TRAINING PACKAGES DEVELOPMENT

PACKAGE II: ELECTRICAL

Presenter: Dr Evan Murimi Wanjiru, PhD, CEM.

Kenya Tea Development Agency Holdings Ltd

german cooperation

Ethical Tea Partnership

Strathmore University Energy Research Centre

Presentation structure

- Target group
- Objectives
- Expected impact
- Sources of electrical energy
- Electricity consumption
- Components of utility bill
- Modules- 8 of them

Introduction

"The age we live in is a busy age; in which knowledge is rapidly advancing to perfection."

-Jeremy Bentham

Target group

- Factory electricians

  They deal with day-to-day running of factories.

  They manage electrical equipment.

Objectives

Main objective

Train, equip and sensitize factory electricians with thorough information on electrical energy saving opportunities and related cost in a tea factory.

Specific objectives

- Provide thorough understanding of the tariff structure with its components
- Enlighten on various electrical energy consumers in a factory and their impact on cost.
- Quantify the impact of efficient operation of electrical equipment
- Sensitize the electricians on importance of proper maintenance.

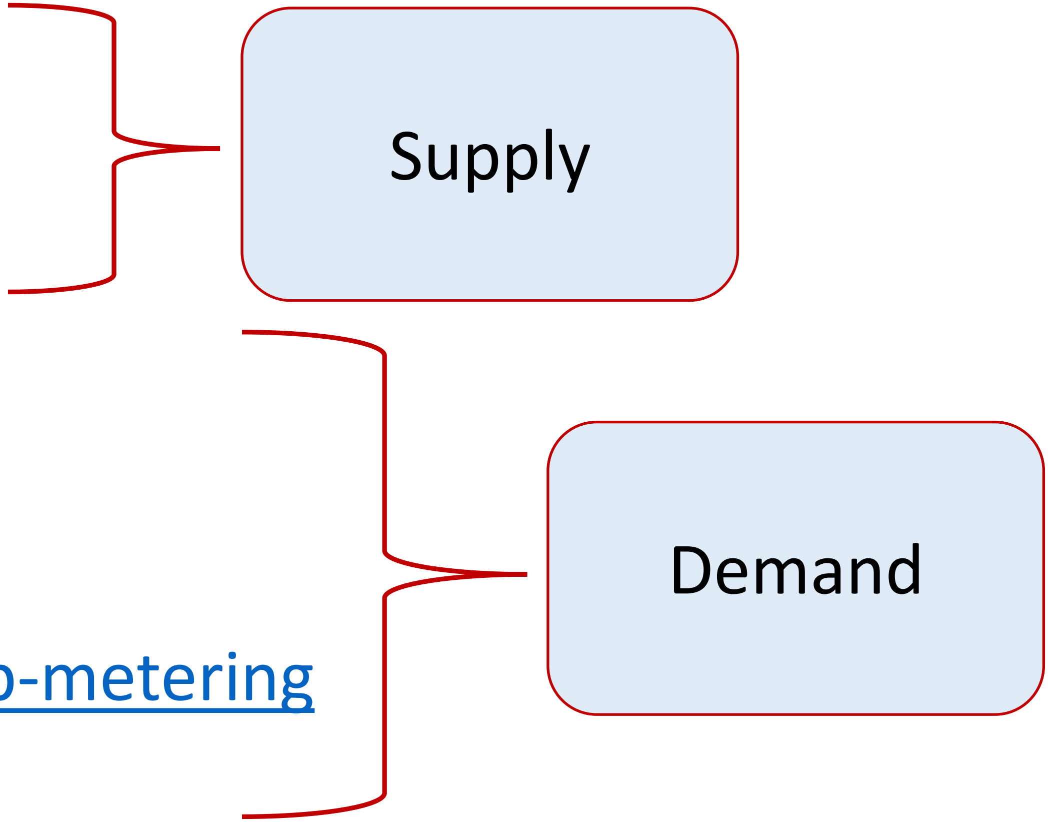
Expected impact

At the end of the training, the electricians shall;

- Understand the billing structure and identify ways of saving cost.
- Be equipped with knowledge on tracking and analyzing energy consumption within the factory.
- Understand efficient operation of various electrical equipment in a factory.
- Ensure proper maintenance is carried out.
- Identify various energy saving opportunities in a factory and estimate energy and cost savings.
- Identify measures to take to stop energy wastage.

Modules

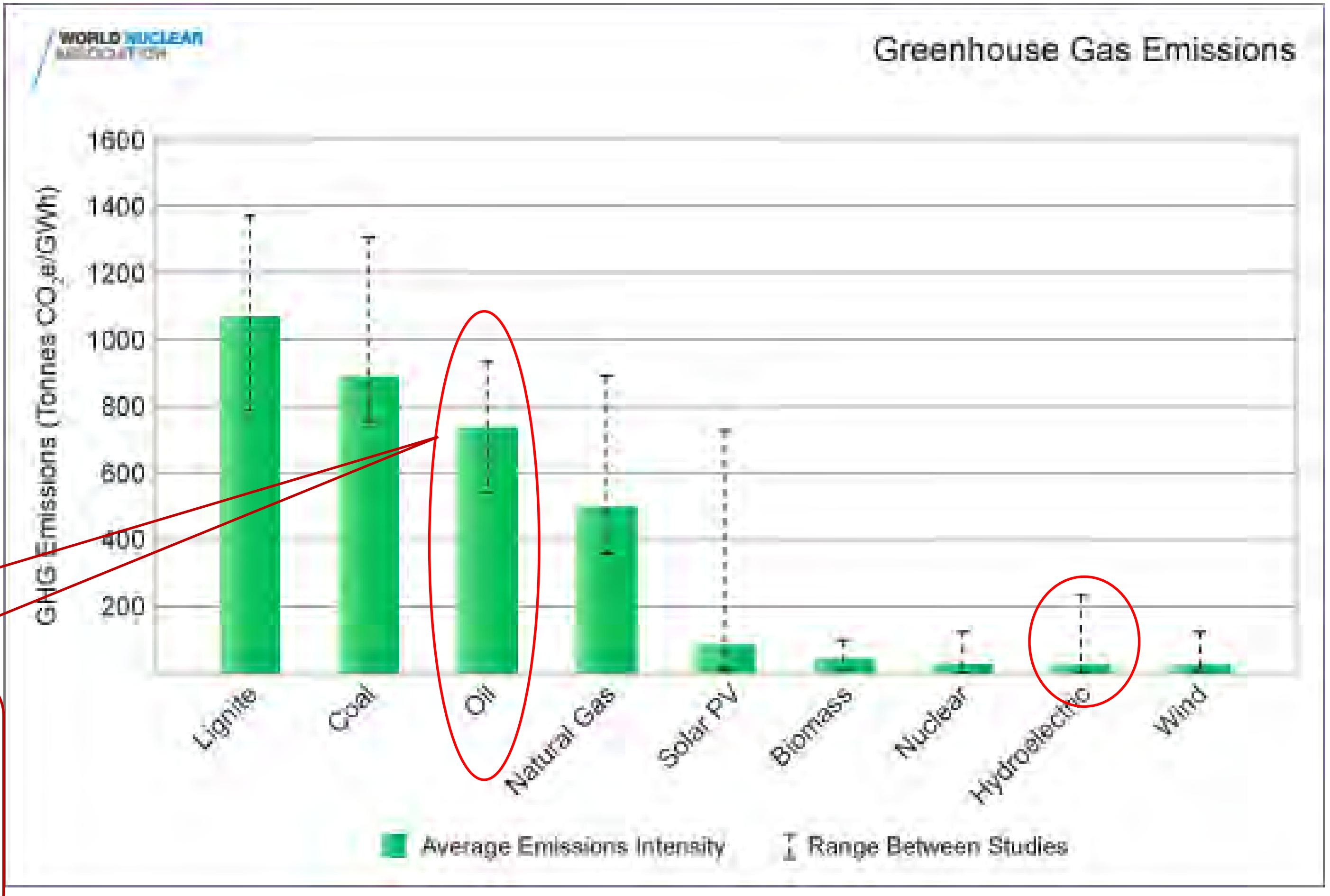
1. Power factor
2. Maximum kVA demand
3. Generator operation
4. Voltage balance
5. Lighting
6. Motors and fans
7. Energy monitoring & sub-metering
8. Maintenance



Sources of electrical energy

Most tea factories rely on

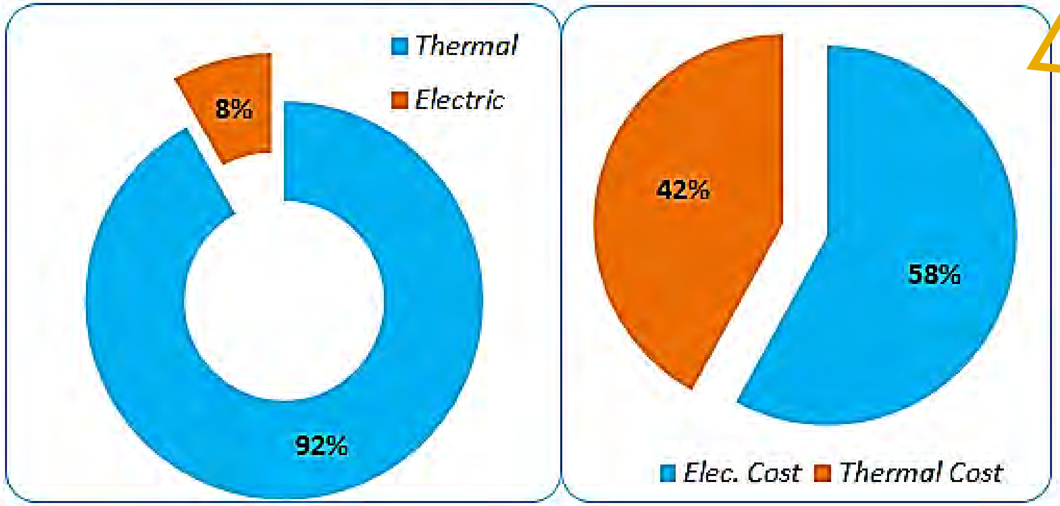
- Grid from Kenya power
- Hybrid (grid+hydro)
- Diesel generators as back up



- Oil generates just below coal.
- Most expensive to use
- Hydroelectric & wind emit the least

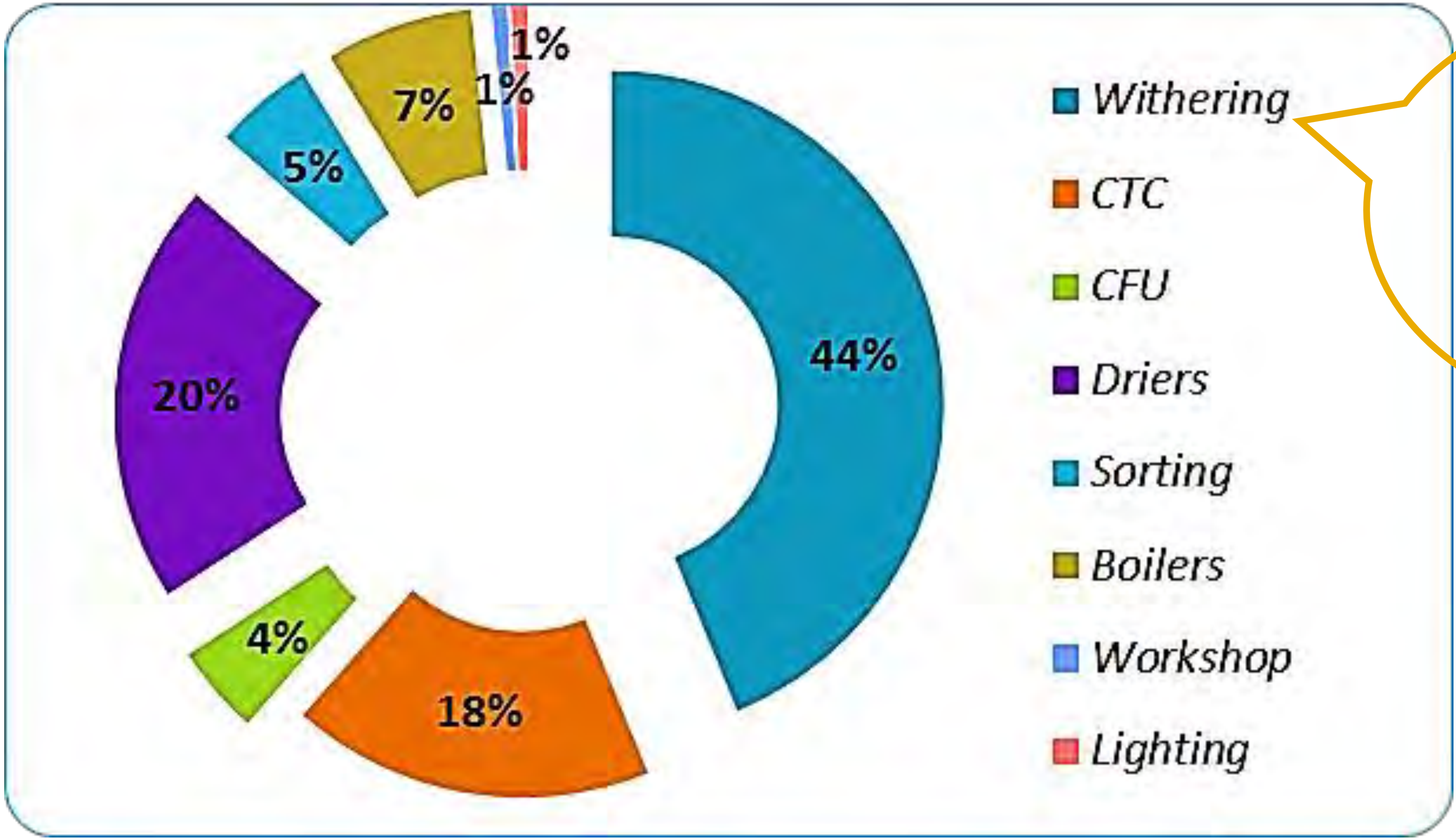
Electricity consumption

Energy Type	Average Annual Units Consumed	Percent	Average Annual Cost	Percent
	kWh	%	kWh	%
Electric	2,029,020	8	23,841,171	58
Thermal	22,917,592	92	17,302,288	42
Total	24,946,611	100%	41,143,459	100%



*Electric energy accounts for less than **<u>10%</u>** total plant energy but accounts for **<u>58%</u>** of total plant energy cost*

Sectional consumption



*Withering, CTC and Driers accounts for appr. **77-82%** of total plant power demand/energy consumption*

Several motors and fans

Highest energy saving potential

Components of previous utility bill-CI1 at 415V

- Fixed charge at **KSh 2500/period**
- Energy Consumption kWh (TOU)
  - peak@ **KSh 9.2/kWh**
  - Off-peak @ **KSh 4.6/kWh**
- Maximum demand kW *(Actual maximum consumed real power)*
- Power Factor kW/kVA *(Surcharge if below **0.9**)*
- Maximum demand kVA *(maximum supplied power)* at **KSh 800/kVA**
- Other levies (WARMA, ERC, REP, FCC, FA, IA) and VAT

Must be at 100% production e.g. high crop season. Extra production can be shifted to off-peak

Components of current utility bill-CI1 at 415V effective from 1st July 2018

- Fixed charge at **KSh 0/period**
- Energy Consumption kWh (TOU)
  - peak@ **KSh 12/kWh**
  - Off-peak @ **KSh 6/kWh**
- Maximum demand kW *(Actual maximum consumed real power)*
- Power Factor kW/kVA *(Surcharge if below **0.9**)*
- Maximum demand kVA *(maximum supplied power)* at **KSh 800/kVA**
- Other levies (WARMA, ERC, REP, FCC, FA, IA) and VAT

Other tariffs;

Code	Customer Type (Code Name)	Energy Limit kWh/month	Charge Method	Unit	2015/16 to date Approved	2018/19 KPLC Application	2018/19 ERC Approved
DC	Domestic		Fixed	KShs/month	150	200	0
	"	0-10	Energy	KShs/ kWh	2.50	13.01	12.00
		11-50	Energy	KShs/kWh	2.50	13.01	15.80
	"	51-1500	Energy	KShs/ kWh	12.75	18.90	15.80
	"	>1500	Energy	KShs/ kWh	20.57	25.56	15.80
SC	Small Commercial	0 - 15,000	Fixed	KShs/month	150	300	0
			Energy	KShs/ kWh	13.50	19.85	15.60
CI1	Comm./industrial	>15,000	Fixed	KShs/month	2,500	3,100	0
			Energy	KShs/ kWh	9.20	13.77	12.00
			Demand	KShs/ kVA	800	1,000	800
CI2	Comm./industrial	No Limit	Fixed	KShs/month	4,500	5,600	0
			Energy	KShs/ kWh	8.00	11.77	10.90
			Demand	KShs/ kVA	520	650	520
CI3	Comm./industrial	No Limit	Fixed	KShs/month	5,500	6,800	0
			Energy	KShs/ kWh	7.50	10.93	10.50
			Demand	KShs/ kVA	270	350	270
CI4	Comm./industrial	No Limit	Fixed	KShs/month	6,500	8,000	0
			Energy	KShs/ kWh	7.30	10.63	10.30
			Demand	KShs/ kVA	220	280	220
CI5	Comm./industrial	No Limit	Fixed	KShs/month	17,000	21,000	0
			Energy	KShs/ kWh	7.10	10.32	10.10
			Demand	KShs/kVA	220	280	220
SL	Street Lighting	No Limit	Fixed	KShs/month	200	250	0
			Energy	KShs/kWh	4.36	15.91	7.50

How can you reduce your electricity bill?

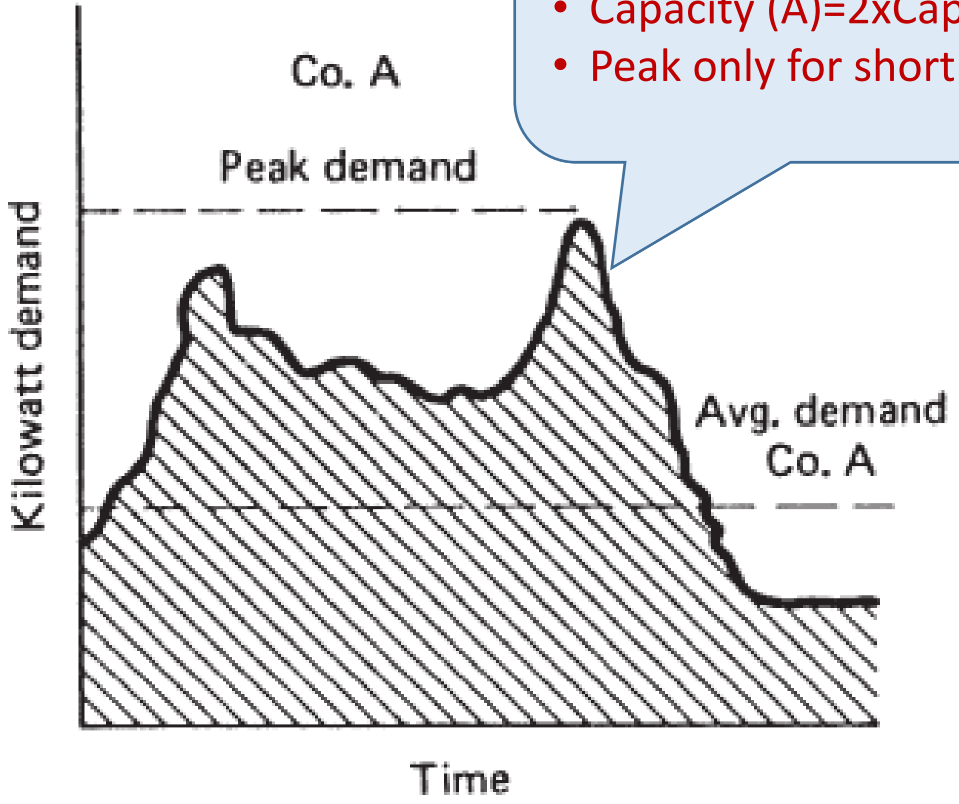
- **Reduce consumption kWh**
  - Lower rated motor/appliance
  - Reduce operation hours/idle operation
- **Improve Power Factor**
  - Install PF correction/Daily check of PF control system
  - Motor capacity vs duty
- **Reduce kVA**
  - Load scheduling
- **Reduce losses**
  - Voltage balancing
  - Motor loading

Module 1: Maximum kVA demand

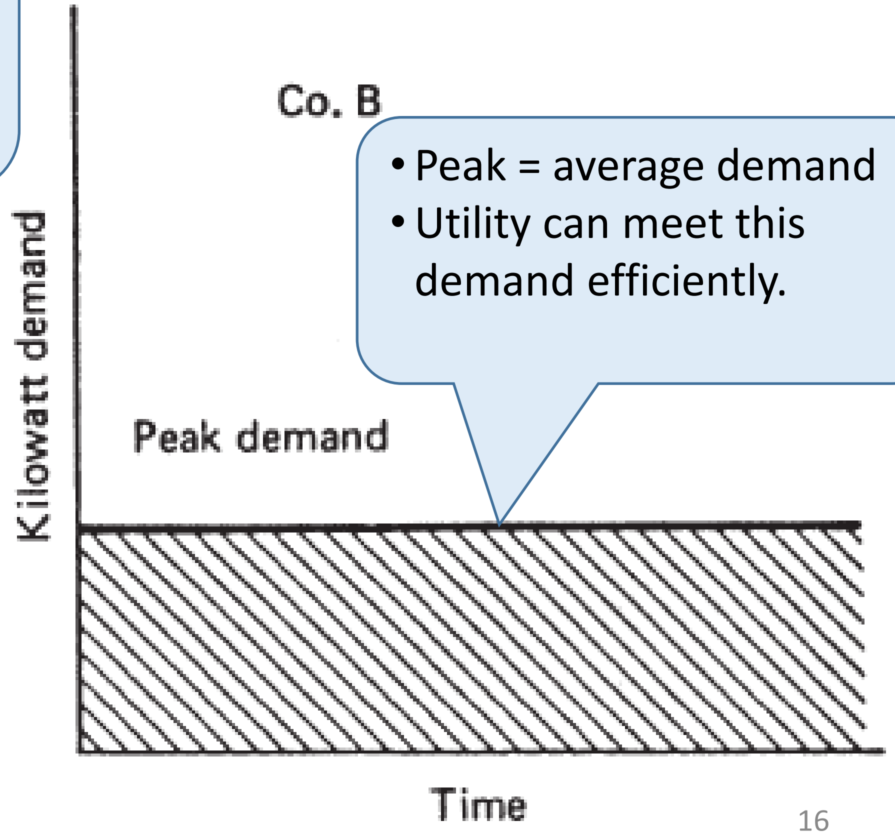
- Demand is the rate at which energy is delivered to an electrical load.
- It is expressed in either kW or kilovoltamperes (kVA).
- Maximum (peak) demand - maximum rate at which electric energy is drawn through the meter during a period of time.
- For example:

For a house with, 4.5 kW water heater, 3.0 kW lighting, 15.0 kW cooking, 1 kW iron box and 1.3 kW microwave. If they all operate at the same time, the peak demand =24.8 kW.

- Electricity consumed after generation.
- Utilities must meet highest demand



- kWh (A)= kWh (B) i.e. shaded area.
- Peak = 2x average demand
- Capacity (A)=2xCapacity (B)
- Peak only for short time



- Peak = average demand
- Utility can meet this demand efficiently.

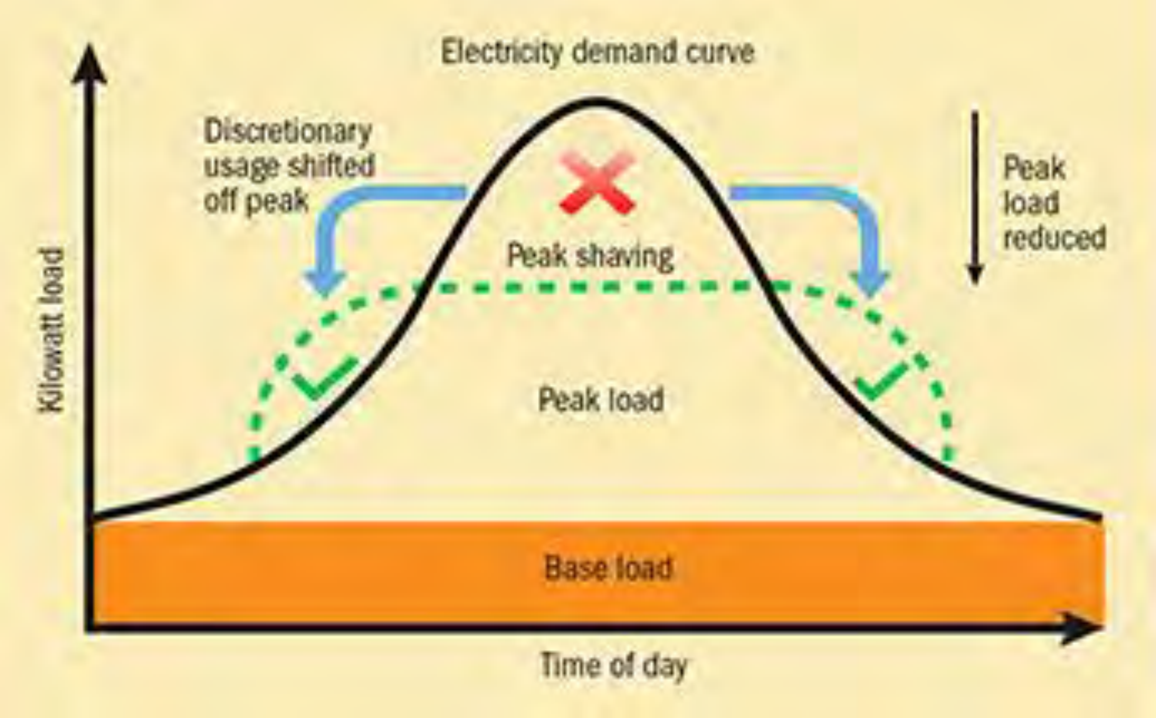
Demand charges

- Are utility's costs for meeting a customer’s higher demand
- Based on the maximum kVA demand recorded in any half hour of billing period.
- Company “A” demand is 80 kW for 50 hours. $Energy = 80 \times 50 = 4000\ kWh$.
- Company “B” demand is 20 kW for 200 hours. $Energy = 20 \times 200 = 4000\ kWh$.
- Both use same amount of energy during the billing period.
- Should they pay the same?
- Required system capacity; 80 kW for Company A, 20 kW for B.

Load shifting and scheduling

- With TOU tariff, scheduling to process tea in cheaper off-peak periods (night) could save money.

Day	Off-peak hours
Weekdays	22:00 to 00:00 and 00:00 to 06:00
Saturdays and public holidays	14:00 to 00:00 and 00:00 to 08:00
Sundays	All day



- Extra tea (above 100%) would require 2000 kWh to process.
- During peak, Energy cost

$$9.45 \times 2000 = Kshs\ 18{,}900$$

- Shifting to off-peak, Energy cost

$$7 \times 2000 = Kshs\ 14{,}000$$

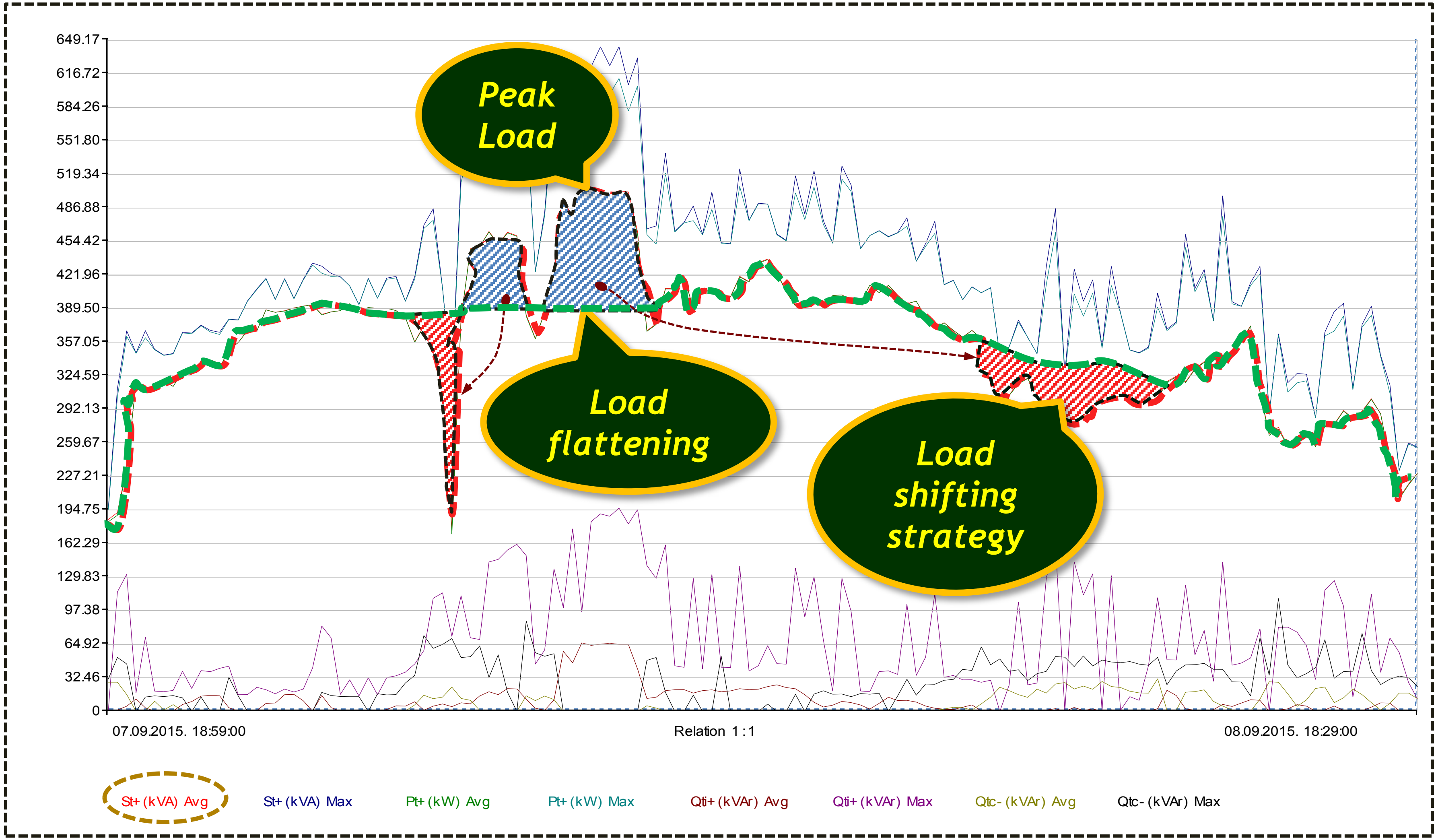
Operational excellence

Do's

- Operate withering when there is no processing
- Fully load processing lines
- Switch off unnecessary processing lines/loads
- Process extra crop during off-peak period if possible

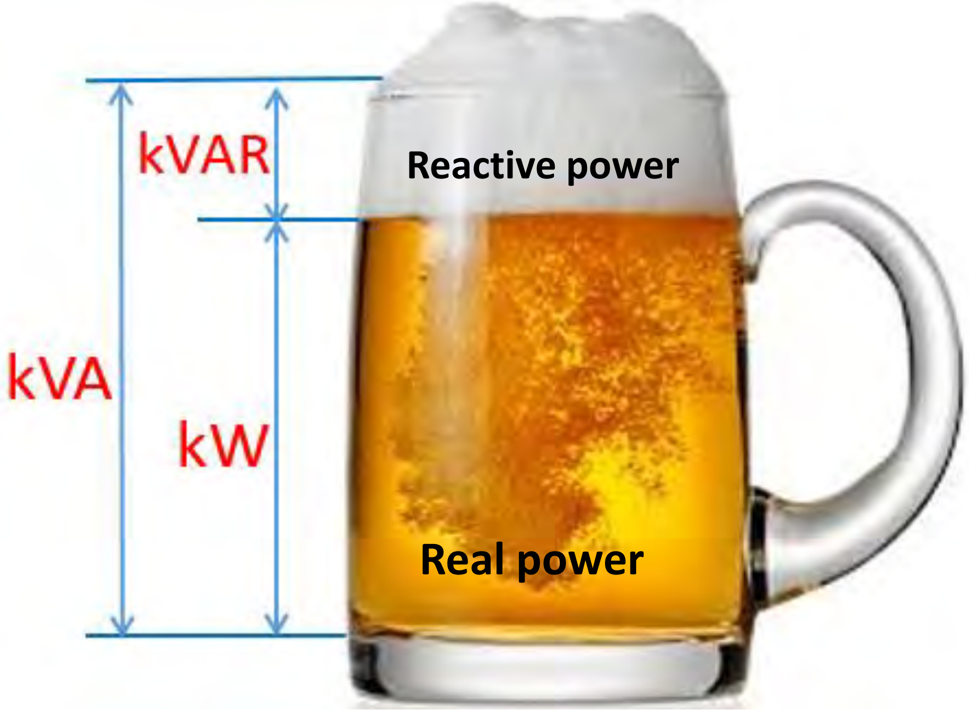
Don'ts

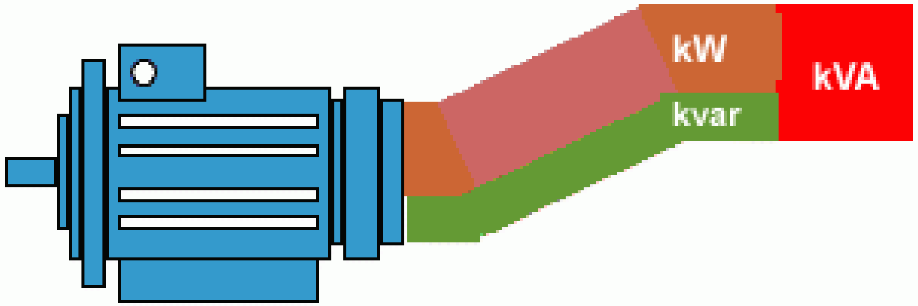
- Run empty processing lines
- Minimize operating withering when processing is taking place

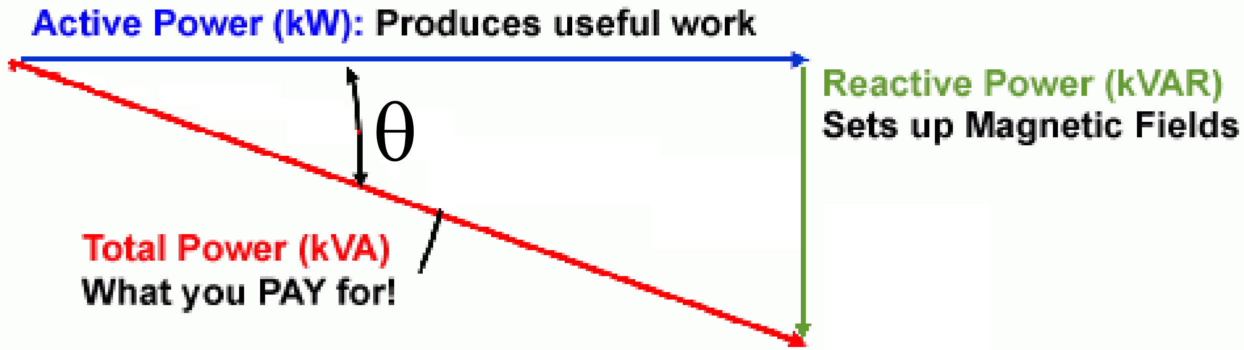


Peak demand reduced from 500 kVA to 400 kVA.
Demand cost= Kshs800/kVA
Cost savings= Kshs 80,000

Module 2: Power factor







$$Power\ factor(PF) = \frac{Working\ power}{Apparent\ power} = \frac{kW}{kVA} = \cos\theta$$

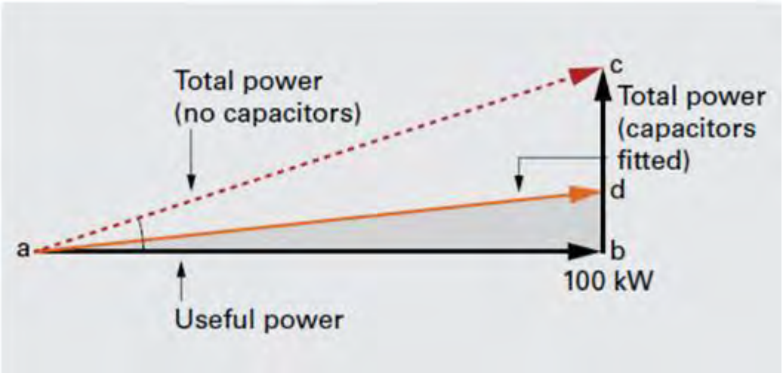
$$= \frac{Beer}{Beer + Foam}$$

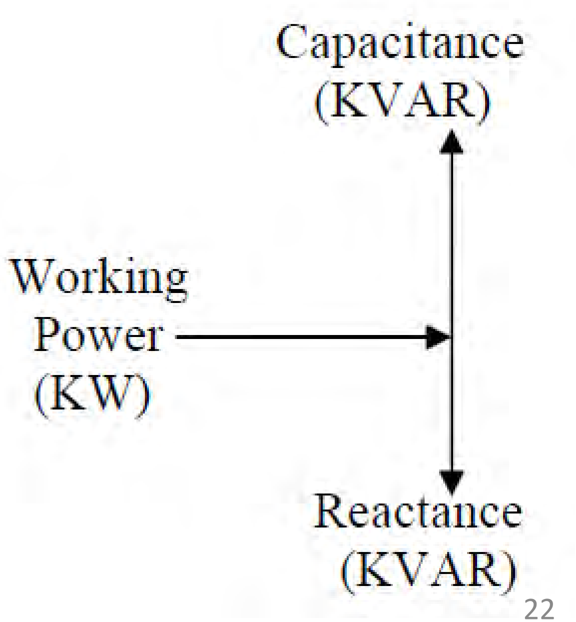
How do I improve power factor

- Consumers of kVAR- transformers, induction motors, high intensity discharge (HID) lamps- **lower PF**.
- Generators of kVAR- capacitors, synchronous generators, synchronous motors- **increase PF**
- **To increase/improve PF:**

1. **Install capacitors (kVAR generators):** Capacitors store KVARs and release it opposing kVAR caused by the inductor load.

$$kVA = \frac{kW}{PF} = \sqrt{(kW)^2 + (kVAR)^2}$$





Energy/cost saving from capacitors

	Jan-16		Mar-16		Apr-16		May-16	
	PF	KSh	PF	KSh	PF	KSh	PF	KSh
Factory 1	0.88	129,478.00	0.84	370,143.00	0.93		0.92	
Factory 2	0.85	412,547.00	0.85	302,163.00	0.84	347,020.00	0.88	
Factory 3	0.96		0.88	95,313.00	0.89		0.98	
Factory 4	0.87		0.93		0.82	714,807.00	0.82	620,460.09
Factory 5			0.97		0.87	173,526.00	0.99	
Factory 6			0.99		1		0.85	349,757.16
Factory 7	0.82	223,387.00	0.82	247,832.00	0.82	249,665.00	0.97	
Factory 8	0.96		0.89	39,524.00	0.94		0.99	
Factory 9	0.98		0.82	281,023.00	0.91		0.96	
Factory 10	0.78	681,879.00	0.9		0.97		0.95	
Total		1,447,291.00		1,335,998.00		1,485,018.00		970,217.25

Assuming Max 600kVA recorded,
With **PF=0.78**, $kW = 0.78 \times 600 = \mathbf{468}$ and $kVAR = \sqrt{kVA^2 - kW^2} = \sqrt{600^2 - 468^2} = 375.$

Correcting **PF to 0.99**, $\text{kVA} = \frac{468}{0.99} = 473\ kVA$ meaning $kVAR = \sqrt{473^2 - 468^2} = 67.$

Capacitors required to correct are $375 - 67 = \mathbf{308\ kVAR}$.

PF 0.78, Assuming Max 600kVA recorded; Correct to PF 0.99, need additional 290kVAR; Investment cost: KSh 0.95m-1.2m; PB: 1.3-1.7yrs

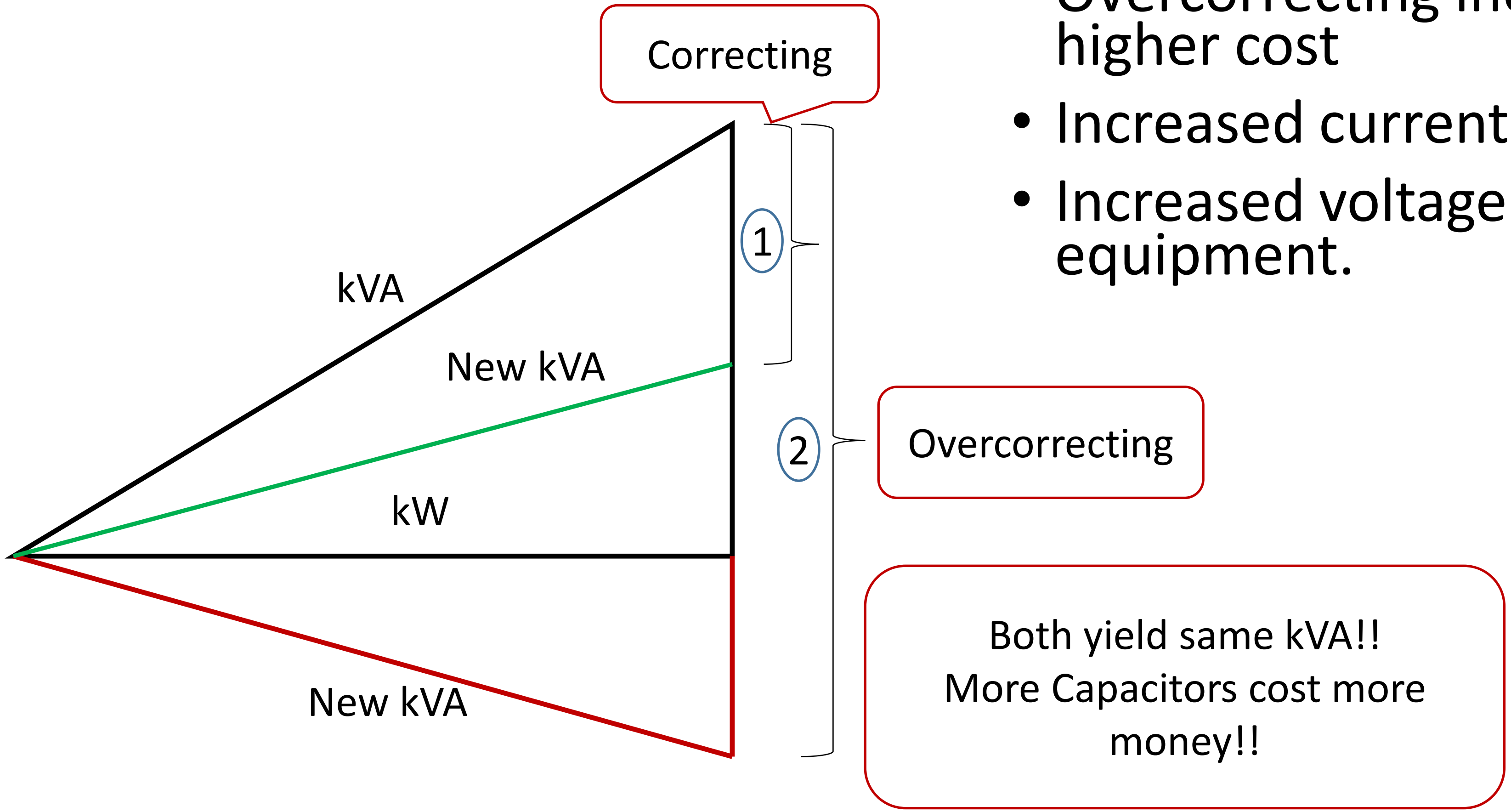
Effect of switching off capacitor bank

- If the capacitor bank is switched off during processing, PF goes back to 0.78
- Demand is raised from 473 kVA to 600 kVA
- Financial losses (kVA demand)

$$(600 - 473) \times 800 = Kshs.\ 101{,}600$$

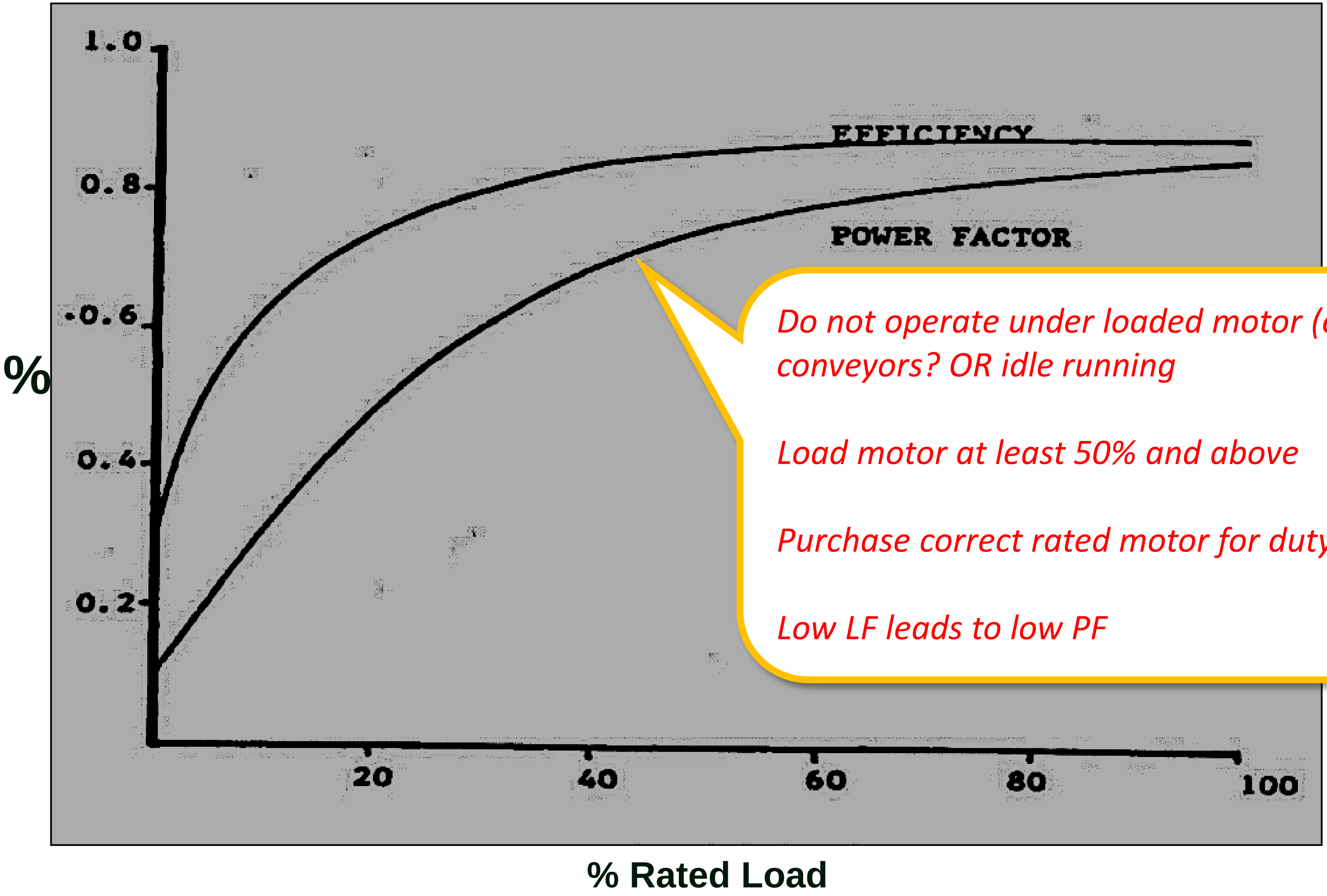
- Additional losses due to PF surcharge

Impact of overcorrecting PF



- When PF=1, kW=kVA
- Overcorrecting increases kVA→ higher cost
- Increased currents-losses!
- Increased voltage can damage equipment.

2. Proper loading of motors



Do not operate under loaded motor (empty conveyors? OR idle running

Load motor at least 50% and above

Purchase correct rated motor for duty

Low LF leads to low PF

Benefits of improving power factor?

1. Lower cost of electricity by;
   a. **Peak kVA billing demand-** high PF $\rightarrow$ low KVAR $\rightarrow$ low KVA.
   b. **Eliminating power factor penalty**- Utility charges for low PF (<0.9).
2. Increased system capacity

For example, a 1,000 KVA transformer with an 80% power factor provides 800 KW of power to the main bus. By increasing the power factor to 90%, the kW that can be supplied are:

$$0.9 = \frac{kW}{1000}, \text{Hence kW} = 900 \text{ kW}$$

3. Improved voltage level: As power factor increases, total line current reduces, meaning more efficient, cooler motor performance and longer motor life.

Operational excellence

Do's

- Do not oversize capacitor banks
- Always switch on capacitor banks when required
- Properly load motors and conveyors (at least 50%)

Don'ts

- Don't run idle or empty conveyors
- Do not overload motors

Module 3: Generator

Cost considerations

- Cost of diesel
- Energy content of a liter of diesel: 32 MJ/l
- Energy conversion: 1 kWh=3.6 MJ
- Generator electricity generation efficiency: 30%

$$efficiency, \eta_g = \frac{output}{input}$$

- 1kWh of electricity requires how many kWh diesel?

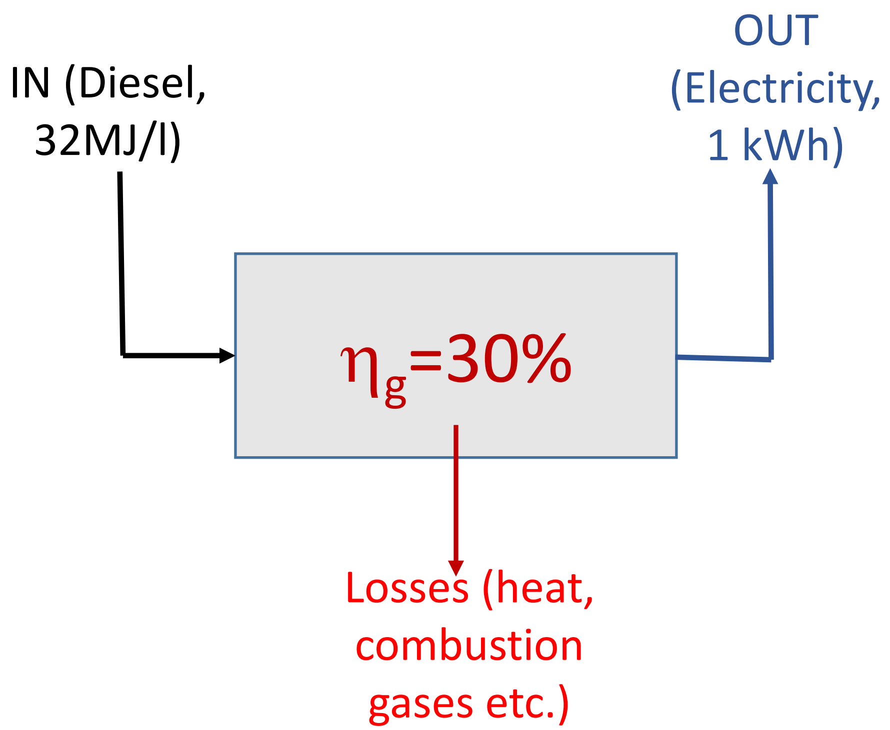
$$input\ (kWh) = \frac{output\ (kWh)}{n_g} = \frac{1}{0.3} = 3.33\ kWh$$

- How many MJ of diesel are these;

$$3.33\ kWh \times \frac{3.6\ MJ}{kWh} = 12\ MJ$$

- 1 liter of diesel has 32 MJ energy content and costs Kshs. 96.
- Cost of generating 1 kWh electricity is;

$$\frac{12\ MJ}{32\ MJ} \times Kshs. 96 = Kshs. 36/kWh$$

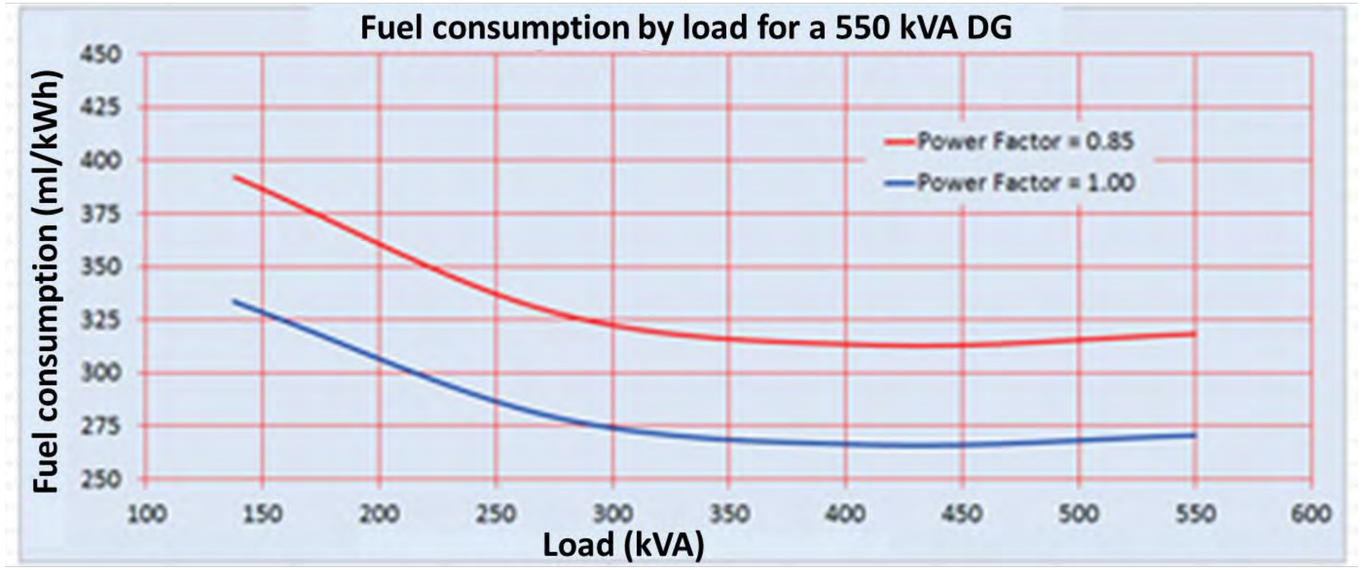


Specific Fuel Consumption (SFC)

- Quantity of diesel required to generate one unit of electricity.

$$SFC = \frac{Fuel\ consumtion\ per\ unit\ time}{power\ produced}$$

- Lower SFC $\rightarrow$ higher efficiency
- Optimum SFC at 75-80% loading
- e.g. a 500 kVA set is observed to have 20% better SFC at 75% than at 25% loading



Generator efficiency

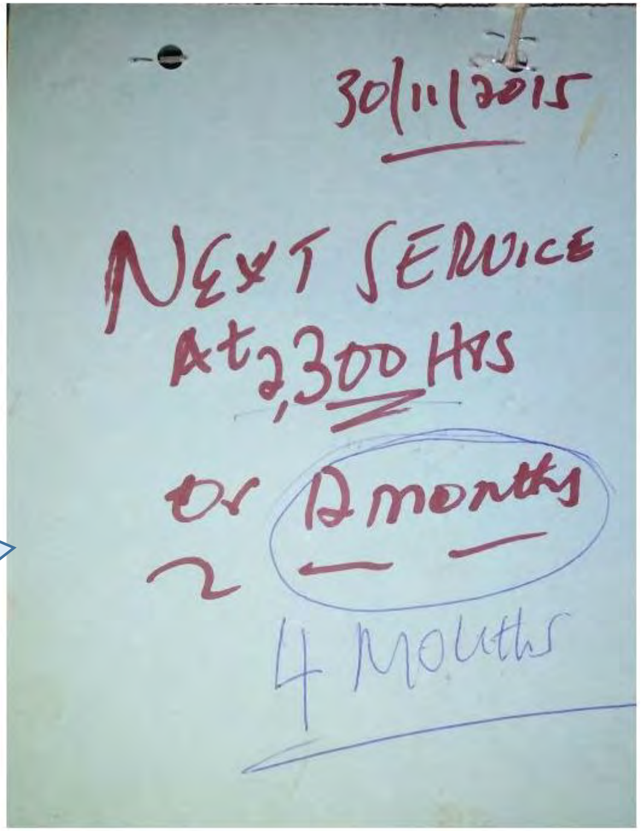
- Do not use a big generator to run small loads!!
- Factory can have 3 generators
  - Biggest generator- to use when at full load.
  - Medium generator- to use when at half load
  - Small generator- use when factory is not processing.

This saves on diesel cost and reduces CO_2 emissions

Generator maintenance

Use manufacturer’s recommended checklist

Service as recommended



Operational excellence

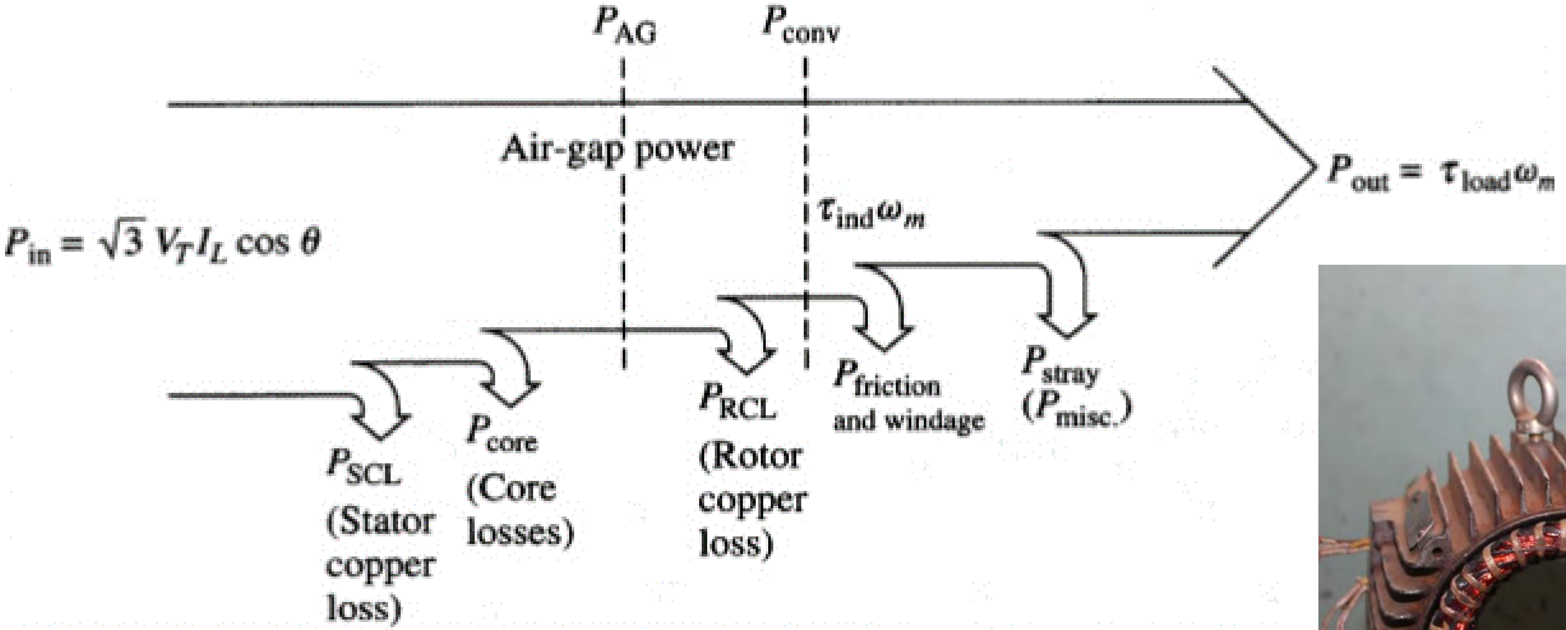
Do's

- Where possible use the right generator for the load
- Regularly maintain generators per manufacturer's recommendations

Don'ts

- Don't use a very big generator for very small loads

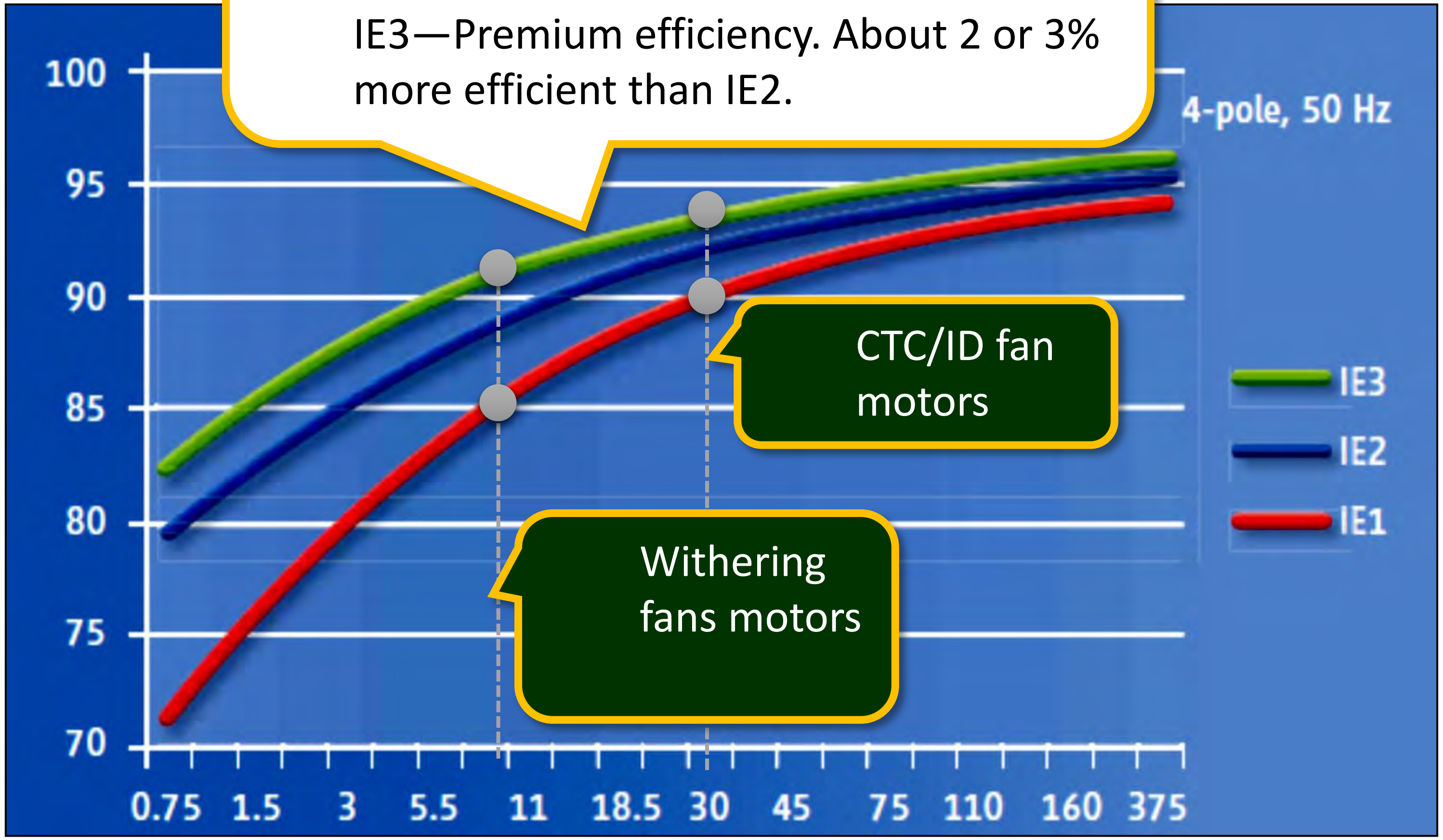
Module 4: Motors & fans



- All induction motors have losses; constant (fixed) & variable losses.
- Full load motor efficiency varies from about 85% to 97%, due to losses;

Motor efficiency

IE1—Standard efficiency (EFF 2)
IE2—High efficiency (EFF 1). About 4 or 5% more efficient than IE1.
IE3—Premium efficiency. About 2 or 3% more efficient than IE2.



Motor retrofitting/replacing

	22 kW	22 kW
Efficiency	93%	86%
Process Hours	4200	4200
Load (70%)	15.4	15.4
Elec. Energy (kWh)	$\frac{15.4}{0.93} \times 4200$=69,548	$\frac{15.4}{0.86} \times 4200$=75,209
Energy Cost [KSh20/kWh]	KSh 1,390,960	KSh 1,504,180

For retrofitting:

- ***Energy Efficient Motor : KSh 200,000***
- ***Savings: KSh 113,220 per year***
- ***Pay Back: 1.76 years***

In case of replace:

- ***EE Motor Extra Cost over Std Motor Cost: KSh 50,000***
- ***Savings: KSh 113,220 per year***
- ***Pay Back: 5.3 months***

Motor rewinding

- Will repaired motor retain its efficiency?
- Repair decision making process involves;
    - Suitability for application (sizing, enclosure)
    - Condition of stator and rotor
    - Assess all damages: cost of repair vs replacement
    - Efficiency; lifecycle costing
    - Availability of funds & replacement motor
    - ROI for replacement acceptable when replacing with energy efficient motor?

Good rewinding practice

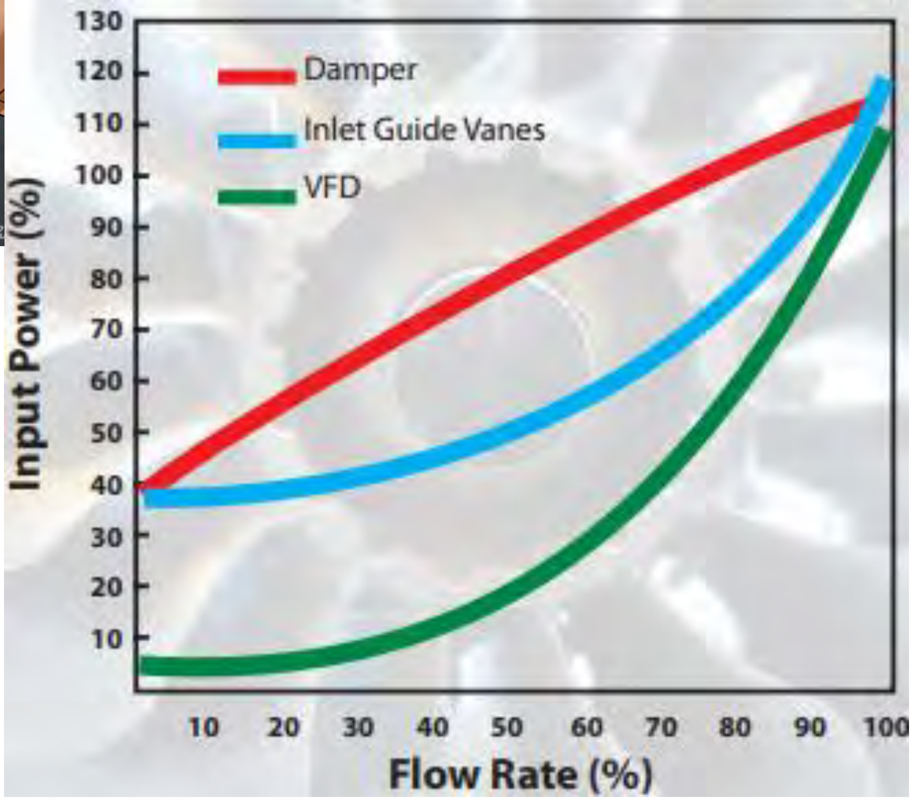
- To maintain or reduce winding copper (i^2R) losses;
  - Ensure overall length of turns in windings does not increase (more resistance increases losses)
  - Increase wire area if slot fit allows it (larger area reduces resistance, reducing losses)
- Maintain efficiency by
  - Copy-rewinding or improving winding pattern
  - Use same or shorter average length of turns
  - Using same parts as before e.g. bearings, fans etc.
- Why could efficiency drop?
  - Damage to the stator while removing damaged windings.
  - Reassembly can cause more acute problems

Methods of starting motors/fans

- Direct-on-line starting (D.O.L)- high starting current that may cause interference with supplies to other consumers.
  - Low power and torque.
  - Suitable for small fans (38 inches)
- Star-delta starting- stator phase winding are star-connected.
  - High energy consumption
  - Higher torque
  - Suitable for larger fans e.g. 48 inches.
- Auto transformer starting- auto transformer reduces stator starting current- torque seriously reduced.
  - When motor is up to speed, switch is moved to direct connection.

Fans: Dampers vs Variable frequency drives (VFDs)

- Dampers used to control volumetric air flow.
  - They are like pressing car's throttle (accelerator) and brakes together!!
  - Cheap to buy & install
  - Energy inefficient
  - Require frequent maintenance
- VSDs/VFDs
  - operate like a car's throttle.
  - Adjusts speed of motor based on demand.
  - Most energy efficient
  - More expensive to buy
  - Pay back within the lifetime.
  - Harmonic concerns



Operational excellence

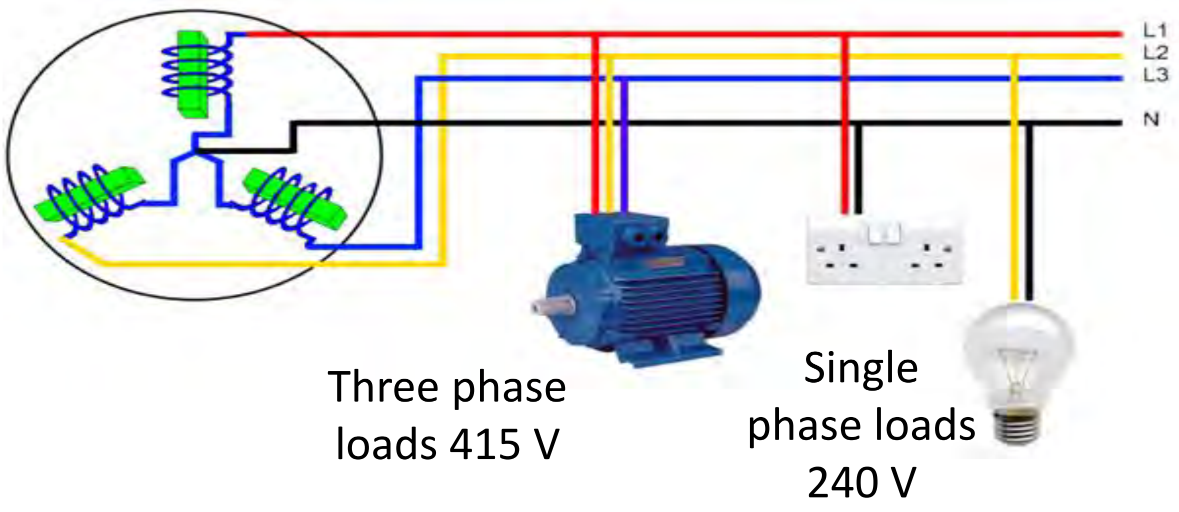
Do's

- Consider high efficiency motors while replacing std motors
- Follow due diligence while rewinding motors.
- Use suitable connection for motors and fans based on torque required.
- Consider VFDs in place of dampers

Don'ts

- Do not connect VFDs and then fix the speed.
- Do not use VFDs and dampers together.

Module 5: Voltage balance



- Line voltage- between phases.
- Phase voltage- between phase and neutral.

- Ideally:
  - Load in each phase should be the same
  - No net current flows thro neutral
- Not possible to achieve ideal situation

Causes of imbalance

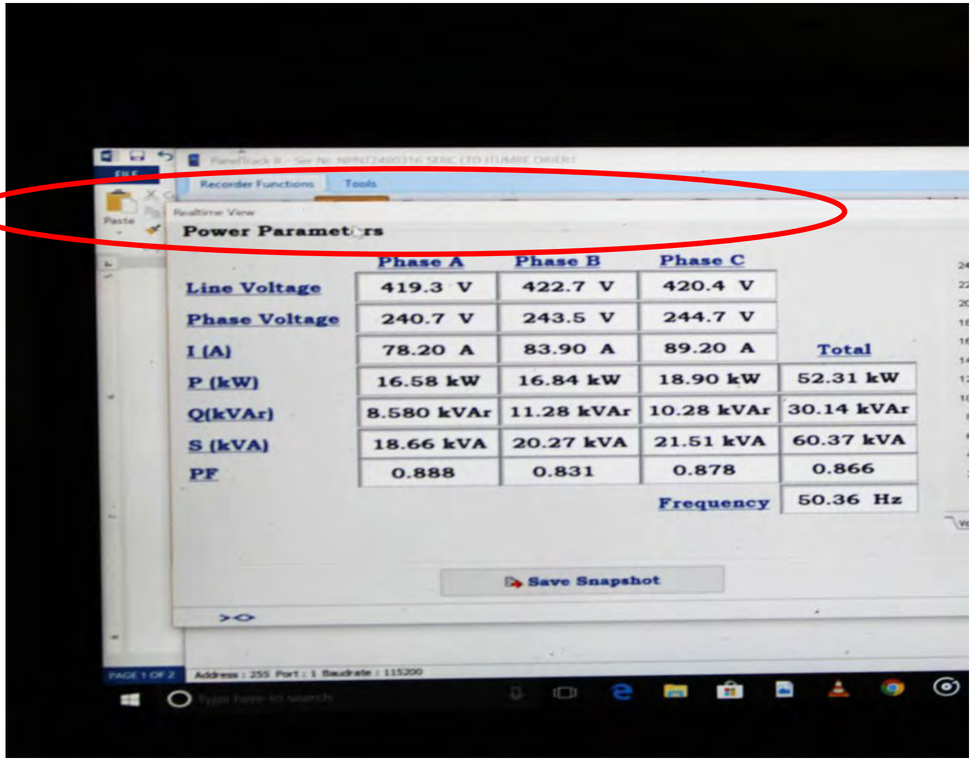
- Unequal reactance in induction motors $\rightarrow$varying current in three phases.
- Connecting single phase loads to only one phase.
- Unequal impedances in power transmission or distribution system.

Control Measures

- Distribute single phase loads equally among the three phases
- Replace or rewind motors with unbalanced three phase reactance

Quantifying the losses

$$\% \; imbalance = \frac{max. \; voltage \; deviation}{\text{average voltage}} \times 100$$



Example: average voltage = $420.8V$.

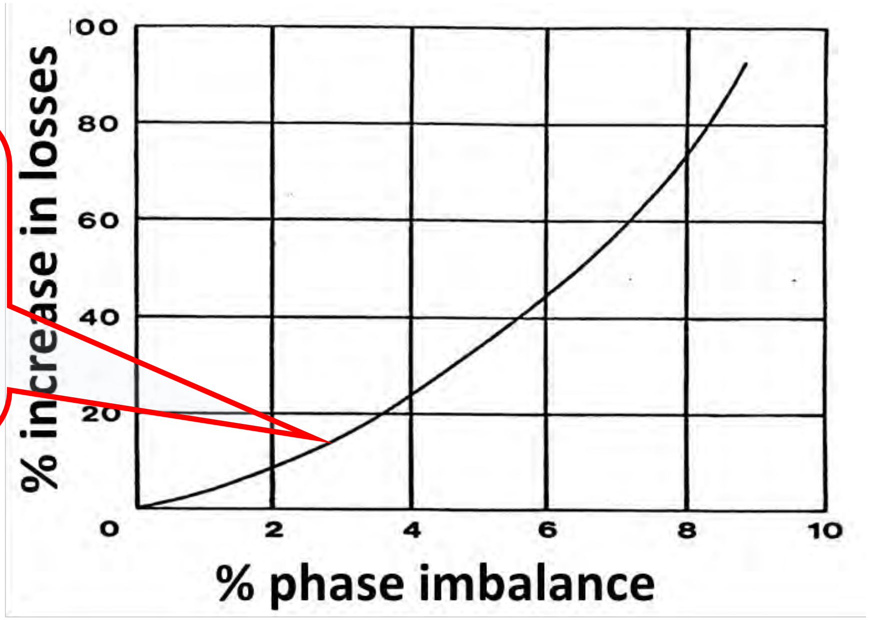
$$\% \; imbalance = \frac{422.7 - 420.8}{420.8} \times 100$$

$$= 0.45\%$$

- Up to 2% imbalance is acceptable.
- Operation of a motor with above a 5% imbalance condition can damage to the motor.

Effects of imbalance

- $temperature\ rise = 2 \times \%imbalance^2$
- 7% imbalance = double temp rise
- 10° C rise in temp. reduces motor life 50%



- Power losses:
  - Low motor efficiency
  - Increased temperature $\rightarrow$ heat losses (i^2R).
- Maintenance issues:
  - Temperature rise: decomposes grease in bearings & de-rates motor winding
  - Fluctuating torque & speed – vibrations & noise damages the motor
  - De-rating of power cables- Imbalances cause higher current$\rightarrow$ heat losses (i^2R).
- More power loss higher $\rightarrow$ more power bills.

Operational excellence

Do's

- Try to equally distribute single phase loads.
- Frequently monitor motors that could cause imbalances.
- Replace/rewind such motors.

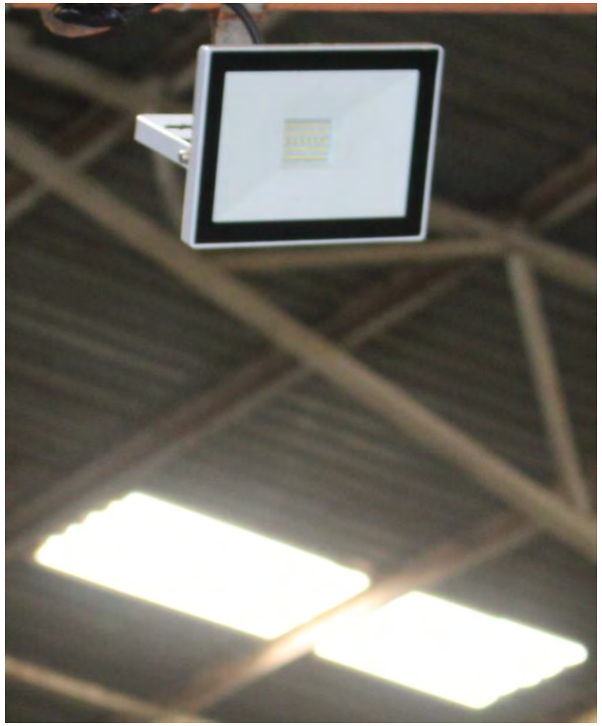
Don'ts

Module 6: Lighting

Common sources of light

- Incandescent- has a wire element. 90% heat and 10% light (100W bulb produces 90W heat and 10W light)
- Fluorescent – linear, U-tubes, CFLs.

  40% light and 60% heat
- LED – Light emitting diodes
- Natural (sunlight)



Skylight and LED at a tea factory

	LEDs	CFLs	Incandescent
Lifespan (hours)	50,000	10,000	1,200
Power (equiv. 60 watts)	6	15	60
Energy used over 50,000 hours (kWh)	300	750	3,000
Electricity cost (@Kes20/kWh)	6,000	15,000	60,000
Bulbs needed for 50,000 hours of use	1	5	42
Cost per bulb (Kes)	500	250	50
Cost of bulbs (Kes)	500	1,250	2,100
Cost of bulbs + energy after 50,000 hours (Kes)	6,500	16,250	62,100
For a house with 5 bulbs only, in 50,000 hours			
Energy (kWh)	1,500	3,750	15,000
Cost (Kes)	32,500	81,250	310,500
Energy savings (kWh)	**13,500**	**11,250**	**0**
Cost savings (Kes)	**278,000**	**229,250**	**0**

Comparing the features of common bulbs

	LEDs	Fluorescent	Incandescent
Frequent On/Off Cycling	no effect	shortens lifespan	some effect
Turns on instantly	Yes	Slight delay	yes
Durability	Durable	Fragile	Fragile
Heat Emitted	Low (3.16 kJ/h)	Medium (15.83 kJ/h)	High (89.68 kJ/h)
Hazardous Materials	None	5 mg mercury/bulb	none
Replacement frequency (over 50,000 hours)	1	5	40+

Evident that LEDs have the best qualities.

Retrofitting fluorescent lamps

	Fluorescent	LED
Power (W)	58	18
Hours (in a year)	3,600	3,600
Energy (kWh/year)	$58 \times 3600/1000 = 209$	$18 \times 3600/1000 = 65$
Cost (Kshs/year)	$209 \times 20 = 4{,}180$	$65 \times 20 = 1{,}300$

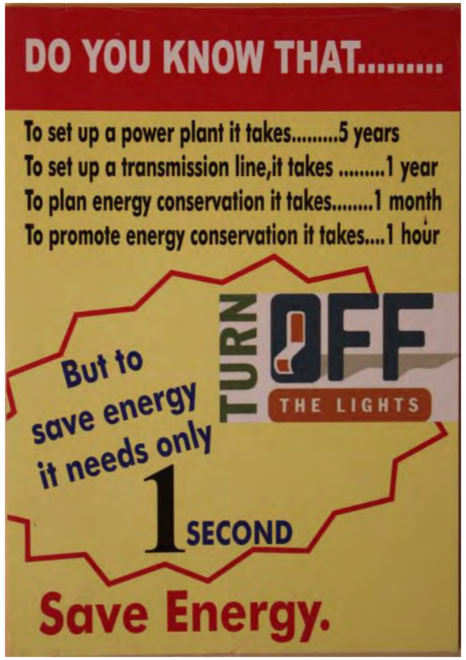
- *Energy Efficient Lamp (LED) : KShs 3000*
- *Assume 200 lamps replacement: KShs 600,000*
- *Savings:* $(4{,}180 - 1{,}300) \times 200 =$ *KShs 576,000/year*
- *Pay Back:* $\frac{600{,}000}{576{,}000} \cong 1\ year$

Retrofitting security lights

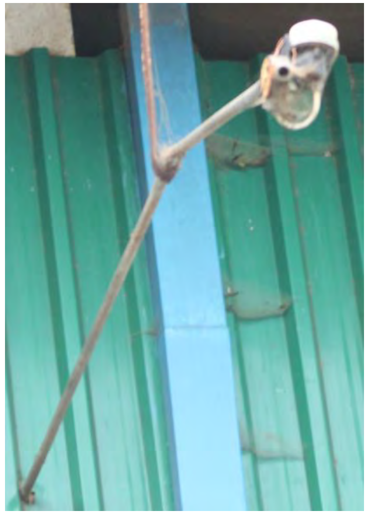
	Metal Halide	LED
Power (W)	250	100
Hours (in a year)	4,380	4,380
Energy (kWh/year)	$250 \times 4380/1000 = 1{,}095$	$100 \times 4380/1000 =$438
Cost (Kshs/year)	$1{,}095 \times 20 = 21{,}900$	$438 \times 20 = 8{,}760$

- Replacing 10 Halogen lamps with LED Equivalent
- Cost of LED lights @2,500= KSh 250,000
- Energy Cost Savings: $(21{,}900 - 8{,}760) \times 10 =$ KSh 131,400/year
- Pay Back: $\frac{250{,}000}{131{,}400} = 1.9\ years$

Proper lights operation



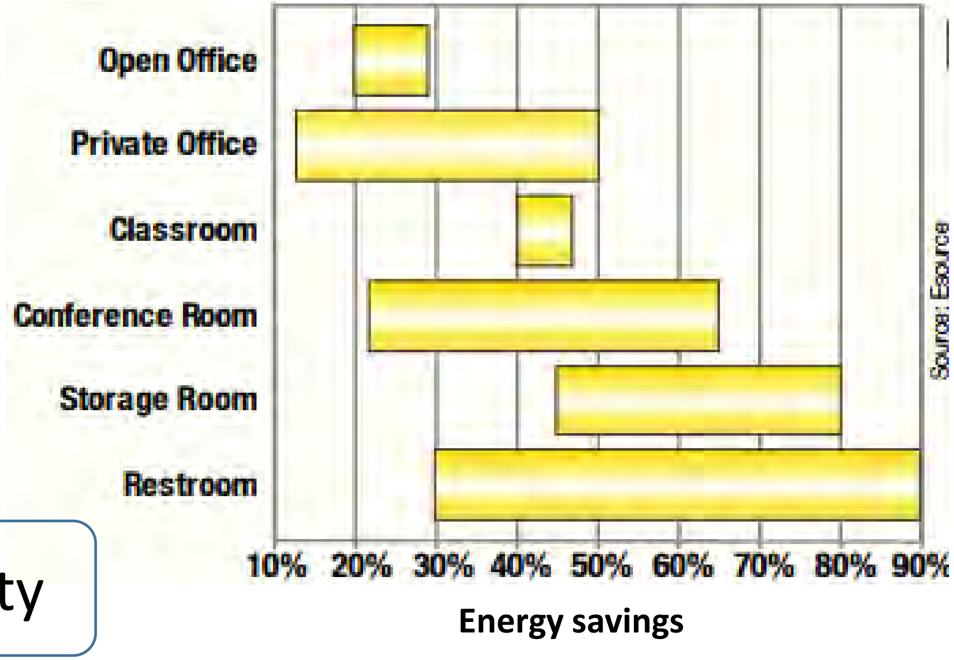
Sensitize



- Security lights should have photocells- night
- Photocells+motion sensors – night & motion

Consider solar security

Where possible, use natural light



Install occupancy sensors

Operational excellence

Do's

- Pay attention to sensitizing materials on lights operation
- Occasionally clean the skylights.
- Automate lights operation where possible.

Don'ts

- Don't leave lights switched on unnecessarily.

Module 7: Energy monitoring & sub-metering

You
can’t manage what
isn’t measured.
If you don’t
measure, you can't
improve it

- Install sub-meters in various sections of the factory.
- Periodically measure & record individual motors/fans
- Compare similar processes

Why sub-meter?

- Verify utility bills
- Allocate energy costs and assign accountability
- Determine equipment/system efficiency
- Identify process problems
- Identifying future energy savings opportunities
- Compare similar processes

Potential energy savings from sub-meters

- Increased awareness- Employees notice energy waste e.g. lights left on when they know it is being metered.
- Savings from increased accountability- Measuring energy costs can show that decisions made by production staff & energy managers play a significant role in the overall cost of energy.
- Savings from automation- e.g. during peak electrical demand, non critical load could be shut down.

Instrumentation

- In case there are no sub-meters, use portable meters such as power meters to record and monitor energy consumption.

What must you do?

By themselves, meters do not save money -- they only cost money to purchase and install. To maximize savings, complement a sub metering system with appropriate procedures.

- Keep records

  Develop & maintaining a database.

- Analyze the data

  Trends, peaks, and correlation with factors such as weather, season, operating shift, and production rate.

  Make sense of the data

- Take action

  For continuous improvement & preventive maintenance

  Actions could save the factory downtime, labour and money.

Operational excellence

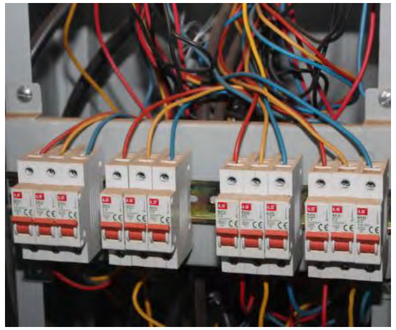
Do's

- Take energy consumption readings occasionally for various loads.
- Record and compare the consumption.
- Analyze the data
- Take appropriate actions.

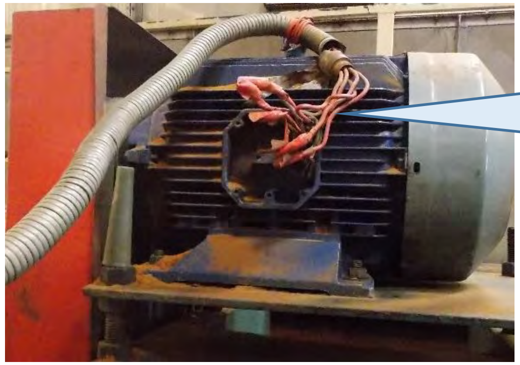
Don'ts

- Don't record data just because you are asked to!

Module 8: Maintenance



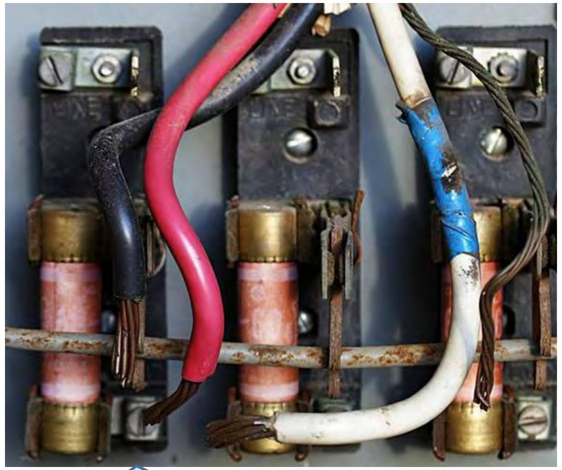
Wiring should be neat!
Ease of troubleshooting



Use/ensure correct cable size, colour coding and termination

Digitize records

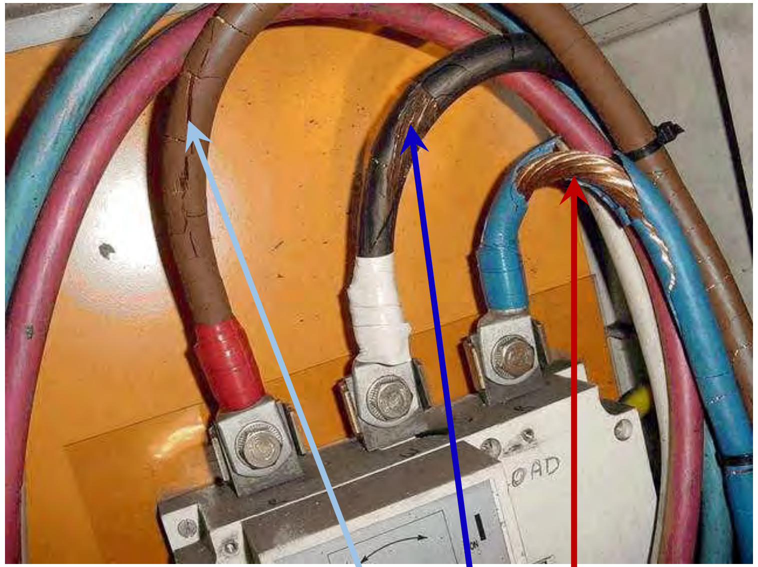
Properly label the distribution panel



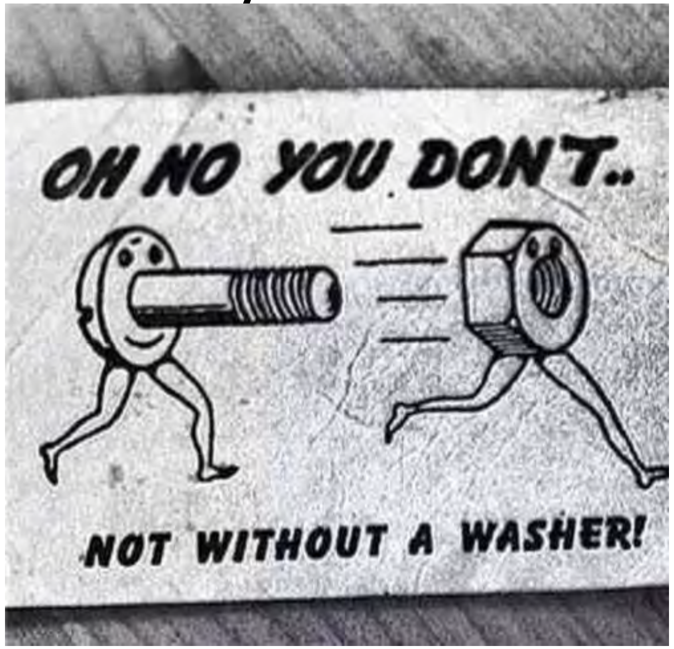
Never short circuit a fuse/circuit breaker. Prevent catastrophe!

Maintenance

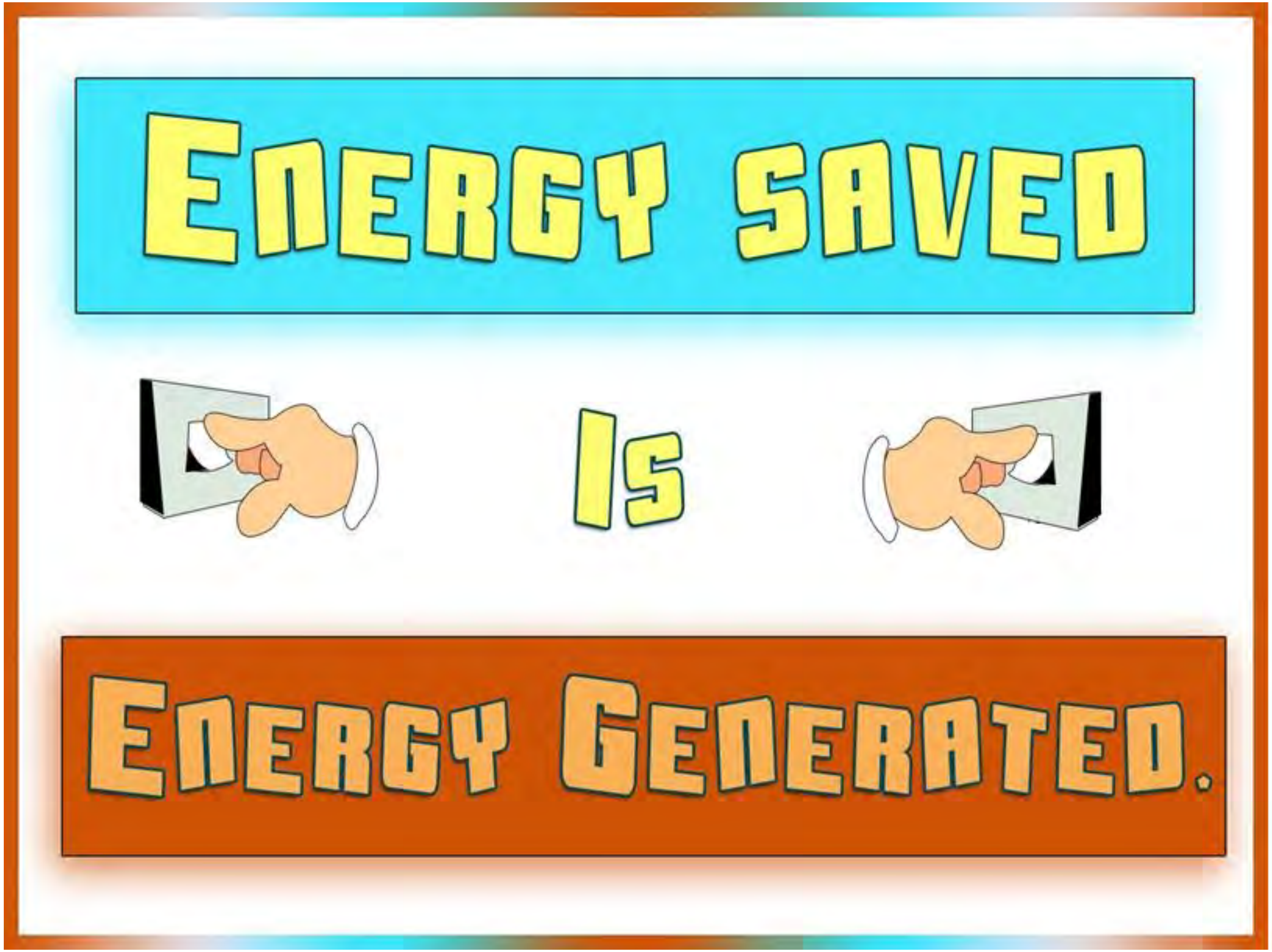
- Power house should be kept clean
  - Close the door so as to only allow authorized personnel.
  - Ensure no water on the floor.
  - Should be well ventilated.
- Ensure all indicating devices are fully functional and properly set.



Examine insulation



NO Shortcuts!!
Follow the procedure


ENERGY SAVED
IS
ENERGY GENERATED.