# REDUCING ENERGY CONSUMPTION

## INTRODUCTION:-

Reducing energy consumption refers to efforts made to conserve energy. Reducing the Consumption of Energy can be achieved through increased efficient energy use, in conjunction with decreased energy consumption and/or reduced consumption from conventional energy sources.

Energy conservation can result in increased financial capital, environmental quality, national security, personal security, and human comfort. Individuals and organizations that are direct consumers of energy choose to conserve energy to reduce energy costs and promote economic security. Industrial and commercial users can increase energy use efficiency to maximize profit. In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design or climatic design because, unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices. The key to designing a passive solar building is to best take advantage of the local climate. Elements to be considered include window placement and glazing type, thermal insulation, thermal mass, and shading. Passive solar design techniques can be applied most easily to new buildings, but existing buildings can be adapted or "retrofitted".

Responsibility for energy conservation fall between three Government departments although is led by the Department for Energy and Climate Change (DECC). The Department for Communities and Local Government (CLG) is still responsible for energy standards in buildings, and the Department for Environment, Food and Rural Affairs (Defra) retains a residual interest in energy insofar as it leads to emissions of CO2, the main greenhouse gas. The Department for Transport retains many responsibilities for energy conservation in transport. At an operational level, there are two main non departmental governmental bodies ("quinoas") - the Energy Saving Trust, working mainly in the domestic sector with some interest in transport, and the Carbon Trust, working with industry and innovative energy technologies. In addition there are many independent NGOs working in the sector such as the Centre for Sustainable Energy in Bristol or the National Energy Foundation in Milton Keynes, and directly helping consumers make informed choices on energy efficiency

Energy Saving Trust (EST) is an organization devoted to promoting energy efficiency, energy conservation, and the sustainable use of energy, thereby reducing carbon dioxide emissions and helping to prevent man-made climate change. It was founded in the United Kingdom as a government-sponsored initiative in 1992, following the global Earth Summit.

Energy Saving Trust is an independent, not-for-profit organization funded by the government and the private sector. It is a social enterprise, and also has a charitable foundation. The EST has regional offices in England, and country offices in Wales, Northern Ireland, and Scotland. It maintains a comprehensive website, and a network of numerous local advice centres.

## History and purpose:-

The Energy Saving Trust was formally established in November 1992. It was formed, as a public-private partnership, in response both to the director-general of Of gas's 1991 proposal to increase energy efficiency in natural gas use, and to the global June 1992 Earth summit call to reduce greenhouse gas emissions and prevent global warming and climate change. In the wake of energy-supplier privatisation in the UK, the EST was also specifically formed as an instrument to ensure energy conservation and carbon-emission reduction in a free-market environment. The structure, scope, nature, and funding of EST's activities and programmes have varied over the years due to governmental policy changes; however its primary focus – on consumers and households – has remained the same. It is the largest provider of energy-

saving advice, and has effected significant and measurable savings of energy, money, and carbon.

EST's main goals are to achieve the sustainable use of energy and to cut carbon dioxide emissions. It acts as a bridge between consumers, government, trade, businesses, sector organisations, local authorities, and the energy market. The EST's target audience is consumers, local authorities, energy companies, and policy makers. Among other activities, they provide:

Free advice, information, and action plans to individuals, organizations, communities, consumers, and the private sector on how to reduce carbon emissions, use water more sustainably, and save money on energy bills

• Grants and grant-finding advice for energy-saving projects, installations, and purchases

• Energy-saving certification, assurance, and accreditation services for businesses and consumer goods

• Independent and authoritative research, and policy analysis, in energy-conservation areas including household energy efficiency, low-carbon transport, renewable energy, and micro generation

• Management or delivery of government programmes

• Testing of low-carbon technology

• Development of energy-efficient models and tools

## Carbon Trust standards

The Carbon Trust runs a series of environmental standards that certify measurement and reduction. Currently these cover carbon, water and waste and have been awarded to hundreds of leading companies and organisations across the world.

In June 2008 the Carbon Trust introduced the Carbon Trust Carbon Standard to address what it describes as business green wash. The Carbon Trust Carbon Standard is only awarded to companies and organisations who measure and reduce their carbon emissions year on year. Examples of organisations who have held the Carbon Standard include Sky, Aldi, Eurotunnel, Buda, Price water house coopers, Samsung Electronics, Angus Council, Capital & Regional, O2, RWE npower, Credit Suisse, and the Scottish Government.

In February 2013 the Carbon Trust introduced the Carbon Trust Water Standard to recognise those companies reducing their water use year on year. The first four companies to receive the Water Standard were Sainsbury's, Coca-Cola Enterprises Ltd, Sunlight Services Group, and Bramston.

In July 2013 the Carbon Trust introduced the Carbon Trust Waste Standard. In November 2013 the waste standard was awarded to the first wave of organisations, which included the Football Association, Reni Shaw plc. Whitbread, Price water house coopers and AkzoNobel Decorative Paints. These last three became the first in the world to gain the triple crown of reaching the carbon, water and waste standard.

In 2015 the Carbon Trust launched the Carbon Trust Supply Chain Standard to look at carbon footprints across the supply chain. It is the world's first independent certification for organisations that are measuring, managing and reducing greenhouse gas (CO2e) emissions in their supply chains.

## ENVIRONMENTAL IMPACT ON ENERGY CONSERVATION:-

Environmental technology (environ-tech), green technology (Genentech) or clean technology (clean tech) is the application of one or more of environmental, green chemistry, environmental monitoring and electronic devices to monitor, model and conserve the natural environment and resources, and to curb the negative impacts of human involvement. The term is also used to describe sustainable energy generation technologies such as photovoltaic, wind turbines, bioreactors, etc. Sustainable development is the core of environmental technologies. The term environmental technologies is also used to describe a class of electronic devices that can promote sustainable management of resources. Of the 52 percent of the country's population that lives in rural areas, 22 percent reside in or near forests. A majority of these people rely on forest resources for their livelihood, making sustainable land and forest management a critically important challenge for the Philippines. This section presents the major trends in land and forest resources management in the country over the past five to ten years. While there has been some increase in forest cover owing to reforestation efforts and natural regeneration, per capita forest cover in the Philippines is still the lowest in Asia. Moreover, the remaining primary or intact forests remain under threat.

## ABSTRACT:-

Today, energy efficiency issues are becoming more and more important within organizations. Many problems arise when these organizations take the challenge of producing with fewer resources, like materials and energy. There is no general procedure to integrate these aspects in everyday organizational practices. The international standard ISO 50001 defines general requirements for the operational and organizational structure for companies but the standard gives no information about how to realize energy-efficient processes on productive or non-productive level. The energy consumption of processes is rarely known because of an insufficient existing infrastructure and missing measuring devices. Furthermore, often there is a lack of manpower and knowledge about new and innovative technologies. If any expertise exists, it is linked to individual positions and not systematically integrated in projects or structures for the improvement of production processes.

The integration of know-how in energy performance such as energy efficiency, energy use and consumption in organizations needs a knowledge management system and a procedure for the consideration of energy aspects. The new approach is to link a systematic methodology for the identification of energy saving potential to the proposal of measures for their improvement. This approach requires a detailed analysis of the technical and structural facts in production processes. The outcomes of this analysis combined with a database of common measures are generating company-specific measures. The measures are going to be evaluated by defined criteria. The results will be provided for the different roles in an organization. Examples are user-specific checklists or processes for individual tasks. With this approach it is possible for organizations to recognize and to document their knowledge about energy efficiency and to build up a base for a continuous improvement process.

The relationship between energy consumption and economic growth has long been the focus at home and abroad. The general view is: energy consumption promotes economic growth; economic growth affects energy consumption on the other hand. In sight of the original theory, this paper adopts the statistical data of Shandong Province from 1980 to 2008, which include Gross Domestic Products (GDP), energy consumption, fixed asset investment and employees. Using unit root, co-integration and Granger causality test, we examined the relationship between energy consumption and economic growth in Shandong Province. The results show that energy consumption and economic growth have long-term trend relation, and there is two-way causality between them. The econometric model is estimated using Generalized Least Square (GLS) method. The conclusions are as follows: energy consumption and economic growth is positively correlated in Shandong province, and economic growth has highly depended on energy consumption.

## Why reducing energy consumption is important?

You may know what energy conservation is, but have you ever stopped to consider why energy conservation is important? The reality is that there are many reasons why conserving energy is significant to our lives. First of all, saving energy is important because energy use effect the environment and everyone in it. Secondly, when you conserve energy you also save on the cost of living.

That said, to help you understand why energy conservation is important you should know that there are two kinds of energy sources we depend on – renewable and non-renewable. Renewable energy sources are those that are continuously

Replenished, such as water, wind, and solar. Non-renewable energy sources, on the other hand, like gas, coal, and oil, cannot be replaced. Hence, the consumption of these sources needs to be controlled to ensure that the limited supply we have will be available to generations in the future.

Therefore, why energy conservation is important is because we depend on energy for virtually everything in our lives. Energy doesn't just make our lives more comfortable, in many ways it's imperative for our survival.

Since this is the case, if we continue to waste it without employing proper conservation methods, one day we will run out of non-renewable energy to use.

Nevertheless, another vital detail to keep in mind is when we use non renewable energy sources we often add pollution to the environment. In fact, it is estimated that every year in the United States the energy use of the average family produces well over 11,000 pounds of air pollutants. How is this possible? When we use fossil fuels (i.e. coal, natural gas, petroleum), for instance, like those found in our combustion appliances (i.e. furnace) we release carbon dioxide into the atmosphere, which contributes to both water and air pollution, as well as climate change.

However, we can dramatically lower the amount of pollution we cause by investing in energy efficient appliances and practicing other energy saving methods.

Need more incentive to make energy cutbacks in your home, how about the fact that the less energy you use the more money you'll keep in your pocket!

Since there are so many ways we can benefit from using less energy, it is imperative that everyone does their part to educate themselves as much as they can when it comes to learning why energy conservation is important, and applying the knowledge they acquire to everyday life. After all, conserving energy isn't just about saving money every month on bills by reducing energy consumption; it's also about saving the environment.


## Energy conservation techniques:-

These few energy conservation techniques may surprise you. While there are practical methods such as insulation, changing light sources, using alternate fuels and carpooling rather than walking – understand the 6 core techniques beneath them will show you more about what to do in life.

1. Education: Education is probably the most powerful of the energy conservation techniques that can be used. Education is about more than teaching people the importance of conservation, it is about showing the alternative choices that can be used in construction, manufacturing and other processes.

2. Zero Energy Balance: Zero Energy Balance is more than techniques of conserving energy in green construction. It is a process of re-evaluating and retrofitting manufacturing and

commercial operations so that they can harvest and store energy, as well as take and replace it onto the grid to relieve brown out stresses.

3. Alternative Power: There are more processes that are starting to use alternative power and fuel sources in many different areas of life. The use of alternative power is one of the most key energy conservation techniques because almost all of the transition models require that the existing processes be upgraded or replaced to more energy efficient models too.

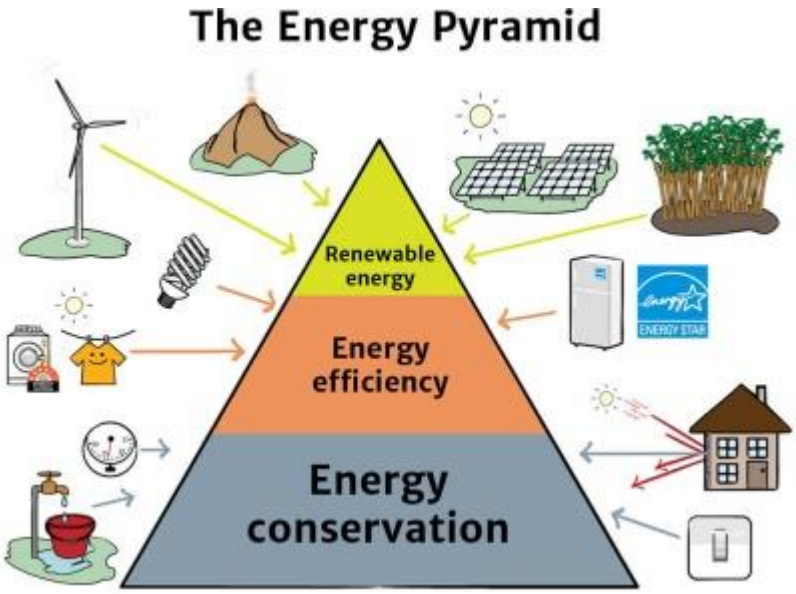
4. Cap and Trade Agreements: Cap and trade agreements are used as part of the process of regulating and conserving consumption and pollution for manufacturing industries. The companies are “allowed” a certain emission rate which they can bid buy to extend. The extension bid is then used for compensating projects. While this may not seem like it is directly related to energy conservation it is very much at its core.

5. Reduced Demand: There are numerous initiatives that are working to reduce the overall demand on the energy resources of the world. This can range everywhere from education programs to changing the type of required insulation in new construction.

6. Research & Development: Continued funding of research and development projects in the energy conservation field is how we discover the changes that can be made to reduce consumption and discover renewable methods to provide us with the energy that modern life requires. It should be one of the energy conservation techniques that are most valued as it is what holds the promise for leading to a solution to the world’s energy crisis.

## What is energy efficiency?

Being energy efficient means reducing our overall demand for energy. We become more energy efficient when we use less energy, or switch to more efficient energy sources, like renewable energy sources.




Fossil fuels are natural, non-renewable fuels such as coal, oil and gas. Burning these fossil fuels releases carbon dioxide into the atmosphere, which contributes to global warming.

Energy efficiency means reducing our overall demand for energy, i.e. by using less energy to produce the same product or service.

Renewable energy comes from a source that will never run out. Renewable energy sources are environmentally-friendly.

Reducing energy use in your home saves you money, increases our energy security, and reduces the pollution that is emitted from non-renewable sources of energy. If you are planning to install a small renewable energy system to make your own electricity, such as a solar electric system or small wind turbine, reducing your electricity loads is the first step—saving you money by allowing you to purchase a smaller system.

There are many ways you can reduce electricity use in your home:

- **Appliances and electronics** -- Purchase energy-efficient products and operate them efficiently. Use an advanced power strip to reduce "vampire loads"--electricity that is wasted when electronics are not in use.
- Lighting -- Purchase energy-efficient products, operate them efficiently, and incorporate more day lighting into your home using energy-efficient windows and skylights.

- Electric space heating and cooling -- Purchase energy-efficient electric systems and operate them efficiently. Incorporate passive solar design concepts into your home, which include using energy-efficient windows. Properly insulate and air seal your home. Select an energy-efficient heating system that doesn't use electricity.
- Electric water heating -- Purchase an energy-efficient electric water heater and operate it efficiently. Or select an energy-efficient water heater that doesn't use electricity.

To improve the overall energy efficiency of your home, see home energy audits.

Time-Based Electricity Rates

To help reduce their peak power demands and save money, many utilities are introducing programs that encourage their customers to use electricity during off-peak hours. The programs pass on the savings to you, the customer, through rebates or reduced electricity rates.

Smart meters and home energy management systems allow customers to program how and when their home uses energy. Such programs might charge you the actual cost of power at any one time, ranging from high prices during times of peak demand to low prices during off-peak hours. If you are able to shift your power use to off-peak times -- such as running your dishwasher late in the evening -- these programs can save you money while helping your utility.

Time-based rates are very attractive to owners of plug-in hybrids and electric vehicles since typically these vehicles are recharged at night. See buying and driving fuel efficient and alternative fuel vehicles for more information.

## Review of literature:-

The imperative to conserve energy is as old as the use of energy. For most of human history, use of energy was limited to the amount of work that could be done by human beings, usually alone, but sometimes in large groups. Later, humans learned to use animals and teams of animals to do the tasks requiring heavy lifting and hauling. Neither humans nor animals like hard work. Aversion to work strongly motivated energy conservation from the beginning. Energy conservation first consisted of doing less. Then, as intelligence evolved, it included finding easier ways to get work done. For example, the invention of the wheel was an early advance in energy conservation. Fire is the oldest major source of energy, other than muscle, that is controlled by humans. Since prehistory, fire has been used for cooking, heating of dwellings, hardening spear points, clearing land, smelting and casting metal, baking pottery, and other applications. Controlled fires require a considerable amount of effort for gathering fuel, so efficiency arose in the use of fuel. For example, the kilns and ovens of many early cultures were quite efficient in their use of fuel. Also, North American Indians devised ways of using far less fuel for comfort heating than European immigrants. Wind power is the oldest major source of mechanical energy, other than muscle. Its earliest major application was ship propulsion, which began perhaps five to ten thousand years ago. This made possible the trading of large tonnages of goods throughout the known world. Moreover, wind power expanded the boundaries of the human world and it was an essential factor in the development of many civilizations. Land-based rotary wind machines have been used in a limited number of cultures for over two millennia. Efficiency evolved by trial and error. The Dutch style of wind machine used for pumping water and grinding grain five hundred years ago achieved a large fraction of the theoretical maximum efficiency. However, usage is limited by the localized and irregular nature of wind. The energy of falling or flowing water has been used to a significant extent for over two millennia, becoming a major energy source in the middle Ages. Unlike wind, which is a nuisance in itself, water is desirable for many

Important purposes. As a result, many cultures settled near water supplies, which they learned to exploit for power. Well designed "overshot" water wheels built 500 years ago have efficiencies that approach the theoretical maximum. Water power is limited by the amount of stream flow and by the height of the fall that is readily available. The technology of building dams tall enough to augment power production was not highly developed until the 19th century. Steam machinery is another application of fire. It was first put into practical application during the 18th century. Its development was revolutionary for several reasons. It enables fire to

produce mechanical work. It was the first invention capable of producing mechanical power in any locale, on land or sea. Virtually any amount of work can be done by building larger machines. Steam engines can operate whenever work is needed, independent of climate. To a large extent, steam power created modern civilization. However, steam machinery requires fuel, unlike wind and water power. The ability of mechanics to build large steam engines, and the growth in applications for such engines, led to rapidly increasing demand for fuel, which could no longer be satisfied by whatever excess wood happened to be in the vicinity. Fuel cost soon emerged as a dominant limitation to the application of steam machinery. In response, efficiency also emerged early as a fundamental issue in the design of steam machinery. In fact, during the 18th and 19th centuries, what we now call mechanical engineering was largely a search for higher efficiency. James Watt and many other engine builders improved efficiency on an empirical basis, while attempting to understand the underlying physics. Sadi Carnot created the first solid theoretical understanding of energy efficiency. During the early 19th century, Carnot explained the Second Law of Thermodynamics, which places a severe theoretical limit on the efficiency of converting heat to mechanical work. New fuel sources were discovered and developed in parallel with the development of power producing machinery. This was largely a fortunate coincidence. It was not primarily a matter of new machinery creating a demand for new energy sources. On the contrary, from the beginning of the 19th century, new sources of fuel were developed or discovered in advance of demand. Steam machinery made coal mining much more productive. The extraction of petroleum in quantity was developed in the middle of the 19th century, before people knew what to do with large amounts of petroleum. The development of internal combustion engines soon provided a large market for petroleum, which later found application as a primary fuel for steam machinery. With petroleum came natural gas, initially a dangerous waste product. Its discovery in quantity again motivated people to develop

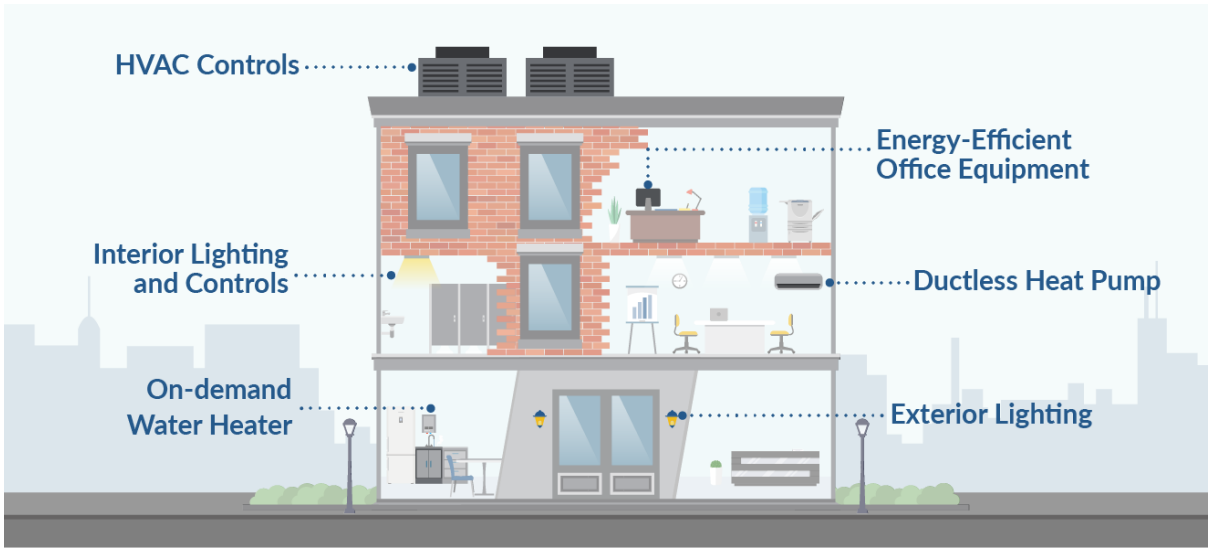
Uses for it. Electrical power first emerged in the late 19th century, specifically for lighting. Electrical power was produced by increasingly efficient engines. However, lamps remained inefficient until the commercialization of fluorescent lighting, shortly before World War II. The development of practical electric motors, largely by Nikola Tesla, occurred toward the end of the 19th century. This enormously expanded applications for mechanical power. It freed the individual energy user from the need to have his own steam plant. Mechanical power could now be used anywhere, even in very small applications. The invention of innumerable small machines and labour saving devices made "energy" a ubiquitous commodity by the beginning

of the 20th century. Unlike the evolution of mechanical equipment, the development of electrical equipment was largely based on theory. All practical electrical motors are efficient, at least in comparison with combustion-driven machinery. However, the efficiency of applications served by inexpensive alternating-current motors is often limited by the fact that these motors are single-speed devices. Efficient variable-speed motors were developed early, but they had serious cost and maintenance limitations. By the beginning of the 20th century, energy consumption per capita was accelerating, while the energy-consuming population of the earth also grew rapidly. Appliances displaced muscle power at home. Machines increased production in factories and in agriculture. Automobiles made transportation a major new consumer of fuels. Fuel replaced wind for the propulsion of ships. Air travel became another user of fuel. All the while, the available supply of energy continued to grow comfortably ahead of demand. Huge hydroelectric generation plants were built to provide jobs during the Depression. Electricity generation by nuclear fission arose as a by-product of nuclear weapons, becoming another major source of energy from the 1950's onward. Until the early 1970's, there was a popular conception of continually diminishing energy prices. For example, nuclear power advocates spoke of electricity that would be "too cheap to meter." As a result, efficiency ceased to be a major concern of the engineers who designed energy-using equipment, and efficiency faded as an issue with the public and the government

# Methodology:-

## At Office:-

While every office building has a unique energy use profile, here are a few general tips that can reduce your power bill.




1. Smart Lights

A great deal of energy waste is due to carelessness. Perhaps the most common needless energy expenditure is the failure of building users to turn off lights. Smart lights fight energy waste in two ways:

1. Automatically dimming when space is already being supplemented by sunlight.
2. Automatically turning on and off.

Installing smart lights comes with upfront costs that are unavoidable; however, given the prevalence of light waste, they are likely to pay off in the long run.

2. Shade

Overlooking the power of shade when working towards cutting energy costs is a mistake. Protecting your building from sunlight is a simple and relatively cheap energy saving solution.

Installing shades or blinds keeps your building temperature down reducing the strain on your air conditioning system, and placing trees and landscaping in sun-facing areas can also help produce shade in the right spots. Another way to help keep your building cool without running up your HVAC bill is through window tinting.

3. Understand you're Building's Energy Use Profile

Knowing how your energy bill is racking up is the first step in reversing the trend. There are a host of tools for building owners to track energy usage. Which tools you elect to incorporate into the management of your property should be based on the amount of energy it consumes. Ranging from installing smart thermostats to hiring dedicated technicians to monitor consumption, understanding your energy use can be a huge cost saver.

4. Ensure Your Building's Ventilation System is Unobstructed

Making sure you're existing heating and cooling system is operating at peak efficiency is a no-brainer.

Dirty heating and cooling coils frequently cause inefficiency in HVAC systems. Check to make sure that your coils are in good operating condition, and if they are not, clean them to get them in working order.

Similarly, air handling unit filters frequently become clogged reducing the effectiveness of your HVAC system. Replacing clogged filters is an easy and quick way to improve your HVAC's efficiency thereby reducing energy expenditure.

Furniture is also a common culprit in HVAC vent obstruction. Avoiding having furniture block vents is a simple way to reduce energy consumption.

5. Stress the Importance of Good Energy Saving Habits

Letting your employees and renters know the importance of efficient energy utilization can make an impact. Encouraging your renters and employees to do simple things like avoid obstructing HVAC vents with furniture or turning lights off when unused can go a long way.

There’s a fine line between respectfully communicating the importance of energy savings to your renters and being overbearing, but walking that line can create a better working environment for them and lower costs for you.

6. New Commercial HVAC Units

While it might seem intimidating, getting a new HVAC system is often the best thing you can do to reduce energy costs. There is a good chance that your building is not equipped with an efficient HVAC system. Your HVAC system is likely accounts for over half of your building’s net energy consumption. While getting a new HVAC system has upfront costs, in the long run, the amount you’ll save will trump the cost of the system.

Managing large properties are tough, and office space is no exception. Keeping energy consumption low is one significant way to minimize expenses. While there is not a cure-all solution to a back-breaking power bill, taking several deliberate steps to reduce consumption in unison can yield considerable savings.

## At Schools:-

“How to save energy at school?” is a simple question with a complex answer. Most schools use a lot of electricity to ensure the facility is safe, secure, comfortable and conducive to learning for students. Everything from lighting to climate control adds to the electrical expenses related to running a school. Teachers can look at energy-saving efforts in school as an option to work with students. The children in class can help come up with innovative ideas to save electricity at school. Getting children involved in energy-saving processes at a young age encourages responsibility and jump starts a lifetime of environmental consciousness. A new school year tends to bring a lot of excitement and energy as teachers and students prepare for the year ahead. Make this the most exciting and energy-efficient year yet by taking these 14 tips to the classroom.


1. Take advantage of natural sunlight

Schools about to be built or those facing rehabilitation or remodelling can include design features that maximize the use of natural light. Adding blinds or other window fixtures in classrooms can allow teachers to reduce glare while trading electrical light for natural sunlight.

You may even want to consider the inclusion of skylights. Adding skylights in hallways, bathrooms, and other common areas can reduce your need for artificial lighting. They can allow filtered light to enter from above, taking advantage of strong solar exposure areas to reduce overall power consumption.

Natural sunlight will create a more relaxed learning environment compared to the harsh overhead lights that are normally in classrooms. Studies have also shown that natural light keeps people more focused and alert and improves their mood. Plus, keeping the lights off will keep the room cooler during the September heat.

*2.* Switch Over to LEDs or CFLs

One of the best tips on how to save electricity at school is a practice you probably already use at home. Replace all of those incandescent bulbs and standard fluorescent lights with more

efficient options. Lights will run all day at the school, making them one of the most significant expenses related to powering a school. Standard lights can also produce a lot of heat, increasing cooling costs as well.

Compact Fluorescent Lights or CFLs can work in fluorescent sockets or even standard screw-base sockets. CFLs last longer than standard incandescent bulbs and cost a fraction of the price to run. However, with mercury inside, they create some other issues if someone breaks one. They also burn out quickly when regularly turned on and off.

Modern LED bulbs can offer a powerful option for lighting at a fraction of the electrical cost. Modern advances in the diodes used in these bulbs allow for more affordable light bulb production, making them more cost-effective at the time of purchase. As an added bonus, some options allow you to control the colour of the light and change it at will.

*3*. Invest in energy-saving power strips

Keep classroom computers and other devices plugged into power strips to help mitigate their stand-by power usage. Not only will this help save power on a day-to-day basis, it will also make it easier to unplug all the devices during long holiday breaks.

*4*. Change Televisions to Flat and LCD Screens

Light bulbs aren't the only fixture that can help you reduce school energy uses. Another consideration when you're learning how to save energy at school's the power used for television screens and computer monitors. Schools depend on screens for writing and viewing educational materials. Older, larger televisions use substantially more electricity than smaller, modern screens.

CRT units use the most power of popular screen styles, while LCD screens use less power, often less than half or a third of the amount of a comparably sized CRT screen. An LED screen

may use even less than that. Plasma screens are the only newer option that may be less efficient. Most flat screen options will help your school save money.

*5.* Invest in Better Cooling Options

Running an industrial air conditioner to keep the school cool can cost a lot of money. It takes a huge amount of electricity to offset the cost of eliminating the heat produced by both machinery and hundreds of human bodies during warm weather. Upgrading to a more efficient cooling option could be a good decision. That may be one way to reduce school electricity use that can actually pay for itself.

Beyond air conditioning, limiting the use of power-sucking cooling options is always wise. Maintain or repair windows so that they can open to provide ventilation. Invest in ceiling fans and window fans to keep air moving in classrooms on days where heat is higher but not overwhelming.

*6.* Encourage Students to Recycle

Most students know what is and isn't recyclable, but don't always act on that knowledge. Encourage kids to do their part by creating a point system for recyclers, or assign extra credit projects focused on recycling and environmental impact.

*7.* Use Sensors for Turning Lights on or Off In a Room

There are many spaces in a school, like bathrooms, that only see occasional use. However, for student safety, many schools leave the lights on in these rooms the entire time school is in session. If you're wondering how to save electricity at school, you may need to invest in motion sensors.

These inexpensive units can turn lights on and off in spaces you don't much use. They will trigger lighting when someone enters and automatically turn the lights back off when there's no movement for some time, indicating that the room is now empty.

Upgrading to more efficient gadgets and systems is only half of how to save electricity at school. Your staff, teachers, administrators, and students can all change and adjust their daily practices a little bit to reduce power use. Small changes over time can add up to big savings for the school budget and the planet.

*8.* Consider Upgrading the Kitchen

When it comes to how to save energy at school, upgrading your cafeteria kitchen is almost always a great idea. Older ovens and microwaves, as well as refrigerators and freezers, use a lot more electricity to run than newer, energy-efficient models. Convection ovens and air fryers, for example, can create healthier foods compared to fried options while also using less power for cooking.

Despite only being used for a portion of the day, the cafeteria kitchen can be a major source of energy use. Investing in better appliances, efficient lights, and even timers for lighting, can all help reduce the overall costs of providing your students with foods.

*9.* Have Class in the Grass

Escape the confines of the classroom by taking the class outside. Older school buildings are sometimes warmer inside on hot days than the temperature is outside. Keep kids from wilting in the warmth by creating an engaging outdoor classroom using dry erase boards or clipboards.

*10.* Keep Doors to Different Areas Closed

Keeping doors to other spaces closed during school hours is a good practice. First of all, closed and locked doors offer more security. They could make all the difference in a situation that places students in danger, such as an attack by an active shooter. Closed doors can also limit thermal loss into unused rooms and even the hallways between classrooms.

When you're paying to cool classrooms, you want to keep that cold air where the students are actually studying, not in the empty hallways. Keeping each room closed, including those in use and those not currently utilized, can help you reduce power consumption related to keeping the students cool.

*11.* Consider Changing Your Electricity Provider

While deregulation of energy providers may have increased some consumer costs, it has also opened up the possibility of seeking a new provider for your energy needs. You will have the option to select your power provider. After years of electricity being a public utility, it's finally privatized, allowing for competition and better pricing for consumers. There may be several lower power companies near you.

Unlike individual customers, schools have a major electrical footprint, meaning that power companies typically want to seek and maintain them to increase their profits. Take advantage of deregulation in Texas by looking at pricing options from many different providers.

*12.* Assign Classroom Jobs

Help make energy-efficiency a habit by assigning jobs to your students. Some examples include an electrician, who is in charge of turning lights on and off, or IT, who can help with classroom computers and other electronics. By giving students extra responsibilities in the classroom, they can take energy savings into their own hands and carry those lessons over at home.

*13.* Turn off Lights and All Screens

Too many schools leave lights on for hours after class. Teachers may leave their individual computers, as well as entire computer labs worth of desktops, running overnight and over the weekend. Taking the time to power down these computers each afternoon (and especially on Fridays and before holidays) can do a lot to reduce your power usage.

*14.* Close Unused Rooms and Spaces

If you don't have gym today and won't host any team sports practices, why are you paying for cooling and lighting the gym? While you may not like the way that closed doors make a space feel, they can certainly do a lot for improving your energy efficiency.

The bigger the space, the more energy you use to light it up and regulate the temperature in the room. Closing off certain rooms by shutting doors and closing vents for the cooling system can also reduce the amount of resources you're wasting on making an unused space comfortable, despite its lack of inhabitants.

## At Home:-

1. Adjust your day-to-day behaviours

To reduce energy consumption in your home, you do not necessarily need to go out and purchase energy efficient products. Energy conservation can be as simple as turning off lights or appliances when you do not need them. You can also use energy-intensive appliances less by performing household tasks manually, such as hang-drying your clothes instead of putting them in the dryer, or washing dishes by hand.

The behaviour adjustments that have the highest potential for utility savings are turning down the heat on your thermostat in the winter and using your air conditioner less in the summer.

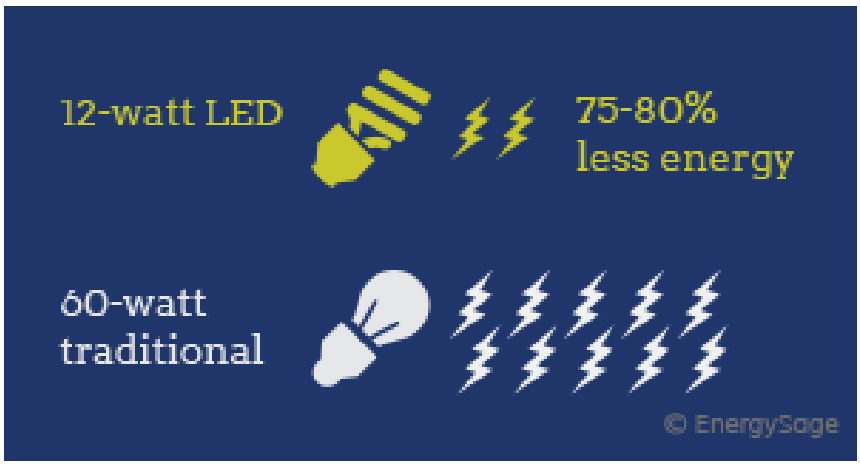
Heating and cooling costs constitute nearly half of an average home's utility bills, so these reductions in the intensity and frequency of heating and cooling offer the greatest savings.

There are tools you can use to figure out where most of your electricity is going in your home. A home energy monitor can help you understand which appliances are using the most electricity on a day-to-day basis.

2. Replace your light bulbs

Traditional incandescent light bulbs consume an excessive amount of electricity and must be replaced more often than their energy efficient alternatives. Halogen incandescent bulbs, compact fluorescent lights (CFLs), and light-emitting diode bulbs (LEDs) use anywhere from 25-80% less electricity and last three to 25 times longer than traditional bulbs.

Although energy efficient bulbs are more expensive off the shelf, their efficient energy use and longer service lives mean that they cost less in the long run. Energy efficient bulbs are the clear winners in terms of their environmental and financial benefits.




3. Use smart power strips

"Phantom loads," or the electricity used by electronics when they are turned off or in standby mode, are a major source of energy waste. In fact, it is estimated that 75% of the energy used to power household electronics is consumed when they are switched off, which can cost you up to $200 per year. Smart power strips, also known as advanced power strips, eliminate the problem of phantom loads by shutting off the power to electronics when they are not in use.

Smart power strips can be set to turn off at an assigned time, during a period of inactivity, through remote switches, or based on the status of a “master” device.

4. Install a programmable or smart thermostat

A programmable or smart thermostat can be set to automatically turn off or reduce heating and cooling during the times when you are asleep or away. When you install a programmable thermostat, you eliminate wasteful energy use from heating and cooling without upgrading your HVAC system or sacrificing any comfort.

On average, a programmable thermostat can save you $180 per year. Programmable thermostats come in different models that can be set to fit your weekly schedule. Additional features of programmable thermostats can include indicators for when to replace air filters or HVAC system problems, which also improve the efficiency of your heating and cooling system.

5. Purchase energy efficient appliances

On average, appliances are responsible for roughly 13% of your total household energy use. When purchasing an appliance, you should pay attention to two numbers: the initial purchase price and the annual operating cost. Although energy efficient appliances usually have higher purchase prices, their operating costs are 9-25% lower than conventional models.

When purchasing an energy efficient appliance, you should look for appliances with the ENERGY STAR label, which is a federal guarantee that the appliance will consume less energy during use and when on standby than standard non-energy efficient models. Energy savings differ based on the specific appliance. For example, ENERGY STAR certified clothes washers consume 25% less energy and 45% less water than conventional ones, whereas ENERGY STAR refrigerators use only 9% less energy.

6. Reduce your water heating expenses

Water heating is a major contributor to your total energy consumption. Other than purchasing an energy efficient water heater, there are three methods of reducing your water heating

expenses: you can simply use less hot water, turn down the thermostat on your water heater, or insulate your water heater and the first six feet of hot and cold water pipes.

If you are considering replacing your water heater with an efficient model, you should keep in mind two factors: the type of water heater that meets your needs and the type of fuel it will use. For example, tank less water heaters are energy efficient, but they are also a poor choice for large families as they cannot handle multiple and simultaneous uses of hot water. Efficient water heaters can be anywhere between 8% and 300% more energy efficient than a conventional storage water heater. Also, be sure to account for its lengthy service life of 10 to 15 years in which water-heating savings can accumulate.

7. Install energy efficient windows

Windows are significant source of energy waste, which can amount to 10-25% of your total heating bill. To prevent heat loss through your windows, you can replace single-pane windows with double-pane ones.

For homes in cold regions, gas-filled windows with “low-e” coatings can significantly reduce your heating expenses. In addition, interior or exterior storm windows can reduce unnecessary heat loss by ten to 20 percent. You should especially consider storm windows if your region experiences frequent extreme weather events.

In warmer climates, heat gain through windows may be a problem. In addition to minimizing heat loss, low-e coatings on windows can reduce heat gain by reflecting more light and lowering the amount of thermal energy diffused into your home. Depending on the climate where you live, ENERGY STAR windows can save you $20-$95 each year on your utility bills. Window shades, shutters, screens, and awnings can also provide an extra layer of insulation between your home and external temperatures.

8. Upgrade your HVAC system

An HVAC system is composed of heating, ventilation, and air conditioning equipment. Heating alone is responsible for more than 40% of home energy use. Because homes in Northern regions are exposed to much colder temperatures during the year, ENERGY STAR gas furnaces have different specifications in the northern and southern halves of the United States.

Upgrading to a “U.S. South” ENERGY STAR certification can save you up to 12% on your heating bill, or an average of $36 per year. ENERGY STAR furnaces in the northern half of the U.S. are labelled with the standard ENERGY STAR logo and are up to 16% more energy efficient than baseline models. This translates to average savings of $94 per year on your heating bill in the Northern U.S.

Air conditioning, by comparison, isn’t a significant contributor to energy bills – on average, it only makes up six percent of the total energy use of your home. ENERGY STAR central air conditioning units are eight percent more efficient than conventional models. Air conditioning systems are usually integrated with heating systems, which means that you should purchase your new furnace and air conditioner at the same time in order to ensure that the air conditioner performs at its maximum rated energy efficiency.

Upgrades to the third component of an HVAC system – ventilation – can also improve your energy efficiency. A ventilation system is composed of a network of ducts, which distributes hot and cold air throughout your home. If these ducts are not properly sealed or insulated, the resulting energy waste can add hundreds of dollars to your annual heating and cooling expenses. Proper insulation and maintenance on your ventilation system can reduce your heating and cooling expenses by up to 20%.

9. Weatherize your home

Weatherizing, or sealing air leaks around your home, is a great way to reduce your heating and cooling expenses. The most common sources of air leaks into your home are vents, windows, and doors. To prevent these leaks, you should ensure that there are no cracks or openings between the wall and vent, window, or doorframe.

To seal air leaks between stationary objects, such as the wall and window frame, you can apply caulk. For cracks between moving objects, such as operable windows and doors, you can apply weather stripping. Weather stripping and caulking are simple air sealing techniques that typically offer a return on investment in less than a year. Air leaks can also occur through openings in the wall, floor, and ceiling from plumbing, ducting, or electrical wiring.

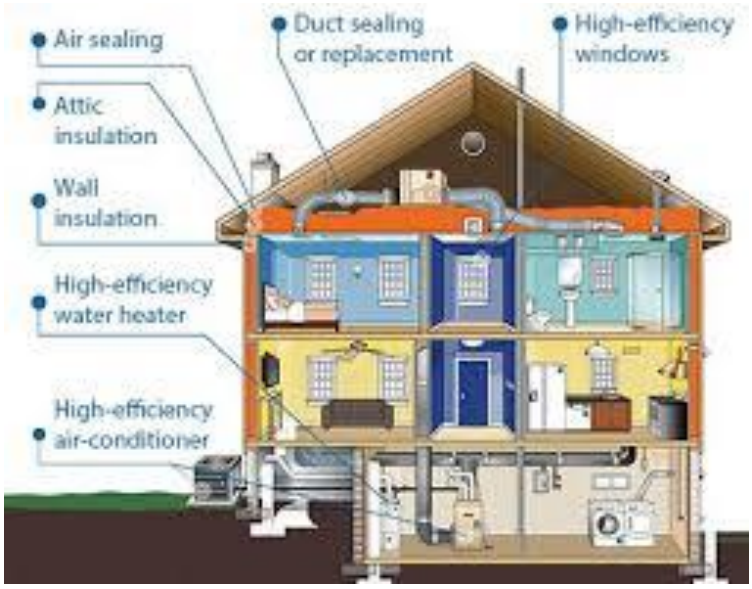
Air leaking out of your home is most often from the home interior into your attic through small openings. Whether it is through ducts, light fixtures, or the attic hatch, hot air will rise and escape through small openings. As the natural flow of heat is from warmer to cooler areas,

these small openings can make your heating bill even higher if your attic is not sufficiently insulated. To reap the full amount of savings from weatherization, you should consider fully insulating your home.

10. Insulate your home

Insulation plays a key role in lowering your utility bills through retaining heat during the winter and keeping heat out of your home during the summer. The recommended level of heat resistance, or "R-value," for your insulation depends on where you live. In warmer climates, the recommended R-value is much lower than for buildings located in colder regions like the Northeast.

The level of insulation you should install depends on the area of your house. Your attic, walls, floors, basement, and crawlspace are the five main areas where you should consider adding insulation. Use the Home Energy Saver tool for recommendations based on the specifications of your home, or find general regional recommendations on the Department of Energy's webpage on insulation.




Type of methodology used:- Interview methodology

Questions asked to a Energy Conservation Engineer

Q1. Share an effective approach to identify energy savings opportunities and make recommendations to achieve more energy efficient operation.

Q2. Walk me through how you manage the development, design, or construction of energy conservation projects to ensure acceptability of budgets and time lines, conformance to federal and state laws, or adherence to approved specifications.

Q3 What is key when reviewing or negotiating energy purchase agreements? Share an example.?

Q4 How often do you conduct jobsite observations, field inspections, or sub-metering to collect data for energy conservation analyses? Share an experience.

Q5 Describe methods you have found effective to inspect or monitor energy systems, including heating, ventilating, and air conditioning (HVAC) or daylighting systems to determine energy use or potential energy savings.

# Findings (Results) :-

INTRODUCTION:-

BEE under Ministry of Power has implemented PAT scheme, a component under NMEEE in India. PAT is a mechanism to enhance cost effectiveness through certification of excess energy savings in energy intensive industries that can be traded. PAT is an innovative policy strictly mandate, market based mechanism launched in 2012. The scheme covers 478 designated consumers from 8 energy intensive sectors. The scheme includes goal setting for the specific energy consumption reduction target for 478 designated consumers. In the Target achieve/ reduction phases the designated consumers under take measures to reduce their specific energy consumption by developing action plans. During Trading phase consumers who exceed their target will be credited with tradable energy permits. This scheme encourages to accelerate energy savings in energy intensive and large industries by giving incentives for energy saving. Achievement above the set targets will result in tradable energy saving certificates (ESCerts), whereas under-achievers have to comply by purchase of ESCerts or by paying a penalty. This scheme is expected to result a saving of 6 to 7 million TOE (Tonnes of Oil Equivalent) of energy, and the other benefits would be a reduction of 25 million Tonnes of CO2 equivalent. Considering the cost of 1 TOE to be Rs. 10,154 as notified by BEE in 2011-12, the cost of energy saved amounts to rupees 6782 crores. In PAT the main focus is to place forward our greatest ideas and values of energy conservation and moderation. This is often additionally necessary within the context that, typical sources square measure running out of offer and sooner is going to be exhausted. The present study was aimed to understand and study analysis of the PAT Scheme which has been rolled out for eight selected sectors during March 2012. The scope of the study includes an assessment of performance of the scheme in the present cycle and learning's. From the constructive feedback, observations and recommendations the scheme may be further strengthened in the future cycles. To analyse the assorted aspects related to the PAT cycle it is vital to satisfy those that have gained expertise during this field. However each and every trade is attempting to realize their specified targets. The studies have been carried out in consultation with SSEF, BEE and other stakeholders. The overall view is likely, institutional mechanism design as well as role assignments are robust and capable of inspiring confidence among the

stakeholders by comprehensive coverage and treatment. The need of the hour is to disseminate the provisions made and develop elaborate working guidelines on roles, independence, practices and procedures etc. to supplement the existing system of framework. PAT brings the sure benefits of reduction in CO2 emission and creates more business and job opportunities in market.

## CURRENT ENERGY SCENARIOS

The country's current energy generation and consumption is greatly alarming. The impact of energy generation on environment is rapidly increasing hence clear and bright policies are highly needed to control and govern else disasters are sure for the same. Therefore regulatory mechanisms like energy efficiency (Star) ratings and PAT by BEE are supportive in this respect. Table 1 also depict similar. Fig 2 presents sector wise consumption Graphical representation of Energy scenario of India (Reference: Central Electricity Authority (CEA), * Up to May 2019) Fig 2 Total energy consumption sector wise view (Reference: Central Electricity Authority (CEA), * Up to May 2019) Mallikarjun G Hudedmani et al., International Journal of Advanced Science and Engineering www.mahendrapublications.com

## PERFOM, ACHIEVE AND TRADE (PAT)

PAT scheme is designed to enhance the effectiveness and energy efficiency in energy intensive and large industries and facilities, through certification of energy savings that could be traded. This mechanism brings the large variation in energy intensities of different units in almost in every sector. With respect to Sec 14(g) of the EC act, the Government has notified targets (in the form of SEC) for 478 DCs in the eight industrial sectors during March 2012 under the PAT cycle-I. The reduction in energy intensity and target for each unit is dependent on its present efficiency. The aimed reduction target is less for those efficient systems and is higher for those less efficient units shows the historical evolution of PAT.

Salient features of PAT and working PAT system and its associated mechanisms give an opportunity to reduce specific energy consumption leading to cost effectiveness through certification method and which can be traded. Following are the salient features noted.

- Regulatory measure or an instrument which is linked with market mechanism which helps to obtain certification of energy saving

- Consultative approach - Ministries/DCs/Associations/FIs/Research Organizations
- Outreach/ Capacity Development - Workshops/Seminars/ Visits
- Self – competing - Unit specific targets
- Relative responsibility for setting targets like low target for more efficient and more for less efficient system.
- Work as a supportive tools to improve energy management system by measurement, recording and reporting The PAT scheme assigns the targets to reduce specific energy consumption and saving targets to the Designated Consumers (DCs) for a three year cycle. The target reduction for each DC is based on their present consumption and energy efficiency, so that energy efficient DCs will be given with smaller and that slightly inefficient consumer with larger target values. For the calculation of the specific energy consumption against the total production, data is collected by "gate-to-gate" approach. This procedure is followed to work out with relevant energy efficiencies, consumption and verification of the performance of DCs at the end of the cycle by the accredited energy auditors by Bureau of Energy Efficiency. PAT Cycle-I (2012-13 to 2014-15) was envisaged to reduce the SEC of 478 designated consumers (DCs) from eight energy intensive sectors namely ,Thermal power plant, Textile, Iron and steel, Aluminium, Cement, Chlor- Alkali, Fertilizer, Paper and Pulp etc. From the study and analysis the overall energy saving targets for PAT Cycle –I was 6.686 Million Tonne of Oil Equivalent (MTOE) by the end of year 2014-15. The achievement in PAT Cycle-I is 8.67 MTOE which is an over achievement of about 30 percent in comparison to the assigned targets. This energy saving translates in to avoiding about 31 million tons of CO2 emission. Ministry of Power has already issued energy saving certificates (ESCerts) in lieu of energy saving beyond their targets and entitlement to purchase of ESCerts for compliance to meet their shortfall towards their targets. There are 306 DCs who have been cumulatively issued about 38.50 lakh ESCerts in lieu of their excess energy saving against the targets and there are 110 DCs that are cumulatively entitled to purchase about 14.50 lakh ESCerts to meet their shortfall to meet energy saving targets. The ESCerts could be traded at two energy exchanges that is Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL) or bought by other units under PAT who can use them to meet their compliance requirements. Units that are unable to meet the set targets either by their own actions or through purchase of ESCerts are sure to face financial penalty under the Energy Conservation Act. The trading infrastructure is currently under finalization and trading is started in the month of

April/May. the phase and working of PAT mechanism and the implementation of PAT as on 2017. Historical mile stones in the view of PAT (Reference: Bureau of Energy Efficiency, 2012. PAT Booklet Int. J. Adv. Sci. Eng. Mallikarjun G Hudedmani et al., International Journal of Advanced Science and Engineering www.mahendrapublications.com Fig 4 Time diagram of Working of PAT (Reference: Market Based Mechanism to Improve Industrial Energy Efficiency) Industry implementation of PAT by 2017 (Reference: Energy Reduction targets for Electricity Distribution companies for PAT Cycle II ) PAT Cycle –II (2016-17 to 2018-19) was expanded to new sectors and new DCs in PAT Cycle –II namely, Railways, Refineries and Electricity Distribution Companies (DISCOMs). PAT Cycle-II has been notified on 31st March, 2016 and aimed to achieve an overall energy reduction in consumption by 8.869 MTOE. Under PAT Cycle-II, energy reduction targets have been assigned and notified to 621 DCs (out of which 448 are existing, 89 additional DCs from existing sectors and 84 DCs from new sectors mainly in Railways, Electricity DISCOMs and Refineries). Shows the information related to old eight sectors and added new ones to the system (eight existing sectors and three new sectors). PAT Cycle –III (2017-18 to 2019-20) scheme is currently proposed to be implemented on rolling basis (i.e. annual inclusion of new DCs). In this regard, the PAT Cycle III has been notified on 30th March, 2017 to be effective from 1st April, 2017 with inclusion of 116 new DCs. The identified 116 DCs found consume about 35 MTOE while they have been assigned energy saving target of 1.06 MTOE at the end of the cycle-III by 2019- 20. In total, there are 737 DCs. Challenges for the implementation of PAT

The following challenges were experienced in the implementation of waste heat recovery systems in two industries namely, Iron & Steel and Cement. High capital cost, quality of heat and equipment maintenance etc. The capital cost to implement a waste heat recovery system may outweigh the benefits gained in heat recovered. Therefore, it is necessary to analyse the cost benefit by considering all the facts clearly. The cost implications for only installing waste heat recovery boilers (WHRB) and other accessories is around USD 0.75 million. The cost of installing whole units along with waste heat recovery in large plants is USD 22.23 million as in an Iron & Steel plant. The cost implication in the Cement industry is approximately USD 11.25 million. Often, waste heat is of low quality (temperature). Some time it is challenging and difficult to utilize the whole of the recovered quantity of low quality heat contained in a waste heat medium exchangers tend to be larger to recover

significant quantities, which increases the capital cost. Additional equipment requires additional maintenance cost. Impact on the generation of Environment a reduction of 2% in CO2 emission by 400 industries was observed in 2012-15. By the implementation of PAT mechanism an energy audit is done to verify the baseline energy consumption of a specific industry to assess the present consumption level and energy efficiency. The individual targets are given to industrial units. The intensive energy consuming industries that consume more energy per unit production are given targets higher than their energy efficient counter parts. This promotes and enhances overall energy savings, as companies strive to surpass their own performance from their past consumption rather than competing with other. According to the statements and achievements of first cycle of PAT (2012 -15) this avoided generation of about 5,635 MW, resulting in monetary savings of Rs 37,685 crore and saving of Rs 9,500 crore have been noticed due to reduction in energy consumption. Therefore PAT is one of the most important initiatives under the NMEEE under National Action Plan on Climate Change (NAPCC) in 2012.

Effects of the policy on different areas:-

PAT II targets energy savings of approximately 18.0 MTOE in the 707 covered facilities under 11 sectors. A comparative assessment of PAT cycle I and PAT cycle II on specific energy consumption (SEC) for power, iron and steel, cement and textile sectors indicate a gradual shift towards the reduction in specific energy consumption in each industry . It is also observed that plants with extremely high SECs are targeted to reduce much faster than plants that have low SECs. The savings in energy have reduced the carbon footprint of the output and also provided cost reductions. For example, energy savings under the PAT scheme in cement manufacturing have resulted in a reduction in CO2 emissions by 25 kg CO2/tone of cement and a 15% reduction in power cost .3.5 Benefits of PAT and The targeted savings in Cycle I and Cycle II Electricity generation and industry account for 50% of total energy consumption in India. Some of these industries use state of the art technologies and performance management, while some plants are close to being obsolete. Thus, there is a wide range of energy efficiency performance at the plant level. The PAT scheme was initiated with the purpose of bringing the energy efficiency of energy intensive industrial sectors in India to a higher level of performance as measured through their specific energy consumption (SEC). SEC is energy consumed to produce one unit of output

by a plant. It was envisaged that a total saving of 4.05%1 in total energy consumption would happen across the eight sectors. The PAT scheme has been successful in India, and PAT cycle I has already been extended to more industries under PAT cycle II. The PAT scheme is replicable in any country or province, although due diligence is required by the host government to audit historical SEC of targeted designated consumers in that country, and set inappropriate legal framework to implement PAT. Sector wise targets in the PAT scheme require specific interventions, such as raw material management, process improvement, installation of new systems such as waste heat recovery, reducing output wastages through better quality control etc. These vary for industry and at the plant level. For instance, around 40 to 50% of units in the Iron & Steel and Cement sectors across India have gone for waste heat recovery projects. The process, notifications and expertise gained by BEE and empanelled accredited energy auditing firms could, thus, be utilized for the benefit of other countries desirous to replicate the Indian PAT scheme in their own countries. The existing scheme could also be expanded to include GHG emission reductions and carbon and environmental trading markets. Presents the targets and achievements by PAT. The second phase of the PAT Scheme (PAT cycle II) runs from 2016-2019, covering 707 units from the 11 energy intensive sectors. PAT cycle II focuses on deepening and widening PAT cycle I - i.e. the inclusion of 61new DCs from the existing 8 sectors, and the addition of 170 DCs from 3 new sectors, namely, Railways, Refineries and Electricity distribution companies (DISCOM).Targeted savings for PAT (Reference: Strengthening energy efficiency mechanism in Indian railways through PAT Scheme) Impacts of energy generation and usage on environment (Reference: Role of electricity distribution companies under PAT cycle II, Bureau of Energy Efficiency) This would expand the coverage from 38% to 70% of total primary energy consumption. There are around 188 units from four sectors (Cement, Pulp & Paper, Iron & Steel, and Textiles), and around 130 units from the remaining four sectors - Aluminium, Fertilisers, Chlor-alkali and Thermal Power Plants. The new sectors - Railway, Refineries and DISCOM include around 170 units to date. More DCs are under identification, which would bring the total to approximately 707.

PAT in Achieving Conservation and Efficiency:-

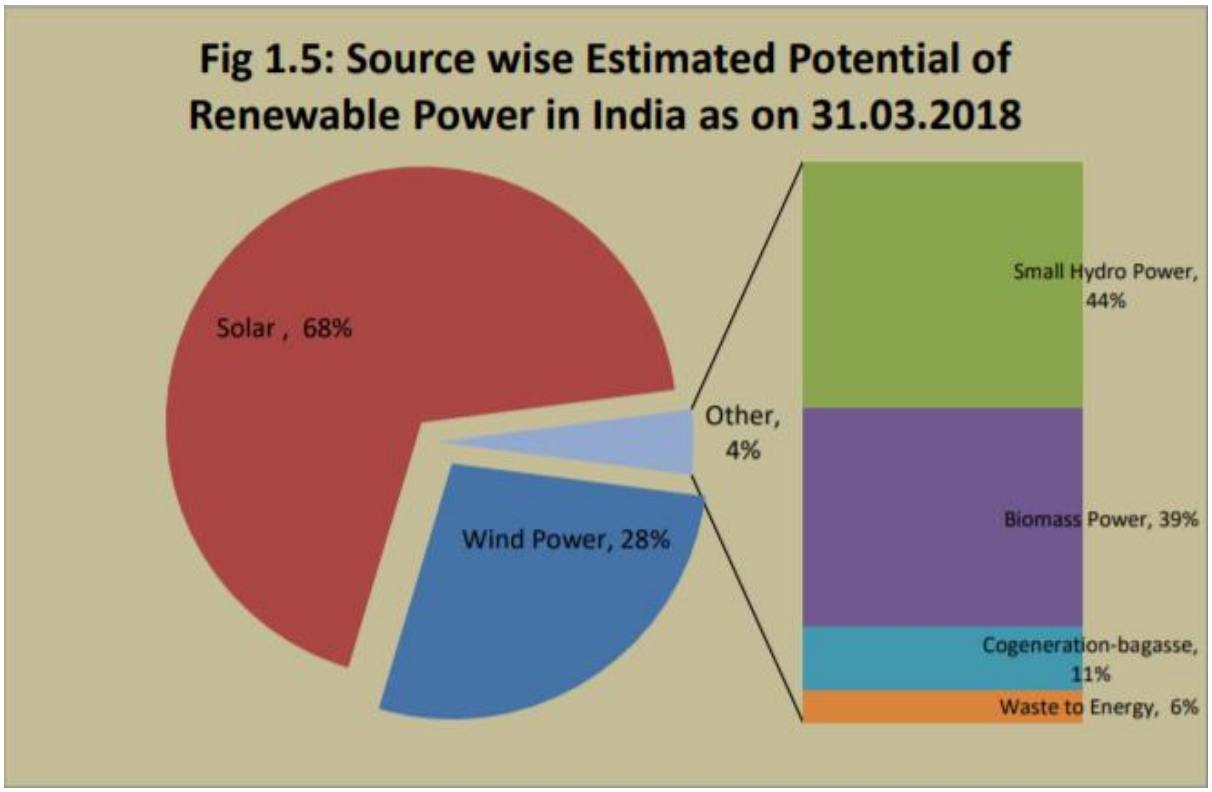
Improving The governments energy efficient-LED lamp scheme to improvise energy efficiency and CO2 emissions as well as effects of best practices and implementations in some of India's most energy intensive industrial units has purportedly exceeded targets, saving enough energy to avoid or postpone the generation capacity addition which is equal to India's entire nuclear-power capacity as of end 2016, and preventing much CO2 from being released into the air as would have been discharged by 19.4 million Indians in one year at 2013 levels. Each company was set a target based on the potential for savings. And when they brought about changes, we then verified what they achieved. For those who exceeded expectations, they would be able to trade the surplus in these exchanges with companies who could not achieve the set target in spite of best efforts. The PAT scheme helped save 8.67 million tonnes of oil equivalent (as against target of 6.68 million tonnes), which is about 30% more than the target set. From the literature it is noticed that the reduction in emission by 31 million tonnes of CO2 and save rupees 9,500 crore due to reduction in energy consumption. These ESCerts provide an opportunity to the industries to en cash the benefits of monetization of energy saving initiatives. However, the saving in energy consumption and specific attainments by the industries is not made public by the government and retained as right to keep them confidential. Releasing or publishing the data even partially by sector, if not by individual unit, for instance would encourage and motivate good performers while creating pressure on under achievers to do better during subsequent cycles. 8.67 million Tonnes].

**Renewable energy sources**

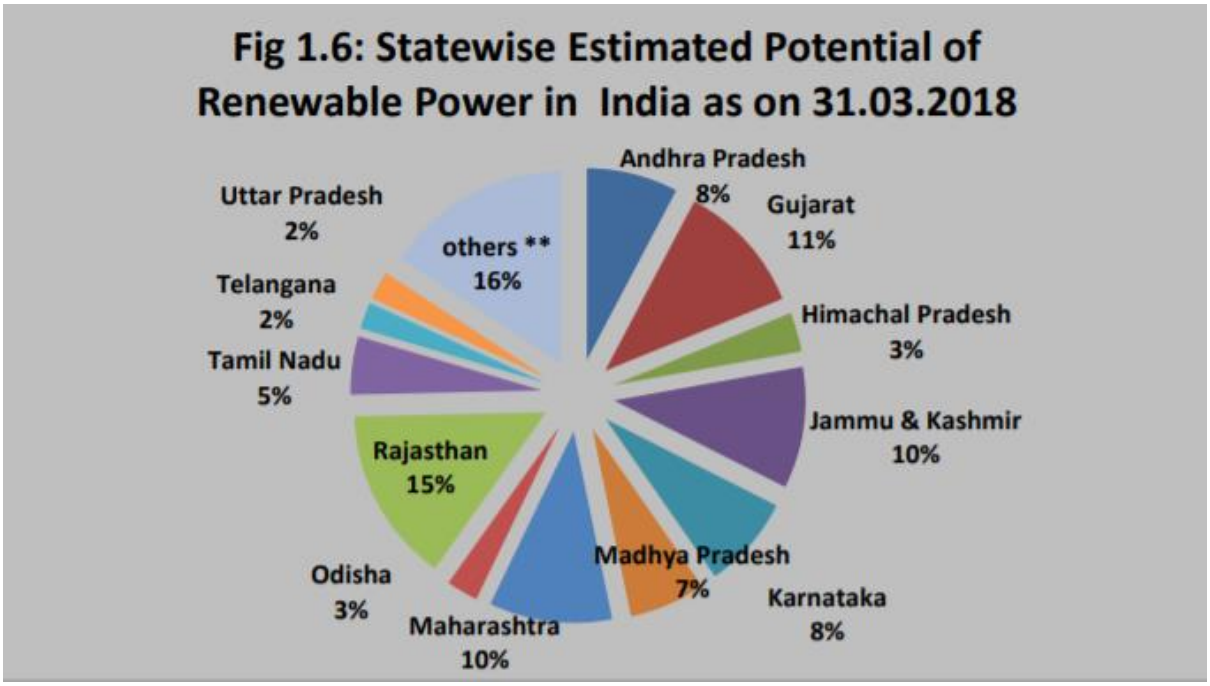
There is high potential for generation of renewable energy from various sources wind, solar, biomass, small hydro and cogeneration bagasse.

The total potential for renewable power generation in the country as on 31.03.18 is estimated at 1096081MW. This includes solar power potential of 748990 MW (68.33%), wind power potential of 302251 MW (27.58%) at 100m hub height, SHP (small-hydro power) potential of 19749 MW (1.80%), Biomass power of 17,536 MW (1.60%), 5000

MW (0.46%) from bagasse-based cogeneration in sugar mills and 2554 MW (0.23%) from waste to energy

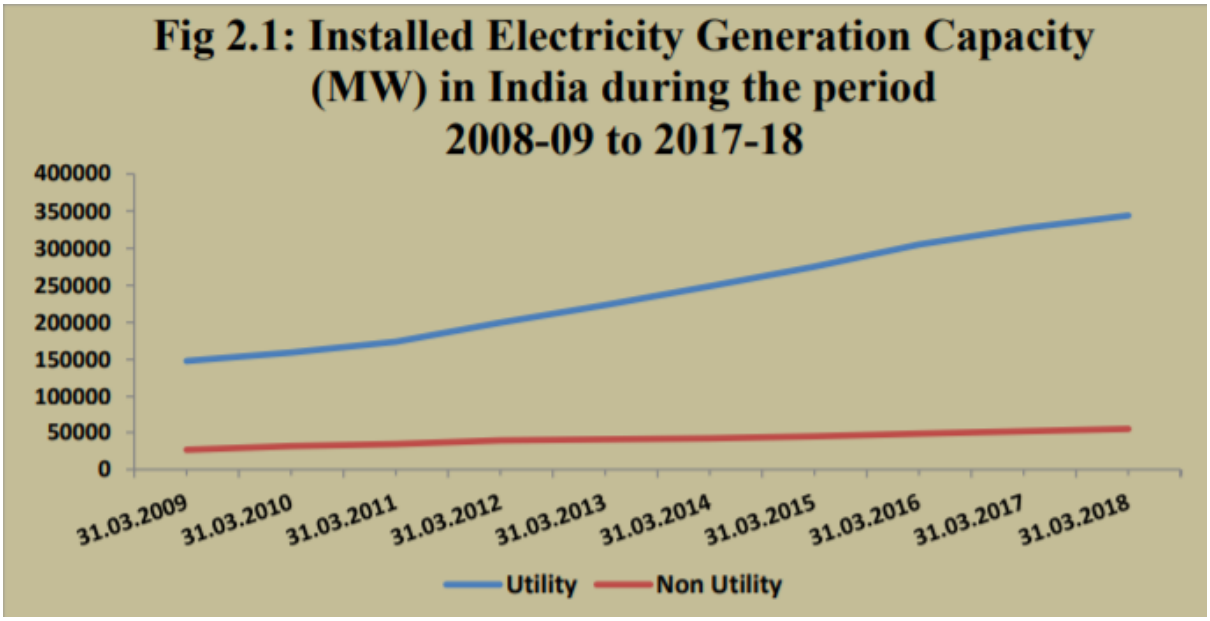



The geographic distribution of the estimated potential of renewable power as on 31.03.2018 reveals that Rajasthan has the highest share of about 15% (162238 MW), followed by Gujarat with 11% share 122086 MW) and Maharashtra with 10% share (113933MW), mainly on account of solar power potential




Installed generating capacity of electricity

The total installed capacity for electricity generation in the country has increased from 174639 MW as on 31.03.2009 to 399000 MW as on 31.03.2018, registering a compound annual growth rate (CAGR) of 8.61%.



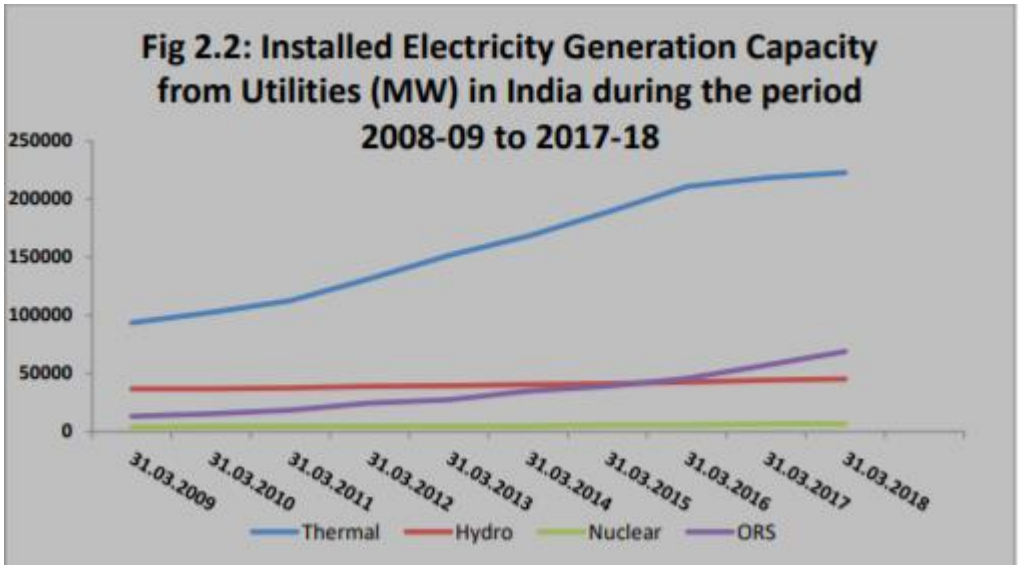
Electricity generation capacity increased by 5.45% to 399000 MW in 2017-18 over 2016-17.

The highest rate of annual growth from 2016-17 to 2017-18 in installed capacity in utilities is from Other Renewable Sources (ORS- 20.58%) followed by Thermal Power (2.10%).

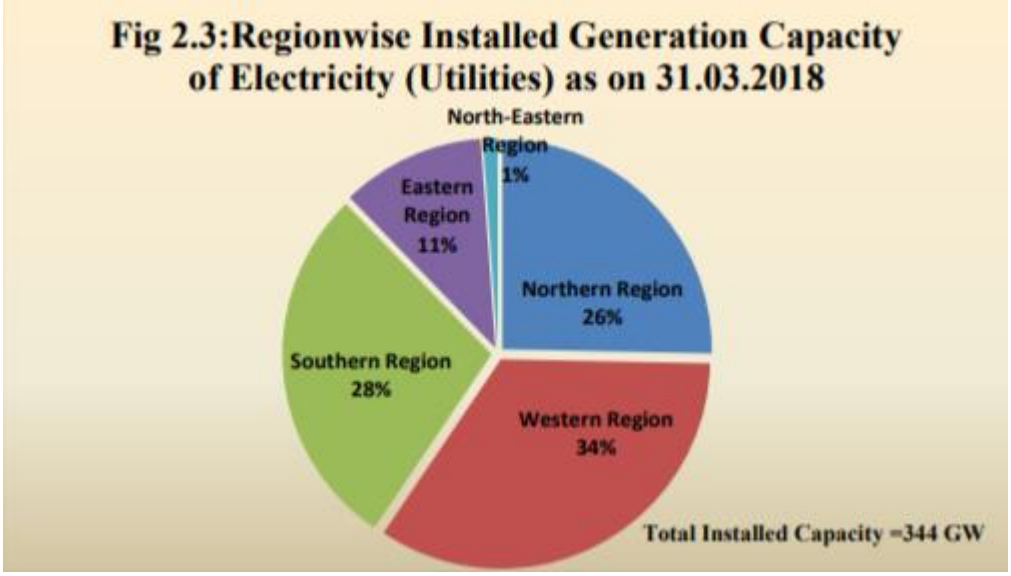
The total installed capacity of power utilities in the country increased from 147966 MW in 31.3.2009 to 344002 MW as on 31.3.2018, with a CAGR of 8.80% over the period

At the end of March 2018, thermal power plants accounted for an overwhelming 69.25% of the total installed capacity in the country, with an installed capacity of 276293 MW. Other renewable Sources (excluding hydro) come next with an installed capacity of 70563 MW, accounting for 17.68% of the total installed Capacity. The share of Hydro and Nuclear energy was only 11.37% and 1.70% of total installed capacity.

Non-utilities accounted for 13.78% (54997MW) of the total installed electricity generation capacity.




The geographical distribution of installed generating capacity of electricity as on 31.03.18 indicates that Western Region (both central and state sector) accounted for the highest share (34%) followed by Southern Region (28%), Northern Region (26%), Eastern Region (11%) and North Eastern Region (1%) (Table 2.4).




Region wise growth in the installed capacity during 2017-18 reveals that Southern region registered the highest annual growth of about 11.09%, followed by Western

Region (4.57%), Northern Region (4.07%), North Eastern Region (0.17%), whereas Eastern Region with negative growth (-2.74%). ϖ Among all the states Bihar registered highest annual growth (106.31%) in the installed capacity followed by Sikkim (33.60%) and Telangana (28.40%).

Grid Interactive Renewable Power

The total installed capacity of grid interactive renewable power, which was 57244.23 MW as on 31.03.2017, had gone up to 73351.81 MW as on 31.10.2018 indicating growth of 28% during the period (Table 2.5).

Out of the total installed generation capacity of renewable power as on 31.10.2018, Wind power accounted for about 47.7%, followed by Solar power including roof tops (33.1%) and Biomass power (13.0%).

Karnataka had the highest installed capacity of grid connected renewable power (12933.23 MW) followed by Tamil Nadu (11899.34 MW) and Maharashtra (8779.87 MW), mainly on account of wind and solar power.

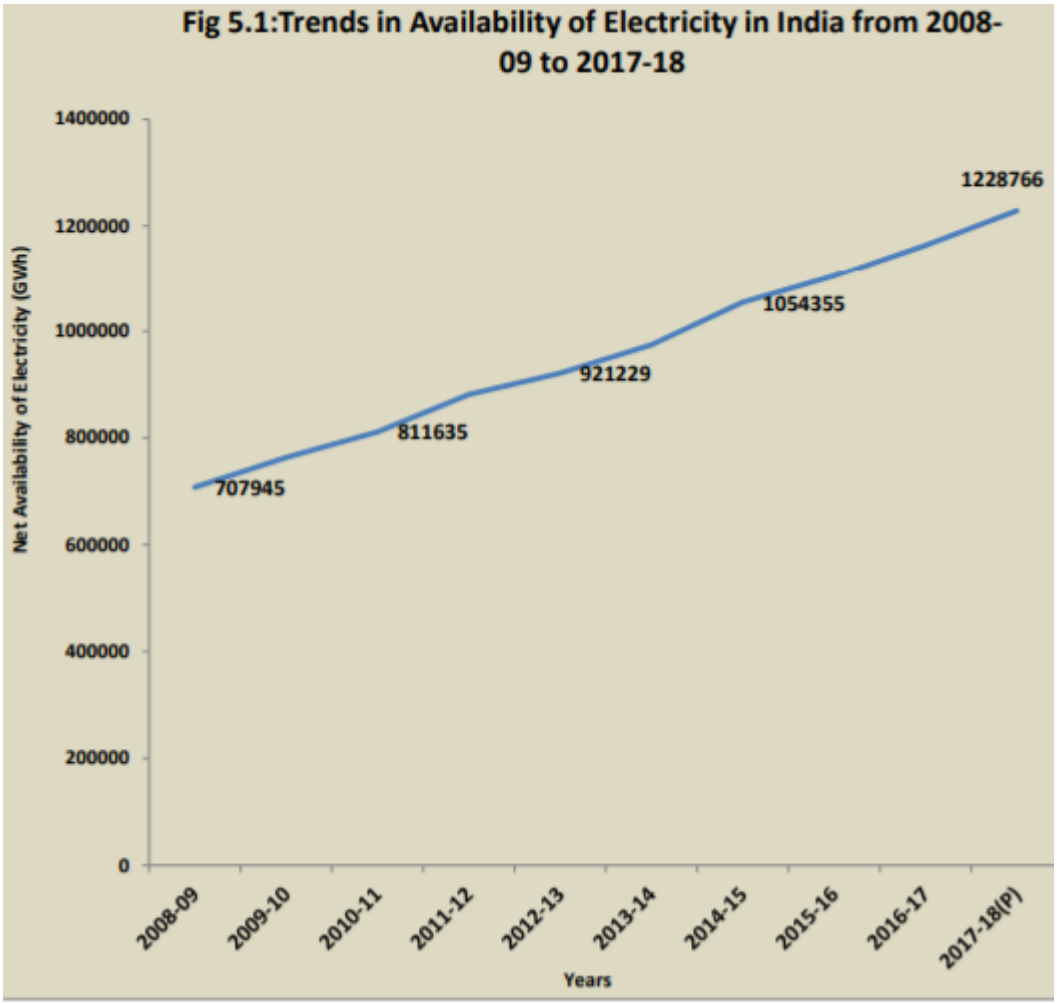
As on 31.10.2018, out of total number of Biogas plants installed (49.57 lakh), maximum number of plants installed were in Maharashtra (8.99lakh) followed by Andhra Pradesh

(5.49 lakh), Karnataka (4.90 lakh), Uttar Pradesh (4.41 lakh) and Gujarat (4.33 lakh) (Table 2.6)

As on 31.3.2018, a total of 5, and 97,121 villages were electrified (Table 2.7) accounting to 99.9% of the total villages in the country.

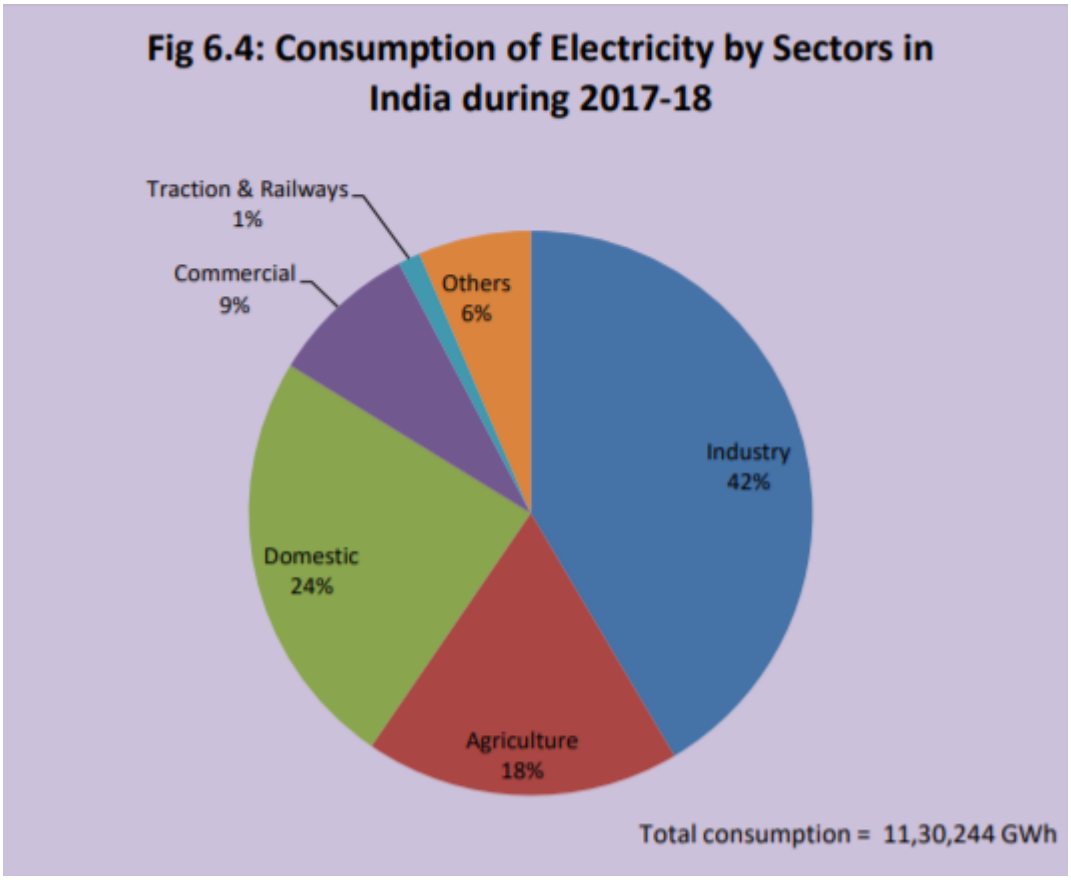
Availability of Electricity

ϖ Electricity available for supply increased from 7, 07,945 Gwh in 2008-09 to 12, 28,766 Gwh in 2017-18, thus recording a CAGR of 5.67% during this period. The availability of electricity increased at 5.63% in 2017-18 over its value in 2016- 17.



Consumption of Electricity

The estimated electricity consumption increased from 553995 GWh during 2008- 09 to 11, 30,244GWh during 2017-18, showing a CAGR of 7.39%. The percentage increase in electricity consumption is 6.51% from 2016-17 (10, 61,183GWh) to 2017-18 (11, 30,244 GWh).



## Discussion:-

Energy management is the key to saving energy in your organization. Much of the importance of energy saving stems from the global need to save energy - this global need affects energy prices, emissions targets, and legislation, all of which lead to several compelling reasons why you should save energy at your organization specifically.

*The global need to save energy*

If it wasn't for the global need to save energy, the term "energy management" might never have even been coined... Globally we need to save energy in order to:

- Reduce the damage that we're doing to our planet, Earth. As a human race we would probably find things rather difficult without the Earth, so it makes good sense to try to make it last.
- Reduce our dependence on the fossil fuels that are becoming increasingly limited in supply.

*Controlling and reducing energy consumption at your organization*

Energy management is the means to controlling and reducing your organization's energy consumption... And controlling and reducing your organization's energy consumption is important because it enables you to:

- Reduce costs – this is becoming increasingly important as energy costs rise.
- Reduce carbon emissions and the environmental damage that they cause - as well as the cost-related implications of carbon taxes and the like, your organization may be keen to reduce its carbon footprint to promote a green, sustainable image. Not least because promoting such an image is often good for the bottom line.
- Reduce risk – the more energy you consume, the greater the risk that energy price increases or supply shortages could seriously affect your profitability, or even make it impossible for your business/organization to continue. With energy management you can reduce this risk by *reducing* your demand for energy and by *controlling* it so as to make it more *predictable*.

On top of these reasons, it's quite likely that you have some rather aggressive energy-consumption-reduction targets that you're supposed to be meeting at some point in future.

## Conclusion:-

*Managing your energy consumption effectively is an ongoing process...*

At the very least you should keep analysing your energy data regularly to check that things aren't getting *worse*. It's pretty normal for unwatched buildings to become *less* efficient with time: it's to be expected that equipment will break down or lose efficiency, and that people will forget the good habits you worked hard to encourage in the past...

So at a minimum you should take a quick look at your energy data once a week, or even just once a month, to ensure that nothing has gone horribly wrong... It's a real shame when easy-to-fix faults such as misconfigured timers remain unnoticed for months on end, leaving a huge energy bill that could have easily been avoided.

But ideally your energy-management drive will be an ongoing effort to find new opportunities to target (step 2), to target them (step 3), and to track your progress at making ongoing energy savings (step 4). Managing your energy consumption doesn't have to be a full-time job, but you'll achieve much better results if you make it part of your regular routine.

The PAT with its features, additional necessary mechanisms and network is sure to give boost to enhance energy efficiency in technology driven industries. On the successful implementation of PAT scheme, it is possible to achieve breakthrough in research by the industries on energy efficiency and technology process. The exhaustive work carried and presentations strongly propose to use the PAT with different controlling institutions as applicable in the interactive mode with international programs like the Clean Development Mechanism (CDM) and World Bank

Energy consumption plays an outstanding role in every country’s sustainable development and environmental performance, so it is necessary to have data, indicators and energy modelling in order to identify and monitor policy decisions and to assess progress toward environmental and sustainable development goals. In general, energy measurement has focused on energy efficiency. Being efficient in the use of all resources makes an important contribution toward both environmental and economic sustainability

Energy is an integral part of economic development in India and the energy sector remains the most powerful element of infrastructure essential for delivering expected levels of GDP Growth. At the same time, its many facets, including implications of energy usage present a complex collage. In order to understand this sector, wide dissemination of appropriate knowledge and analysis about energy and energy application becomes crucial. The energy sector of Kerala still remains almost unexplored and undocumented even more than half a decade of energy planning and development. Kerala is not a major commercial energy producing state because of its poor energy resource endowments. The energy sector in Kerala is nothing but the electricity sector, so the industries in Kerala depend mainly on electricity. The study examined the energy scenes of global, India and Kerala. The energy status of Kerala reveals that power consumption of Kerala is dominated by industrial and domestic sector. It has been experiencing tremendous increase in the domestic consumption of electricity. It can be observed in the study that agricultural sector consumes a low percent of power in Kerala. The share of domestic sector has been increasing while other sectors have been declining on a relative basis. On analysing the percentage share of petroleum consumption of Kerala, there is a slight increase in the share of diesel as a percentage of total commercial energy in Kerala. The share of electricity consumption has gone up where as in the case of coal there has been a declining trend. LPG has the lowest share, but it is found to be increasing. 142 The study gives a clear picture of energy consumption pattern and output of the industries of Kerala. Changes in energy use do not provide energy efficiency of the industries. Thus an attempt has been made to analyse the energy efficiency performances of industries using data envelopment analysis. Since the demand for energy services grows faster than energy efficiency improvements, energy conservation police alone cannot cope with growing energy demand. There is a need for restructuring of energy–intensive industries for improving energy efficiency (through energy technological efficiency). 2 The overall objective of the thesis has been to analyse the energy efficiencies of industries and to determine the influence of different factors in their performance in Industries of Kerala from 1980-81 to 2008-09 using Data Envelopment Analysis. The factors that could affect the increase or decrease of energy efficiency also got identified by developing an econometric model. It also seeks to explain the observed variation in energy efficiency results across non energy intensive sectors and energy intensive sectors of industries by carrying out simulation of the econometric model developed.3 The study summarizes the results of the analysis and concerning the influence of various factors on energy efficiency performance of these industries. An analysis was also carried out by

taking aggregate industries of Kerala, Tamil Nadu, Andhra Pradesh, and Karnataka and aggregate industries of India to develop a relative knowledge of the energy efficiency developments. Thus a comparison between the energy efficiency scores of other south Indian states and all India with respect to Kerala has also been attempted. In order to explain the observed variation in energy efficiency across EISs and NEISs in industries of Kerala over sample period an econometric analysis has also been attempted. The results suggested that the energy efficiency performance in the manufacturing industry is dependent on economic factors and that energy intensity performance is more sensitive to economic changes. During the decade of 1980-81 to 1989-90,the year 1986-87 shows highest value of technical efficiency (0.936) and 85-86 is the year which shows lowest technical efficiency(0.774). In the decade of 1990‟s the industries are found to be highly technical efficient. The decade of twenties corresponded to not much significant energy status; as the draughts influenced the hydroelectric power generation, the major source of energy in the state. The year in which industries are highly technical efficient over the period was 2006-07 (0.912) and are showing lowest technical efficiency in 2004-05(0.749). 143 For the country as a whole, cost efficiency is quite low compared to technical efficiency and the average cost can be reduced by about 10% if the existing firms can attain full cost efficiency. Among the individual states Karnataka is the worst performer. For all other states, costs can be reduced by around 20% without reducing the level of output. Using the nonparametric method of Data Envelopment Analysis we find considerable evidence of cost inefficiency in Indian manufacturing. Although cost efficiency varies across states, Karnataka had disturbingly very low energy efficiency. From the results it is implied that Karnataka is the state which needed energy efficiency policies to make energy inefficient industries to become efficient. Kerala had a better score than Andhra Pradesh and Tamil Nadu. The states Andhra Pradesh and Tamil Nadu had a comparatively similar score. The presence of significant cost inefficiency implies that there is, indeed, a potential for Indian industries to become far more cost-competitive which could enable to gain a larger share in the Indian economy. At the same time, it is important to eliminate the existing inefficiencies, for the bright future for industries. There exists considerable potential for energy savings in each of the selected industries. However, the extent to which the energy savings potential can actually be achieved will depend on the existing technology of different units and economic viability of investments made to exploit such potential.4 Lastly, the study describes the findings to understand the factors and strategies that address energy efficiency in the industrial sector. The information regarding energy policy and

program development is important to generate strategies to improve technology in industrial sectors with the aim of increasing productivity and optimising energy consumption. The results highlight the need for policy makers and scientists to increase their attention towards energy efficiency, especially in Kerala to have a positive impact in non-energy intensive sectors as well as energy intensive sectors of industries. In Kerala, it is important to provide significant opportunities for enhanced production and utilization of environment friendly/green energy.

Energy efficiency is the wave of the future. ... An energy efficient home is a personal step toward the direction of renewable energy, environmental protection, and sustainable living. Having such a home helps homeowners reduce their bills and provides an excellent investment.

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