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ENERGY EFFICIENCY IN FLOUR MILLS

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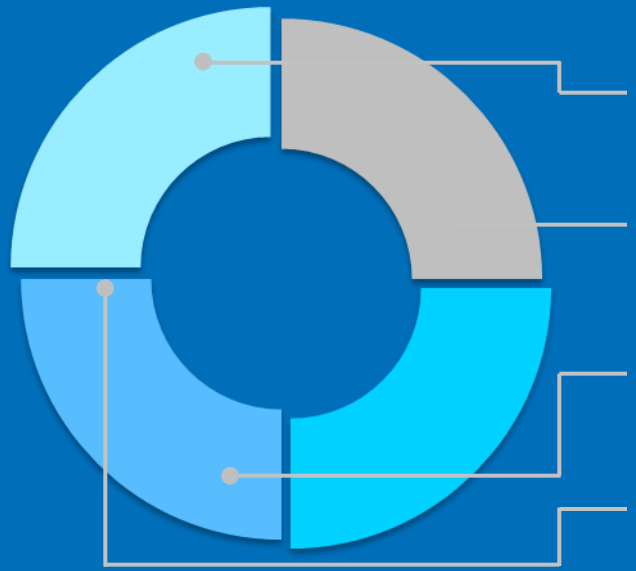
Main Cost Factors in the Flour Mill



Raw Material (Wheat)

Electricity

Water, Distribution, Marketing ,etc

Labor Cost (Staff)

Main Factors

Main Cost Factors of Flour Mill

78%

Raw Material

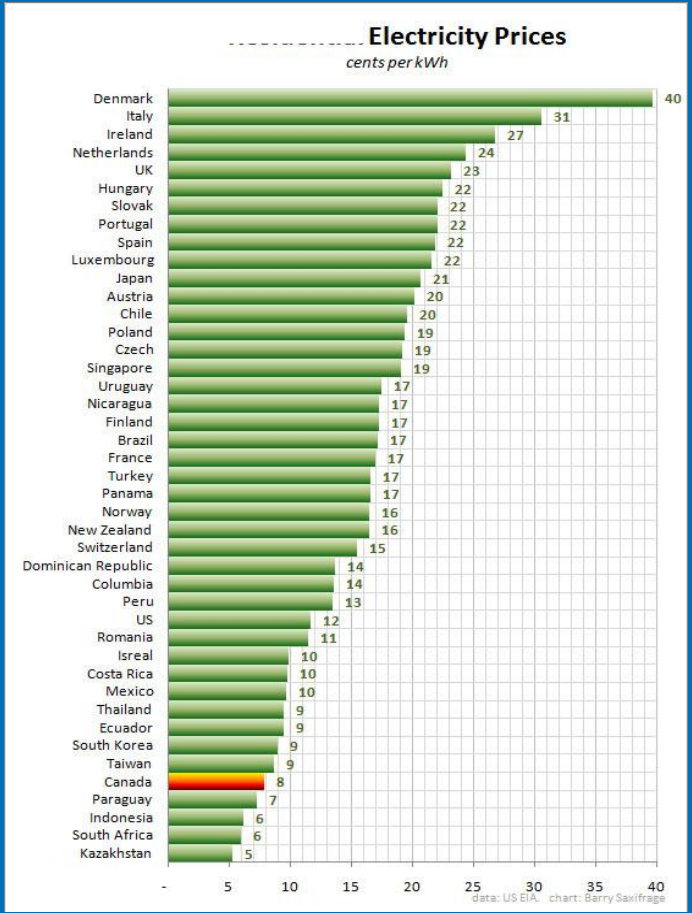
3-4%

Electricity Cost

The largest operating cost is raw material .
Then ,the electricity cost in running of the flour mill.

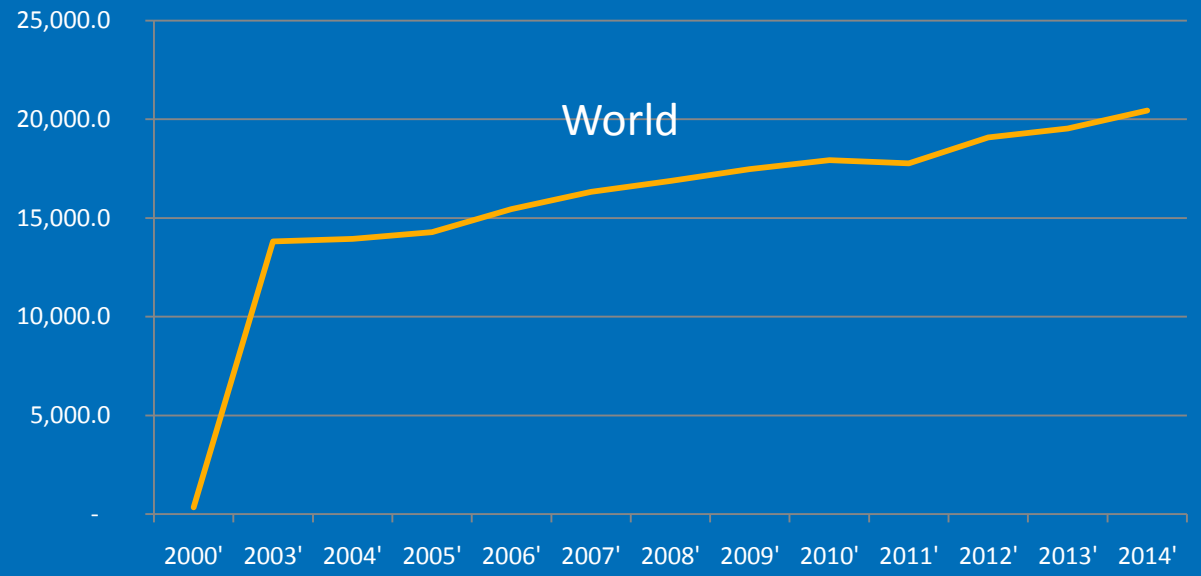
Electricity Price is changing country to country

World Electricity Prices



Electricity consumption (Billion KWH)

As a demand is increasing faster than the supply .

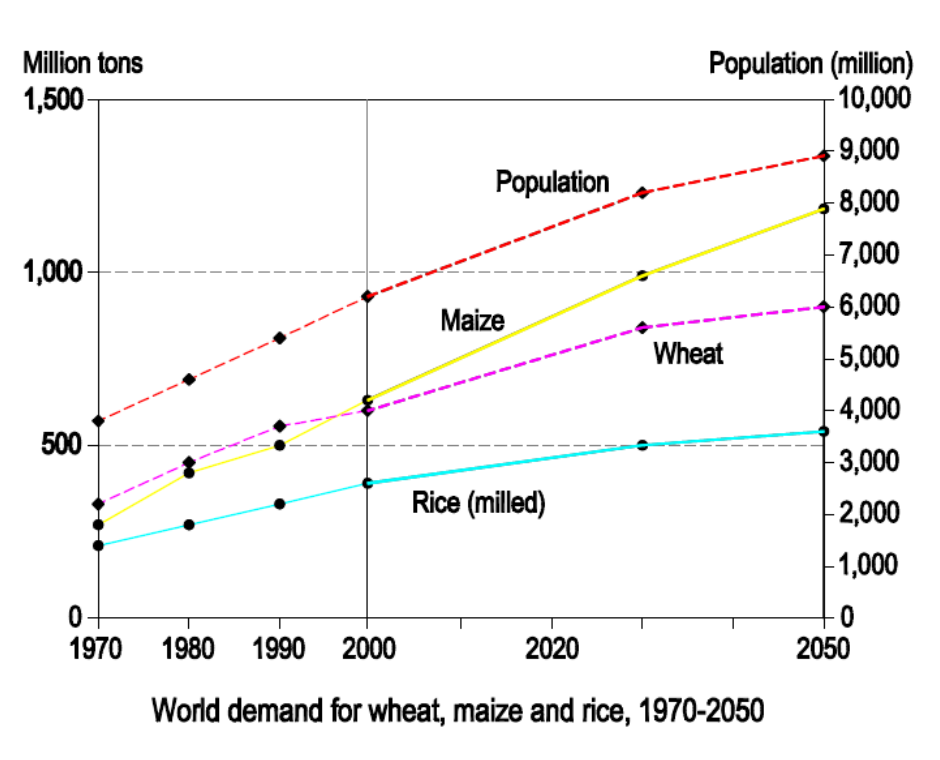


Today = Almost 20 billion Megawatt

Years	2000'	2003'	2004'	2005'	2006'	2007'	2008'	2009'	2010'	2011'	2012'	2013'	2014'
World	342,7	13.810	13.940	14.280	15.450	16.330	16.880	17.480	17.930	17.780	19.090	19.540	20.450

Source : CIA World Factbook

World demand for wheat, maize and rice 1970-2050



Electric usage is increasing simultaneously with grain demand and electricity cost is increasing too.
For that reason energy efficiency is getting more crucial.

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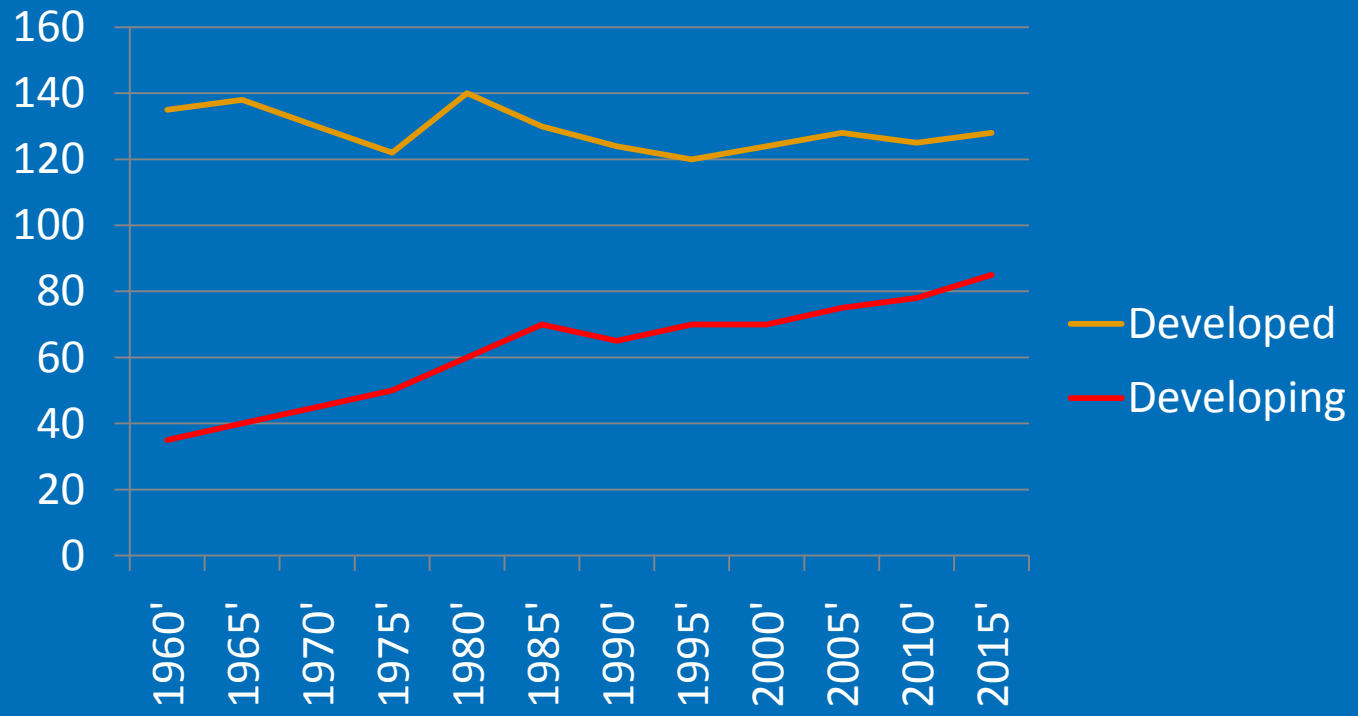
Per Capita Consumption of Wheat (Kilograms per year)



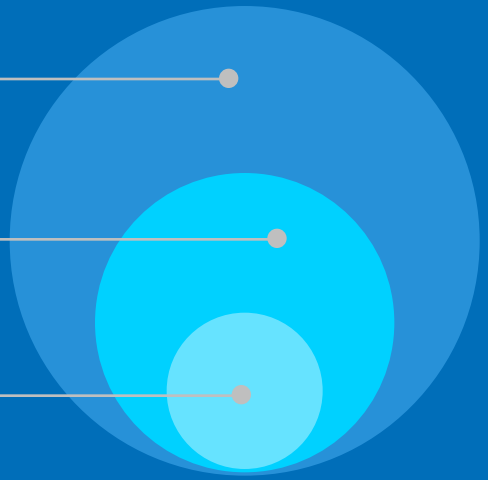
Developing countries will need more electriticy to produce flour . For that reason energy efficiency is critical for millers especially in these countries

Total Electricity Consumption of All Flour Mills in the World versus Total World electricity Consumption

19.540 billion KWH

37,5 billion KWH

0,2%



Total Electricity Consumption in the World

Total Wheat Mills Electricity Consumption in the World

% Wheat Flour Mills over Total Consumption

We did not consider Maize and Rice in this study.

Energy Efficiency Analysis can be divided 3 categories

Operational Solutions for Energy Efficiency

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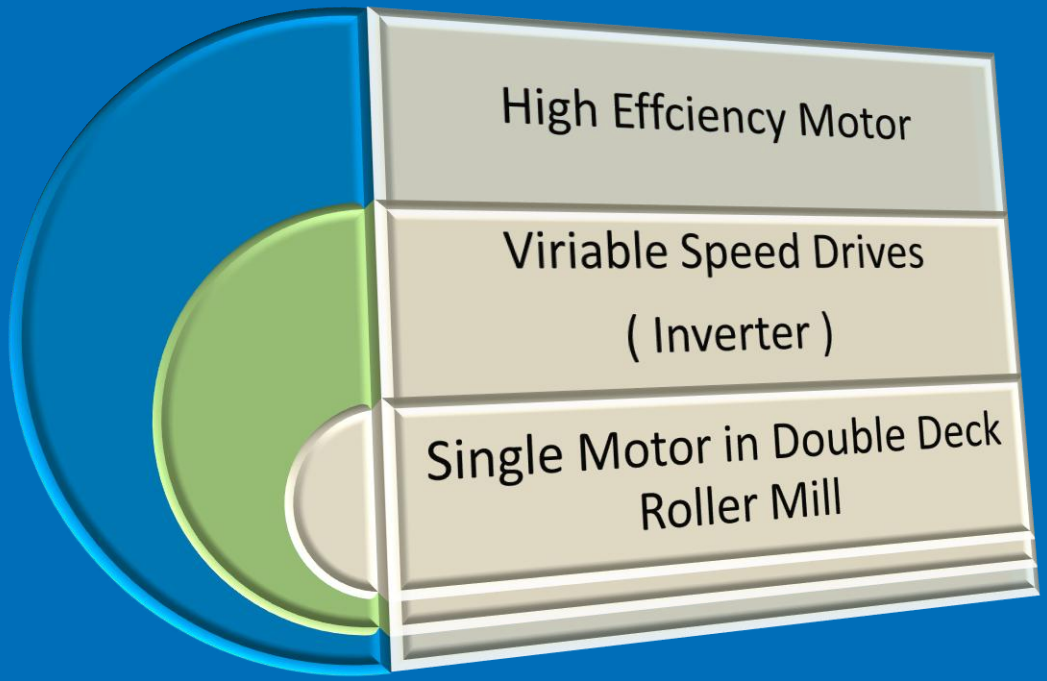
Electro-mechanical solutions

Technological solutions

Some of Electro-Mechanical Solutions for Higher Energy Efficiency



Some Technological Solutions for Higher Energy Efficiency

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- Optimization of flow chart with good diagramme and high quality and reliable machines – no need more machines. Efficient designing of pneumatic conveying and aspiration.
- High standard parts of the machines- bearings , rolls , belts and high quality electrical parts
- Maximize the efficiency of the operations , working full capacity all the time . For that you need high quality and reliable machines.

Operational Solutions for Energy Efficiency

1)New and special energy efficiency motors IEC NORM IE3 PREMIUM EFFICIENCY MOTORS (this motors have even higher efficiency than FF1 type motors)

2)single motors in two passages in double deck roller mills

3)inverter to drive blower

4)variable frequency drive on high pressure fan motors and compressors

Product Quality and Climatic Effect on Energy Efficiency

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Product Quality

- Wheat Quality
- Impiruties Ratio
- Optimum capacity utilization

Climatic

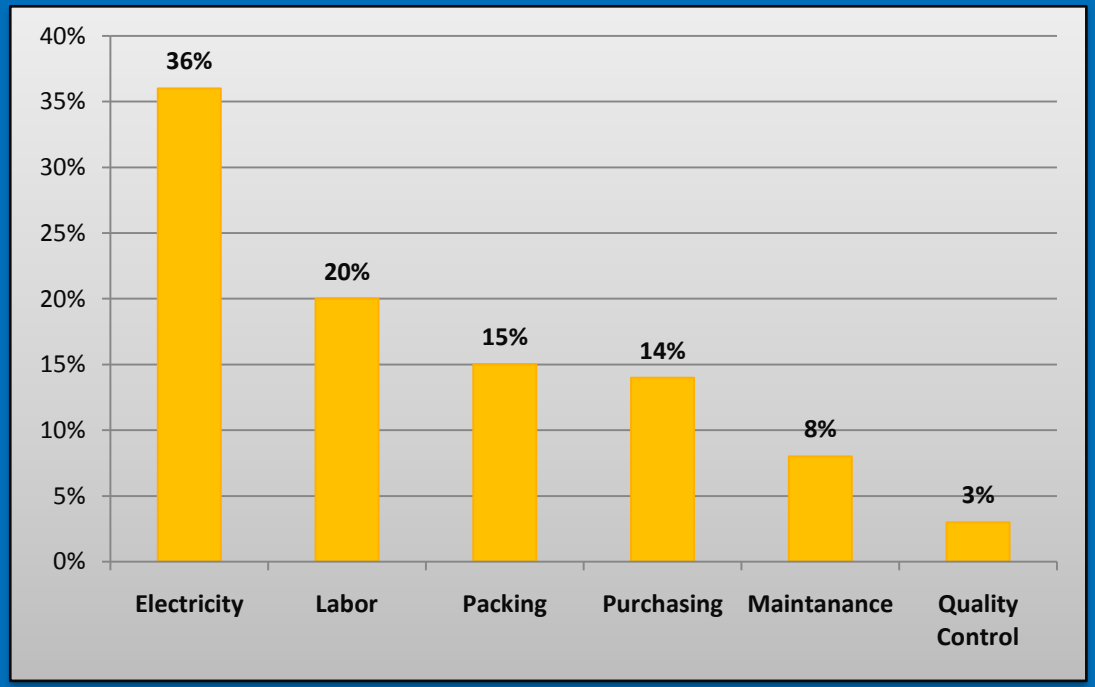
- Temperature
- Altitude

(High temp.or high altitude means less density of air means need more volume of air)

Maintanance and Control on Energy Efficiency

- Regular maintenance and cleaning
- General vibration control (mechanical balance application)
- Proper alignment in the machines
- On time Lubrication to minimize friction loss
- Periodic Belts changing
- Parallelism of the pulleys to each other
- Tension of the belts
- Leak prevention

The cost breakdown of operating the mill and the electricty cost



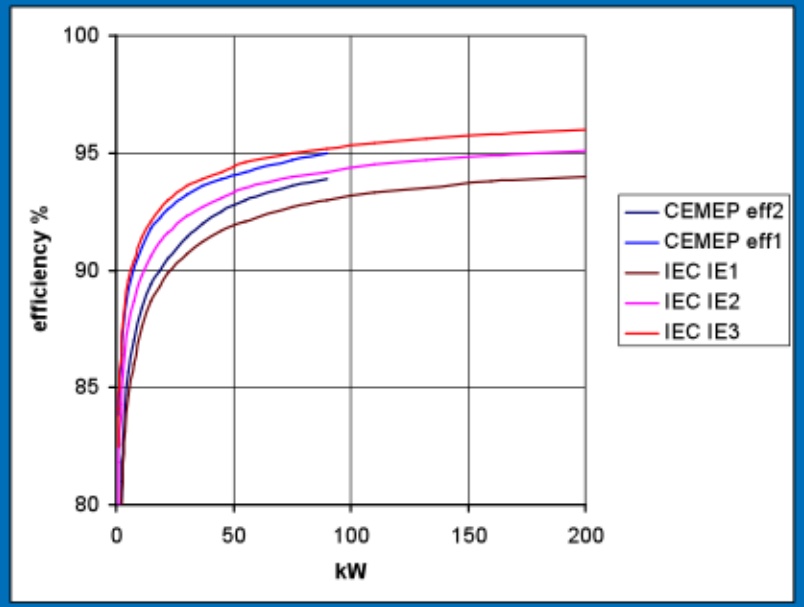
Energy Consumption in the mill sections

UNITS	ELECTRICITY % KW/H
INTAKE SECTION	0,4%
CLEANING SECTION	7,7%
SECOND CLEANING SECTION	3,0%
MILLING SECTION	10,8%
Roller Mill	49,6%
P. Fan	17,1%
FLOUR PACKING SECTION	10,5%
BRAN PACKING SECTION	1,0%
Total	100,0%

Do improvement in these area

Effect of High Efficiency Motors

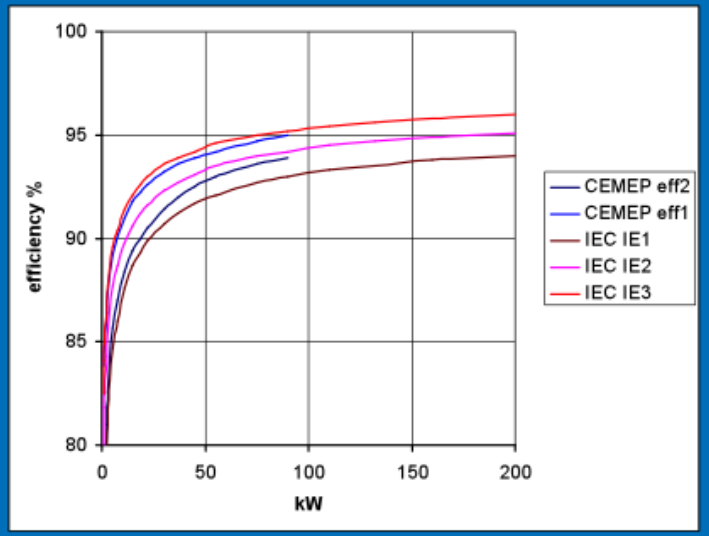
		Motor Yield
IE1 motor	Normal Motor	89,9%
IE2 motor	High Efficiency 2	91,6%
IE3 motor	High Efficiency 3	93,0%



SOURCE ;
PREMIUM EFFICIENCY WIKIPEDIA

Effect of High Efficiency Motors

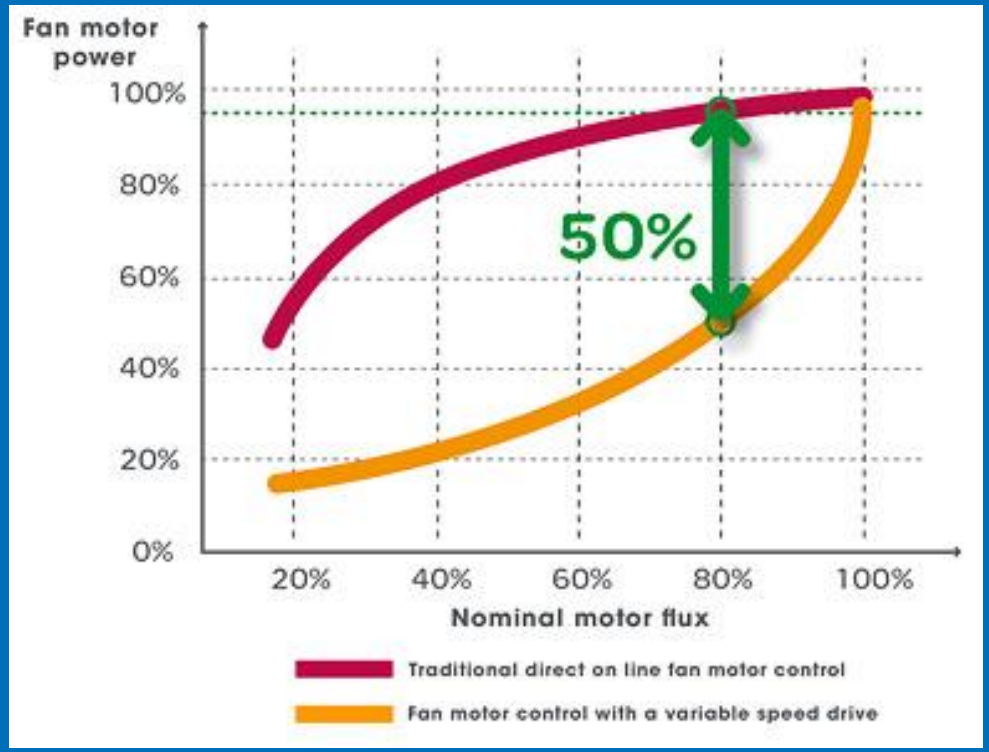
	IEC IE1 - standard	IEC IE3	DIFF %
10 KW	88,50%	91,50%	3,0%
25KW	90,00%	93,50%	3,5%
50KW	92,50%	94,20%	1,7%
75KW	92,70%	95,00%	2,3%
100KW	93,00%	95,50%	2,5%
150KW	94,00%	96,00%	2,0%



VFD (Inverter)

A **variable-frequency drive** (**VFD**) (also termed *adjustable-frequency drive*, *variable-speed drive*, *AC drive*, *micro drive* or inverter *drive*) is a type of adjustable speed drive used in electro mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage .

Variable Speed Drives



If the VSD is used in a fan control application savings of up to 50% are possible.
For example a fan running at 80% speed only uses 50% of the energy, compared to one running at full speed.

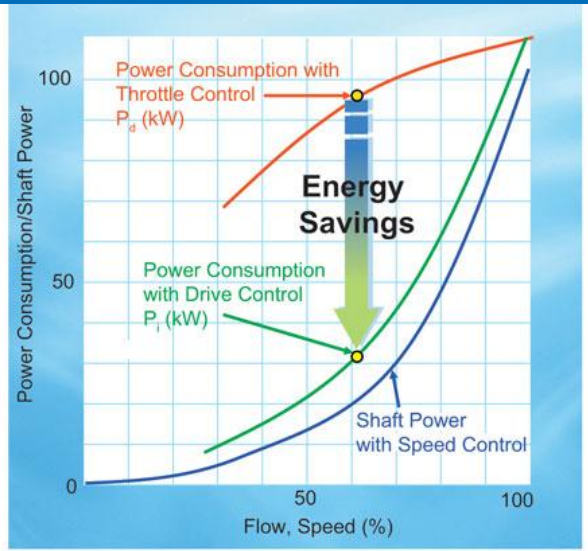


Figure 1: Energy Savings with Speed Control

Source : RS component

Variable Speed Drives

Total air moved (L) depends on the speed (n)
m3/sec $L = f(n)$

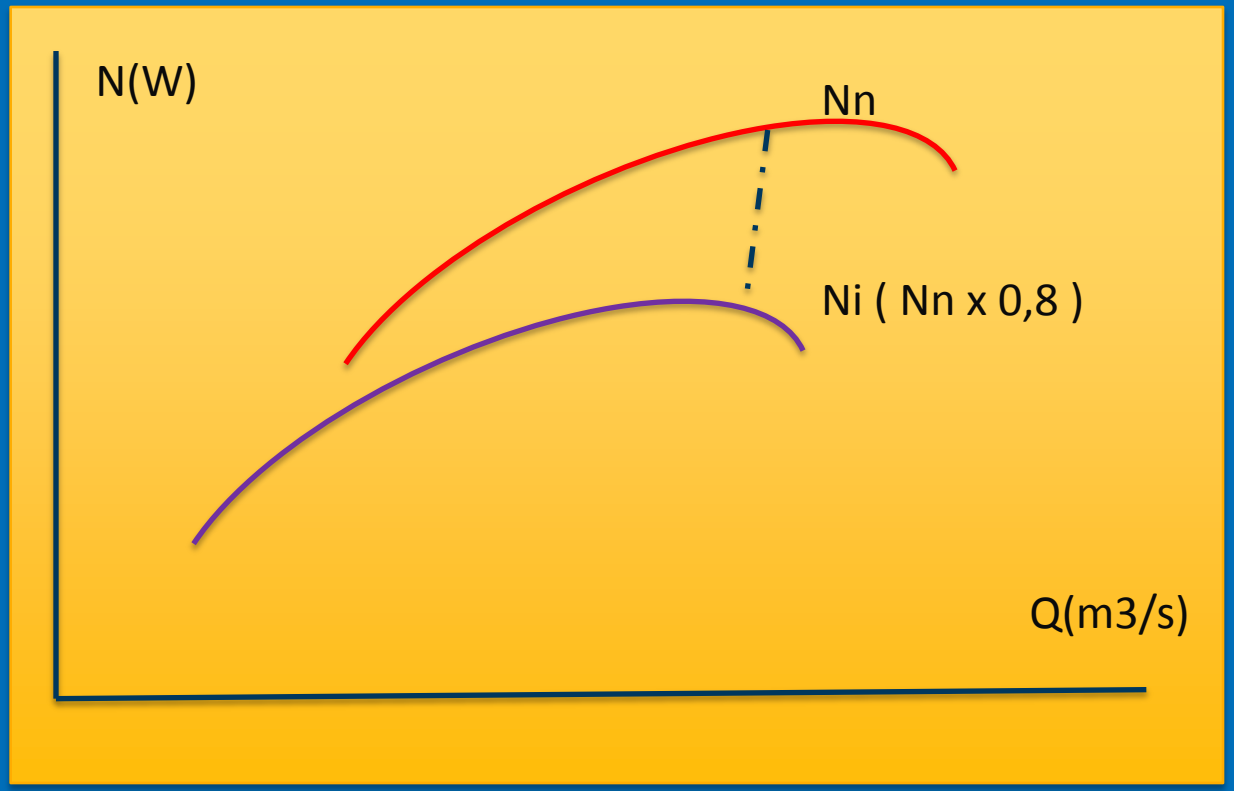
Static pressure (P) is proportional to the square of the speed (n2) New/m2 $P = f(n2)$

Required power (N) is proportional to the cube of the speed n3 watt $N = f(n3)$

Summary, when 20% of the air is reduced, the fan speed is decreased at the same rate and the force used is reduced by 50%. (0,8 x 0,8 x 0,8)

If the VSD is used in a fan control application savings of up to 50% are possible.
For example a fan running at 80% speed only uses 50% of the energy, compared to one running at full speed.

Effect of Inverter (Variable Speed Drives)



THE EFFECT OF EFFICENCY MOTOR AND INVERTER

	NUMBER OF MOTORS	TOTAL KW	HIGH EFFIENCY	% DIFF
TOTAL	**280**	**2483,12**	2430,0	-2,1%
0-10 KW	177	489,02	474,3	-3,0%
10-25 KW	94	1456,28	1424,2	-2,2%
25-50 KW	6	204,82	202,8	-1,0%
50 KW +	3	333	328,7	-1,3%
	NUMBER OF BLOWER	TOTAL KW	AFTER INVERTER	% DIFF
		150	142,5	-5,0%
75 Kw	1	75	71,25	-5,0%
30 kw	1	30	28,5	-5,0%
45 kw	1	45	42,75	-5,0%
PNEUMATIC FAN	**2**	TOTAL KW	AFTER INVERTER	% DIFF
132	2	264	237,6	-10,0%
TOTAL BLOWER AND P.FAN		414	380,1	-8,2%

600 Ton / day factory as referance

BENEFIT of High Efficiency Motors

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	NUMBER OF MOTORS	TOTAL KW	YEARLY CONSUMPTION KWH	YEARLY COST USD	HIGH EFFIENCY	YEARLY CONSUMPTION KWH	YEARLY COST USD	DIFFERENCE USD	PRICE DIF IE3-IE1	TOTAL DIF
TOTAL	**280**	**2483,12**			2430					
0-10 KW	177	489,02	3.423.140	513.471	474,3	3.320.100	498.015	15.456	100	17700
10-25 KW	94	1456,28	10.193.960	1.529.094	1405	9.835.000	1.475.250	53.844	125	11750
25-50 KW	6	204,82	1.433.740	215.061	198	1.386.000	207.900	7.161	150	900
50 KW +	3	333	2.331.000	349.650	324	2.268.000	340.200	9.450	500	1500
				2.607.276			2.521.365	85.911		31.850

600 Ton / day factory as referance

BENEFIT IS ALMOST 86.000 USD

4,5 MONTHS RETURNING OF INVESTMENT

% EFFECT OF EFFICENCY MOTOR AND INVERTER

2,1 % FROM EFFICENCY MOTOR

1,3 % FROM INVERTER OVER P.FAN AND BLOWER

TOTAL IS % 3,4

This electrical consumption study is therotical analysis. There could be +/- 5 % differences in real consumption..

Conveying Equipment on Energy Efficiency

Bucket Elevators
Chain conveyors
Augers

- Prevent the friction
- On time preventive maintenance
- Don’t use when it is not required
- Using as full capacity

Preventive Maintanance

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Preventative Maintenance = increased efficiency and energy efficiency

- Increased productivity
- Improved throughput
- High quality product
- Reduction in downtime
- Reduce costly replacements
- Reduce the need to repair
- Prevent damaged spouts

The Costs of Unplanned Maintenance

- Lost production
- Unbudgeted expense
- Unnecessary disruption
- Dependence on contractors
- Lost time

Periodic Maintenance

- Belts
- Pulleys
- Oil Changing
- Filter cleaning
- Spouting Control

Control for leakages and contamination.

The future –

One Sample

In 2011, one mill in USA consumed 49 million KWh as total energy.

This Mill invested in having a wind turbine on their land .
The project has the capacity to generate 50 Megawatts of electricity enough to supply approximately 12.000 household.

The future –

One Sample

In 2011, one mill in USA consumed 49 million KWh as total energy.

The company installed solar panels at several of its facilities, including warehouse and the company’s headquarters. Studies have found that green roofs can reduce both summer cooling and winter energy needs by as much as 26 percent.

THANK YOU

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