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

Öljypolttimen säätö, vaikutus 0 – 15 %

Energiansäästö
- Kustannus €: 400
- Säästö: 5,0%

Säästö €/v: 190
Takaisinmaksuaika v: 2,1
Efficiency in oil burning

Adjustment of burner air amount has effect on

- SFlue gas temperature
- CO₂ – content
- losses
Drying during good weather

In this example during cold weather, energy need is almost 20% higher.

Air must be heated 55°C

Air must be heated 65°C
Insulation

Dryer insulation effect is 10 – 20%
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

Effect of drying air temperature on germination

Drying air temperature 119°C, fast grain circulation

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 done, 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 with air and heating units with water, problems in assemblies
Wood chips

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

<table>
<thead>
<tr>
<th>Calculation basis</th>
<th></th>
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<tbody>
<tr>
<td>Grain area</td>
<td>100 ha</td>
</tr>
<tr>
<td>Harvest moisture content</td>
<td>22%</td>
</tr>
<tr>
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Cold (ambient) 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 the grain layer is thicker than 1m, a centrifugal 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 often more difficult and manpower is needed.

![Diagram of cold air drying equipment](image-url)
Other preservation methods

![Graph showing costs and investments for different preservation methods.]

- Air tight silos
- Crushed grains and acid
- Whole grains and acid
- Hot air dryer

Legend:
- Losses
- Operating costs
- Investments
This material has been produced in ENPOS project. ENPOS is acronym for Energy Positive Farm.

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• MTT Agrifood Research Finland - Agricultural Engineering
• Estonian University of Life Sciences

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

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