



KEMENTERIAN
PENDIDIKAN
MALAYSIA

DUAL LANGUAGE PROGRAMME

SCIENCE FORM 4



THEME

2 Maintenance and Continuity of Life



- **What do you know about Green Technology?**
- **Is it safe for us to consume genetically modified foods?**
- **Which system supports our body and protects our internal organs?**
- **How are plants able to grow vertically against gravity?**
- **What is hormone?**



Chapter

4

Green Technology for Environmental Sustainability



Keywords

- ◆ Green Technology
- ◆ Socio-scientific issues
- ◆ Application of Green Technology

What is the meaning of Green Technology?

What are the available sectors within Green Technology?

How do we apply Green Technology in our everyday life?



Science Digest

Green Vehicle Era

A green vehicle is an eco-friendly vehicle, that does not emit fumes into the environment. The examples of green vehicles are electric and solar cars. The electric car uses energy from the battery while the solar car uses solar energy from the Sun to move the motor in a vehicle.

You will learn about:

- environmental sustainability
- energy sector
- waste and wastewater management sector
- agriculture and forestry sector
- transportation sector
- Green Technology and life

4.1

Environmental Sustainability

Technological advancement and holistic development in this era have simplified and expedited various human tasks. However, the advancement of technology has also brought negative effects to the environment. For example, there is an increase in environmental pollution and a decrease of natural resources.

Realising the extent of the current damage done to the environment, various initiatives have been introduced to spread the awareness on environmental sustainability. All the efforts and initiatives that have been carried out are regarded as Green Technology.



Photograph 4.1 Green Technology Concept

Green Technology Concept

Green Technology is the development and application of products, equipment and systems used to conserve the environment and nature, as well as minimising and reducing the negative effects of human activities.

Important in:

- overcoming the destruction of the environment
- reducing carbon emissions
- improving human health and lifestyle
- conserving the country's natural resources by applying renewable energy sources



Solar vehicles are used to reduce the use of fossil fuels

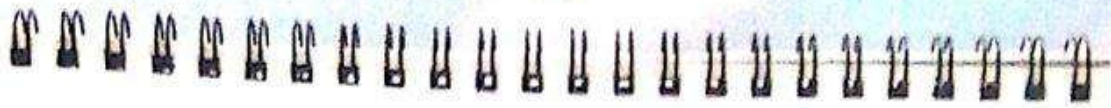


Renewable energy sources are used to generate energy

Photograph 4.2 Examples of Green Technology in daily life

Relating Energy Efficiency to Green Technology

For Green Technology to succeed in our country, the **National Green Technology Policy** was launched in July 2009. What are the **pillars** of that policy? Let us look at the following note:



There are four **main pillars** that uphold the National Green Technology Policy:

- **energy** – promoting energy efficiency and seeking energy independence
- **environment** – minimising negative effects and conserving the environment
- **economy** – enhancing the country's economy through the use of technology
- **social** – improving the quality of life for all

If we look at the four pillars above, they clearly show that Green Technology emphasises on the aspect of energy efficiency. Do you still remember the topic on energy efficiency that you studied in Form 3? **Energy efficiency** refers to the use of less energy to carry out work at the same or higher rate without affecting the production and the quality of the desired outcome.

When energy efficiency is given priority in a country through the practice of Green Technology, then:

- energy conservation can be increased
- the country's economy can be strengthened and wastage can be reduced
- wastes can be converted into a cleaner and safer form of renewable energy

Malaysia strongly supports and is committed to sustainable energy efficiency. Among the initiatives and efforts carried out in the implementation of energy efficiency are:

- the implementation of energy efficiency labels for electrical appliances (Figure 4.1)
- Green Building Index (GBI)
- energy efficiency technology campaigns
- using electricity from solar source campaigns
- consumer awareness campaigns through energy-saving practices



Figure 4.1 Energy efficiency label

My Nation



Green Building Index (GBI) is a rating system given to buildings with environmentally-friendly features. Raja Haji Fisabilillah mosque in Cyberjaya is the first mosque in Malaysia to receive this recognition.



First 'Green' Mosque
in Malaysia

<http://bukuteksssm.my/Science/F4/Pg53>

Sectors in Green Technology

Green Technology is divided into several sectors for a more focused implementation. Let us identify each sector that is involved in this Green Technology.

Energy Sector

- Focuses on the use of a cleaner and carbon-free alternative energy that can replace the use of fossil fuels. Among the examples of alternative energy is renewable energy such as hydroelectric, solar and wind.



Agriculture and Forestry Sector

- Focuses on controlling the rate of carbon dioxide in the air through agriculture and forestry. This sector also emphasises soil nutrient care and improvement in agriculture practices.

Transportation Sector

- Focuses on the improvement of a cleaner transportation infrastructure, vehicle fuel and public transportation.



Waste and Wastewater Management Sector

- Focuses on minimising waste disposal and wastewater into the environment by converting waste or wastewater into something new such as compost.





Building Sector

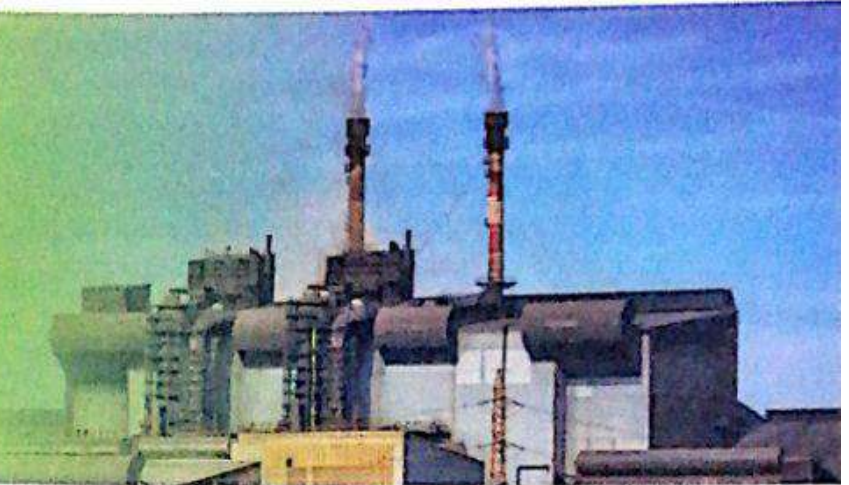
– Focuses on Green Building construction, for example the Diamond Building, which is the Energy Commission headquarters that emphasises close scrutiny of the environment and the building, use of green construction materials, efficient use of energy and water, and good solid waste management.



The Diamond Building
<http://bukutekskasrn.my/Science/F4/Pg55>

Industrial and Manufacturing Sector

– Focuses on energy efficiency and energy management programmes to reduce the negative effects of the greenhouse effect, haze and acid rain.



Information and Communications Technology (ICT) Sector

– Focuses on the practice of green ICT in the manufacturing, design, use and disposal of computer equipment. Green ICT aims to reduce the use of dangerous materials by using biodegradable materials and also to conserve energy.



Photograph 4.3 Sectors in Green Technology



FORMATIVE PRACTICE 4.1

1. What is the meaning of Green Technology?
2. State two importance of energy efficiency.
3. State the sectors that can be found in Green Technology.

4.2 Energy Sector

Socio-scientific Issues

An increase in the population growth rate raises our daily needs in all aspects. This has a direct impact on the environment and natural resources, thus causing various socio-scientific issues. **Socio-scientific issues** are open problems that are controversial social issues related to science. These issues also emphasise moral and scientific applications on real-world situations. Figure 4.2 shows several socio-scientific issues that are related to the environment.

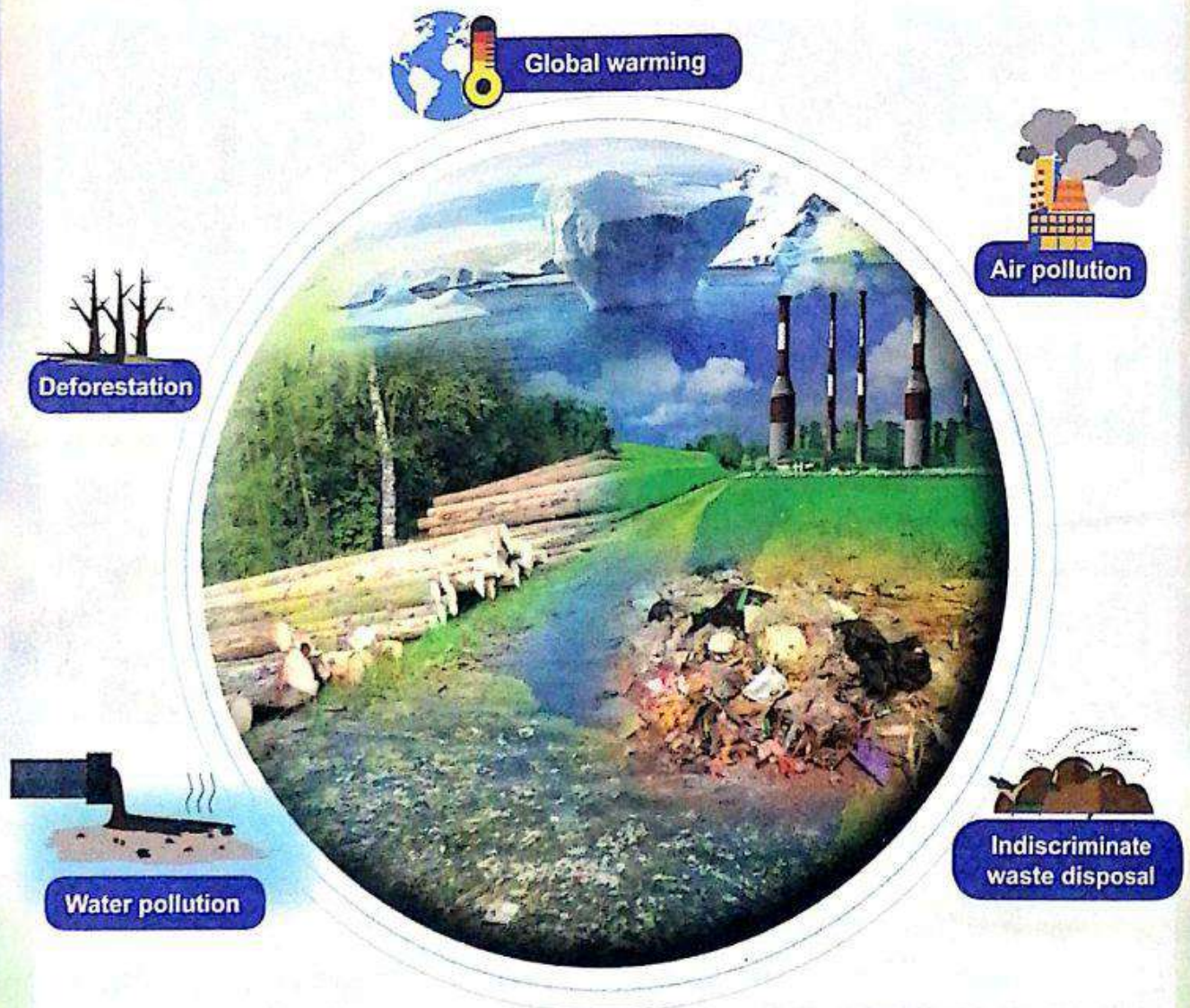


Figure 4.2 Socio-scientific issues related to the environment

Socio-scientific issues arise as a result of human activities. Emissions of greenhouse gases resulting from human activities cause climate change phenomena. The greenhouse effect causes draughts, flash floods, an increase in Earth's temperature, thunderstorms and the destruction of biodiversity.

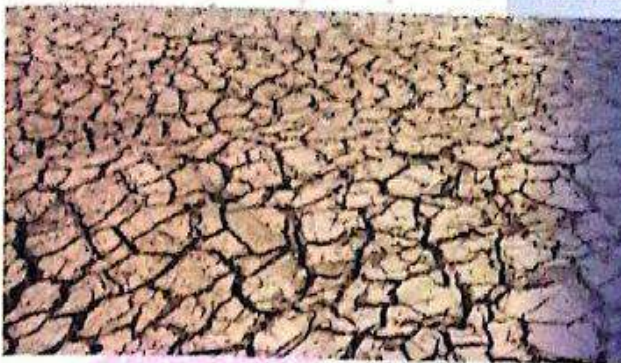
Socio-scientific Issues in the Energy Sector

Let us take a closer look at the socio-scientific issues in the energy sector.



The use of non-renewable energy sources such as petroleum, coal and natural gas increases each year according to the needs of the countries around the world. If this continues, it would not be long before fossil fuels are depleted.

The burning of fossil fuels produces greenhouse gases such as carbon dioxide in large amounts and this causes global warming to become increasingly critical.



The burning of fossil fuels causes extreme climate changes that lead to long draughts and various natural disasters.

Photograph 4.4 Socio-scientific issues in the energy sector



Activity 4.1

Result Showcase

Aim: To understand the socio-scientific issues in the energy sector.

21st Century Skills

Instructions:

1. Carry out this activity in groups.
2. Carry out active reading and discuss:
 - (a) socio-scientific issues in the energy sector
 - (b) factors that contribute to the socio-scientific issues in the energy sector
 - (c) application of Green Technology in overcoming socio-scientific issues in the energy sector
3. Present the outcome of your group discussion using a multimedia presentation.

Application of Green Technology to Overcome Socio-scientific Issues in the Energy Sector

The energy sector is the main sector in Green Technology. Two aspects that are emphasised in Green Technology for solving socio-scientific issues related to the energy sector are:

- (a) how energy is produced or supplied
- (b) efficiency in usage and distribution of energy produced

Let us look at Figure 4.3, which shows several examples of renewable energy that can be developed to replace fossil fuels.

My Nation



Kenyir Dam in Terengganu is the largest hydroelectric dam in Peninsular Malaysia. This dam controls the overflowing flood water and generates electricity for our country.

Wind energy source is a clean energy source that can replace fossil fuel in the future.

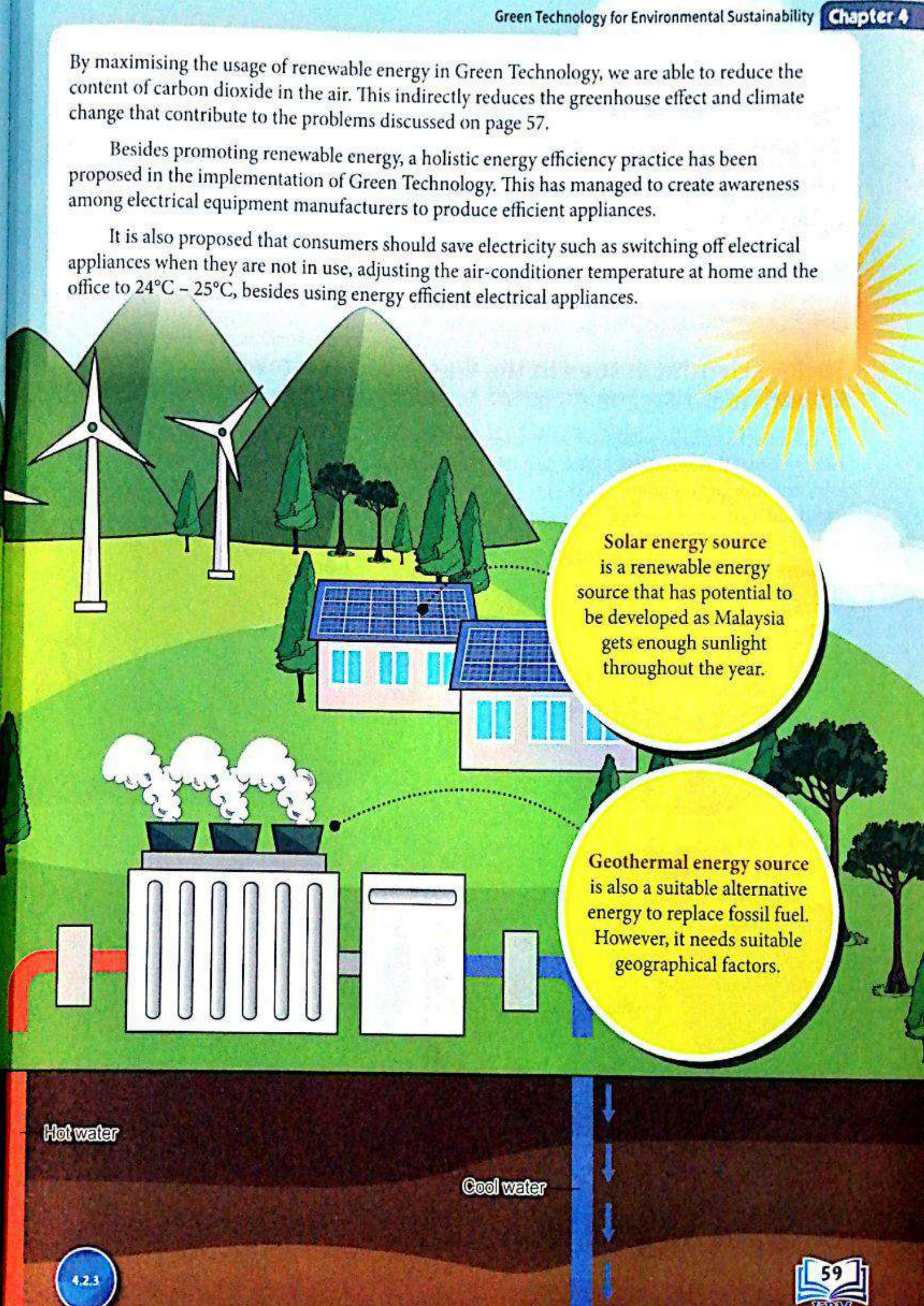
Hydro energy source is a renewable energy source that has become one of the main energy sources in the world to generate electricity.

Figure 4.3 Application of Green Technology in the energy sector

By maximising the usage of renewable energy in Green Technology, we are able to reduce the content of carbon dioxide in the air. This indirectly reduces the greenhouse effect and climate change that contribute to the problems discussed on page 57.

Besides promoting renewable energy, a holistic energy efficiency practice has been proposed in the implementation of Green Technology. This has managed to create awareness among electrical equipment manufacturers to produce efficient appliances.

It is also proposed that consumers should save electricity such as switching off electrical appliances when they are not in use, adjusting the air-conditioner temperature at home and the office to 24°C – 25°C, besides using energy efficient electrical appliances.



Solar energy source is a renewable energy source that has potential to be developed as Malaysia gets enough sunlight throughout the year.

Geothermal energy source is also a suitable alternative energy to replace fossil fuel. However, it needs suitable geographical factors.

Hot water

Cool water



FORMATIVE PRACTICE

4.2


1. State three socio-scientific issues related to the energy sector.
2. What measures should be taken to conserve energy?

→ practicing & implementing green technology

4.3 Waste and Wastewater Management Sector

Socio-scientific Issues in the Waste and Wastewater Management Sector

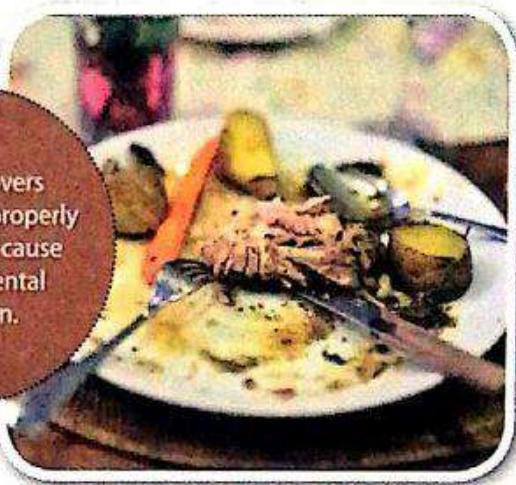
In this modern era, the public should be made more aware of solid waste and wastewater management. This is because a change in lifestyle and socio-culture, rapid development in infrastructure and economy plus the growing number of global inhabitants have increased solid waste and wastewater disposal. Let us look at these issues in more detail.




Sewage, chemical wastes and rubbish that are disposed into the rivers and seas interfere with the ecosystem of rivers, seas and the surrounding areas.



Production, management and decomposition of solid waste contribute to an increase in greenhouse gases. This causes climate change around the world.



Food leftovers that are not properly disposed of cause environmental pollution.



Around 268 million tons of paper is produced in a year. To produce 1 ton of paper only, we need 2 to 4 tons of timber. Paper is also a contributor of solid waste.

Photograph 4.5 Socio-scientific issues in the waste and wastewater management sector



Activity 4.2

Result Showcase

Aim: To understand socio-scientific issues in waste and wastewater management sector.

21st Century Skills

Instructions:

1. Carry out this activity in groups.
2. Gather information and discuss:
 - (a) socio-scientific issues in the waste and wastewater management sector
 - (b) factors that contribute to the socio-scientific issues in the waste and wastewater management sector
 - (c) application of Green Technology in overcoming socio-scientific issues in the waste and wastewater management sector
3. Present the outcome of your group discussion using a multimedia presentation.

Application of Green Technology to Overcome Socio-scientific Issues in the Waste and Wastewater Management Sector

The application of Green Technology has managed to prepare an effective platform for waste and wastewater management. It has succeeded in reducing the greenhouse effect efficiently besides saving costs. Let us look at the applications of Green Technology in waste and wastewater management.

Prevention and reduction

- Consumers are encouraged to control paper usage by recycling paper or using paper only when it is necessary.
- Consumers are advised to prepare sufficient food for the whole family in order to prevent food wastage.

Treatment and processing (biological process)

- Biological treatment process of solid waste enables waste to be converted into beneficial organic substances such as organic fertilisers.
- This process also converts solid waste into a main source of renewable energy (biomass) that is capable of replacing fossil fuel.

Sorting and recycling

- Since 2015, the government has been encouraging all households to sort their household waste. By doing this, we are able to reduce the disposal of recyclable materials while at the same time solid waste at landfills are lessened.

Refuse, Reduce, Reuse, Recycle and Recovery (5R)

- The 5R concept, which is Refuse, Reduce, Reuse, Recycle and Recovery, has been introduced to replace the previous 3R concept. The addition of the two 'R's at the beginning and at the end – 'refuse' and 'recovery' – is aimed at achieving zero waste. How do you practise the 5R concept at home?



FORMATIVE PRACTICE

4.3

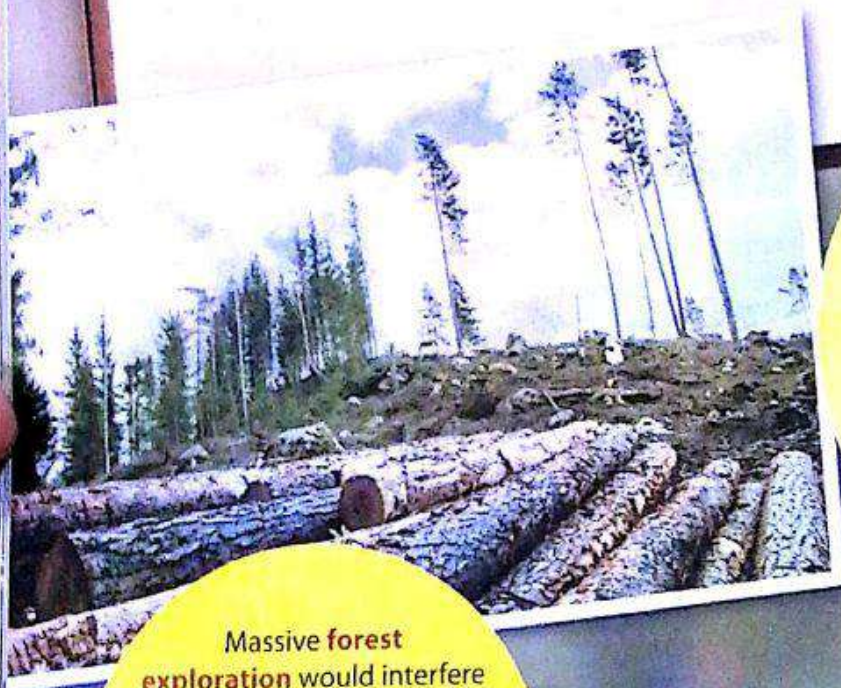
1. State two socio-scientific issues in the waste and wastewater management sector.
2. State two methods to overcome the problems in the waste and wastewater management sector.

4.4

Agriculture and Forestry Sector

Socio-scientific Issues in the Agriculture and Forestry Sector

An increase in population density and change in lifestyle are among the factors that contribute to the high demand for new settlement areas, sufficient food supply and good transportation route. At a glance, these issues are not big problems. In fact, they make our lives easier. Did you know that these issues would become a huge disaster if they are not controlled and regulated properly?



Massive forest exploration would interfere with the gas cycle of Earth. This is because forests are like the 'lungs of Earth'. The conversion of carbon dioxide into oxygen can only be done by plants during photosynthesis.

Deforestation for the purpose of development is meant for a new settlement area or agriculture. If this is not controlled and regulated properly, this would lead to landslides, floods and the extinction of flora and fauna.

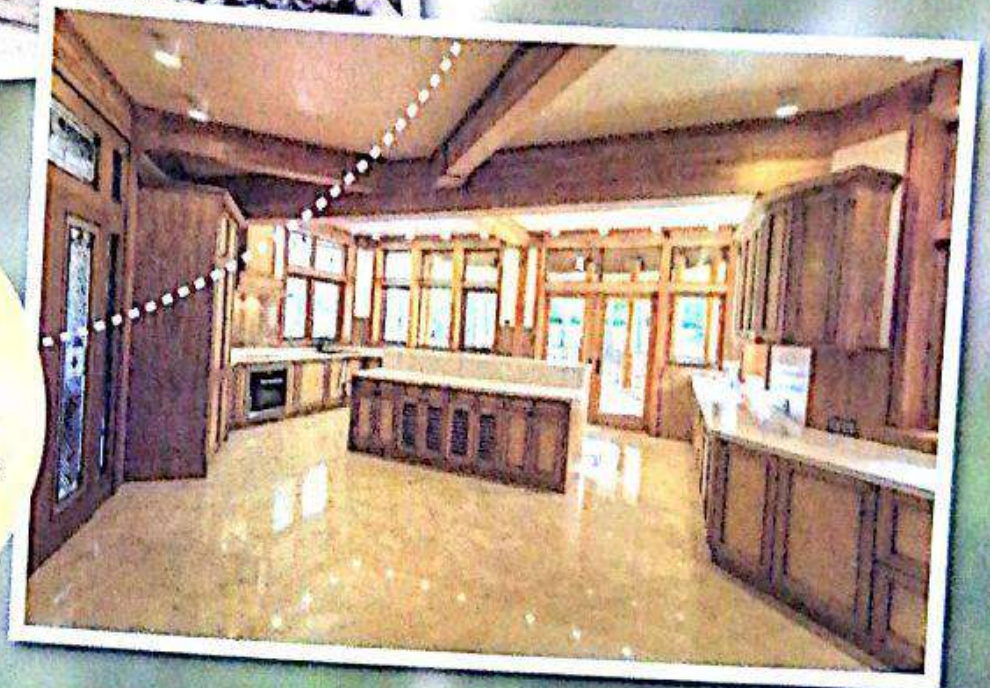
Open burning carried out by farmers on their farms can cause severe haze. If this continues, it would compromise the air quality throughout the country and neighbouring countries.

Photograph 4.6 Socio-scientific issues in the agriculture and forestry sector



Landslide on the Kuala Lumpur-Karak Highway on 11 November 2015 was believed to be caused by indiscriminate logging in Lentang Forest Reserve.

High demand for furniture and indiscriminate paper usage cause massive deforestation because furniture and paper originate from trees.



Widespread use of pesticides and chemical fertilisers cause soil pollution of agriculture land. For example, the acidity of the soil increases thus making it not suitable for agriculture.

Chemical substances absorbed by the soil would also flow into the nearby rivers. This would contaminate the rivers.





Activity 4.3

Result: 100%

21st Century Skills

Aim: To understand the socio-scientific issues in the agriculture and forestry sector.

Instructions:

1. Carry out this activity in groups.
2. Gather information and discuss:
 - (a) socio-scientific issues in the agriculture and forestry sector
 - (b) factors that contribute to the socio-scientific issues in the agriculture and forestry sector
 - (c) application of Green Technology in overcoming socio-scientific issues in the agriculture and forestry sector
3. Present the outcome of your group discussion using a multimedia presentation.

Application of Green Technology to Overcome Socio-scientific Issues in the Agriculture and Forestry Sector

We have seen several socio-scientific issues in the agriculture and forestry sector. Therefore, several measures have been introduced through Green Technology to restore the existing forests, and at the same time protect the agricultural yield.



Science Career

Forest Ranger

A forest ranger has to guard and coordinate forest development projects, factory-operation enforcement and trespassing of recreational forests. A forest ranger must also check and monitor forest operation licencing for timber-based industries, enforce the forestry law and take actions when necessary.

Treating and processing agricultural waste into compost is a Green Technology practice that is capable of controlling the balance of nature.



Replanting trees can maintain the existing species.

Logging activities have to be regulated in order to conserve forest resources. Besides that, more forest reserves have to be gazetted to maintain a balanced ecosystem in the forest.



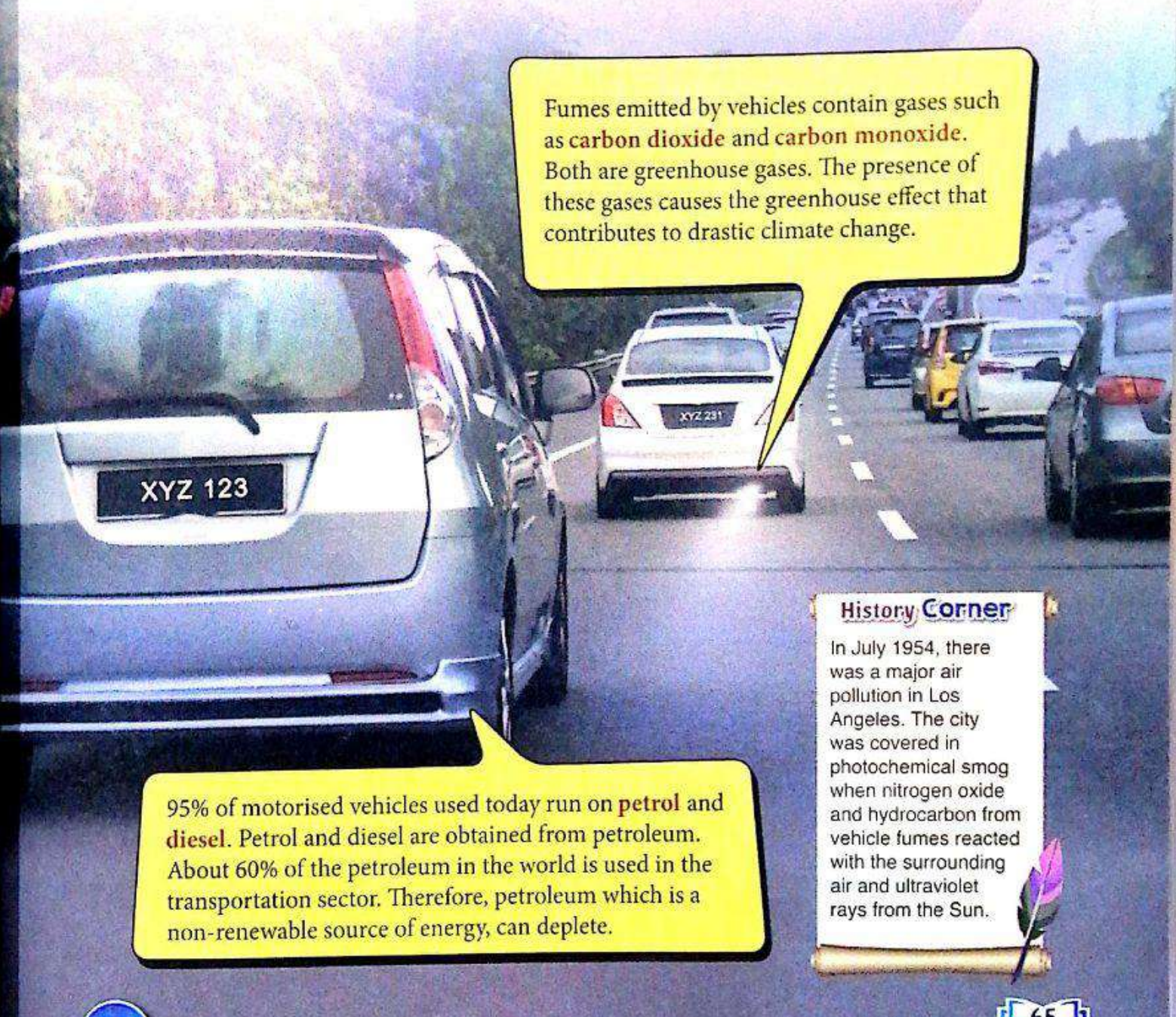
Photograph 4.7 Application of Green Technology in the agriculture and forestry sector


FORMATIVE PRACTICE
4.4

1. What causes landslides and mud floods to happen?
2. State the effect of using excessive chemical fertilisers in agriculture.
3. State two measures that can be taken to reduce deforestation.

4.5 Transportation Sector

The transportation sector is among the main sectors in Green Technology. This sector is one of the main contributors to air pollution. Let us look closely at the issues in this sector.




Fumes emitted by vehicles contain gases such as **carbon dioxide** and **carbon monoxide**. Both are greenhouse gases. The presence of these gases causes the greenhouse effect that contributes to drastic climate change.

95% of motorised vehicles used today run on **petrol** and **diesel**. Petrol and diesel are obtained from petroleum. About 60% of the petroleum in the world is used in the transportation sector. Therefore, petroleum which is a non-renewable source of energy, can deplete.

History Corner

In July 1954, there was a major air pollution in Los Angeles. The city was covered in photochemical smog when nitrogen oxide and hydrocarbon from vehicle fumes reacted with the surrounding air and ultraviolet rays from the Sun.





Photograph 4.8 Socio-scientific issues in the transportation sector

Dangerous gases emitted from vehicles can cause acid rain. Acid rain destroys plants, corrodes buildings and irons, and damages tyres on vehicles.



Activity 4.4

Result Showcase

21st Century Skills

Aim: To understand socio-scientific issues in the transportation sector.

Instructions:

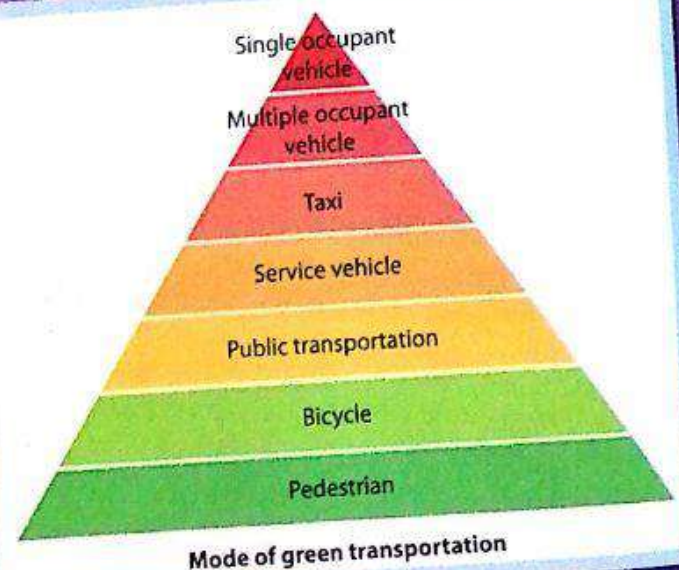
1. Carry out this activity in groups.
2. Gather information and discuss:
 - (a) socio-scientific issues in the transportation sector
 - (b) factors that contribute to the socio-scientific issues in the transportation sector
 - (c) application of Green Technology in overcoming socio-scientific issues in the transportation sector
3. Present the outcome of your group discussion using a multimedia presentation.

Application of Green Technology to Overcome Socio-scientific Issues in the Transportation Sector

Issues in the transportation sector need holistic awareness from everyone. Through Green Technology, efforts in preventing air pollution whilst ensuring sustainability of life can be implemented well. Let us look at the measures and efforts taken in Green Technology.

Green Transportation

Green transportation refers to any form of transportation that releases very minimal greenhouse gases or none at all. For example, vehicles that use renewable energy. Among the forms of green transportation are walking, cycling and using green vehicles.



Invention of Natural Gas Vehicle (NGV)

Natural gas vehicles use either liquefied natural gas (LNG) or compressed natural gas (CNG). Today, vehicles that rely on petrol can be modified to use LNG or CNG.



Biofuel as an alternative for petroleum

Malaysia has begun using biofuel. Biofuel is an alternative source that refers to fatty acid methyl ester that is produced from plant oils and animal fats. It is obvious that this is a renewable energy source and it is more environmentally-friendly.



Photograph 4.9 Application of Green Technology in the transportation sector

Science Gallery

The Melaka State Government is very committed to the application of Green Technology in the state. Melaka has begun using electric buses to transport passengers around the city. Visit the website below or scan the QR code to know more about the electric buses in Melaka.



Electric Buses in Melaka
<http://bukutekskssm.my/Science/F4/Pg67>



1. State the consequences if the number of vehicles using fossil fuel increases.
2. Biofuel is _____ that is produced from _____ and _____.

4.6 Green Technology and Life

Role of Individuals in Managing Global Warming and Climate Change in order to Reduce Carbon Footprint

Global warming and drastic climate change issues are the hot topics of discussion throughout the world. Severe consequences of global warming await us if the global community fails to realise the effects of rapid development without considering our surroundings. Therefore, what should we do to address this issue?

We tend not to realise that activities we carry out every day increase carbon footprint. **Carbon footprint** is the amount of greenhouse gas, such as carbon dioxide, released into the atmosphere as a result of human activities such as open burning and burning of fossil fuels (Figure 4.4). Therefore, we should apply Green Technology in our life so that we can reduce the amount of carbon dioxide that is being released into the environment and hence, reduce carbon footprints at the same time.

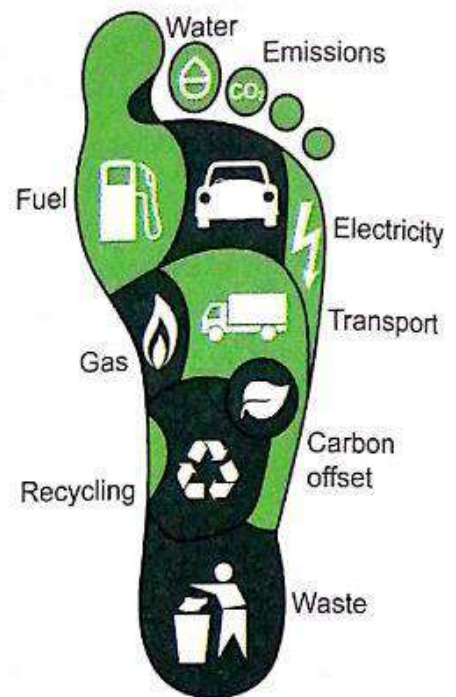


Figure 4.4 Carbon footprint



Low Carbon Footprint could Reduce the Impact of Climate Change

<http://bukuteksssm.my/Science/F4/Pg68>

INFORMATION



Photograph 4.10 Students participating in an exhibition of green city design innovation in conjunction with the International Greentech and Eco Products Exhibition and Conference (IGEM) in Kuala Lumpur

Activity 4.5

STEM Project

Aim: To implement awareness campaigns through the Internet on issues pertaining to global warming and climate change phenomena.

Instructions:

1. Carry out this activity in groups to study the following statement.

The phenomena of global warming and climate change is plaguing our world now and need to be given serious attention. The phenomena have resulted in many extreme effects on Earth. It is therefore important that we reduce these problems by applying our knowledge on Green Technology to ensure environmental sustainability for the future generations.

2. Discuss and gather relevant information from academic journals or websites.
3. Create an online awareness campaign to overcome global warming and climate change phenomena for the sustainability of living things on Earth.

FORMATIVE PRACTICE 4.6

1. The figures below show the activities carried out by Mariam and her father.



What are the advantages of the activities carried out by them? Explain your answer by using the Green Technology concept.

2. In your opinion, what is the effect on the environment when we implement Green Technology?

GREEN TECHNOLOGY FOR ENVIRONMENTAL SUSTAINABILITY

Definition of Green Technology

Socio-scientific issues

Transportation Sector

- Socio-scientific issues
- Increase in the number of vehicles
 - Production of vehicle fumes that contain dangerous gases

Application of Green Technology

- Practice of green vehicle mode
- Use of biofuel

Sectors in Green Technology

Agriculture and Forestry Sector

- Socio-scientific issues
- Uncontrolled forest exploration
 - Use of pesticides and chemical fertilisers

Application of Green Technology

- Recycling
- Usage of compost
- Replanting

Waste and Wastewater Management Sector

- Socio-scientific issues
- Indiscriminate waste disposal
 - Release of greenhouse gases

Application of Green Technology

- 5R practice
- Biological treatment and waste processing

Energy Sector

- Socio-scientific issues
- Use of non-renewable energy sources
 - Burning of fossil fuels

Application of Green Technology

- Renewable energy sources
- Energy efficiency

Information and Communications Technology Sector

Building Sector

Industrial and Manufacturing Sector

Self-reflection

After studying this chapter, you are able to:

4.1 Environmental Sustainability

- Define and justify Green Technology in life.
- Relate the energy efficiency to Green Technology.
- Identify sectors in Green Technology.

4.2 Energy Sector

- Describe socio-scientific issues.
- Explain socio-scientific issues in the energy sector.
- Justify the application of Green Technology to overcome socio-scientific issues in the energy sector.

4.3 Waste and Wastewater Management Sector

- Explain socio-scientific issues in the waste and wastewater management sector.
- Justify the application of Green Technology to overcome socio-scientific issues in the waste and wastewater management sector.

4.4 Agriculture and Forestry Sector

- Explain socio-scientific issues in the agriculture and forestry sector.
- Justify the application of Green Technology to overcome socio-scientific issues in the agriculture and forestry sector.

4.5 Transportation Sector

- Explain socio-scientific issues in the transportation sector.
- Justify the application of Green Technology to overcome socio-scientific issues in the transportation sector.

4.6 Green Technology and Life

- Justify the role of individuals in addressing the phenomena of global warming and climate change in reducing carbon footprint.

Summative Practice 4



QUIZ

Objective Questions
<http://bukutekskssm.my/Science/F4/Q4>

1. Read the extract below.

Green Technology practices proposed in the National Green Technology Policy have been infused in lessons at schools. The awareness of environmental sustainability through Green Technology should be inculcated from a young age.

Based on the extract above:

- (a) what is meant by Green Technology?
- (b) state the four pillars of the National Green Technology Policy.

2. The statement below explains energy efficiency.

Energy efficiency is using less energy to carry out work at the same or higher rate without affecting the production and the quality of the desired outcome.

Based on the statement above:

- (a) state the importance of energy efficiency in everyday life.
- (b) give an energy efficiency practice that you can carry out at home. Explain your answer. 🧠
3. The following statement is pinned on the school noticeboard.

In order to enable a holistic implementation of Green Technology practices, several sectors have been created for a more direct and focused implementation.

- (a) State three sectors found in Green Technology.
- (b) Explain each sector mentioned in question 3(a).
4. Photograph 1 shows a socio-scientific issue in the energy sector.




Photograph 1

- (a) State the effects of the issue on the environment.
- (b) Suggest two methods to overcome the issue through Green Technology. 🧠
- (c) State one advantage of using Green Technology in overcoming the issue.
- (d) Do you agree that the use of Green Technology in our life reduces environmental pollution? Justify your answer. 🧠

5. Read the statement below.


- Fumes from vehicles that use fossil fuel are among the main contributors to the increase of carbon dioxide in the air.
- Acid rain destroys forests and corrodes metal and concrete.

- (a) Explain the transportation sector in Green Technology practices.
- (b) Explain two appropriate measures that can be taken in the transportation sector to overcome the issues mentioned in the statement. 

Mind Challenge

6. Azman likes farming. He decides to plant mustard in one corner of his house. However, he does not have a suitable container for planting.

Help Azman to plan how to recycle materials at his home to solve his problem.

You can use labelled sketches to support your answer. 

Materials:

Handwriting practice area with five horizontal lines for writing.

Sketch:

Large empty rectangular box for drawing a sketch.