Energy optimization in a Flour Milling plant

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Introduction

Primary concern:

- Contribution to energy saving depate
- Global energy prices
- Energy costs up to 5% of total running costs
- Investments for lowering power consumption must pay off

Overview

- Cost structure of a flour mill
- Energy consumption
- Consumption monitoring with WinEnergy control module
- Plant layout of transformer and low tension
- Starting characteristics and quality aspects of motors
- Technology and engineering aspects
- Summary

Cost structure of a Flour Mill

Example from mills in Europe

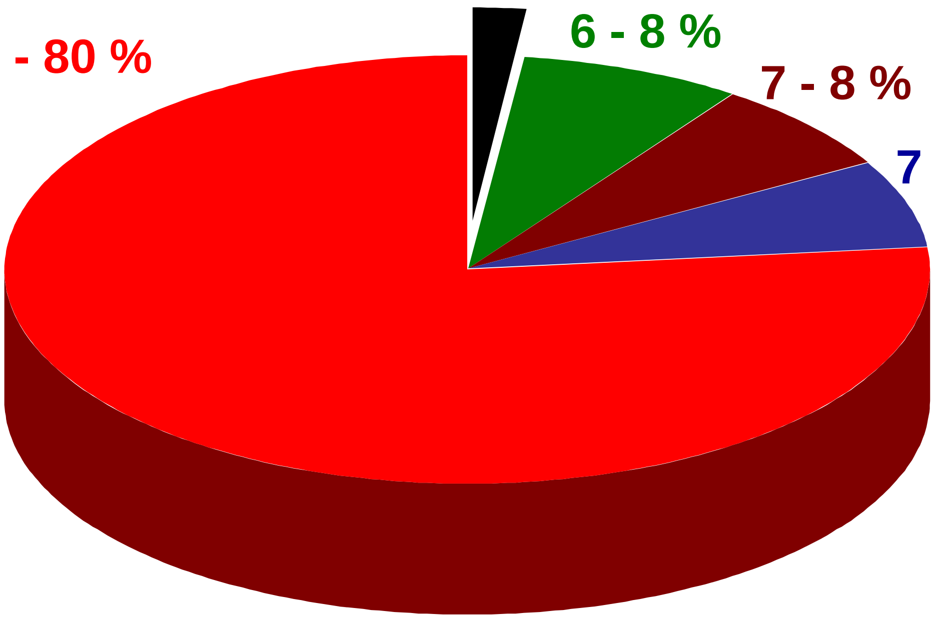
Profit xx %

Capital costs: 6 - 8 %

- amortization 3-4 %
- interest 3-4 %

Raw material: 76 – 80 %

- Grain
- Additives



Distribution: 7 - 8 %

- packing 2 %
- transport 2 %
- staff 2 %
- marketing 1 %

Production: 7 – 10 %

- Energy 3 – 5 %
- Staff 3 – 5 %
- Maintenance ~ 1 %

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Operating costs

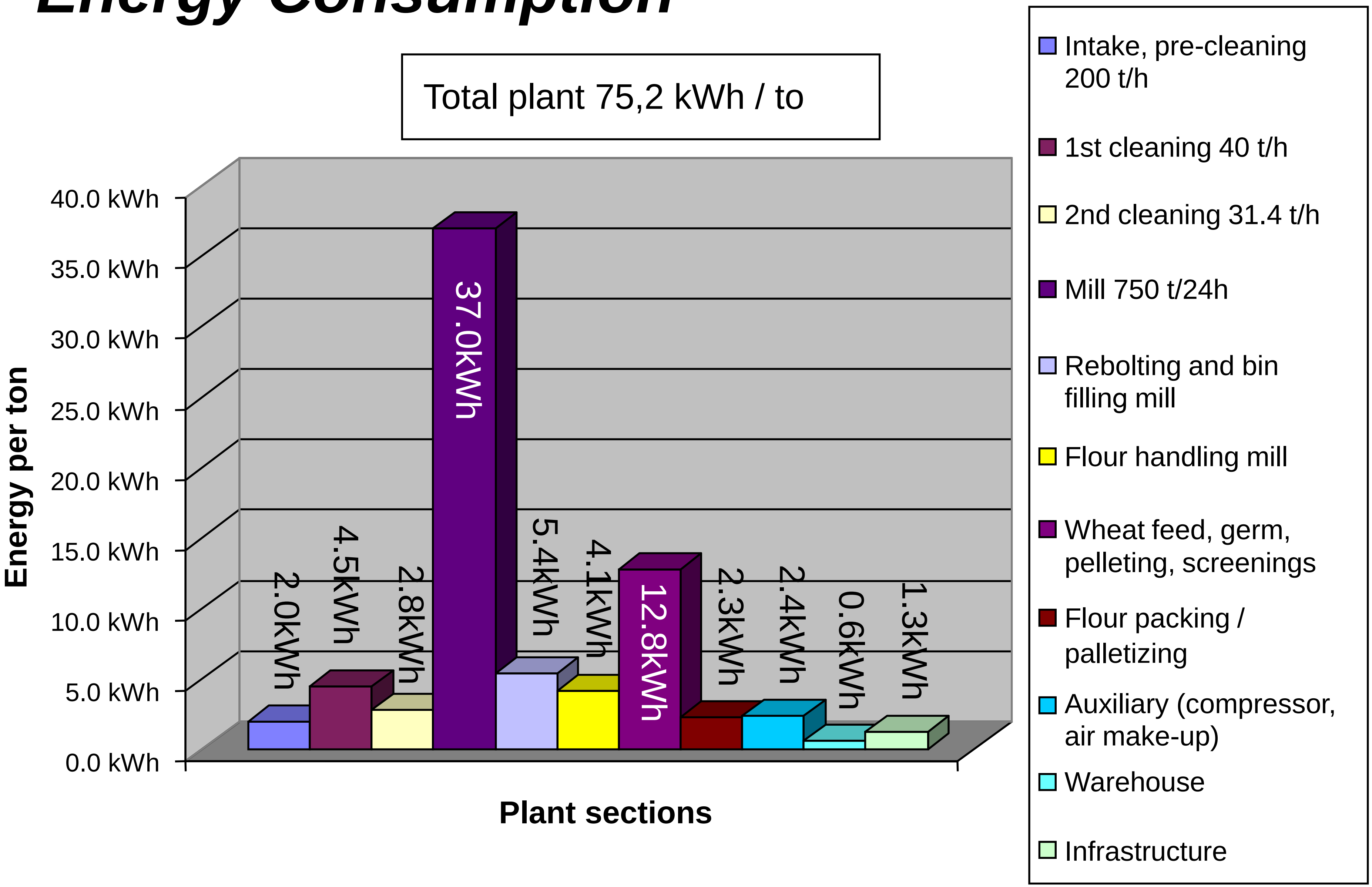
Much attention has been already paid to operating costs in the past:

- *Processes were constantly streamlined, reducing labor costs*

➡ ***the focus now should be on saving energy***

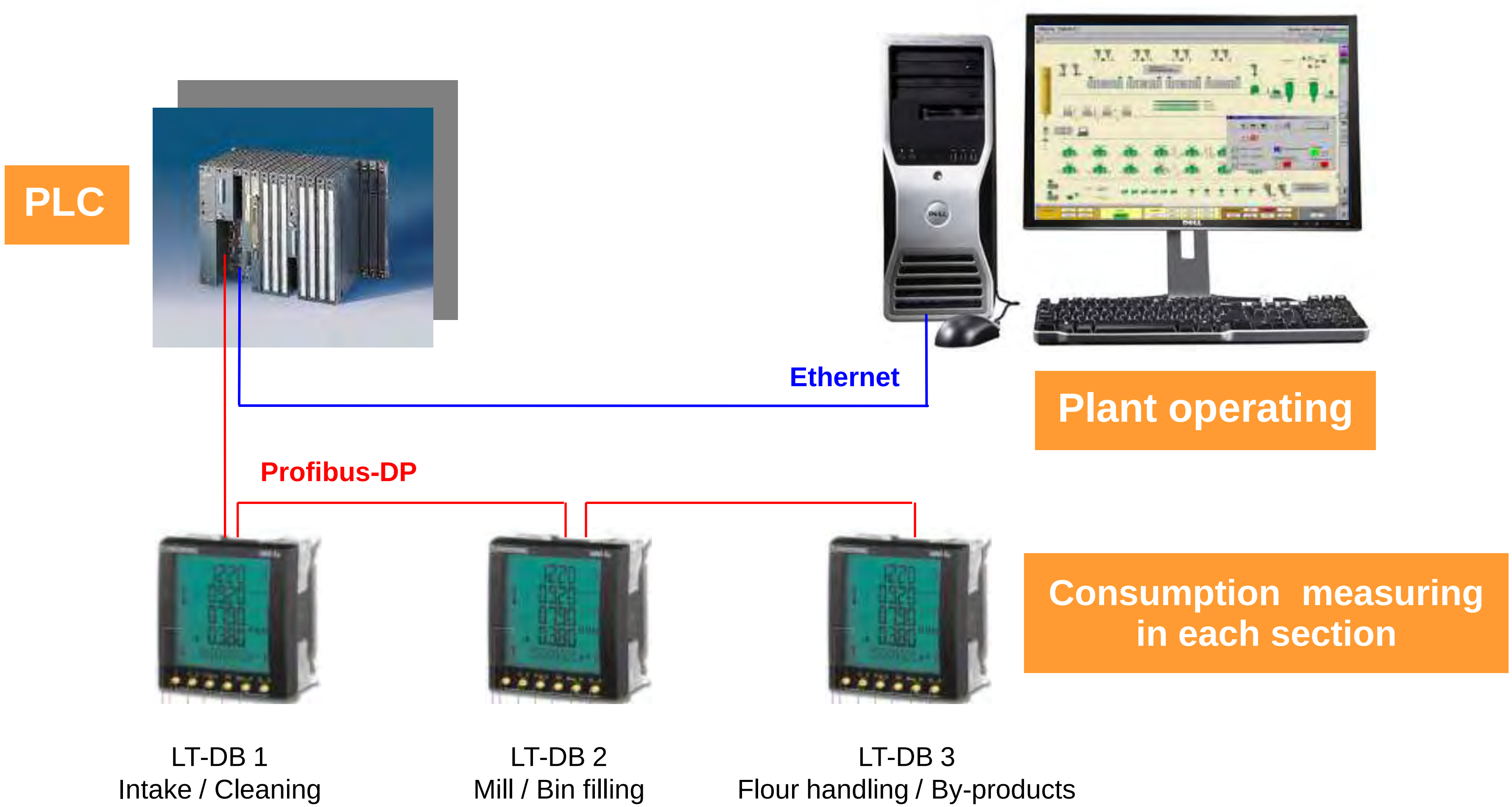
and optimizing power consumption !

Energy Consumption



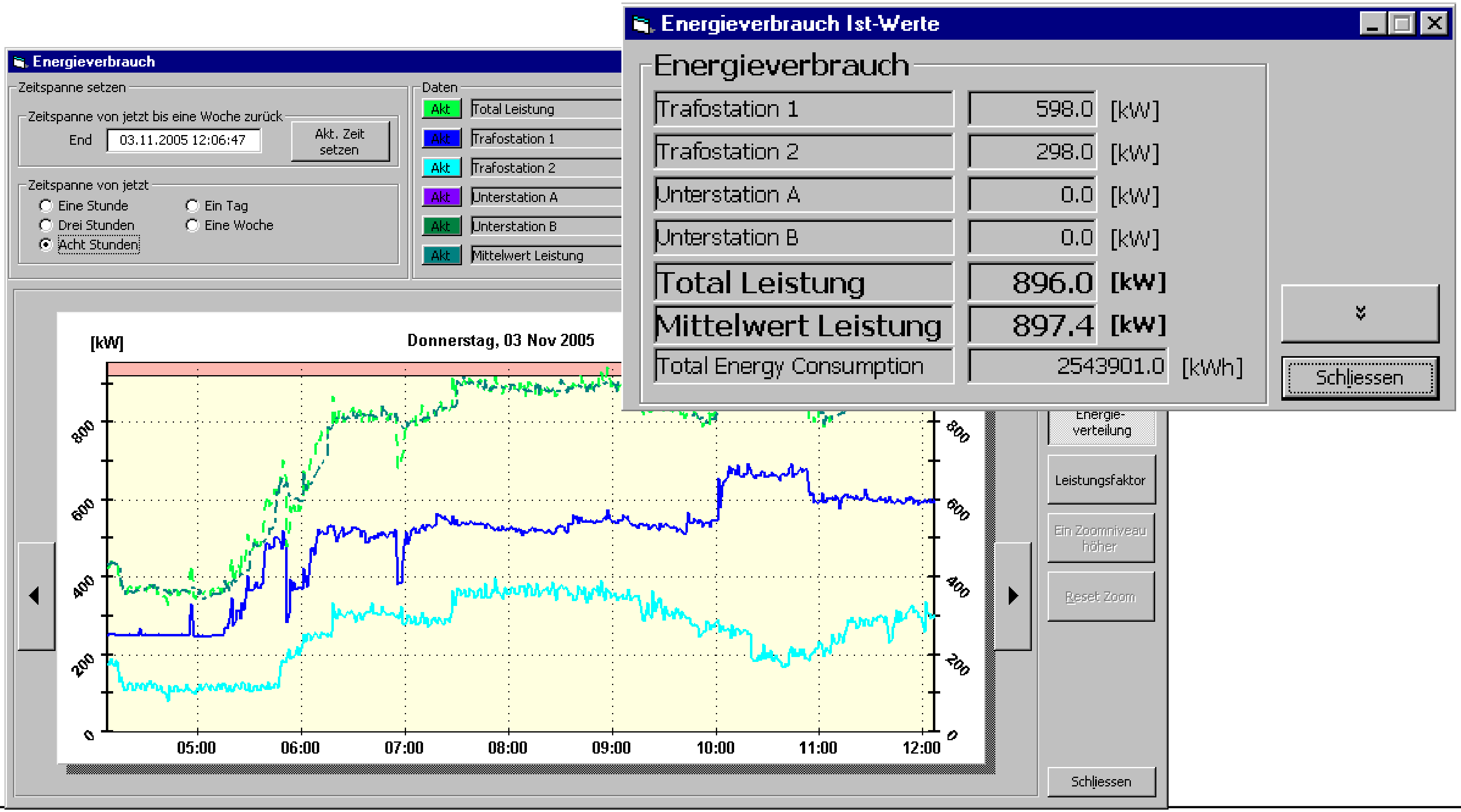
Automated Plant control

Power monitoring with WinEnergy



Plant control with WinCos

Power monitoring with WinEnergy.



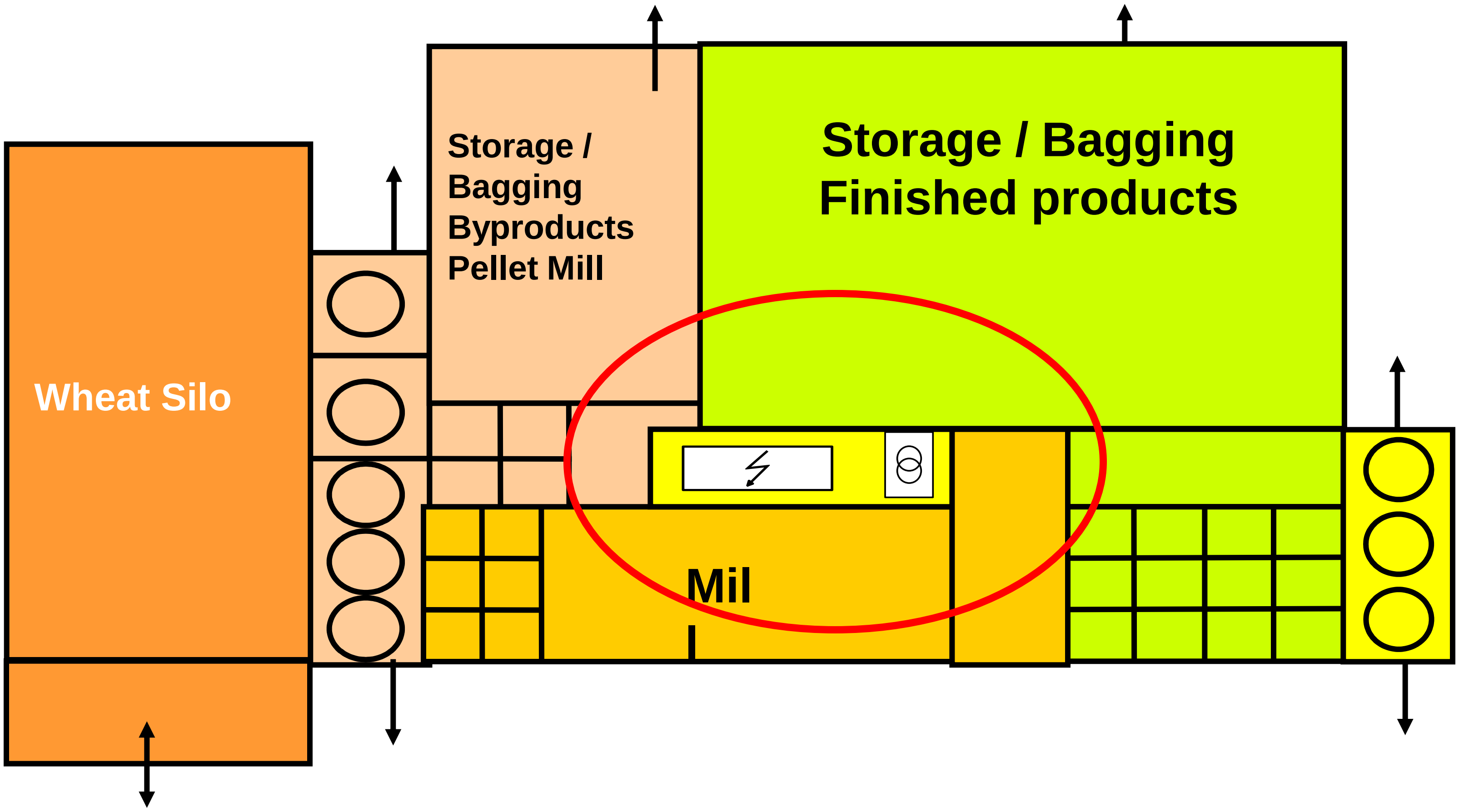
Power supply / Infrastructure Critical factors:

- △ actual power consumption vs. installed kW
- Oversized motors
- Simultaneous factor not considered
  (machines not running simultaneously)

➡ Consequences

- Oversized transformer
- Power factor correction unit on limit
- Enormous loss trough reactive power
- Cables, contactors and starters over-dimensioned

Plant layout: transformer and low tension



- *Transformer / Generator close to low tension-DB*
- *Low tension-DB close to **Motor Control Center***

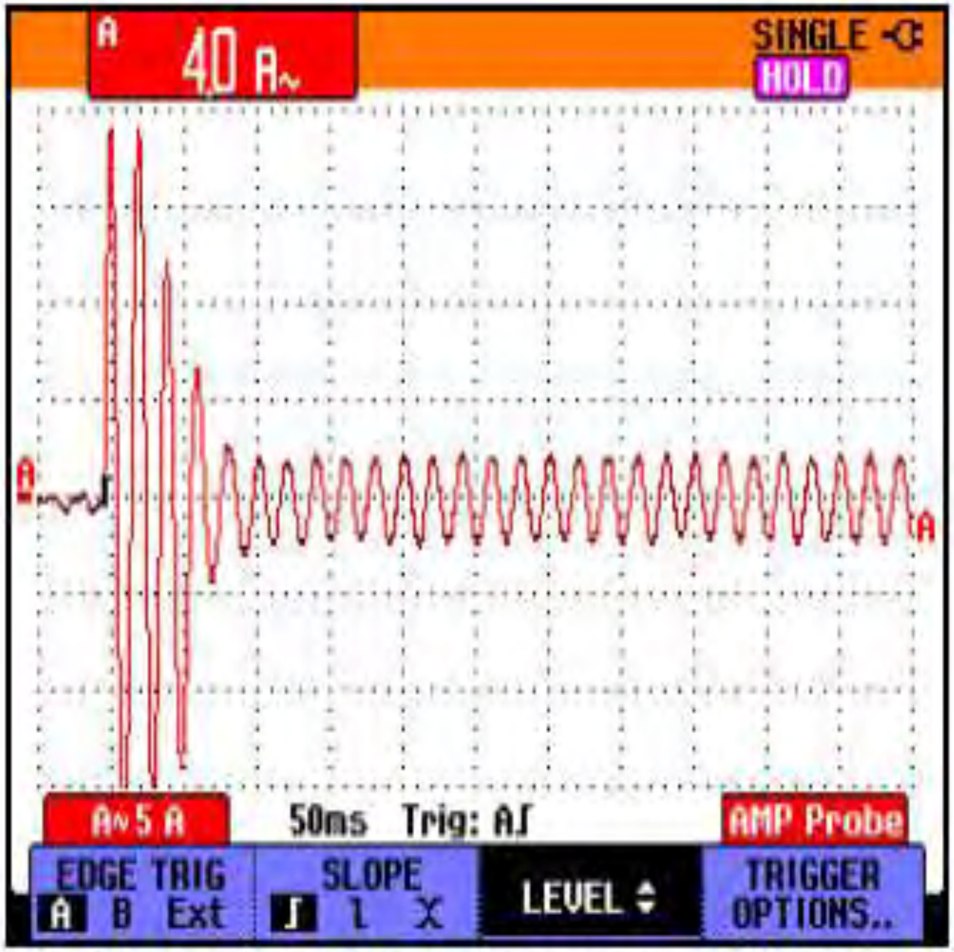
Starting characteristics of motors

- Depending on service hours, specific function and rating, the starting mode of drives have an appreciable impact on efficiency and electricity costs
- Frequency converters (FC) and Softstarters (SS) are interessting alternatives
- FC and SS are technically improved, moderate prices
- FC improves power factor and motor efficiency

→ This leads to reduction in Energy

and costs for power factor correction

Starting characteristics & Network current



direct start $I_{N\,(Motor)}$ = 2,3 A

Process:

Direct on Line

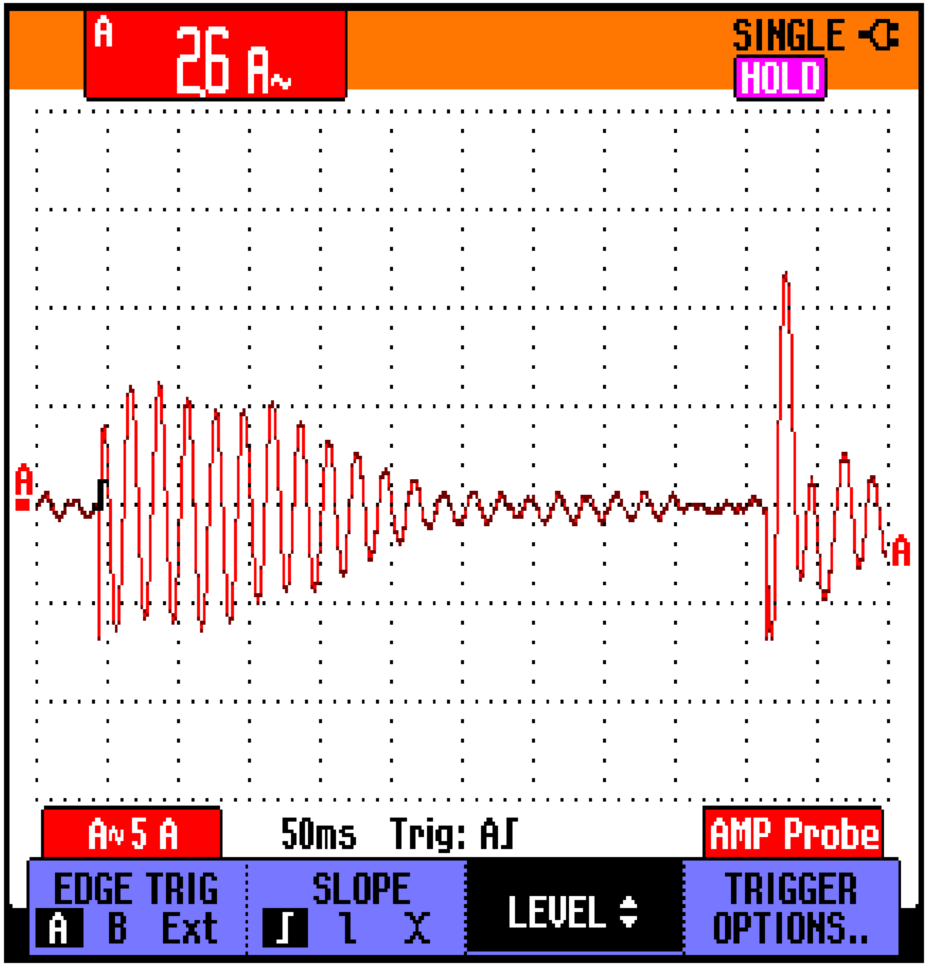
Advantages:

- torque straight available
- no extra investment
- simple installation

Disadvantage:

- huge starting current (7x I_N)
- high transformer load (short)
- voltage dip (short)

Starting characteristics & Network current



Star / Delta $I_{N\,(Motor)}$ = 2,3 A

Process:

Star / Delta

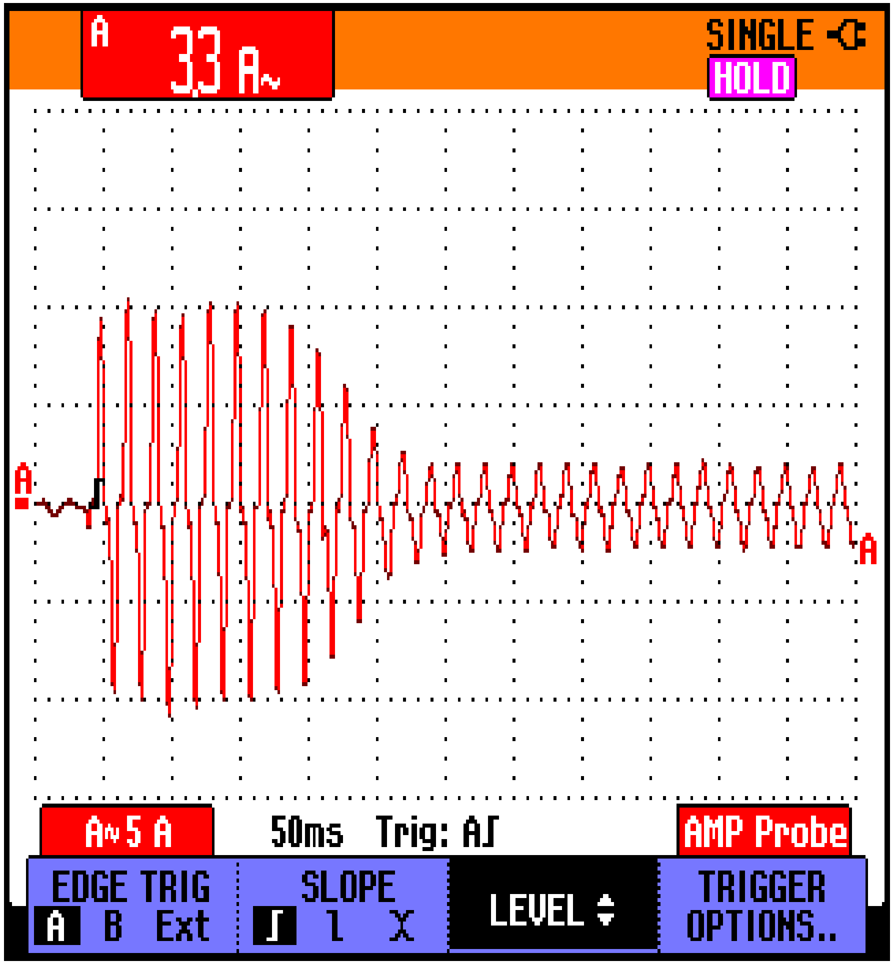
Advantages:

- moderate investment
- simple installation
- known technology

Disadvantage:

- high starting current (2x I_N)
- 5-6x lower torque
- voltage dip (short)

Starting characteristics & Network current



Softstart with a 30% of boost

Process:

Softstart (SS)

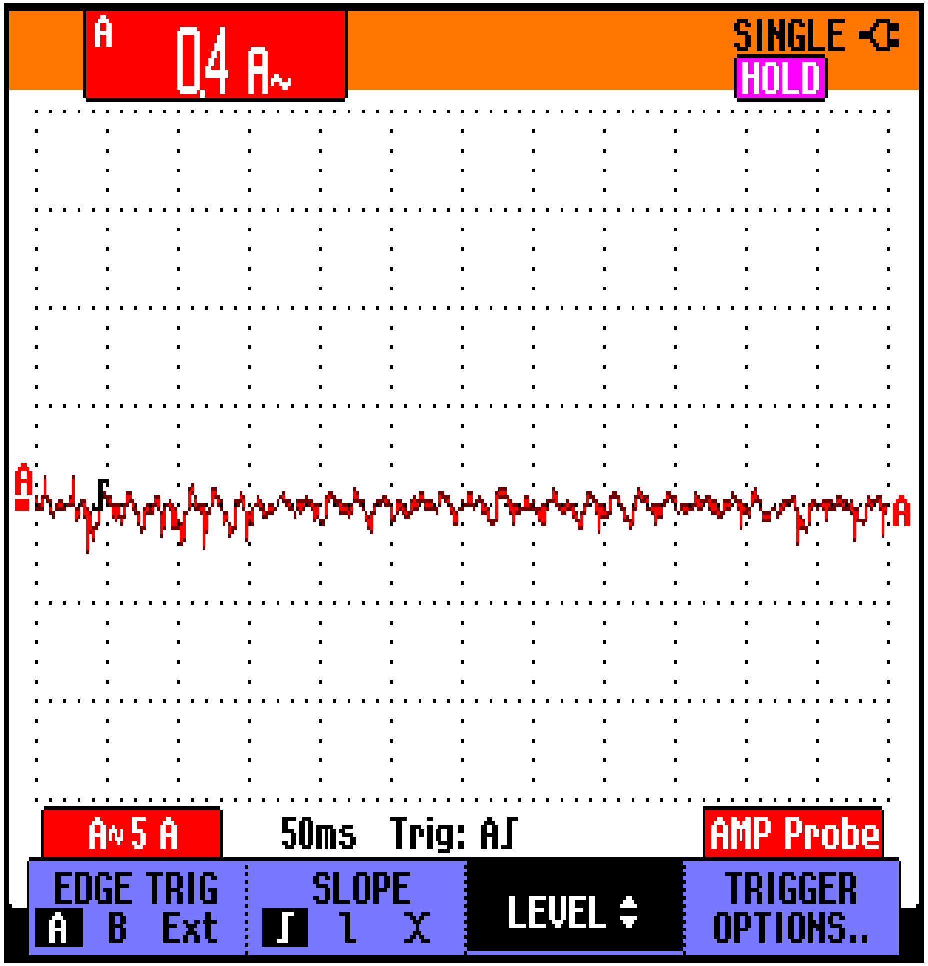
Advantages:

- min. additional cost
- simple installation
- transformer friendly appl.

Disadvantage:

- moderate starting current
- high transformer load (short)

Starting characteristics & Network current



Start with a frequency converter

Process:

Frequency converter (FC)

Advantages:

- low starting current (<2x I_N)
- increase Cos φ (> 0.97)
- no Voltage dip
- energy saving
- great flexibility

Disadvantage:

- high initial Investment
- space requirement
- shielded cables (EMC)

Quality aspects of Motors

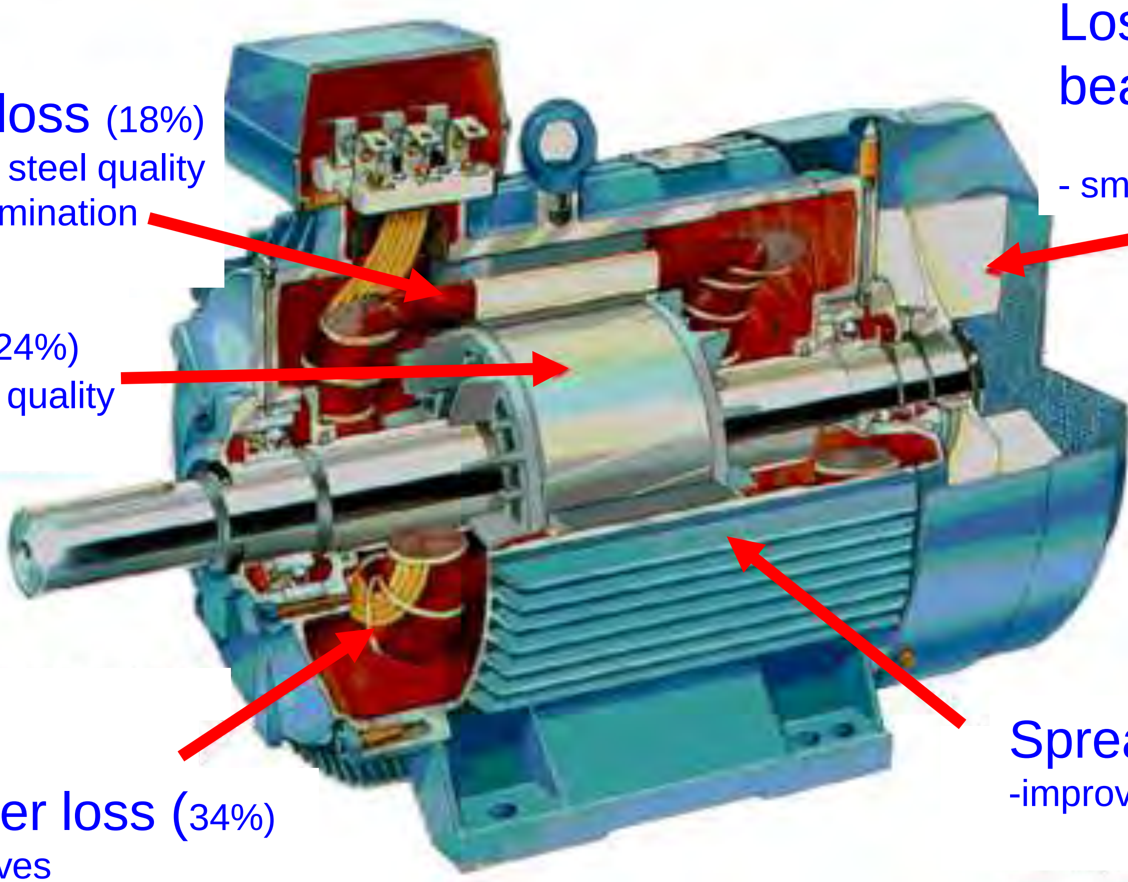
Quality indication of motors ➡ real efficiency $\eta > 0.9$

Loss due to
bearing/air friction (10%)

- smaller fan

Iron core loss (18%)
- optimized steel quality
- thinner lamination

Rotor loss (24%)
- optimized steel quality
- thinner slats

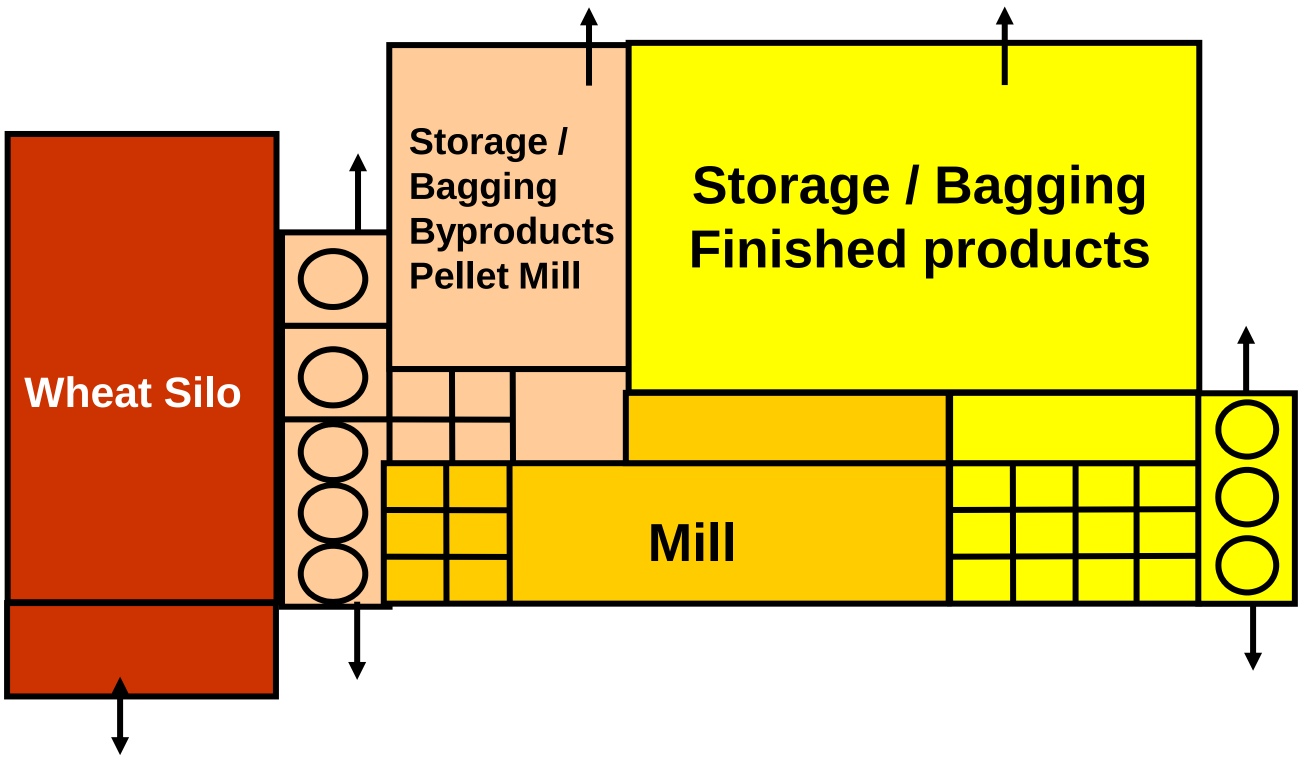


Spread loss (14%)
-improved design of surface

Stator copper loss (34%)
- optimized grooves
- larger wiring

Technology and Engineering aspects.

Compact building concept minimizes conveying distance



- reduction in installation costs
- saving in power consumption

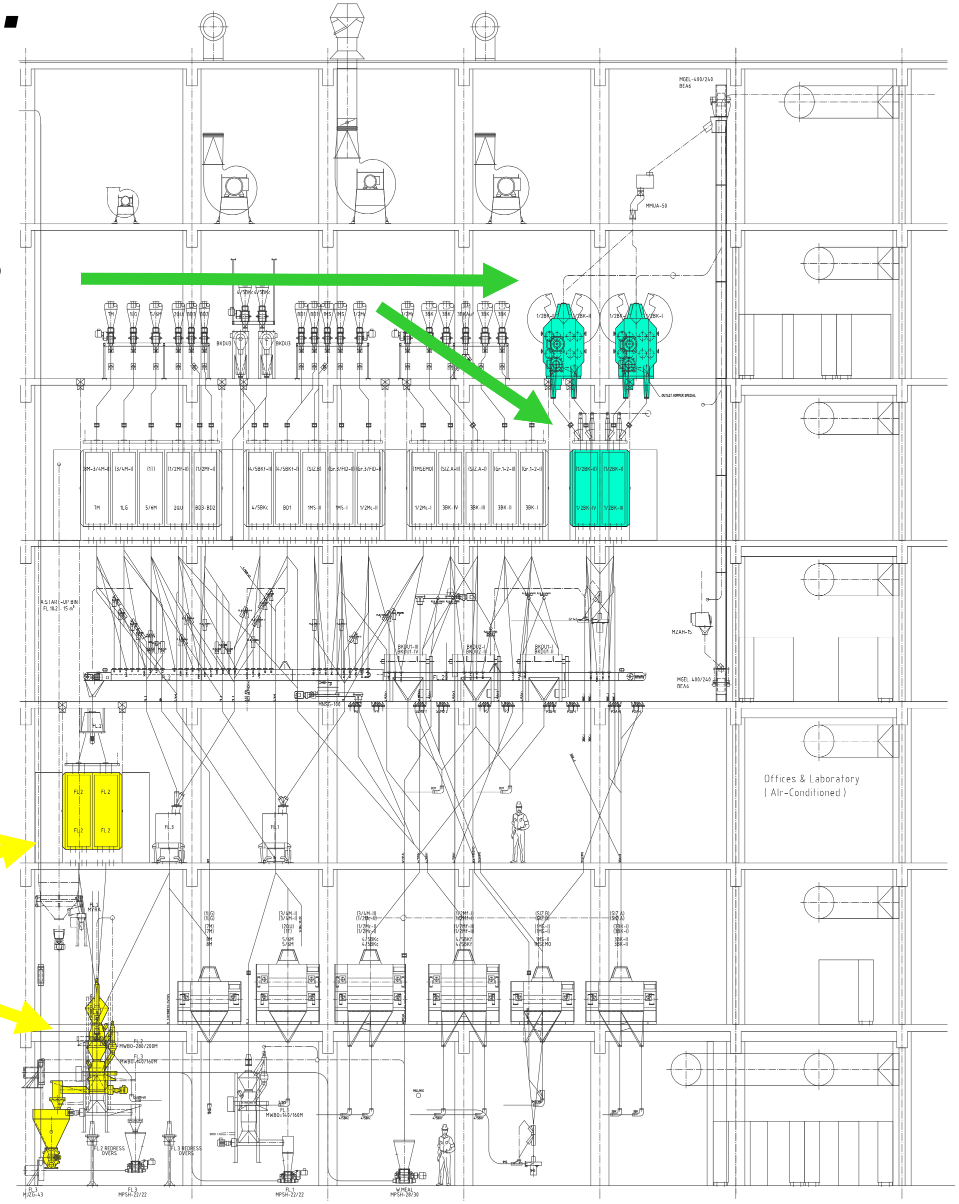
Engineering aspects:

- 1st and 2nd Break roller mills installed above plansifter
  (12-18% lower air volume)

➡ Less pneumatic lifts
➡ Energy saving

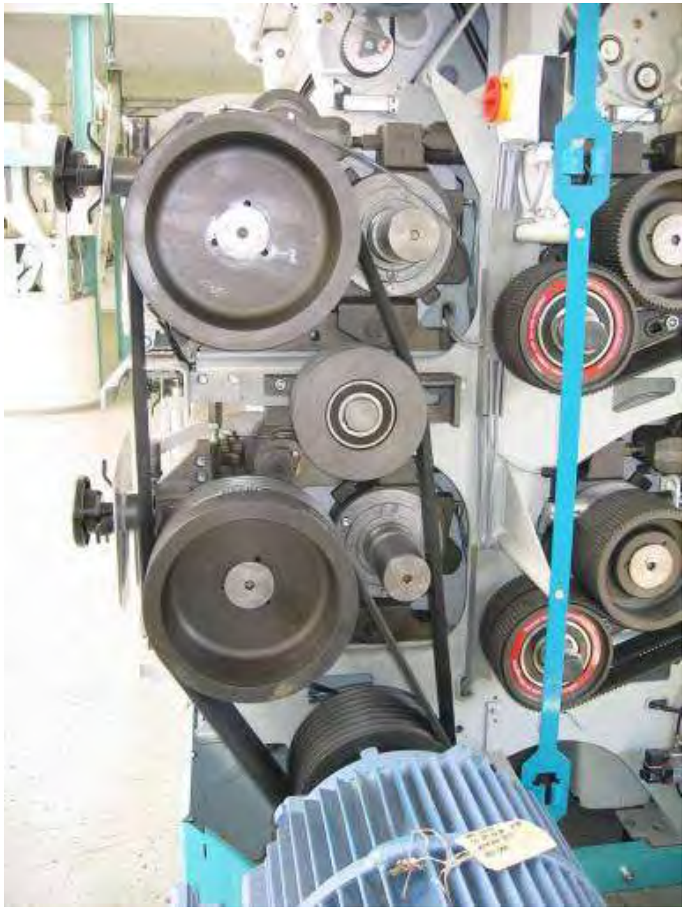
- Control sifter and weigher in direct flow

➡ no relift
➡ Energy saving



Eight-roller-mill
Twin-Drive with one motor for 2 passages

up to 45kW motors

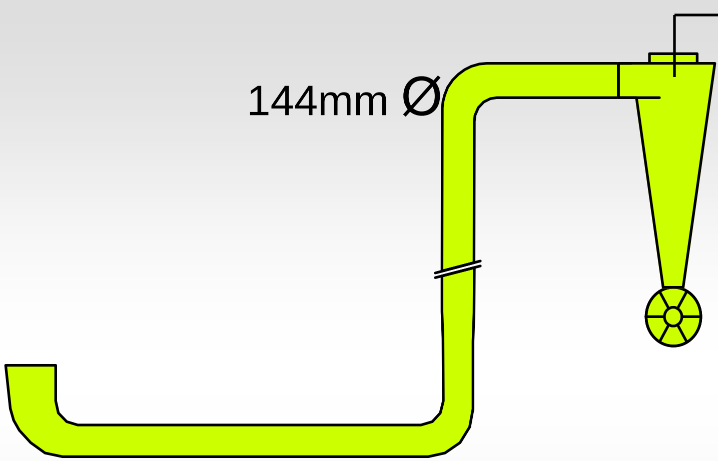


Eight-roller-mill "Twin- Drive"

- Eight roller MDDO with 4 motors of 37 kW each passage (total 148 kW)
- Eight roller MDDO with 2 motors of 45 kW for two passages (total 90 kW).

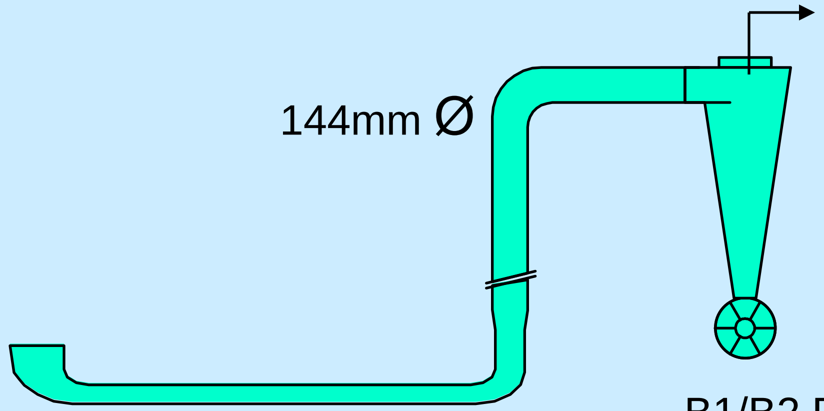
→ Reduction up to **39%** of the installed power

Mill pneumatic:
‘Energy saving through air volume reduction’



Previous design

- 20% reduced air speed (m/s)
- 10% lower negative pressure
- 25% reduced air volume (m3/min)



Optimized design

Mill pneumatic: Summary

Example of a 275to / 24h Wheat flour mill

- 1st BK / 2nd BK Eight Roller mill above plansifter

Power requirement with optimized design of pneumatic system : 76,5 kW (310m^3 instead of 360m^3)

➡ motor installed: 90 kW instead of 110 kW

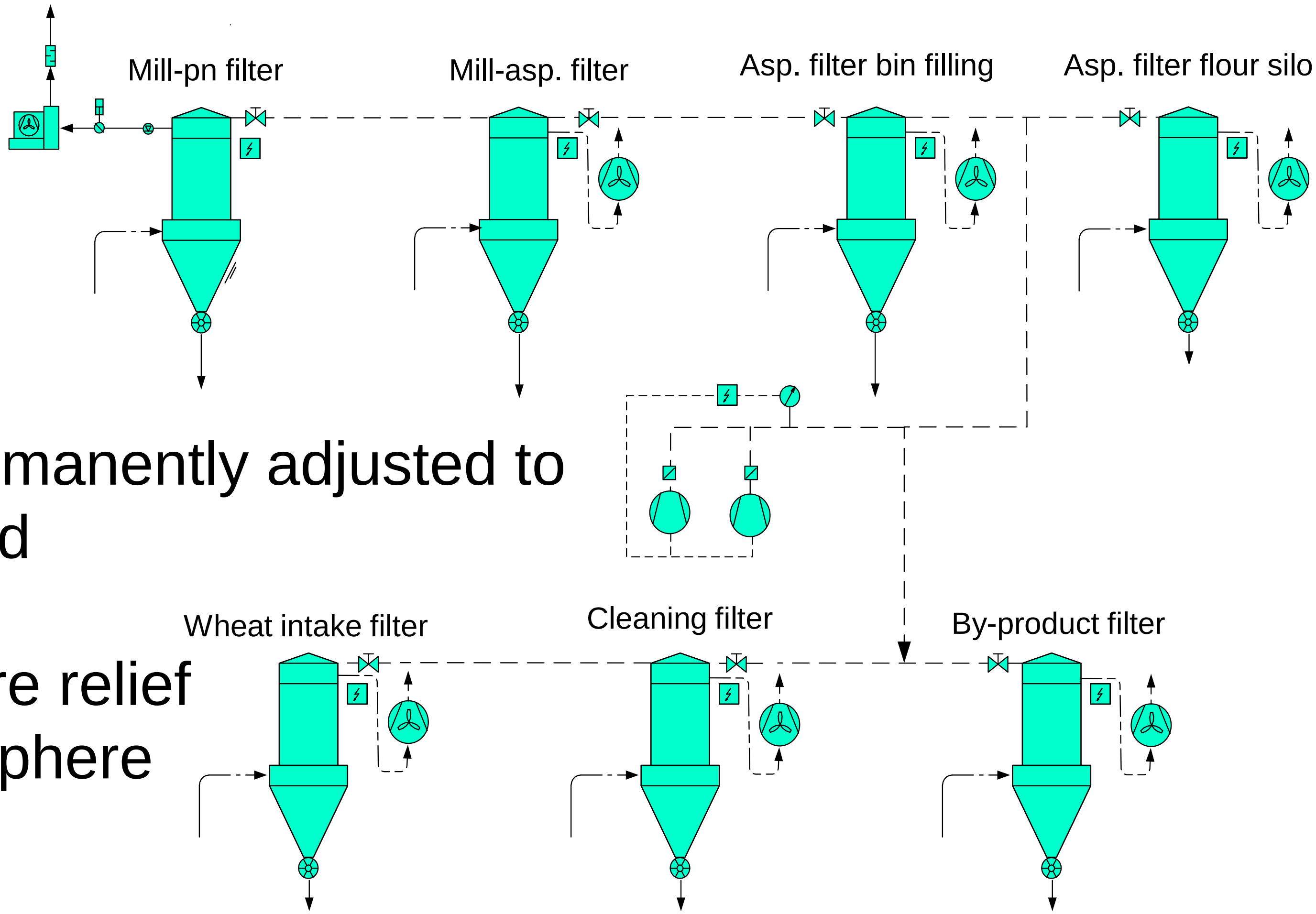
- Mill-Pneumatic fan equipped with a Frequency converter

Power factor improved cos φ > 0,97

Energy saving up to 10% possible

Central rinsing air blower with frequency converter

FC operation ➔ 10 - 30% Energy saving

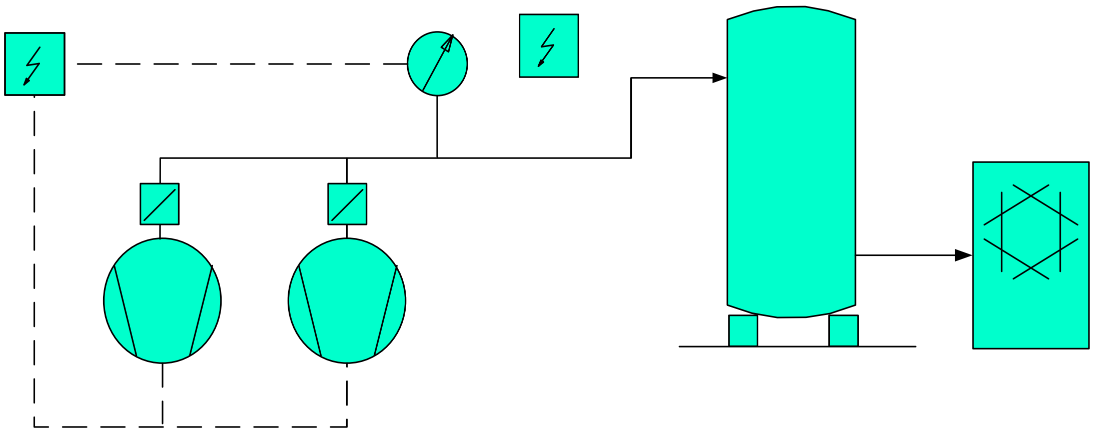


- airflow permanently adjusted to actual need

- no pressure relief into atmosphere

Air compressor with frequency converter

FC operation → - 40% Energy saving



- necessary pressure lower, remaining constant
- airflow permanently adjusted to actual need

Summary

- Each motor which can be avoided leads to a power saving
- Use motors with a power factor cos φ >0.9
- Evaluate the use of frequency converters

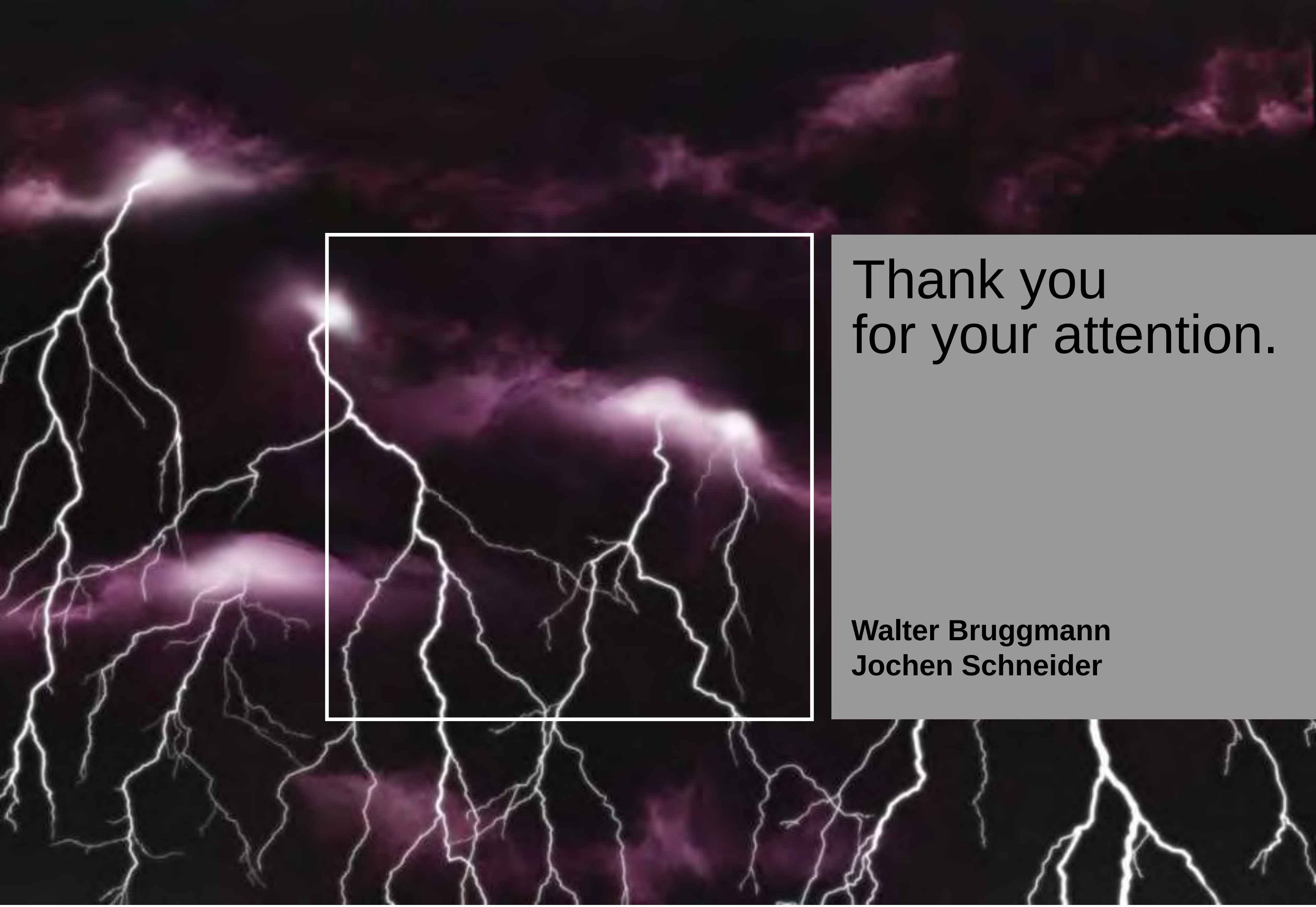
- Optimize mill pneumatic
- Use of Twin-Drive on eight-roller mills
- 1st BK / 2nd BK roller mills above plansifter can save energy
- In-line flour re-bolting and weighing avoid re-lifting

- Use elevators instead of blow lines where adequate
- Operate sub-processes during off-peak times
  (over night)

Summary ***continued***

- Design transformers only as large as really needed
- Place transformers close to DB and consumers
- Long cable distances mean higher power losses
- Oversizing cables creates high investment costs
  (copper and steel prices)

- Use automated control systems to improve processes
  (optimize start- / stop sequences, control controller, adjustment settings)
- Use energy management systems (WinEnergy)
  (supervision / monitoring of energy consumption)



Thank you for your attention.

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