SAARC training course

Slot-2:
Motor Systems efficiency and check with model tools

Rolf Tieben, Impact Energy
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Rolf Tieben

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- co-owner of Impact Energy
- program leader of

TOP MOTORS

„The information platform for efficient motor driven systems in Switzerland”

Rolf Tieben

IMPACT ENERGY

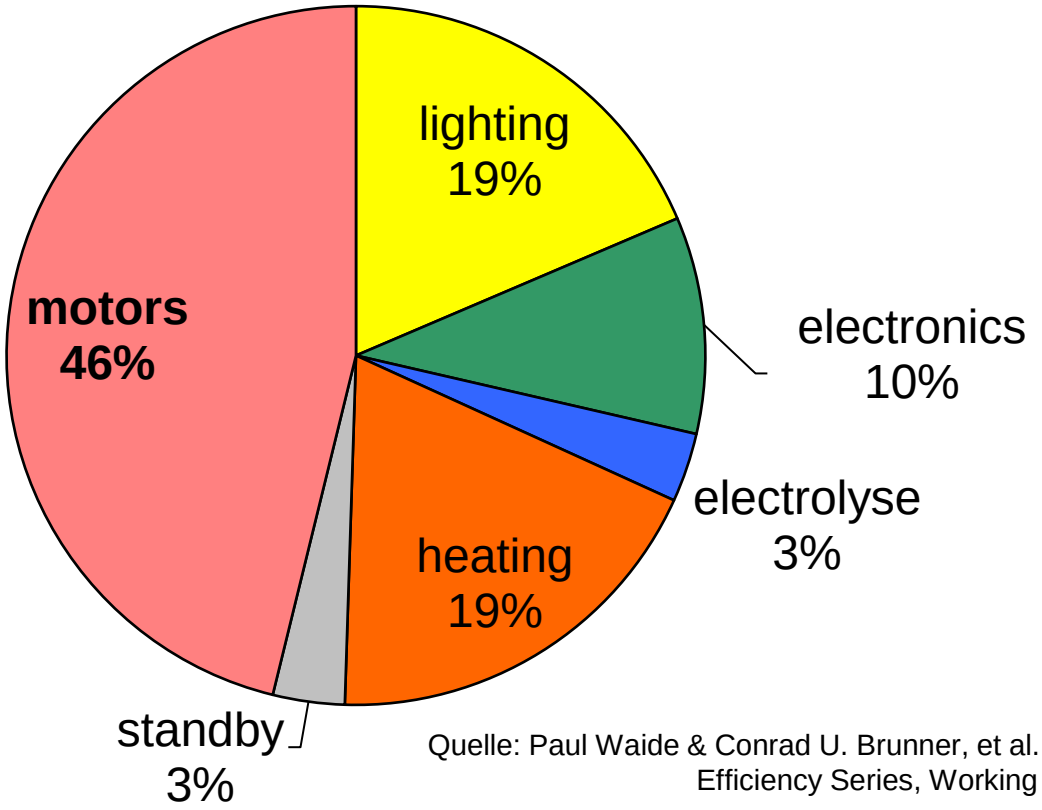
Content

- Share of motors in energy consumption
- Results and findings from “Easy”
- Efficiency
- What is a electric motor system?
- Fans, pumps, VFD, transmissions
- Saving potentials?
- Tools (SOTEA, ILI+, Motor Systems Tool)

Global eclectricity consumption

SOURCE: IEA Energy Efficiency Series, Paul Waide, Conrad U. Brunner, et al. 2011

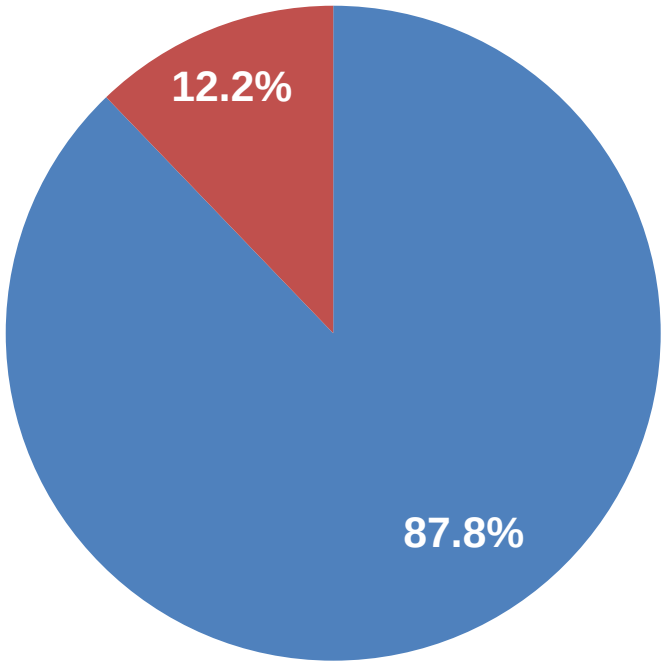
1. pumps
2. fans
3. compressors
4. conveyor belts
5. processing machines



Quelle: Paul Waide & Conrad U. Brunner, et al., IEA Energy Efficiency Series, Working Paper, 2011

Source: IEA Energy Efficiency Series, Paul Waide, Conrad U. Brunner, et al. 2011

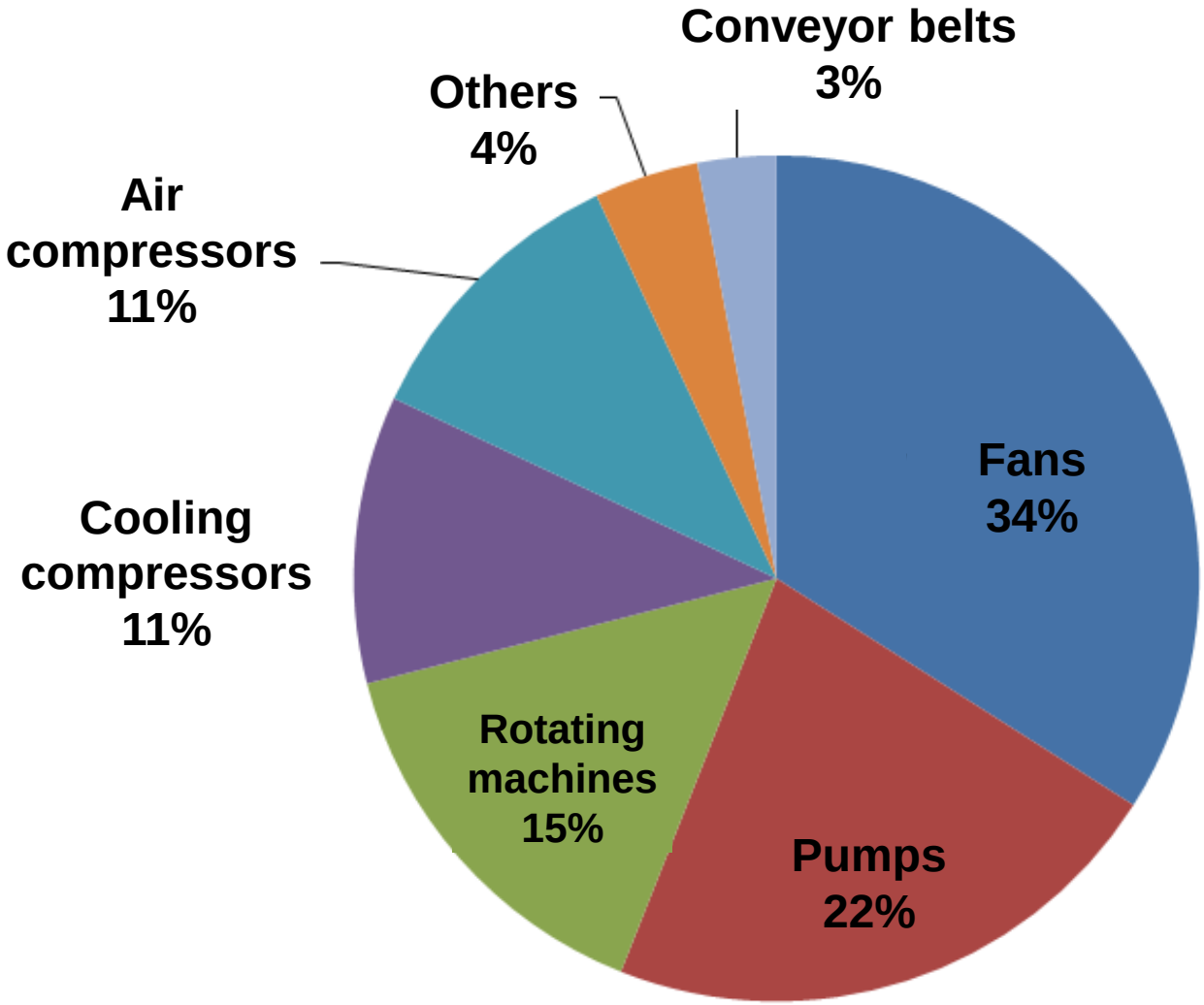
Electricity in industry



Analysed factories:	25
Total electric energy consumption:	691.0 GWh/a
Electric energy consumption of motors:	606.7 GWh/a

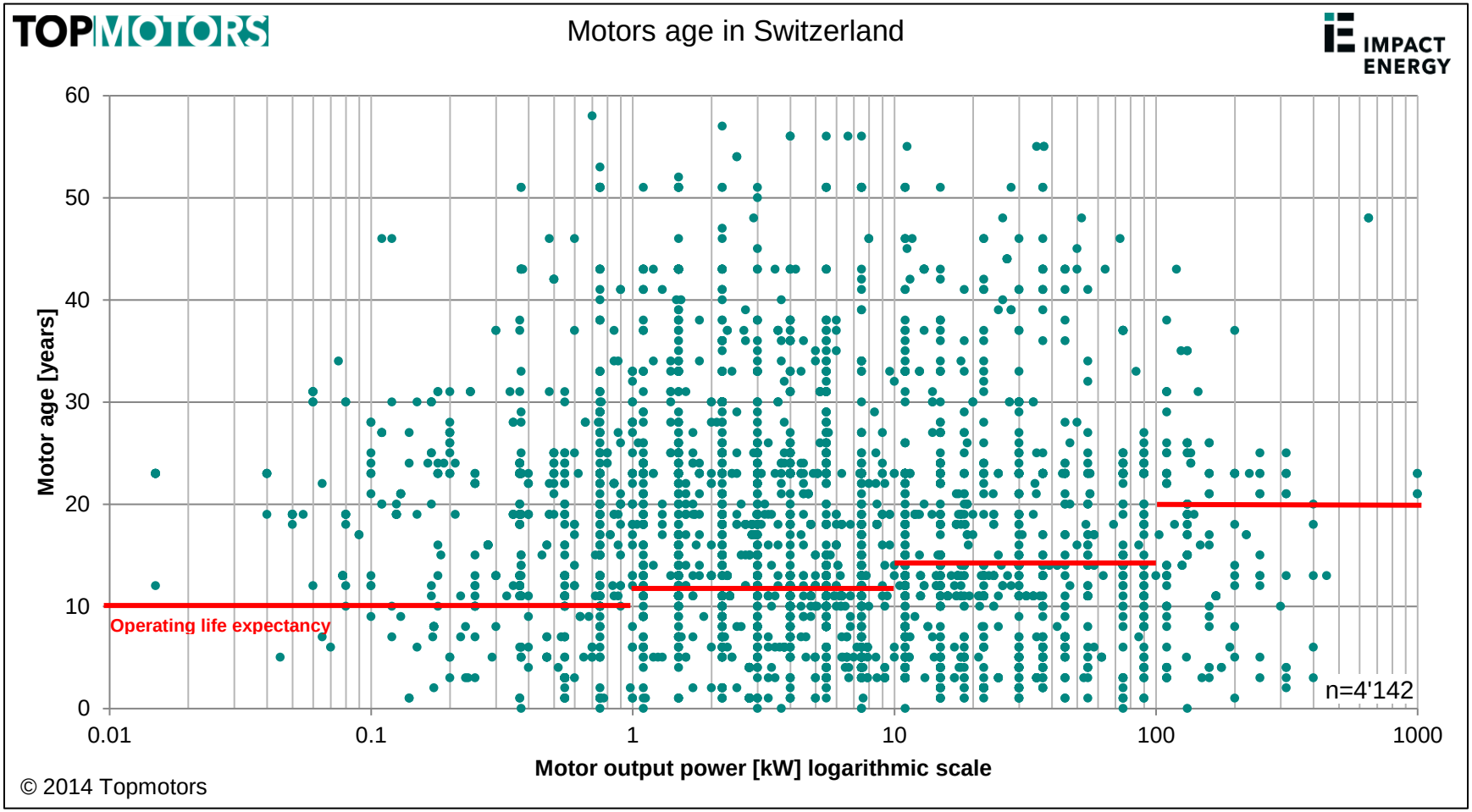
Source: Easy Switzerland, Conrad U. Brunner, Rita Werle, Rolf Tieben, 2013

Share of energy consumption



n=4‘142

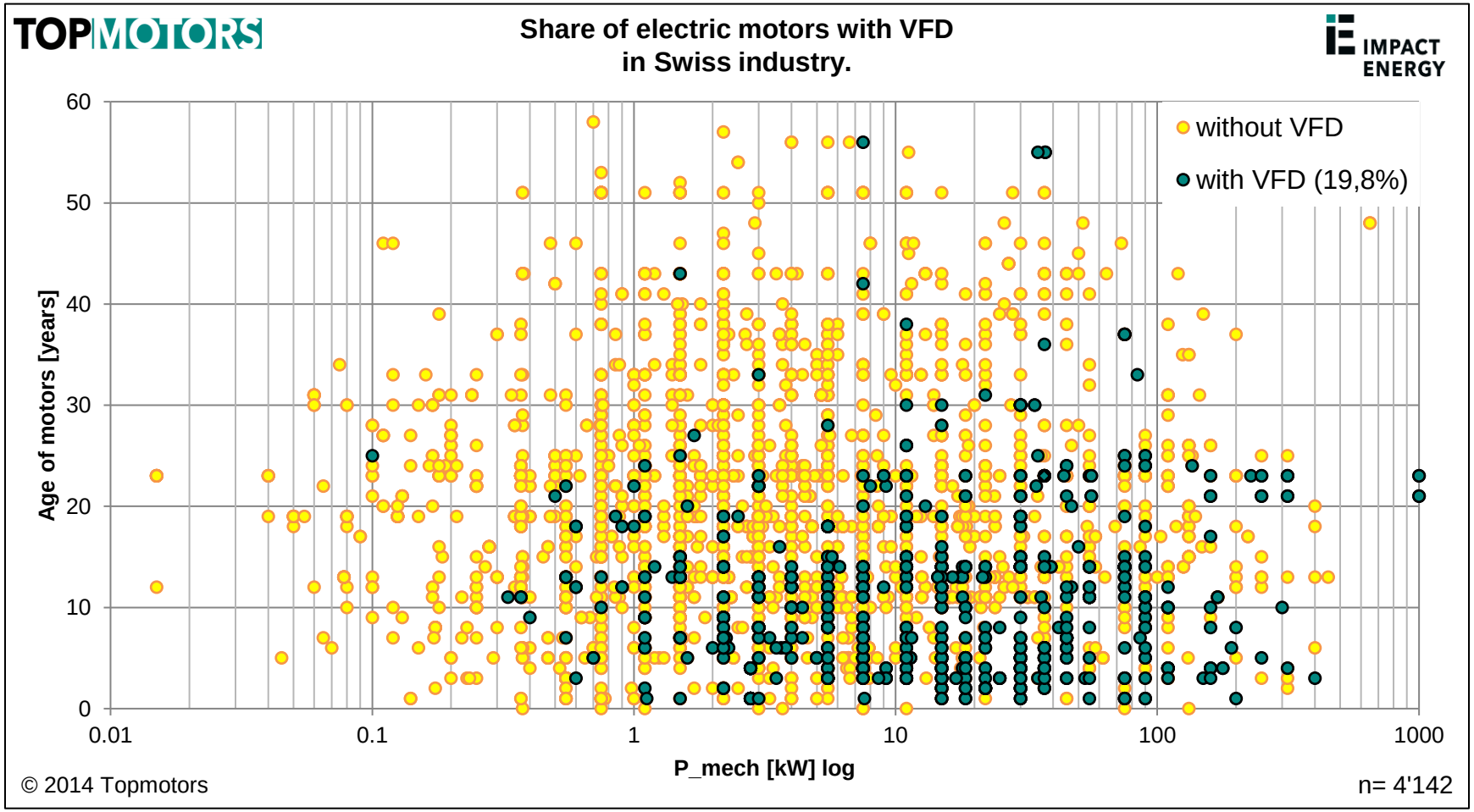
Motors are too old



56% of the analysed motors are too old- in average 99% too old

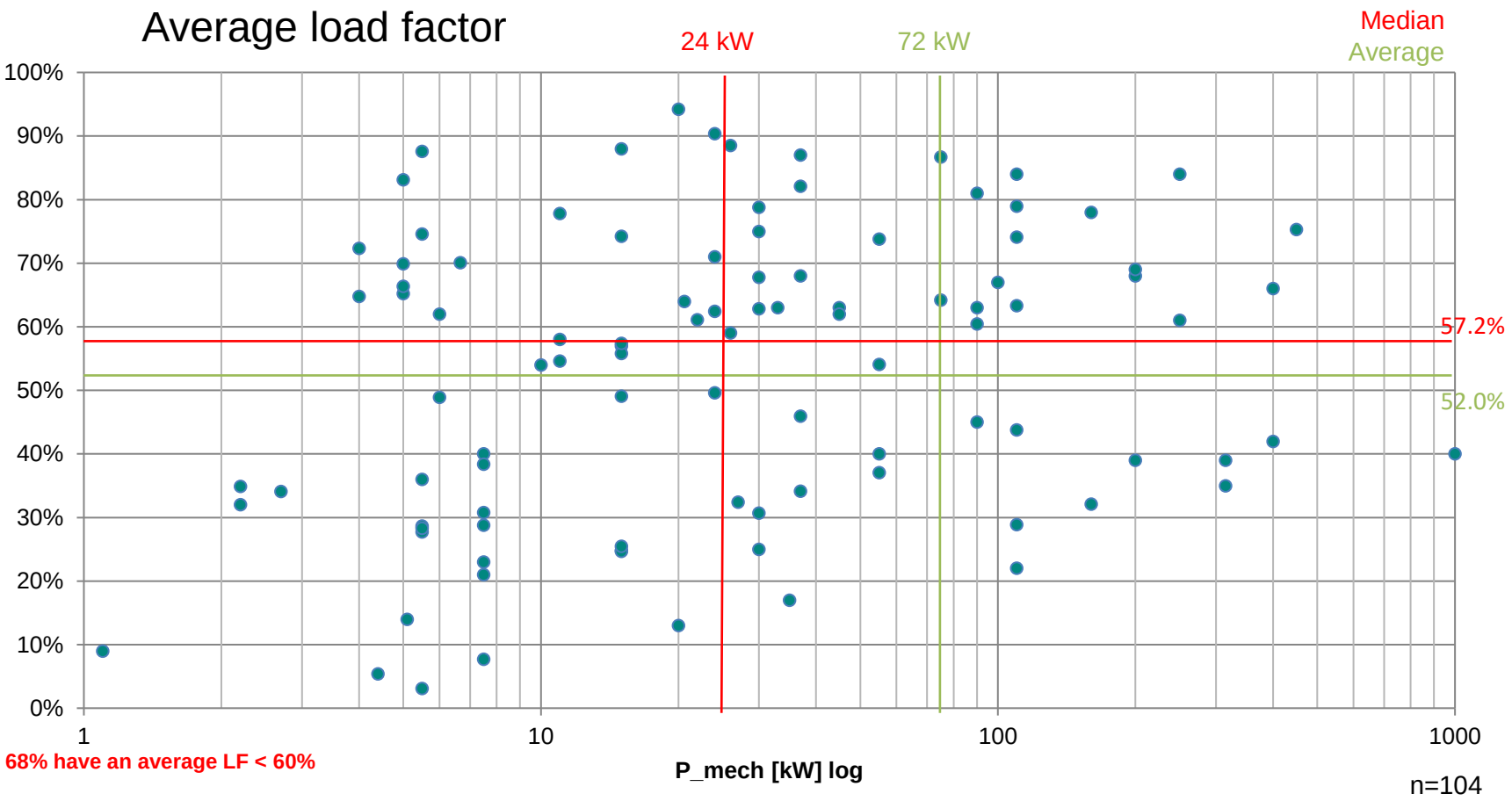
Source: Easy (Switzerland), Conrad U. Brunner, Rita Werle, Rolf Tieben, 2013

VFD ins Swiss industry



SOURCE: Easy (Switzerland), Conrad U. Brunner, Rita Werle, Rolf Tieben, 2013

Average load factor

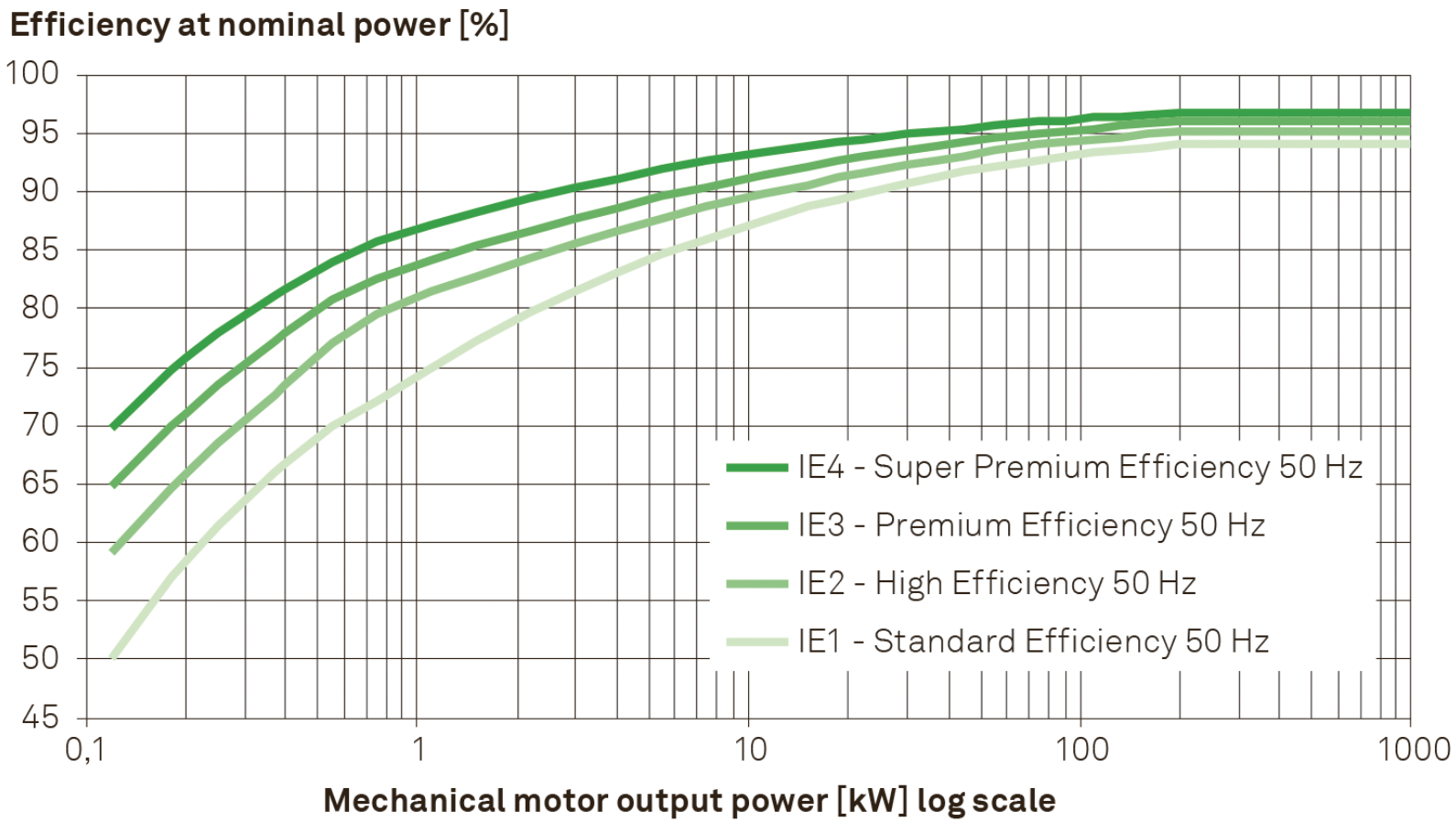


SOURCE: Easy (Switzerland), Conrad U. Brunner, Rita Werle, Rolf Tieben, 2013

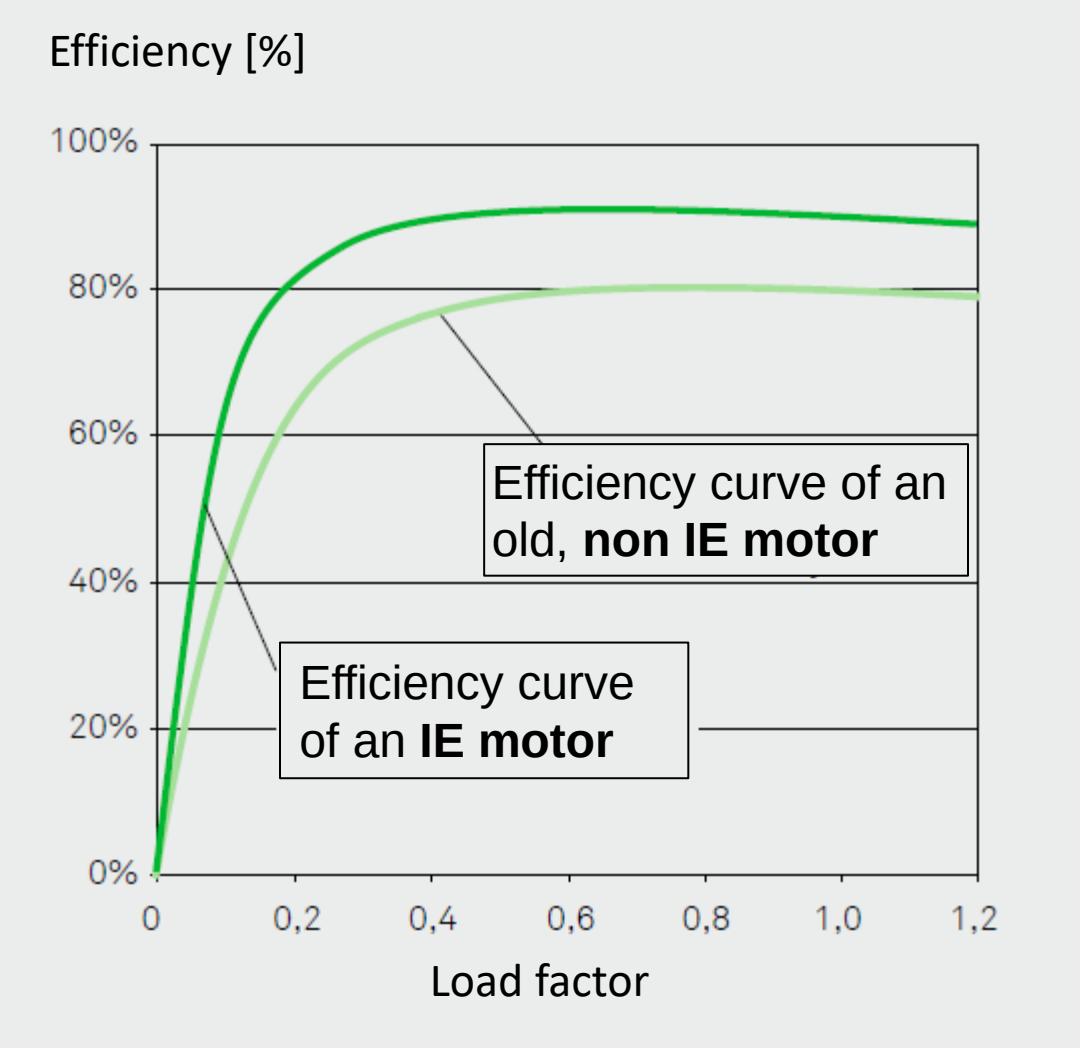
Key findings

1. 56% are already older than their operating life expectancy
   (10-20 years), in avarage twice as old
2. 68% of the measured motors have been oversized (LF <60%)
3. less than 20% already have a VFD
4. motor systems are rarely designed to meet the real needs of the process
5. qualified staff is available - but without experience in the field of energy efficient motor systems
6. the savings potential is often between 20- 30%, depending on the initial situation.

IEC efficiency classes for motors



Efficiency in partial load



Energy costs

1. ??% **of the liefecycle costs of a motor are energy costs**

2. **Within** ?? **operting hours, the energy costs as much as the purchase price of the motor.**

Quelle: De Almeida, 2014

- save money
- increase reliability - reduce risk
- reduce peak electrical power and consumption
- reduce environmental impact (electricity also from coal, nuclear)
- improve the good image of the company

Efficiency of motors

$$\text{Efficiency } (\eta) = \frac{\text{Output } (P_{mech}\text{: mechanic power) [kW]}}{\text{Input } (P_{el}\text{: electric power) [kW]}}$$

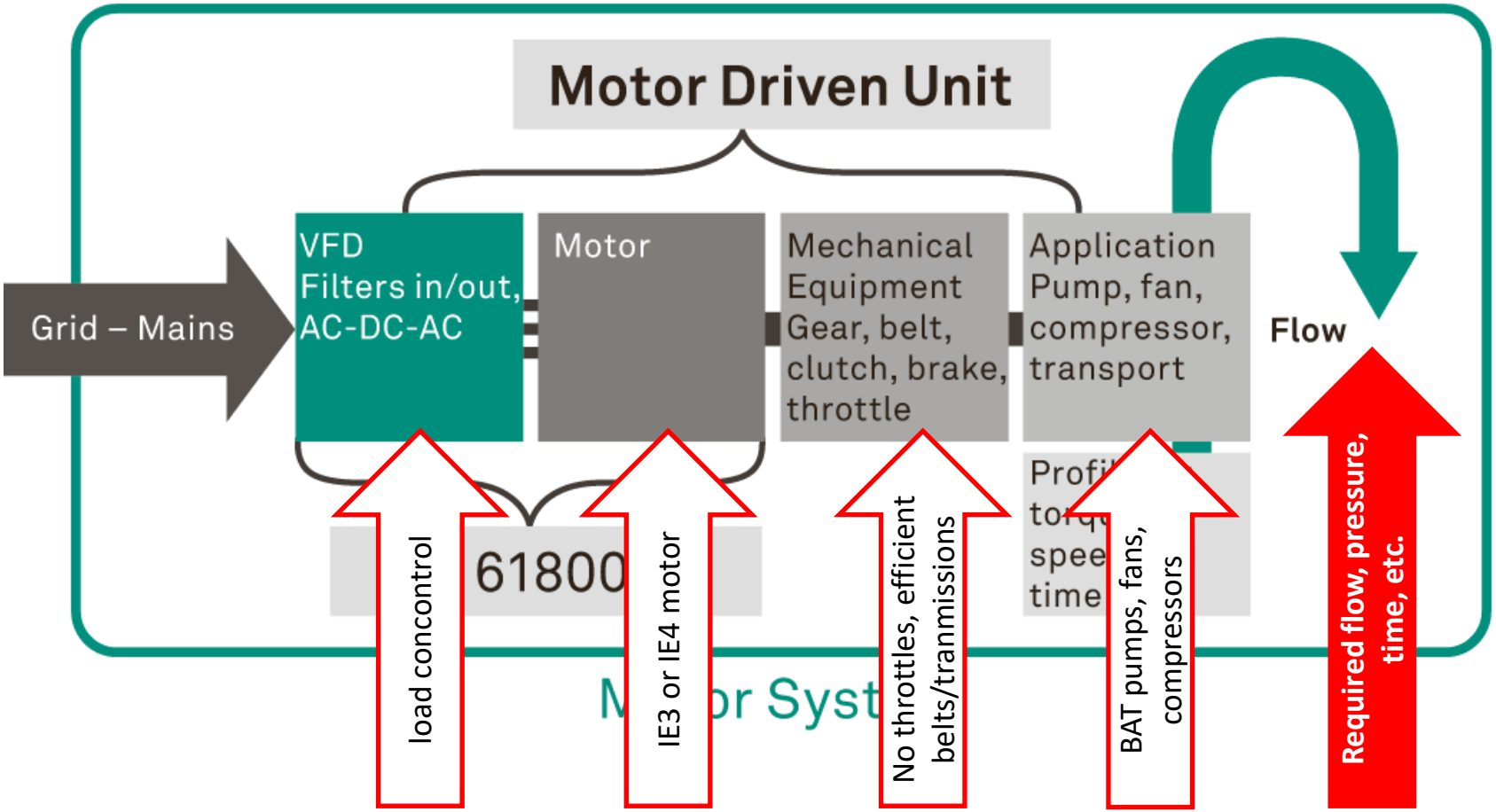
$$P_{el} = \frac{7.5\ kW}{0.881} = 8.5\ kW$$

$$P_{el} = 400\ V * 13.4\ A * 0.92 * \sqrt{3} = 8.5\ kW$$

$$\eta = \frac{P_{mech}}{P_{el}} = \frac{7.5\ kW}{8.5\ kW} = 0{,}88 = 88\%$$

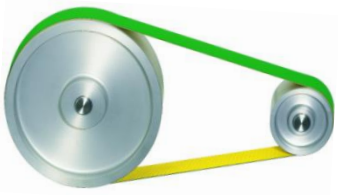
System apporach

- motors are "only" part of a drive system
- 1:1 motor replacement brings only small improvements



BAT: Best Available Technology

$\eta_{VFD} \cdot \eta_m \cdot \eta_{tr} \cdot \eta_f$ Efficient fan systems

VFD	motor	transmission	fan
			
70 … 98%	50 … 98%	80 … 100%	20 … 80%

Bilder: EUP Lot 11 und Habasit AG

VFD

nominal efficiency
96-98%

POSITIV

speed variation > regulated flow

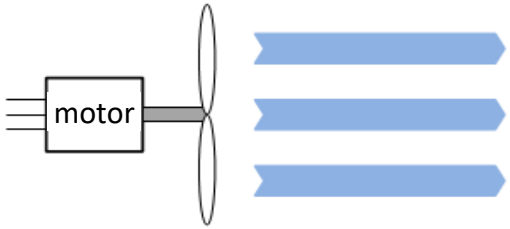
NEGATIV

additional losses: VFD & motor
low efficiency at low load
high additional costs

How to use a VFD in fan systems

nominal operation

full electic power



full cooling

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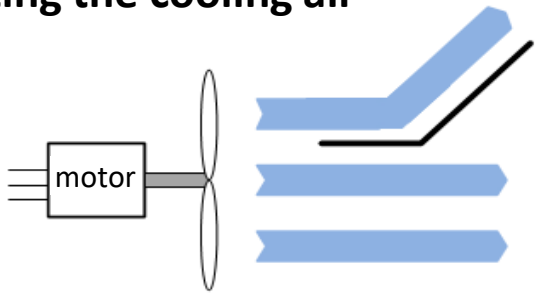
reduced cooling by diverting the cooling air

full electic power



reduced cooling

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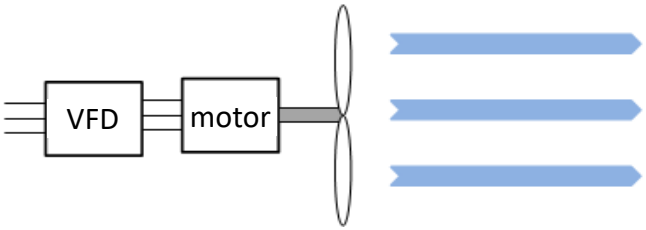
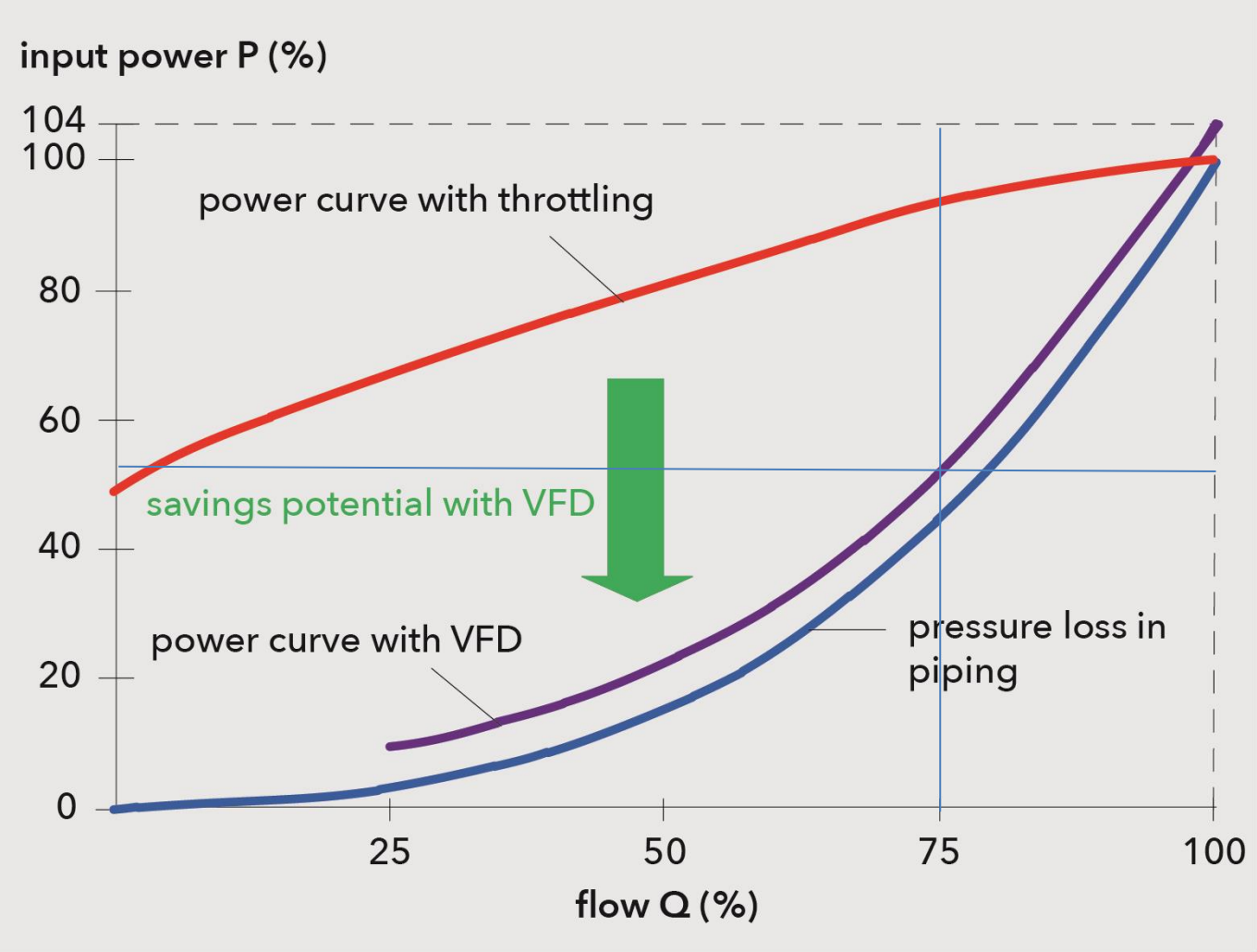
reduced cooling by reducing the speed

reduced electic power



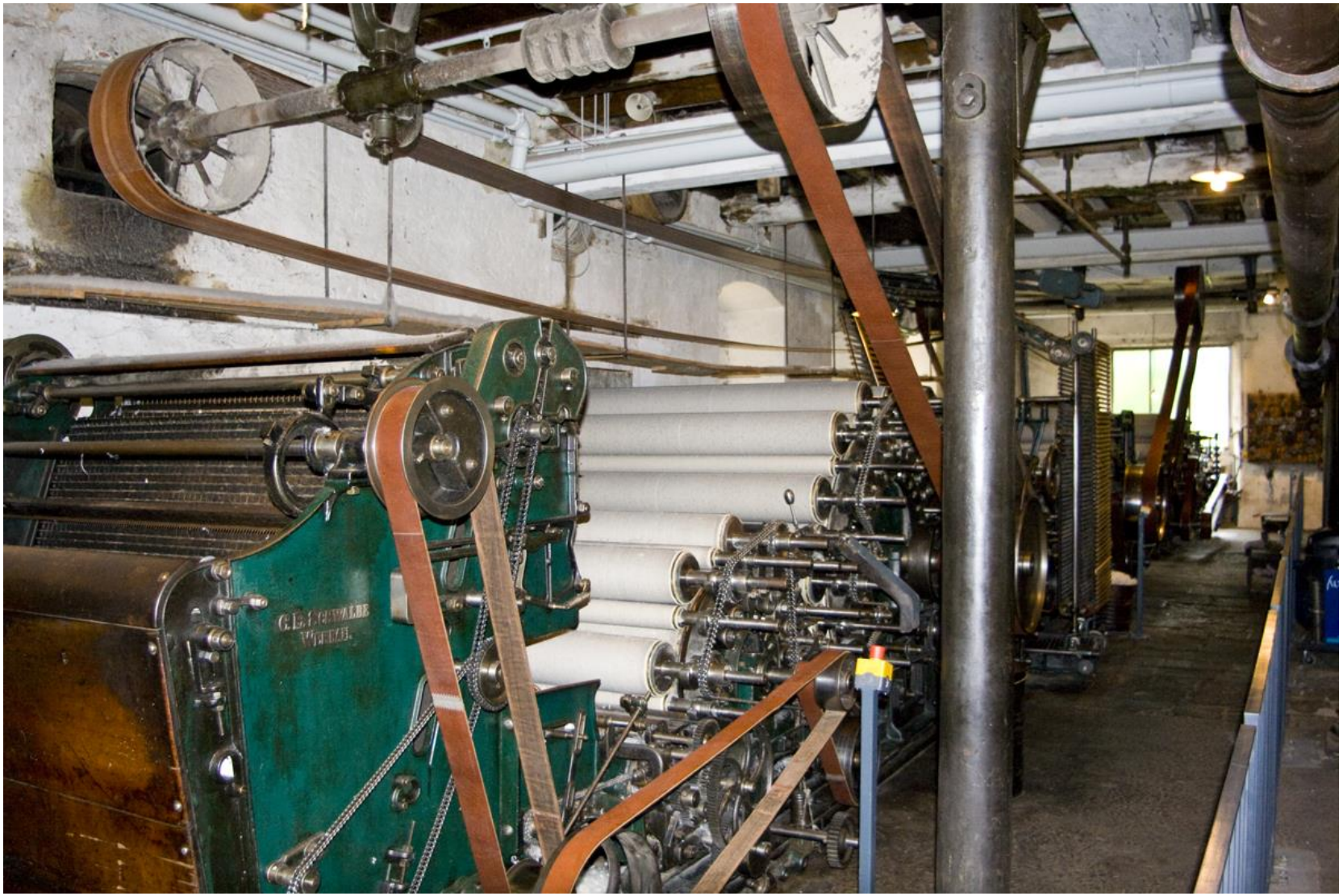
reduced cooling

Saving potential in closed systems

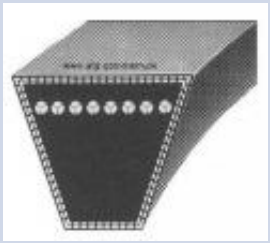
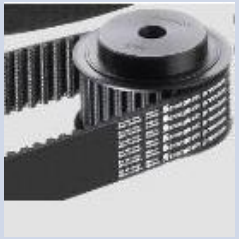


$P=Q^3$

Transmission (belts)

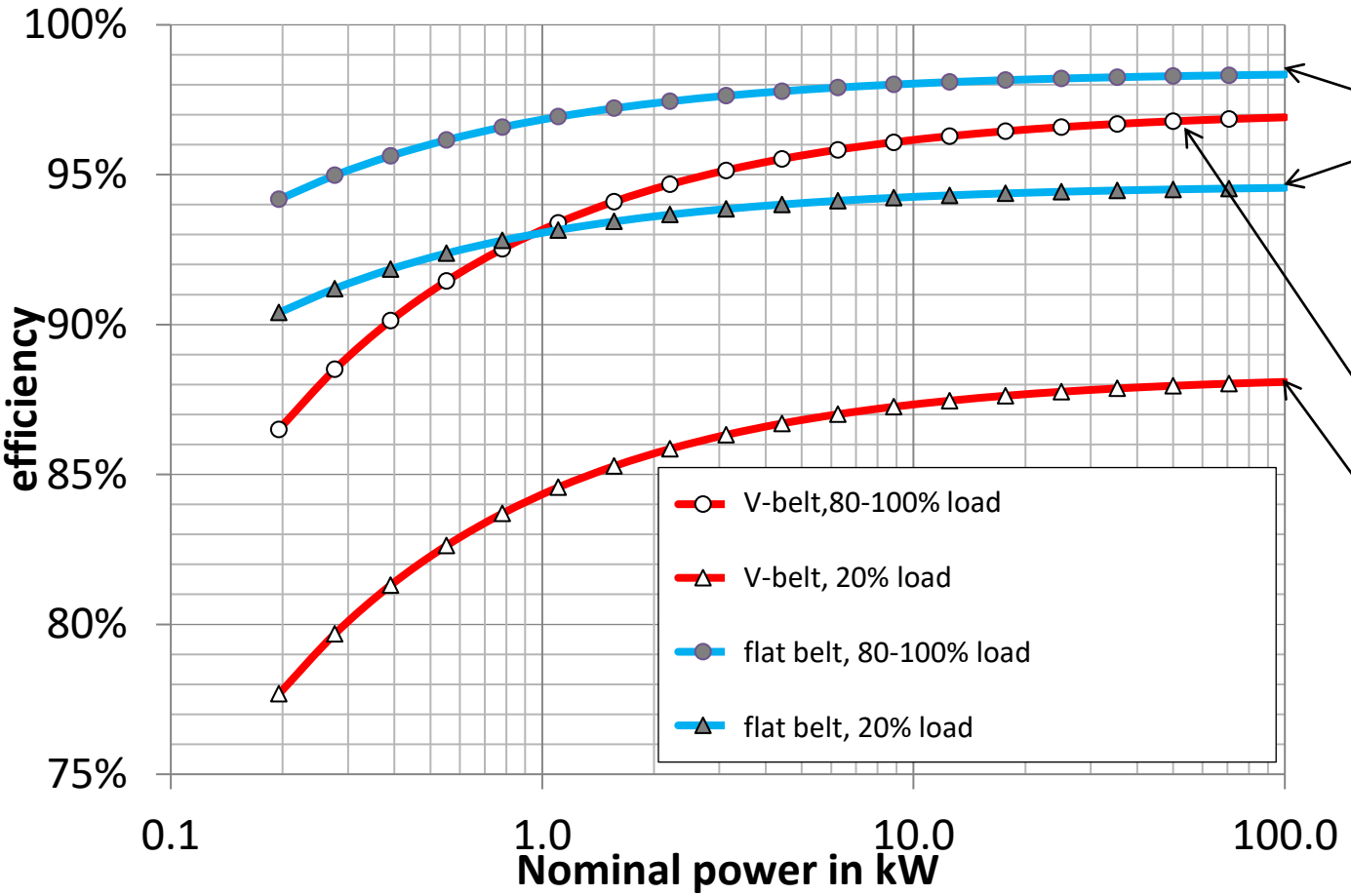


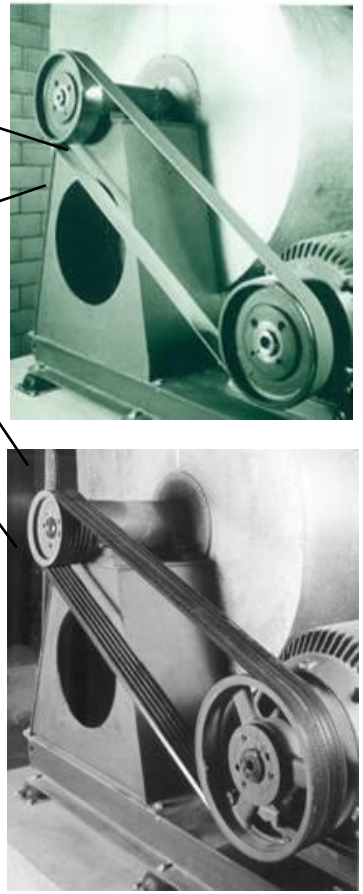
Typical transmissions

type	V-belt	flat belt	toothed belt
picture			
mounting retensioning	easy, depends on product	challenging, no retensioning	medium, no retensioning
operation Smooth operation lifetime abrasion/pollution	 restless short - lon high - low	 calm long lery low	 noisy long low
purchase price operating costs	low - medium depends on abrasion	medium low	high low

Source picture: http://keilriemen24.eu; www.polytechna.ch
Quelle: Motor Summit 2014 / Effizienteransmissionssysteme / H. Huber

Efficiency of belts (partial and nominal load)

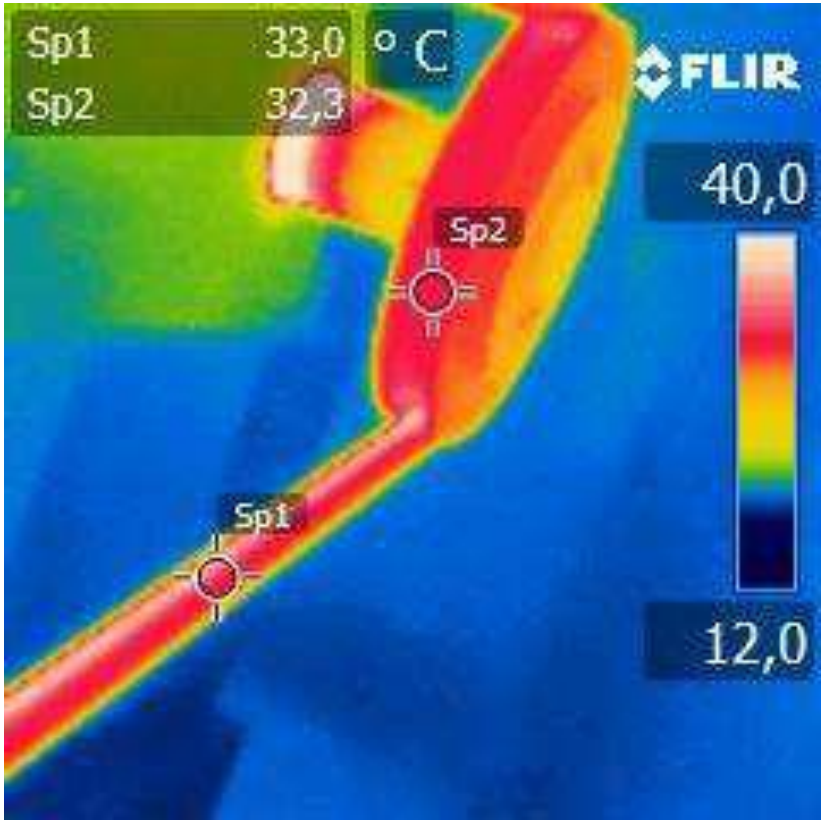




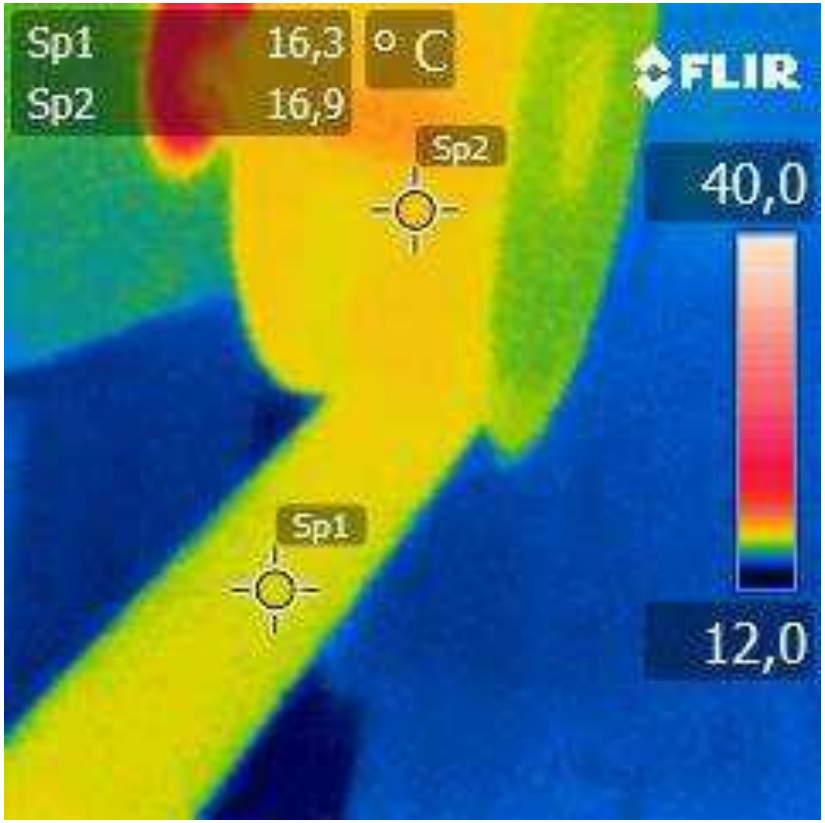
Fotos: Habasit AG

Temperatur of a V-belt and flat belt with pulley

V-belt

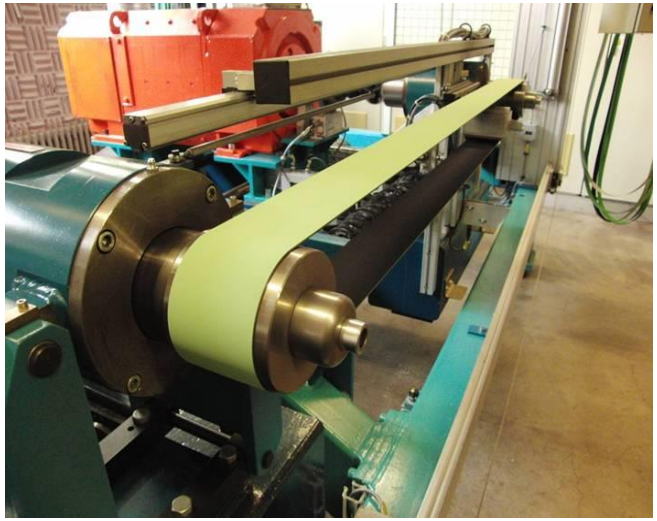


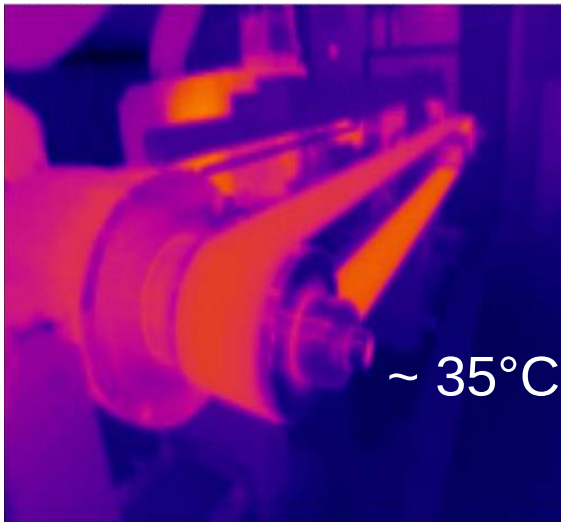
Flat belt

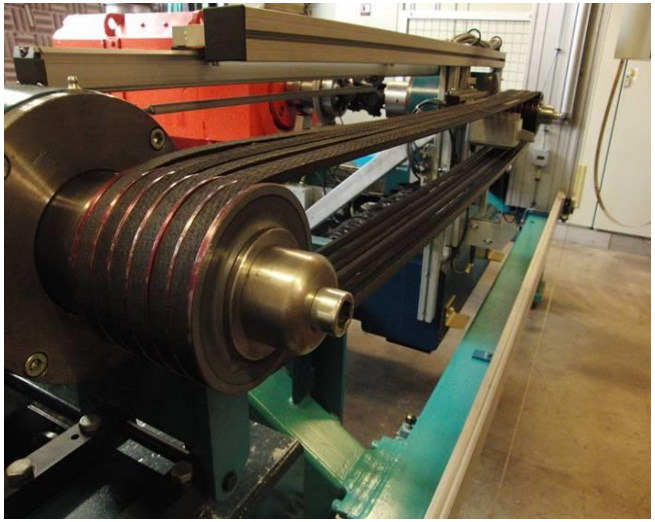


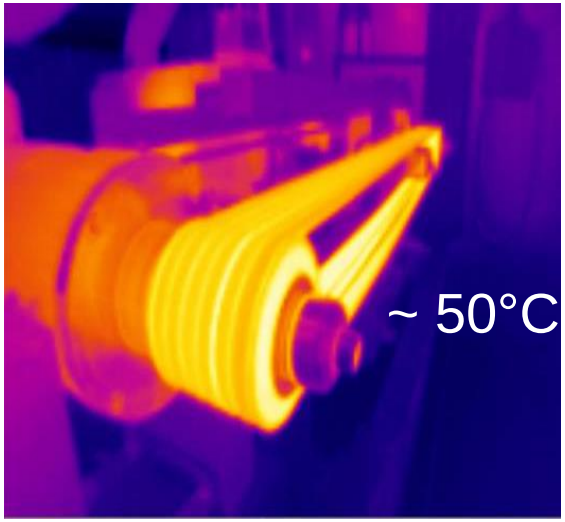
Source: Projektarbeit «Wirkungsgrad von Riemenantrieben», FHNW, Studiengang EUT 2013

Measurement Habasit AG, 2012/13



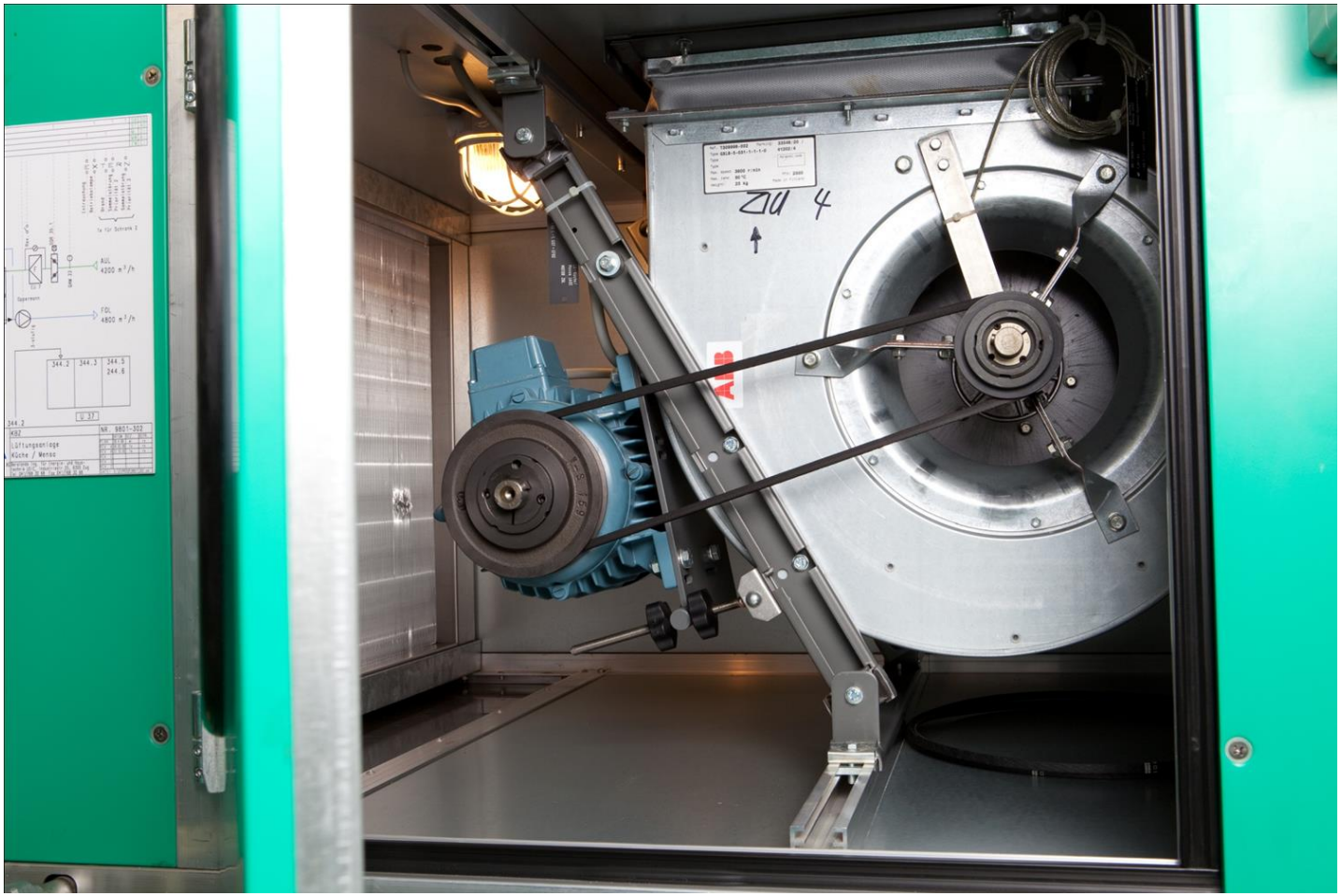






picture: Habasit AG

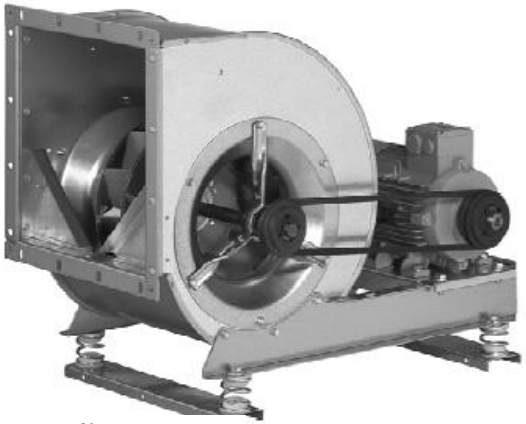
Fan system (motor + belt + fan)

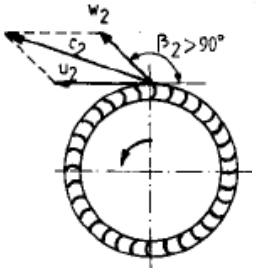


fan types

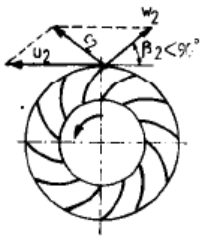
axial-fan

radial fan with spiral casing





forward curved blades

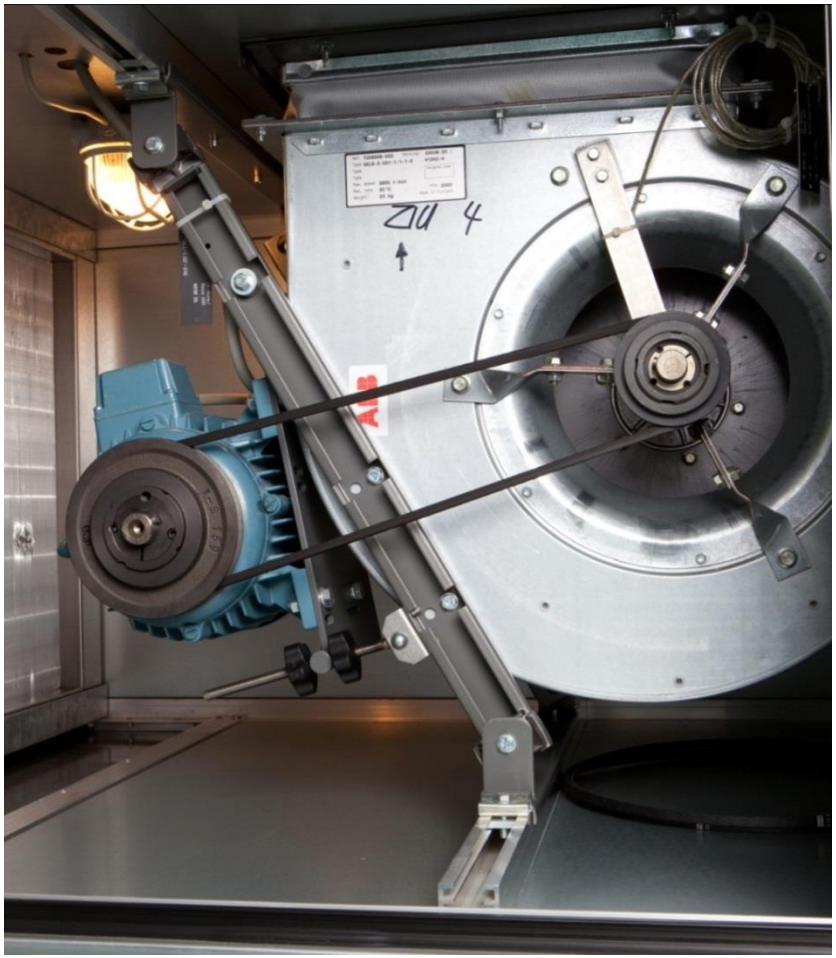


backward curved blades

radial fan with direkt drive (motor+VFD)

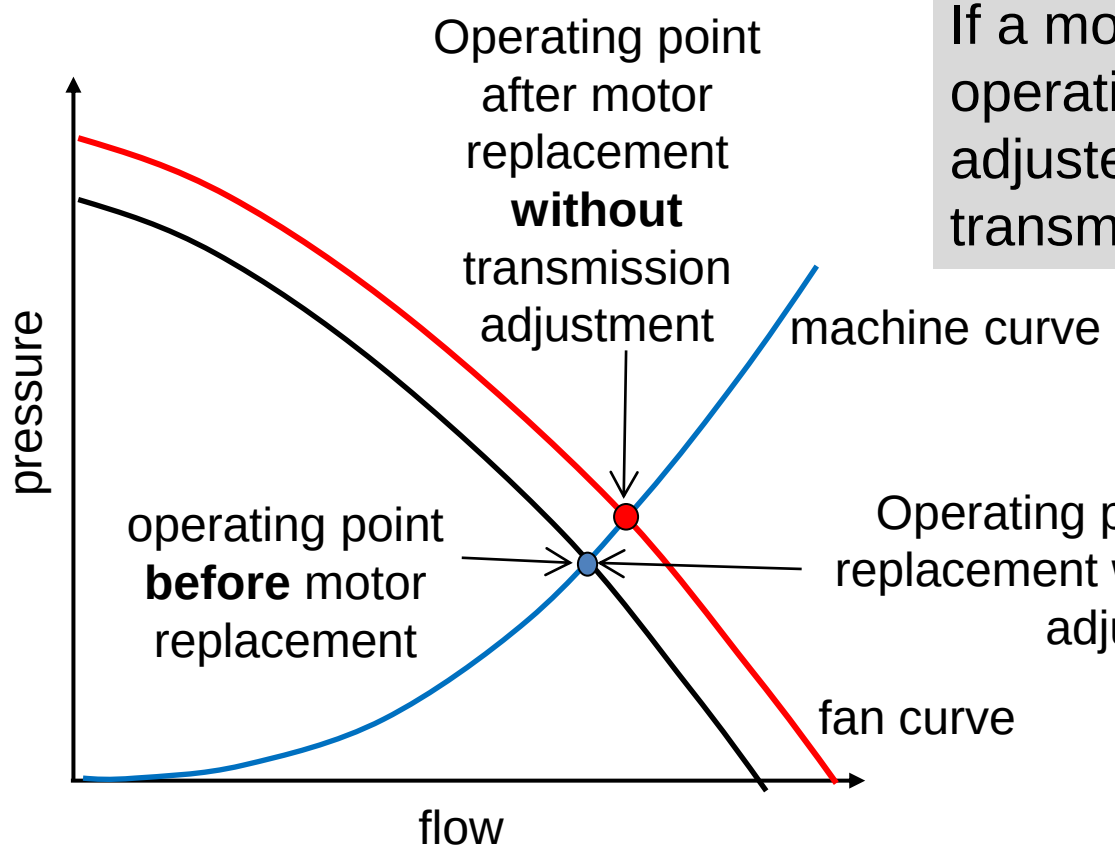
System optimisation

1. **correct volume flow**
2. conveying speed
3. channel size
4. operating hours (night?)
5. sensors in the room
6. variable volume flow



Efficient motors spin faster

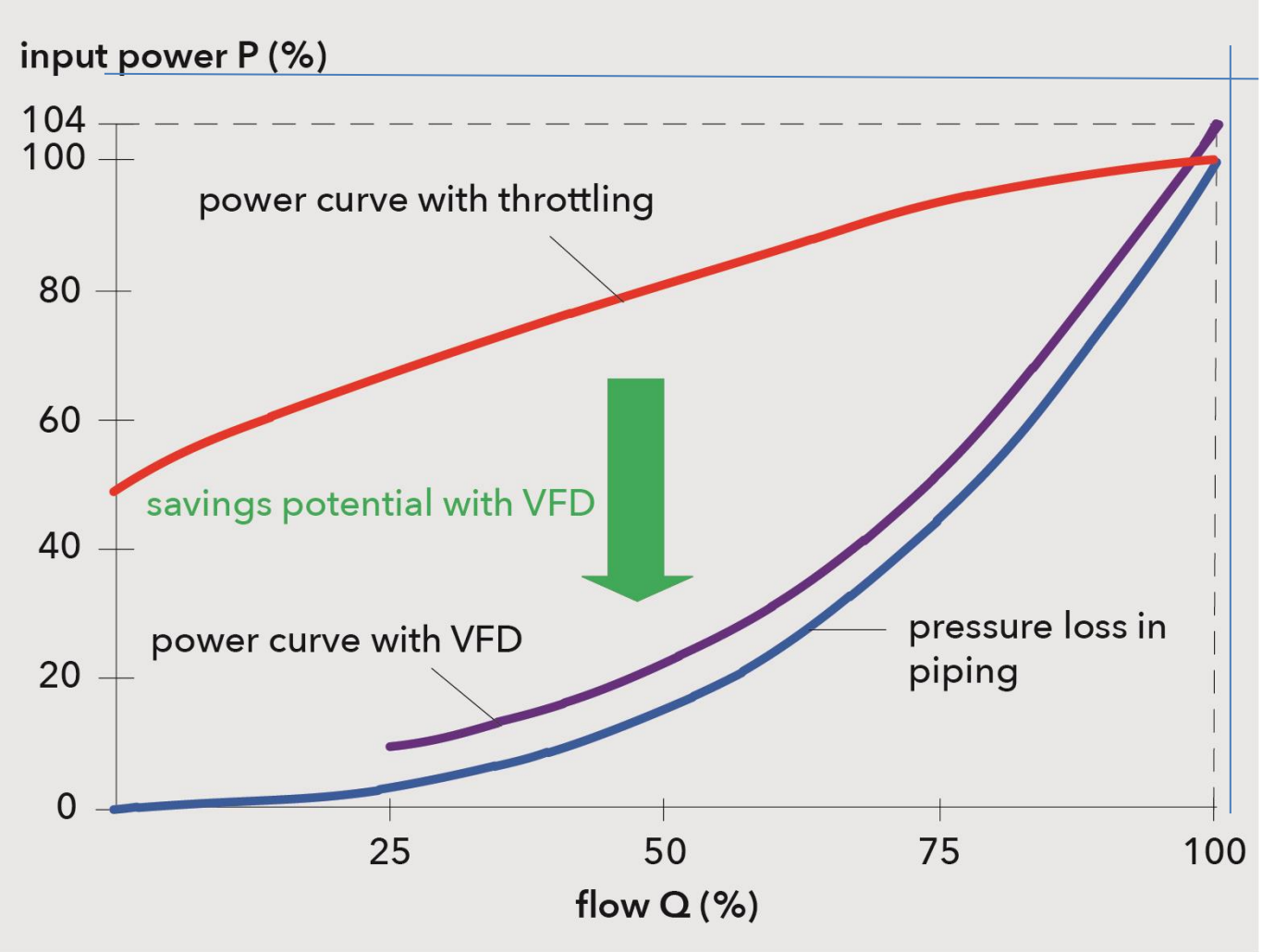
New efficient motors have a 1- 5% higher nominal speed



If a motor is replaced, the operating point must be adjusted by adapting the transmission.

3% more speed equals
9% more el. power

Reminder



$P=Q^3$

Fans

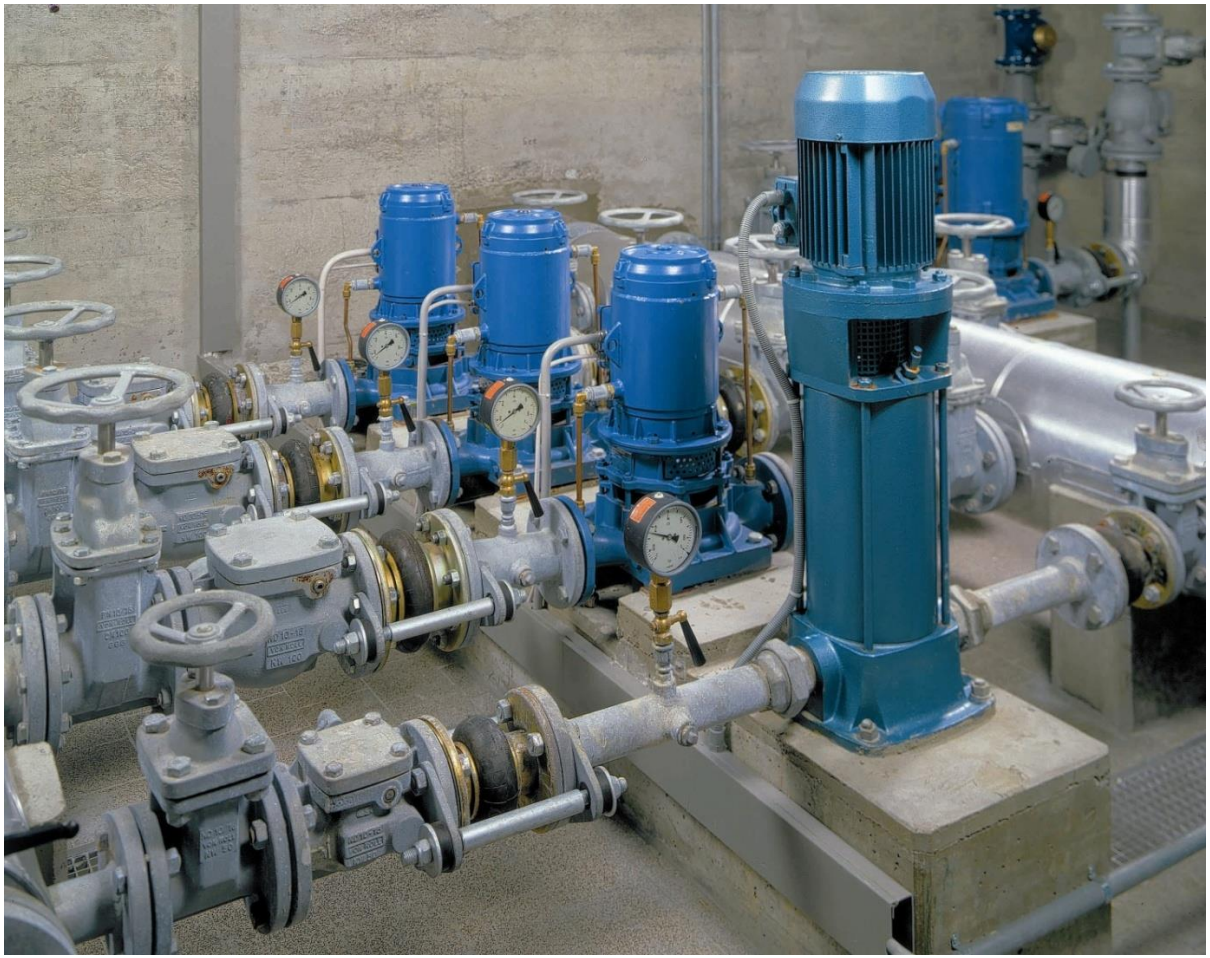
How can energy be saved?

- optimise operating hours
  - huge savings at almost no cost
- regulated operation with sensors
  - minimum required air flow
- correct sizing
  - Ideal pressure and flow
- Best Available Technology (BAT)
  - Efficient fans (e.g. EC fans), IE3 or IE4 motors

Fans

- multiple benefits:
  - less heating/cooling
  - less filter losses
  - less maintenance
  - less noise
  - better climate comfort

Pumps



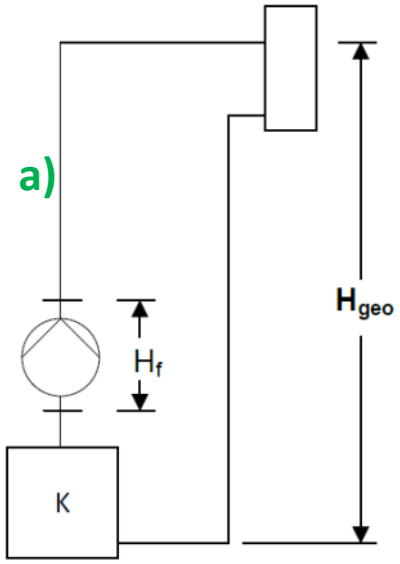
Application categories

- **circulation: circulation in closed circuits**
  - Energy is used to overcome flow losses
  - e.g. heacting/cooling
- **lifting**, to a higher geodetic level
  - Most of the energy goes into lifting
  - e.g. in water supply systems or in sewage treatment plants (lifting inflow into basins)
- **pressure increase: to higher pressure level**
  - Only "lifting work", hardly any flow losses
  - e.g. drinking water supply in high-rise buildings (often multi-stage pumps)
- **transport: moving media, mainly horizontally**
  - Mainly flow losses, but often high pressures due to viscosity
  - e.g. in the food industry, to the next process or storage facility. Also suspensions (solids in liquids)

Closed vs. open systeme

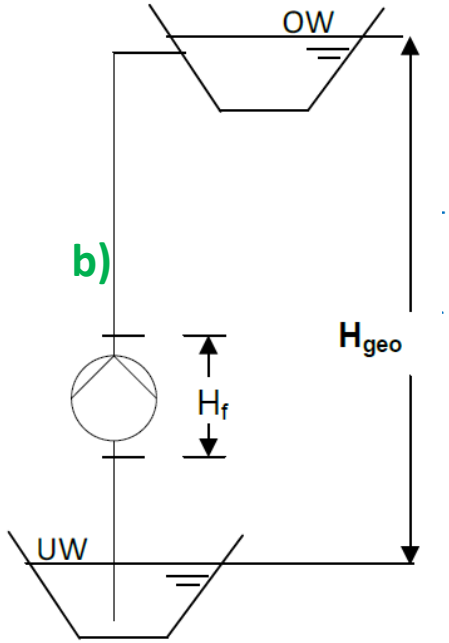
a) in closed systems:
What role does the geodetic height play?

- What determines the required head H_f?
- Pressure loss calculation: planner task
  - Pipe friction + "individual resistances»



b) in open systems:
What role does the geodetic height play?

- What determines the required head H_f?
  - Geodetic hight + flow losses



Pumps

How can you save energy?

- optimise operating hours
  - huge savings at almost no cost
- regulated operation with sensors
  - minimum required flow
- correct sizing
  - Ideal pressure and flow
- Best Available Technology (BAT)
  - Effiziente Pumpen, IE3 oder IE4 Motoren

Systematic approach

Software tools SOTEA & ILI+

Step1: SOTEA

SOTEA — Software Tool for the estimate of energy efficiency — TOPMOTORS

General

deutsch/français/english/中文	english	
Currency	USD	
Date	08.08.2019	
Company name	Example Company	
Object	Factory 1	
Supplying electricity company	"local suplier"	
ZIP code and city	1234 Industry Town	
Contact person in company	Mr. Maintenance	
Energy consultant	Mr. Smart	
Turnover	30'000'000	[USD/a]
Total number of workplaces	1.500	
Factor of office workplaces	20	[%]
Industry branch, type of plant	Mechanical Engineering	

Electricity

Annual costs of electricity	5.000.000	[USD/a]
Use of electricity	38.000.000	[kWh/a]
Average price of electricity (present)	0,132	[USD/kW
Peak electric load	11'616	[kW]
Additional own electricity production (not included in electricity bill)	☐	
Electric energy	0	[kWh/a]
Electric power	0	[kW]
Special energy users		
Electric water heating	☑	
Process heat	☑	
Electric steam production	☐	
Large computer center	☑	
Restaurant/cafeteria/canteen	☐	
When was the last major renewal of electric machinery?	2005	[Year]
When is the next general renewal planned?	4	[Years]
Production changes in future	None	
Annual budget for maintenance or renewal of motor systems	550'000	[USD/a]

Clear | Calculate

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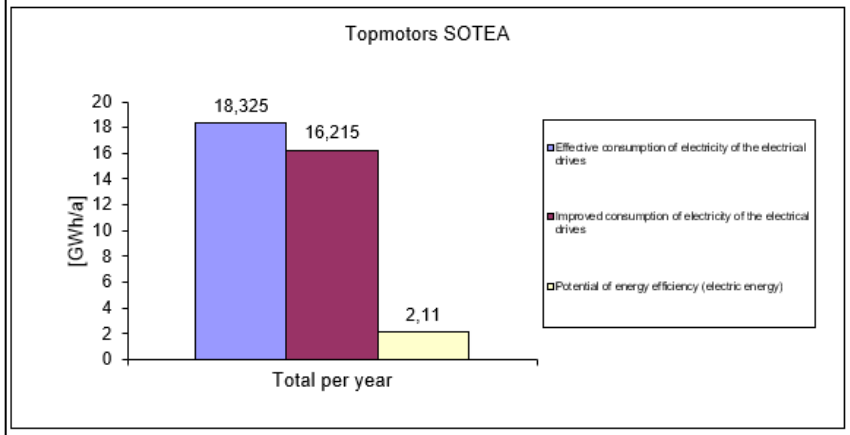
Calculations

Effective consumption of electricity of the electrical drives	18,325	[GWh/a]
Fraction of effective consumption of electricity of electrical drives	48,2	[%]
Percentage of motors to be replaced	52,0	[%]
Numbers of motors with VFD	40,0	[%]
Improved consumption of electricity of the electrical drives	16,215	[GWh/a]
Potential of energy efficiency (electric energy)	2,11	[GWh/a]
Potential of energy efficiency (Currency)	0,279	[Mio. USD/a]
Potential of energy efficiency (in percentage)	11,5	[%]
Additional investments for realisation of the potential of energy efficiency	0,156	[Mio. USD]
Payback-time for realisation of efficiency potential	0,6	[a]



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Potential assessment with SOTEA tool

- Rough initial estimate of savings potential: 1 hour in discussion with management

- inputs:
  - annual electrical consumption and costs
  - average age of the machines
  - electrical use for non-motor applications
- outputs:
  - share of electrical consumption of motors
  - rough estimate of the savings potential
  - Amount of additional investment for energy improvements

- **decision:**
  Does a systematic analysis of the motor systems make sense?

Calculation of the savings potential

actual state:

Determining the efficiency

- by age (last renewal of electric machinery)
- motor size (standard distribution
- share VFD: 20%

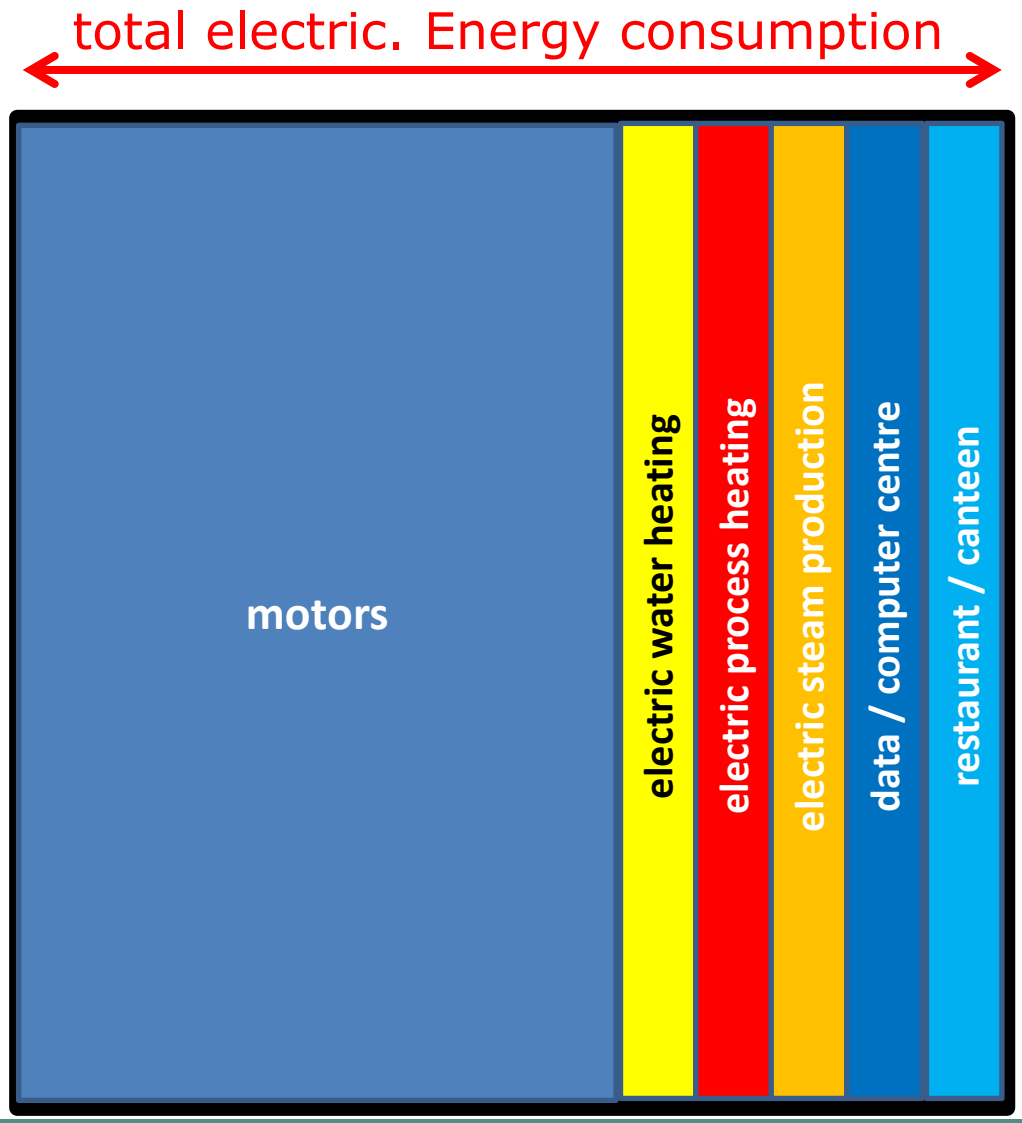
target state:

- IE4 motors
- share VFD: 60%
- Additional costs for better motors, VFD and mounting

Customize inputs

- Importat customizable values:
  - Share of „special energy users“
  - Share of VFD (before/after)

- „special energy users“
  - electric water heating
  - electric process heating
  - electric steam production
  - data/computer centre
  - restaurant/canteen



Step 1: SOTEA

SOTEA

Software Tool for the estimate of energy efficiency

TOPMOTORS

General

deutsch/français/english/中文	english	
Currency	USD	
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Step 1: SOTEA

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Special energy users		
Electric water heating	☑	
Process heat	☑	
Electric steam production	☐	
Large computer center	☑	
Restaurant/cafeteria/canteen	☐	
When was the last major renewal of electric machinery?	2005	[Year]
When is the next general renewal planned?	4	[Years]
Production changes in future	None	
Annual budget for maintenance or renewal of motor systems	550'000	[USD/a]

Clear Calculate

Step 1: SOTEA results

SOTEA Result

TOPMOTORS

Input record

General

Date	08.08.2019	
Company name	Example Company	
Factory name	Factory 1	
Power utility name	"local suplier"	
Zip code and city	1234 Industry Town	
Contact person in factory	Mr. Maintenance	
Energy consultant	Mr. Smart	
Turnover	30'000'000	[USD/a]
Total number of workplaces	1.500	
Factor of office workplaces	20	[%]
Industry branch, type of plant	Mechanical Engineering	

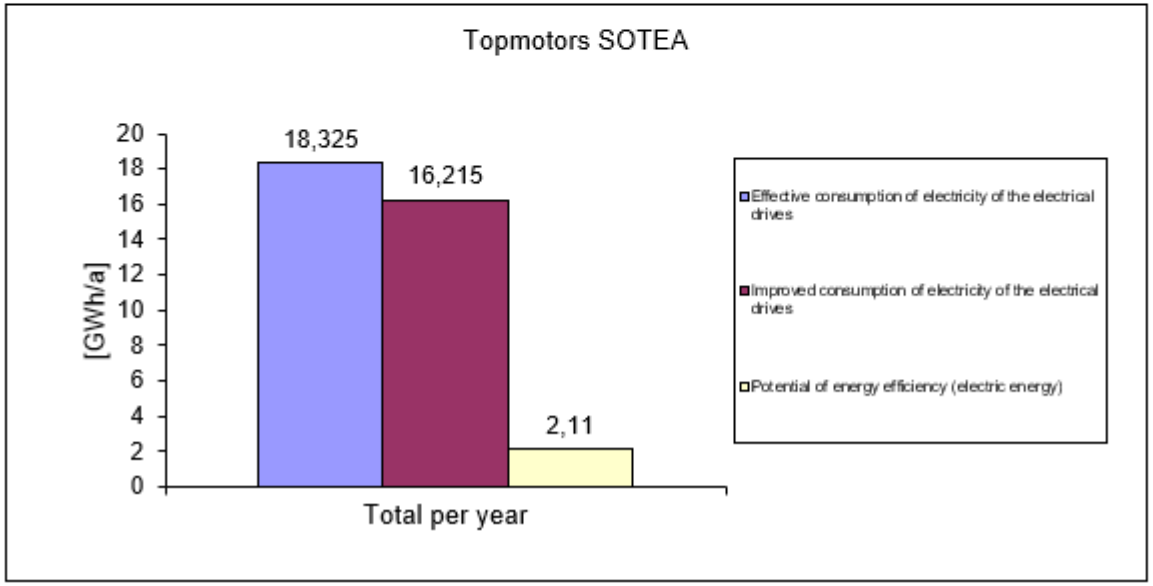
Electricity

Annual costs of electricity	5.000.000	[USD/a]
Consumption of electricity	38.000.000	[kWh/a]
Average price of electricity (present)	0,132	[USD/kWh]
Peak electric load	11'616	[kW]
Additional own electricity production (not included in electricity bill)	none	
Electric energy		[kWh/a]
Electric power		[kW]
Total consumption of electricity (incl. own production)	38.000.000	[kWh/a]
Special energy users	Electric water heating, Process heat, Large computer center	
When was the last major renewal of electric machinery?	2005	[Year]
When is the next general renewal planned?	4	[Years]
Production changes in future?	None	
Annual budget for maintenance or renewal of motor systems	550'000	[USD/a]

Step 1: SOTEA

Calculations

Effective consumption of electricity of the electrical drives	18,325	[GWh/a]
Fraction of effective consumption of electricity of electrical drives	48,2	[%]
Percentage of motors to be replaced	52,0	[%]
Numbers of motors with VFD	40,0	[%]
Improved consumption of electricity of the electrical drives	16,215	[GWh/a]
Potential of energy efficiency (electric energy)	2,11	[GWh/a]
Potential of energy efficiency (Currency)	0,279	[Mio. USD/a]
Potential of energy efficiency (in percentage)	11,5	[%]
Additional investments for realisation of the potential of energy efficiency	0,156	[Mio. USD]
Payback-time for realisation of efficiency potential	0,6	[a]



User estimates

Special factory data

Currencies

Currency (ISO-Code)	Exchange rate to CHF
CHF	1,00
EUR	0,82
USD	1,14
JPY	116,50
CNY	7,12

Discount rate

Discount rate compared to Swiss consumer price level	1

Constants

Constant	Default value	Used value
Electric energy use per office workplace and per employee [kWh/a]	250	250
Electric energy use for lighting per employee [kWh/a]	400	400

Fraction of special users of total consumption

Special users	Default value	Used value
Electric water heating [%]	5	5
Process heat (if relevant also include electrolysis, galvanic processes, others) [%]	30	30
Electric steam production [%]	5	5
Large computer data center (without AC) [%]	15	15
Restaurant/cafeteria/canteen (without AC) [%]	15	15

Replacement of existing motors

Fraction of replacement	Default value	Used value
Motors less than 5 years old [%]	0	0
Motors 5 years old [%]	20	20
Motors 10 years old [%]	40	40
Motors 20 years old [%]	60	60
Motors more than 25 years old [%]	80	80

Consideration of VFD

Use of VFD (Variable Frequency Drive)

Assumptions on VFD use	Default value	Used value
VFD use today [%]	20	20
Efficiency improvement with existing VFD []*	0,8	0,8
VFD use with new motors [%]	60	60
Efficiency improvement with new VFD []*	0,7	0,7

Payback calculation

Reduced motor costs	Default value	Used value
IE1 compared to IE4** [%]	30	30

Step2: ILI+

Software tool for the systematic assessment and energetic evaluation of all drives of a company

inputs:

- Nominal data of the motors
- age
- Operating hours
- VFD present (yes/no)

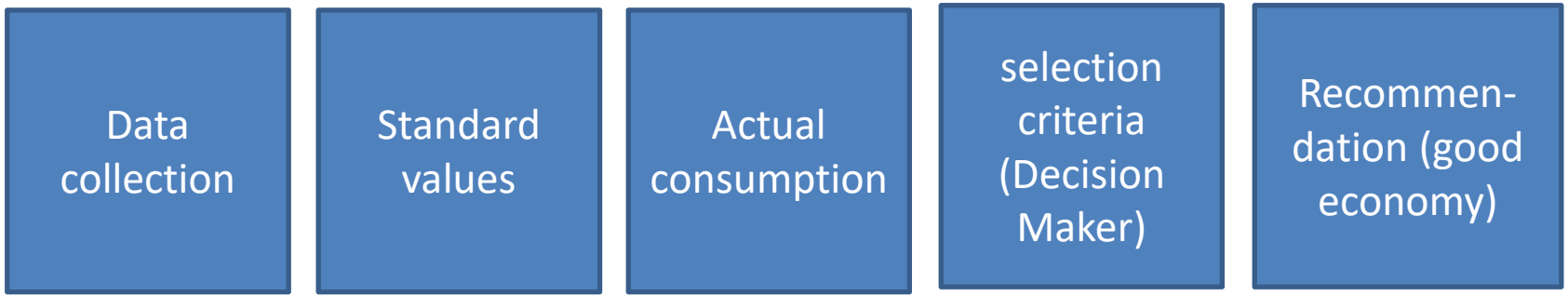
calculation:

- estimates the load factor according to nominal power
- defines efficiency of the motor according to age
- calculates the actual annual consumption
- calculates a possible savings potential through motor replacement

output:

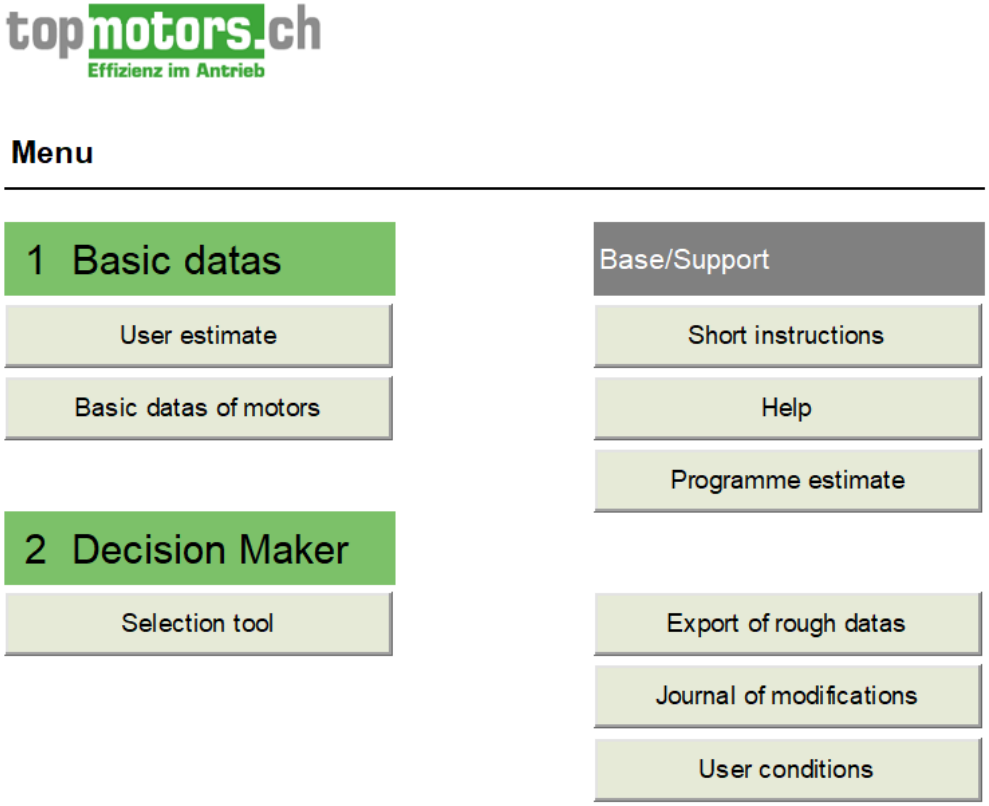
- Identification of the biggest savings potentials
- Criteria for selecting the most economical improvement measures:
  - age
  - Operating hours
  - VFD present
  - nominal power

Structure and analysis of the motor list



ILI+: Language selection

ILI+: Menu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Menu
1 Basic datas
User estimate
Basic datas of motors
2 Decision Maker
Selection tool
Base/Support
Short instructions
Help
Programme estimate
Export of rough datas
Journal of modifications
User conditions
ILI Plus 2.0 | © topmotors | 2014

ILI+: User estimates

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back to menu

User estimate

Indications about the company

Firm*	Example Company
Factory	Factory 1
Building	Building 1
Examined installation	Produktionline 1
company*	Mr. Company
Energy consultant*	Mr. Expert
Date of work amendments*	12.03.2015
Currency*	USD

Indications about energy use

Total use of electricity*	2.500	[MWh/a]
Total costs electricity*	375.000	[USD/a]

Constants

Description	Unit	Energy cost
Energy price per kWh*	USD	0,15

Currencies

Currency (ISO-Code)
CHF
EUR
USD
JPY
CNY

Apply

Please note

*Entry is compulsory, all entries must be confirmed by Return-button.

ILI+: Data base of motors

Data base of motors

Fixation row on/off

Column on/off

Example row on/off

Basic information

No.	Type of plant	Type of motor	Manufacturer	No. of identi-fication	Year of construc-tion	Age	Operating hours	Application
						[a]		
1	Example Plant 1	Motor 1	Manufacturer a	No 1	1970	51	8000	Pump
2	Example Plant 2	Motor 2	Manufacturer b	No 2	1982	39	5000	Pump
3	Example Plant 3	Motor 3	Manufacturer c	No 3	1982	39	4000	Pump
4	Example Plant 4	Motor 4	Manufacturer a	No 4	1982	39	1500	Ventilator
6	Example Plant 5	Motor 5	Manufacturer b	No 5	1975	46	1500	Ventilator
7	Example Plant 6	Motor 6	Manufacturer c	No 6	1995	26	1500	Ventilator
8	Example Plant 7	Motor 7	Manufacturer a	No 7	1995	26	4000	Compressor air compr.
9	Example Plant 8	Motor 8	Manufacturer b	No 8	1982	39	4000	Compressor air compr.
10	Example Plant 9	Motor 9	Manufacturer c	No 9	1982	39	8000	Compressor air compr.
11	Example Plant 10	Motor 10	Manufacturer a	No 10	1992	29	1500	Compressor cold
12	Example Plant 11	Motor 11	Manufacturer b	No 11	1992	29	1500	Compressor air compr.
13	Example Plant 12	Motor 12	Manufacturer c	No 12	1992	29	1500	Compressor cold
14	Example Plant 13	Motor 13	Manufacturer a	No 13	1978	43	2000	Pump
15	Example Plant 14	Motor 14	Manufacturer b	No 14	1988	33	2000	Pump

ILI+: Data base of motors

Validate

						Display				
FC available	Mechanical nominal power	Loading factor, estimated	Loading factor, measured	No. of poles	Efficiency class	Consumption EFFECTIVE	Consumption DESIGNATED	Potential of reduction	Potential of reduction	Potential of reduction
	[kW]	[%]	[%]			[kWh/a]	[kWh/a]	[kWh/a]	[kWh/LC]	[USD/LC]
no	150	71		4		936.425	890.758	45.667	913.336	137.000
no	210	71		4		815.912	777.943	37.969	759.380	113.907
no	90	69		4		276.399	261.297	15.103	286.804	43.021
no	4	53		4		4.250	3.639	611	6.296	944
no	5,5	55		4		5.874	5.117	756	7.909	1.186
no	4	53		4		4.160	3.639	521	5.367	805
no	90	69		4		274.280	261.297	12.983	246.546	36.982
no	12	60		4		34.878	31.431	3.448	38.308	5.746
no	370	73		4		2.360.122	2.250.292	109.830	2.196.598	329.490
no	4	53		4		4.160	3.639	521	5.367	805
no	4	53		4		4.160	3.639	521	5.367	805
no	4	53		4		4.160	3.639	521	5.367	805
no	55	65		4		80.904	75.888	5.015	77.509	11.626
no	55	65		4		80.197	75.888	4.309	66.588	9.988

ILI+: Data base of motors

Filter on/off | Export

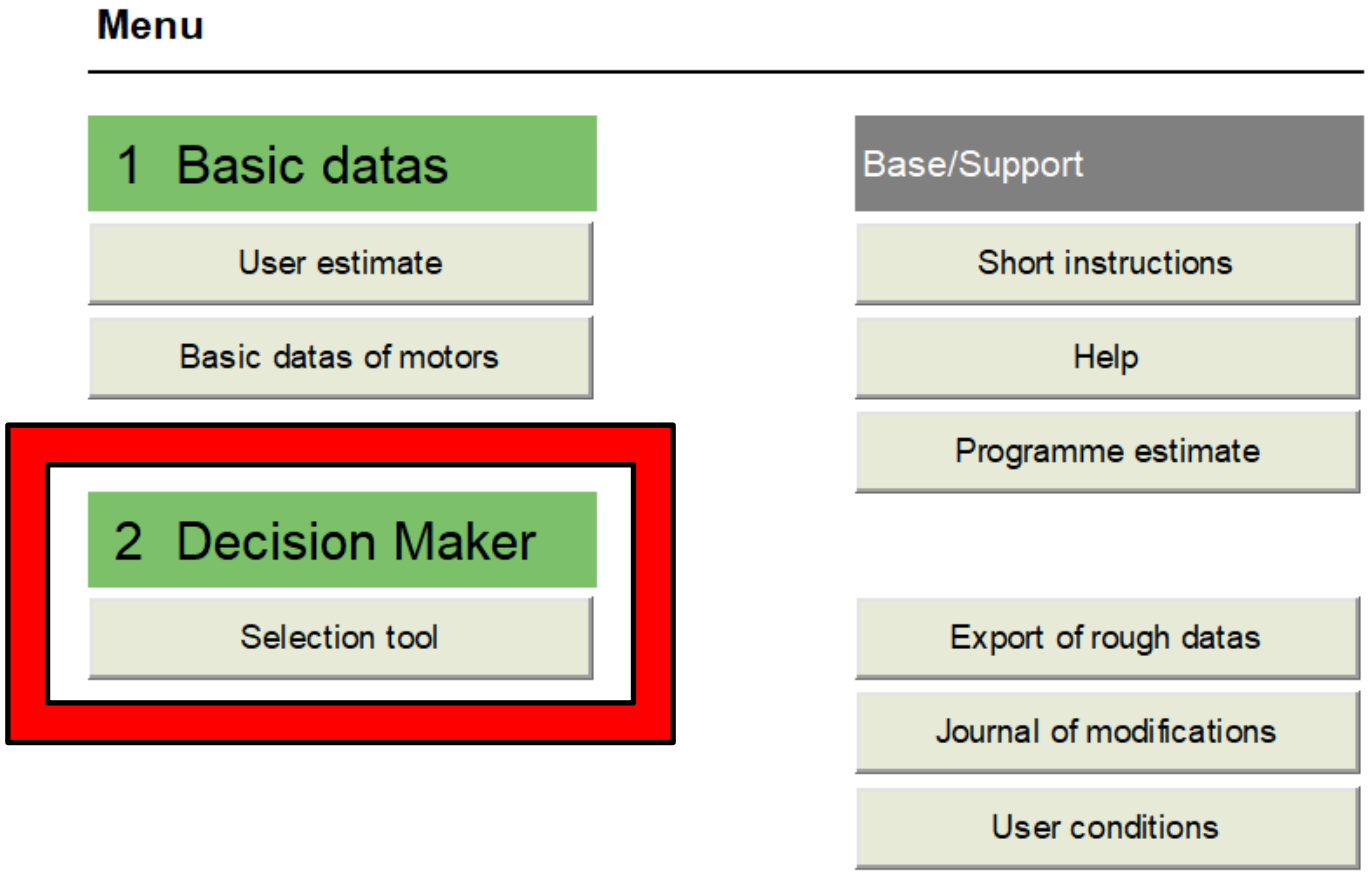
Sum/Average | Summary

Result decision maker according to criterias							Motor selection	Total additions (if yes)			Average values (if yes)		
Maximal saving potential	Age	Operating hours	Dimension of motors	Motors without FC	Appli-cations	Number of conformin g criterias	yes/no selection by double click	Number	Mechanical nominal power [kW]	Potential of reduction [kWh/a]	Age [a]	Operating hours	Mechanical nominal power [kW]
								9	1.712	451.191	42	6.333	190
						6	yes						
						6	yes						
						5							
						3							
						3							
						3							
						5							
						5	yes						
						6	yes						
						3							
						3							
						3							
						5							
						5							
						5							
						3							
						3							
						6	yes						
						6	yes						
						5	yes						
						3							

ILI+: Decision Maker

- Evaluates the data of ILI+
- identifies the greatest savings potentials
- Compares motor data with selected criteria
- Marks fulfilled criteria in colour
- Sums up the fulfilled criteria
- Sums up the potential savings of the selected motors

ILI+: Decision Maker



Decision Maker: criteria

Potential of reduction according to criteria

Criteria		Default values	My values	Number of motors		Potential of reduction of energy		Potential of reduction of costs	
				absolute	in %	[kWh/a]	[kWh/LC]	[USD/a]	[USD/LC]
(1) Rate of realisation of the maximal saving potential in %		50	80	7	21%	440.193	8.803.840	66.029	1.320.576
(2) Age, older than x years		15	20	34	100%	523.620	10.164.685	78.543	1.524.703
(3) Operating hours per year > x Stunden		3000	1800	17	50%	511.079	10.018.350	76.662	1.502.753
(4) Dimension of motors > x kW		10	10	18	53%	514.310	10.068.291	77.147	1.510.244
(5) Motors without FC (frequency converter)		yes	yes	34	100%	523.620	10.164.685	78.543	1.524.703
(6) Application	Pump	yes	yes	12	35%	268.280	5.228.660	40.242	784.299
	Ventilator	yes	yes	6	18%	3.776	39.144	566	5.872
	Compressor air compr.	yes	yes	10	29%	248.276	4.862.889	37.241	729.433
	Compressor cold	yes	yes	4	12%	2.084	21.468	313	3.220
	Mechanical conveyor	yes	yes	2	6%	1.204	12.524	181	1.879
	Others	yes	yes	0	0%	0	0	0	0

Calculate

Display

- Goal: Identify motors for optimization
- 20% of motors save 80% of the efficiency potential

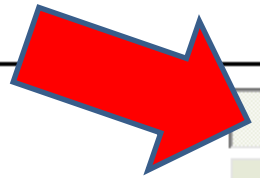
Decision Maker: fulfilled criteria

Filter on/off

Sum/Average

	Result decision maker according to criterias							Motor selection	Tota
Potential of reduction	Maximal saving potential	Age	Operating hours	Dimension of motors	Motors without FC	Appli-cations	Number of conformin g criterias	yes/no selection by double click	Num
[USD/LC]									
137.000							6	yes	
113.907							6	yes	
43.021							5		
944							3		
1.186							3		
805							3		
36.982							5		
5.746							5	yes	
329.490							6	yes	
805							3		
805							3		
805							3		
11.626							5		
9.988							5		
11.626							5		
939							3		
939							3		
137.000							6	yes	
136.688							6	yes	
21.510							5	yes	
944							3		

Decision Maker: Filter on/off

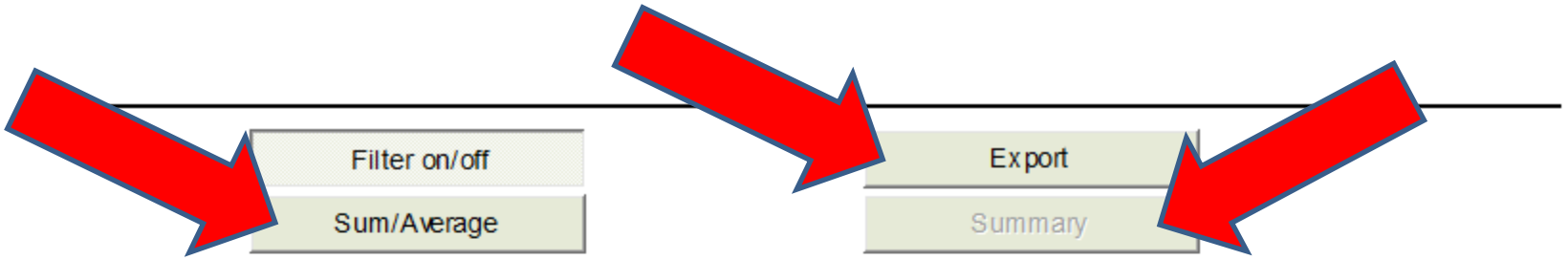


Filter on/off

Sum/Average

	Result decision maker according to criterias							Motor selection	Tota
Potential of reduction	Maximal saving potential	Age	Operating hours	Dimension of motors	Motors without FC	Appli-cations	Number of conformin g criterias	yes/no selection by double click	Num
[USD/LC]									
137.000							6	yes	
113.907							6	yes	
5.746							5	yes	
329.490							6	yes	
137.000							6	yes	
136.688							6	yes	
21.510							5	yes	

Decision Maker: Sum/Average



	Motor selection	Total additions (if yes)			Average values (if yes)		
Number of conforming criterias	yes/no selection by double click	Number	Mechanical nominal power [kW]	Potential of reduction [kWh/a]	Age [a]	Operating hours	Mechanical nominal power [kW]
		7	1.192	295.694	42	5.857	170
6	yes						
6	yes						
5	yes						
6	yes						
6	yes						
6	yes						
5	yes						

Motor Systems Tool

Motor Systems Tool

The Motor Systems Tool

Version 4.20.02 (September 2021)

The Motor Systems Tool is an independent calculator for complete motor systems that utilizes impartial models of standardized components, to determine the efficiency at any given duty point on a complete motor system. It is intended for engineers, machine builders, energy consultants and others interested in motor systems optimization.

It consists of a full motor system from power supply to application. From one known duty point all partials are calculated as well as the total system efficiency. Any change in speed, load or components is calculated dynamically and results are presented instantly.

The Motor Systems Tool is developed continuously. The Motor Systems Tool is developed on a LabVIEW platform and runs on Microsoft Windows. The latest version can be downloaded here:

DOWNLOAD V 4.20.02

International Standards
Testing
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- WEBINAR ON HOW TO USE THE MOTOR SYSTEMS TOOL
- WEBINAR SLIDES
- MOTOR SYSTEMS TOOL, EXAMPLE 1
- MOTOR SYSTEMS TOOL, EXAMPLE 2
- MOTOR SYSTEMS TOOL, SOLUTION EXAMPLE 2
- MOTOR SYSTEMS TOOL QUICKGUIDE

- Free download: www.iea-4e.org/emsa/our-work/emsa-tools/

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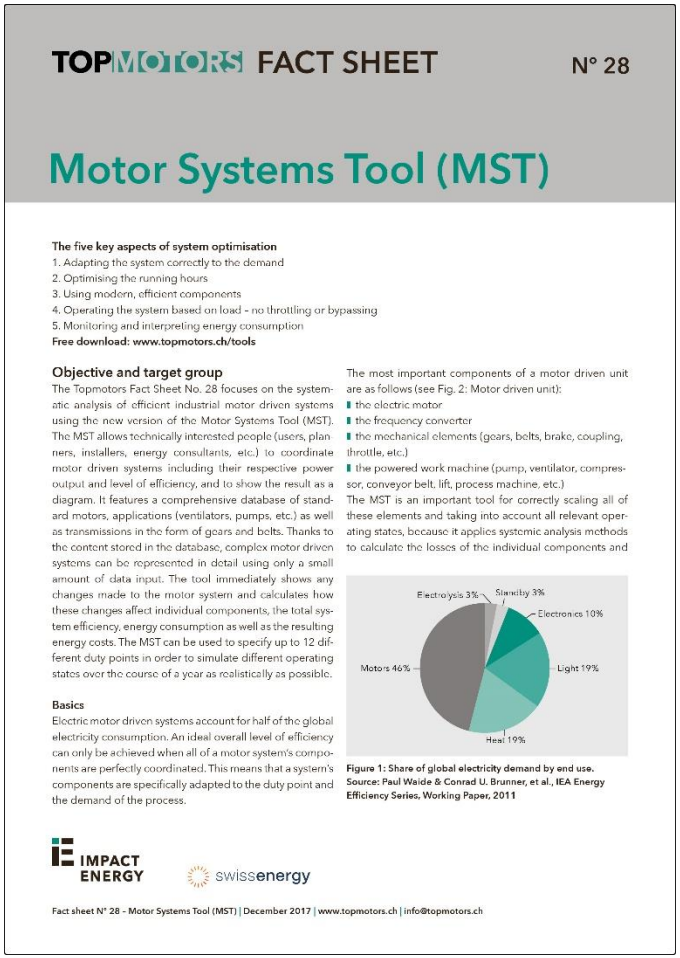

TOPMOTORS FACT SHEET N° 28

Motor Systems Tool (MST)

The five key aspects of system optimisation
1. Adapting the system correctly to the demand
2. Optimising the running hours
3. Using modern, efficient components
4. Operating the system based on load – no throttling or bypassing
5. Monitoring and interpreting energy consumption

Free download: www.topmotors.ch/tools

Objective and target group

The Topmotors Fact Sheet No. 28 focuses on the systematic analysis of efficient industrial motor driven systems using the new version of the Motor Systems Tool (MST). The MST allows technically interested people (users, planners, installers, energy consultants, etc.) to coordinate motor driven systems including their respective power output and level of efficiency, and to show the result as a diagram. It features a comprehensive database of standard motors, applications (ventilators, pumps, etc.) as well as transmissions in the form of gears and belts. Thanks to the content stored in the database, complex motor driven systems can be represented in detail using only a small amount of data input. The tool immediately shows any changes made to the motor system and calculates how these changes affect individual components, the total system efficiency, energy consumption as well as the resulting energy costs. The MST can be used to specify up to 12 different duty points in order to simulate different operating states over the course of a year as realistically as possible.

Basics

Electric motor driven systems account for half of the global electricity consumption. An ideal overall level of efficiency can only be achieved when all of a motor system's components are perfectly coordinated. This means that a system's components are specifically adapted to the duty point and the demand of the process.

The most important components of a motor driven unit are as follows (see Fig. 2: Motor driven unit):
- the electric motor
- the frequency converter
- the mechanical elements (gears, belts, brake, coupling, throttle, etc.)
- the powered work machine (pump, ventilator, compressor, conveyor belt, lift, process machine, etc.)

The MST is an important tool for correctly scaling all of these elements and taking into account all relevant operating states, because it applies systemic analysis methods to calculate the losses of the individual components and

Figure 1: Share of global electricity demand by end use. Source: Paul Waide & Conrad U. Brunner, et al., IEA Energy Efficiency Series, Working Paper, 2011

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Fact sheet N° 28 - Motor Systems Tool (MST) | December 2017 | www.topmotors.ch | info@topmotors.ch

- 10 page «guided example»

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Thanks for your attention

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