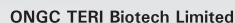


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**ONGC TERI Biotech Limited**  
(An ISO 9001:2008; 14001:2004; 18001:2007 Certified Company)  
CIN-U74120DL2007PLC161117



### **Message**

The advent of Industrial Revolution witnessed massive exploitation of natural resources in order to keep up with the increasing energy demands. This has resulted in the dwindling population of the global biodiversity, and yet energy consumption is not showing any signs of slowing down. The burgeoning population and the requirements that come with it are largely being blamed for this crisis-like situation.

The fossil-fuelled inventions have made life easier for us, but its cascading effects have wreaked havoc on the environment. Adverse climatic conditions leading to extreme weather events, health challenges, threats to crops are just some of the effects of climate change. Renewable energy is being seen as the immediate overall solution for climate change; however, conserving energy is also undeniably significant in making our planet a sustainable one – as energy conserved is energy produced. With natural resources going scarce, the cost of energy will definitely become expensive, limiting the economic development of a country.

Governments, technocrats, scientists, policy makers, and researchers are relentlessly discovering ways to conserve energy and move towards an energy-efficient society. However, the contribution of every individual through the practice of reducing the quantity of energy used is indispensable to make their efforts successful.

OTBL's programme "Protectors of the Environment" is aimed at raising awareness and educating children on the importance of energy conservation and efficiency in saving our planet. The programme anticipates creating energy conscious citizens who will ensure an energy secure country.

This comprehensive book has touched upon the concept of energy and has beautifully woven in the topic of energy conservation and efficiency through examples, experiments, and activities. The resounding theme of the book is "how every act counts". I hope the children are inspired to think and act beyond the book.

Best wishes,

Shri (Dr.) Banwari Lal  
Chief Executive Office (CEO)  
ONGC TERI Biotech Limited (OTBL)

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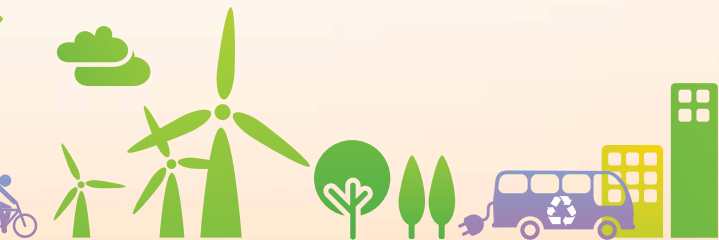
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The book is aimed at explaining the students about the role of energy conservation in saving the planet from climate change. Students are expected to understand the importance of energy conservation, their role, inculcate energy saving habits and promote sustainable lifestyle.



## Warming up

Before reading the text, the teacher could generate a discussion among students on climate change, energy, pollution, and conservation of natural resources. Some of the questions can be:

- What are the sources of fossil fuels?
- How is burning of fossil fuels related to pollution?
- What is the source of energy?
- What is conservation?
- What is sustainable development?

## Learning outcome

- To understand and infer the difference why every activity counts
- To understand that natural resources are exhaustible and their need of conservation
- To understand various environmental issues and promote awareness about them
- To acknowledge energy-related issues and develop a solution-based approach
- To engage in energy conservation activities at homes, schools, and in their communities





# Energy

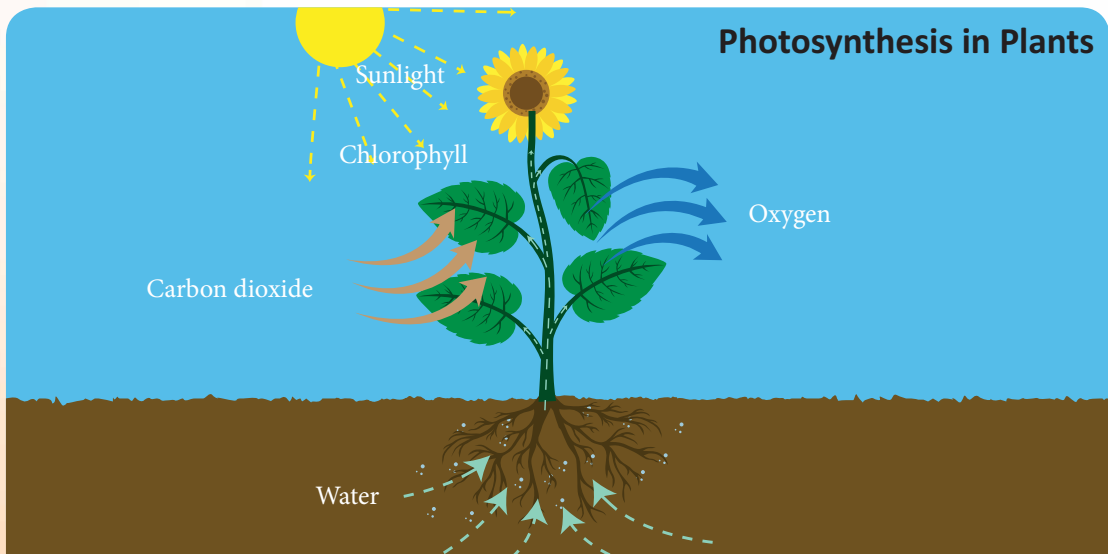
Don't we feel exhausted after a good run or a game of football? We sweat and pant, and then say that we are tired. Why does this happen? It happens because we burn the energy in our body. Athletes who practise every day can perform physical activities with much vigour than the average person, although we too can perform most of the similar physical activities. So we see that the energy level differs, but is not non-existent.

## What is energy?

The universal definition of 'energy' is the ability to do work. It can neither be created nor destroyed. Energy changes only its forms into chemical, electrical, heat (thermal energy), light (radiant energy), mechanical, and nuclear energy. It exists as light, heat, sound, mass, moving objects, fuel, chemicals, and electricity.

## What happens during photosynthesis?

Green plants use sunlight, water, and carbon dioxide to produce their own food. Plants convert light energy into chemical energy that is later released to fuel their activities. Again, during digestion, chemical energy of food is converted into heat energy that helps keep the body warm and the chemical energy is also converted



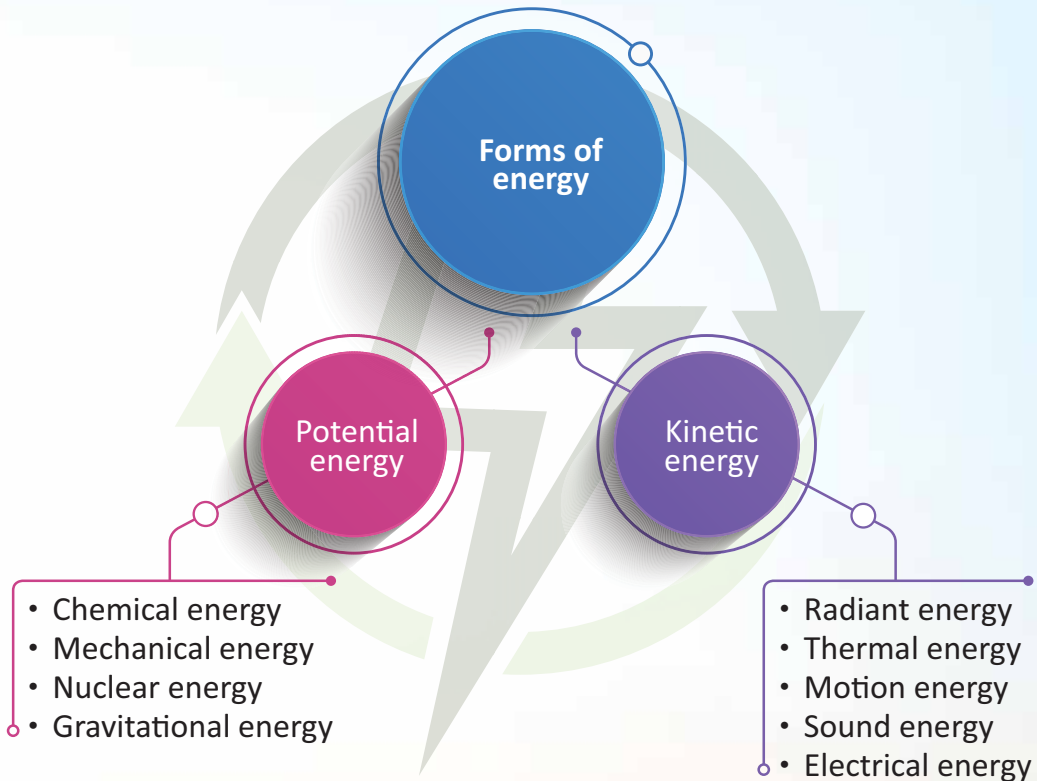
into mechanical energy that enables us to do work. So, it proves that energy can be found in many things and in various forms.

Joule (J) is commonly used by scientists around the world as the unit of energy. The metric system uses calories (cal), joules (J), or kilojoules (kJ). One kilojoule (1 kJ) is equal to 1000 J.

$$1000 \text{ J} = 1 \text{ kJ} = 1 \text{ Btu}$$

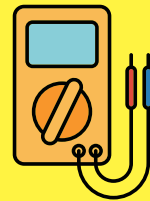
## Forms of energy

Energy has two major forms and each form can be further divided as shown below:



## Energy meter!

Every day the earth is hit by around eight million lightning strikes and each lightning bolt heats the air around it to about five times hotter than the sun. Global warming will only increase the number of lightning strikes!



Let us look at what each types of energy mean:



### Potential energy

Energy in an object at rest that has the potential to make a change.

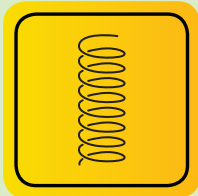
**For example:** Boulder on a cliff



### Chemical energy

Energy that is stored in the bonds of atoms and molecules is chemical energy. Any substance that can be used as a fuel contains chemical energy.

**For example:** Dry wood



### Mechanical energy

Energy stored in an object because of compression.

**For example:** Compressed spring



### Nuclear energy

Energy that results due to splitting or combining of atomic nuclei.

**For example:** Nuclear medicine



### Gravitational energy

Gravitational energy is the potential an object has to do work as a result of being located at a particular position in a gravitational field.

**For example:** Ocean tides





### **Kinetic energy**

Energy of an object formed due to its motion.

**For example:** Boulder falling from a cliff



### **Radiant energy**

Energy radiated by a light source.

**For example:** Heat emitted from lighting fixtures



### **Thermal energy**

Energy that comes from heat.

**For example:** Hot frying pan



### **Motion energy**

Energy in an object as a result of being in motion.

**For example:** Blowing wind



### **Sound energy**

Movement of energy through a substance in waves. The medium can be solid, liquid, or gas.

**For example:** Clapping hands



### **Electrical energy**

Electric charges in motion.

**For example:** Batteries



## Let's work it out

Now that you have learnt about the different forms of energy, write whether the following actions are potential or kinetic energy.

1. Your eraser on the table: \_\_\_\_\_
2. A person climbing a ladder: \_\_\_\_\_
3. A glass of water: \_\_\_\_\_
4. Wind blowing: \_\_\_\_\_
5. A spring at rest: \_\_\_\_\_
6. A moving skateboard: \_\_\_\_\_
7. Clapping hands: \_\_\_\_\_
8. Photosynthesis: \_\_\_\_\_
9. Unstretched rubber band: \_\_\_\_\_
10. A flying bird: \_\_\_\_\_

Answers:

1. potential energy, 2. kinetic energy, 3. potential energy, 4. kinetic energy, 5. potential energy, 6. kinetic energy, 7. kinetic energy, 8. potential energy, 9. potential energy, 10. kinetic energy



# Energy Guzzlers

Can you imagine a day going without electricity or without any means of transport? We can't. Humans have been harnessing energy for centuries to make their lives easier. Residential, commercial, transport, agriculture, and industrial are the five major energy-consuming sectors.

## Residential

The energy requirement in the residential sector is mainly for cooking and electricity. While earlier cooking was done using biomass, now it is performed through LPG, electricity, and piped natural gas; electricity too has made inroads into almost every household. This fuel transition in a way is a result of an increase in household income and the development of technology and infrastructure of an area. This transition has resulted in lifestyles changes with comfort and convenience in our daily activities, and increase in economic activities.



## Commercial

Energy for lighting, heating, and cooling needs to be used with care in commercial complexes. The malls, schools, offices, and public spaces are all part of the commercial sector. If you look around, you will see that all corridors, washrooms, staircases, and so on are lighted, which is necessary in public places. However, in doing so, it is very difficult to gauge the usage and wastage of energy.



## Transport

The development of the transport system has contributed to the massive movement of people and goods across the globe. Fossil fuels are still the main source of energy for transportation. This means that if we aren't using renewable energy to power all our needs, we are leaving behind a trail of environmental destruction and degradation.



## Agriculture

India's agriculture has evolved from human and animal labour based to machine based. In this process, this sector has emerged as one of the major commercial energy consumers. The development of irrigation system, use of tractors and tillers, and the use of fertilizers have resulted in the increase of diesel and electricity consumption.



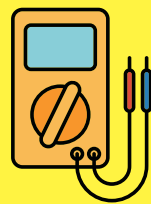
## Industrial

About 45 per cent of the total commercial energy is consumed by the industrial sector. Crude oil industries, wood industries, and chemical refining industries are some of the most energy-intensive industries. The chemical and refinery industry produces huge quantities of waste gases that, if not collected and burnt effectively, results in a massive loss of energy.



## Energy meter!

A device on standby can consume upto 10 per cent energy. This energy consumption is called phantom energy. Do you want a phantom lurking around in you school and home?



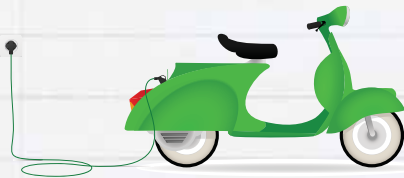


## Interesting Facts



1. LPG helps to reduce black carbon (BC) emissions, which are the second biggest contributor to global warming and can also cause serious health issues.

2. We all know about the energy ratings of electrical products; there are similar ratings for buildings as well. Buildings that make an optimum use of energy and have facilities for water conservation, solid and water waste management, and so on are called green buildings. Is your school a "green school"?



3. The Gujarat Energy Development Agency (GEDA), Gujarat Government has been providing subsidies for the purchase of two-wheeler electric vehicles and it is also planning to sanction around 600 battery-operated e-rickshaws.

4. Drones are popularly used for photography, but it can also be put to excellent use in the agricultural sector for soil analysis, field evaluation, planting, irrigation, and assessment of crop health. Wouldn't it save a lot of energy?



5. Recycling saves a lot of energy; for example, if we recycle aluminium cans, we can save 95 per cent of the energy required to make the same amount of aluminium from its virgin source bauxite. We can conserve 207 million Btu by recycling 1 tonne of aluminium cans, which is equivalent to saving 1665 gallons of petrol.



## Let's work it out

**A. List three uses of energy those are different at home and at school in the following categories.\***

*(Hint: How the number of lighting fixtures and heaters/coolers differs)*

At School	At Home
1. Lighting:	1. Lighting:
2. Cooling:	2. Cooling:
3. Heating:	3. Heating:

**B. Give one suggestion on how to save energy for each of them. (If you cannot find the solutions now, revisit the question after completing the book.)**

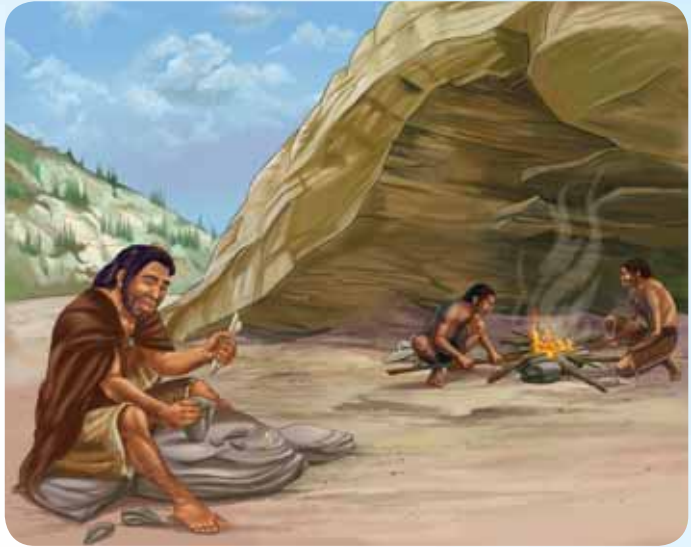
At School	At Home
1. Lighting:	1. Lighting:
2. Cooling:	2. Cooling:
3. Heating:	3. Heating:

*\* You may use the space provided to write your answers.*



# Harnessing Energy

Energy has been harnessed for hundreds of years. Although the uses of energy were much simpler in earlier times, it was still challenging for man. For example, before the Industrial Revolution, man relied only on the sun and human and animal labour to complete even the simplest activities, such as cooking and washing. Now compare this with the present time when we are always “just a click” away from most of our necessities.



## Through the ages

Look at the comparison of the pre-industrial, Industrial Revolution, and current times:

### Pre-industrial times

#### Source:

Sun, firewood, animals, wind, water

#### Uses:

Heating, cooking, transportation

### During Industrial Revolution

#### Source:

Coal

#### Uses:

Heating, cooking, transportation, consumption in industries and factories

### Current times

#### Source:

Fossil fuels (petroleum, natural gas, coal), renewable sources (solar, hydro, wind, geothermal, wave)

#### Uses:

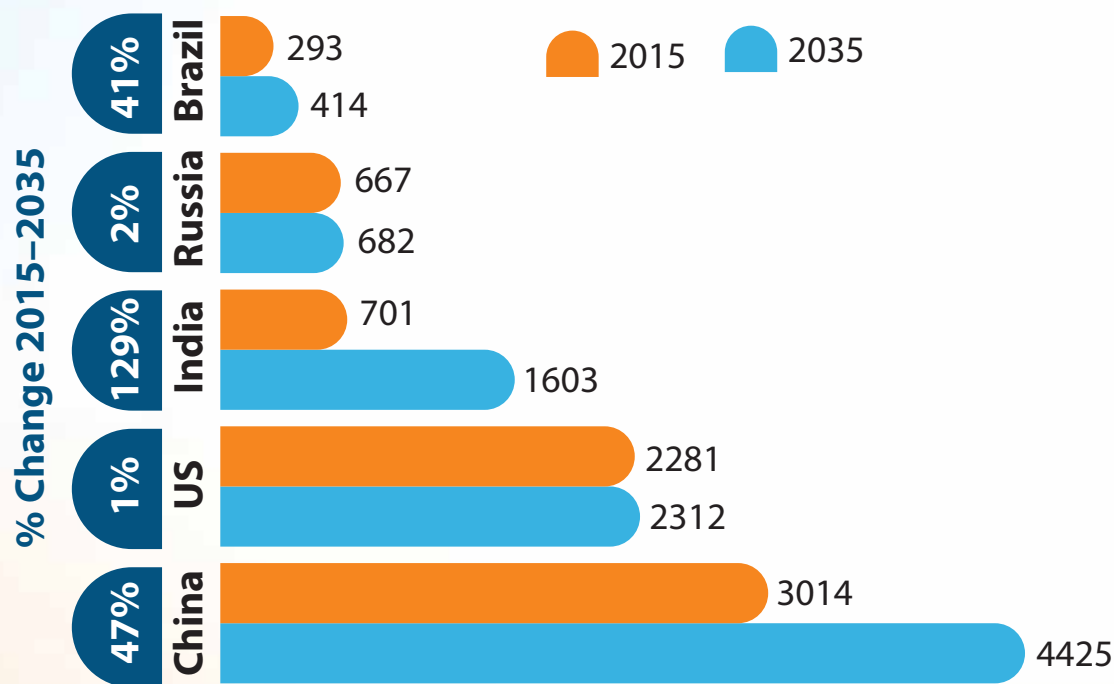
Heating, cooling, cooking, lighting, transportation, utilization in advanced industries



Although there are evidences of the use of windmills as early as the twelfth century, the limitations of data and the unreliability of the sources make it difficult to calculate the exact energy consumption before the Industrial Revolution.

According to BP Energy Outlook, India's energy consumption is set to grow at 4.2 per cent per year by 2035, faster than all the major economies in the world. Since 2000, the energy consumption in India has increased more than three times, with residential and commercial taking the lead, followed by the industrial sector. According to a report published by WHO in 2018, 13 Indian cities are among the top 20 cities in the world with the highest levels of ambient PM<sub>2.5</sub> concentration.

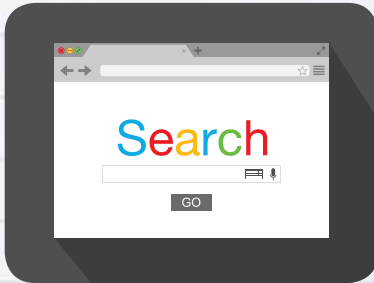
**The following bar diagram shows India's fast changing energy consumption pattern:**



Source: <https://economictimes.indiatimes.com/industry/energy/oil-gas/indias-energy-consumption-to-grow-faster-than-major-economies/articleshow/56800587.cms>



## Interesting Facts



1. The energy used in one Google search is equal to the energy required to turn on a 60 watts light bulb for 17 seconds.

2. India has approximately 1 per cent of world's energy resources, but it has 16 per cent of world's population.



3. Fireflies emit cold light with nearly 100 per cent efficiency through a chemical reaction. Scientists are working to design efficient LEDs in the similar model.

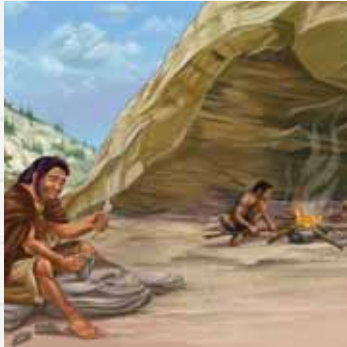
4. Energy production and use account for 83 per cent of the total greenhouse gas emissions.



5. Worldwide proven coal reserves are estimated to be 1.1 trillion tonnes, and they are expected to last for around 150 years at the current rates of production. The oil and gas reserves will last for only around 50 and 52 years, respectively, at the same rates of their production.

## Let's work it out

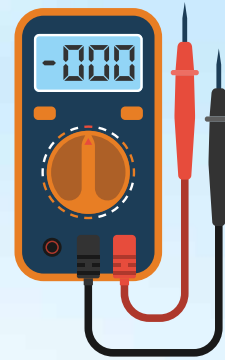
**Spot the differences in these three images and write three points about the differences. Don't forget to add one fact to support each of your points.**



### How to generate power from potatoes?

#### Materials

- Two large potatoes
- Two 2" pieces of thick copper wire
- Three 4" pieces of thin copper wire
- Two galvanized nails (nails with a zinc coating)
- Six alligator clips
- Wire cutter
- One multimeter
- 1.5 V light bulb



Multimeter

#### Steps:

1. Make two 1" deep slits on each end of the two potatoes.
2. For both the potatoes, insert the thick copper wire into one slit and the nail as shown in the diagram.
3. Connect the alligator clips to each end of the three pieces of thin copper wire.
4. Connect one alligator clip on the first piece of wire to the heavy copper wire on the first potato and attach the other clip to one end of the light bulb.
5. Attach one alligator clip on the second piece of wire to the other end of the light bulb and attach the other clip to the nail on the second potato.
6. Attach one alligator clip on the last piece of wire to the thick copper wire on the second potato and attach the other clip to the nail on the first potato.
7. Did the bulb light up?

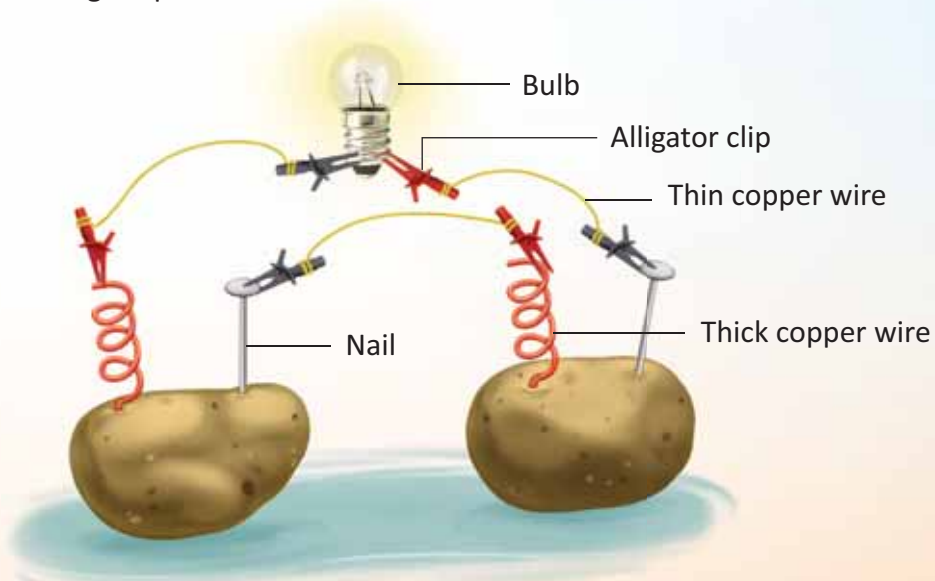


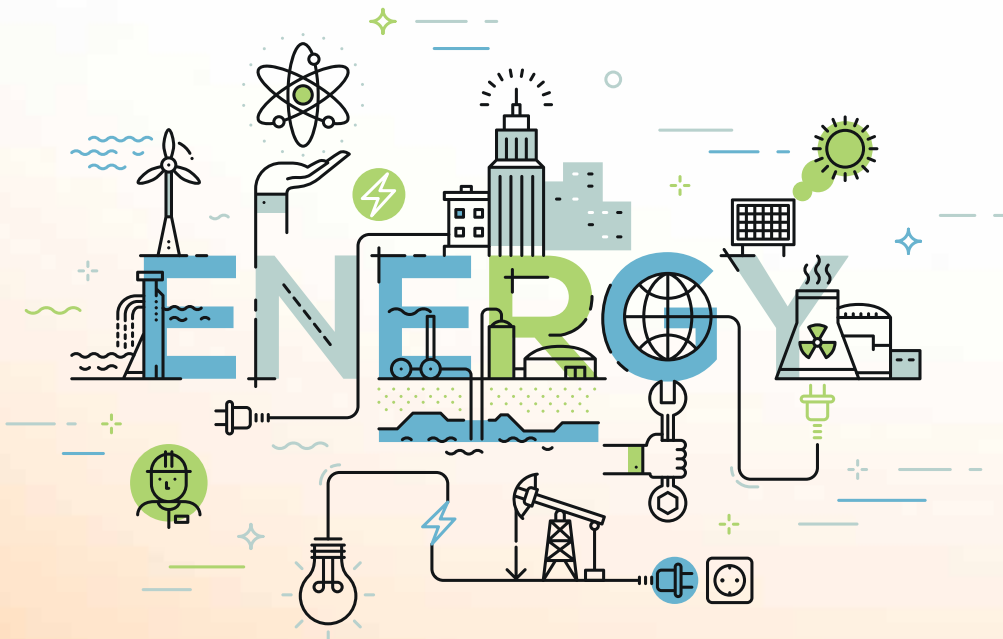
Diagram showing generation of power from potatoes

# Energy and Related Problems

Energy is a quintessential component of our everyday life. Without energy, modern life would not exist. But, as you know, there are two sides to every coin. So, on the one hand, energy has become an indispensable part of our lives, while, on the other hand, there are some related problems that have crept in due to different uses of energy. We will learn about such problems in this chapter.

## Energy: Fundamental Component of Society

Human society requires energy to function optimally, which it gets from energy resources that could be fossil fuels or even renewable energy. We use energy in our daily lives at our homes, for commercial purposes, for our transportation needs, for communication, for agriculture, and for industry in general. The world is rapidly becoming a global village due to the increasing daily requirement of energy by all human beings across the world. Worryingly, the requirement for energy and its related services to satisfy human social and economic development, welfare, and health is increasing at an alarming pace. Our environment has to bear some impact of all the sources of energy. Fossil fuels—coal, petroleum, and natural gas—do considerably more harm than renewable energy sources, including air and water pollution, damage to human health, wildlife and habitat loss, water use, desertification, and global warming emissions.





## Energy Use Leads to Environmental Degradation and Depletion of Natural Resources

All forms of energy usage, consumption, and electricity generation have an ecological impact on Earth's air, water, and land. The harnessing and utilization of energy is associated with distressing problems, such as exhaustion of natural resources and environmental damage. Energy resources all over the globe are getting depleted. Majority of the energy used in the entire world comes from fossil fuels (coal, oil, and gas) that are exhaustible. Scientists fear that at our current rate of consumption, all the known oil reserves could be exhausted by the middle of this century. It is now an established fact that the greater the energy consumption, the greater the carbon emission resulting from the consumption of fossil fuels. The emission of carbon dioxide ( $\text{CO}_2$ ) is a major cause of global warming. Now, let us examine these environmental problems.



Acid Rain



Air Pollution



Water Pollution



Destruction of Forests

### Global warming

Global warming refers to the incessant increase in the average temperature of the Earth's surface and its atmosphere, which has been attributed to the accumulation of greenhouse gases (GHGs), such as  $\text{CO}_2$ , methane ( $\text{CH}_4$ ), water vapour, nitrous oxide ( $\text{N}_2\text{O}$ ), and chlorofluorocarbons (CFCs). The concentrations of GHGs in the atmosphere are increasing gradually due to human activities, such as industrialization and increased use of vehicles. Global warming leads to rise in sea levels, occurrence of weather extremes (due to climate change), and shifting of vegetation zones.

### Acid rains and water pollution

Acid rains are caused by the release of sulphur dioxide ( $\text{SO}_2$ ) and oxides of nitrogen when fossil fuels are burnt. The oxides combine with water vapour in the air to form acids, which return to the ground as acid rain. The problems posed by acid rains include corrosion of the built environment, soil degradation, water pollution, and so on. Water bodies are polluted when acid rains dissolve toxic substances such as





aluminium and mercury and dissolve them in water bodies, including underground water. Acid rains decrease the pH of water bodies. Textile, paper, and pulp industries discharge huge amounts of cooling water and waste material into the adjoining water bodies. These organic pollutants not only pollute the water but also kill different aquatic organisms. Japan's Minamata Disaster is an example of mercury poisoning in water. The mercury was part of the wastewater released into the bay by a nearby chemical factory. Over time, the Minamata disease that attacked the central nervous system of humans killed thousands of people.

### **Air pollution from vehicles and other sources**

You all must be using different modes of transportation for your daily needs, such as bus, car, bicycle, metro train, and so on. But have you ever thought that energy usage in transportation causes air pollution? Vehicles plying on our roads are a significant source of air pollution. Major studies suggest that amongst the vehicles, trucks, two-wheelers, and cars cause the maximum pollution on roads. Emissions from vehicles, thermal power plants, and factories contain unburned hydrocarbons, particulate matter ( $PM_{2.5}$  and  $PM_{10}$ ), carbon dioxide, carbon monoxide, and oxides of nitrogen and sulphur that contribute to the lowering of the quality of air. These substances in the air irritate the eyes, throat, and lungs and cause respiratory illnesses.



### **Oil spills and hazardous radiations**

Oil spill is the leakage of fuel oil from storage vessels, oil tankers, pipelines, tanker trucks, or other vessels used for transporting fuel oil. Oil spills really damage the land, vegetation, and water bodies, including the oceans. Fuel oil is poisonous if ingested by animals.



Also, accidental leakage of gases from power plants has led to some major accidents in the history of mankind. In December 1984, a highly toxic gas called methyl isocyanate (MIC) leaked from the Union Carbide pesticide plant in Bhopal. The Chernobyl disaster was a calamitous nuclear accident that occurred in April 1986, in the nuclear reactor at the Chernobyl Nuclear Power Plant, in Ukrainian SSR, Soviet Union.



## Global Impacts

Energy usage affects each of us every day of our lives. Many problems and the resulting complications arise from the use of energy: GHG emissions, acid rain, climate change, global warming, dependency on depleting supplies of fossil fuels, and so on.

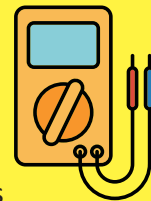
According to the Global Energy Transformation report of International Renewable Energy Agency (IRENA) published in 2019, energy-related emissions have risen around 1% yearly since 2015, and therefore energy-related CO<sub>2</sub> emission reductions would have to decline 70% by 2050, compared to current levels, to meet climate goals. A large-scale shift to electricity from renewable sources could deliver 60% of those reductions.

## National Impacts

The UN website says that although India is home to nearly 18% of the global population, the country uses only 6% of the world's primary energy resources. The country's primary energy consumption, however, has risen significantly over the past three decades. This trend is expected to continue, driven by strong economic growth and population expansion. Ensuring adequate energy supply to satisfy these demands is a key challenge facing India.

## Energy meter!

Pradhan Mantri Sahaj Bijli Har Ghar Yojana – 'Saubhagya' was launched by the Hon'ble Prime Minister on September 25, 2017. Under Saubhagya, free electricity connections to all households in rural areas and poor families in urban areas were provided. As on July 30, 2019, 214,473,043 households have been electrified, which is 99.99% of the total target. (Source: saubhagya.gov.in).



### Let's work it out

In the following table, match the names of four of the most dreadful disasters in the human history that occurred due to different kinds of energy usage with their respective reasons.

Name of the Disaster	Reason for the Disaster
1. Japan's Minamata Disaster	a. Atomic bomb
2. Bhopal Gas Tragedy	b. Catastrophic accident at a nuclear power plant
3. Chernobyl Accident	c. Mercury poisoning in water
4. Hiroshima and Nagasaki Disaster	d. Toxic gas leakage from pesticide plant



# Solutions at Hand

In the last chapter, we learnt about the different problems being faced by the human society with the use of different forms of energy. So, did you try wondering about the possible current solutions that we can come up with to counter the problems created by indiscriminate consumption of energy? Let us discuss some possible solutions with the current options.

## Current Options

You would agree that even if there are several problems associated with the harnessing and utilization of energy, the total use of energy globally must increase significantly to meet the needs of the growing population and economies such as India. As it is very difficult to completely avoid using energy, solutions must be found to the problems that arise from energy harnessing and utilization. Consequently, several 'clean' technologies have been designed to take care of specific energy-related environmental problems, for example, installation of pollution control equipment in industries and power plants.

This is where the adoption of renewable energy technologies also comes into play as apart from technological interventions, apt solutions could help address the problem of depletion and environmental damage associated with the harnessing and utilization of energy.



- Harnessing alternate energy sources that are inexhaustible or renewable and non-polluting. For example, solar, wind, biogas, and hydropower. Therefore, it becomes quite necessary to create awareness about inexhaustible and non-polluting energy sources amongst the masses and students.
- Using energy efficiently, thereby reducing the adverse environmental impact, while at the same time making renewable energy resources last longer. Students should be provided with knowledge and skills needed to use energy efficiently. A practical approach is to promote energy management in schools as a rational and logical component of the energy education course.

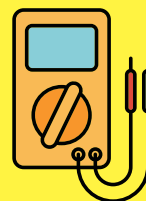
## Adopting (Renewable Energy)

The most effective way to reduce pollution and fight climate change is to use renewable sources of energy instead of fossil fuels. The energy from sun, wind, biomass, and other renewable sources is more sustainable and will not get exhausted. Renewable or non-conventional sources of energy not only cause less emission but are also available locally. Their use can significantly reduce chemical, air, water, radioactive, and thermal pollution. The use of renewable sources of energy leads to reduction of greenhouse gases (GHGs) during energy consumption, thus making our planet safe and healthy for its inhabitants.

The Government of India is leaving no stone unturned to adopt renewable energy technologies for the betterment of the country. You will be proud to know as an Indian citizen that the year 2018–19 saw India progressing quite well towards fulfilling its renewable energy targets.

### Energy meter!

By March 31, 2019, India attained global 4th and 5th positions in wind and solar power installed capacities, respectively. India is now at 5th global position for overall installed renewable energy capacity. (Source: pib.nic.in)



## Reducing Energy Use and Conservation

There is a direct correlation between your energy use and the environment. When you consume less power, you reduce the amount of toxic gases released by power plants, conserve the Earth's natural resources, and protect ecosystems from devastation. By taking measures to reduce your energy use, you'll contribute to the



health and well-being of the world. Energy conservation refers to efforts made to reduce energy consumption. This can be achieved either by using energy more efficiently or by reducing the amount of service used (for example, by avoiding unnecessary driving of cars). Conservation is the process of reducing energy use by going without an energy-expensive service. Energy conservation reduces the need for energy services and results in increased quality of the environment, national energy security, and higher personal savings. It also lowers energy costs by preventing future resource depletion.

Energy can be conserved by reducing wastage and losses, improving efficiency through technological upgrades, and improved operation and maintenance. On a global level, energy use can also be reduced by achieving a balance in population growth so that the resources could be utilized optimally.



## Enhancing Efficiency

While energy efficiency and energy conservation are often used interchangeably, there is a small but significant difference between these two energy-saving practices. For example, you can improve energy efficiency by selling or exchanging your old washing machine for a new energy star certified washing machine. This new machine would still consume electricity to wash and dry your clothes, but it would use much less energy to get the same end result. On the other hand, you can conserve energy by leaving your washed clothes to dry outside using sunlight. This form of conservation cuts energy consumption out of the drying process completely.



## What Can Be Done At Personal Level?

To reduce energy consumption in your home, you do not necessarily always have to go out and purchase energy-efficient products. We just need to make certain behavioural adjustments that have the highest potential for utility savings.





A few examples are as follows:

- Energy conservation can be as simple as turning off lights or appliances when you do not need them. Also, do not leave electrical devices on standby.
- If you are not going to use your computer or laptop for a while, switch it off rather than leaving it on screensaver mode.
- 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 manually.
- You can simply turn down the heat on your thermostat in the winter and use your air conditioner less in the summer. Heating and cooling costs constitute a large portion of an average household's electricity bills, and so these reductions in the intensity and frequency of heating and cooling provide us the greatest savings.
- Also, if two or more people are going to the same destination, you can do carpooling and go together.

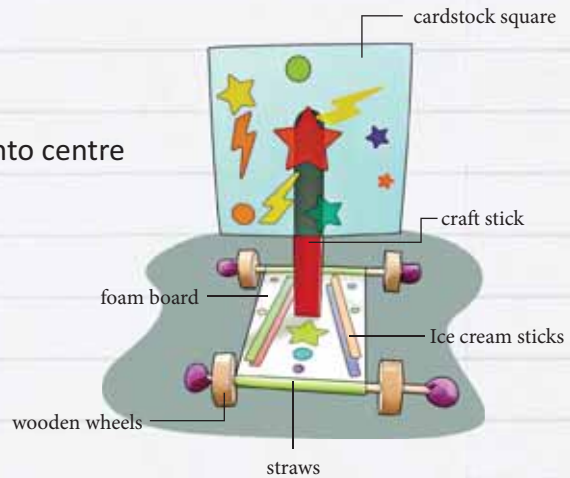


## Wind Power

### Let's make our own wind car

#### Materials

1. One 8×5" foam board with slit cut into centre
2. Two 5" straws
3. Two 8" Ice cream sticks
4. One 5×5" cardstock square
5. One large craft stick
6. Four wooden wheels
7. Stickers
8. Tape



#### Steps

1. Decorate your foam board with stickers or as per your own wish.
2. Attach the straws to both ends of the foam board, using tape.
3. Slide the cake pop sticks through the straws.
4. Slide the wooden wheels on to the cake pop sticks and cap it with the play dough to keep the wheels from falling off.
5. Decorate the paper sail with stickers.
6. Attach the sail to a craft stick with tape and insert the craft stick into the slit in the foam board. Now your wind car is ready to race!

You can now have fun with your wind car by blowing it with your breath or using a table fan on high speed. The wind car demonstrates a simple application of wind energy. Do you think it is a form of clean energy? Note down your observations below.

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## Game time

### Bingo Adventure!

For each letter, find one person about whom the statement is true.  
Write each name in one of the boxes below.

**A** has seen a wind mill

**L** has visited a power plant

**I** recycles paper

**M** composts kitchen waste

**B** knows the cost of a kilowatthour of electricity

**F** can name two ways to save energy at home

**J** has seen a dam

**N** uses electric vehicle

**C** has never seen coal

**G** has seen a solar rooftop

**K** cooks using electric stove

**O** knows about the star rating for household appliances

**S** goes to school on a bicycle

**D** donates old items

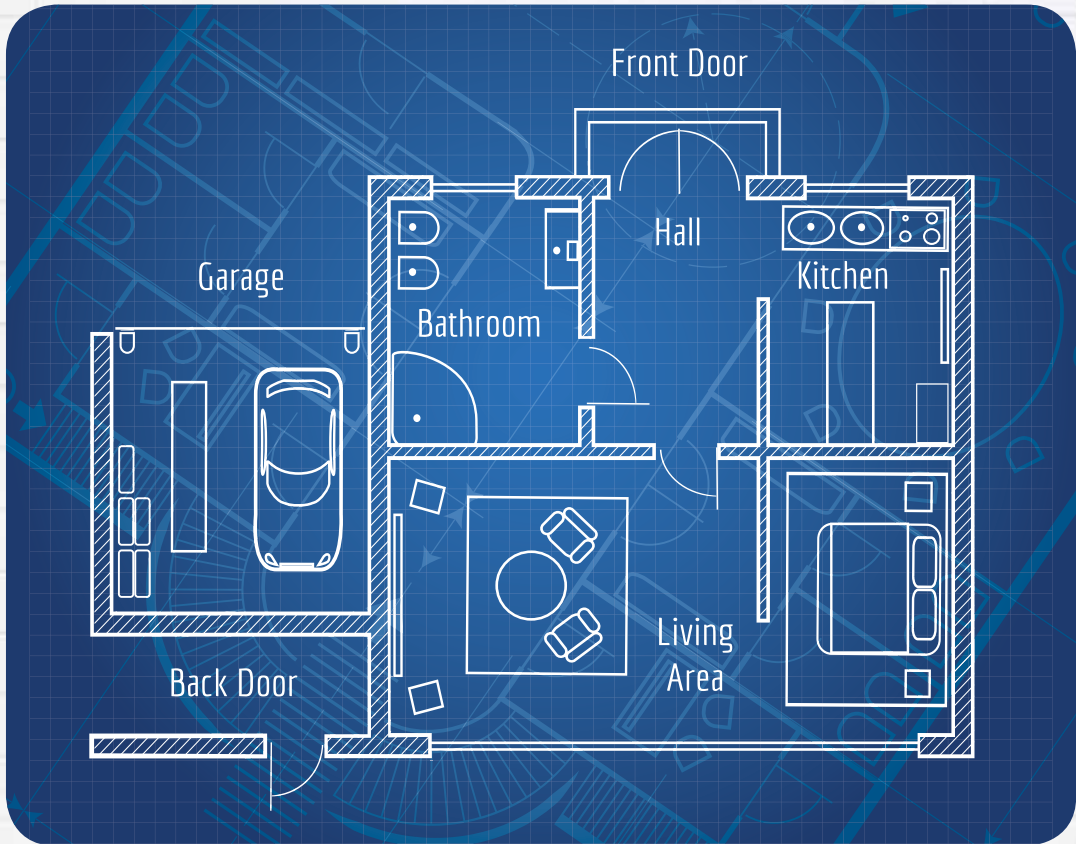
**H** has LED bulbs at home

**P** has maximum indoor sunlight

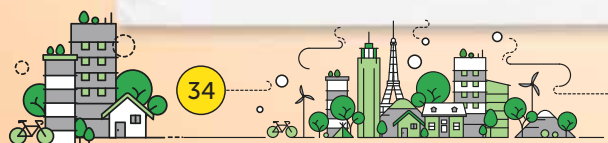


<b>A</b>	<b>L</b>	<b>I</b>	<b>S</b>
<b>M</b>	<b>B</b>	<b>F</b>	<b>D</b>
<b>J</b>	<b>N</b>	<b>C</b>	<b>H</b>
<b>G</b>	<b>K</b>	<b>O</b>	<b>P</b>





Here is an example of a blueprint.



## Be a Green Architect!

### Let's design an energy-efficient room.

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Section: \_\_\_\_\_

School Name: \_\_\_\_\_

Your work area: \_\_\_\_\_ (choose any one room: classroom/ living room/ kitchen)

Members in your work group: \_\_\_\_\_

1. Number of exterior and interior doors in your work area: \_\_\_\_\_ | \_\_\_\_\_

2. Number of windows in work area: \_\_\_\_\_

3. Number of electrical devices in your work area: \_\_\_\_\_

4. Number of light fixtures in your work area \_\_\_\_\_

5. Number of heating/cooling devices or vents in your work area: \_\_\_\_\_

### Complete the chart below with data from your diagrams:

LOCATION	DOORS	WINDOWS	ELECTRICAL DEVICES	LIGHTS	HEATING/ COOLING DEVICES/ VENTS	OTHERS

### Things to remember when you design:

1. Renewable or natural sources should be used for construction
2. Use natural light to the maximum
3. Use renewable energy for the lighting, heating, and cooling purposes



**Draw your blueprint in the space provided below.**



## Questionnaire

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Section: \_\_\_\_\_

School Name: \_\_\_\_\_

1. What does the body burn during activities?

\_\_\_\_\_

2. During digestion, chemical energy converts to \_\_\_\_\_ and then

\_\_\_\_\_

3. What are the two major forms of energy?

\_\_\_\_\_

4. What are the five major energy-consuming sectors?

\_\_\_\_\_

5. Which emissions are the second biggest contributors to global warming?

\_\_\_\_\_

6. India's agriculture has evolved from \_\_\_\_\_ and \_\_\_\_\_ to

\_\_\_\_\_

7. How can drones be used in agriculture?

\_\_\_\_\_

8. What saves a lot of energy?

\_\_\_\_\_

9. Name a few energy-intensive industries.

\_\_\_\_\_

10. What is the name for energy that does not run out or get exhausted?

\_\_\_\_\_



11. Name the environment-friendly activity in which sharing of car journeys is done so that more people travel in a car, and prevents the need for others to have to drive to a similar location themselves.
- 
12. Most lakes and streams have a pH between 6 and 8. How does acid rain increase the acidity in water environment?
- 
13. In the Bhopal Gas Tragedy, a highly toxic gas called methyl isocyanate (MIC) leaked from the Union Carbide pesticide plant in Bhopal, India. When did it occur?
- 
14. Which pollutant poisoned the water of the Minamata Bay in Japan?
- 
15. What will you do if you see somebody wasting electricity by keeping an appliance on unnecessarily?
- 
16. When a refrigerator is full of food, does it need more electricity or less to keep cool?
- 
17. The burning of trees in tropical rainforests increases the amount of which gas in the atmosphere?
- 
18. Hydroelectric power produces electricity using \_\_\_\_\_
19. One problem with \_\_\_\_\_ energy is that it produces radioactive waste.
20. Loss of sea ice by global warming will result in \_\_\_\_\_



### Energy Audit at Home

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Section: \_\_\_\_\_

School Name: \_\_\_\_\_

It is important to keep a close watch on the amount of energy you are consuming. Complete the below sheet to find out how much energy you are using and then think of ways to save electricity.

Name of the energy appliance	Capacity (in Watts) (a)	Total number of fixtures (b)	Number of operating hours in a day (c)	Consumption in a day [(a x b x c)/1000] (kWh) (d)	Consumption in a month (d x number of days the appliance is used in a month) (e)
Ceiling fan					
Cooler/Air Conditioner (AC)					
Table fan					
Refrigerator					
Incandescent bulb					
Tube light					
LED bulb					
Geyser					
Television					
Computer system					
Iron					
Washing machine					
<b>Total units consumed per month</b>					

#### Instructions:

You can also ask your teacher or check online about the power consumption (in Watts) of different electrical appliances. It will help you to fill the above energy audit sheet more accurately.





## Reviewing Outcomes

1. Which gadget/appliance consumes the greatest amount of electricity?

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2. Which gadget/appliance consumes the least amount of electricity?

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3. Can you suggest places or rooms where energy is wasted in your home?

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4. Can you suggest some remedial measures to prevent or stop energy wastage in your home?

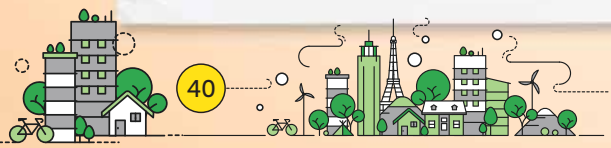
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5. Suggest some ways in which you can reduce the overall energy consumption in your household.

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# About the book

How does switching off electrical appliances help? Does unplugging laptop and mobile chargers really matter? What is energy security? These are just some of the questions that are answered in *Save Energy to Save the Future*. The book engages children in learning about energy production and their uses through hands-on activities, and experiments. These will instil in them energy conserving habits and help in choosing the right options in their everyday lives, thus making sustainable planet a reality.

