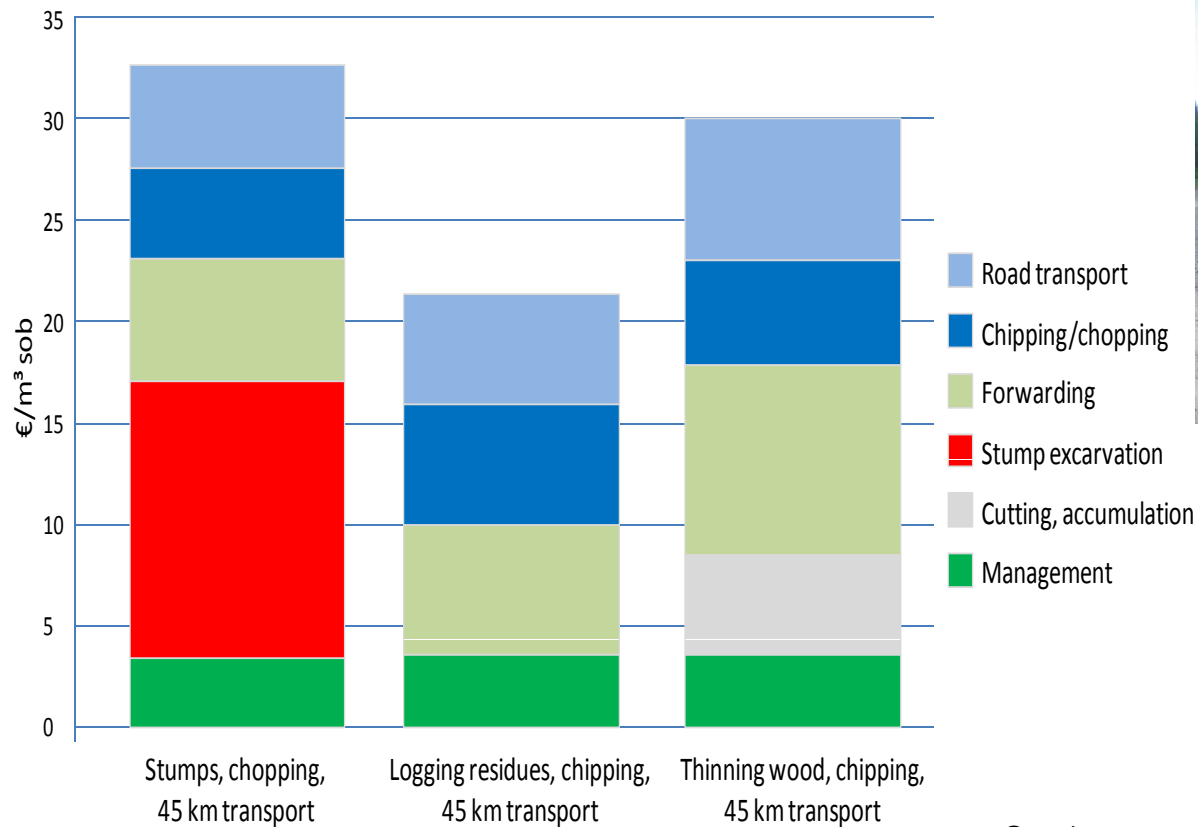
Euro MWh⁻¹



©Björheden, Skogforsk

Forestry residues - Cost calculation

Typical costs (€/m³) of efficient systems (FIN, S):
Logging residues 21; thinning 30; stumps 33

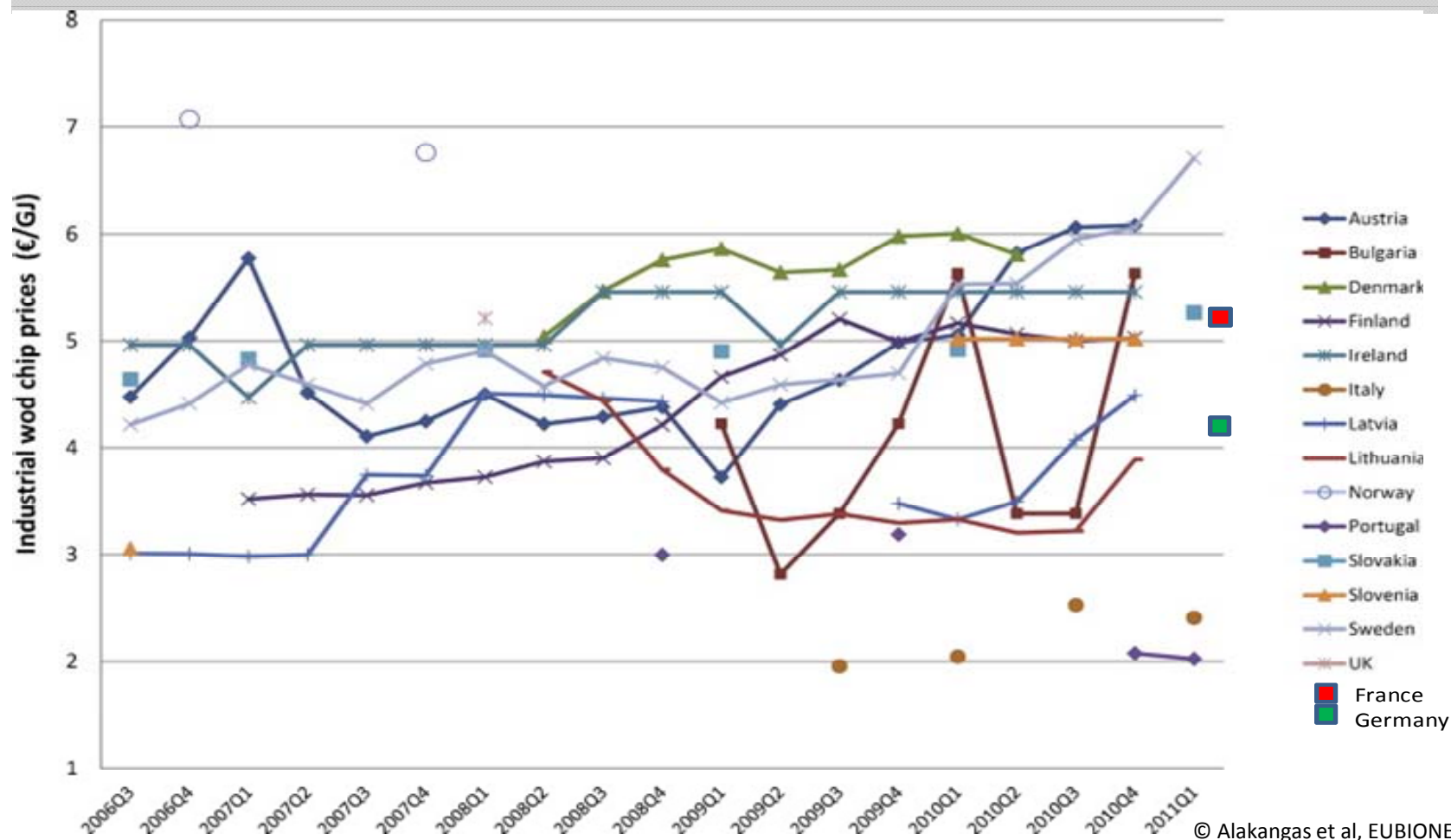


©Metla

Forestry residues - Price free consumer



Broad span, partly high temporal variability



© Alakangas et al, EUBIONET III

Forestry residues - Chip price



Key parameters for wood chip PRICE

- Material: stems, whole trees, high \emptyset tree tops \uparrow , branches \downarrow
- Water content: below 30% \uparrow , fresh (50%) \downarrow
- Geometry: small, even chips (G20) \uparrow , large, coarse chips (G100) \downarrow



Pictures ©F. Gerlach, wikimedia

Forestry residues - Market environment

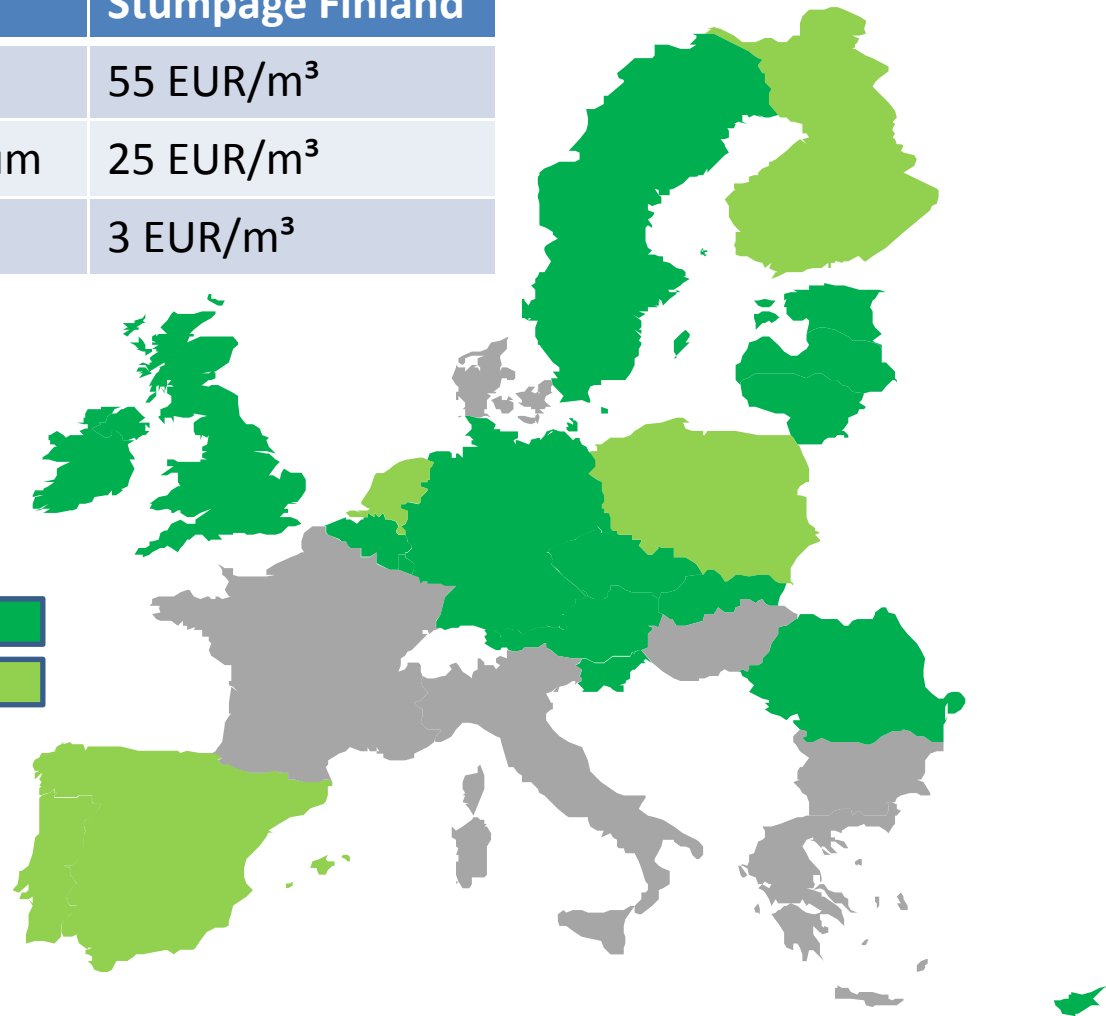


Forestry residue Market environment



Commodity	Value	Stumpage Finland
Round wood for timber	high	55 EUR/m ³
R'wood for pulp/industry	medium	25 EUR/m ³
Residues as forest fuel	low	3 EUR/m ³

High share of sawlogs (>EU: 44%) 
 High share of pulplogs (>EU: 33%) 
 Data: Eurostat 2010



PRICE SUPPLY-CURVES

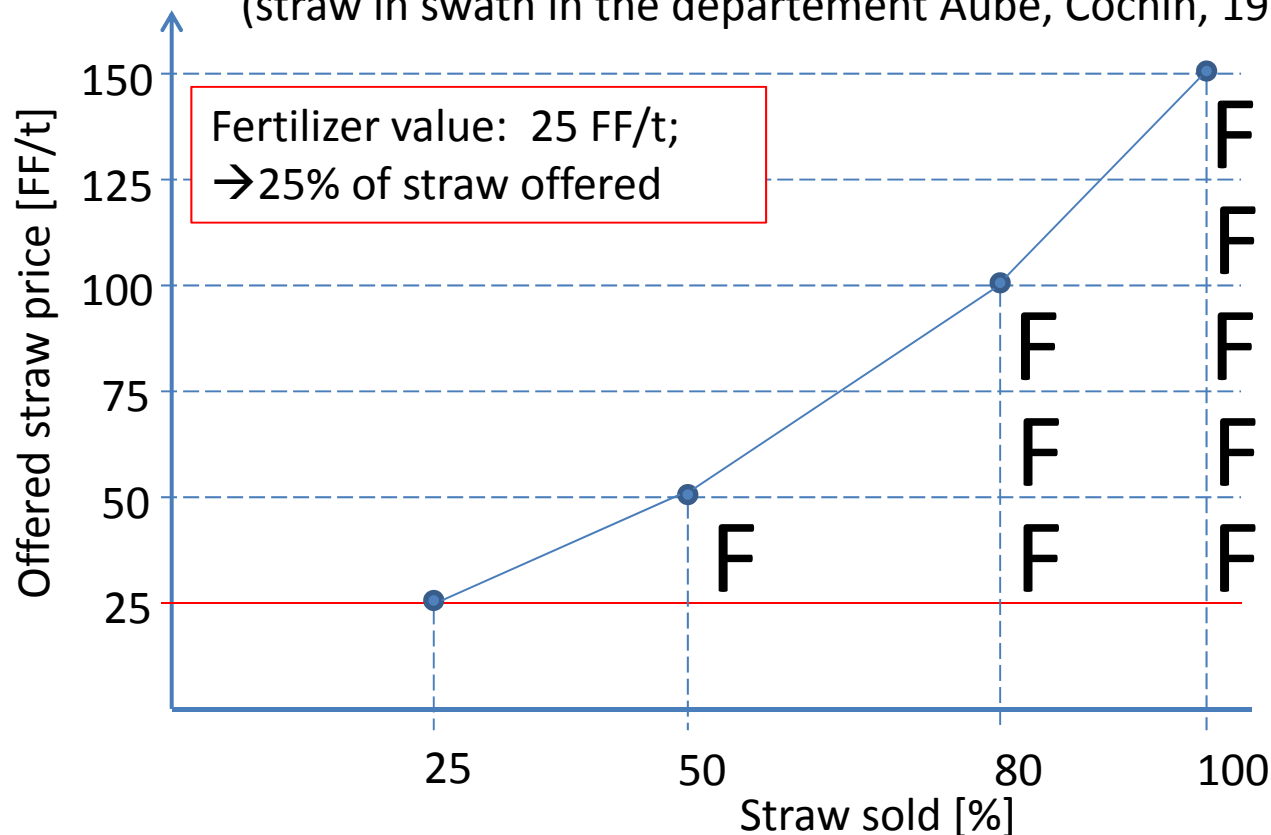
APPROACH:

- Reference biomasses: **straw, forestry residues, organic municipal waste**
- Literature review
- Formulate a price/supply equation
- Estimate the degree of utilisation

Price / supply



Agreement of farmers on selling straw for an offered price
(straw in swath in the département Aube, Cochin, 1977)



+1x fertilizer value as profit → 50% of available straw can be sourced
+3x fertilizer value as profit → 80% - +5x → nearly 100% sourcing

PRICE-SUPPLY MODEL

- Base price for sourcing ratios between 0% and 50%
- Gradual increase to high price with increasing sourcing ratios

Price / supply



RESULTS:

STRAW (BLUE LINE)

Base price: Straw costs + 1 fertilizer value as profit

High price: Straw costs + 5 fertilizer value as profit

FORESTRY RESIDUES (RED DASHED LINE)

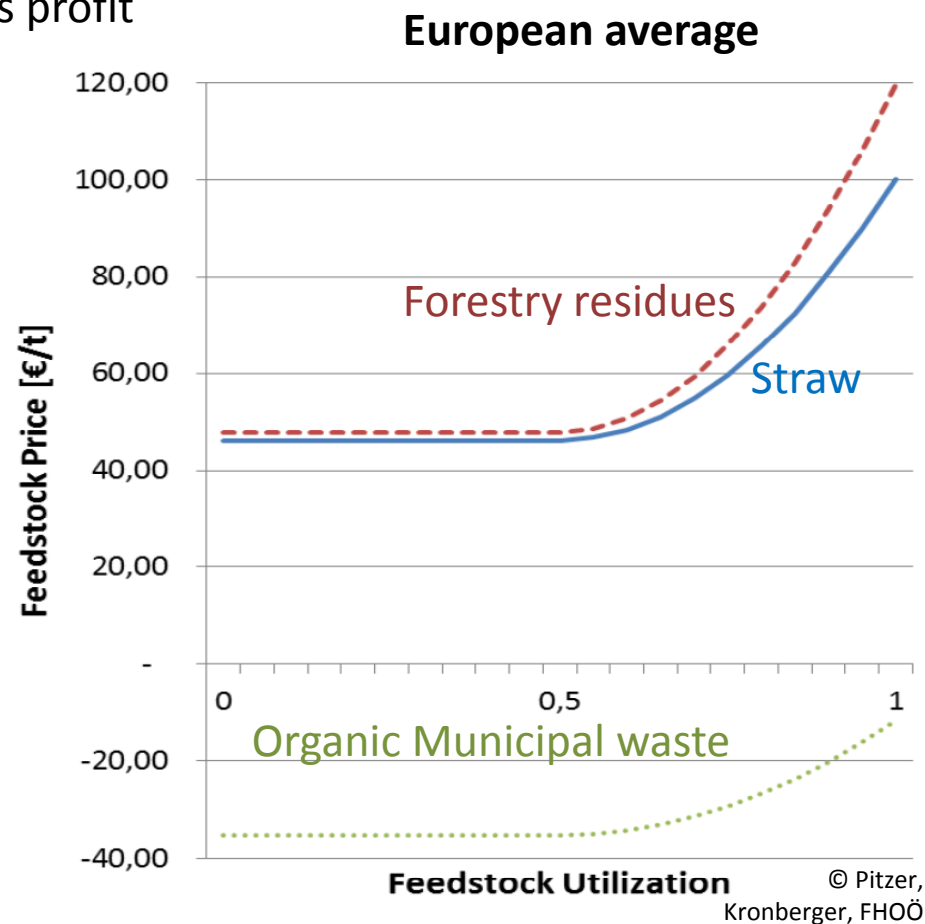
Base price: Observed prices

High price: Chipped pulp wood

ORGANIC MUNICIPAL WASTE (GREEN DOTTED)

Base price: In-vessel composting costs

High price: In-vessel composting OPEX





© Alexander.Stohr, wikipedia