Renewable energy in organic farming

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What is organic farming

- Organic farming describes a self-sustaining and persistent agro-ecosystem in good balance
- As far as possible, the system is based on local and renewable resources
- It builds on a holistic view that incorporates the ecological, economical and social aspects of agricultural production in both the local and global perspectives

Synthesis of knowledge on energy in organic farming

Funded by: Danish Research Centre for Organic Farming (www.darcof.dk)

Objectives:

- To synthesise knowledge on energy use, energy savings and renewable energy
- To evaluate the inclusion of reduced fossil energy use into the organic regulations
- To evaluate possible win-win solutions with biomass production for energy

Participants: 26 experts from different disciplines

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Energy balance calculation in organic and conventional farming

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Energy model

Direct energy		Indirect energy
Diesel for farm operations	Other direct energy	
1. Tillage and sowing 2. Fertilising and liming 3. Plant protection 4. Harvesting and baling 5. Transport 6. Loading and handling	1. Lubrication 2. Field irrigation 3. Drying 4. Heating 5. Ventilation 6. Milking	1. Machinery & Buildings 2. Other external inputs (nitrogen, phosphorous, potassium, pesticides and imported fodder)

Source: Dalgaard et al. 2001

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Barley grain production

1 ha barley	**Conventional**	**Organic**
Direct energy		
Fuel and lubricants	3,700 MJ	5,440 MJ
Field irrigation	1,500 MJ	1,500 MJ
Drying	500 MJ	360 MJ
Subtotal	5,700 MJ	7,300 MJ
Indirect energy		
Machinery	1,100 MJ	1,600 MJ
fertilisers and lime	6,700 MJ	50 MJ
Pesticides	250 MJ	0 MJ
Subtotal	8,050 MJ	1,650 MJ
Total energy use	13,750 MJ	8,950 MJ
Yield	5,000 (SFU/ha)	3,600 (SFU/ha)
Energy Efficiency	2.8 (MJ/SFU)	2.5 (MJ/SFU)

Source: Dalgaard et al. 2002

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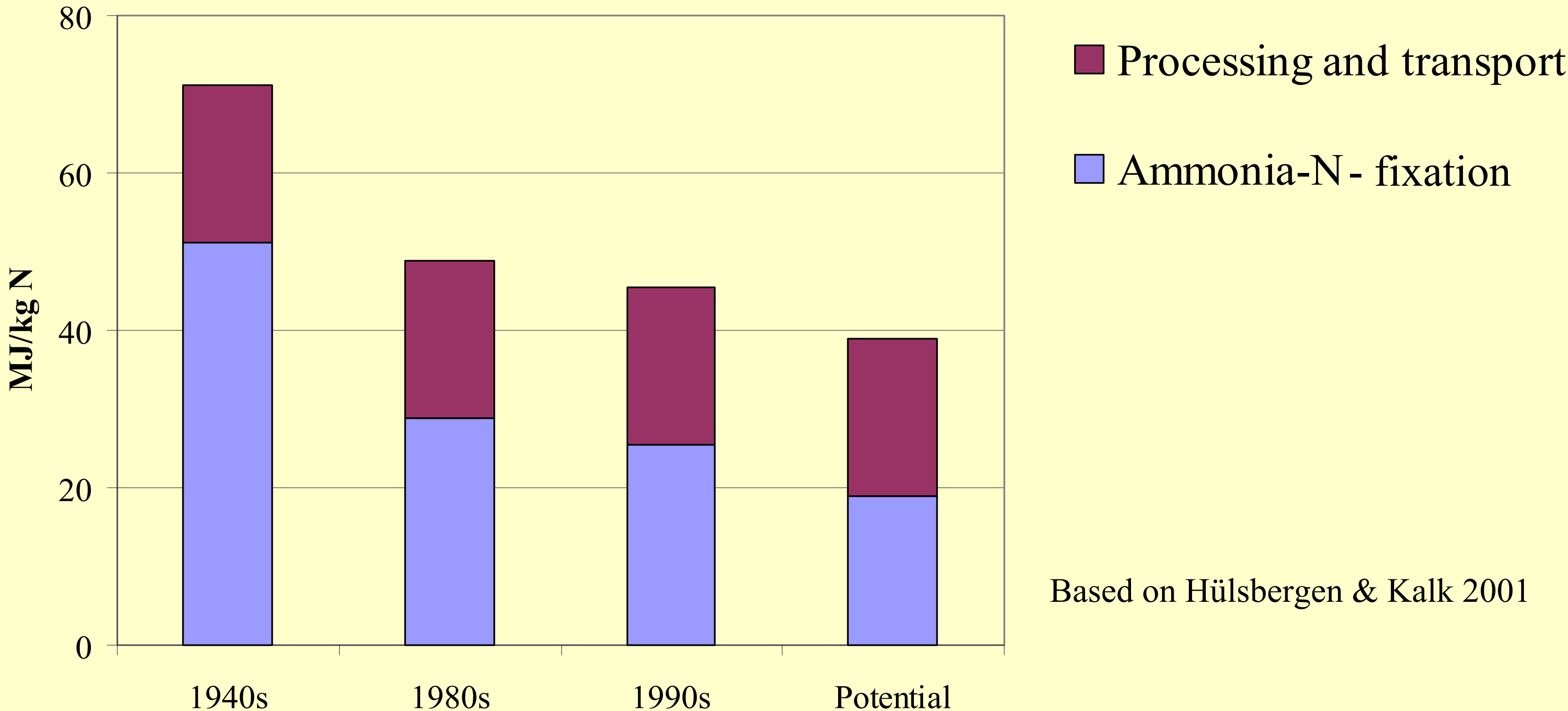
Milk production

1 cow in 1 year	**Conventional**	**Organic**
Fodder:		
Grazing	3,600 MJ	2,300 MJ
Silage	3,400 MJ	2,300 MJ
Grain cereals	2,700 MJ	3,300 MJ
Imported concentrates	7,400 MJ	6,700 MJ
Straw bedding	400 MJ	400 MJ
Housing	8,000 MJ	8,000 MJ
Farm buildings	2,500 MJ	2,500 MJ
Total energy use	28,000 MJ	25,600 MJ
Milk production	9,000 kg	9,000 kg
Energy efficiency	3.1 MJ/kg	2.8 MJ/kg

Energy for synthetic N-fertilisers



Based on Hülsbergen & Kalk 2001

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National Danish Energy use and production in agriculture

PJ	Present conventional farming	Organic farming lower pig production	Organic farming sustained animal prod
Crop production	38	18	18
Livestock production	39	13	40
Total	77	31	57
Energy production	14	0	0
Net energy use	63	31	57

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Source: Dalgaard et al. 2000

Biomass energy in organic farming

Decentralised, small-scale technologies are in focus

- Biogas from slurry, crop residues, clover-grass etc. -> electricity and heat
- Oil (and seed cakes) from rape or false flax (*Camelina*) -> biofuel for tractors
- N-fixing alder (*Alnus*) -> heat and maybe electricity

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Alder (*Alnus*) – N-fixing short rotation coppice for organic farming?

- Only limited trials – apparently high yield potential
- Can be established without weed treatment – lower yield
- Annual N-fixing of 30 – 185 kg N/ha
- Frost hardy and resistant to pests

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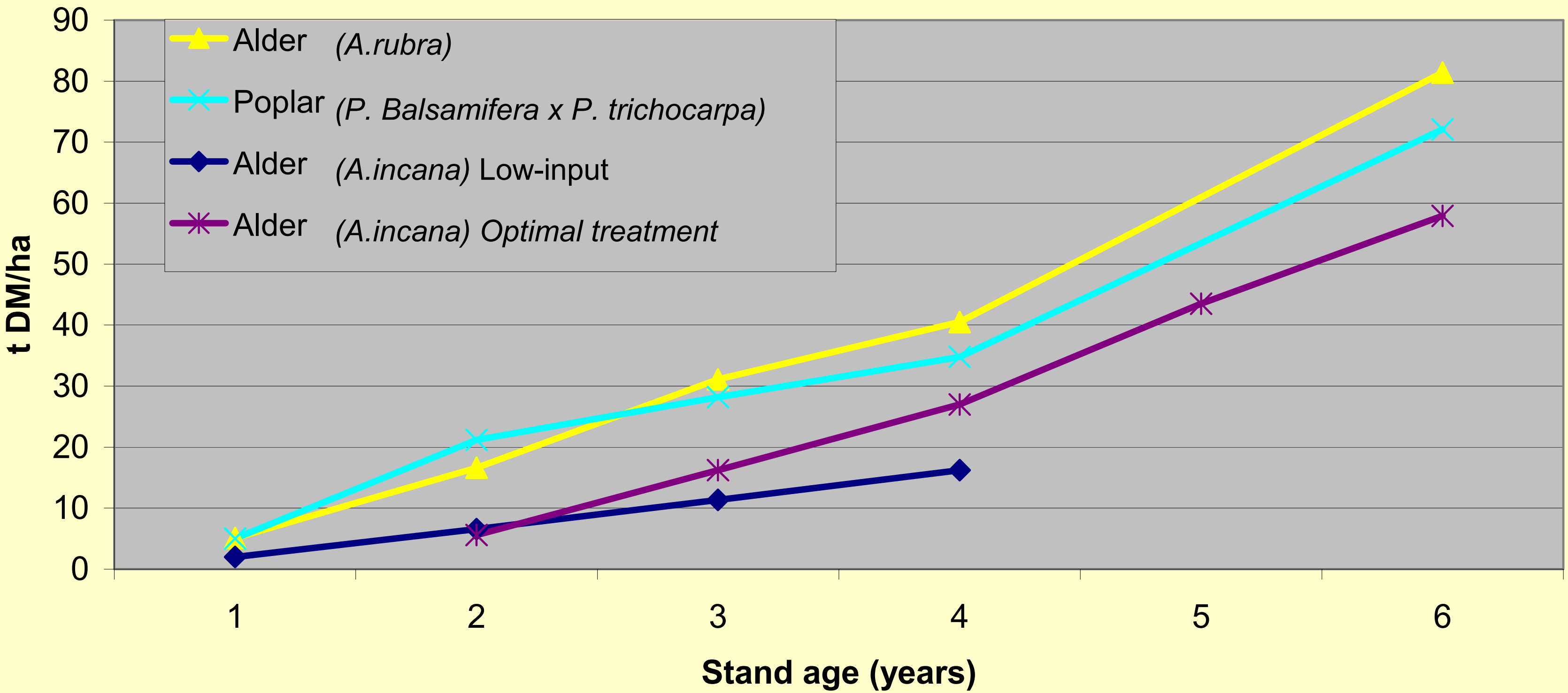
Productivity of alder and poplar in Scotland, Sweden and Estonia



A. *rubra* and poplar: herbicide treated, no fertiliser (Proe et al., 2002)
Low-input *A. incana*: no weed treatment, no fertiliser (Uri et al., 2002)
Optimal *A. incana:* PK-fertilised, irrigated (Granhall & Verwijst, 1994)

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Grey alder 6 year old

Foto by courtesy
of Ulf Granhall

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R & D to facilitate alder implementation in organic farming systems

- Testing and selection of species and provenances
- Breeding
- Low cost establishment (vegetative?)
- Harvest equipment and harvest cycle
- More full scale experience
- Influence on soil fertility and on the organic crop rotation

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Possible win-win solutions

- SRC for energy and for protection of groundwater quality
- Utilisation of sewage water or sludge in SRC
- Combination of SRC and animal keeping (e.g. pigs or poultry)

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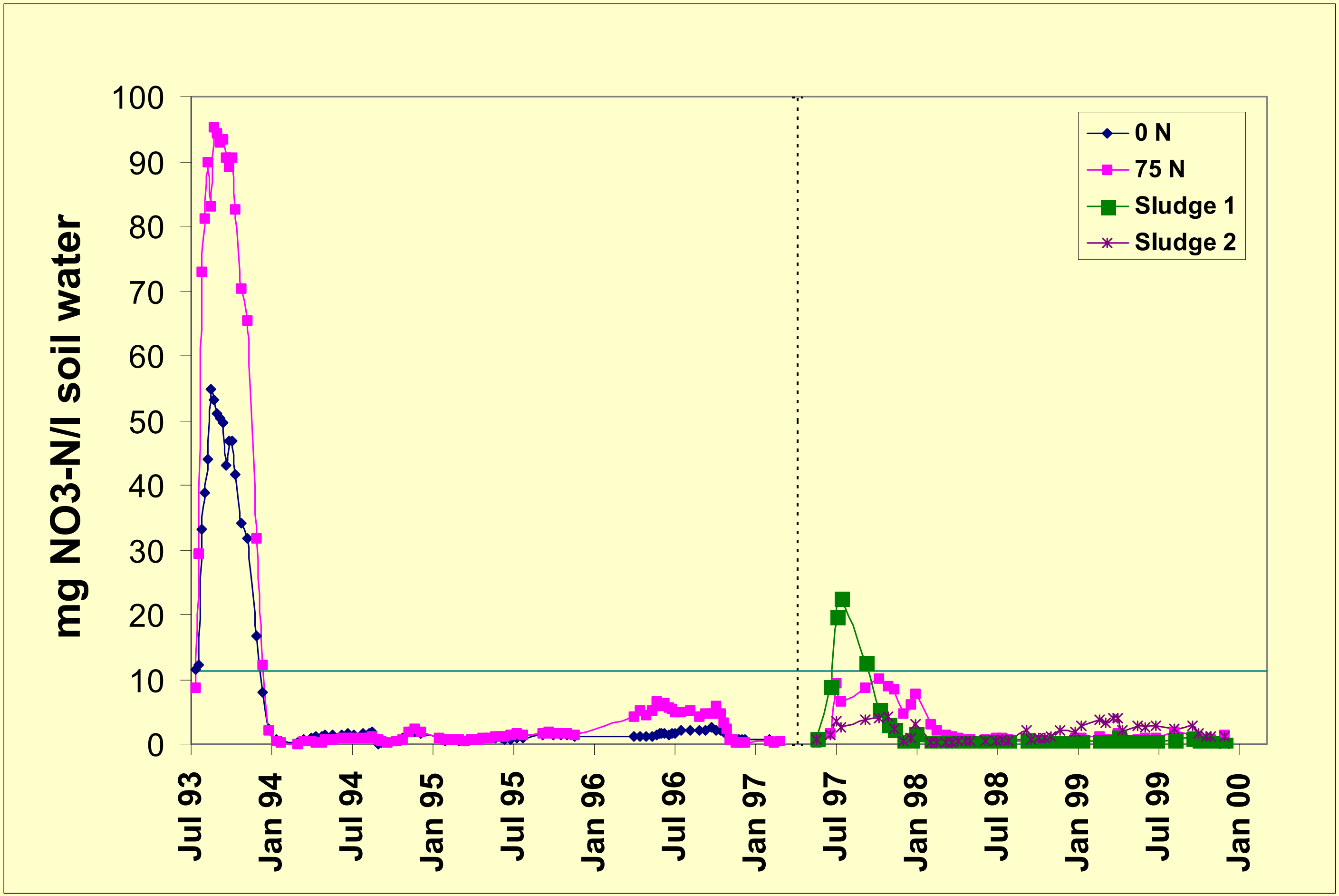
Nitrate leaching from willow on a coarse sand



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Conclusions

- Slightly lower energy use per produced unit in organic farming systems
- Conversion to organic farming will reduce total energy use
- Low energy output from organic farming
- Good prospectives for renewable energy in organic farming
- Alder: good candidate for low-input production of feedstock for heating and electricity
- Further R&D important to develop alder into efficient SRC
- Develop win-win solutions to improve economic viability of SRC

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