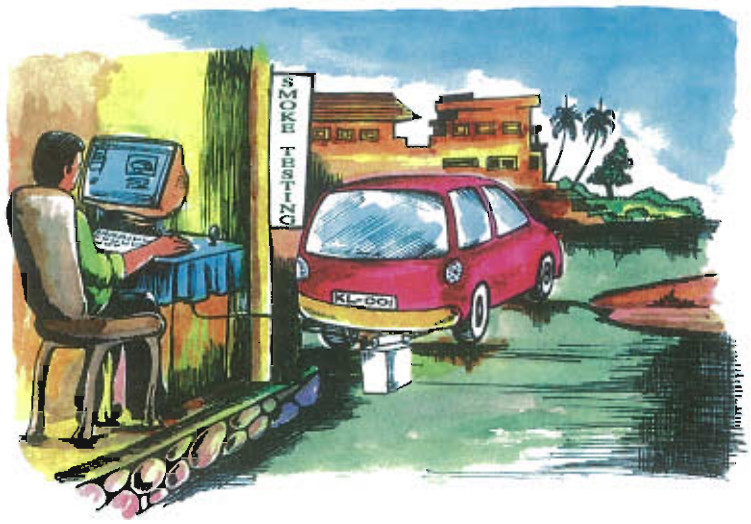
12 ENERGY MANAGEMENT



Why is smoke testing made compulsory? Is this for the owner of the vehicle? Or for all?

Let's find out.

✶ What are the different activities depicted in the picture given below ?

✶ What are the other activities going on around us?

Don't you observe the changes occurring around you when you go to school or a shop?

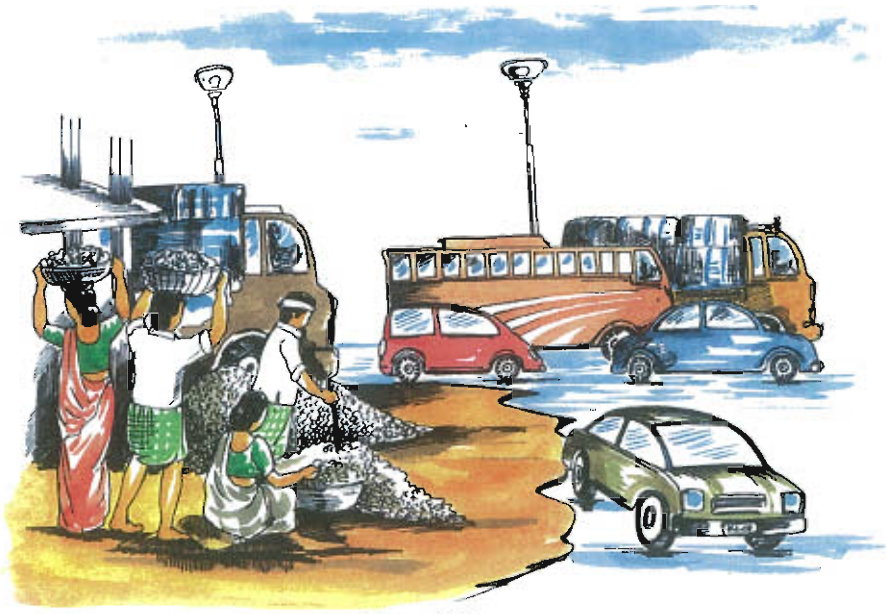


Fig. 12.1

What are the changes you see now that are different from those when you were in the fourth or fifth standard? Try to write the changes as in the case of buildings, vehicles etc.

Such changes might have happened in a period of four or five years when your parents were young too. Compare the changes in both the generations, discussing it with them. Can't you imagine the increase in energy consumption brought about by these changes?

Based on your findings what is your conclusion about the percapita consumption of energy in the modern world?

In the context of the increased need for energy, shouldn't we try to control its wastage and avoid related problems? Let's see how this is possible.

We use fuels to cook food in the kitchen.

What are the substances used as fuels? Classify them as solid, liquid and gas and tabulate.

Solid	Liquid	Gas

Table 12.1

★ Have you seen air being blown while kindling firewood? Why does the flame flare up when blown?

Let's do an experiment.

Take two large pieces of paper. Roll one of them and keep the other flat. Hook each one to separate spindles and burn. What difference do you observe in their burning? Write them down in the table.

Rolled paper	Flat paper
• More smoke is produced	

Table 12.2

★ What may be the reasons for the differences in burning recorded in the table. Record them in relation to your experience with blowing air in an oven.

★ Haven't you understood what substances are formed when fuels burn? Write them down.

- Carbon dioxide
-

Combustion

Fuels burn with the help of oxygen. Burning is the process in which heat and light are formed by the intense reaction of substances with oxygen. In the absence of sufficient quantity of oxygen, carbon monoxide is formed in a greater measure, and carbon dioxide, carbon and smoke in a small measure. This kind of burning is partial burning. You have understood earlier the problems that arise when carbon monoxide mixes with air.

★ What are the conditions for the complete combustion of different substances?

- Dryness
-

★ What are the drawbacks of partial combustion? Expand the list.

- Fuel loss
- Wastage of time
-

★ What are the advantages of using smokeless ovens in homes?

Smoke testing is conducted to know in what quantity components are present in the smoke coming out of a vehicle. Visit a nearby smoke testing centre. Interview the employees there and prepare a note.

How fierce are the consequences that the smoke, thrusted out every second into the atmosphere from lakhs of vehicles, can make! Hope you are convinced why smoke testing is made mandatory.

Find out and record instances where the atmosphere in your locality is polluted due to combustion, other than from houses and vehicles.

Fuels

Note the cartoon (Fig.12.2) drawn by a student in a cartoon contest in connection with energy conservation. Organise a general discussion about the state of affairs depicted in the picture. What are your responses?

★ What may be the reasons that led us to such a state?

★ What are the fuels we use nowadays in vehicles?

Apart from houses and vehicles, where else are fuels necessary?

What are the fuels used in each of them? Try to write.

★ Note down the source of each fuel you have listed.

- Diesel, LPG → Petroleum
-

Fig. 12.2

★ Where do you get petroleum from?

Fossil fuels

Fossil fuels are formed by the transformation of animals and plants buried in the earth millions of years ago, in the absence of air, at high temperature and pressure. Coal, petroleum and natural gas are fossil fuels. They cannot be renewed as and when consumed. So they are termed non-renewable sources of energy. Their mining and use are therefore to be controlled.

You have learnt earlier about the products that are obtained when petroleum is subjected to fractional distillation.

★ What is the property by which petroleum products are separated by fractional distillation?

★ Which are the substances, other than fuels, that are obtained when petroleum is distilled? What uses are they put to?

CNG

This is a fossil fuel obtained along with petroleum. CNG is the abbreviation for compressed natural gas. The main content of this gaseous substance is methane. CNG is used as a fuel in vehicles, industries and thermal power stations and also as a source of hydrogen in the manufacture of fertilisers.

★ CNG is used as a fuel in many vehicles in Delhi. What are the advantages of CNG over petrol, diesel etc?

LPG

The expanded form of this is liquefied petroleum gas. This is a colourless and odourless gas. Its odour is due to the mixing of ethyl mercaptan. LPG contains the substances propane and butane.

★ What is the advantage when we are able to know about the leakage of gas used in houses?

LNG

The expanded form of this is liquefied natural gas. The importance of LNG is that it can be transported conveniently to the market by cooling and liquefying it. There it is again converted into gas at atmospheric temperature and distributed through pipelines. Pollution is low. The decreased volume when it is liquefied at low temperature and atmospheric pressure, reduces the cost of transportation to far off places (where there are no pipelines).

Find more details of CNG ,LNG and LPG as fuels and record them.

CNG	LNG	LPG

Table 12.3

★ Coal is another fossil fuel. Find situations where these are used and record them.

Coal

Coal is the major part of the fossil fuels available on earth. Carbon is the main content of coal. Based on the carbon content, it is classified into four groups as peat, lignite, anthracite and bituminous coal. When coal is distilled in the absence of air, the substances coaltar, coal gas, coke and ammonia are obtained.

- Why is coal called a fossil fuel?

- Based on the knowledge you have attained about fossil fuels, record your response to the conversation in the picture.

Fig. 12.3

Based on the discussions held about fossil fuels, don't you too feel to preserve them for future generations? Prepare some posters to show that fossil fuels are invaluable and that they are to be used judiciously, and display them in your campus.

Is the amount of heat obtained from different fuels the same when burnt?

Fuel efficiency

What are the different substances used as fuels in your home? Is the heat obtained from each of them the same when burnt? Let us examine.

- Don't some of you, atleast, use LPG in your houses? What is the weight of the LPG filled in the cylinders supplied to your homes?

- How many days can you work with this much of fuel? Record.

- How many days can you cook if you use firewood of the same weight?

- What difference do you see in the efficiency of these two fuels?

Calorific value

The amount of heat liberated by the complete combustion of 1 kg of fuel is its calorific value. Its unit is joule/kilogram.

Certain fuels and their calorific values:

Hydrogen	-	*150000 kJ/kg*
CNG	-	*50000 kJ/kg*
Cowdung cakes	-	*6000 - 8000 kJ/kg*
LPG	-	*55000 kJ/kg*
Biogas	-	*30000 - 40000 kJ/kg*
Coal	-	*25000 - 33000 kJ/kg*
Petrol	-	*45000 kJ/kg*
Methane	-	*50000 kJ/kg*

★ If these fuels are classified based only on calorific value, which fuel can be considered the most valuable?

Hydrogen

Hydrogen is the fuel which has the highest calorific value. This is a highly inflammable and explosive substance. So it is difficult to be stored and transported. However it is used as a fuel in rockets.

★ Where is hydrogen used as fuel?

★ Why is hydrogen not used as a domestic fuel?

What properties must a substance have in order to be considered as a good fuel? Add them to the list.

- increased availability
- low cost
- minimum atmospheric pollution
- a liquid fuel must not evaporate quickly at ordinary temperatures.
-

Biomass

Biowastes are generally known as biomass. Firewood, dry leaves, cowdung cake etc belong to this. What are the problems that arise due to their combustion? Record them.

- Smoke is produced
-

Haven't you seen solid waste heaped in corporations and municipalities?

When you pass by them you experience a pungent smell. Which is the gas responsible for this smell? What are the problems that may arise when this gas spreads in the atmosphere? Discuss and record.

Besides atmospheric pollution, what are the other problems that may arise when wastes are heaped up?

When domestic waste is deposited into a biogas plant, biogas is formed by the action of bacteria in the absence of oxygen. The slurry left out from the plant is a good manure. When biomass is converted into biogas a fuel of greater calorific value is obtained. Not only that, atmospheric pollution is reduced too.

Discuss the necessity of community biogas plants and prepare a note on it.

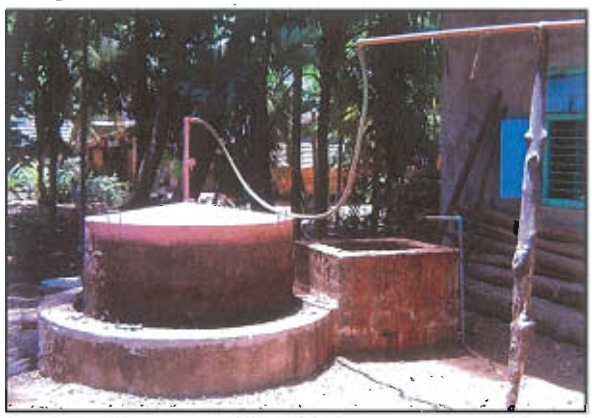


Fig. 12.4
Biogas plant

Nobody remembers that the waste we throw indiscretely on wayside invites contagious diseases. Though we are in the forefront regarding individual hygiene, we are far behind in community hygiene. Organise a seminar in your PTA describing the advantages of the effective utilization of domestic garbages.

★ We indulge in a large number of activities everyday. From where does the body get energy for these?

★ From Fig. 12.5 you may be convinced of the role of plants in the sustenance of life on earth. From where do plants get energy for preparing their food?

- -

★ What are the different forms of energy we get from the sun?

- -

The attempts to utilise solar energy to its maximum are in progress recently. What are the devices by which we have started making use of it? Discuss and expand the following list.

- Solar panel
- Solar water heater
-

Solar panel

Solar panel is made by suitably assembling a number of solar cells. This is an electronic device. When solar energy falls on one side of a solar cell, a small electric current is produced. This is photovoltaic effect. The electric current obtained from a large number of such cells can be stored in a storage battery and used as and when required. Street lights are made to function using solar panels. Solar panels were used initially in satellites on a large scale. Nowadays Solar Photo Voltaic Power Plants (SPV) capable of producing electricity of thousands of kilowatts are in use.

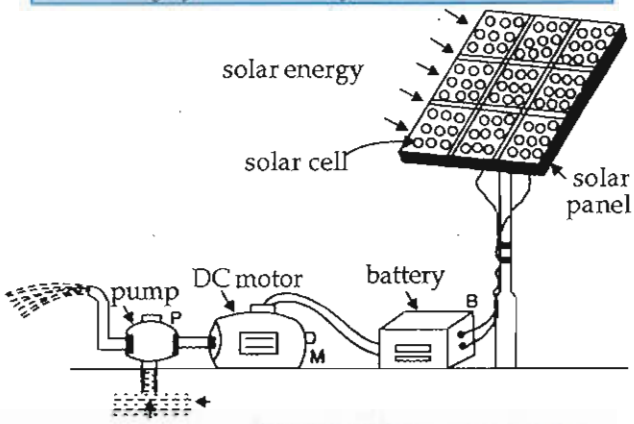


Fig. 12.6

Fig. 12.5

★ What is the energy transformation taking place in a solar panel?

★ What are the situations where a solar panel cannot be made use of?

★ What are the situations where a solar panel alone is depended upon?

Solar water heater

Fig. 12.7

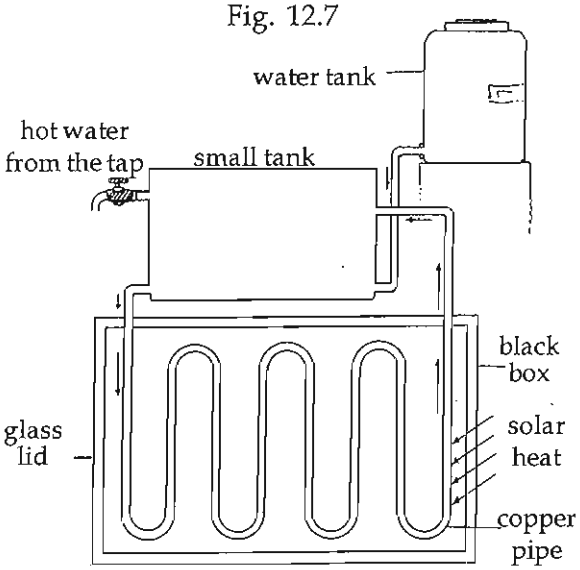


Fig. 12.8

Illustration of the functioning of a solar water heater

Black surfaces

Black and rough surfaces absorb radiant heat well. They also emit radiations well. White and smooth surfaces reflect the radiant heat. So they don't become hot.

★ Why are the copper pipes placed in the box of a solar water heater made black and rough?

★ What change occurs in the density of water when the temperature increases?

★ How does the change in density facilitate the flow of water through the pipes? Discuss and record.

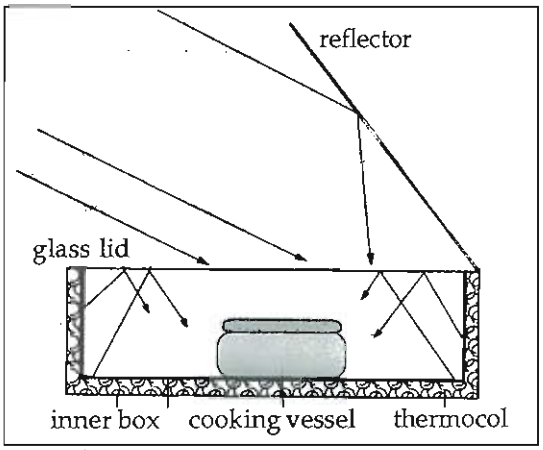
★ What is the reason for taking out water through the top of the small tank?

Note down in the science diary the function of a solar water heater.

Solar cooker

Fig. 12.9

What are the advantages of cooking food in a solar cooker? Discuss and expand the list.



A box type solar cooker with reflector

Fig. 12.10

- No atmospheric pollution at all
-

  What are the limitations of a solar cooker? Discuss and record.
- It is not possible to fry, make chappathis etc. since high temperatures cannot be attained.
-

Solar thermal power plant

Solar power plants generate electricity using solar energy. Concave reflectors are used to focus the sun's rays on blackened pipes filled with water. As a result, water boils and becomes steam. The steam rotates the turbine, so that the generator attached to the turbine is activated. A power plant of this type operates at Gurgaon in Haryana on an experimental basis. The capacity of this plant is 500 kilowatt.

★ What is the energy transformation taking place in solar power plants?

We have familiarised ourselves with certain devices which directly make use of solar energy. Isn't the sun a party to almost all phenomena on earth such as wind, waves etc.? Hence the sun can be considered the source of energy for these. In olden days the wind was used in yachts for transportation. But now the wind is used for generating electricity.

Fig. 12.11

Windmill

★ For what all purposes can the energy from windmills be utilised?

★ What are the factors to be considered while selecting land for a wind farm?

★ Where are the wind farms in Kerala set up?

Waves in the sea are caused by wind. Can waves be used for the generation of energy?

Ocean as a source of energy

One method is by converting the kinetic energy of sea waves into mechanical energy and then into electrical energy.

★ Can this method be adopted permanently in the coastal regions of Kerala? Discuss.

The high and low tides formed in the sea due to lunar gravitation can be considered as another source of energy.

✶ How can tidal energy be used to generate energy ? Record it after discussion, with the help of the figure.

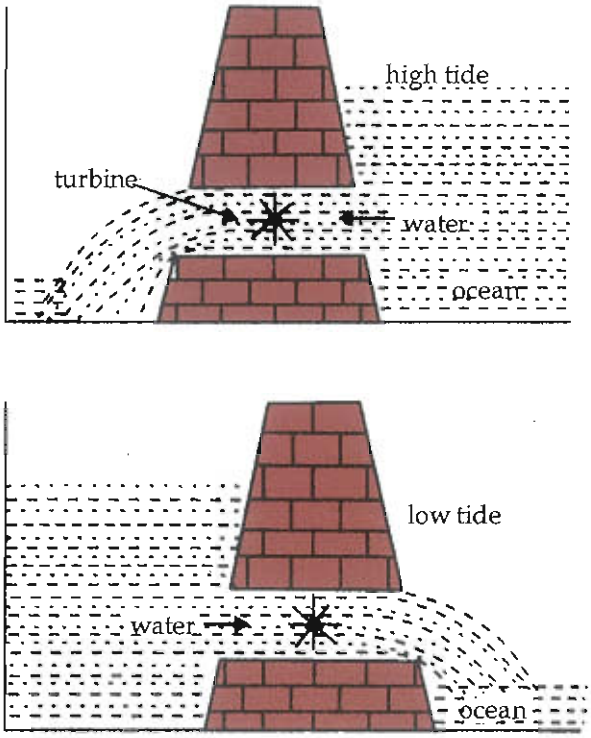


Fig. 12.12

As the rise of sea water due to high tide is below 1m, tidal energy is not used for energy generation in Kerala.

Like the wind and the waves, rain is yet another contribution of the sun. We have already studied about hydroelectric power stations where electricity is produced by storing rain water in dams.

The method adopted by us nowadays is to convert any form of energy to electricity which is the convenient form.

We have identified the earth also as a source of energy and have started utilizing it.

Geothermal energy

The interior of the earth exists as molten lava. This heat is now utilised as a source of energy.

Geothermal energy

Though the surface of the earth cooled, making it suitable for life, the interior still remains in a molten state. This magma which is at a high temperature comes out of the core through places which are less hard. Such places are the hot spots. The water here becomes steam by accepting heat from the hot spot. The steam trapped between rocks is taken out through pipes laid in bored rocks. This steam rotates turbines, thereby generating electricity.

✶ Why is it said that geothermal power plants are not feasible in Kerala? Discuss and record.

Energy from the nucleus

Which catastrophe do the newspaper reports in Fig. 12.13 demonstrate?

Fig. 12.13

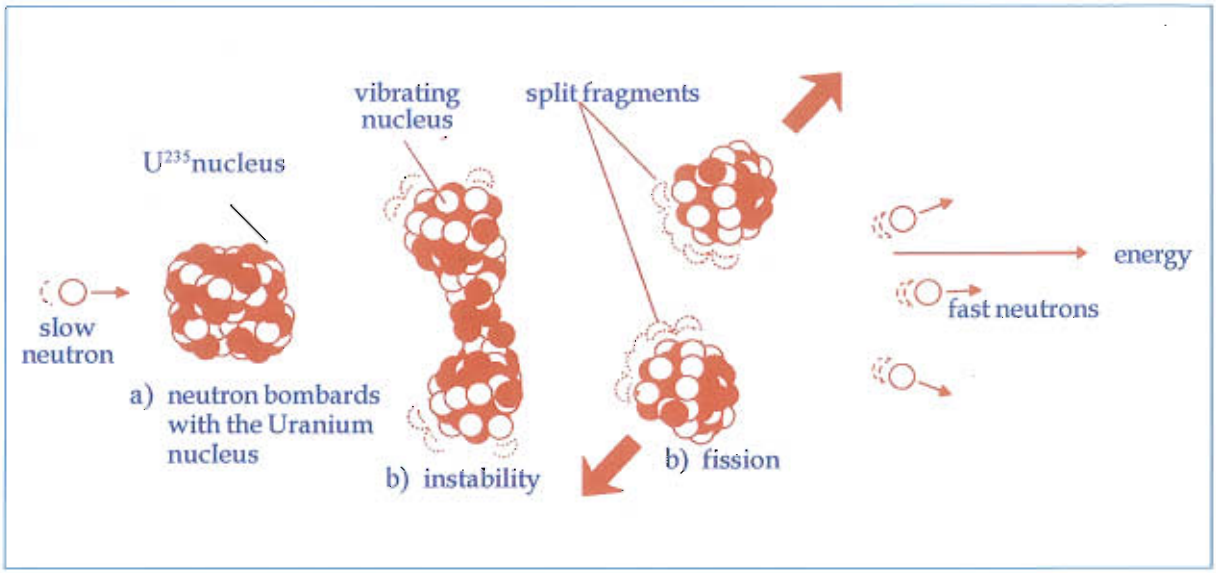


Fig. 12.14
The fission of U^{235} nucleus

How was it possible to produce such extreme devastating energy from an atom bomb? Can this energy be used for peaceful purposes?

Nuclear fission is the process in which the nuclei of greater atomic mass are split into lighter nuclei using neutrons. Einstein's equation $E=mc^2$ shows that even if the mass of the matter converted is very small, the energy produced will be very large. The uncontrolled fission reaction will end in a big explosion. This is the process which takes place in an atom bomb.

Nuclear fusion is the process in which lighter nuclei are combined to form heavier ones. In this process the matter lost is converted into energy. Haven't you understood that energy is produced in the sun and stars in this way? This is the principle used for making a hydrogen bomb.

★ What are the different methods by which energy is produced from the nucleus?

There are power stations which produce electrical energy from controlled fission reaction. They are known as nuclear power stations.

We have discussed about certain sources of energy. Have they been in use from very early days? Enquire. Find out the sources of energy which have been in use conventionally and those that have come in use only recently. Tabulate them. Sources of energy used conventionally are conventional sources of energy. Others are nonconventional.

Conventional energy sources	Nonconventional energy sources
• Fossil fuels	• Solar energy
• Biomass	• Tidal energy
• Hydroelectric power	• Nuclear energy
•	•

Energy crisis

We have started using new energy sources besides the conventional ones. Aren't we forced to face load shedding and power cut inspite of this? What may be the reason?

The main reason for the increase in the demand of energy is the increase in population.

In what all ways has the increase in population affected the consumption of energy? Expand the list.

- Building construction
- Luxuries
- Food
-

Do you know that the increase in consumption of energy becomes many times greater even for a small increase in population?

Though the necessity of energy has increased many folds, its generation has not increased in that proportion. Energy crisis is the increase in the need of energy and its decreased availability.

What can we do to reduce energy crisis as far as possible?

Expand the list.

- Judicious utilisation of energy.
- The maximum utilisation of solar energy.
-

Let's familiarise ourselves with certain devices which will reduce energy consumption.

✶ How does a hotbox help to reduce energy consumption.

✶ What are the different ways by which an energy efficient oven reduces energy consumption? Record.

✶ Why can food be cooked easily using a pressure cooker? How is energy saved here?

✶ What are the points to be considered to minimise the consumption of energy while constructing a house? Arrange an interview with an architect. Note down the results in the science diary.

Discuss and find out other methods to reduce energy consumption and expand the list.

- Use public conveyance for journeys as far as possible
- The construction and renovation of new roads and houses must be done with a scientific vision.
- Regulate street lights using light dependent resistor (LDR)
- Repair machines in time.
- Limit the size of newly constructed houses.
- Use energy efficient machines.
-

Follow up Activities

1. Percapita consumption of energy is found to have increased recently
   (a) What are the purposes for which we use energy?
   (b) What are the circumstances that have led to the increase of energy consumption?
   (c) What can you do to decrease energy consumption in your kitchen?
2. (a) How does combustion cause atmospheric pollution?
   (b) What measures can be taken to reduce atmospheric pollution due to combustion?
   (c) Explain how atmospheric pollution takes place even when heaped garbages are left unburnt.
3. (a) Energy is produced in different ways from oceans. Explain them.
   (b) What are the different ways in which we make use of solar energy?
   (c) How is so much energy produced in the sun?
4. (a) Which are the fuels known as fossil fuels?
   (b) What are the reasons for calling them fossil fuels?
   (c) Why is it said that the use and mining of fossil fuels are to be controlled?
5. (a) Classify the following into conventional and nonconventional energy sources: Petrol, firewood ,coal, solar energy.
   (b) Why is nonconventional energy called so?
6. (a) What are the four different types of coal?
   (b) What is the basis of this division?
   (c) What are the substances obtained when coal is distilled?

7. Do biogas plants create atmospheric pollution? Explain.
8. Can wind farms be established in Kerala? What are the peculiarities that such places must have?
9. "Hydroelectric power generation is comparatively less expensive," Analyse this statement and record your conclusion.
10. Construct and exhibit a hotbox. Explain how the modes of heat transmission are prevented in it.