Chapter 8

Energy: A World of Alternatives

The nature of energy

Viewed through a geographer's eyes, the vastness of the world can be **spatially** organised in a logical way. One vital component, energy, has influenced the world in the past and present and, most importantly, will play a vital role in determining the future. It is the geographer's role to understand the importance, availability and vulnerability of energy in order to ensure a secure future for us all.

What is energy?

The actual definition of exactly what energy is and consists of can vary considerably. It depends upon how the source of the energy is seen and the background of the researcher, whether they be scientist, historian or geographer. Generally speaking, energy is the basis of all life, movement and progress; that is, it makes everything happen. It is part of our everyday activities and living, and can occur in many forms. Scientific definitions usually state that **energy** is the ability to do work, to produce movement, heat and light.

The **Sun** is our greatest energy source, giving heat and life to our planet.

Throughout the history of the human being, the use of energy has involved the need to control it. These demands for energy have changed over time as our dependence and knowledge have also increased, and as our ability to control energy has also improved.

In scientific terms, energy can exist in a number of forms. Many

Figure 8.1 A simple example of energy transfer

of these are related and often involve some sort of **energy transfer** (see Figure 8.1). Examples of these energy types are:

- **(M) Mechanical**: motion involved (for example, a car moving).
- **(T) Thermal**: heat we can feel and see (for example, hot air balloon, Sun for warmth, and friction).
- **(L) Light**: Sun for radiant heat and light, indirect in the form of **photosynthesis** in plants and direct in the form of a **solar cell**.
- **(C) Chemical**: energy of living things (for example, photosynthesis, fossil fuels) that involves change.
- **(E) Electrical**: movement of electrons, limitless use (for example, light globes and appliances).
- **(N) Nuclear**: involves changing matter, reaction between atoms, complex and sometimes dangerous.

Therefore a basic energy transfer could be: burning wood (C) creates heat (T) and light (L).

Many energy transfers are more complex and are usually dealt with in more complicated physics and chemistry texts. In order to understand the nature of energy and our constant need to control and change it, the scientific background should also be explained. In the true science of energy, there exists a **Law of Conservation of Energy**. This means that the amount of energy in the universe is fixed and cannot be created or destroyed. Thus energy cannot be used up, only changed from one form to another. In addition, all forms of energy can be classified in terms of being **kinetic** (actually moving) and **potential** (stored energy).

The uses of energy

Despite all the classifications, types, definitions and history of energy, the simple fact remains, that in order to use energy's potential for our gain, we must be able to **control** it. Today we use energy in many ways:

- **Industry** (heating fires, power for production and processing) 37%
- **Transportation** (moving people and goods) 27%
- **Housing** (heating, light and other electrical appliances) 22%
- **Commerce** (heat and light for offices and machinery) 14%

EXERCISE 1

OPTION A

1 a Think of as many ways that you use energy in one day. Classify them by type and list in order of importance. Indicate the areas that also may involve some energy wastage.

b What conclusions can you draw from your classifications?

2 From the data above, draw a pie graph showing our energy use in society. What does this tell you about our society's reliance on energy and potential for the future?

3 Figure 8.2 shows a series of energy sources and their purposes. Place these into sequence according to their level of sophistication and development over time.

OPTION B

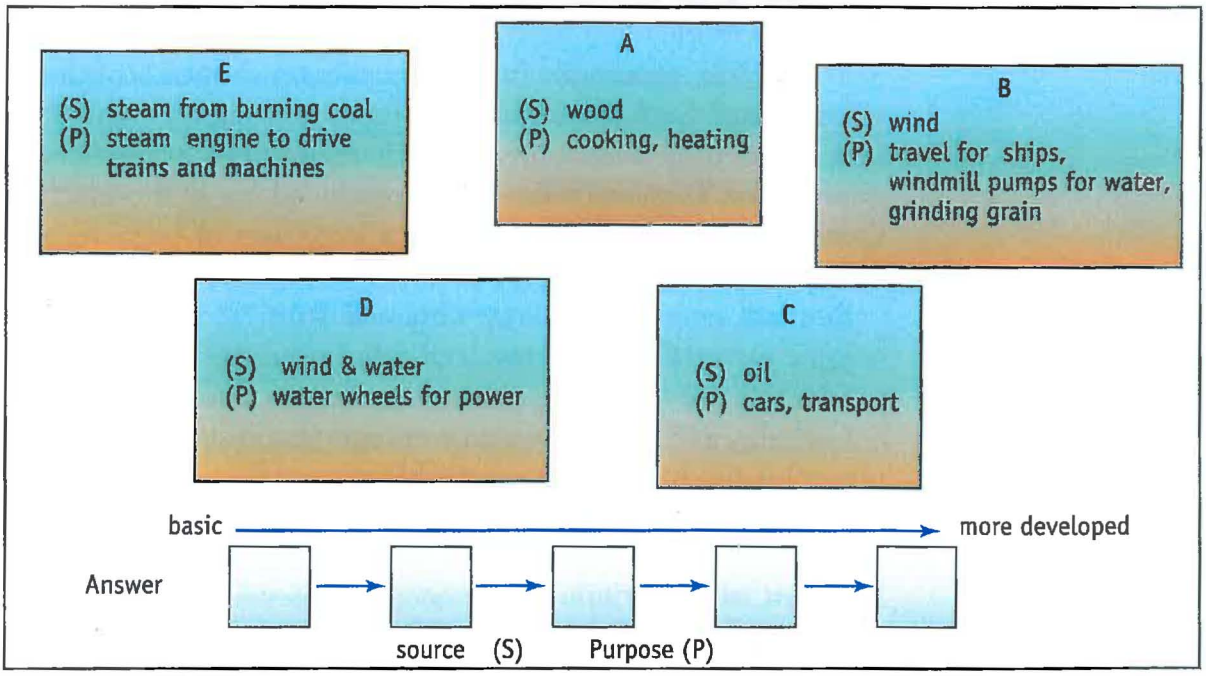
Research some of the early energy sources found in Figure 8.2 and explain how they worked. Determine how the **spatial distribution** of energy use varies throughout the world. Were any specific regions more dominant in their discovery and use of energy sources? Why?

> See **Skill Sheet 10** for an explanation of spatial distribution.

OPTION C

Explore, by means of an essay, the idea that 'Energy is the heart of progress'.

Figure 8.2 Energy sources and their purposes



Types of energy

Energy can be classified into several groups, according to their sources, availability and location.

Renewable energy

Renewable energy comes from sources which are able to produce an unlimited supply of energy. This unlimited supply may be because the energy source replenishes itself quickly or because there is a limitless supply of the energy and its raw materials. Common types of renewable energy include solar, wind, hydro-electricity, geothermal, biomass and tidal.

Although it seems relatively easy to obtain figures relating to energy usage (especially non-renewable energy), we rarely take into account some renewable energy, such as the energy used when we walk, ride, swim or carry out any sort of physical activity. This occurs even though the energy we are using is **stored** solar energy, obtained from the food we have eaten. Another type of renewable energy which is difficult to measure is the solar and wind energy which is used to dry clothes. These types of energy usage are rarely accounted for because they are much more difficult to measure.

In Australia, renewable fuels only make up about 5% of the total energy usage. Each State's usage of renewable energy sources relies heavily on their availability in each region. For example, three-quarters of Tasmania's energy is produced by hydro-electricity. Queensland, on the other hand, is a large user of **bagasse**, a type of biomass energy.

Biomass energy is energy obtained from the combustion of organic material left as a result of other processes. Bagasse is a by-product of the sugarcane industry.

Globally, 18% of the world's energy (excluding hydro-electric power) is produced from renewable resources.

Non-renewable energy

Between 94% and 96% of our energy comes from non-renewable energy sources. These include oil, natural gas, nuclear and coal. All

Table 8.1 The potential long-term future contribution of renewable energy in Australia

Technology	*Potential long-term future contribution in Australia*
Solar heat	
Various drying (salt, clothes, etc.)	Large
Passive solar buildings	Intermediate
Domestic hot water	Intermediate
Residential heat	Intermediate
Industrial heat	Intermediate
Solar electric	
Photovoltaics—flat panels	Large
PV concentrators	Large
Solar thermal-parabolic troughs	Large
Parabolic dishes	Large
Central receivers	Intermediate
Other electrics	
Hydro	Intermediate
Wind	Intermediate
Ocean thermal currents	Small
Tidal	Small
Geothermal	Intermediate
Wave	Intermediate
Fuels	
Biomass for burning (wood, bagasse)	Small
Biomass for alcohol fuels (especially ethanol)	Intermediate
Hydrogen	Small
Energy storage	
Batteries—standard	Small
—advanced	Intermediate
Rock beds	Intermediate
Liquid salt, oil, etc.	Intermediate
Chemical reactions	Intermediate
Hot water storage	Intermediate

Source: Australian Bureau of Statistics, *Australians and the Environment*, 1996, cat. no. 4601.0

of these types of energy have limited life spans before they become so scarce that they cannot be processed economically or they run out.

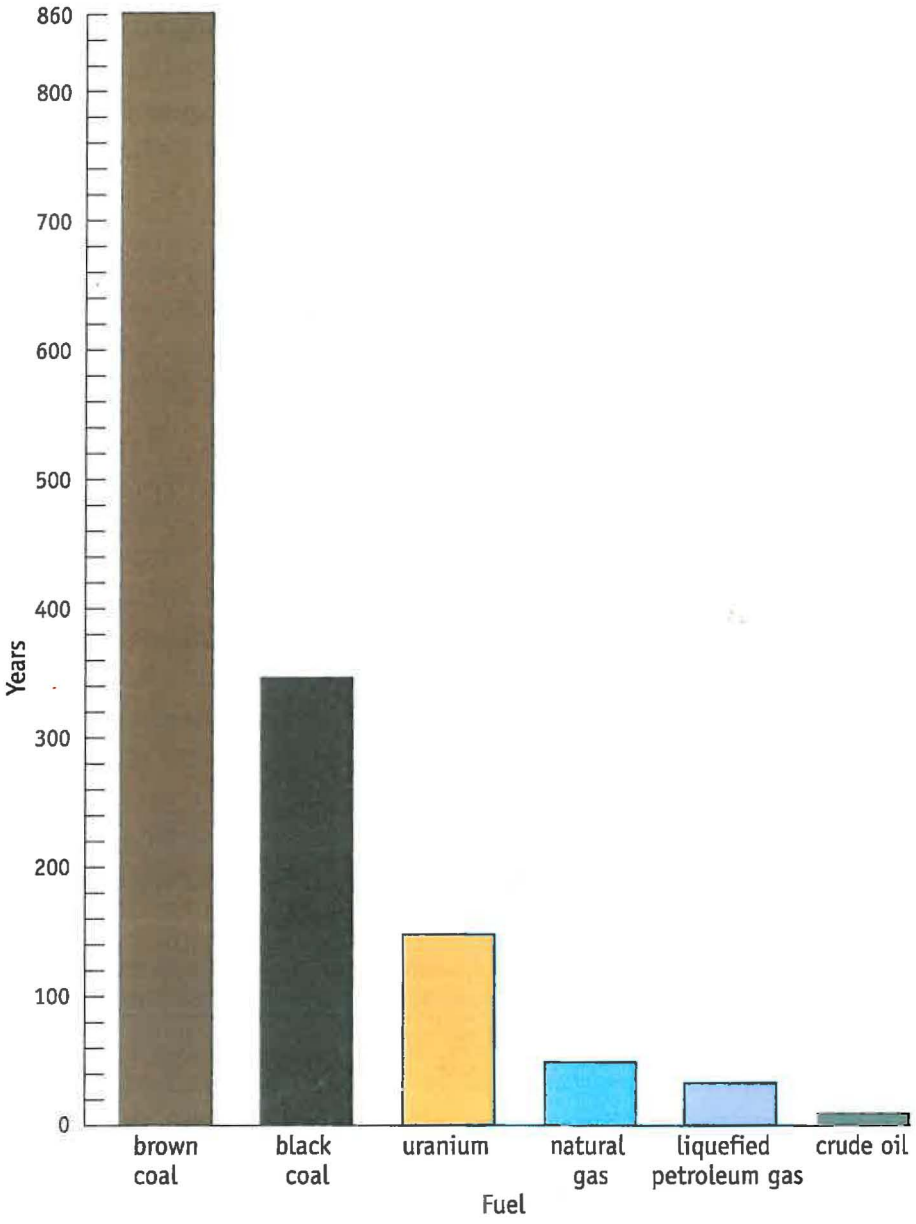


Figure 8.3 Life expectancy of energy reserves in Australia

Non-renewable fuel is currently a readily available energy source for Australians because we have large reserves. The most commonly used fuel reserve in Australia is crude oil, followed by black coal and natural gas. Australia produces a lot more non-renewable energy than it can use, which has meant that we are able to sell it to other countries. In 1993–94 about 71% of Australia's production was exported and black coal was a major export.

Table 8.2 Energy consumption in Australia, 1993–94 by type

Purpose	*Coal and products*	*Briquettes*	*Wood*	*Bagasse*	*Crude oil*	*Petroleum products*	*Natural gas*	*Town gas*	*Electricity*	*Solar*	*Total*
	Pj	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*	*Pj*
Agriculture						53.1	0.1		9.1		62.3
Mining	82				0.6	43.0	106.1		38.2		196.1
Iron and steel	52.6					1.6	23.1		19.0		96.3
Chemical	10.2	3.4				47.3	55.7		13.5		130.1
Other industry	101.6	4.1	24.9	84.5		60.9	228.5		174.5		679.0
Construction						42.5	0.2		0.1		42.8
Road transport						848.7	1.2				849.9
Rail transport						23.3			6.2		29.5
Air transport						144.5	0.4		0.4		145.3
Water transport	3.8					43.1	0.1		0.6		47.7
Commercial	2.3		1.7	0.6		13.1	39.7	0.7	111.0		169.1
Residential	0.1		0.2	81.6		16.5	98.7	1.5	148.3	2.4	349.3
Lubricants, greases, bitumen and solvents						56.0					56.0
Total energy consumption	**178.9**	**7.5**	**9.4**	**107.1**	**0.6**	**1393.8**	**553.8**	**2.3**	**520.9**	**2.4**	**853.5**

Source: Australian Bureau of Statistics, *Australians and the Environment*, 1996, cat. no. 4601.0

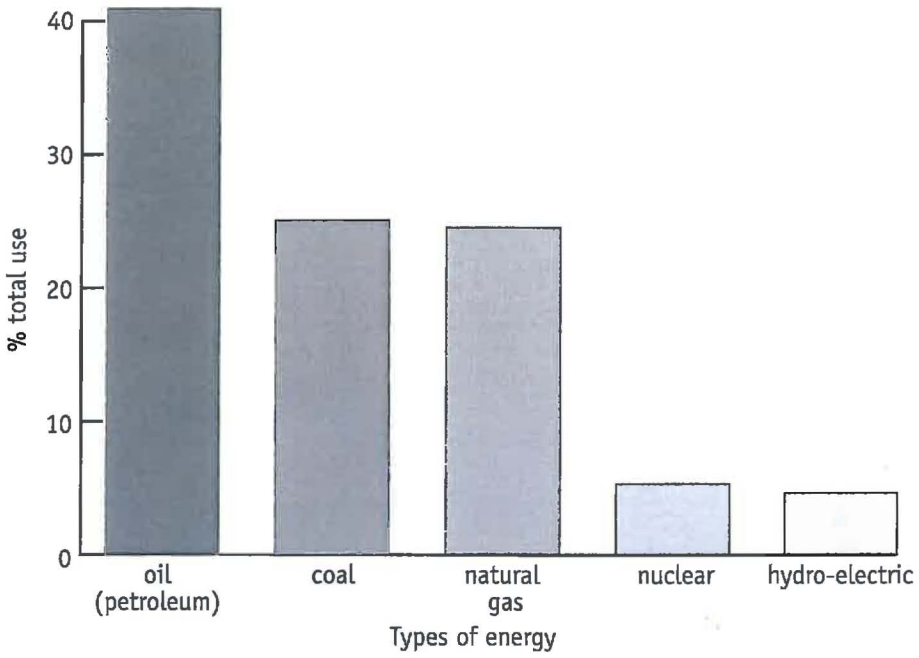
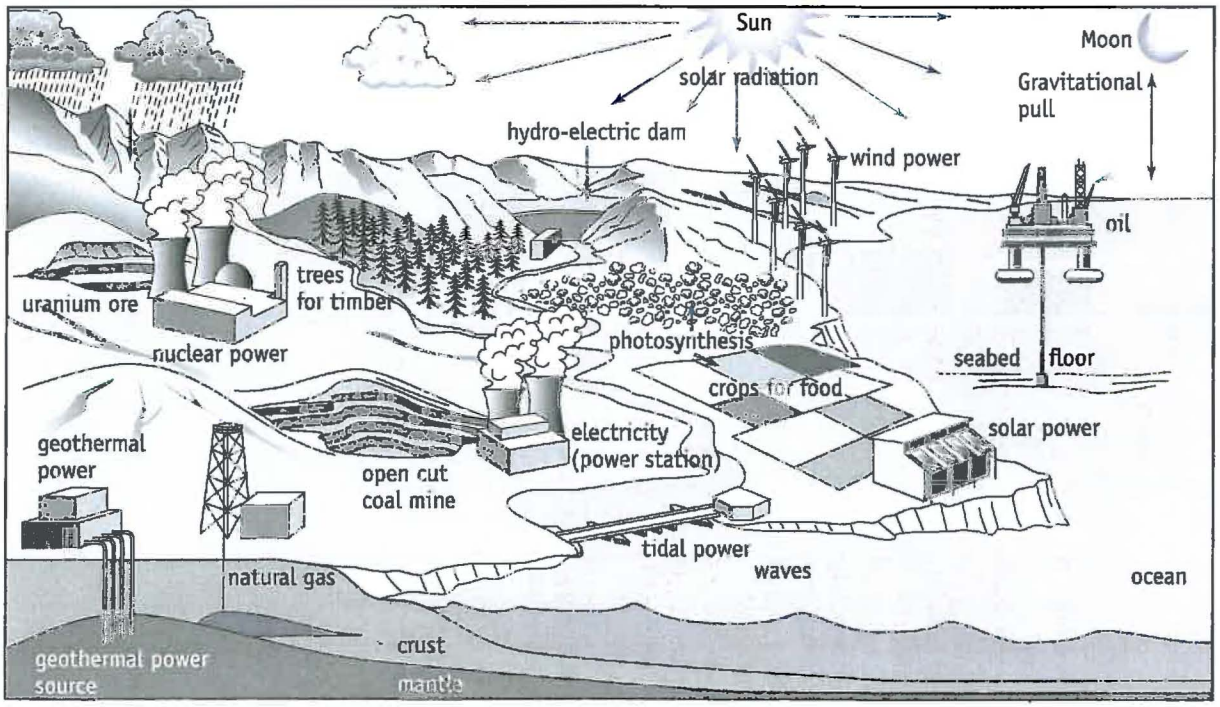


Figure 8.4 World energy use by type of consumption

EXERCISE 2

OPTION A

Figure 8.5 The world's resources of energy



EXERCISE 2 (cont.)

1 Using Figure 8.5 as a guide and all the above information on the classification of energy sources, create a simplified **concept diagram** of all the energy resources. It might be useful to include a colour code to aid in the classification system. Figure 8.6 could be used as a starting point.

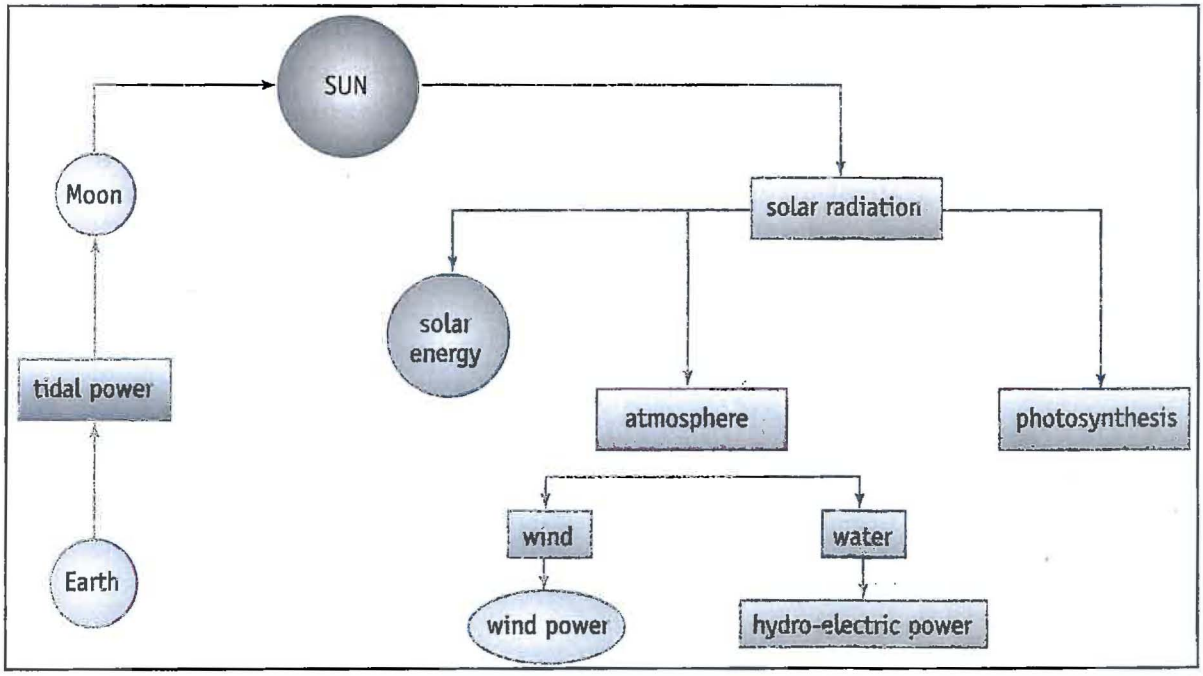


Figure 8.6 Concept diagram—a starting point

See **Skill Sheet 6** for ideas on concept maps.

2 What does all this information reveal about the importance of energy in our lives?

OPTION B

1 List all the types of activities you can think of which are rarely measured for energy usage.

2 Design methods to measure the amount of energy which is used in each situation.

OPTION C

Using the information in Figure 8.2, answer the following questions.

1 For each purpose shown, list the main source of energy.

2 How many of these end uses depend on a renewable source of energy?

3 What are the implications for the future of such heavy usage of non-renewable fuels?