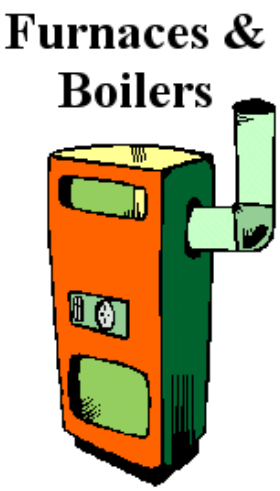
Tips for Energy Conservation in Industrial Sector

GENERAL

- Undertake regular energy audits.
- The maintenance in plant should follow the "Zero Leak" philosophy, particularly in the areas of steam and utilities so that loss of energy could be totally eliminated.
- Plug all oil leakage. Leakage of one drop of oil per second amounts to a loss of over 2,000 litres/year.
- Filter oil in stages. Impurities in oil affect combustion.
- Pre-heat the Oil. For proper combustion, oil should be at right viscosity at the burner tip. Provide heat capacity.
- Incomplete combustion leads to wastage of fuel. Observe the colour of smoke emitted from chimney. Black smoke indicates improper combustion and fuel wastage. White smoke indicates excess air and hence, loss of heat. Hazy brown smoke indicates proper combustion.
- Use of low air pressure "film burners" helps save oil up to 15 per cent in furnaces.

FURNACE



- Recover and utilise waste heat from furnace flue gases for preheating of combustion air. Every 21^{o}C rise in combustion air temperature results in one per cent fuel oil savings.
- Control excess air in furnaces. A 10 per cent drop in excess air amounts to one per cent saving of fuel in furnaces. For an annual consumption of 3,000 kilolitres of furnace oil means a saving of Rs. 3 lakh (assuming the cost of furnace oil is Rs. 10 per litre).
- Reduce heat losses through furnace openings. Observation shows that a furnace operating at a temperature of 1,000 °C having an open door results in a fuel loss of 10 litres/hour. For a 4,000 hour furnace operation, this translates into a loss of approximately Rs. 4 lakh per year.
- Improve insulation if the surface temperature exceeds 20°C above ambient. Studies have revealed that heat loss from a furnace wall 115 mm thick at 650°C amounting to 2650 Kcal/m² /hr can be cut down to 850 kcal/m²/hr by using 65 mm thick insulation on the 115 mm wall.
- Proper design of lids of melting furnaces and training of operators to close lids helps reduce losses by 10 per cent to 20 per cent in foundries.

BOILER

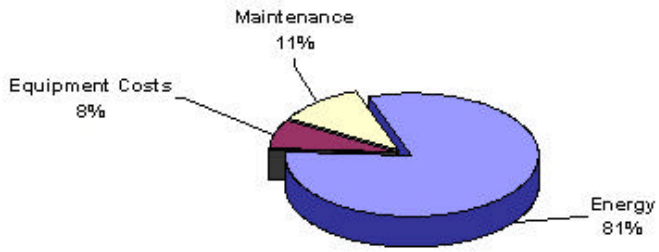
- All possible attention should be paid to control excess air by monitoring oxygen level in flue gas and also by visual inspection of flame colour.
- Use only treated water in boilers. A scale formation of 1mm thickness on the waterside would increase fuel consumption by five per cent to eight per cent.
- Remove soot deposits when flue gas temperature rises 40°C above the normal. A coating of 3mm thick soot on the heat transfer surface can cause an increase in fuel consumption of as much as 2.5 per cent.
- Recover heat from steam condensate. For every 6°C rise in boiler feed water temperature through condensate return, there is a one per cent saving in fuel.
- Soot blowers can always be maintained in perfect working condition so that their regular and periodic use does not suffer.
- Improve boiler efficiency. Boilers should be monitored for flue gas losses, radiation losses, incomplete combustion, blow down losses, excess air etc. Proper control can decrease consumption up to 20 per cent.
- Stop steam leakage. Steam leakage from a 3mm-diameter hole on a pipeline carrying steam at 7 kg/cm² would waste 32 kilolitres of fuel oil per year amounts to a loss of Rs. 3 lakh.

DG SETS

- A poorly maintained injection pump increases fuel consumption.
- A faulty nozzle increases fuel consumption.
- Blocked filters increase fuel consumption.
- A continuously running DG set can generate 0.5 tonne/hour of steam at 10 bar to 12 bar from the residual heat of the engine exhaust per MW of the generator capacity.
- Measure fuel consumption per kWh of electricity generated regularly. Take corrective action in case this shows a rising trend.

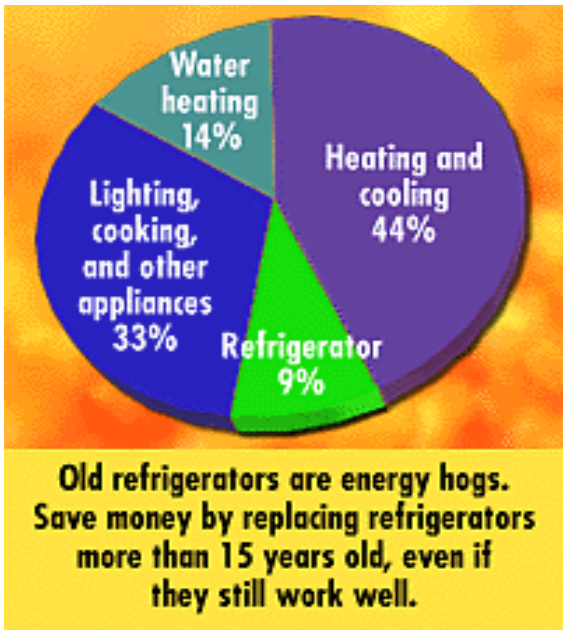
COMPRESSED AIR

Figure 1
Life-Cycle Cost of Compressed Air System



- Compressed air is very energy intensive. Only five per cent of electrical energy is converted to useful energy. Use of compressed air for cleaning is rarely justified.
- Increase in inlet air temperature by 3°C increases power consumption by one per cent. Ensure low temperature of inlet air.
- Reduction in discharge pressure by 10 per cent saves energy consumption up to five per cent. It should be examined whether air at lower pressure can be used in the process.
- A leakage from a ½" diameter hole from a compressed air line working at a pressure of 7 kg/cm. (Please note: This sentence seems to be incomplete)
- Air output of compressors per unit of electricity input must be measured at regular intervals. Efficiency of compressors tends to deteriorate with time.

REFRIGERATION AND AIR CONDITIONING



- Close doors and windows while running the air conditioning. Don't use a whole-house fan or window fan while the air conditioner is on, but do use a ceiling fan
- Use of double doors, automatic door closures, air curtains, double glazed windows, polyester sun films etc. reduces heat ingress and air-conditioning load of buildings.
- Maintain condensers for proper heat exchange. A 5°C decrease in evaporator temperature increases

specific power consumption by 15 per cent.

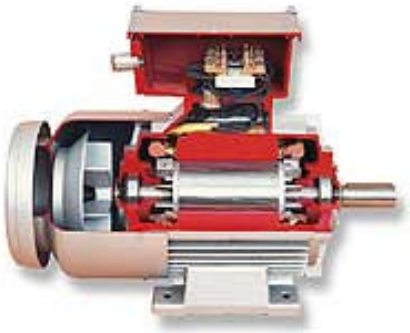
- Utilisation of air conditioned/refrigerated space should be examined and efforts made to reduce cooling load as far as possible.
- Utilise waste heat of excess steam or flue gases to change over from gas compression systems to absorption chilling systems and save energy costs in the range of 50 per cent to 70 per cent.
- The compressor of the central air conditioner should be located in a cool, shaded place outside.
- Specific power consumption of compressors should be measured at regular intervals. The most efficient compressors should be used for continuous duty, while other are kept on a standby.
- The air conditioning unit must be inspected, cleaned and tuned by a professional every two to three years to keep it going longer and to using less electricity. If the refrigerant needs to be recharged, make sure it is done correctly. If it is overcharged, it would reduce operating efficiency and could damage the unit. If it is undercharged it would also use energy less efficiently.
- The duct system should be properly sealed. This could save 10 per cent to 15 per cent of the electricity into air conditioner.

PUMPS

- Select a pump of the right capacity in accordance with the irrigation requirement. Improper selection of pump can lead to large wastage of energy. A pump with 85 per cent efficiency at rated flow may have only 65 per cent efficiency at half the flow.
- Matching of the motor with the appropriate-sized pump.
- Using throttling valves instead of variable speed drives to change flow of fluids is a wasteful practice. Throttling can cause wastage of power to the tune of 50 per cent to 60 per cent.
- It is advisable to use a number of pumps in series and parallel to cope with variations in operating conditions by switching on or off pumps rather than running one large pump with partial load.
- Void valves in the pipe line throttle wastes energy. A positive displacement pump with variable speed drive is recommended.
- Proper installation of the pump system, including shaft alignment, coupling of motor and pump is a must. Drive transmission between pumps and motors is very important. Loose belts can cause energy loss up to 15 per cent to 20 per cent.

- Use efficient transmission system. Maintain right tension and alignment of transmission belts.
- Use of modern synthetic flat belts in place of conventional V belts can save five per cent to 10 per cent of energy.
- Properly organised maintenance is very important. Efficiency of worn out pumps can drop by 10 per cent to 15 per cent, unless maintained properly.
- Use low friction rigid PVC pipes and foot valves.
- Avoid use of unnecessary bends and throttle valves.
- Use bends in place of elbows.
- The suction depth of six meters is recommended as optimum for centrifugal pumps. The delivery line should be kept at the minimum required height in keeping with requirements.
- Periodically check pump system and carry out corrective measures such as lubrication, alignment, tuning of engines and replacement of worn-out parts.
- Over irrigation can harm the crops and waste vital water resource. Irrigate according to established norms for different crop.
- Use drip irrigation for specific crops like vegetable, fruits, tobacco, etc. Drip systems can conserve up to 80 per cent water and reduce pumping energy requirement.

MOTORS



- The motors should be energy efficient.
- Convert delta to star connection for lightly loaded motors.
- Install soft start–cum-energy saver for lightly loaded motors.
- In case of centrifugal blower pump, install variable voltage frequency (vvvf) drives for speed control of motors.
- Install multi speed motor.
- Optimise operating voltage level of motor for lightly loaded motors
- Replace eddy current controls with variable frequency drives for varying speed driven equipment.
- Provide interlock for electric motor to avoid idle running.
- Replace motor generating sets with thyristor drives.
- Avoid frequent rewinding of motors. Greater the number of rewind, lesser the efficiency.
- Carry out preventive maintenance and condition monitoring schedule regularly.

Advantages of Energy Efficient Motors

- Reduced operating costs.
- Less heat losses.
- Extended winding lifespan.

- Extended lubricating grease service life.
- Lower noise levels than other motors.
- Reduced energy costs. The higher purchase price investment pays off.
- Reduce emission of CO_2 and NOx greenhouse gasses from power stations for positive environmental effect.

COOLING TOWERS

- Replacement of inefficient aluminium or fabricated steel fans with moulded FRP fans with aerofoil designs results in electricity savings in the range of 15 per cent to –40 per cent.
- A study on a typical 20 feet diameter fan revealed that replacing the wooden blade drift eliminators with newly developed cellular PVC drift eliminators reduces the drift losses from 0.01 per cent to 0.02 per cent with a fan power energy saving of 10 per cent.
- Install automatic ON-OFF switches on cooling tower fans and save up to 40 per cent on electricity costs
- Use of PVC fills in place of wooden bars results in a saving in pumping power of up to 20 per cent.