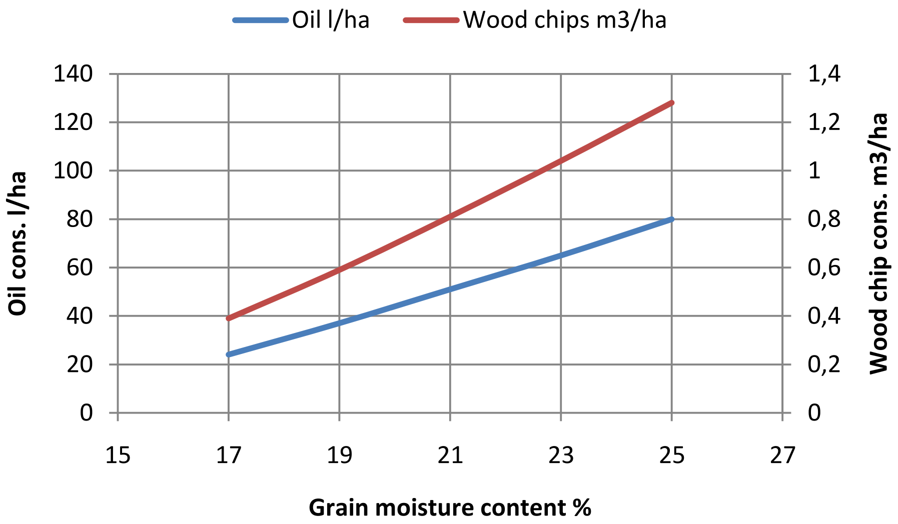
Energy savings in drying

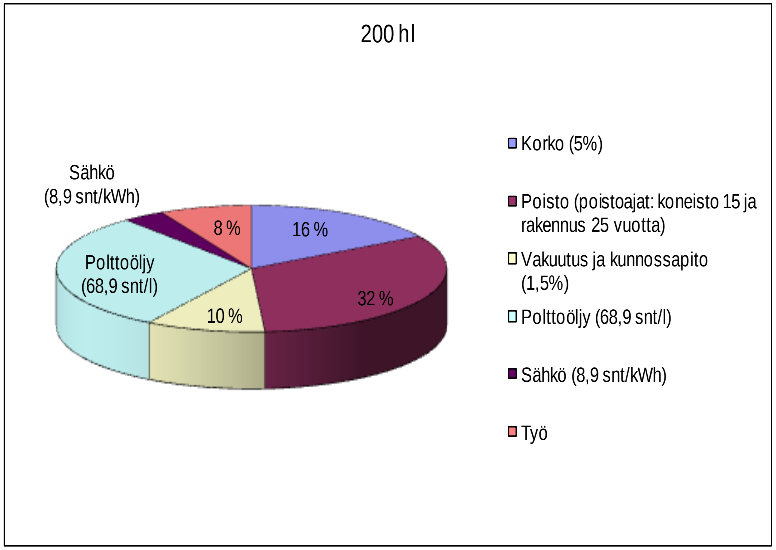
Need for drying

- During drying water is removed from the material
- For every evaporated water kg 0.15 l of oil is needed
- To dry 1 ha yield 30 – 70 l of oil is needed depending on moisture content of grain

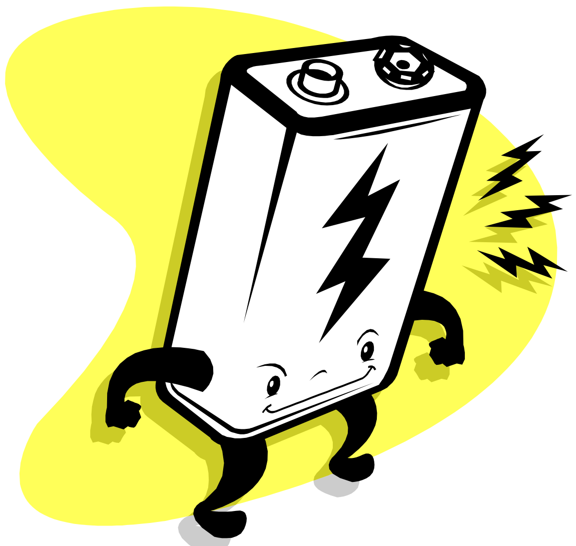


Energy savings in drying

- Technically it is possible to decrease energy consumption more than 50%
- Oil usage can be stopped by moving to renewable energies – drying can be done with biofuels
- Drying can be omitted by changing to other preservation techniques
- Remember that to save energy investments must be done – economy is for the farmer more important than energy savings



Energy savings



- Adjustment of oil burner, effect 0 – 15 %
- Drying during good weather, effect 0 – 20 %
- Insulation of dryer, effect 10 – 20 %
- High drying temperature, effect 10 – 15 %
- Avoiding overdrying, effect 0 – 20 %
- Heat recovery from outlet air, > 50 %

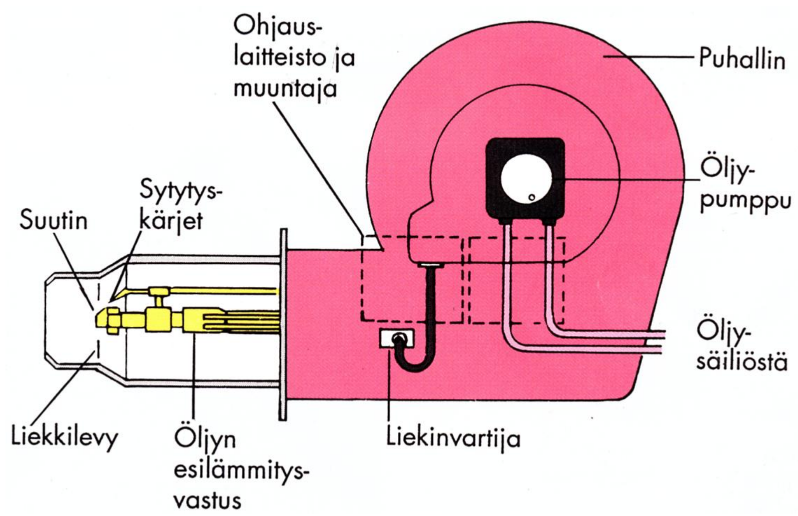
Oil burner adjustment

Laskentaperuste

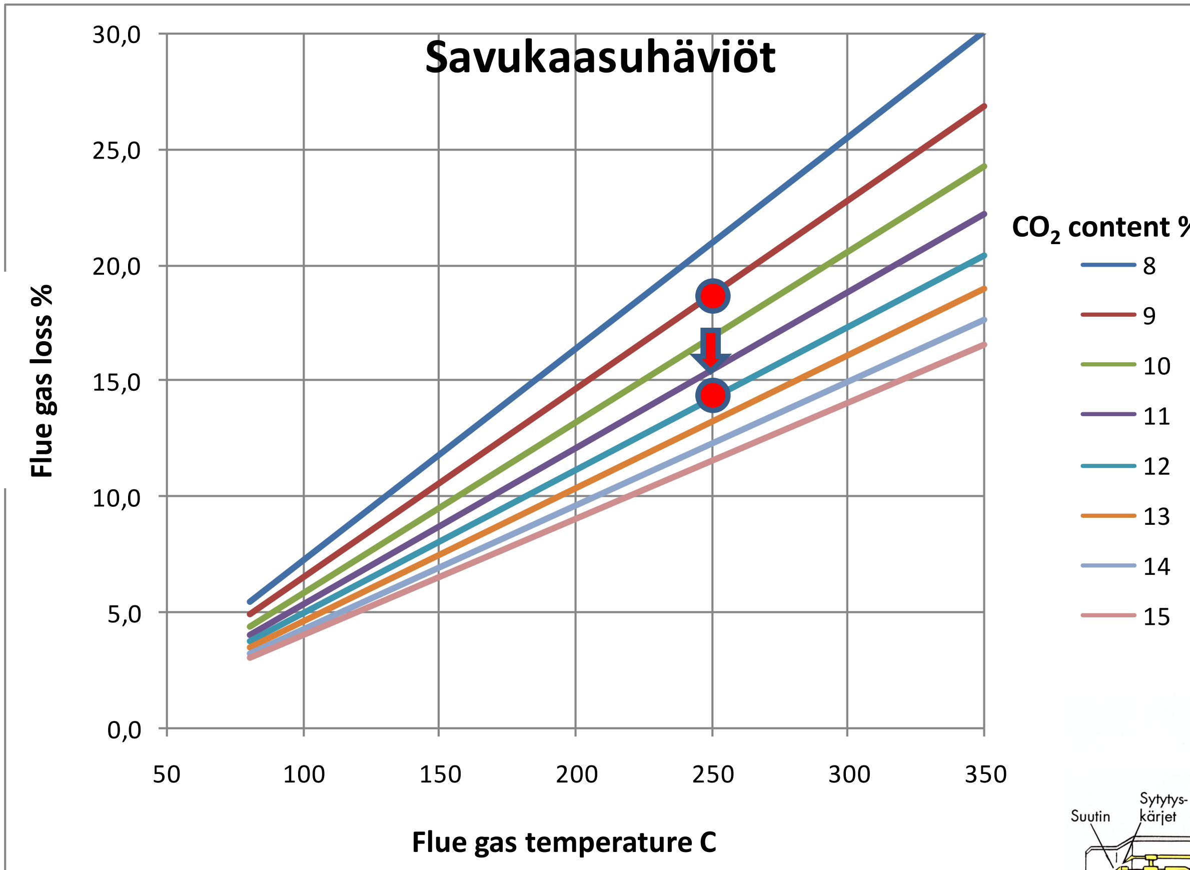
Vilja-ala	100	ha
Puintikosteus	22 %	
Varastointikosteus	13 %	
Sato	3500	kg/ha

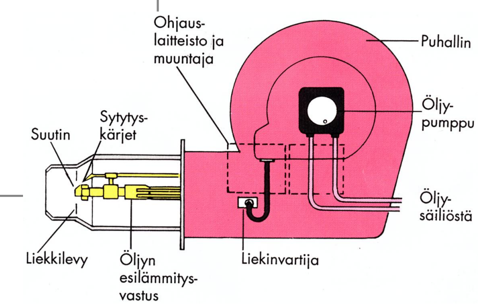
<u>Öljypolttimen säätö, vaikutus 0 – 15 %</u>

Energiansäästö	
Kustannus €	400
Säästö	5,0 %
Säästö €/v	**190**
Takaisinmaksuaika v	**2,1**



Efficiency in oil burning

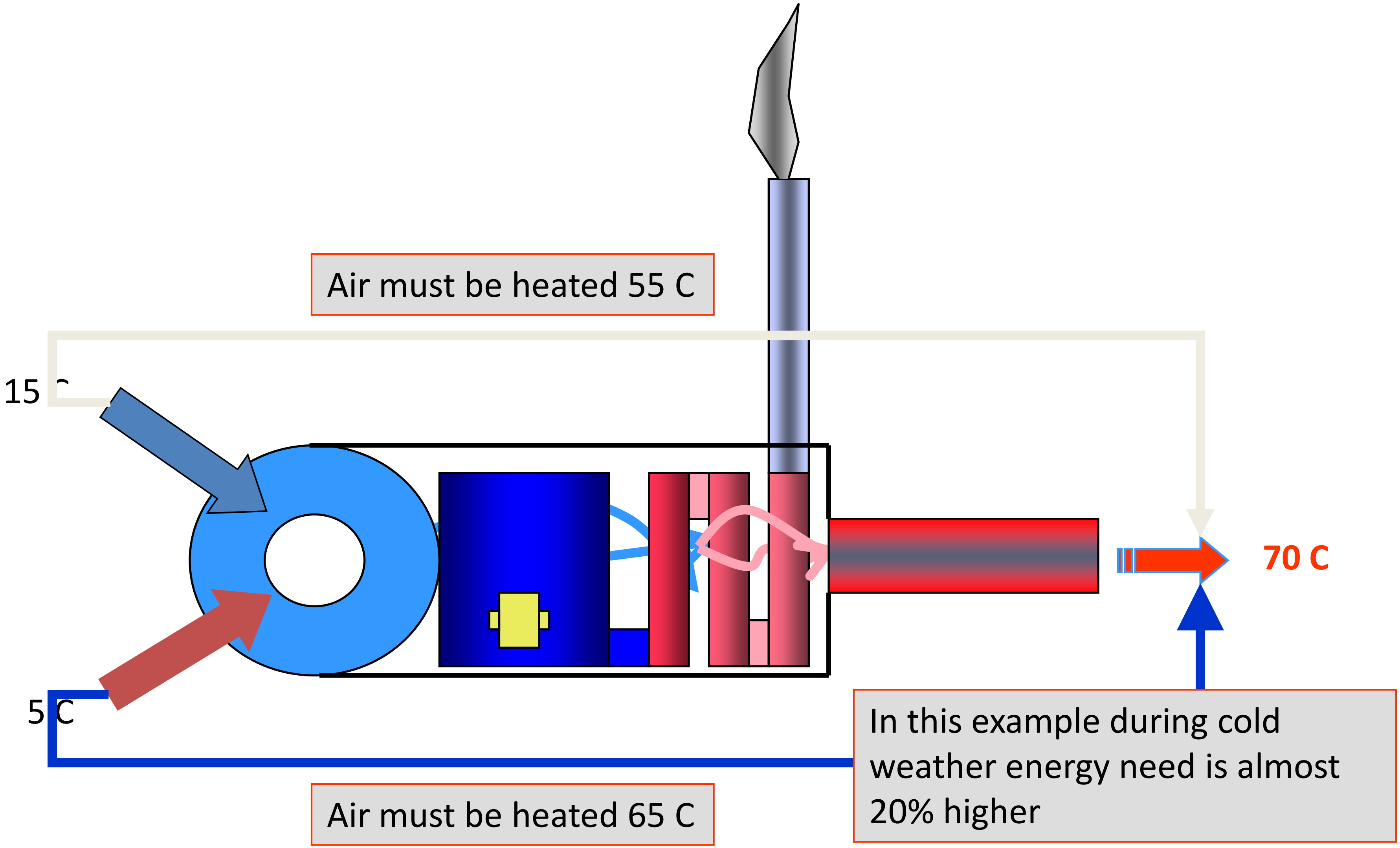




<u>Adjustment of burner air amount has effect on</u>

– SFlue gas temperature
– CO_2 – content
– losses

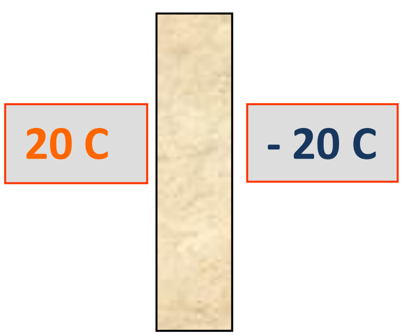
Drying during good weather



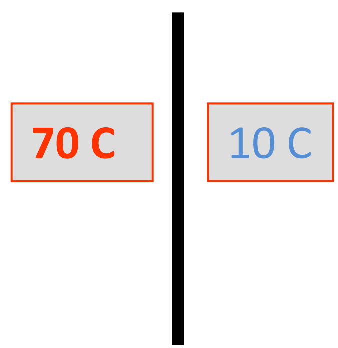
Insulation

Dryer insulation effect is 10 – 20 %

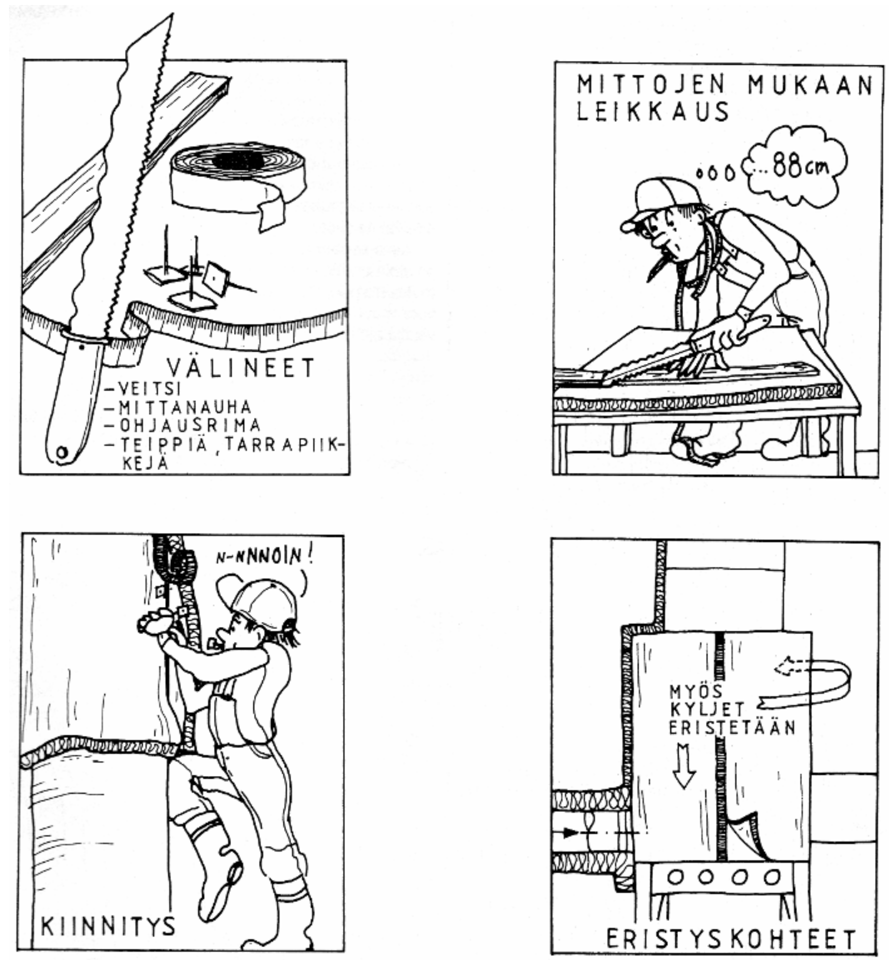
Energiansäästö	
Kustannus €	2000
Säästö	10,0 %
Säästö €/v	**379**
Takaisinmaksuaika v	**5,3**



House



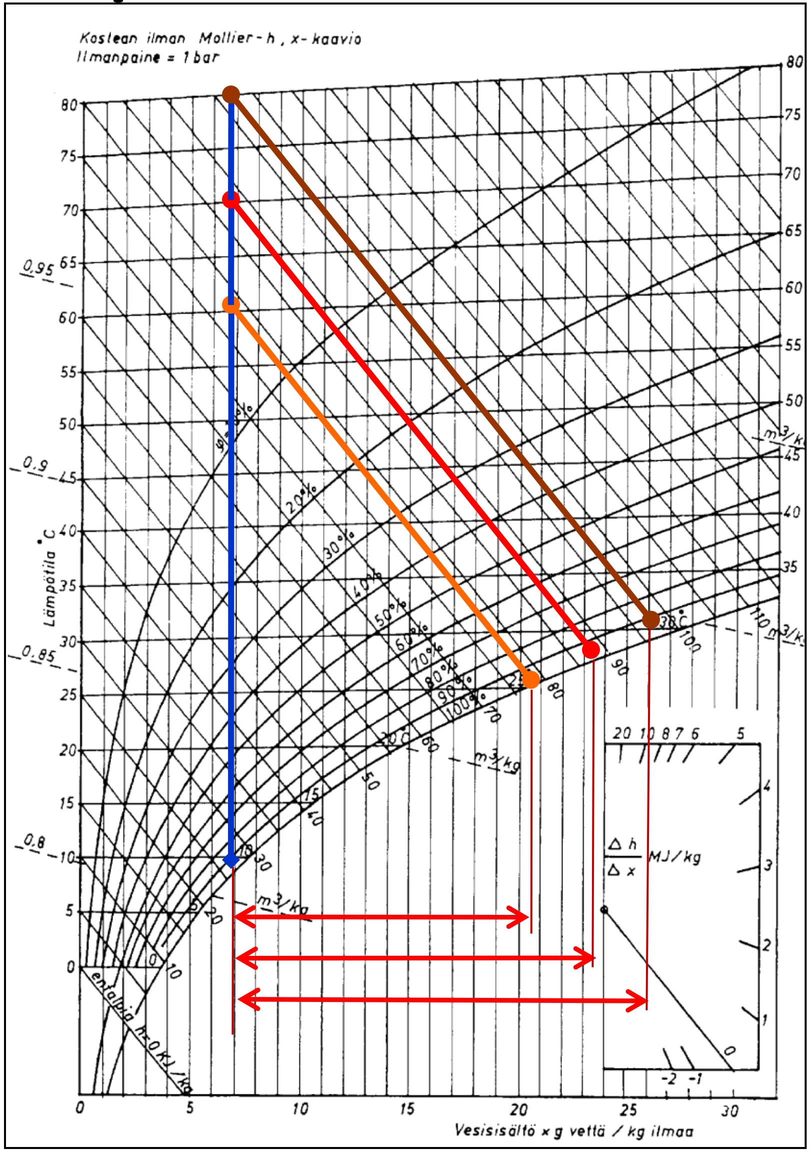
Dryer



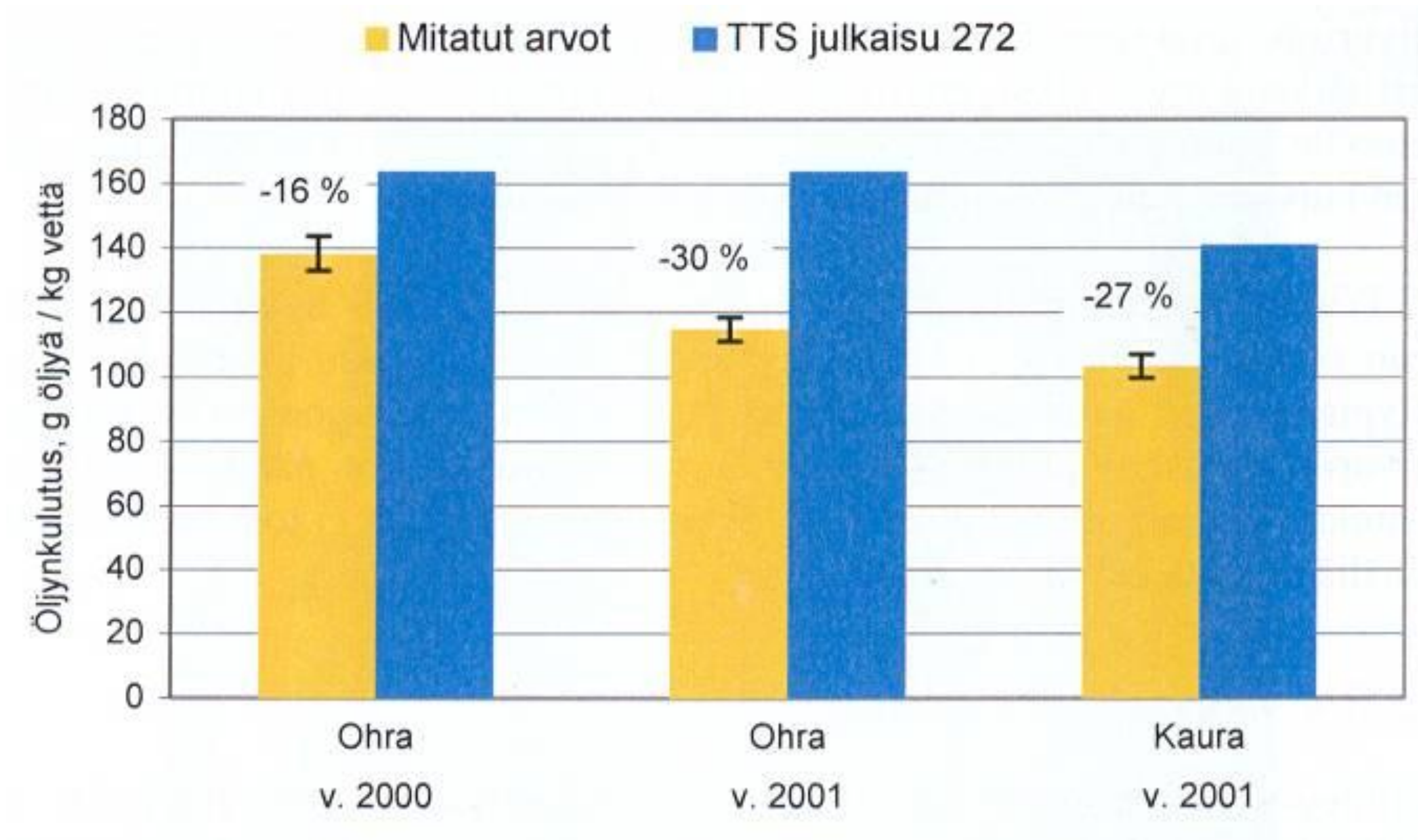
Insulation also increases dryer capacity!

High drying temperature

- High temperature increases water movement speed inside the grain
- Hot air can engage more water from the grain
- Increase of temperature
  - Decreases energy consumption
  - Increases dryer capacity
  - Increases dryer heat losses – insulation becomes more important
  - High temperature damages baking properties and germination

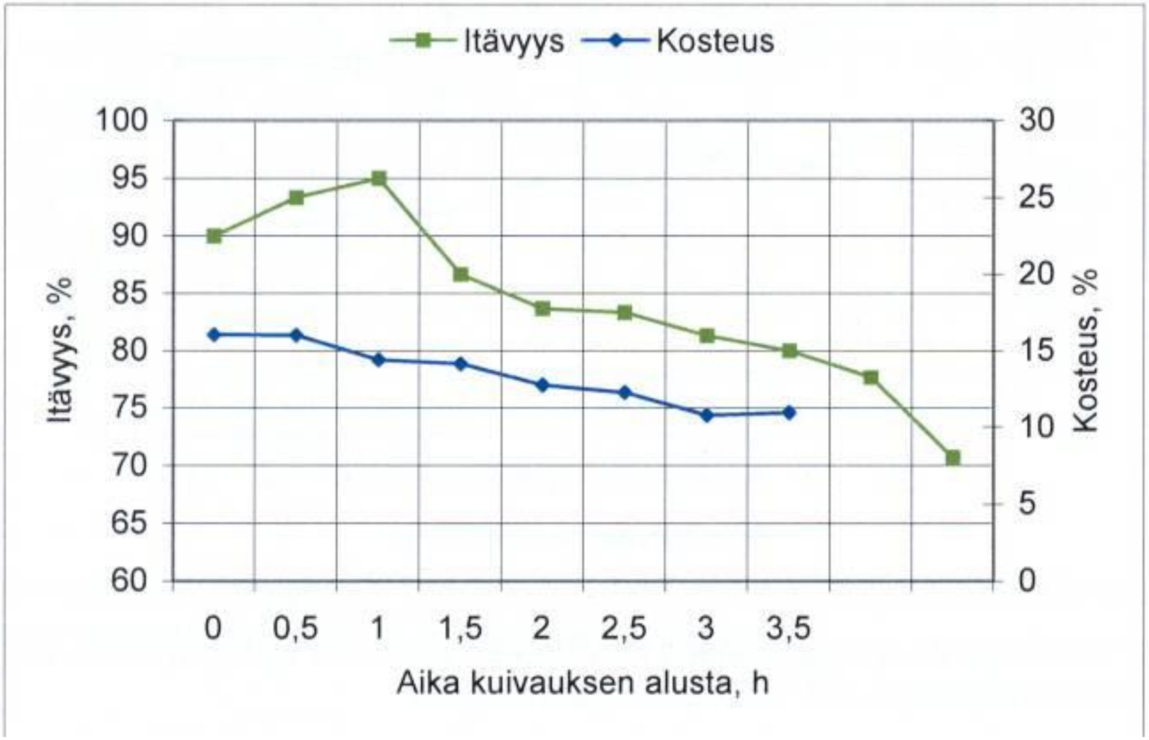


Results of experiments



Lähde: Suomi et al. 2003. Viljan korjuu ja varastointi laajenevalla viljatilalla. Maa- ja elintarvike 31.

Effect of drying air temperature on germination



Drying air temperature 119°C, fast grain circulation

Lähde: Suomi et al. 2003. Viljan korjuu ja varastointi laajenevalla viljatilalla. Maa- ja elintarvike 31.

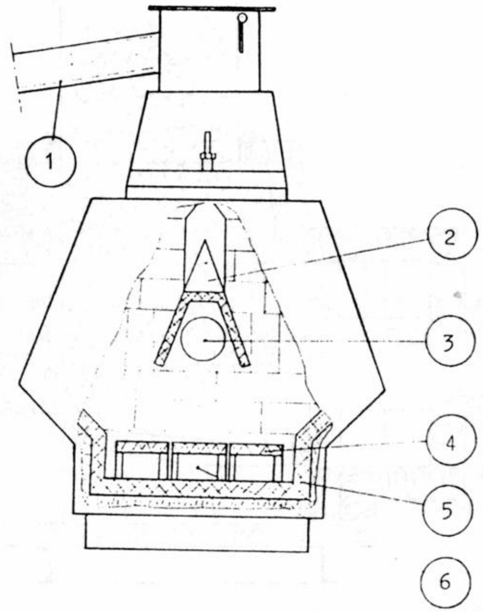
Heat recovery

- Outlet air heat can be used to warm up inlet air
- Recovery rate can be over 50%
- Difficult to realise and expensive
- Outlet dust complicate heat recovery unit functions

Renewable energy in grain drying

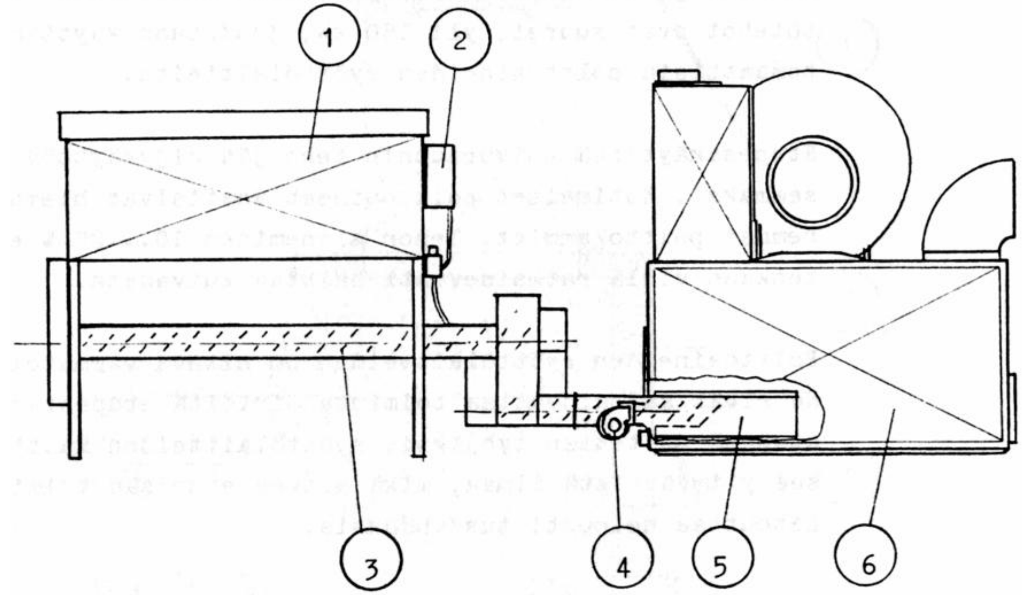
- Wood chip
  - Fuel must be reserved in advance
  - Investments must be doen, new furnace, automatic fuel feed, automatic ash removal
- Bio-oil
  - Existing furnaces can be used
  - Economical only if the crushed rape seeds can be utilised as animal feed
- Grain
  - Poor quality grain could be used to heat the furnace
  - Is burning of grain ethically acceptable?
- Utilize of biomass heat unit
  - Farms may have biomass heating units to heat dwelling and animal houses
  - In most cases dryer power demand is much higher than heating unit power
  - Dryer furnaces work wiht air and heating units with water, problems in assemblies

Wood chips



Antti etupesä

1. Hakkeen syöttöputki, 2. Hakkeen jakaja,
3. Tuliputki, 4. Arina, 5. Muuraus, 6. Tuhkatila



Näppärä-stoker

1. Hakesiilo, 2. Vesipalosulku, 3. Syöttöruuvi, 4. Palamisilmapuhallin, 5. Hakepoltin, 6. Kuivuriuuni

Gasification unit

- Existing oil furnace can be utilised
- Heating power is lower than with oil

Wood chip burner (stoker)

- New furnace must be purchased

Economy of wood chips

Calculation basis	
Grain area	100 ha
Harvest moisture content	22%
Yield	3500 kg/ha
Oil price	56 cnt/l

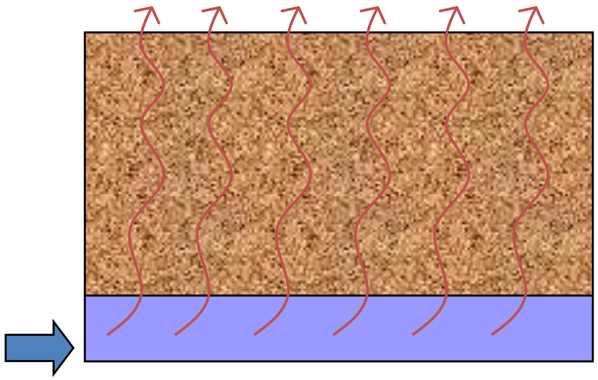
Calculation basis	
Grain area	100 ha
Harvest moisture content	22%
Yield	3500 kg/ha
Oil price	100 cnt/l

Vaihtoehdot	**Hake**	0	€/m3
Investointikustannus	Uusi hakeuuni	25000	€
	Polttoainevarasto	3000	€
	Hakkuri	5000	€
	Yhteensä	33000	€
Polttoaine	Kosteus	35 %	
	Tiheys	200	kg/m3
	Lämpöarvo	11,5	MJ/kg
		3,2	kWh/kg
		639	kWh/m3
	Hyötysuhde	0,8	
Määrät	Määrä	0,02	m3/ha
	Määrä	2	m3
	Hinta	0	€
Säästö €/v	**Säästö €/v**	**1**	
Takaisinmaksuaika v	**Tak.maksuaika v**	**36666,7**	

Vaihtoehdot	**Hake**	0	€/m3
Investointikustannus	Uusi hakeuuni	25000	€
	Polttoainevarasto	3000	€
	Hakkuri	5000	€
	Yhteensä	33000	€
Polttoaine	Kosteus	35 %	
	Tiheys	200	kg/m3
	Lämpöarvo	11,5	MJ/kg
		3,2	kWh/kg
		639	kWh/m3
	Hyötysuhde	0,8	
Määrät	Määrä	1,11	m3/ha
	Määrä	111	m3
	Hinta	0	€
Säästö €/v	**Säästö €/v**	**6384**	
Takaisinmaksuaika v	**Tak.maksuaika v**	**5,2**	

Cold (ambnient) air drying

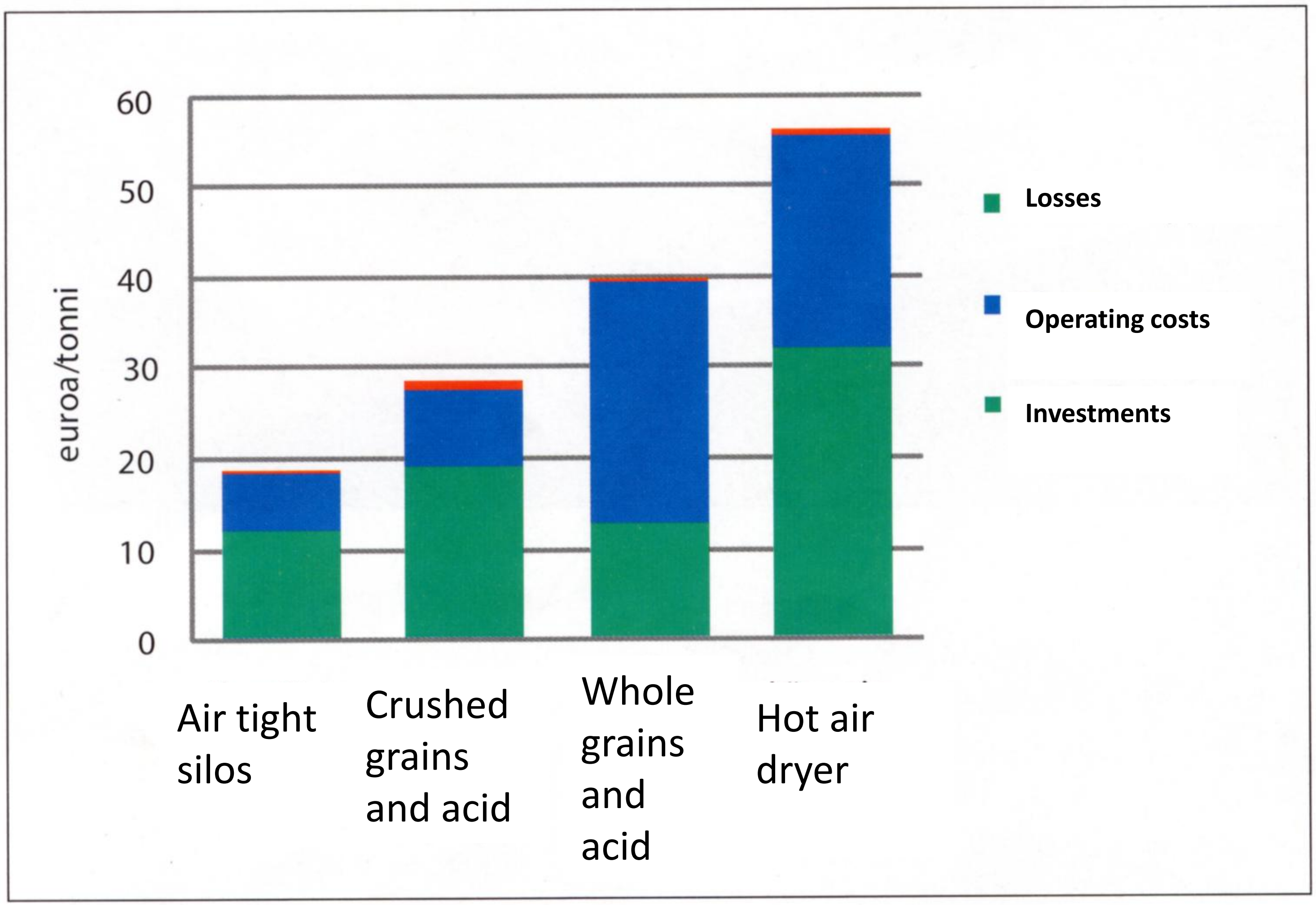
- Energy consumption is only one quarter of hot air drying energy consumption
- Good reception capacity -> storage dryer, large areas can be combined before the dryer is full
- Long drying time
- No grain sorting devices, more trash in the grain
- Trade moisture content 13% is very hard to achieve without extra heating unit
- Not good with several species



Cold air drying

- If grain layer is thicker than 1m, sentrifugal fan is needed
- Wet grain with over 60 cm layer begins to spoil from the surface
- With thick layers mixing of wet grain is a necessity
- Large dryers need large fans, demand for good electrical lines or the fans must be operated by diesel engines
- Handling of the grain is many cases more difficult and man power is needed

Other preservation methods



Palva R. Tuoresäilöntä on entistä kiinnostavampi vaihtoehto. Teho 5/2008

This material has been produced in ENPOS project. ENPOS is acronym for ***Energy Positive Farm***.

The project partners are
• University of Helsinki, department of Agricultural Sciences – Agrotechnology
• MTT Agrifood Research Finland - Agricultural Engineering
• Estonian University of Life Sciences

Project home page is at http://enpos.weebly.com/

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