
CORPORATE PRESENTATION & INDUSTRIAL CASE STUDIES FOR ENERGY EFFICIENCY



About Us

Anama Enertech Solutions is a group company of 17-year-old Anama Energies Pvt. Ltd. dedicated to provide Cogeneration and Trigeneration solutions in Steam, Gas and Liquid fuel-based systems.

Energy conservation begins with Optimum utilization of energy resources and to optimize the same Anama has created a niche entity Anama Energy Solutions Pvt. Ltd. which is dedicated to offer services in the field Energy Audit and optimization.



Our Commitment

- **Mission:** Providing services to industrial sectors to improve their energy efficiency on a sustainable basis, thereby enhancing their competitive edge and profitability.
- **Vision:** To be a global leader in energy conservation domain, through energy audit services, energy efficiency project implementations, training in energy management and execution of green eco-friendly projects.



AREAS OF OPERATION

Anama Energies Pvt Ltd:

- **Steam Turbine Based Cogeneration and Trigeneration.**
 - Tailor made CHP solutions through extensive range of steam turbines
 - Back pressure, Extraction cum condensing as well as condensing turbines
- **Natural Gas based Cogen.**
 - CHP solutions using Gas Engines and Turbines with Waste heat recovery system
 - Vapor Absorption, Process heat projects from waste heat of gas engines
- **Biogas/Biomass based Power generation and CHP.**
 - Sole representative of Schmitt Enertech
 - Technology licensee of IISC – Bangalore
 - Biomass briquette based process steam and CHP
 - **Biomass gasification for process/power**



AREAS OF OPERATION

Anama Enertech Solutions Pvt Ltd:

- Comprehensive Energy Audits for Electrical and Thermal Systems.
- Energy Efficiency Project Implementation.
- Energy Management Training Programs.
- Energy Management services for Gas Turbine Power plants
- CDM Projects for Carbon Credits.
- Waste Heat Recovery and Cogeneration Feasibility.
- Water System Audits.



PEOPLE & LOCATIONS

- **H.M. Kamat: (Managing Director)** – IITian with 23 years of professional experience in energy and power field in companies like Thermax and Alfalaval.
- **Pramod Kembhavi (Managing Director: Anama Enertech Solutions Pvt Ltd)**
Certified Energy Auditor with distinction in the certification examination conducted by Bureau of Energy Efficiency (Government of India). Expertise on Boilers Design/performance optimisation, Energy conservation opportunities for Utilities including Thermal and electrical systems.
- **Sanjay Pethe (Founder Director)** IIT, MS (USA), MBA (USA). Over 23 years experience in energy and power with Thermax, Aspentech and currently with Conco Phillips USA.
- **Deepak Mahurkar (Technical Advisor to be taken on Board)** BE, MBA, PhD (Pursuing) 18 years of technical experience. Currently with Price waterhouse Cooper in the capacity of Associate Director.
- **Shireesh Kedare:** Adjunct Associate Professor IIT Bombay and an authority on Wind and Solar energy. His fields of specialization includes Concentrating Solar collectors, Industrial energy storage and thermal hybrid systems with solar devices.
- **Ratnakar Gokhale:** An Engineer MBA having Over 20 years of experience in Sales & Marketing, Business Development, Operations and Management. Having a rich experience with organizations like Akzo Nobel Coatings India, Thermax, Kirloskar, Mazda & Schlumberger.

LOCATIONS

- Pune (Head office)
- Baroda
- Bangalore



ENERGY SERVICES

Objectives of Energy Audit

- ✓ To study the present pattern of energy consumption
- ✓ Examination and evaluation of energy efficiency of major energy consuming systems, processes and equipments
- ✓ Identify the potential areas for energy optimization
- ✓ To recommend energy conservation proposals with cost benefit analysis
- ✓ To identify CDM, cogeneration and renewable energy projects
- ✓ Training to plant personnel for effective energy management



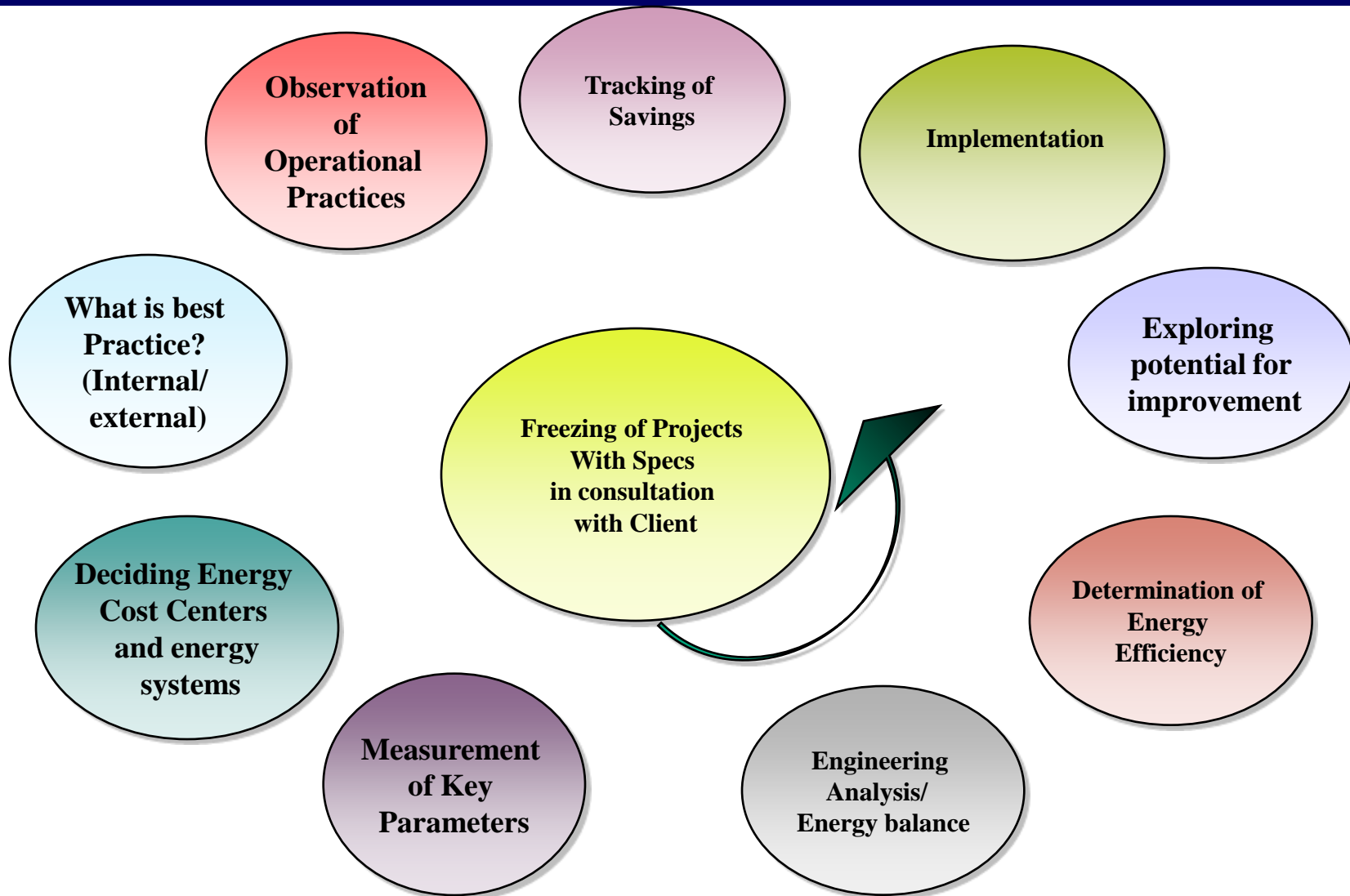
STATE-OF-THE-ART INSTRUMENTS AT ANAMA

Major instruments used for energy audit

- ✓ 3 phase power quality analyser
- ✓ Single phase power analyser
- ✓ Flue gas analyser – Measurement of parameters in flue gas
- ✓ Contact type temperature indicators
- ✓ Infra-red non contact temperature indicator
- ✓ Ultrasonic flow meter – Fluid flow
- ✓ Anemometer – Air velocity



OUR APPROACH FOR ENERGY AUDIT



Areas Covered in Audits

- **Thermal System:** Boilers, Hot Water Generators, Waste Heat Recovery Systems, Steam distribution system, Insulation, Steam Traps, Condensate and Flash Recovery system, Insulation, Steam Traps, Condensate and Flash Recovery system, Thermic Fluid Heaters, Instrumentation and Controls, Monitoring , Cogeneration & Fuel switch over options.
- **Electrical System:** Transformers, Distribution, Analysis of Demand, PF Improvement, Motor Loading, Optimizing measures for equipment and system performance such as Blowers, Pumps, Fans, Compressors, option of Variable Speed Drives, Controls and Monitoring System, Cable Size analysis etc.
- **Compressed Air System:** Compressor Efficiency, Distribution, Distribution, Line Sizing, Layout, Accessories, Air Quality, Leakage Identification, Pressure Drop, Controls and Monitoring system
- **Water System:** Water Balance, Line Sizing, Pump Selection, Piping Layout, Accessories, Optimization of Consumption,
- **HVAC and Refrigeration System :**Chiller performance , AHU , optimization of A/C loads, Cooling Towers , Pumps
- **Lighting Systems**



OUR ESTEEMED CLIENTELE

ENERGY AUDITS - 2008

AUTOMOTIVE & TYRE

- BAJAJ AUTO LTD.
- BADVE GROUP
- APPOLO TYRES

STEEL

- ISPAT INDUSTRIES LTD.
- UTTAM GALVA STEELS LTD.

HOTELS

- TAJ GROUP OF HOTELS
- INTERCONTINENTAL GROUP OF HOTELS
- LE-MERIDIEN
- BHARAT GROUP OF HOTELS

STARCH

- RIDDHI SIDDHI GLUCO BIOLS

PHARMA

- BRIOCIA
- BIOCON

OUR INTERNATIONAL CLIENTS

- Al Sallan Foods SAOG – Oman
- Strategic Foods – Dubai (Britannia group)
- Bidco Oil Refineries (Kenya)
- Ispat / Kremikovetzi(Bulgaria)
- Pure Ice cream (Sharjah)
- Taj Pamodzi (Zambia)

TEXTILE INDUSTRY

- BHARAT VIJAY MILLS – TEXTILE DIV.

FOOD & BEVERAGE INDUSTRY

- KWALITY BRAND COMPANIES
- UNITED BREWERIES LTD.



ENERGY EFFICIENCY AVENUES FOR PORT TRUST



ENERGY CONSERVATION AVENUES

FACILITIES INCLUDE :

**MATERIAL HANDLING SYSTEMS : STACKERS , RECLAIMERS , SHIP LOADERS ,SHIP UNLOADERS,
CONVEYORS , VEHICLES ,CRANES,HOISTS ETC.**

UTILITY SYSTEMS : WATER PUMPS, COMPRESSORS , LIGHTING , DG SETS

**ADMIN.BUILDINGS,OFFICES,
HOSPITALS,GUEST HOUSES ETC.:AIRCONDITIONING , HEATING ,PUMPS , LIGHTING**

ELECTRICAL SYSTEMS : TRANSFORMERS , SUBSTATIONS , SWITCH GEAR



POTENTIAL AREAS FOR ENERGY OPTIMIZATION

- **Replace underloaded motors with correct sized motors for improved efficiency**
- **Replace rewind motors with new high efficiency motors**
- **Provide full automation (or semi automation) for optimum loading of conveyors with variable speed drives for conveyor motors**
- **Improve power factor to near unity by providing appropriate capacitor banks and ensuring automatic P.F. control**
- **Provide capacitors at user ends wherever possible.**
- **Optimize loading on the transformers (by cyclic deenergizing of one of the transformers for optimum loading on the others)**
- **Monitor specific consumption (Such as units / ton of ore dispatched , and fuel Lit / ton of ore dispatch on a daily , monthly basis.**
- **Provide adequate energy metering for all major feeders to enable monitor specific energy consumption**



POTENTIAL AREAS FOR ENERGY OPTIMIZATION

- **Analyse major motors for their daily pattern of loading & variation pattern in voltage , current , p.f . Also, monitor the harmonics during logging for above analysis.**
- **Optimize Capacitors to reduce capacitor losses**
- **Optimize High Mast Lighting / Consider LED**
- **Optimize Pump performance for higher rating pumps (Above 10 KW)**
- **Separate feeder for Lighting with voltage regulation Optimize Air conditioning system for Hospital**
- **Bio gas generation from food waste can be considered for Hospital**
- **Use solar heating system wherever possible.**



FUEL SAVING TIPS FOR VEHICLES

- **Stop Fuel leaks. A leak of one drop of diesel / second leads to wastage of 2000 Lit / year. Leakage in continuous stream leads to a wastage of 33000 liters / year.**
- **Maintain Correct Air pressure in wheels and clean the air filters regularly.**
- **Avoid pumping the accelerator during starting**
- **Anticipate stops , obstacles and turns, and avoid sudden acceleration / breaking .Drive steadily at optimum speed.**
- **Do not rest the foot on the clutch peddle always. Clutch riding costs more fuel. Press clutch only during gear change / stop.**
- **Stop the engine if idling time is more than 2 minutes.**
- **Tuning / servicing of engines at regular intervals to reduce emission levels leads to 6% of fuel saving.**
- **A vehicle which visibly emits black or dark grey smoke consumes nearly 10% more diesel.**



ELECTRICITY BILLING MECHANISUM

- **Energy charges**
 - **Actual charges based on active power**
 - **Charge based on apparent power**
- **Maximum demand charges**
 - **Based on maximum demand registered**
 - **Penalty for peak load**

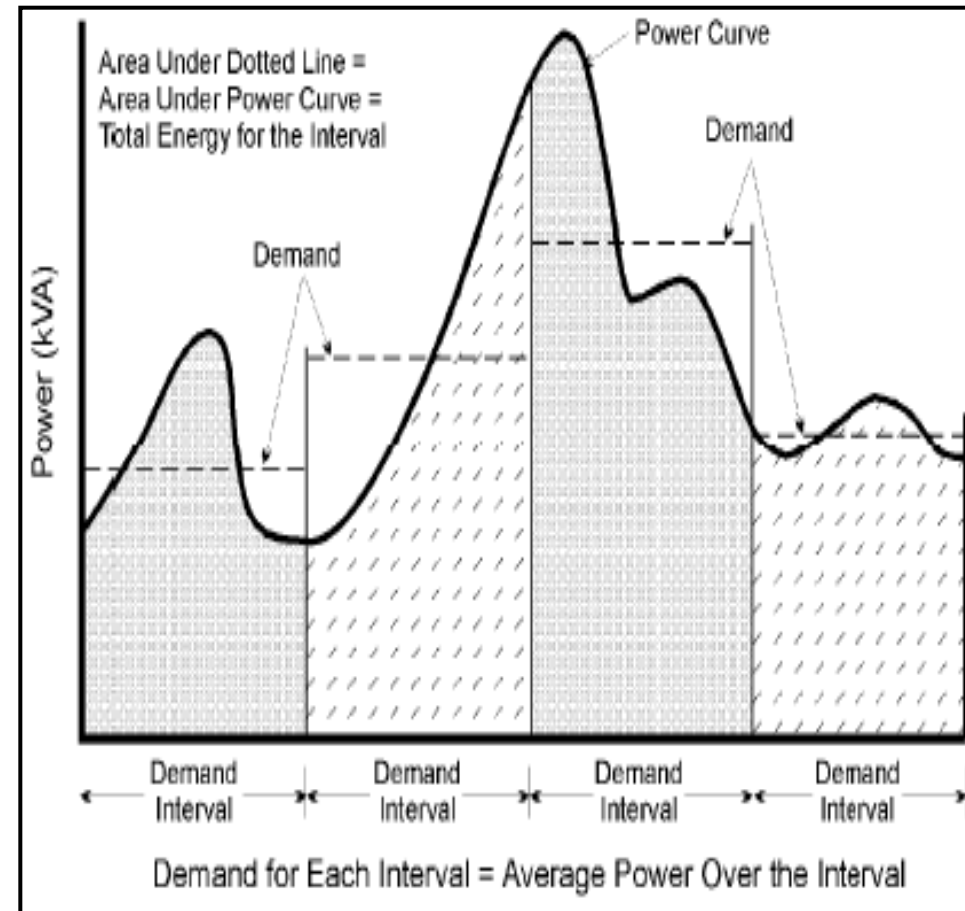


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- **ELECTRICITY BILLING MECHANISUM**
 - **Power factor penalty or bonus**
 - **Fuel costs**
 - **Electricity duty charges**
 - **Meter rentals**
 - **Lighting & fan power consumption**
 - **Time of Day (TOD) rates**



Electricity Billing Mechanism

- Demand measured in time intervals
- Maximum demand is highest reading
- Customer charged on highest maximum demand value!



ELECTRICAL LOAD MANAGEMENT

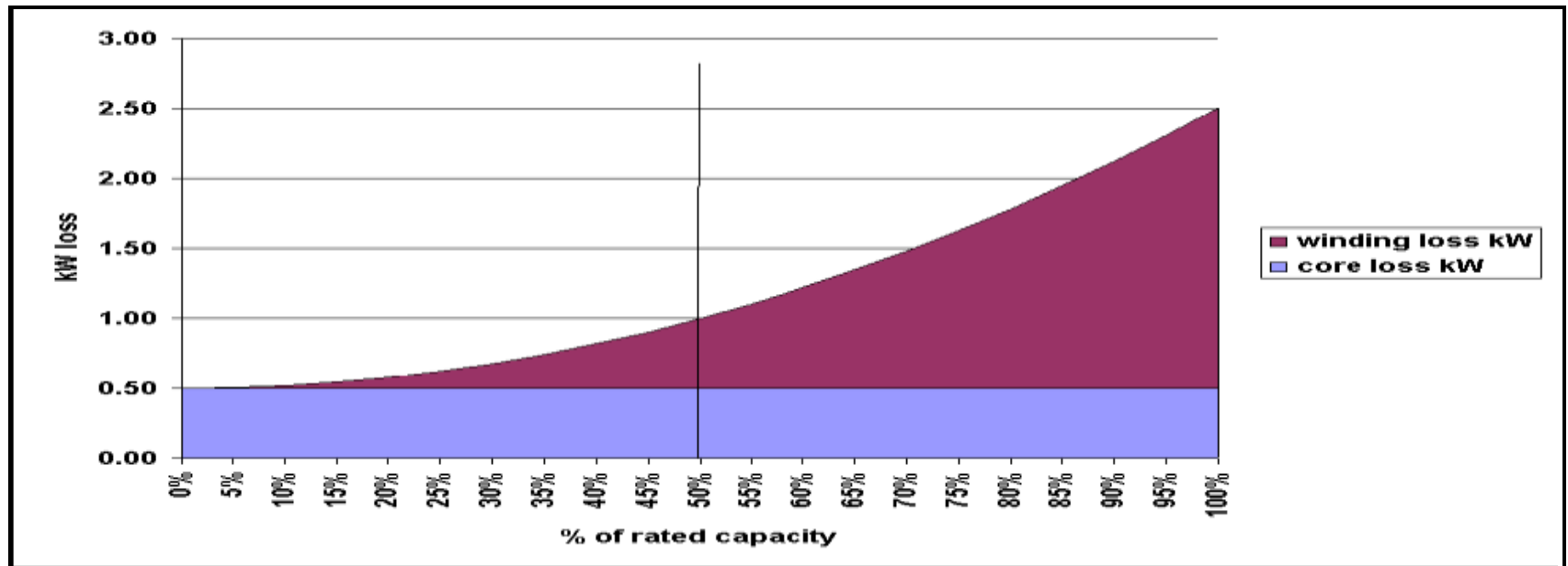
- **Strategies to manage peak load demand:**
- **Shift non-critical / non-continuous process loads to off-peak time**
- **Shed non-essential loads during peak time**
- **Operate in-house generation or diesel generator (dg) sets during peak time**
- **Operate AC units during off-peak times and utilize cool thermal storage**
- **Install power factor correction equipment**



Transformer Losses & Efficiency

$$P_{\text{TOTAL}} = P_{\text{NO-LOAD}} + (\% \text{ Load}/100)^2 \times P_{\text{LOAD}}$$

$$P_{\text{TOTAL}} = P_{\text{NO-LOAD}} + (\text{Load KVA}/\text{Rated KVA})^2 \times P_{\text{LOAD}}$$



Transformer loss versus percent loading (BEE, 2004)

- Transformer losses: constant and variable
- Best efficiency: load where constant loss = variable loss

Common Energy Conservation proposals Admin & other Buildings

Sr. No	Section	Measures	Investment
1	Hot water generator	1. Tuning of Boiler/ Hotwater generator	Nil
		2. Fuel Substitution High Speed Diesel (HSD) to Light Diesel Oil (LDO)	Nil
		3.Solar Heating	Medium term
3	Chilled water system	1. Increase in evaporator set temp	Nil
		2. Chiller pump optimization	Nil
		3. Installation of VFDs for condenser/chilled water pumps	Medium term
		4. Timer controls for air handling unit blowers	Short term
4	Electricity Bill	1. Maximum Demand optimization	Medium term
		2. Optimization of tariff slots	Nil
5	Lighting	1. Replacement of incandescent lamps with milky effect CFL	Medium term
		2. Stoppage of excess lighting in daytime	Nil
		3.Voltage control in areas like kitchens, laundry, back office etc.	Medium term



COST ECONOMICS OF DIFFERENT LIGHTING SOURCES

DETAILS	INCANDESCENT LAMP	FLUROCENT LAMP	CFL	LED
Life Expectancy Hrs.	1500	25000	10000	60000
Watts	60	40	14	6
Cost Rs.	30	50	150	2400
Efficacy Lumens per Watt	10 to 18	50 to 100	35 to 60	60 to 150
No.of fittings used for 60000 Hrs. operation	40	3	6	1
Cost of fittings Rs.	1200	150	900	2400
Used units(KWH) per fitting (for 60,000 Hrs.)	3600	2400	840	360



ENERGY CONSERVATION AVENUES

- BOILER / HOT WATER GENERATOR / TF HEATER EFFICIENCY OPTIMIZATION
- OPTIMIZATION OF OPERATING PARAMETERS
- OPTIMIZATION OF STEAM SYSTEM / CONDENSATE AND FLASH RECOVERY SYSTEMS
- FUEL SWITCH OVER / COGENERATION POSSIBILITY
- WASTE HEAT RECOVERY POSSIBILITIES
- CHANGE OVER FROM ELECTRICAL HEATING TO GAS / LPG
- DEHUMIDIFICATION AND A / C LOAD OPTIMIZATION
- WASTE MANAGEMENT AND INCINERATION
- USE OF RENEWABLE ENERGY SUCH AS SOLAR FOR HOT WATER
- BIOGAS BASED COGENERATION FROM EFFLUENT
- AUTOMATION
- MONITORING
- **UTILITIES**
- OPTIMIZATION OF MOTOR LOADING
- OPTIMIZATION OF COMPRESSED AIR SYSTEM
- OPTIMIZATION OF PUMPING SYSTEMS / BLOWERS / VFD FOR THESE
- OPTIMIZATION OF A/C AND LIGHTING SYSTEMS
- OPTIMIZE VENTILATION SYSTEM
- COOLING TOWERS OPTIMIZATION
- MAXIMUM DEMAND CONTROL
- PF OPTIMIZATION / TRANSFORMER LOADING OPTIMIZATION



ENERGY CONSERVATION AVENUES IN BUILDINGS

- ENVIRONMENT ARCHITECTURE :Climate Responsive Designs to optimize energy use for space cooling / heating
- WATER CONSERVATION / RAIN WATER HARVESTING
- ENERGY EFFICIENT LIGHTING : CFL /T8/T5/LED USAGE
- ENERGY EFFICIENT STAR EQUIPMENT (MIN.4 STARS) FOR CEILING FANS,EXHAUST FANS,REFRIGERATORS,AIRCONDITIONERS ETC.
- ENERGY EFFICIENT PUMPING SYSTEMS : Automatic Level controls , Hydro pneumatic pumping system with VFD etc.
- LIFTS : VARIABLE VOLTAGE / Variable Frequency Drives, Duplex controls for 2 or more lifts, Interlocking for fans/lighting
- SOLAR ENERGY FOR WATER HEATING
- GAS HEATERS INSTEAD OF ELECTRIC HEATERS
- OPTIMIZED HEAT RECOVERY FOR AIR CONDITIONED ROOMS
- INCREASE SET POINTS FOR A/C WITH FANS FOR COMFORT COOLING.
- INTERLOCKS FOR LIGHTING WITH TECHNOLOGIES SUCH AS OCCUPANCY SENSORS ETC.
- ENERGY EFFICIENT ELECTRICAL INSTALLATIONS : TRANSFORMERS / MOTORS/ PF OPTIMIZATION/ OPTIMUM CABLING
- EXTERNAL LIGHTING / PASSAGE LIGHTING WITH VOLTAGE CONTROLS AND INTERLOCKS , PREFERABLY WITH SOLAR PV
- USE OF ELECTRONIC BALLAST IN PLACE OF CONVENTIONAL CHOCK
- AWARENESS ABOUT GOOD OPERATIONAL PRACTICES : Run Washing M/C full load, Turn off ventilation fans when not required, switch off lights while going out, Use day light as far as possible ,shut off computer monitor when not in use
- .BIOGAS GENERATION THROUGH KITCHEN WASTE

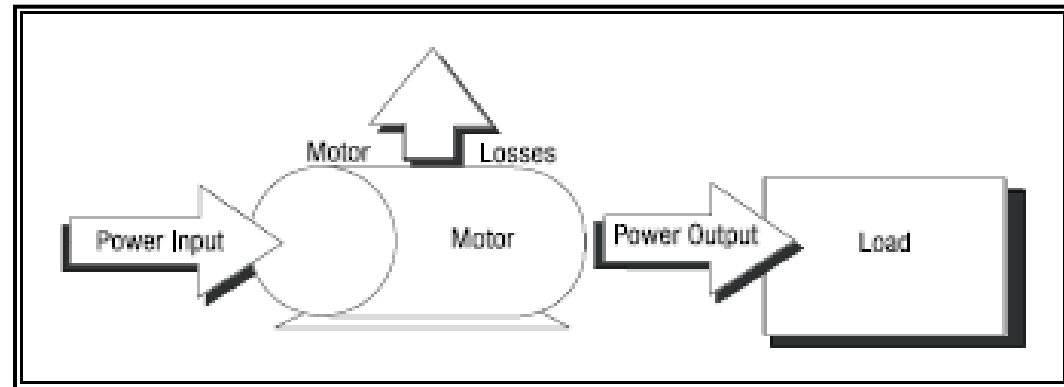


Assessment of Electric Motors

Efficiency of Electric Motors

Motors lose energy when serving a load

- Fixed loss
- Rotor loss
- Stator loss
- Friction and rewinding
- Stray load loss



Assessment of Electric Motors

Efficiency of Electric Motors

Factors that influence efficiency

- Age
- Capacity
- Speed
- Type
- Temperature
- Rewinding
- Load

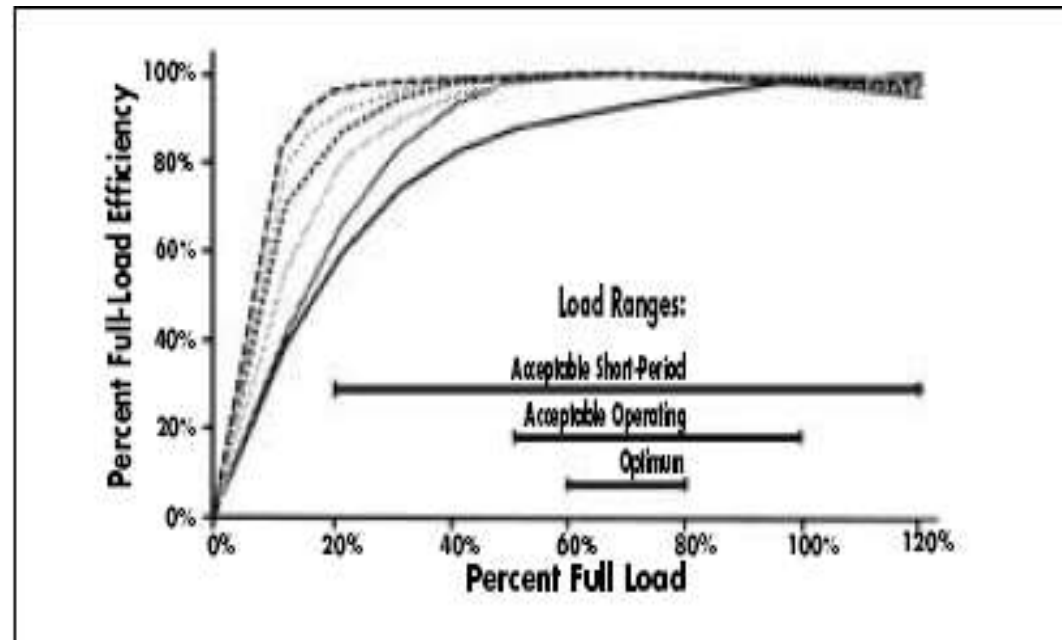


Assessment of Electric Motors

Efficiency of Electric Motors

Motor part load efficiency

- Designed for 50-100% load
- Most efficient at 75% load
- Rapid drop below 50% load



Assessment of Electric Motors

Motor Load

- Motor load is indicator of efficiency
- Equation to determine load:

$$\text{Load} = \frac{\text{Pi} \times \eta}{\text{HP}} \times 0.7457$$

η = Motor operating efficiency in %
HP = Nameplate rated horse power
Load = Output power as a % of rated power
Pi = Three phase power in kW



Assessment of Electric Motors

Motor Load

Three methods for individual motors

- **Input power measurement**
 - Ratio input power and rate power at 100% loading
- **Line current measurement**
 - Compare measured amperage with rated amperage
- **Slip method**
 - Compare slip at operation with slip at full load

Assessment of Electric Motors

Motor Load

Input power measurement

- Three steps for three-phase motors

Step 1. Determine the input power:

$$P_i = \frac{V \times I \times PF \times \sqrt{3}}{1000}$$

P_i = Three Phase power in kW
V = RMS Voltage, mean line to line of 3 Phases
I = RMS Current, mean of 3 phases
PF = Power factor as Decimal



Assessment of Electric Motors

Motor Load

Input power measurement

Step 2. Determine the rated power:

$$P_r = hp \times \frac{0.7457}{\eta_r}$$

P_r = Input Power at Full Rated load in kW
 hp = Name plate Rated Horse Power
 η_r = Efficiency at Full Rated Load

Step 3. Determine the percentage load:

$$Load = \frac{P_i}{P_r} \times 100\%$$

Load = Output Power as a % of Rated Power
 P_i = Measured Three Phase power in kW
 P_r = Input Power at Full Rated load in kW

Assessment of Electric Motors

Motor Load

Result

Action

- | | |
|--|---|
| 1. Significantly oversized and underloaded | → Replace with more efficient, properly sized models |
| 2. Moderately oversized and underloaded | → Replace with more efficient, properly sized models when they fail |
| 3. Properly sized but standard efficiency | → Replace most of these with energy-efficient models when they fail |



Energy Efficiency Opportunities

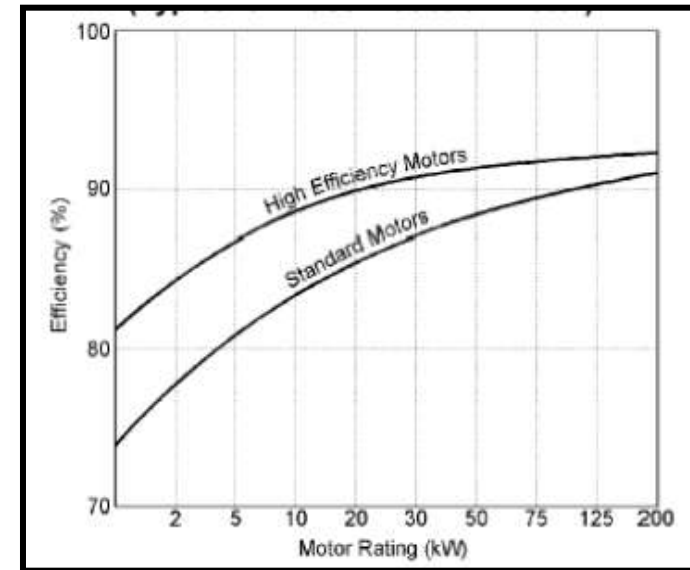
- 1. Use energy efficient motors**
- 2. Reduce under-loading (and avoid over-sized motors)**
- 3. Size to variable load**
- 4. Improve power quality**
- 5. Rewinding**
- 6. Power factor correction by capacitors**
- 7. Improve maintenance**
- 8. Speed control of induction motor**



Energy Efficiency Opportunities

Use Energy Efficient Motors

- Reduce intrinsic motor losses
- Efficiency 3-7% higher
- Wide range of ratings
- More expensive but rapid payback
- Best to replace when existing motors fail



(Bureau of Indian Standards)



Energy Efficiency Opportunities

Use Energy Efficient Motors

<i>Power Loss Area</i>	<i>Efficiency Improvement</i>
1. Fixed loss (iron)	Use of thinner gauge, lower loss core steel reduces eddy current losses. Longer core adds more steel to the design, which reduces losses due to lower operating flux densities.
2. Stator I ² R	Use of more copper & larger conductors increases cross sectional area of stator windings. This lower resistance (R) of the windings & reduces losses due to current flow (I)
3 Rotor I ² R	Use of larger rotor conductor bars increases size of cross section, lowering conductor resistance (R) & losses due to current flow (I)
4 Friction & Winding	Use of low loss fan design reduces losses due to air movement
5. Stray Load Loss	Use of optimized design & strict quality control procedures minimizes stray load losses



Energy Efficiency Opportunities

2. Reduce Under-loading

- **Reasons for under-loading**
 - Large safety factor when selecting motor
 - Under-utilization of equipment
 - Maintain outputs at desired level even at low input voltages
 - High starting torque is required
- **Consequences of under-loading**
 - Increased motor losses
 - Reduced motor efficiency
 - Reduced power factor



Energy Efficiency Opportunities

2. Reduce Under-loading

- **Replace with smaller motor**
 - If motor operates at <50%
 - Not if motor operates at 60-70%
- **Operate in star mode**
 - If motors consistently operate at <40%
 - Inexpensive and effective
 - Motor electrically downsized by wire reconfiguration
 - Motor speed and voltage reduction but unchanged performance



Energy Efficiency Opportunities

3. Sizing to Variable Load

- **Motor selection based on**
 - Highest anticipated load: expensive and risk of under-loading
 - Slightly lower than highest load: occasional overloading for short periods
- **But avoid risk of overheating due to**
 - Extreme load changes
 - Frequent / long periods of overloading
 - Inability of motor to cool down

Motors have 'service factor' of 15% above rated load

X

✓

Energy Efficiency Opportunities

4. Improve Power Quality

Motor performance affected by

- **Poor power quality:** too high fluctuations in voltage and frequency
- **Voltage unbalance:** unequal voltages to three phases of motor

	Example 1	Example 2	Example 3
Voltage unbalance (%)	0.30	2.30	5.40
Unbalance in current (%)	0.4	17.7	40.0
Temperature increase (oC)	0	30	40



Energy Efficiency Opportunities

4. Improve Power Quality

Keep voltage unbalance within 1%

- **Balance single phase loads equally among three phases**
- **Segregate single phase loads and feed them into separate line/transformer**



Energy Efficiency Opportunities

5. Rewinding

- **Rewinding: sometimes 50% of motors**
- **Can reduce motor efficiency**
- **Maintain efficiency after rewinding by**
 - **Using qualified/certified firm**
 - **Maintain original motor design**
 - **Replace 40HP, >15 year old motors instead of rewinding**
 - **Buy new motor if costs are less than 50-65% of rewinding costs**



Energy Efficiency Opportunities

6. Improve Power Factor (PF)

- **Use capacitors for induction motors**
- **Benefits of improved PF**
 - **Reduced kVA**
 - **Reduced losses**
 - **Improved voltage regulation**
 - **Increased efficiency of plant electrical system**
- **Capacitor size not >90% of no-load kVAR of motor**



Energy Efficiency Opportunities

7. Maintenance

Checklist to maintain motor efficiency

- **Inspect motors regularly for wear, dirt/dust**
- **Checking motor loads for over/under loading**
- **Lubricate appropriately**
- **Check alignment of motor and equipment**
- **Ensure supply wiring and terminal box and properly sized and installed**
- **Provide adequate ventilation**



Energy Efficiency Opportunities

8. Speed Control of Induction Motor

- **Multi-speed motors**
 - Limited speed control: 2 – 4 fixed speeds
- **Wound rotor motor drives**
 - Specifically constructed motor
 - Variable resistors to control torque performance
 - >300 HP most common



Energy Efficiency Opportunities

8. Speed Control of Induction Motor

- **Variable speed drives (VSDs)**
 - Also called inverters
 - Several kW to 750 kW
 - Change speed of induction motors
 - Can be installed in existing system
 - Reduce electricity by >50% in fans and pumps
 - Convert 50Hz incoming power to variable frequency and voltage: change speed



