



ENERGY CONSERVATION – THE INDIAN PERSPECTIVE

Dr. S. Devaki

Associate Professor, Department of Commerce, Vellalar College for Women,
Erode, Tamilnadu

Cite This Article: Dr. S. Devaki, “Energy Conservation – The Indian Perspective”, International Journal of Interdisciplinary Research in Arts and Humanities, Volume 1, Issue 1, Page Number 171-178, 2016.

Abstract:

Energy conservation means reduction in use of energy consumption and is measured in physical terms. Energy conservation is the practice of decreasing the quantity of energy used while achieving a similar outcome of end use. This practice may result in increase of financial capital, environmental value, national security, personal security and human comfort. Energy conservation also means reduction or elimination of unnecessary energy used and wasted.

Key Words: Energy, Consumption & Measurement

Introduction:

Energy is the primary and the most universal measures of all kinds of work by human being and nature. Electrical energy is proved to be an ideal energy in all sorts of energy available in nature. Energy is the prime mover of economic growth and is vital to the sustenance of a modern economy. Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible and environmentally friendly. Electrical energy is universally accepted as an essential commodity for human beings. In the domestic sector, it is used extensively for lighting, refrigeration, heating, entertainment etc. In commercial building and hotels, it is used in air-conditioning, lifts, laundry, cooking, water heating etc. In industries, it is used for heating, driving and rotating machines, drying etc.

Nature of Electrical Energy:

All matters whether solid, liquid or gas, is made up of minute particles called molecules which can be further subdivided into atoms. Elements are composed of molecules containing atoms of one kind only. Compounds are composed of molecules containing atoms of different kind. Modern theory indicates that atoms of all substances are built up of positive electricity called protons, negative electricity called electrons and neutrons which show no electrical state. An atom consists of a central nucleus made up of protons and neutrons, and around this nucleus there are a number of electrons on orbits, the number of each present vary with atoms of different substances. In the normal state, the number of protons equals the number of electrons, and the atom as a whole is electricity uncharged i.e, neutral.

Units of Measurement:

When referring specially to electricity, measurement is expressed in watt-hours (Wh) or watts (W):

JOULES	=	0.948 quads
MJ (megajoules)	=	10^4
kWh (kilowatt-hours)	=	10^3 watt-hours = 3.6 MJ
TWh (terawatt-hours)	=	10^{12} watt-hours = 3.6 PJ
kW (kilowatts)	=	10^3 watts
MW (megawatts)	=	10^4 watts
TW (terawatts)	=	10^{12} watts

Work, Power and Energy:

Mechanical Work is done when force acting on a body causes it to move. Unit of work is ‘joule’. It is the work done when the point of application of a force of one newton is moved one meter in the direction of the force. Power is a rate of doing work. The electrical unit of power is joule per second, called Watt. Hence another name for joule is the watt-second. The joule or watt-second is a very small unit of electrical energy and for commercial purposes energy is measured in watt-hours or kilowatt-hours (kWh). Energy is capacity for doing work. Energy may exist in several forms and may be changed from one form to another. A lead-acid cell changes chemical energy or discharge vice versa on charge, a generator changes mechanical energy to electrical energy, an electrical heater converts electrical energy to heat energy. Work cannot be done without energy being used, and the amount of work done is a measure of the energy used. Mechanical, electrical and heat energy are measured in joule. Energy means ability to do something like moving something, lighting something that can be derived from any source such as fossil fuels, materials and electricity generated from renewable sources.

Energy Conservation Vs Energy Efficiency:

Energy conservation and energy efficiency are often used interchangeably, but there are some differences. At the most basic level, energy conservation means using less energy and is usually a behavioural change, like turning your lights off or setting your air conditioner lower. Energy efficiency, however, means *using energy more effectively*, and is often a technological change. Energy efficiency measures the difference between how much energy is used to provide the same level of comfort, performance or convenience by the same type of product, building or vehicle. Conservation certainly reduces energy use, but it's not always

the best solution because it may impact comfort or safety as well. Efficiency, on the other hand, maintains the same level of output (e.g. light level, temperature) but uses less energy to achieve it. A combination of both energy conservation and energy efficiency measures yields an ideal solution. Energy conservation refers to actively reducing the amount of energy used and it differs from efficient energy use, which refers to the using less energy for a constant. Energy efficiency involves the use of technology that requires less energy to perform the same function whereas Energy conservation includes any behavior that results in the use of less energy. Energy efficiency focuses on the equipment or machinery being used. One example is installing LED light bulbs throughout the house. Using day lighting through windows rather than turning on the lights is an example of energy conservation. Both are energy saving techniques.

Energy Conservation in India:

Access to electricity is a prerequisite to the satisfaction of basic human need namely improving living standards, maintaining good human health, implementation of the right to education, facilitating sustainable development and maintaining clean environment. The majority of the rural population in India has no access to electricity, thus majority of the Indians are energy poor and there is energy crisis in India. It is a critical infrastructure on which modern economic and social activities are fully dependent. The installed capacity of utility power plants is 267,637 MW as on 31 March 2015 and the gross electricity generated by utilities is 1106 GWh (1106 billion kWh) which includes auxiliary power consumption of power generating stations. The installed capacity of captive power plants in industries (1 MW and above) is 47,082 MW as on 31 March 2015 and generated 166.426 billion kWh in the financial year 2014-15

Energy Policy in India:

In India, energy efficiency policy and investment in industrial energy efficiency are regarded as important issues. Energy demands in India will increase by 150% in the next 15 years. A number of energy efficiency polices have been developed and implemented in India. These policies include (1) pricing policy; (2) institutional development policy; and (3) energy efficiency technology policy. In 1997, these policies have attracted over \$12 billion of capital investment in energy efficiency in the industrial sector. Some policies, for example disclosure of energy efficiency particulars and mandatory appointments of energy efficiency managers and professionals at the industrial enterprises, have greatly facilitated energy efficiency in the industrial enterprises.

Statutory Framework in India:

History of Energy Policies in India:

Year	Energy Policy
1988	The Companies Act stressed the importance of disclosing the particulars on energy efficiency, such as energy consumption, value added, and the amount of major products for 3 years
1991	India liberalized the regulatory regime in India to promote industrial competitiveness. The objective of this reform was to increase market-based competition
1995	The Government of India adopted a policy to promote energy efficiency in the country by allowing the accelerated depreciation for energy efficiency and pollution control equipment
1997	Capital investment in industrial energy efficiency totaled \$12 billion

Energy Conservation Act 2001:

The government identified certain energy-intensive industries as designated consumers brought under The Energy Conservation Act, and gave a period of 5 years for those energy-intensive industries to comply with a number of mandatory provisions. These include: (1) establishing norms for energy consumption; (2) mandatory energy audits by accredited energy auditors; (3) establishing efficiency standards and labeling; (4) mandatory appointment of energy managers In, the government identified certain energy-intensive industries as designated consumers brought under The Energy Conservation Act, and gave a period of 5 years for those energy-intensive industries to comply with a number of mandatory provisions. These include: (1) establishing norms for energy consumption; (2) mandatory energy audits by accredited energy auditors; (3) establishing efficiency standards and labeling; (4) mandatory appointment of energy managers.

Energy Conservation has emerged as a major policy objective, and the Energy Conservation Act 2001, was passed by the Indian Parliament in September 2001. This Act requires large energy consumers to adhere to energy consumption norms; new buildings to follow the Energy Conservation Building Code; and appliances to meet energy performance standards and to display energy consumption labels. Government of India has undertaken a two pronged approach to cater to the energy demand of its citizens while ensuring minimum growth in CO2 emissions, so that the global emissions do not lead to an irreversible damage to the earth system. On one hand, in the generation side, the Government is promoting greater use of renewable in the energy mix mainly through solar and wind and at the same time shifting towards supercritical technologies for coal based power plants. On the other side, efforts are being made to efficiently use the energy in the demand side through various innovative policy measures under the overall ambit of Energy Conservation Act 2001. The Energy Conservation Act (EC Act) was enacted in 2001 with the goal of reducing energy intensity of Indian economy. The Act also created the Bureau of Energy Efficiency to implement the provisions of the Act.

Bureau of Energy Efficiency (BEE):

Bureau of Energy Efficiency (BEE) was set up as the statutory body on 1st March 2002 at the central level to facilitate the implementation of the EC Act. The mission of Bureau of Energy Efficiency is to "institutionalize" energy efficiency services, enable delivery mechanisms in the country and provide leadership to energy efficiency in all sectors of the country. The primary objective would be to reduce energy intensity in the economy. The Bureau launched the Energy Conservation Building Code (ECBC) with the goal of specifying standard for new, large, efficient commercial building. The BEE programme rates office building on a 1 to 5 star scale with 5-Star labelled buildings being the most energy efficient. This programme has the target air-conditioned and non air-conditioned office building in the following three climatic zones of warm and humid, composite, hot and dry. Energy Performance Index (EPI) in kWh/sq m/year is considered for rating the building. Bandwidths for EPI for different climatic zones have been developed based on the percentage of air conditioned space. For example, for a building in a composite climatic zone like New Delhi and having air-conditioned area greater than 50% of their built up area, the bandwidths of EPI range between 190-90 kWh/sq m/year. Thus, a building would get a 5-Star rating if its EPI falls below 90kWh/sq m/year and 1-Star if it is between 165-190 kWh/sq m/year.

If the same building is located in a warm and humid climate zone like Chennai, the bandwidths of EPI range between 200-100 kWh/sq m/year and therefore it would get a 5-Star rating if its EPI is below 100 kWh/sq m/year and 1-Star if it is between 100-175 kWh/sq m/year. The star rating programme provides public recognition to energy efficient building and creates a demand side pull for such building. Those building having a connected load of 500 kW and above are considered for BEE star rating scheme. EPI is kWh/sq m/year in terms of purchased and generated electricity divided by built up area in sq m. However, the total electricity does not include electricity generated from on-site renewable source such as solar photovoltaic etc. Some examples are the National Archive of India is a 5-Star rated building by BEE and the Reserve Bank of India office is a 4-Star building. The legal provisions on 'access to electricity' in India are contained in the Constitution of India, Electricity Act 2003, Electricity Rules, 2005, National Electricity Policy, 2005, Rural Electrification Policy, 2006, Central Electricity Authority Regulation, 2006, various schemes of Central Government and the case of T. M. Prakash vs. The District Collector & the superintending Engineer, Tamil Nadu Electricity Board.

Other Regulatory Measures:

There are several regulatory measures that can produce energy savings in the industrial sector. These include:

Minimum Energy Performance Standards:

India has introduced regulations requiring office equipment to meet minimum standards of energy efficiency

Deregulation of the Electricity Industry to encourage the development of cogeneration

Building codes can be used to ensure that new buildings meet minimum standards for passive solar design in order to reduce energy use

Changes in the Regulatory Environment as a result of the control of emissions, such as carbon dioxide and international obligations

The Economic Measures available to encourage energy efficiency in the industrial sector are similar to those offered to the commercial and domestic sectors and include:

- ✓ Time of use tariffs
- ✓ Subsidies for substitute fuels (including bio-fuels)
- ✓ Subsidies for the use of renewable energy
- ✓ Tax relief for investment in energy efficient equipment
- ✓ Levies and penalties on energy use

Incentives and Issues:

The rating systems are now getting linked with government promotional policies for green building. Increasingly governments are linked official incentive programmes to promote rating of buildings to give a bush to the green building movement in the country. Incentives designed by the MNRE targeting the builders and developers. MNRE has adopted GRIHA (Green Rating Integrated Habitat Assessment) as a national rating system and has generated number of incentives to various stakeholders like Awards of Rs. 50 lakhs to Municipal Corporation and 25 lakhs to other Urban Local Body who performs best, reimbursement of 90% of the registration cum rating fee for up to 5000 sq m. built-up area with minimum 3-Star rating and for projects more than 5000 sq m. built-up area with minimum 4-Star rating to the building owners. There are other forms of incentives as well. The Ministry of Environment and Forests in 2011 has given special consideration to pre certified LEED (Leadership in Energy and Environment Design) India and GRIHA projects by having a separate queue for clearance. This is provided with the faith that the green rating agencies have carried out the due-diligence of these project designs and will be accountable for the environmental performance of such projects. However, pre-certification is only a pledge and there is no legal provisions for requiring the project proponents to achieve the level of rating promised in the pre-certification application.

Electrical Energy in Industrial Sector:

Electricity is only a minor component of industrial energy use although its use in driving electric motors is very important. The major sectors within industry can be categorized as follows:

Manufacturing – this includes the processing of primary resources into consumer products. Mineral refining, oil refining and chemical manufacturing are some areas of energy use where considerable savings could be made. Such activities often occur in the industrial zones of major cities.

Power Generation - the power generation industry is a massive user of fossil fuels and accounts for more than 50% of international greenhouse gas emissions. Many power stations are very inefficient and there are strong economic and environmental incentives to save energy in the power supply industry. Most cities have major power stations and these are often a cause of air pollution as well.

Mining – this is a primary industry which generally occurs outside cities, often in remote parts of the country. Energy intensity is high in most mining operations but there is an incentive to save energy because energy wastage is reflected in the cost of the minerals.

Agriculture – another major user of primary energy which takes place in rural areas and is largely beyond the scope of city.

Construction – is a modest user of energy, particularly liquid fuels because this activity often takes place at sites where electric power is not readily available. Considerable savings are available in this sector because there is often a large amount of wastage in construction activities.

The main focus will therefore be on energy savings in manufacturing and power generation as these are the major users of energy.

Energy Conservation Methods:

Industry is the major user of energy in modern society. A large amount of electrical energy is used to drive the machines and equipments like pumps, fans, compressed air system, refrigeration, air-conditioning, cooling towers, dust control equipment etc. in addition to the fuel consumption for captive power generation. The following are the various utilities considering for energy efficiency and conservation:

Pumps: Practically every industry employs pumps while the number varying as per the scale of operation. Because of their unlimited and continuous use in almost all applications methods of conserving energy used in pumping systems deserves utmost attention. The following steps can be taken to improve efficiency of pumping system:

- ✓ Use of pipes, valves and other hardware to minimize friction losses
- ✓ Proper matching of pumps and system characteristics
- ✓ Use of variable speed drives and sophisticated monitoring and control system

The potential for energy saving in pumping system is of utmost importance because pumping system in industries has generally been specified with large factors of safety. This results in oversized pumps and motor ratings. During normal operation, the pumps operate at a point far from its efficiency point. The efficiency is quite low, as the excess head produced by pumps is wasted in the throttling of valves. Use of variable speed drives in place of constant speed lead to high system efficiency, over a wide range of head and flow requirements. The additional capital costs for variable speed drives can be recovered very quickly due to reduced energy costs for running the pumps. The reduction of pumps running costs is becoming much more important with steep rising of electricity rates, necessitating the use of variable speed drives in many applications like municipal water supply system, power station and waste treatment system. These drives are now being specified in many industries like paper, cement, steel, textile and oil pipelines.

Industrial Fans and Blowers: Blowers have their flow controlled by outlet dampers. System head resistance is added by damper to force operating point up the head flow characteristic to a desired reduced flow which leads to reduction power consumption. Blowers and fans are good candidates for adjustable speed operation.

Compressed Air System: Almost every industry uses compressed air. Pneumatic power and instrumentation systems are very popular due to ruggedness, inherent safety from fire hazard, convenience of getting linear motion as well as high rotational speeds and total freedom from electromagnetic interference. The following tests will have to be carried out periodically to ensure the operation of system at maximum efficiency without losses:

- ✓ Free air delivery capacity
- ✓ Quantification of compressed air leakage
- ✓ Pressure drop in air distribution system.

Refrigeration and Air-conditioning System:

The purpose of refrigeration system is to remove heat from an area or product. This heat is normally rejected to air or water which is at ambient temperature. Heat flows naturally from a warmer substance to a cooler one. The refrigeration system enables heat to flow against this natural gradient, but requires an input of energy to do this. There are two classic refrigeration systems used for industrial refrigeration. One is the vapour compression system and other is the absorption system which is economically attractive where waste heat is available. The energy input to vapour compression system is the electrical power supplied to the compressor. In

addition, electricity is also used for circulation of refrigerants, water brine through various heat exchangers like condensers, cooling towers, evaporators, chillers, etc. In many cases, the consumption of auxiliaries may be more than consumption of refrigerant compressors. The auxiliary consumption also must be critically looked into. Stopping of fans and pumps on light loads and use of variable speed drives are some of the options which may be considered.

There are normally three important strategies to reduce power consumption in the industrial refrigeration systems:

- ✓ Reducing the refrigeration load
- ✓ Design of equipment and system
- ✓ Operation and maintenance of equipments

Cooling Towers:

Main purpose of cooling tower is to reduce the inlet warm water temperature close to the wet bulb temperature of ambient air. Cooling towers are generally designed to have an approach temperature of 2 to 5 °C depending upon the type of cooling tower. In practice, because of microbial growth, scale of formation, corrosion and improper maintenance, the intimate contact between air and water is tampered resulting high temperature outlet water which will affect compressor inter cooler effectiveness and performance. Proper maintenance of cooling tower is very important to achieve desired approach temperature.

Motors:

- ✓ **Improving Power Supply Quality:** Maintaining the voltage level within the BIS standards i.e. with tolerance of +/-6% and frequency with tolerance of +/-3% motor performance improves life.
- ✓ **Optimum loading:** Proper selection of the rating of the motor will reduce the power consumption. If the motor is operating at less than 50% of loading then there will be energy loss
- ✓ **Energy Conservation by Using Power Factor Controller:** Low power factor will lead to increased current and hence increase losses and will affect the voltage.

Office Equipment:

Office equipment such as printer, scanner, photocopier, facsimile/fax, calculator, cash machine, paper shredder, detacher, transformer are to be in accordance with the suppliers/manufacture operational procedure manual; failure to comply can and would result in poor equipment operation and failure. It has to be used as necessary or as the need arise. All nuisance use or non-work related task and assignments are to be avoided. Do not leave transformers plugged into the wall outlet receptacle. It has to be disconnected (turn-off the outlet switch) and isolated (remove) all transformers at the end of the working day. Unnecessary computers, printers, and copiers that are not in use are closed-down/disconnected at the end of the working day.

Computer & Electronic (Operational) Equipment:

For efficient use of personal computers, electronic (processing) equipment, it is recommended that all personal computers (PC's) utilize the power management option. PATH - go to the computer Desk Top, click on Start-Settings-Control Panel-Power management Option, time settings in this power option controls how long if unattended the PC takes to go to the standby mode to conserve energy [low-power state].

Suggested Settings:

- ✓ Monitor – 15 min.
- ✓ Hard Disk (Central Processor Unit) – 25 min.
- ✓ System Standby – 30 min.
- ✓ Screen Saver – 1 min.
- ✓ Additionally, use the automatic save feature when working in all applications, preferable at one (1) minute intervals.

Energy Conservation in Lighting System:

Good lighting is required to improve the quality of work, to reduce human's / worker's fatigue, to reduce accidents, to protect his eyes and nervous system. In industry it improves production, and quality of products / work. The power consumption by the industrial lighting varies depending on type of industries. In the year 2015, **Prime Minister Mr. Modi** launched a scheme called '**Prakash Path**' urging people to use LED lamps in place of other lamps to drastically cut down lighting power requirement.

- ✓ **Optimum Use of Natural Light:** Whenever the orientation of a building permits, day lighting has to be used in combination with electric lighting. The maximum use of sunlight can be get by means of transparent roof sheets, north light roof, etc
- ✓ **Replacing Incandescent Lamps by Compact Fluorescent Lamps (CFL's):** CFL's are highly suitable for places such as Living rooms, Hotel lounges, Bars, Restaurants, Pathways, Building entrances, Corridors, etc. Fluorescent lamps are three (3) times more efficient and last ten (10) times longer. So, it is better to purchase of compact fluorescent lamps/luminaries (CFL).
- ✓ **Replacing Conventional Fluorescent Lamp by Energy Efficient Fluorescent Lamp:** Energy efficient lamps are based on the highly sophisticated technology. They offer excellent color rendering properties in addition to the very high luminous efficacy.

- ✓ **Replacement of Mercury/Sodium Vapor Lamp by Halides Lamp:** MHL provides high colour rendering index and offer efficient white light. Hence for critical applications where higher illumination levels are required, these lamps are used. They are highly suitable for applications such as assembly line, inspection area, painting shops etc.
- ✓ **Replacing HPMV Lamps by High Pressure Sodium Vapour Lamp (HPSV):** Where color rendering is not critical for such applications e.g street lighting, yard lighting because CRI of HPSV is low but offer more efficiency.
- ✓ **Replacing Filament Lamps on Panels by LED:** LED lamps consumes less power (1 W lamp), withstand high voltage fluctuation in the power supply, longer operating life (>100,000 hrs). Hence nowadays they are also used in street lighting, signaling, advertising boards, even as replacement for tube light or CFL.
- ✓ **Replacement of Conventional Ballast by Electronic Ballast:** Installation of high frequency (28 – 32Mhz) electronic ballast in place of conventional ballasts helps to reduce power consumption.
- ✓ **Installation of Separate Transformer for Lighting:** In most of the industries, the net lighting load varies between 2 to 10%. If power load and lighting load fed by same transformer, switching operation and load variation causes voltage fluctuations. This also affects the performance of neighboring power load apparatus, lighting load equipments and also reduces lamps. Hence, the lighting equipment has to be isolated from the power feeders. This will reduce the voltage related problems, which in turn provides a better voltage regulation for the lighting. This also increases the efficiency of the lighting system.
- ✓ **Installation of Servo Stabilizer for Lighting Feeder:** Wherever, installation of separate transformer for lighting is not economically attractive and then servo stabilizer can be installed for the lighting feeders.
- ✓ **Control Over Energy Consumption Pattern:** Occupancy Sensors, Daylight Linked Control are commonly used in commercial buildings, malls, offices, where more no. of lights are to be controlled as per operational hours microprocessor based Light control circuits are used. As a single control unit it can be programmed to switch on /off as per the month wise, year wise and even season wise working schedule.
- ✓ **Periodic Survey and Adequate Maintenance Program:** Illumination level reduces due to accumulation of dirt on lamps and luminaries. By carrying periodic maintenance i.e. cleaning, dusting of lamps and luminaries will improve the light output / luminance. As part of maintenance programme, periodic surveys of installation, lightning system with respect lamp positioning and illumination levels, proper operation of control gears should be conducted to take advantage of energy conservation opportunities as user requirements changes.

Awareness through Education:

Education about energy conservation is important to the industrial sector. Operator behaviour can have a significant effect on the effectiveness of energy efficiency measures in industrial plant. Simply turning off equipment when it is not being used can provide an easy way of saving both energy and money. Education programs can provide considerable potential for energy savings.

Barriers to Energy Conservation:

Several factors act as obstacles to the full realization of energy-saving potentials in the buildings sector. Some of them are:

Lack of Awareness: The lack of or limited awareness of the potential of energy efficiency is likely the most important obstacle to wide-scale adoption of energy efficiency measures and technologies in the country (Adegbulugbe 1991). This is a by-product of two major issues. One is inadequate information to raise the level of awareness of the potential of energy efficiency (including costs and benefits) as well as the available technologies and proven practices. The other issue is a lack of an overall energy demand management policy. If there were an energy demand management policy, this would probably have necessitated the need to develop a databank on the proven measures and technologies that promote rational energy utilization which would be available to the public for effective implementation of the policy.

Energy Supply Constraints/Lack of Incentives and Motivation: Even when there is a desire to adopt energy efficiency measures, the structure of the electric energy supply may be a bottleneck. Due to an unreliable supply of electricity, the motivation to adopt any conservation measure or technology is limited. In addition, a general lack of incentives, such as tax rebate or low customs and excise duties on imports of improved energy efficient technologies, hinders both the importers and consumers.

Inappropriate Energy Pricing: Pricing is an important tool to promote efficient use of energy. However, the energy pricing regime in India is still perceived to be below the marginal opportunity cost (MOC), a result of the government monopoly of the electricity sector and the use of energy supply solely as a social service (provision of energy far below production cost through government subsidies) in order to achieve political objectives. Successive governments have upheld the culture of energy subsidies in the country. Over the years, this has sent

the wrong signals to energy consumers to the extent that any attempt to raise energy prices to the MOC level has often led to both social and political upheavals. In addition, the energy subsidy culture has discouraged any incentive for innovation on energy efficiency measures.

Private and Public Buildings: Often, houses are built, especially by the affluent, with a view to projecting prestige rather than from the economic perspective. Such buildings are generally devoid of energy efficiency features. Lack of information on trends in energy efficient architecture among professionals is a formidable obstacle. This has also encouraged a lack of energy-conscious building standards and regulations.

Lack of Skilled Manpower and Technical Know-How: There is a limited and inadequate human resource capacity to carry out energy audit studies and projects. Energy engineers are rather few in our country. Provision of the required skilled manpower entails specialized training institutions which are not providing presently. Consequently, it is necessary to review the educational curricula in tertiary institutions to close this gap. There is a general dearth of skilled manpower and adequate technical know-how on how to carry out technical energy conservation measures in the country.

Non-availability of Standard Measures: Where such standards exist, non-compliance may result from lack of enforcement and hence the consumers, to sub-standard technologies which are likely to be energy inefficient and may have even been outlawed in their country of manufacture. Both non-availability of standards and lack of enforcement of standards, where they exist, discourage local manufacturers of energy technologies from investing in improving the efficiency of their products.

Possible Strategies to Promote Energy Conservation:

Development of Adequate Database:

Energy efficiency improvement programs aim to reduce unnecessary energy costs through identification and elimination of inefficiencies. This requires the collection and proper analysis of relevant data, which can help to indicate whether or not there is need for improvement in energy use. For the data acquisition activity, users should be compartmentalized into various sub-sectors in which the electricity use can be adequately monitored and analyzed. Such sub-sectors may include the building envelope, which could be further compartmentalized into lighting system, cooling system, building materials, etc. The databank should also include other energy conscious parameters and energy efficient devices and measures.

Research, Development, Demonstration and Dissemination (R, D, D&D):

Funding of research is needed in tertiary institutions and appropriate research institutes in order to develop for a longer period of use of passive energy than obtained presently. The R, D, D&D should also include external designs that provide sufficient shade, reduce solar radiation reflections into the building and thereby reduce demand for active energy services in the building. These may include shade trees, green facades, etc.

Awareness Campaign/Outreach Program:

As the old adage says, "knowledge is power". There is the need for the electric utility, federal ministries and agencies involved in energy reach out to the public, including: investors, professionals, planners, and decision makers through various campaign programs such as seminars, conferences, workshops, radio/television talks and programs. The campaign should be taken to the grassroots in order to educate every stakeholder on the needs for, benefits of, and options for energy conservation.

Supportive Measures:

Supportive Measures to promote energy conservation in the country need adequate regulatory backing. This will involve the institutionalization of standards and codes, as well as incentives and motivation that will enhance the national promotion of energy conservation. Various professionals and all other stakeholders will have to be involved in the regulatory processes for meaningful and functional legislative measures and regulatory practices.

Conclusion:

Energy is an important driver for industrial and agricultural growth. Recognizing inefficiencies in existing energy utilization, the Government of India enacted the energy conservation act in 2001 with a view to provide a legal and institutional framework to provide energy efficiency services and to enable the economy to become energy efficient. The Act envisages the development of policies and strategy with thrust on self-regulation and market principles for production of energy efficiency in the economy. This can be achieved only with active participation of all stakeholders, most importantly state Govt.'s Power Utilities and consumers. Industrial sector plays a crucial role in rapid and balanced development of the state.

References:

1. U.S Energy Information Administration. International Energy Outlook 2009: World Energy and economic Outlook; 2009, Available Online at: <http://www.eia.doe.gov/oiaf/ieo/world.html>, <http://www.eia.doe.gov/oiaf/ieo/highlights.html>, <http://www.eia.doe.gov/oiaf/ieo/industrial.html>, <http://www.eia.doe.gov/emeu/aer/eh/total.html> [A].
2. United Nations Industrial Development Organization (UNIDO). Policies for promoting industrial energy efficiency in developing countries and transition economies; 2008, Available online at:

<http://www.greenhouse.gov.au/challenge/html/about/about.html>,
http://www.unido.org/fileadmin/media/documents/pdf/Energy_Environment/ind_energy_efficiencyEbookv2.pdf

3. Worrell E, Price L. Policy scenarios for energy efficiency improvement in industry. *Energy Policy* 2001; 29:1223–41.
4. National Bureau of Statistics. *China Statistical Yearbook 1999*. Beijing: China Statistics Press; 1999.
5. Yanjia W. Energy efficiency policy and CO₂ in China's industry: tapping the potential. Beijing, China: Tsinghua University; 2006.
6. Mahlia TMI. Emissions from electricity generation in Malaysia. *Renewable Energy* 2002; 27:293–300.
7. Hepbasli A, Ozalp N. Development of energy efficiency and management implementation in the Turkish industrial sector. *Energy Conversion and Management* 2003; 44:231–49.
8. Petrecca G. *Industrial energy management: principles and applications*. USA: Kluwer Academic Publisher; 1992.
9. Bureau of Energy Efficiency. *Energy management and audit*; 2010 [Online] Available at: <http://www.em-ea.org/Guide%20Books/book-2/2.8%20Waste%20Heat%20Recovery.pdf>.
10. Kannan R, Boie W. Energy management practices in SME—case study of a bakery in Germany. *Energy Conversion and Management* 2003; 44:945–59.
11. Dr. S. Devaki (2016) “A Study on Electrical Energy Conservation Practiced in Shop Floor Management of Select Oil Mills in Kangayam, Tirupur District, Tamilnadu”, *International Journal of Multidisciplinary Research and Modern Education (IJMRME)* ISSN (Online): 2454 – 6119, Volume II, Issue II, Page Number 424-434.