ENERGY CONSERVATION & SUSTAINABILITY – A CONCEPT

Dr. D. Palit

INTRODUCTION

Energy Conservation :

Definition - **Energy conservation** is the practice of decreasing the quantity of energy used for the same quality and quantity of Output.

It may be achieved through Efficient energy use, in which case energy use is decreased while achieving a similar outcome, or by reduced consumption of energy services.

Energy **is** ***sustainable*** **if it "meets the needs of the present without compromising the ability of future generations to meet their own needs".**

Why Conserve Energy :

Energy conservation results in increase of Financial capital, environmental value, national security, personal security, and human comfort.

Individuals and organizations that are direct consumers of energy may want to conserve energy in order to reduce energy costs and promote economic security.

Industrial and commercial users may want to increase efficiency and thus maximize profit.

Energy Management :

Energy Conservation

- Energy Conservation Includes any behavior that results in the use of less energy.
- Focuses on Behavior of People
- One example is using Daylight through window rather than turning on the Lights.

Energy Efficiency

- Energy Efficiency involves the use of Technology that requires less energy to perform the same function.
- Focuses on the Equipment or Machinery being used.
- One example is installing LED Light Bulbs for the Street Lights.

Renewable Energy

Renewable Energy is the energy obtained from sources that are essentially inexhaustible.

Focuses on the resources such as Wind, Solar, Geo-Thermal.

One example is installing Solar Power Plant.

Objective Of Energy Management in Industry :

In any industry, the 3 top operating costs are often found to be Energy (both electrical and thermal), Labour and Materials.

Among the three, energy has the highest potential for cost reduction.

- ✓ To achieve and Maintain Optimum Energy Procurement And Utilization, throughout the Organization.
- ✓ To minimize Energy Costs / waste without affecting Production & Quality.
- ✓ To minimize Environmental Effects.

National Energy Policy

- The **National Energy Policy** (NEP) aims to chart the way forward to meet the Government bold ambitions for India's **energy** sector developments.
- This includes providing access to electricity to all the Census villages by 2018, and for universal electrification to be achieved, with 24x7 electricity by 2022.
- The **energy policy of India** is largely defined by the country's expanding energy deficit and increased focus on developing alternative sources of energy, particularly nuclear, solar and wind energy.
- India attained 63% overall energy self-sufficiency in 2017

Energy trading neighboring countries

- The per capita electricity consumption is low compared to many countries despite cheaper electricity tariff in India.
- Despite low electricity per capita consumption in India, the country is going to achieve surplus electricity generation during the 12th plan (2012 to 2017) period provided its coal production and transport infrastructure is developed adequately.
- India has been exporting electricity to Bangladesh and Nepal and importing excess electricity in Bhutan.
- Surplus electricity can be exported to the neighbouring countries in return for natural gas supplies from Pakistan, Bangladesh and Myanmar.

Saving Potentials
In Different Industrial Equipments :

Industrial Sector uses both, the **Thermal** and **Electrical** energy in various Equipment like

Boilers

Compressors

Furnaces

Diesel Generating engines

Motors

Pumps

Refrigeration etc.

Electrical Energy :

Tips for Electrical Energy Saving

- Improve Power factor by installing capacitors to reduce KVA demand charges and also line losses within the plant.
- Improvement of power factor from 0.85 to 0.96 will give 11.5% reduction of peak KVA and 21.6% reduction in peak losses.
- Avoid repeated rewinding of motors. Observations show that rewound motors practically have an efficiency loss of upto 5%. This is mainly due to increase in no load losses.
- Use of variable frequency drives and fluid couplings for variable speed applications such as fans, pumps etc. helps in minimizing consumption.

Electric Motors :

The electric motors are used to provide motive power to equipment such as compressors, pumps, blowers, etc. It is important that the industrial users define their need accurately to enable proper selection of a motor for a particular application.

Of the total electricity consumed in the industrial sector, electric motors account for approximately **70%.**

- The motors should be energy efficient.
- Convert delta to star connection for lightly loaded motors.
- Install variable voltage frequency (VVVF) drives for speed control of motors.
- Install multi speed motor.

- Optimize operating voltage level of motor for lightly loaded motors
- Provide interlock for electric motor to avoid idle running
- 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. The higher purchase price investment pays off.
- Less heat losses.
- Extended winding lifespan.

Air Compressors :

Compressed air is used in almost all types of industries and accounts for a major share of Electricity used in some of the plants.

It is utilized for a variety of end uses such as pneumatic tools and equipment, instrumentation, conveying, etc. and is preferred in Industries because of its convenience and safety.

- Compressed air is very energy intensive. Only 5% of electrical energy is converted to useful energy. Use of compressed air for cleaning is rarely justified.
- Ensure low temperature of inlet air. Increase in inlet air temperature by 3°C increases power consumption by 1%.

- It should be examined whether air at lower pressure can be used in the process. Reduction in discharge pressure by 10% saves energy consumption upto 5%.
- A leakage from a ½" diameter hole from a compressed air line working at a pressure of 7kg/cm^2 can drain almost Rs. 2500 per day.
- Air output of compressors per unit of electricity input must be measured at regular intervals. Efficiency of compressors tends to deteriorate with time.

Cooling Towers :

A cooling tower is a specialized heat exchanger in which two fluids (air and water) are brought into direct contact with each other to effect the transfer of heat.

In a spray filled towers, this is accomplished by spraying a flowing mass of water into a rain - like pattern, through which an upward moving mass flow of cool air is induced by the action of a fan.

- Replacement of inefficient aluminum or fabricated steel fans by moulded FRP fans with aerofoil designs results in electricity savings in the range of 15-40%.
- Install automatic **on-off** switching of cooling tower fans and save upto 40% on electricity costs.

Pumps :

Most of the industrial processes in and out of plants involve transportation of fluids and the pump is the only mechanical means available to facilitate this transportation.

The prime mover can either be an electric motor, a diesel engine, on a steam/gas turbine. All prime movers consume energy, either in the form of electric power or precious petroleum products like diesel, oil or gas, to impart working capacity to the pump.

- Select a pump of the right capacity in accordance with the requirement. Improper selection of pumps can lead to large wastage of energy. A pump with 85% efficiency at rated flow may have only 65% efficiency at half the flow.
- Matching of the motor with the appropriate-sized pump.

- Use of 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 to 60%.
- Use of 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 to 60%.
- 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 upto 15-20%.
- Modern synthetic flat belts in place of conventional V-belts can save 5% to 10% of energy.

Lighting :

A lumen is the measurement of light output from a lamp, often called a tube or a bulb. All lamps are rated in lumens. For example, a 100-W incandescent lamp produces about 1750 lumens.

Another lighting term is efficacy, which is the ratio of light output from a lamp to the electric power it consumes and is measured in LPW (lumens per watt).

- Use of electronic ballast in place of conventional choke saves energy upto 20%.
- Use of CFL lamp/LED in place of GLS lamp can save energy upto 70%.

- Clean the lamps and fixtures regularly. Illumination levels fall by 20-30% due to collection of dust.
- Use of 36W tube light instead of 40 W tube light saves electricity by 8 to 10%.
- Use of sodium vapour lamps for area lighting in place of mercury vapour lamps saves electricity upto 40%.

Thermal Energy :

Tips for Thermal energy saving

- Undertake regular energy audits.
- Plug all oil leakage as leakage of one drop of oil per second amounts to a loss of over 2000 liters/year.
- Filter oil in stages. Impurities in oil affect combustion.
- Incomplete combustion leads to wastage of fuel. Observe the color 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.
- 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.

Boilers :

Boilers are used in various industrial units to convey heat for different process applications.

Steam is commonly used as the heating medium mainly due to two reasons: one -it is generated from water which is usually available; and two-it is able to store a large quantity of heat at a temperature which can be conveniently used.

Various types of fuels, namely; coal, oil, gas, biomass, etc. are used for steam generation in boilers depending on the availability of fuel and cost economics prevailing in the plant.

The motive of the industry should be to generate the required quantity and quality of steam at minimum possible costs. This can only be achieved by reducing the various avoidable heat losses occurring within the boiler system, thus improving the efficiency of the same.

- All possible attention- should be paid to control excess air by monitoring oxygen level in flue gas and also by visual inspection of flame color.
- 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%.
- Soot blowers can always be maintained in perfect working condition so that their regular and periodic use does not suffer.
- Recover heat from steam condensate. For every 6°C rise in boiler feed water temperature through condensate return, there is 1% saving in fuel.
- 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 the consumption upto 20%.

- Use only treated water in boilers. A scale formation of 1 mm thickness on the waterside increases fuel consumption by 5-8%.
- Stop steam leakage. Steam leakage from a 3 mm-diameter hole on a pipeline carrying steam at 7kg/cm^2 would waste 32 kl of fuel oil per year amounting to a loss of Rs. 3 lakh.
- Maintain steam pipe insulation. It has been estimated that a bare steam pipe, 150 mm in diameter and 100m in length, carrying saturated steam at 8kg/cm^2 would waste 25 kl of furnace oil in a year amounting to an annual loss of Rs. 2.5 lakh.

Diesel Generating Set :

Depending on the type of industry and the magnitude of the connected load, DG sets are employed in various modes like:

The standby mode to meet a part or the full requirement of the plant in case of power failures.

The peak-load mode to meet the requirement during peak demand, thereby reducing the maximum demand.

- Maintain Diesel engines regularly.
- A poorly maintained injection pump increases fuel consumption by 4gm/kWh.
- Blocked filters increase fuel consumption by 2gm/kWh.
- Measure fuel consumption per KWH of electricity generated regularly. Take corrective action in case this shows a rising trend.

Energy Audit :

Energy Audit means the Verification, Monitoring and Analysis of use of Energy including submission of technical report containing recommendations for improving Energy Efficiency with cost benefit analysis and an action plan to reduce energy consumption.

Audit Methodology :

>> Preliminary Energy Audit

>> Detailed Energy Audit

Preliminary Energy Audit

- Establish Energy Consumption report of the plant (Source : Energy Meter Data)
- Obtain related data of production to know the specific Energy Consumption.
- Identify the most likely and easiest areas of attention. (like unnecessary lighting, leakages etc.)
- Identify immediate (no cost / Low cost) improvement or saving areas.
- Identify areas for more detailed study / improvements.

Detailed Energy Audit

- Establish/organize a Energy Audit team.
- Primary data gathering, Process flow diagram and Energy Utility data.
- Conduct survey and monitoring (like motor survey, lighting survey, compare operating data with design data)
- Conduct of detailed trials for selected equipment. (e.g. Load variation trend of pumps, Boiler efficiency)
- Energy Loss / Waste analysis
- Identification and development of Energy Conservation (ENCON) opportunities.
- Cost Benefit Analysis with payback.
- Reporting And Presentation to TOP Management
- Implementation & follow up.