

Biogas and slurry separation in Danish agriculture

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20 centralised biogas plants
60 farm scale biogas plants
50 plants for slurry separation



Agricultural advantages of biogas

- Improved fertilizer value of nitrogen
- Balanced P and K-balance in slurry
- Homogeneous and light fluid
- Free from germs and weed seeds
- Reduced costs for transportation of slurry
- Easier environmental approval on the farm



Fertiliser value



Mixing and digesting slurry change the characteristic of the slurry

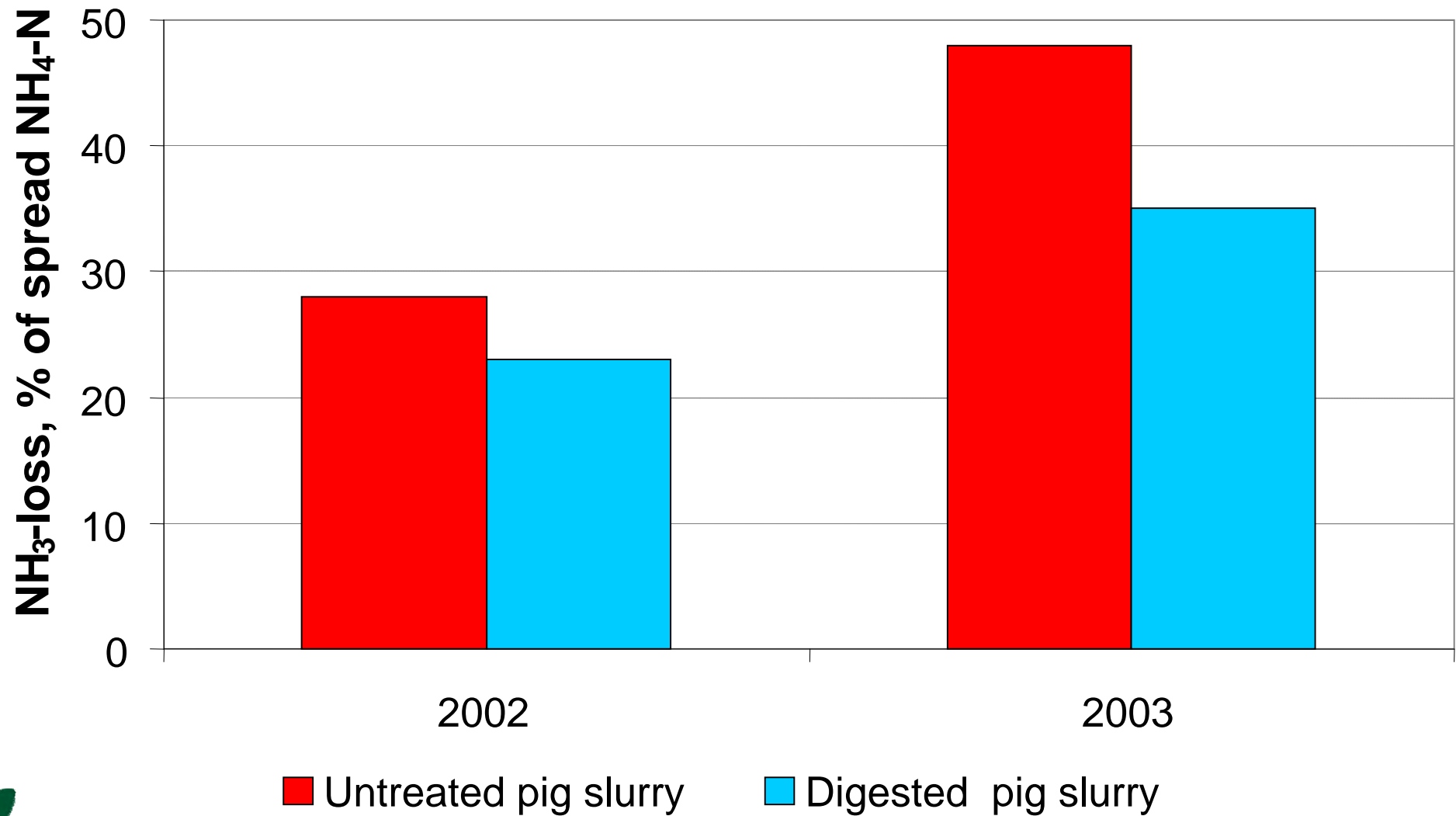
	DM, %	N-tot, kg/t	NH ₄ - N, kg/t	P, kg/t	K, kg/t	pH	NH ₄ - N, %
Digested slurry	4.8	4.4	3.5	1.0	2.3	7.6	81
Pig slurry	5.0	4.8	2.9	1.1	2.3	7.1	74
Cattle slurry	7.5	3.9	2.4	0.9	3.5	6.9	61



Two major contributions to a higher fertiliser value of nitrogen

1. Increased availability of nitrogen due to mineralization of organic bound nitrogen 😊
2. Faster infiltration in the soil, which reduce the risk of ammonia volatilisation 😊

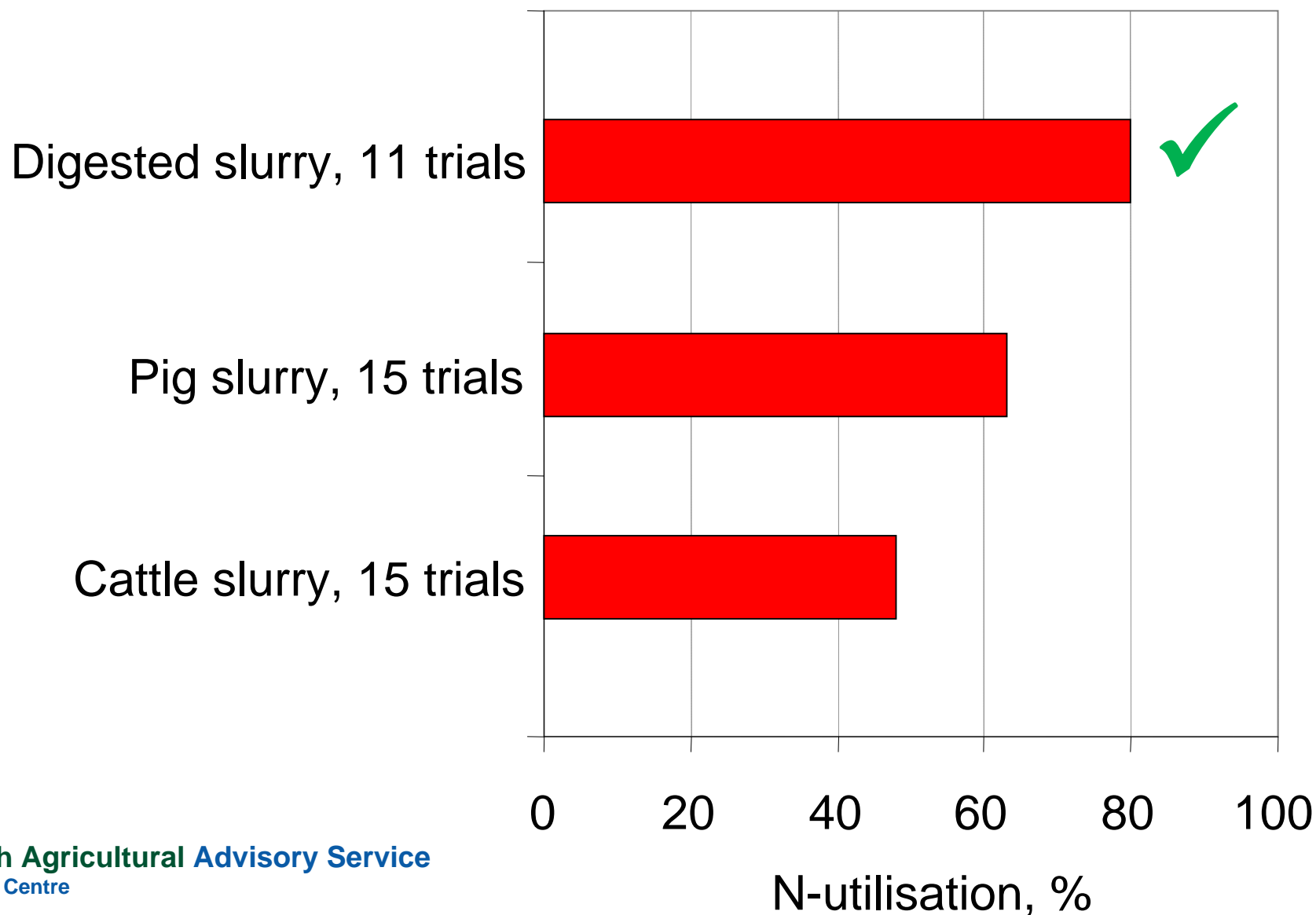
Ammonia volatilisation in spring barley



Danish Agricultural Advisory Service
National Centre

Source: Grøn Viden no. 296, University of Aarhus

Improved fertiliser effect of nitrogen - trials in winter wheat



Fertiliser plan for nitrogen for 1 ha of grass

Per hectare	Cattle slurry	Digested slurry
N-requirement, kg	250	250
N in slurry, kg total	170	170
N-utilisation, %	40	60
N in slurry, utilised, kg	68	102
Mineral fertiliser	182	148
Saved, kg per ha	-	34
Saved, € per ha	-	23



Separation of slurry



Why separate slurry?

- Concentration of nutrients (cheaper long distance transport)
- Reduce surplus of nutrients (phosphorus)
- Produce biomass for biogas plants (fibre fraction)
- Easier environmental approval on the farm



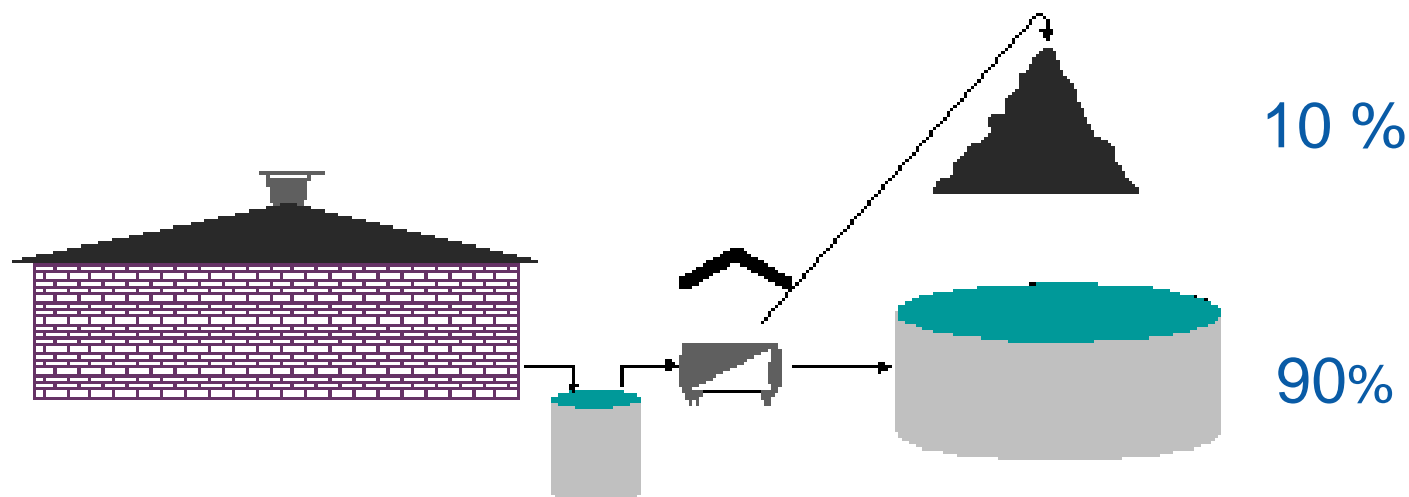


Low tech...



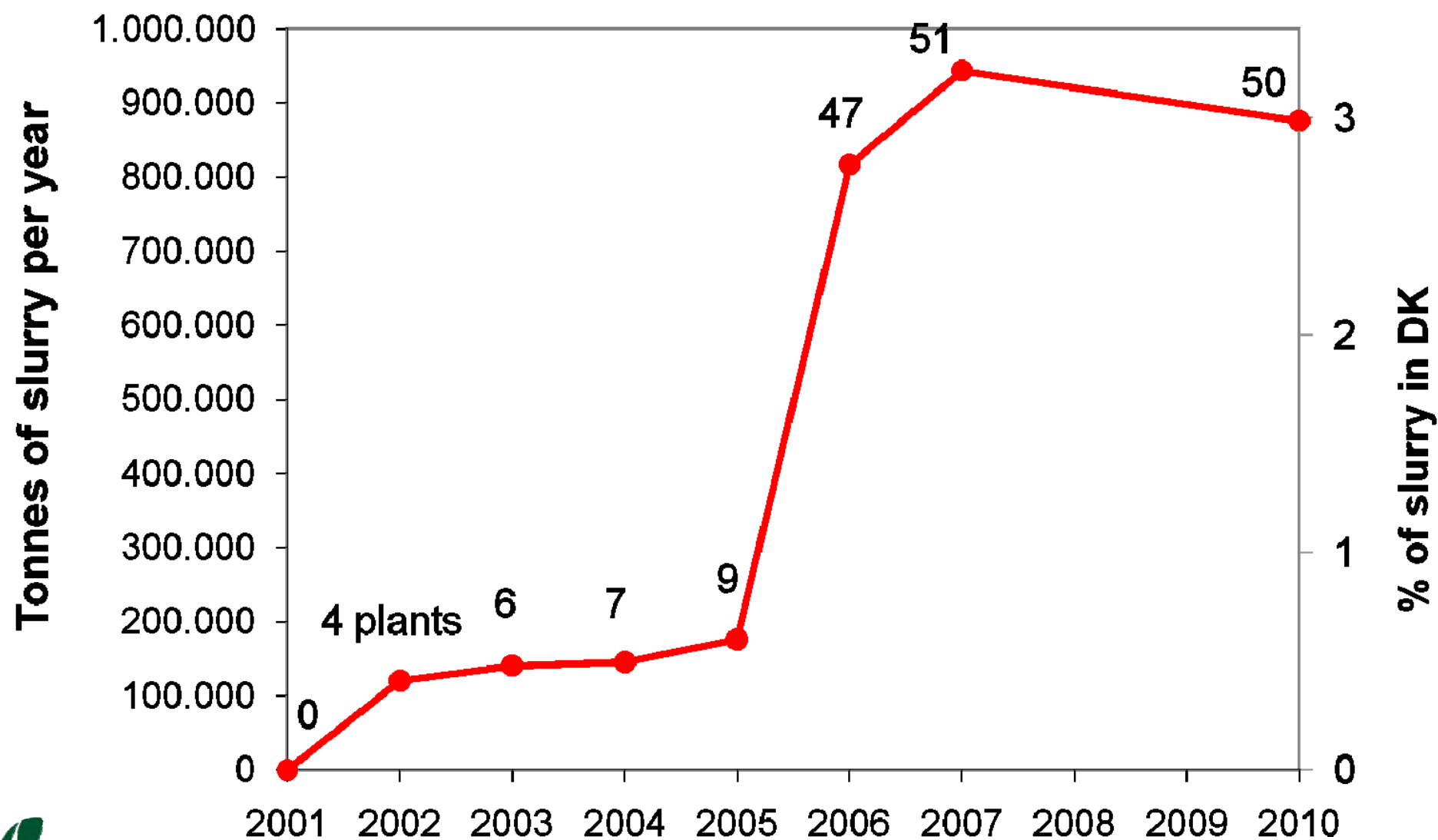
... or high tech?

Slurry separation in Denmark anno 2010: **Mechanical separation only!**



Raw slurry → liquid fraction + fibre fraction

Amount of slurry separated in Denmark



Separation companies on the Danish market

- ~~Envotech~~
- ~~Funki Manura~~
- ~~Bioscan~~
- ~~Ansager SepTec~~
- ~~Bjørnkjær~~
- ~~"Gyllekraftværket"~~
- ~~Orgenergy~~
- Alfa Laval and other screw presses
- ~~Vredo~~
- ~~MEC Energy~~
- REN-Technology
- SB Engineering
- Nutrival
- ~~FUOSO~~
- ~~ABC Komposterings~~
- ~~Seaborne~~
- ~~Green Farm Energy~~
- ~~Bioscent~~
- ~~Kemira Miljø~~
- AL-2
- ~~Echberg Manutech~~
- Pieralisi and other decanters
- Staring
- Samson Bimatech
- ~~Purliq~~
- Hjortkjær

Mass balance for the three dominating separation methods in Denmark

	% of volume in fibre fraction	% of N in fibre fraction	% of P in fibre fraction	Concentration of N, times	Concentration of P, times
Decanter centrifuge	10	23	70	2.3	7.0
Chemical precipitation	9	29	73	3.2	8.1
Screw press	8	10	16	1.3	2.0



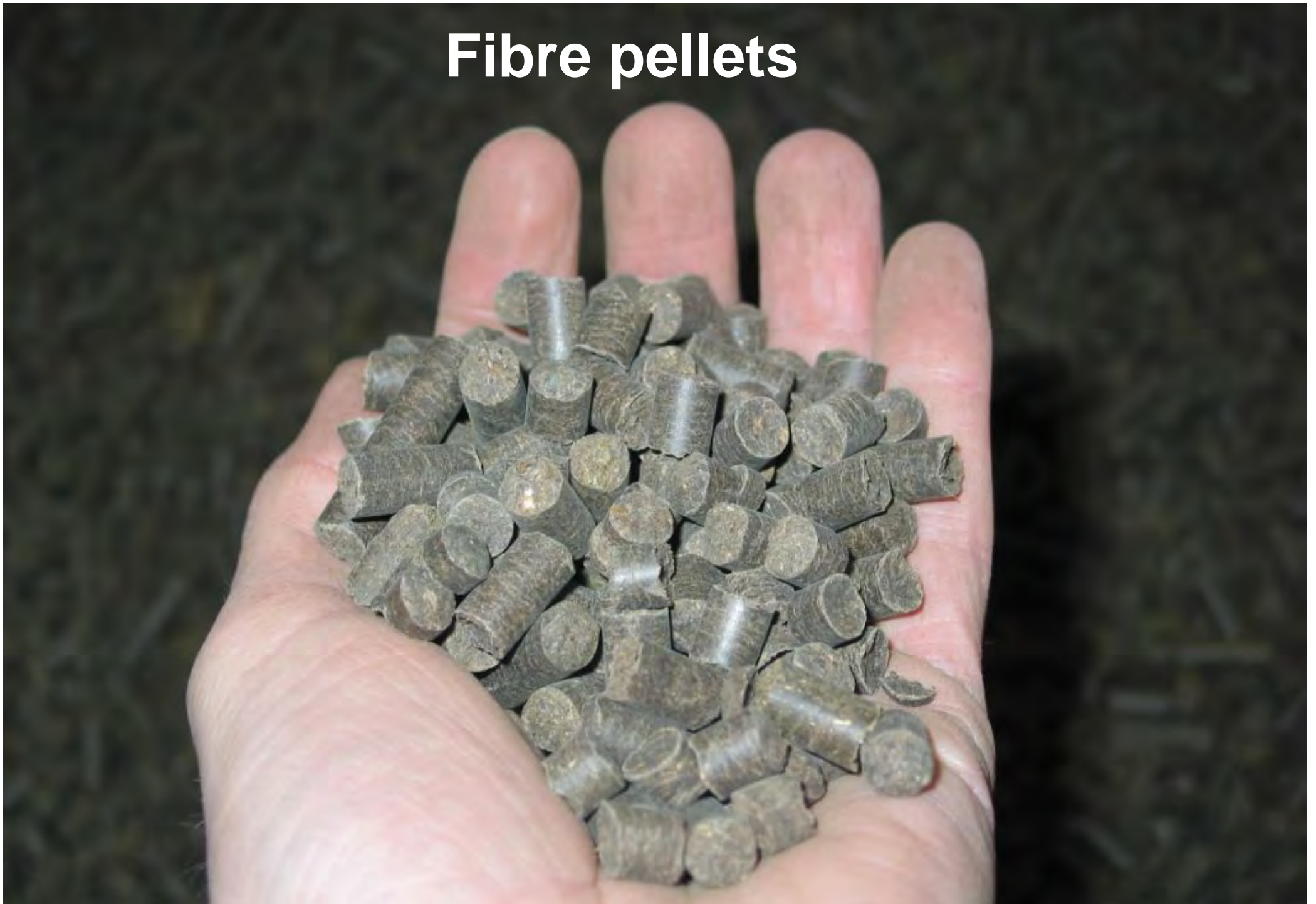


Handling of the fibre fraction

- Used on centralised biogas plants as a substrate for biogas production
- Long distance transport as „raw-fibre“ to areas with less intensive animal production
- Used for compost production for golf courses etc.
- Incineration of the fibre
- Drying and pelleting the fibre to a more tradable product



Fibre pellets



Example of a fertiliser plan for winter wheat using liquid fraction

	Kg N per ha	Kg P per ha
Without separation:		
Mineral fertiliser: 280 kg 24-7	67	0
<u>Pig slurry</u> : 30 tonnes per ha	98	31

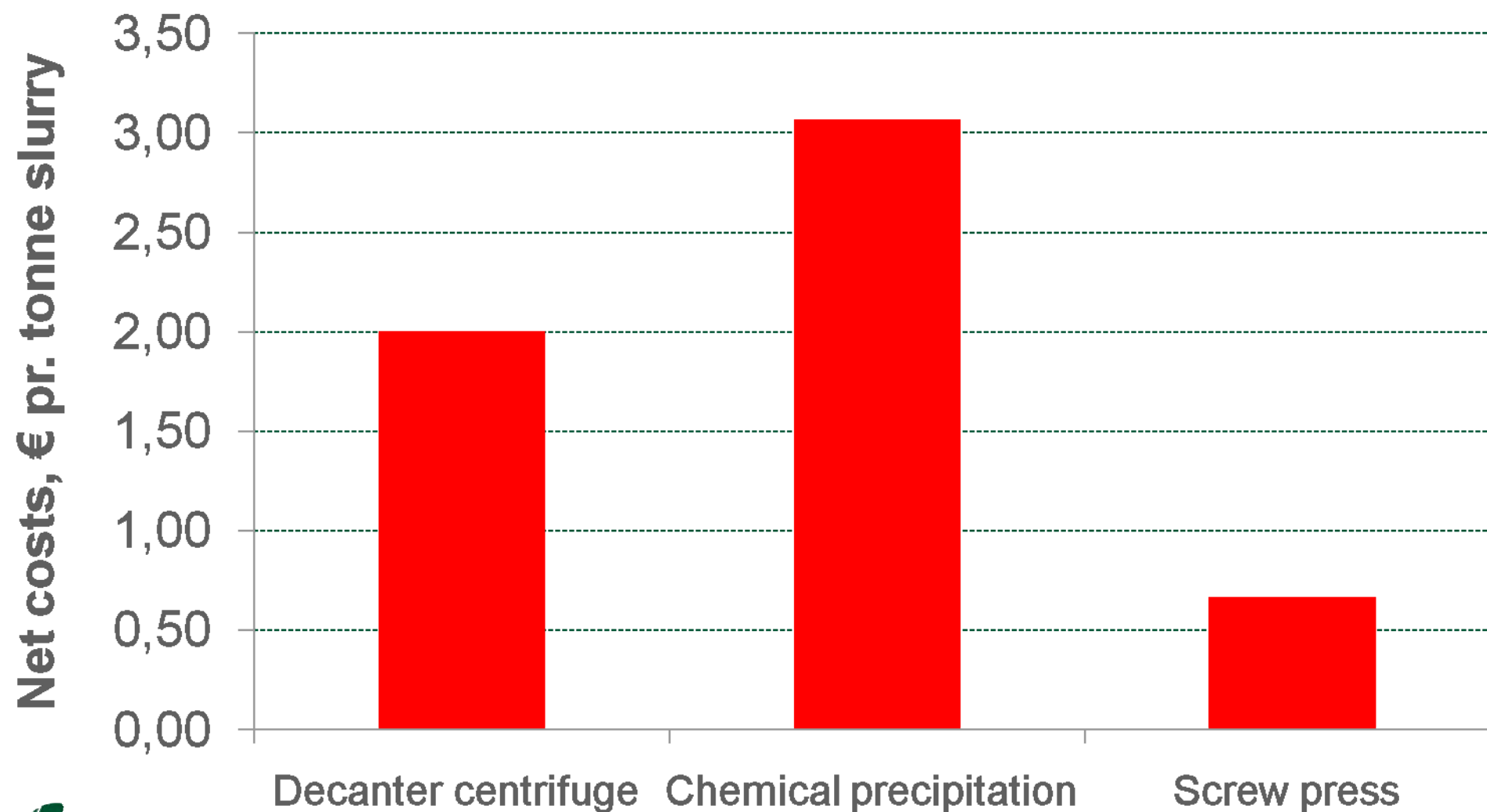
- Phosphorus balance:
- Fertiliser bill:

+6 → ÷2 kg per ha 🤔

€60 → €0 per ha 🤔



Is separation expensive?



Future of separation in Denmark

- Political target of 50 percent of all manure to be used for energy (mainly biogas) in 2020
 - More fibre to be used as substrate
 - More post treatment on biogas plants
- Less focus on nutrients in fibre and more focus on biogas potential (today lack of knowledge)
- Less need of separation because of decreasing animal production in Denmark?



Conclusions

- Increase of fertiliser value is a major factor for Danish farmers interest of biogas plants
- Demand for biomass for biogas plants may strengthen the demand for separation.
- “Low tech” separation seems to win. “High tech” is more or less given up.
- The authorities recognise the environmental advantages of biogas and separation



Thank you for your attention...

