

# *UNIT ELEVEN*

## Alternative sources of energy



## Pre-reading task

Work in pairs to answer the following questions before you read the text below.

- ❖ What are some of the most common sources of energy worldwide today?
- ❖ To what extent is each source of energy used?
- ❖ Is the situation likely to change in the future?

### Reading 1

Read the text below to check your answers to the questions of the pre-reading task.

#### Energy consumption worldwide

**T**his is how the energy consumption has evolved since 1925. Coal was the most widely-used fuel before the middle of the 20th century. However, since the 1950s the use of coal has *declined* rapidly, while oil and natural gas have gradually replaced it as the main energy source. They now provide more than half of the world industrial energy supplies. The use of hydroelectricity grew between 1925 and 1955, but since then it has stayed at a figure of 2%.

Nuclear power provided only a *fraction* of the industrial energy supplies in 1970, but it now meets 6% of the need (Fig. 1).

In the last 60 years the world's industrial energy demand has increased at least by 1000%, and this trend is likely to continue. Since fuels such as oil and gas will run out during the next 40 years, we will have to find new ways of getting the energy we need. The *energy pie* of 2025 will probably include a large slice of solar power, wind energy and *biomass*.

Source: Adapted from <http://www.eia.doe.gov/oiaf/ieo/index.html>

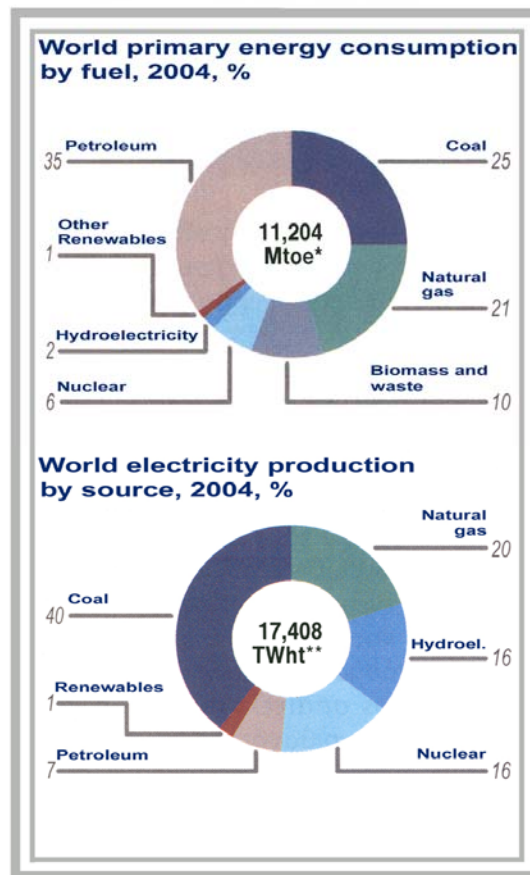


Fig. 1: World primary energy consumption by fuel and World electricity production by source

\* Millions of tonnes of oil equivalent

\*\* Terawatt hour

Renewables include biomass, waste, wind energy, geothermal energy and solar energy

Hydroel. = Hydroelectricity

## ➔ Reading task 1

Decide whether the following statements are **true** or **false**. If false, make the appropriate corrections.

1. Coal is the most widely-used fuel nowadays.
2. Nuclear power provides 6% of the worldwide demand for energy.
3. Biomass will eventually run out during the next 40 years.
4. Natural gas and hydroelectricity provide more than half of the world industrial energy supplies.

1. .... 2. .... 3. .... 4. ....

## Word study

*Rearrange the letters in capitals so as to complete the sentences.*

1. Though experts agree the world faces an alarming challenge in finding nonpolluting energy sources, research into new technology has .....

**CLIDEDEN**

2. Natural gas remains the fastest growing component of primary world energy .....

**STOPINNOCUM**

3. Russian gas export monopoly Gazprom warned European customers of a potential shortage in gas ....., as it has hit a deadlock in a pricing dispute with Ukraine

**PLESUIPS**

4. Natural ..... is an attractive petroleum alternative because it is a renewable resource that is more evenly distributed over the Earth's surface than finite energy sources, and may be exploited using more environmentally friendly technologies.

**BASOIMS**

5. Commercial and industrial uses of renewable energy changed little between 2006 and 2007 and have also changed little as a ..... of total renewable consumption since 2003.

**FOICTRAN**

## ➡ Reading task 2

*Look at the graph below illustrating the energy consumption in the United States from 1650 till 2000. Then read the relevant passage that follows. Complete the gaps in the passage using information from the graph. Three words are used twice.*

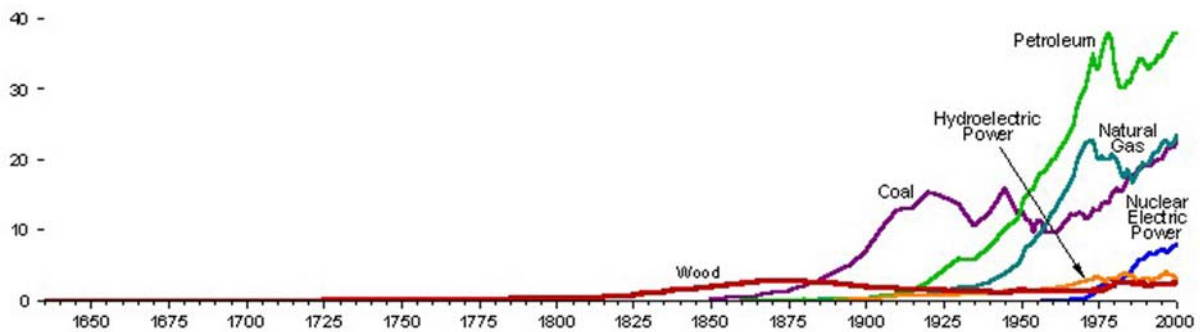


Figure 2. U.S. Energy Consumption By Energy Resource 1635-2000 (in Quadrillion Btu)

petroleum (2)	nuclear	natural gas (2)
wood	coal (2)	hydroelectric

### Energy sources in the United States

From its founding until the late 1800s, the United States was a largely agrarian country with abundant forests. During this period, energy consumption overwhelmingly focused on readily available firewood. Rapid industrialization of the economy, urbanization, and the growth of railroads led to increased use of 1. ...., and by 1885 it had eclipsed 2. .... as the nation's primary energy source. Coal remained dominant for the next seven decades, but by 1950, it was surpassed in turn by both 3. .... and 4. .... While coal consumption today is the highest it has ever been, it is now mostly used to generate electricity. 5. ...., which is cleaner-burning and more easily transportable, has replaced 6. .... as the preferred source of heating in homes, businesses and industrial furnaces. At the beginning of the 20th century, 7. .... was a minor resource used to manufacture lubricants and fuel for kerosene and oil lamps. One hundred years later it had become the preeminent energy source for the U.S. and the rest of the world. This rise closely paralleled the emergence of the automobile as a major force in American culture and the economy. While petroleum is also used as a source for plastics and other chemicals, and powers various industrial processes, today two-thirds of oil consumption in the U.S. is in the form of its derived transportation fuels. In the 1970s and 1980s hydroelectric and 8. .... resources began to become more important. By the year 2000, the U.S. had moved away from absolute predominance of one particular resource to a complex mix of fossil fuels, 9. .... and nuclear resources although fossil fuels still far exceeded any other source.

Source: Adapted from [http://en.wikipedia.org/wiki/Energy\\_use\\_in\\_the\\_United\\_States](http://en.wikipedia.org/wiki/Energy_use_in_the_United_States)

## Pre-reading task

Match the terms on the left with their definitions on the right.

1. geothermal	a. the regular rise and fall in the surface level of the Earth's oceans, seas, and bays caused by the gravitational attraction of the moon and to a lesser extent of the sun
2. fuel cell	b. a fine-grained black or dark brown shale containing hydrocarbons in the form of kerosene
3. viable	c. of or relating to the internal heat of the Earth
4. oil shale	d. a cell in which chemical energy is converted directly into electrical energy
5. tide	e. capable of success or continuing effectiveness, practicable

1. ....	2. ....	3. ....	4. ....	5. ....
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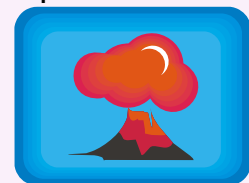
## Reading 2

Read the text below to check your answers to the pre-reading task.

### Alternative energy sources - Part I: Geothermal and ocean power

In light of the reserves available and the pessimistic projections, it is apparent that alternative energy sources will be required to sustain the civilized societies of the world in the future. The options are indeed few, however, when the massive energy requirements of the industrial world come to be appreciated. Commercial *oil shale* recovery and the production of a synthetic *crude oil* have yet to be demonstrated successfully, and

serious questions exist as to the competitiveness of production costs and production volumes that can be achieved by these potential new sources. Although alternative energy sources, such as *geothermal* energy, *solar* energy, *wind* power, *ocean* power, *biomass*, *fuel cells* and *nuclear* energy, hold much promise, none has proved an economically *viable* replacement for petroleum products.





## Energy Alternatives: Geothermal and Ocean power

Three other renewable energy sources may play an important part in the next century's energy system.

### GEOTHERMAL

Geothermal heat, found deep in the Earth's *crust*, can be captured for direct heating, or it can be used to generate electric power. Some 8000 megawatts of electricity around the world are currently generated from geothermal energy, a tiny fraction of global electrical production. The world's largest geothermal energy complex is located at The Geysers in northern California. Iceland sits atop a massive *volcanic system*, and geothermal energy heats most of the country's homes. Although the potential to *tap* geothermal energy around the globe is almost without limit, in many regions



adequate heat to generate electricity lies 5 km or more beneath the Earth's surface. Drilling holes to access that heat can be prohibitively expensive.

### OCEAN POWER

Scientists are also looking at ways to tap the energy *embodied* in the ocean's *tides*, waves, currents, and *temperature differentials*. Two sizeable tidal power installations are currently in place, including a facility in Nova Scotia's Annapolis Basin that has been in service since 1984. Some researchers believe the most promising of these ocean energy technologies is ocean thermal energy conversion (OTEC), a process that uses temperature differences in the ocean to create electricity. The process works by *capturing* the heat differential between the warm water on the ocean's surface and the colder water below to drive a generator. This technology is still at an experimental stage.

Source: Adapted from Microsoft Encarta Student 2009 DVD



Fig. 3:  
Geothermal  
activity in  
Hveragerdi,  
Iceland

## ➔ Reading task

*Read the text again and complete the sentences.*

1. The heat that is found deep in the Earth's crust and that can be captured for direct heating is called...

.....

2. Drilling holes to access geothermal heat can be extremely...

.....

3. Examples of alternative energy sources are...

.....

4. Scientists are developing ways to exploit the energy embodied in the ocean's...

.....

## Word study 1 – Vocabulary building

*Using your dictionary, complete the following table with the correct word forms which can also be found in Reading 2.*

	Verb	Noun	Adjective
1.	to .....	.....	civilized
2.	to .....	.....	recoverable
3.	to .....	competitiveness	.....
4.	to .....	alternation	.....
5.	to experiment	.....	.....
6.	to tide	.....	.....
7.	to promise	.....	.....



## Word study 2

Connect the words in the left hand column with those on the right to form collocations which appear in the two previous texts.

1.	crude	A.	societies
2.	geothermal	B.	differentials
3.	volcanic	C.	oil
4.	temperature	D.	consumption
5.	pessimistic	E.	energy
6.	energy	F.	projections
7.	civilized	G.	system

1. ....	2. ....	3. ....	4. ....
5. ....	6. ....	7. ....	—

## Pre-reading task

Match the terms on the left with their definitions on the right.

1. crop	<i>a. an increase in the density of something s</i>
2. to subsidize	<i>b. to put or use a thing in place of another</i>
3. hull	<i>c. cultivated plants or agricultural produce, such as grain, vegetables, or fruit, considered as a group</i>
4. waste	<i>d. the outer membranous covering of some fruits or seed</i>
5. concentration	<i>e. any materials unused and rejected as worthless or unwanted</i>
6. to substitute	<i>f. to support materially or financially</i>

1. ....	2. ....	3. ....	4. ....	5. ....	6. ....
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## Reading 3

Read the text below to check your answers to the pre-reading task.

### Alternative energy sources - Part II: Biomass

**B**iomass provides another ready source of renewable energy. Agricultural wastes, ranging from *sugarcane bagasse* (the pulpy waste remaining after the cane is crushed) to *rice hulls*, can be burned directly or turned into *combustible gases* or liquids, such as ethanol. These products are currently used to produce electricity and as a substitute for petroleum. In Brazil, waste materials from the sugar industry alone could, in theory, provide most of the country's power. Ethanol from sugarcane already supplies half of Brazil's automotive fuel. The United

States government is currently *subsidizing* efforts to turn Midwestern *corn* into ethanol for use as a transportation fuel. Advocates argue that efficient use of biomass will not lead to an increase in atmospheric *concentrations* of *carbon dioxide* because newly planted *crops* - a primary source of biomass- will *absorb* any carbon dioxide produced. But the price of biomass fuels cannot yet successfully compete with fossil fuels in most markets. Technological advances that allow biomass to be converted into fuels with greater efficiency could eventually make biomass a competitive alternative.

Source: Adapted from *Encyclopaedia Britannica Ultimate Reference Suite 2007 DVD*

### ➔ Reading task 1

Decide whether the following statements are **true** or **false**. If false, make the appropriate corrections.

1. Agricultural wastes can be burned directly or turned into combustible gases or liquids.
2. The price of fossil fuels cannot successfully compete with biomass fuels in most markets.

3. The US government supports efforts to turn sugarcane to ethanol as automotive fuel.
4. In Brazil, waste materials for the sugar industry provide most of the country's power.

1. .... 2. .... 3. .... 4. ....

## Word study

*Connect the initial letters below with their appropriate counterparts in the box to form correct terms. The first one has been done for you.*

1. et- hanol  
 2. su...  
 3. ab...  
 4. co...

5. ag...  
 6. di...  
 7. ad...  
 8. re...

-hanol	-oxide	-newable
-ricultural	-sorb	-bstitute
-mbustible	-vocate	—

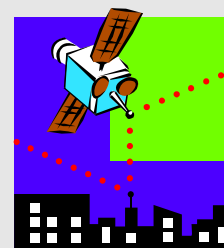
## Use of English

*Fill in the gaps of the following text using the words from the list below.*

lower	cells	mass
pumps	renewable	cellular
cost	satellites	electronic

## The Falling Cost of Renewables

The major obstacle to increased use of 1. .... energy technologies remains their high 2. .... relative to fossil fuels. As a result, most of the new technologies currently remain at the niche<sup>1</sup> stage. Those niches are growing rapidly, however. As markets expand, manufacturers of the new technologies can shift toward 3. .... production, a process that can dramatically 4. .... costs. Solar cells, for example, have gone from powering 5. .... and remote communication systems to providing energy for a growing range of applications that are not connected to a main power grid, including consumer 6. .... devices, highway signals, and water 7. .... Remote military bases, island resorts, and wastewater treatment plants are among the niches where fuel 8. .... may soon gain a foothold. Some companies are focusing on developing tiny fuel cells for laptop computers and 9. .... phones; weighing half as much as conventional batteries, they can supply 50 times as much power.



## Reading task 2 – Cloze

*Skim the passage quickly to get the gist, and then select the appropriate word for each blank from the choices provided.*

### *Preparing for an energy revolution*

The pace and extent of the move toward renewable energy in the next century will depend 1. .... many factors. Foremost among them are the



1. a. over    b. in  
c. on

<sup>1</sup> An area of the market specializing in a particular type of product.

relative expense of **2.** ..... fuels and the intensity of **3.** ..... to renewable energy coming from powerful oil and electric power companies. International initiatives, such as the Kyoto Protocol, which ultimately could serve to **4.** ..... demand for fossil fuels, may have an important impact. And the willingness of governments to fund research, enact tax incentives, and break open electric utility monopolies, could also encourage the turn toward **5.** ..... energy sources.

Many economists argue that because it is difficult and expensive to find an alternative to fossil fuels, the transition should be delayed for as long as possible. But their position may be based on a technological pessimism that is out of place today. The first automobiles and computers were **6.** ..... and difficult to use, but the pioneers persevered, made improvements, and ultimately triumphed in the marketplace. Just as **7.** ..... followed horses and computers displaced **8.** ....., so the advance of technology may one day make smokestacks and gasoline-powered automobiles look primitive and **8.** .....

**2. a. fossil    b. cell**  
c. earth

**3. a. support    b. opposition**  
c. proposal

**4. a. increase    b. depress**  
c. rise

**5. a. renewable    b. conventional**  
c. traditional

**6. a. cheap    b. priceless**  
c. costly

**7. a. automobiles    b. rafts**  
c. rockets

**8. a. TV sets    b. radios**  
c. typewriters

**9. a. profitable    b. uneconomical.**  
c. economical



## Speaking 1

*Work in pairs to do the following task:*

**Student A:** Ask Student B's opinion on one of the topics below.

**Student B:** Support the idea and give one advantage or oppose the idea and give a disadvantage.

### **Topics:**

- Geothermal energy
- Biomass
- Ocean power



## **Speaking 2**

*Research the two topics below. Find out what each of the following topics is about. Then be able to explain it in your own words.*

**Student A:** *Make a sentence such as “An article I’m reading is about..”*

**Student B:** *Ask for clarification or further information.*

**Student A:** *Clarify the point or give further information.*

### **Topics:**

- Battery-powered cars
- Fuel cells for laptop computers

*You can use the following expressions to ask for clarification:*

I don't quite understand what you mean by...

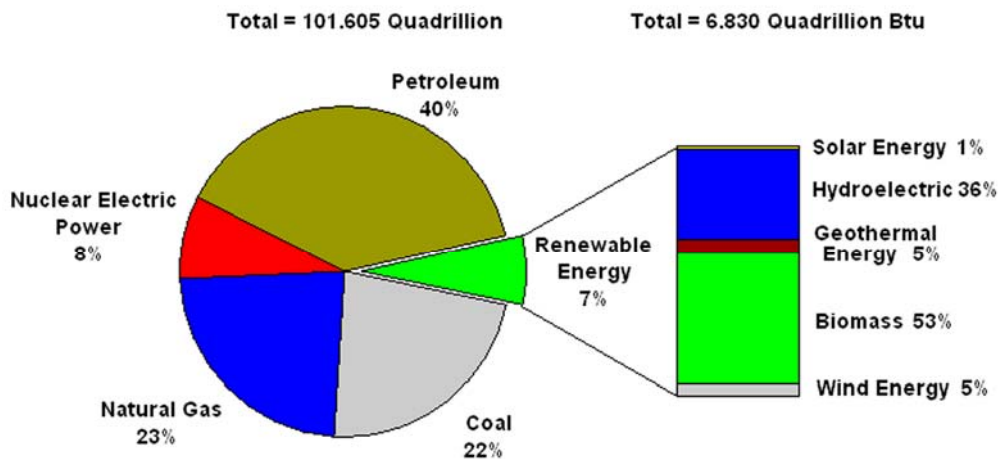
What do you mean by...?

Could you please explain to me what/how...?



## **Writing**

*Write an essay (180-200 words) on the renewable energy technology of your choice and its prospects. Present arguments for and against giving a balanced view of the issue. You can use the diagram below to derive information about the percentage of energy consumption worldwide.*



Source: EIA – US Renewable Energy Consumption and Electricity preliminary 2007 statistics



## Listening

*a. Listen carefully to the recording about fuel cells and complete the text below.*

### Fuel cells

The fuel-cell concept first attracted interest in the late 19th century, when a fuel cell three times as 1. .... as American inventor Thomas Edison's best electric 2. .... was demonstrated. But the technology was expensive, and interest in the concept withered. Advances in materials and 3. .... were necessary to make fuel cells useful and 4. .... In the 1960s fuel cells captured the interest of the U.S. space program, which developed small, efficient fuel cells for use in 5. .... These orbiting fuel cells were expensive, but by the 1980s - in the wake of the 1970s oil 6. .... - they had again attracted the interest of government 7. .... and investors. Ballard, a Canadian company that has invested heavily in PEM fuel cells, believes the cells can eventually produce electricity at less than \$100 per kilowatt, undercutting modern coal-fired 8. .... by a factor of five or more.

*b. Listen to the recording again to check your answers.*