

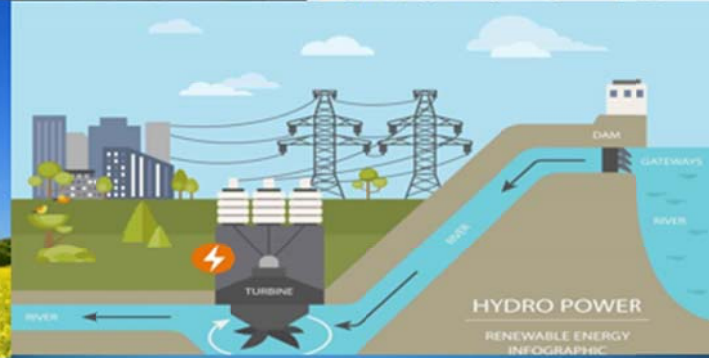


**GOVERNMENT OF MEGHALAYA
INSPECTORATE OF ELECTRICITY**

**AND
STATE DESIGNATED AGENCY ON ENERGY CONSERVATION**

THERMAL POWER PLANT

**ENERGY, IMPACT OF ENERGY GENERATION,
CONSERVATION OF ENERGY AND ITS AWARENESS**



**SENIOR ELECTRICAL INSPECTOR
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GOVERNMENT OF MEGHALAYA
INSPECTORATE OF ELECTRICITY AND STATE DESIGNATED AGENCY: SHILLONG

**ENERGY, IMPACT OF ENERGY GENERATION, ENERGY CONSERVATION
AND
AWARENESS ON ENERGY CONSERVATION**

INTRODUCTION:

In this context, the term energy is “electrical energy, " simply called energy or power. In the modern world, electricity plays a crucial role in our daily lives. It is used for lighting and powering;

- i. Homes
- ii. Business establishments
- iii. Manufacturing processes in industries
- iv. Healthcare facilities and hospitals
- v. Offices
- vi. Computer systems and information technology
- vii. Defense
- viii. Transportations
- ix. Banks
- x. Large and small businesses
- xi. Farming, etc,

As such, electricity is the essential commodity of the present generation. The economic and scientific development of a country depends largely on electricity. Therefore, without electricity, all works of life in a country would be at a standstill

Surprisingly, electricity is the main source of pollution and the reason for the climate change. Therefore, to reduce its impact on the environment, efficient use of energy is the need of the day and every citizen needs to take part individually or collectively to conserve this energy. In this regard, the Government of India has enacted the Energy Conservation Act 2001 to devise ways and means for the efficient use of energy and its conservation for sustainable energy demand in the future and a pollution-free environment. To understand the need for energy conservation and its awareness, it is vital to understand the sources of electricity and its impact on the environment.

SOURCES OF ENERGY

Micheal Faraday the father of electricity invented it in 1831. Thereafter, this power is generated from various sources with unique characteristics, benefits, and drawbacks and the main issue the world faces is its impact on the environment.

The sources of electricity are classified into two categories, they are:

- i. **Renewable Energy.** Renewable energy sources are the electricity generated from *solar, wind, hydroelectric, geothermal and biomass*. The energy received from these sources is replenished naturally and has a lower environmental impact than non-renewable sources. As of date Meghalaya has a hydroelectric capacity of 367.5 Mega Watts (MW) and is mostly available during rainy seasons. Solar energy is at the initial stage and its capacity is unknown. However, some government buildings such as NEIGRIHMS, Shillong College, NEIAH, and Meghalaya Energy Corporation Ltd have tapped this energy for lighting and powering computer devices.
- ii. **Non-renewable Energy.** Non-renewable energy sources are the energy that is generated by burning *coal, natural gas, oil and nuclear energy* called *fossil fuels*. These resources are finite and will be exhausted in no time. Power generation from fossil fuels contributes to environmental issues like air pollution and climate change. Out of these fossil fuels, coal is the major contributor to greenhouse gas emissions, air pollution, and other environmental issues, giving rise to the temperature of the earth. The total capacity of power generated from the coal-based power plant in Meghalaya is about 110.50 Mega Watts (MW) and these power plants are mainly for industrial uses and are located at Lumshnong East Jaintia Hills, Rwiang

near Nongstoin in West Khasi Hills and Byrnihat in Ri Bhoi District. Further, the total capacity generated from diesel fuel is about 10.50 Mega Watts (MW).

ENVIRONMENTAL IMPACT OF ENERGY GENERATION

Currently, the world is 1.2°C warmer than it was in the 19th century. The effects of this climate change include increased droughts, rise of sea levels and ecological degradation where more species such as flora and fauna are going extinct. In this context, power generation plays a key role in releasing the highest amount of these harmful greenhouse gasses into the atmosphere. Burnt **coal releases carbon dioxide, carbon monoxide, sulphur dioxide, nitrous oxide, methane and other harmful gases** into the atmosphere posing health risks to human lives as well as **global warming due to the greenhouse effect**. Moreover, burnt coal from thermal power plants also produces waste such as ash in large quantities and gets disposed of on its site causing pollution to the land, river and its surroundings.

In addition to the pollution, hot air at a very high temperature from steam turbines, furnaces and kilns from these thermal power plants gets released into the atmosphere as waste heat, thus heating the surrounding air. The nearby plants and vegetation are greatly affected by the air pollution and heat from the thermal power stations. Waste heat and carbon footprint are the main issues of global warming of the present generation.

Fossil fuels such as **diesel and petrol** also contribute to climate change due to the pollution it emits after it get burnt. Scientific studies show the various gases that come out from these fuels as in the table below:

| Combustion-engine exhaust gases <i>All figures are approximate</i> | % of total | |
|---|-----------------|---------|
| Compound | Petrol | Diesel |
| Nitrogen | 71 | 67 |
| Carbon dioxide | 14 | 12 |
| Water vapor | 13 | 11 |
| Oxygen | 0 | 10 |
| Trace elements | < 0.6 | ~ 0.3 |
| Nitrogen oxides | < 0.25 | < 0.15 |
| Carbon monoxide | 1 - 2 | < 0.045 |
| Particulate matter | | < 0.045 |
| Hydrocarbons | < 0.25 | < 0.03 |
| Sulphur dioxide | possible traces | < 0.03 |

Sample case study on the requirement of coal: The Cement Power Plants located at Lumshnong East Jaintia Hills District, Meghalaya burn about 700 to 800 grams (on average) of coal to produce one unit of energy per hour i.e., 1 (one) kilowatt hour. It is important to know that power available to electric users of Meghalaya during winter and dry seasons mainly comes from coal-based power plants from outside the state since the water level of reservoirs, dams and rivers gets depleted. Power generation from Meghalaya Energy Corporation Ltd (hydropower stations) during dry seasons is at the minimum and is generated mainly during peak hours from 4 pm to 10 pm (high demand for power) to meet the power requirement in the State in addition to the power purchase from outside the state.

To understand the impact of pollution from the use of coal for the generation of electricity, it is important to know the quantity of coal burned for the generation of power. For example, the requirement for power for the electric users in Shillong City is about 75MW (Mega Watts) or 75000 kW (kilo Watts) or 75000 kilowatt-hours. Based on the above study, the coal requirement for providing uninterrupted power for Shillong city is about 75000 kW x 0.70 Kg = 52, 500 kilograms of coal per hour or 52.5 Metric Tons of coal per hour. Hence, in 24 hours the quantity of coal required to burn to provide an uninterrupted power supply for Shillong will be about 24x52.50 Metric = 1260 Metric Tons. How much more quantity will it be needed to burn coal to generate power for the whole state of Meghalaya, the country and the world? and how much more pollution will it cause for the entire world? The answer will be huge. The issue here is not only the polluting gases but the waste heat it produces from the thermal power stations that get released into the atmosphere; thus there is a rise in pollution and global warming.



North to get hotter

IMD forecast of expected rise in maximum temperature across India between March and May

Less than 0.5°C

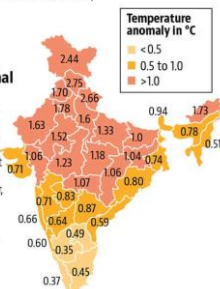
Kerala, Tamil Nadu, south interior Karnataka and Rayalaseema

Warmer than normal by 1°C or more

Jammu & Kashmir, Punjab, HCD (Haryana, Chandigarh & Delhi), Himachal Pradesh, west and east Rajasthan, Uttarakhand, west and east Uttar Pradesh, west and east Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Vidarbha, Gujarat and Arunachal Pradesh.

Between 0.5°C and 1°C

Remaining subdivisions



The picture and newspapers above on the effects of global warming.

IMPACT OF BURNT FOSSIL FUELS ON THE ENVIRONMENT



Sources of pollution in cities are mainly from burnt fossil fuels emitted from vehicles and industries.



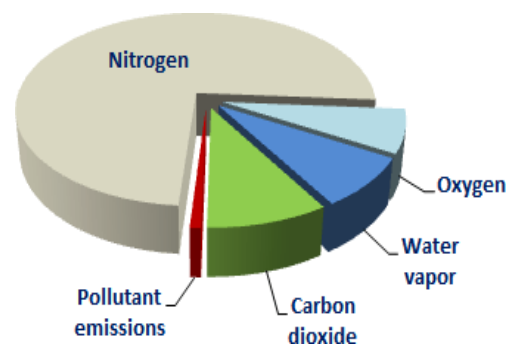
Smoke from one of the coke plants at Nongdaju in West Khasi Hills, Meghalaya.



Smoke from one of the coke plants in East Jaintia Hills, Meghalaya. People in the surrounding areas near the coke factory have to learn to live with the harmful gases that comes out from the burnt coal.



Smoke from heavy vehicles is seen on the road. Non-compliance with the emission norms is one of the reasons that cause pollution.



The impact on the environment from the energy generated from diesel generating set or petrol generating set and the relative concentration of pollutant emissions in the diesel exhaust gas.

ENERGY GENERATION:

i. Thermal Power Plants:

Thermal power plants burn fossil fuels, such as coal and natural gas to heat thousands of gallons of water to produce steam and at high temperatures and pressures, the steam is forced through pipes/penstocks, to propel the turbine which is coupled to a generator to generate electricity.



Photos of black smoke and pollution from one of the Thermal Power Plants at Lumshnong East Jaintia Hills

ii. Gas Power Station:

At present there is no gas power plant in Meghalaya. However, there are four gas-based power plants in the neighbouring state of Assam with an installed capacity of 617.60 MW. There are also three gas-based power plants in Tripura with an installed capacity of 831.60 MW. Steam at high temperatures of 370°C to 420°C gets released into the atmosphere from the turbine of these plants as waste heat.



Photo of a Gas Power Station

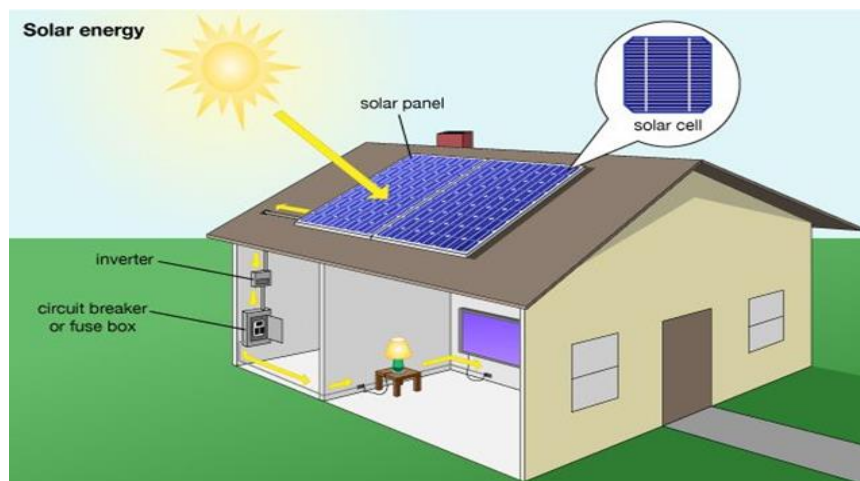
iii. Nuclear Power Plants:



Nuclear is another major source of electricity. Nuclear power plants generate electricity through nuclear fission, a process in which atomic nuclei are split, releasing vast amounts of energy. This energy is used to heat thousands of gallons of water to produce steam that drives turbines to generate power. Nuclear reactors are highly efficient, and nuclear energy has a relatively low carbon footprint when compared to other fossil fuels. However, concerns about nuclear safety, radioactive waste disposal, and high construction costs have limited the expansion of nuclear power in our country and in other parts of the world.

iv. Solar Energy:

Among renewable energy sources, solar power is gaining popularity in every country due to the falling costs of solar photovoltaics and the availability of sunlight. Solar panels can be installed on a small scale, such as on residential rooftops, or a large scale in solar farms. Unfortunately, solar energy is intermittent, meaning their output varies depending on weather conditions. However, advancements in energy storage technologies are helping to mitigate this challenge. There is less environmental impact from the generation of this type of energy and is considered green energy.



A typical house installed with solar panels on its roof

v. Wind Energy:

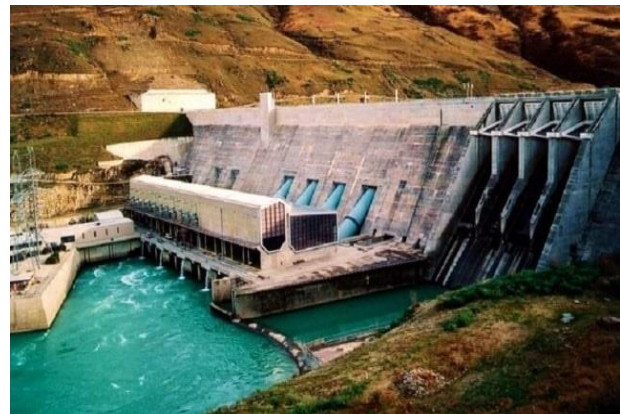
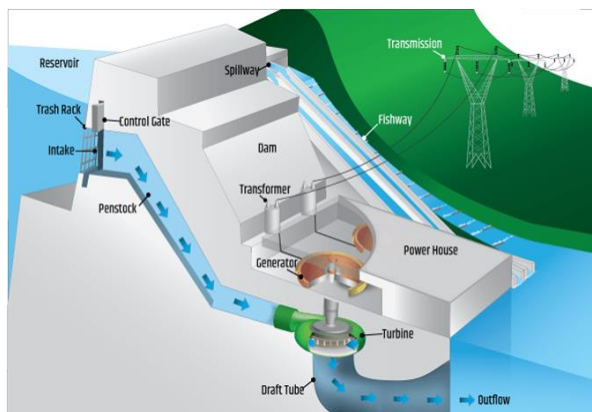
Wind power rotates the windmill and converts it to electricity through the rotating shaft that is coupled to a generator. Unfortunately, wind power is intermittent in Meghalaya and its output varies on weather conditions. However, advancements in energy storage technologies are helping to mitigate this challenge. There is less environmental impact from the generation of these types of energy and is also a green energy.



Picture of a typical Wind mill installed on the hilltop

vi. Hydroelectric Power Station:

Hydroelectric power is another significant renewable source of energy. It harnesses the energy from the flowing water of hilly regions or store in dams (at higher elevations) then releases the water through penstock to propel a turbine that is coupled to a generator to generate electricity. However, while hydroelectric power is clean and renewable, it can have negative environmental impacts, disrupting ecosystems and displacing communities due to the construction of large reservoirs for storing water. Hydroelectric power is the cleanest source of energy and has a lesser impact on the atmosphere.



A typical hydroelectric power station

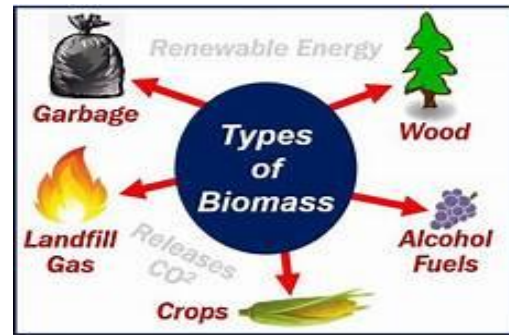
vii. Geothermal Energy and Biomass Energy

Geothermal energy taps from the Earth's internal heat. Energy can be tapped from this type of source by installing a power station with steam turbine which is coupled to a generator to produce electricity. However, their contributions to global power generation are relatively small compared to other sources.



viii. Biomass Energy:

Biomass energy involves burning organic materials and is also considered a renewable energy source. However, the power generation from biomass is very small. Photo of different sources of Biomass. →



ix. Ocean Energy:

This includes both wave power and tidal power to drive the turbine and generate electricity. However, its availability is limited and is available to countries that are surrounded by seas or oceans. This source of energy is also clean energy and has less impact on the environment.

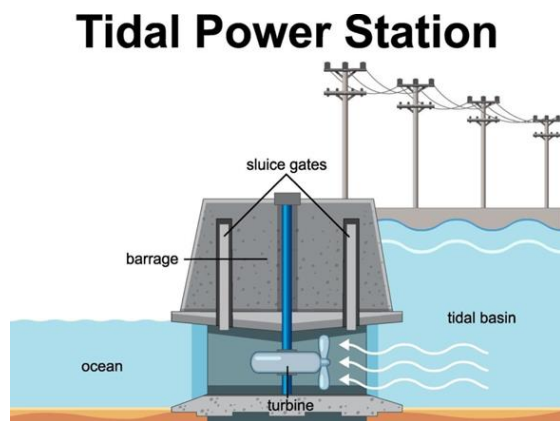


Photo of a typical Tidal Power Station

ENVIRONMENTAL CONSIDERATION, AN AIM TOWARDS CLEANER AND GREENER ENERGY:

The electricity demand is directly related to the increase in the number of buildings and industries. The higher the number of households and industries, the more will be the demand for electricity. Thus to fulfil the demand there has to be an increase in the capacity for the generation of power. Therefore, the higher the generation of electricity from fossil fuels the more will be pollution and global warming.

Approximately three-quarters of electricity generated in India comes from fossil fuels and the main fuel is coal, its availability is degrading due to the rampant mining and the increase of its usage.

As the global community grapples with climate change, the transition to cleaner, renewable sources of energy is becoming increasingly crucial. To stop any further effects of climate change, there is a need to change the way of generating and utilising electricity. Transitioning to cleaner energy is essential for reducing greenhouse gas emissions and mitigating climate change for a sustainable future and the availability of electricity.

To meet its demand of greener energy, the world is developing technologies to produce and tap cleaner energy sources. Hydro, Wind and Solar Power, have a significantly lower environmental impact and produce less carbon footprint compared to fossil fuels. The development of advanced energy storage solutions, improvements in renewable energy technologies and innovative power generation methods will likely shape the future of power generation.

Governments and industries are increasingly investing in research and developments to enhance the efficiency and cost-effectiveness of renewable energy systems. Technology to integrate smart grids, microgrids, and distributed energy resources is expected to transform the electric power sector in distribution to electric users for better and higher efficiency.

WHY IS CLEAN ENERGY SO IMPORTANT?

Clean energy production is very important to meet the rise in the demand for electricity since it produces less carbon emissions and there is less negative impact on the environment as compared to energy that comes from fossil fuels. Thus, it helps to reduce climate change and the rise in global temperature.

BENEFITS OF CLEAN ENERGY

There are many benefits from clean energy as it has fewer pollutants to the environment compared to the energy that is generated from fossil fuels. Reducing harmful gas emissions from thermal power plants is a vital step in combating climate change which will improve air quality, reduce environmental hazards and preserve fossil fuels. In terms of financial perspective, as the clean energy industry continues to grow, it can help to create new job opportunities and stimulate the economy of the country.

WHAT IS ENERGY CONSERVATION?

Energy conservation means using less energy to achieve the same tasks. It can be attained through efficient use of power or through efficient electrical appliances that consume less energy while achieving the same result or even better. The reduction or elimination of unnecessary or unwanted energy consumption is also considered energy conservation. One of the simplest ways to help the environment is by reducing pollution and utilising whatever energy is available in nature.

For example,

- i. Turning off lights or fans or air conditioners when there is no one in the room.
- ii. Construct houses as per the Energy Conservation Building Code to keep the rooms warm in the winter and cool in the summer.
- iii. Behavioural change of running the electrical appliances during peak hours (6 to 9 am and 4:30 pm to 9 pm) to off-peak hours helps to reduce power consumption. This means it helps to reduce the overloading of electric lines and transformers. For eg using a washing machine during the daytime or early in the morning will help in reducing the electrical load of the substation hence it minimises the voltage drop thereby reducing the energy consumption of the building. With lesser voltage, the current drawal is more, hence the electricity bill will be higher. *[Peak hours is the period when both lighting loads and the equipment loads are switched ON or get utilised by the electricity users at the same period, thus there is an increase in the demand for power during this particular period. Off Peak is the period when both lighting load and equipment load are mostly not utilised at the same period by the electricity users].*
- iv. Use electrical appliances such as '**Star-rated and Smart appliances**' that consume less energy than ordinary electrical appliances.

These simple ways of energy savings will not only help in saving money on energy bills but directly help to protect the environment from carbon emissions by minimising the use of energy generated from thermal power plants.

IMPORTANT OF ENERGY EFFICIENCY

The growing energy demand is not sustainable in the long run and the prolonged usage of fossil fuels is damaging the environment. As the demand for energy keeps escalating, rampant mining of fossil fuels will take place to fill the gap between energy demand and supply. This will further increase the cost of energy and become more difficult to afford.

Therefore, energy efficiency plays a vital role in the sustainability of energy in the future as it can reduce energy consumption and minimise the gap between energy demand and supply. More importantly, this

can lower the dependence on fossil fuels for the generation of power thereby lessening greenhouse gas, carbon dioxide, etc., thus reducing the waste heat to be thrown out into the atmosphere from thermal power plants.

APPLIANCES FOR ENERGY SAVINGS

Energy-efficient appliances offer many benefits that make them a worthy investment. Investment in energy-efficient appliances or star-rated appliances helps to reduce energy consumption that has the advantages of a reduction in greenhouse gas emissions with a smaller carbon footprint and more energy savings. The majority of people prefer ordinary appliances due to their low cost as compared to energy-efficient appliances because that has higher costs. However, the energy that will be saved from energy-efficient appliances or star-rated appliances is more as compared to ordinary appliances, hence it will bring monetary benefit or payback period to the user in the long run due to lesser electricity bill. Energy appliances such as light-emitting diode (LED) bulbs give the same illumination but consume less power than the higher-wattage incandescent bulbs. For example, a 12-watt LED bulb can give the same illumination or intensity of light as a 100-watt incandescent bulb but in terms of power usage, it saves about 88 watts of power i.e., (100 – 12 watts i.e., 88 watts). Hence, for the same illumination, the LED bulb saves about 88 percent of energy as compared to an ordinary bulb. Moreover, an LED bulb has also a longer life period than an ordinary incandescent bulb.

The table below is the comparison of energy appliances (refrigerator) between No Star-rated and Star-rated appliances with payback period:

| Star Rating | Energy consumption per year | Rate per Unit for Domestic | Energy cost/Year | Total Savings w.r.t No Star /year | Cost of Refrigerator (Approx) | Cost Difference | Payback Period |
|-------------|-----------------------------|----------------------------|------------------|-----------------------------------|-------------------------------|-----------------|-----------------------------|
| | Units (kWh) | Rupees | Rupees | Rupees | Rupees | Rupees | Years |
| No Star | 1100 | 5.00 | 5500.00 | Nil | 20000.00 | Nil | This may increase with time |
| 1 | 977 | 5.00 | 4885.00 | 615.00 | 22000.00 | 2000.00 | 3.25 |
| 2 | 782 | 5.00 | 3910.00 | 1590.00 | 26000.00 | 6000.00 | 3.77 |
| 3 | 626 | 5.00 | 3130.00 | 2370.00 | 28000.00 | 8000.00 | 3.37 |
| 4 | 501 | 5.00 | 2505.00 | 2995.00 | 31000.00 | 11000.00 | 3.67 |
| 5 | 400 | 5.00 | 2000.00 | 3500.00 | 34000.00 | 14000.00 | 4.00 |

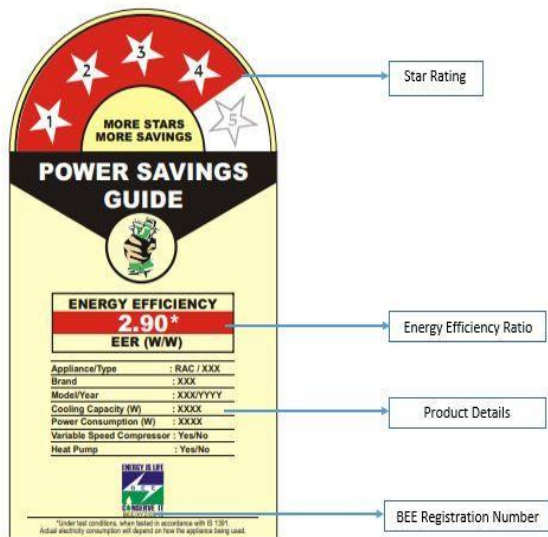
****Source Bureau of Energy Efficiency.** Approximate cost of a 250 Litres Refrigerator. Some star-rated appliances may give a lesser payback period than those shown in the table above.

The payback period for the additional cost of a star-rated appliance compared to the ordinary or no star-rated appliances is estimated to be between three and a half years to four years. However, the energy consumption of a no-star-rated appliance will remain the same and may increase with time due to aging. Therefore, purchasing energy-efficient appliances can be a good idea as it will reduce long-term expenditure on electricity bills.

BETTER QUALITY OF LIFE

Energy-efficient appliances enhance the quality of life by providing better performance, standard quality with better operating conditions and less noise. They also have a longer life span and require fewer repairs over time than ordinary or no-star-rated appliances. This may bring greater peace of mind, less time on maintenance and more satisfaction to the users. It is also found that manufacturers of energy efficiency appliances are multinational branded companies, therefore they are more trusted than ordinary brands and have better warranty periods.

UNDERSTANDING ENERGY LABELS.



From the picture above, the label of the appliance is a 4 star-rated with an energy efficiency ratio of 2.90

Energy labels provide information on how energy-efficient a product is. This helps the consumers to have a ready reckoner on the energy performance of a product. It also encourages people to pick energy-efficient appliances that can save more energy that will reduce the electricity bills.

In India Bureau of Energy Efficiency (BEE) is the authority that is responsible for setting norms and standards for energy ratings in India. BEE awards star rating certificates for electrical appliances of different brands if they meet certain criteria for energy efficiency. BEE also punishes and penalises fake star rated labelling company if found in the market.



Appliances having more Stars, save more energy.

BEE Issues Two Kinds of Labels:

i. Comparative Star Rating Label

The BEE star label showcases an appliance's energy performance. Every appliance is rated between one and five stars. The number of stars indicates the energy efficiency of the appliance. The rating considers several factors apart from power consumption to determine its energy efficiency.

ii. Endorsement Label

This label serves as an endorsement that a product meets the specified criteria of energy efficiency. It conveys to the consumer that the product saves more energy in comparison to other similar products.

ENERGY-EFFICIENT APPLIANCES IN INDIA

The following are the energy-efficient appliances as notified by the Bureau of Energy Efficiency (BEE).

- Lighting such as LED bulbs, TFL (tubular fluorescent lamp) and LED Streetlights
- Refrigerators
- Geysers

- Central Air Conditioners
- Ceiling fans
- Washing machines
- Smart thermostats
- Microwave oven (Cooking Appliances)
- Television (colour)
- Distribution Transformers

*May refer to the website @ <https://beeindia.gov.in/en/star-label>

FACTORS TO CONSIDER WHILE BUYING

Energy-efficient appliances can differ in their energy efficiency and operating costs. ***More electricity bills can be saved by investing in appliances that have more Stars.*** Here are a few factors that should be considered while buying energy-efficient appliances:

- ❖ Ensure that enough space is available in the room to keep or accommodate the new appliance. There should be enough space to open the door or lid of the appliance.
- ❖ Avoid buying a larger size appliance unless it is required to do so. Larger appliances require more energy and hence the cost is also higher.
- ❖ When considering a brand to buy, the cost and the estimated energy consumption should be kept in mind. It is to be noted that energy can be saved more in the long run by investing in a more expensive and energy-efficient model.
- ❖ The energy label and star-rated label can be compared before buying so that the energy efficiency can be understood to compare the efficiency of other similar products.
- ❖ ***More Stars more Savings***

25 WAYS OF AWARENESS ON ENERGY CONSERVATION, ENERGY SAVING TIPS AND PRACTICES

There are several ways to save energy and here are the tips and practices that can be followed:

- ➔ Consider upgrading or replacing the old appliances that are inefficient or do not work properly. Switching to high energy efficiency ratings with extended warranties is an excellent way to save energy and reduce the electricity bill. Older appliances may have outdated technology that consumes more power with less performance. Install Energy monitoring sensors to identify equipment that consumes an unusually high amount of power. This helps to spot potential faults or breakdowns before they occur.
- ➔ Reduce the frequency of unnecessary use of electric appliances to save energy. For example, dishwashers and washing machines can account for more than 10 percent of the electricity bills. Washing at lower temperatures and full loads can also help to conserve energy.
- ➔ Switching off the Air Conditioners, lights, fans, etc., when there is no occupant in the room are a few practices that help in energy conservation. When appliances are left on standby mode for the entire day, gradually consume a large amount of electricity. According to the energy auditors, energy can be saved by about 5 to 10% of their energy consumption (and costs) by changing behaviour such as switching electrical equipment **OFF** at the mains rather than leaving it on **standby mode**.
- ➔ Consider using smart plugs and power strips to enhance energy efficiency. These devices automatically turn off the appliances when not in use by adjusting the settings according to the requirement and at the same time it can be scheduled to run during off-peak periods. These will also allow the owner to track the energy usage and find out the areas where it improves to save more energy.

- ➔ Energy appliances consume less energy during the period from 8 am to 4 pm and 9 pm to 5 am, these are called off-peak periods as the electricity users utilise lesser power during these periods.
- ➔ Replace the old incandescent light bulbs or fluorescent tube lights with more energy-saving lights LED bulbs that give the same illumination or light intensity but with less power consumption, therefore helping to save energy. LED lamps last 25 times more than ordinary bulbs.
- ➔ Make use of natural light from windows and skylights. Do not rely on artificial lights during day time, electricity can be switched ON only during gloomy days and dark evenings. Daylight blind curtains can help reduce glare while still allowing natural light to enter the room and reflect onto the ceiling. During the cold season use thicker curtains to prevent the escape of warm air from the room while the room heater is ON.
- ➔ Notice should be given to employees such as “*Do not leave lights ON in unoccupied rooms*”. Reminders should be given to all employees to **switch off electricity when there is no occupant in the room**. Use occupancy monitoring sensors to help automate lighting controls depending on whether the room is occupied or not. This will help to save up to 30% on electricity costs. All computers should be shutdown when not in use.
- ➔ Reducing the temperature setting of the airconditioners by just 1°C can cut fuel consumption by about 8%. In a large office, this can save enough energy and expenditure on electricity bills.
- ➔ Holes and gaps around walls, windows, doors and skylights should be sealed and fixed straight away to prevent the circulation of air from outside into the room to avoid wastage of energy consumption by the air conditioner. If a lot of footfalls in and out of the building, consider using automatic doors to minimise the amount of heat to escape from the room
- ➔ Use loft and cavity wall insulation. A building can lose up to 40% of its heat through its roof.
- ➔ Adopt a Smart Building Management system will conserve lots of energy.
- ➔ The maintenance schedule is important for effective energy efficiency, especially for refrigerators and air conditioners. Well-maintained equipment is more energy efficient and lasts longer. Keep equipment free from obstructions and clean fans and filters regularly to prevent overheating. Proper and regular maintenance can reduce costs by up to 15% over that period.
- ➔ Tree plantation outside the office building compound provides shade in summer and helps prevent the chilly winds in winter.
- ➔ Using light colour paints helps to improve the brightness of the room, thus minimising the use of electricity light.
- ➔ Running of air conditioner inside a room at a moderate temperature of 25° C is considered comfortable, this saves a lot of energy. It is recommended to vehicle users that for a weather temperature of less than 25 ° C, running of air conditioners should be avoided, instead open the window glass to get natural air; this will save a lot of fuel and minimise the environmental impact due to the heat generated from the air conditioner and pollution from the burnt fuel.
- ➔ Consider installing solar panels on the roof of the building to tap renewable energy available from the sun to conserve fossil fuel energy sources. The initial investment for solar panels and related materials may be more but due to the free energy available from sunlight, the investment cost can be recovered within a few years from the date of purchase.
- ➔ Consider installing a solar water heater for heating water. Solar water heaters can be used to pre-heat water up to a certain possible temperature then switch to conventional energy to heat the water to about 75 ° C to 80 ° C before having a bath or wash. This will save a lot of energy and reduce electricity bills.
- ➔ Consider installing solar lights for the terrace and compound/garden. Solar lights and solar streetlights are easily available in the market and can be used in the streets, compounds, gardens, walls or terraces for lighting without the need to connect to a conventional electricity source.
- ➔ Consider installing solar water pumps for gardenings, and cultivations wherever possible.
- ➔ Consider buying of solar cooker for cooking in the areas where plenty of sunlight is available.
- ➔ Consider buying solar lanterns for people dealing with work during the night. This can also be used for charging of mobile phones.

- ➔ *Use a Timer Switch to automatically ON or OFF streetlights as per the desired timings to conserve energy.*
- ➔ *Consider purchasing a vehicle with higher mileage or a smart-hybrid or an Electric Vehicle to reduce the impact on the environment and thus save fossil fuels.*

MORE WAYS TO CONSERVE ENERGY:

➔ Cold wash and cold bath if possible.

Treat the warm wash as optional and use only when it is needed. Not heating water every time, for washing clothes/utensils are easy way to save energy. Having a cold bath may be good for health if it can be done.

➔ Dry clothes, hair and dishes naturally

Dry clothes in the sunlight instead of using fans, or an electric drier. Hair can be dried using towels instead of an electric dryer. If a dryer is unavoidable, use a lower setting, even if drying might take longer. Utensils can be left to dry on their own without using an electric drier and allowing natural air for drying will be more hygienic.

➔ Install a programmable thermostat for comfort and cost savings

Use a programmable thermostat for energy-efficient appliances and pre-set the desired home's temperature at different times of the day.

In Western countries, the cost of energy is higher during peak periods (i.e. 4:30 pm to 10 pm and 5:30 am to 9 am) this is done to discourage the use of electricity during this period for running electric appliances. Meghalaya Energy Corporation Ltd will soon adopt such electricity tariffs which can be programmed in an energy meter and is known as the Time of Day (ToD) Tariff. Therefore switching OFF the electric appliances during peak hours is highly recommendable since this will reduce heavy drawal of current during this period and thus save energy.

➔ Install ceiling fans for cooling

Ceiling fans that circulate hot or cold air around the room can prevent extra energy use of an air conditioner for cooling. In warmer climates, the use of both at the same time helps to feel cool, while setting the temperature of air conditioning to about 24° C to 25° C consumes less power.

➔ Unplug and defrost freezer monthly

Defrosting a freezer once a month will reduce energy consumption. When excessive ice builds up in the freezer, the system ends up working harder to preserve all the ice and uses more energy which will add to its cost. To defrost, simply unplug the freezer and remove all food items. Leave the door open for a faster melting process, and then dry out the freezer. Turn it back on, and once cool, repack the food items again. Ensure that all items are placed correctly to allow easy flow of cooling air and improved energy saving. Unplugging mini-fridges around the house and using one central bigger fridge can save more energy.

➔ Stay up to date on maintenance to save energy.

Regular maintenance of electric appliances will work more effectively and save more energy. By changing the filter (monthly or as recommended), enough cold air can be received at a minimal temperature, and in turn, there will be a reduction in the electricity bills. The same applies to dishwashers, tumble dryers, and other appliances.

ALTERNATIVE WAYS TO CONSERVE ENERGY:

SOLAR STREETLIGHT utilises renewable sources of energy and it is an alternative to conventional streetlights. The installation procedure is similar to the conventional streetlight with the exception that solar streetlights does not require an electricity connection from MeECL and are a stand-alone system. Electrical contractors can install solar streetlights as per the requirement of the owner either in the compound of a building or on the terrace of a building where sufficient sunlight is available during day time. These streetlights may come up with a programmable sensor to automatically ON or OFF depending on the availability of natural light, while some can be ON or OFF with remote control.



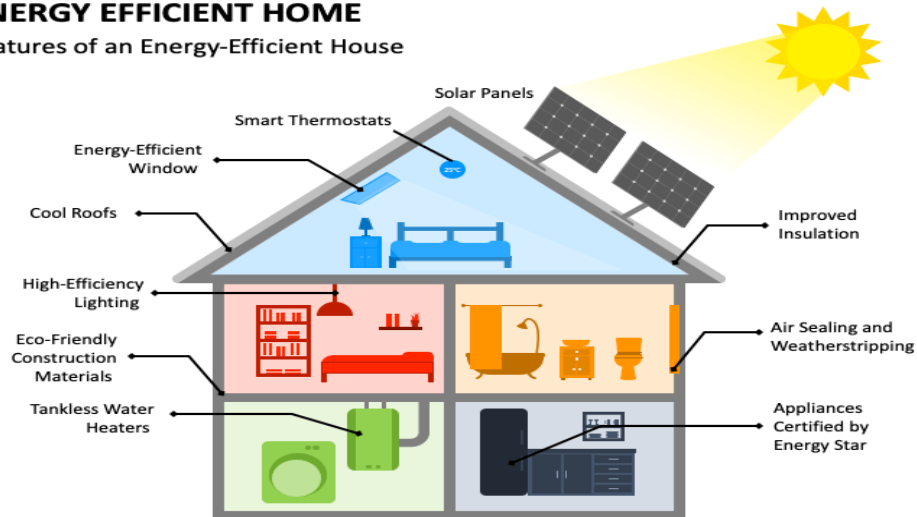
A typical solar water heater is installed on the rooftop.

SOLAR WATER HEATER is a renewable source of energy and it can be used as an alternative way for heating of water at home or in the offices. Such water heater can be used to preheat or pre-warm the water to a certain temperature and then use conventional power to heat warm to a desired temperature to conserve conventional energy.

SMART HOME: A home that adopts energy conservation is considered a Smart Home. The picture below is a typical design of a building that adopts Energy Conservation Building Code (ECBC) Rules. A Smart Home **uses energy-efficient appliances and taps all available renewable energy sources. The building** uses maximum natural light and is constructed with insulated walls to protect the warm air from escaping outside the house and to block the cold air from entering the room during winter. Windows, doors and ventilations are so designed to enable the room to remain cool during summer and warm during winter.

ENERGY EFFICIENT HOME

Features of an Energy-Efficient House



A typical Smart Home that adopts an Energy Conservation Building Code

SOLAR WATER PUMP as shown in the photo below can be used in a paddy, garden or for watering plants and vegetables. Though the initial investment is high, however, due to the free energy received from the sun the cost can be recovered after three and a half to four years.



A typical SOLAR WATER PUMP is installed in the paddy field for pumping of water from a well or pond for irrigation purposes. It can also be installed in the building premises for pumping of water for various household uses.

ELECTRIC VEHICLE: With the growing concern of global warming, many car manufacturing industries have come up with the technology for manufacturing electric cars with higher mileage. On the availability of subsidies from the government, many city commuters are turning their mood to purchase electric vehicles. With better and more sustainable technologies for fast charging, future transportation will certainly change to electric vehicles. It is worth mentioning that electric vehicles that are charged from renewable energy sources are clean and have less impact on the environment. However, if such vehicles are charged from non-renewable sources of energy, then the impact on the environment will be the same and maybe more. Therefore charging such vehicles using non-renewable energy will not help the environment.

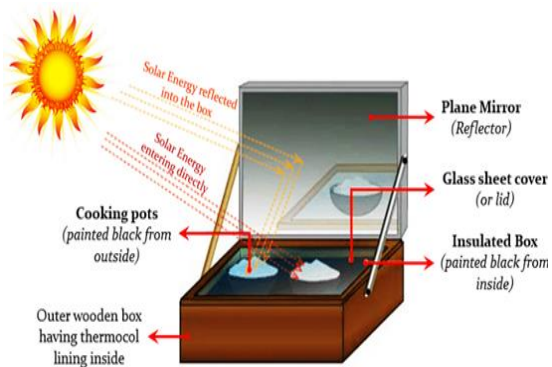


SMART HYBRID VEHICLES can be an alternative to electric vehicles as these vehicles are powered by petrol or diesel for their movement and at the same time. The batteries are specifically fitted inside the vehicle and get charged while the vehicle moves. When the battery is charged, the movement of the vehicle can be driven by battery power using a battery mode. In battery mode, the vehicle functions similarly to the electric vehicle. When the battery power is reduced it can be altered back to fuel mode i.e., petrol or diesel mode and vice versa. Hybrid vehicles give better mileage and thus save fuel and energy.



A typical method of how a **SMART HYBRID VEHICLE** gets charged while moving and vice versa. Some hybrid cars claim to have a mileage of more than 35 km per liter, thus saving fuel consumption and conserving energy and fossil fuel.

SOLAR COOKER is another smart way to cook food in areas where sufficient sunlight is available during the daytime. Switching to such technologies will further enhance the purpose of conservation of energy.



SOLAR LANTERNS OR SOLAR TABLE LAMPS:



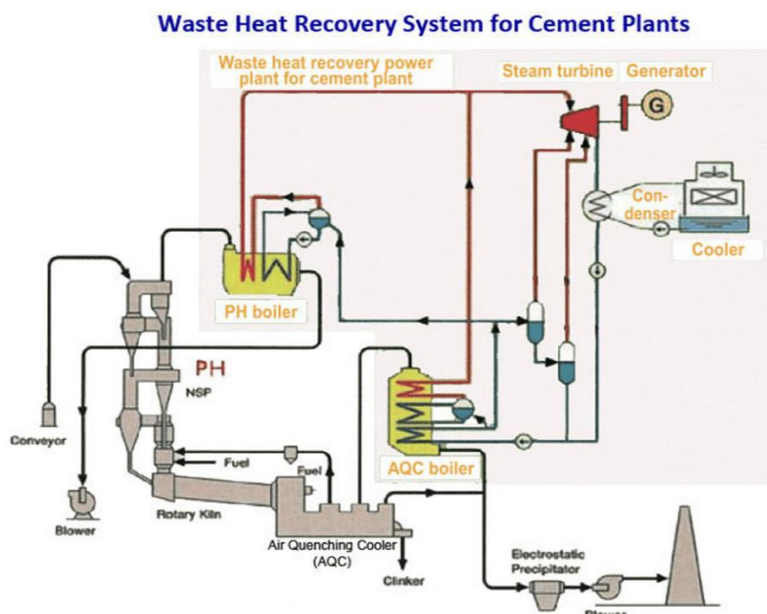
Photos of typical solar lanterns that can be used at night or in the dark, especially for people living in rural areas who do not have conventional power supply.

WASTE HEAT RECOVERY SYSTEM (WHRS)

Waste Heat between 400° C to 700° C is the heat that gets released from burnt materials and fossil fuels such as hot flue gases are generated from Boilers, Kilns, Ovens and Furnaces from industries, power plants, cement plants, etc., escapes as unused heat and is lost, wasted and dumped into the environment. This unused heat that gets released into the atmosphere affects the surrounding areas of the industries and creates an environmental hazard. Recovering the waste heat can be conducted through various waste heat recovery technologies to provide valuable energy sources and reduce overall energy consumption. By

recovering waste heat, industries can reduce energy costs and CO₂ emissions while increasing energy efficiency.

Scientific developments have devised technologies to tap this waste heat into useful steam to generate electricity or other energy for industrial uses. Recently two cement plants have adopted this technology namely Star Cements Meghalaya Ltd and Meghalaya Cements Ltd at Lumshnong, East Jaintia Hills District where they produced electricity of about 13 MW and 9 MW respectively without the use of additional fuel i.e, free fuel thus saving energy, fossil fuel and the environment.



BEHAVIOURAL CHANGES FOR SUCCESSFUL CONSERVATION OF ENERGY:

Behavioural changes play an important role in the Net Zero Emissions by 2050 (NZE) Scenario, cutting CO₂ emissions and reducing growth in energy demand. Behavioural changes can improve well-being and public health and address three main challenges to decarbonisation: existing carbon-intensive assets, hard-to-abate sectors and the need for rapid growth in clean energy supply. Behavioural changes are actions that electricity consumers need to adapt to reduce or eliminate unnecessary or wasteful energy consumption. For example, moderating the use of heating and air conditioning; replacing incandescent bulbs with LED bulbs, and wearing clothes to keep cool in summer and warm in winter instead of using electricity for heating or cooling. Unnecessary use of electric equipment to carry out a task when the same can be done manually is another way to conserve energy. Choosing a more fuel-efficient vehicle of higher mileage than a lower mileage vehicle is also another way to conserve energy and help the environment.

CONCLUSION AND RECOMMENDATION

It is understood that burnt fossil fuels such as coal, petroleum and diesel contribute to the maximum change in global warming and are the main sources of pollution of the environment. According to the National Oceanic and Atmospheric Administration (NOAA), 2016 and 2020 were two of the warmest years ever recorded, with the Earth warming an average of 0.18°C per decade since 1981. Simple supply and demand would mean that the less energy we use from non-renewable sources, the fewer pollutants we put into our atmosphere, which can minimize the effects of rising temperatures. It is also important to understand that there is a connection between energy use and the environment. Though individual energy conservation changes might seem small, they all add up through the collective effort of individuals. Firstly to preserve natural resources and secondly to slow down the effect of global warming. Therefore, to save the impact of climate change, it is the need of the day to follow the tips and practices to conserve energy

for a sustainable and better future. It is important to note that load shedding is incidentally another way of energy conservation during the dry season where power is purchased from outside the state of Meghalaya which are mostly non-renewable sources of energy.

Last but not the least “Energy Saved is Energy Generated”.



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