МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
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імені адмірала Макарова

С. Г. ЛУК'ЯНОВА, О. С. ШЛЯХТІНА

ENERGY PICTURE

Методичні вказівки з англійської мови за напрямом "Теплоенергетика" для студентів I–II курсів

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Кафедра сучасних мов

Наведено інформаційно насичений текстовий матеріал, вправи та завдання для практики читання й усного та письмового мовлення англійською мовою. Автентичні тексти за фахом і вправи фокусують увагу на проблемах виробництва та використання різних видів джерел енергії і спонукають студентів до сприйняття та вироблення нового способу мислення у розв'язанні галузевих завдань.

У додатку (Supplementary Reading) наведено тексти для самостійної роботи.

Рецензент кандидат філологічних наук, доцент Т.І. Козимирська

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Unit 1. **What is Energy. The Energy Picture**

Ex. 1. Warm up discussion.

1. Look around you and give examples where and how energy is used.
2. What forms of energy do you know?
3. Can one form of energy be changed into another form? Give some examples.
4. What do you think is the largest source of energy?

Ex. 2. Decide whether these statements are true or false. Give your reasons.

1. You can do nothing without using some kind of energy.
2. An object losing its potential energy, that energy is turned into kinetic energy.
3. Natural sources of energy are not depleted.
4. Problems connected with energy are not so important nowadays.
5. The sun is an unlimited source of energy.

Ex. 3. Read the text and arrange the following headings according to its parts.

A. Two kinds of energy.
B. Sources of energy.
C. The main source of energy for the earth.
D. Changes in energy.
E. Energy and matter.

Text 1. **Energy**

Energy is the name given to the ability to do work.

1. All human life depends upon the energy in the universe. Most of the energy on earth comes from the sun. It travels from the sun to the earth in the rays that the sun gives off. The sun's rays are needed so that plants can make food. The food that plants make is the food on which all the animals in the world depend in order to live. Animals and human beings use the energy found in food to operate their bodies and muscles. The sun's energy is stored up in coal, wood, and oil, which people burn to do work for them. The sun evaporates the water which falls as rain. This causes rivers to flow and produces other energy that people can use. The amount of energy falling on the earth's surface each year is equal to that supplied by 227 billion tons of coal.

2. Energy is one of the two fundamental ideas in physics. The other is matter. These two ideas are not completely separate. Many physicists believe that energy and matter are merely two aspects of the same thing, as much as ice, water, and water vapor are three different aspects of water. The tiny electric particles (electrons) inside the atom give off the energy we know as light. A body loses part of its mass when it releases energy. It gains mass when it absorbs energy.

3. Throughout history, people have developed sources of energy to do their work. Primitive people had only the strength of their arms and the use of fire. They later discovered how to use the energy of the wind to move sailing vessels. They used water to turn mills. They tamed animals as new sources of energy. The animals pulled plows and wagons. A new stage in development came with the invention of the steam engine. Steam could be used to develop energy to run machines. The discovery of electricity created an even more important way of using energy. In a similar way, so did the invention of the gasoline engine. A new era of the use of energy began with the application of nuclear energy.

People find many ways to release energy to do work. They change the energy in a waterfall into electrical energy. They can turn this electrical current into radio waves that carry ideas thousands of miles or kilometers. They can release the energy in gasoline by burning it to power automobiles. People burn coal to turn water into steam and, in turn, use steam to generate electrical energy. The nucleus of some atoms can produce millions of times more energy per pound or kilogram of material that can be made available by chemical means.

4. Potential energy is often called stored energy. It represents work that has already been done. A rock lying on the top of a cliff has potential energy and so does the cartridge in a loaded rifle. When the rock topples over the cliff or the gun fires, potential energy becomes kinetic energy.

Kinetic energy is the energy of movement. The rock on the edge of the cliff had to be placed in that position and the gun had to be loaded. If you stretch an elastic band between your fingers, it represents potential energy. Let the elastic band snap back into its normal position, and the potential energy is changed to kinetic energy as long as the band keeps moving. The word kinetic comes from a Greek word meaning to move. A moving train or a high speed electron in a TV tube exhibits kinetic energy.

5. Energy is constantly changing from the potential to the kinetic state and back again. Every change in the universe represents the change of energy from one form into another. This process is called the transformation of energy. For example, let us analyze what happens when a boy shoots a stone from a slingshot. When he pulls back the rubber band, the potential energy in the boy is changed to the potential energy in the stretched band. When he releases the band, the potential energy of the band is changed to kinetic energy of the thrown stone. When the stone strikes a target, the kinetic energy becomes heat energy.

Ex. 4. Read the text again and answer the following questions.

1. What is the role of the sun as a source of energy?

2. How have people improved the ways of using energy throughout history?
3. What are the ways of changing one form of energy into another one?
4. What is the difference between potential energy and kinetic energy?
5. What is the transformation of energy? Give your own examples.

Ex. 5. Make up a list of terms related to the topic "Energy".

Forms of energy: sun's/solar energy, … .
Functions: to come from, to use, … .
Actions: to operate, … .

Ex. 6. Read and translate the following derivatives into your native language.

To produce – product – production – productive; physics – physical – physicist; electron – electrical – electricity; to invent – invention – inventor; engine – engineer – engineering; to discover – discovery – discoverer; to create – creation – creator; power – to power – powerful; to generate – generator – generation; chemistry – chemical – chemist; to transform – transformer – transformation; to develop – developer – development.

Ex. 7. Read and translate these verbal forms into your native language.

To burn – burning – burned; to supply – supplying – supplied; to use – using – used; to store – storing – stored; to move – moving – moved; to change – changing – changed; to find – finding – found; to release – releasing – released.

Ex. 8. Make up as many expressions as possible and translate them into your native language.

To operate	the water
to store up in	bodies and muscles
to burn	coal
to evaporate	electricity
to produce	energy
to release	mills
to turn	machines
to generate	
to absorb	
to run	

Ex. 9. Writing and speaking. Write and get ready to speak on using different kinds of energy at home.

Helpful words: gas-cooker, central heating, home appliances, vacuum cleaner, TV set, home theatre, an iron etc.

Ex. 10. Read the text and make a list of its key ideas.

Text 2. **The Energy Picture**

Throughout human history, growing population and developing technology have demanded ever-increasing amounts of energy. For centuries, people met their energy needs with manual labor, fire, and animal power. Later the wind was harnessed with sails and windmills, and flowing water was used to turn waterwheels. Today the energy needs of most people are far more complicated. Oil and natural gas provide about two-thirds of the energy used in the world; large amounts of energy are also generated by harnessing the power of coal, running water, radioactive minerals, and the Sun.

The enormous demand for energy in the modern world is exhausting the planet's known resources. And unfortunately, new energy sources have become increasingly difficult to find. Many people, however, remain unaware of the world's growing dependence on nonrenewable resources, some of which may be exhausted within the next 50 years.

Most energy experts agree that it is important to make major changes in the way humanity uses energy. Scientists are hard at work to find ways to use limited energy sources more efficiently and to make renewable sources of energy more practical.

A largely untapped 'source' of energy exists in the form of energy conservation. It is safe, inexpensive, and readily available. A combination of conservation, more efficient use of known resources, and development of new, renewable sources could avoid energy shortages and brighten the future.

The amount of fossil fuels (oil, natural gas, and coal) consumed in the United States has nearly doubled every 20 years since 1900. Between 1960 and 1994, the U.S. population increased by 45 percent. During that same period, however, total energy consumption rose by nearly 95 percent – more than twice as fast as the population growth. Similar patterns have occurred in other industrialized countries. Most experts believe that an increase in energy demand is more directly correlated with economic growth than with population growth.

People have continually demanded additional goods and services that are energy-intensive. Energy supplies have been strained even further by the demands for increased productivity of labor and capital. The output of heavy industry, agriculture, transportation, and services has been substantially increased by the use of energy-intensive tools, such as jet aircraft and computers. For virtually all the nations of the world, the developing as well as the developed, energy consumption rises as the economy grows and diversifies.

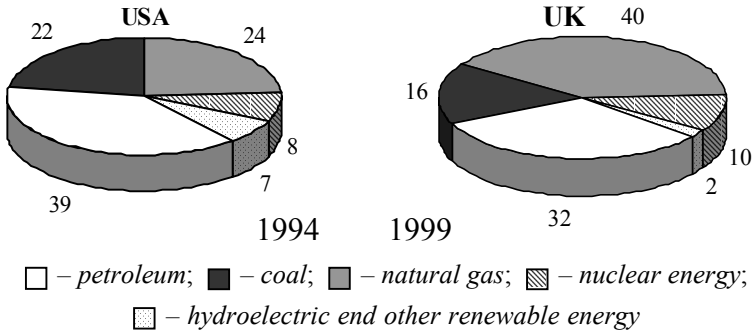
As nations shift from agricultural to industrial economies, energy consumption increases greatly to sustain factories and to fuel modern farming techniques. As their industries grow, nations develop new, energy-intensive

transportation and communication systems to link the interdependent sectors of their economies.

In the 20 century, a major trend in energy demand has been a dramatic increase in the use of electricity. In 1995, the United States used more than 400 times more electricity than it did in 1900. Energy used for transportation has also increased steadily over the years. For example, motor vehicles in the United States consumed an estimated 428 billion liters of gasoline in 1993, compared to about 341 billion liters in 1970. The increasing use of energy for transportation reflects not only growth in the distances travelled, but also a change to more rapid modes of transportation that use more energy.

Although its energy demands are less visible to the public, the production of manufactured goods and agricultural products increasingly consumes more and more energy. Indeed, industry is the largest consumer of energy in the world. This energy consumption provides the power for the extraction of minerals, the refining of resources, higher productivity and the addition of energy-intensive devices such as robots, computers, and automated systems. Now, many industrialized nations face numerous energy-related problems. Dependence on imported oil creates a number of economic and national-security problems. Increased extraction and use of fossil fuels create environmental problems. And supplies of some energy sources are unstable and unreliable. These problems are forcing careful consideration of ways to slow the accelerating use of energy. Such consideration focuses on energy supply systems, sources, and uses.

Ex. 11. ***Pair work****. Study the following pie charts on energy consumption in the USA and the UK and give your comment on them (numbers indicate percentage).*



Ex. 12. Find the necessary information and draw a similar pie chart on energy consumption in Ukraine. Get ready to speak on it.

Unit 2. **Sources of Energy**

Ex. 1. Warm up discussion.

1. What sources of energy do you know?
2. Which of them are the most common?

Ex. 2. Match these words with their definitions:

1. Fossil fuel	a) a line of connecting pipes, often under the ground, used for taking gas, oil etc. over long distances
2. Natural gas	b) the soft grey powder that remains after something has been burnt
3. Ash	c) a volatile, flammable, colorless liquid, a product of petroleum, used chiefly as fuel for cars (internal combustion engines)
4. Pipeline	d) the act of making something a liquid or of becoming a liquid
5. Refinement	e) the process of making a substance pure
6. Distillation	f) a deep hole sunk into the earth to reach a supply of water, oil, gas etc.
7. Liquefaction	g) such as coal or oil that is produced by the very gradual decaying of animals or plants over million of years
8. Gasoline	h) gas used for heating and lighting, taken from under the earth or under the sea
9. Well	i) discarded material, as garbage, sewage, or ashes; refuse
10. Wastes	j) a process that separates crude oil into a variety of hydrocarbon groups, or fractions, by boiling them until they vaporize

Ex. 3. Match the following words with their synonyms.

1. energy	a) investigation
2. motion	b) pipe
3. application	c) movement
4. oil	d) power

5. amount	e) quantity
6. generate	f) deplete
7. tube	g) rise
8. exhaust	h) use
9. research	i) produce
10. increase	j) petroleum

Ex. 4. Read the text and choose five most common / uncommon sources of energy. Where do they come from? What are they used for?

Text 1. **Sources of Energy**

The world's chief sources of energy, in order of importance, are fossil fuels, water power, and nuclear energy. Wood, solar, wind, tidal, chemical, and geothermal sources also provide energy. Future energy sources may include fuel cells, solid and liquid wastes, hydrogen, and magnetohydrodynamic (MHD) generators.

Fossil fuels include, in order of the amount used worldwide, petroleum, coal, natural gas, bituminous sands and oil shale. **Petroleum** furnishes 40 % of energy used in the world. Most of the heat energy in petroleum is used to produce transportation fuels, such as gasoline and diesel fuel, and heating fuels. Most petroleum is removed from deep within the earth as a liquid called crude oil. Workers pump crude oil out of the earth through wells drilled into oil-bearing formations called reservoirs. Because it is a liquid, crude oil can be economically transported over long distance by pipeline to refineries. Refineries process crude oil into gasoline and other useful petroleum products.

Coal provides about 28 % of energy used in the world. Much of the heat energy in coal is used to produce steam in boilers. The steam, in turn, generates electricity or operates steam engines. In some countries people use coal to heat homes and other buildings.

The mining and burning of coal involve certain problems. Accidents in coal mines and diseases that result from breathing coal dust make coal mining a dangerous occupation. When burned, coal releases sulfur and other impurities that pollute the air. To reduce pollution, many large factories that burn coal have installed filters and other cleaning devices.

Natural gas accounts for about 21 % of the energy used in the world. Most of the heat energy contained in natural gas is used to generate steam for electricity or steam engines, to heat buildings, and for cooking and other household needs. Like petroleum, natural gas comes from deposits in the earth. Natural gas is a clean source of energy because it is refined naturally during its formation within the earth and does not require further refining. In addition,

natural gas can be compressed into a liquid and transported long distances through pipelines.

Bituminous sands and oil shale may become energy sources in the future. Bituminous sands, also called tar sands, are deposits of sand covered with an oil-producing substance. Oil shale is a type of rock that can be processed to yield crude oil and natural gas. The cost of obtaining oil from tar sands and oil shale is higher than that of obtaining petroleum, coal, or natural gas directly from the earth. But as reserves of these fuels run out, it will become necessary to recover the more costly energy from sands and oil shale.

Water power, or hydropower, furnishes about 6 % of the world's energy. Where water flows from a high place to a lower one, the gravitational energy of the falling water can be captured and used to produce other forms of energy. Most water power is used to generate electricity. Water power supplies energy without pollution and without using up the water in the process. But costly dams and other structures are required to harness water power.

Nuclear energy provides about 6 % of the energy used in the world. Today, nuclear energy comes from fission – that is, the splitting of atomic nuclei of certain elements, especially uranium. But scientists hope eventually to produce nuclear energy from fusion, the combining of atomic nuclei. Nuclear fission creates huge amounts of energy from small amounts of fuel.

Solar energy is used throughout the world to perform various small jobs. People capture this type of energy with various devices that change the sun's energy into heat or electrical energy. Flat-plate collectors convert solar energy into heat energy to heat water and the air inside buildings. Solar cells, also called photovoltaic cells, convert solar energy into electrical energy.

Solar power can provide a clean and almost unlimited source of energy. But it is thinly distributed over a wide area and must be collected and concentrated to produce energy. In addition, darkness and bad weather interrupt the supply of sunlight.

Wind power turns windmills and propels sailboats. Private uses of the clean energy that is provided by wind occur all over the world. But wind power is commercially practical only in areas that have strong, steady winds.

Tidal energy comes from the gravitational energy of water as it flows from high tide to low tide. This energy can be captured by closing a bay with a dam. At low tide, the stored water is released through a turbine in order to generate electricity. The chief disadvantage of tidal power plants is that they can produce energy only during falling tides. In addition, the plants can be built in few places.

Geothermal power is generated wherever water comes in contact with hot rocks below the earth's surface. The rocks give off heat that makes the water hot enough to turn into steam. The production of geothermal energy can occur only in areas where hot rocks lie near the earth's surface. Iceland, Italy, Japan, the Philippines, New Zealand and the United States have developed geothermal power plants.

Solid and liquid wastes also can provide energy. Burning trash can produce heat energy and electricity. Some paper and lumber mills use waste wood to fuel boilers, which generate steam for the plant. Many cities throughout the world produce usable energy by burning trash. Cities also can process liquid organic wastes, such as sewage, to produce methane gas that can be used for fuel. Another process, called bioconversion, converts organic plant and animal wastes into useful liquid fuels, such as methanol, natural gas, and oil.

Magnetohydrodynamic (MHD) generators convert fuel directly into electricity. An MHD generator burns coal or some other fuel at high temperatures to produce hot, ionized (electrified) gases. After this gas has passed through the generator, it can be used to drive a turbine and generate more electricity.

(Abridged from World Book Encyclopedia)

Ex. 5. Make up compound nouns from the following words and translate them into your native language.

For example: power plant – електростанція.

Liquid, wind, water, fossil, fuel, solid, animal and plant, oil, heat, crude, steam, fuels, power, cells, wastes, shale, energy, engine.

Ex. 6. Put the verbs in brackets into the Passive Voice.

A. 1. In future hydrogen (use) as fuel to produce energy for road vehicles, such as cars.
2. Crude oil (remove) from reservoirs located in the earth's depth.
3. Natural gas and oil (can, transport) by pipelines over long distances.
4. Gasoline (produce) by the process of refining crude oil.
5. Natural gas (refine) naturally during its formation within the earth.
6. The gravitational energy of the falling water (call) waterpower or hydropower.
7. When atomic nuclei of certain elements (split), they give off nuclear energy.
8. Liquid organic wastes (can, process) to produce methane gas used as fuel.

9. At a power plant gas (burn) to create steam for a steam turbine.
10. Geothermal power plants (develop and build) in Italy, Japan, New Zealand, the USA etc.
11. In fuel cells, hydrogen and oxygen (combine) to produce electrical energy.
12. In future the shrinking reserves of fossil fuels (have to, replace) by renewable sources of energy.

B. Make up your own sentences in the **Passive Voice** about energy sources with the following verbs.

To produce, to generate, to use, to provide, to convert.

Ex. 7. Using the text above define if these sentences are true or false. Correct the false ones.

1. Nuclear energy, fossil fuels and waterpower are the world's chief sources of energy in order of importance.
2. Fossil fuels include petroleum, coal and natural gas.
3. Crude oil is removed from deep within the earth through wells.
4. Coal is used to produce gas for power plants.
5. Natural gas is an unclean source of energy and it should be refined before use.
6. Geothermal power comes from the gravitational energy of the falling water in rivers.
7. Nuclear energy comes from fusion, that is the splitting of atomic nuclei.
8. Solar energy can be used to obtain electricity for homes.
9. Solid and liquid wastes will be used to produce heat energy, electricity and methane gas.
10. MHP generators use coal or some other fuel to convert it into hot gas and to generate electricity.

Ex. 8. Read the following text. What kind of fuel is used in the nuclear reactor in the USA?

Text 2. **Nuclear Fuel**

In the USA, the fuel most commonly used in the reactor is enriched uranium: uranium that has been modified by increasing the concentration of U-235 above the 0,7 percent found in nature. Although various techniques have been devised to cause this enrichment, a process called gaseous diffusion is most often used. Pure uranium is changed into uranium hexafluoride (UF6) and vaporized. The UF6 gas is pumped through many layers of very fine filters. Because the molecules containing U-235 are lighter than the molecules containing U-238, they tend to pass through the filters faster.

Most reactors operate on slightly enriched uranium, which contains about three percent U-235. For practical purposes, uranium containing 93,5 percent U-235 is considered fully enriched, although higher enrichments have been achieved. Fully enriched uranium is used in special-purpose reactors, such as those on submarines, where compactness is a higher priority then cost (the price of uranium rises in direct proportion to its degree of enrichment). Because it contains a higher percentage of U-235, enriched fuel is better able to sustain a chain reaction than is natural uranium.

Nuclear fuel, unlike coal and other fossil fuels, must be precisely fabricated. Most reactors use fuel in the form of small, dense pellets of uranium oxide. The pellets are placed inside metal fuel rods some 12 feet (4 meters) long that stand upright in the reactor's core. Free neutrons can pass through the walls of these rods. The rods, in turn, are placed in bundles, containing as few as 64 fuel rods (arranged 8 by 8) or as many as 289 fuel rods (arranged 17 by 17). Each bundle of fuel rods is referred to as a fuel assembly. A reactor may contain anywhere from 150 to 580 fuel assemblies, depending on its design. The fuel assemblies are encased in a sheath, or cladding, commonly made of a zirconium alloy, which protects the uranium from corrosion by the coolant. It also keeps the fissionable products, which are highly radioactive, from contaminating the coolant.

Ex. 9. Answer the following questions.

1. What is so called enriched uranium and where is it used?
2. What process was devised in order to enrich uranium?
3. Why do molecules containing U-238 tend to pass through the filters faster?
4. What is the difference between slightly enriched uranium and fully enriched uranium?
5. Why is enriched fuel better able to sustain a chain reaction than natural uranium?
6. How is fuel used inside a reactor?
7. Why is a sheath for the fuel assemblies made of a zirconium alloy?

Ex. 10. Read and translate the following word combinations with -ed forms and -ing forms.

Enriched uranium, used, is changed and vaporized, is pumped, has been modified, is considered, have been achieved, must be fabricated, are placed, arranged 8 by 8, is referred, are encased, techniques have been devised, called.

By increasing, depending on its design, from contaminating the coolant, containing.

Ex. 11. Put the verbs in brackets into the Passive Voice.

1. Reactors often (name) by the type of coolant used in them.
2. The chain reaction in a nuclear reactor (must, control) carefully.
3. Reactors that use deuterium as the moderator and coolant (refer) to as heavy-water reactors.
4. The water in the pressurized-water reactors (keep) under very high pressure to prevent it from boiling.
5. The first gas-cooled reactors (build) in Great Britain and France.
6. Earth's supply of U-235 (limit) and likely to be depleted early in the 21st century.
7. A facility designed to convert nuclear energy into electricity (call) a nuclear-power plant.
8. Like fossil fuels, nuclear fuel (consume) and (must, replenish).
9. Much of nuclear fuel (can, recycle) and (use) again.
10. New nuclear plants (construct) in the United States since the 1970.
11. When the fuel (allow) to undergo fission in a controller chain reaction, heat (generate).

Ex. 12. Decide whether these statements are true or false.

1. The chain reaction in a nuclear reactor mustn't be carefully controlled.
2. A nuclear power station is like any other power plant but the familiar coal-burning furnace is replaced by a nuclear one.
3. A nuclear power plant may be able to run for a year or more on a single fuel charge.
4. Steam generator of a nuclear reactor contains water.
5. Nuclear energy comes from fission – i.e. the splitting of atomic nuclei of certain elements, especially uranium.
6. It is not necessary to encase the fuel assemblies in a sheath made of a zirconium alloy.
7. Reactors on the submarines use natural uranium.
8. Pallets of uranium are placed inside fuel rods.

*Ex. 13. **Pair work**. With your partner discuss the answers to these questions. Then compare your answers around the class. Add information from your own experience.*

1. What energy sources can be most efficiently used:
   a) to generate electricity? c) for household uses?
   b) to produce thermal power? d) as a fuel?
2. What energy sources are safe for our environment?
3. What energy sources are called renewable? Why?

4. Do you think renewable sources of energy can provide enough power for people?

5. What sources of energy are found and used in Ukraine? Give your examples.

Ex. 14. Write and get ready to speak on.

1. Sources of energy found and used by humanity in the world / Ukraine.
2. Advantages and disadvantages of using different kinds of fossil fuels.
3. Energy sources for our homes.

Unit 3. **Problems. Depletion of Fuel Reserves and Environmental Effects**

Ex. 1. Warm up discussion.

1. Do you know any problems connected with energy production and use?
2. What kinds of energy sources might be depleted in the future?
3. Are there a lot of environmental effects caused by producing and using energy?

Ex. 2. Match the words on the left with the definitions on the right.

1. Contaminate	a) to make air, water, soil etc. dangerously dirty and not suitable for people to use
2. Pollute	b) the air, water and land where people, animals, and plants live, and the way all these things depend on each other so that life can continue
3. Recycle	c) discarded material, as garbage, sewage or ashes; refuse
4. Renewable energy	d) to make a place or substance dirty and dangerous by adding something to it, for example chemicals or poison
5. The environment	e) sources such as wind power, wave power, and solar power that do not pollute the environment
6. Deplete	f) to lessen, to exhaust or empty by using up the supply
7. Wastes	g) to take materials that have already been used, and put them through a special process so that they can be used again

Ex. 3. Read the following international words. Give several meaning if possible.

Problem, reserve, effect, accumulate, natural, pressure, to form, extraction, degradation, transportation, stationary, respiratory, to indicate, substance, to

react, phenomenon, permanent, construction materials, combination, tank, processing, thermal, aquatic, minerals, recreation, transmission, associated, to monitor, to detect, unauthorized.

Ex. 4. **A**. *Determine the function and the meaning of the -ed forms in the following sentences.*

1. An industrial and intensively *farmed* country, Ukraine contains some of the most *polluted* landscapes in Europe.
2. The greenhouse effects is the gradual warming of Earth *caused* by gases that stop heat from leaving the Earth's atmosphere.
3. Greenhouse gases are *produced* when we burn fuels, especially coal *burned* in power stations to make electricity.
4. There should be taken worldwide efforts to ensure that radioactive waste is safely *handled, stored, processed, transported* and d*isposed of.*
5. Russia is *reported* to import spent fuel rods from Ukraine, Bulgaria, Slovakia and Hungary for reprocessing.
6. In order to solve the burning problems of the environmental protection, special legislation has been *adopted* and *registered* in the Constitution of Ukraine.
7. Global warming is being *discussed* not only just by environmentalists but also by economists and politicians.
8. According to the Kyoto protocol *industrialized* countries *agreed* on reducing industrial emissions into the atmosphere.

B. *Find the following -ed forms in the first part of the text, define their function and meaning: used up, accumulated, buried, changed, removed, supplied.*

Ex. 5. **A**. *Explain the use of tense forms in the following sentences. Translate them into Ukrainian.*

1. Thermal energy clearly *contributes* to the greenhouse effect.
2. When people began consuming too much fuel, the atmosphere *showed* a growing concentration of carbon dioxide.
3. Local people *are protesting* because the planned filling station *will destroy* the environment in their neighborhood.
4. New laws *are being introduced* to protect the environment from industrial gases that *cause* acid rain.
5. Renewable energy is the energy that *is* always *replaced* naturally after it *has been used*.
6. Fish *are being killed* by pollution in the water.
7. In the longer term, harmful emissions *will be reduced* as the world *changes over* to less environmentally damaging energy sources.

8. Modern societies *will have to find* the way to meet basic human needs and develop economic growth without undermining the natural resources and environmental integrity.

B. *Define the function and meaning of the following predicates from the text.*

Have used up, were buried, changed, is still going on, is being used up, have removed, will have used up, will have to use, will last, have been found, has been linked, is discharged, have damaged, have been polluted, are not fully understood, has affected, has initiated, had accumulated, must be monitored.

Ex. 6. Read the following text and fill in the table.

Kinds of environmental pollution	Sources of environmental pollution
Air pollution	
Water pollution	
Thermal pollution	
Land pollution	
Radiation pollution	

Text 1. **Problems**

Energy use creates serious problems. They include the depletion of fuel reserves and environmental effects.

Depletion of fuel reserves. People have rapidly used sources of energy that accumulated for millions of years. The period of greatest fossil-fuel formation began about 360 million years ago. For about 40 million years, huge quantities of dead trees and other plants were buried in the earth through natural processes. Time, heat, and pressure slowly charged this buried plant material into coal. Petroleum and natural gas, were both formed in much the same way from the remains on ocean plants. The formation of fossil fuels is still going on but people burn the fuels thousands of times faster than they form.

The rapid growth of energy use threatens to exhaust the world's supply. Petroleum may become the first fuel to give out – growing scarce by the mid-2000's. Natural gas is also being used up quickly. At present rates of consumption, natural gas may last only slightly longer than petroleum. When people have removed all the oil and natural gas from the earth, they will have used up the "easy energy" supplied by nature. After that, they will have to use such solid fuels as coal and oil shale, which are more difficult to remove from the earth. Coal, the most plentiful fossil fuel, will last more than 200 years.

Energy and environment. Converting fossil and nuclear fuels into energy can cause damage to the environment. Among the many problems that energy

extraction and consumption create are air pollution, water pollution, creation of solid wastes, land disruption, and aesthetic degradation of our surroundings.

Air pollution. Energy systems are the largest source of pollutants emitted into the air. Automobiles and other forms of transportation, and stationary sources such as power plants and residential and commercial heating units, release millions of tons of gas and noxious particles into the air each year. These pollutants cause discomfort to and endanger the health of humans and other animals. Particles can irritate the lungs and worsen respiratory diseases. In addition, many scientific studies indicate that these pollutants cause or contribute to emphysema and cancer. Rates of illness and death, for example, have been found to increase during prolonged periods of heavy pollution.

Air pollution has been linked to many other problems. The burning of coal and oil pollutes the air with nitrogen oxides and sulfur dioxide. These substances can react with moisture in the air and fall to earth as acid rain, polluting lakes and rivers. Motor-vehicle fuels rank as a leading source of air polluting.

Even the cleanest fossil fuel produces carbon dioxide when it burns. Carbon dioxide is a harmless gas. But a built-up of this gas in the atmosphere may cause a phenomenon called the greenhouse effect. Carbon dioxide, like glass in a greenhouse, allows sunlight to warm the earth but prevents heat from escaping back into space. The greenhouse effect could permanently raise temperatures on the earth, partially melting the polar icecaps and causing floods. Air pollution can even hurt buildings: most construction materials, including steel and concrete, wear out sooner in polluted air than in clean air.

Water pollution. Oil and water can be a deadly combination. Unfortunately, oil is often discharged into inland waterways and the sea from accidents involving drilling rigs, pipelines, storage tanks, or tankers. Massive spills that occur near shorelines have damaged recreation areas, seashore life, and the spawning grounds of fish and other aquatic animals.

Coal extraction represents another important source of water pollution. The U.S. Department of the Interior estimates that tens of thousands of streams and lakes in the United States have been polluted by acidic mine drainage and sediment deposition from coal mining and its subsequent processing.

Other energy sources can cause an invisible, but serious, form of water contamination known as thermal pollution. Water that is used for cooling in industrial plants is much warmer than the bodies of water into which it runs. Power plants are the major source of such thermal pollution. The consequences of thermal discharges are not fully understood, but they alter and may damage the natural balance of aquatic life in lakes, bays, estuaries, and rivers. The effects vary with the size of the receiving body of water, the climate, the uses

to which the water is put, and the temperature, rate, and constancy of the discharge.

Land Use. Strip mining, a process in which huge power shovels remove the rock, vegetation, and soil that cover coal and other economically important minerals, has affected more than 2 million acres (800,000 hectares) of land in the United States. Stripping the land destroys its value for recreation, wildlife habitation, and other uses. The government has initialed substantial regulatory action to prevent and remedy this massive destruction. These efforts have helped reclaim about one-third of the nation's stripped land in some fashion.

Other energy activities occupy large areas of land or destroy its scenic value. Overhead transmission lines and their rights-of-way, for example, require millions of valuable acres.

Solid Wastes. Mining wastes associated with energy systems account for a substantial portion of the 6 billion tons of waste produced in the United States annually. Furthermore, the combustion and processing of fuels, particularly coal, add significantly to the total waste contributed by energy systems.

Nuclear-power plants produce more thermal pollution than fossil-fuel plants do, but when operated properly, emit less air pollution. However, nuclear plants present some trick environmental problems because of the need to dispose of their high-level radioactive wastes. Spent fuel contains radioactive materials that can remain dangerous for thousands of years. In 1982, the U.S. Congress passed the Nuclear Waste Policy Act to deal with the problem of wastes that had accumulated for almost 40 years – and that continue to accumulate. The act calls for permanent storage in deep underground mines or repositories. Choosing the initial repository sites, however, has become a matter of considerable political controversy. During storage, the wastes must be carefully monitored to detect any leakage; radioactive waste products present the greatest storage challenges, especially since they must be guarded to prevent anyone from stealing spent material for unauthorized purposes.

Our societies are totally dependent on nonrenewable energy sources, despite the efforts by some governments to promote alternative sources. The industrialized world is completely unprepared to face the threatening exhaustion of these energy sources, and is currently depleting the deposits of high quality and easily obtainable resources, leaving for our children deposits that cannot be easily or efficiently processed to produce energy. The pollution effects of our excessive resource use are making the planet inhabitable for future generations.

(From "World Book")

Ex. 7. Read the text again and answer the following questions.

1. What problems does energy use create?
2. Why are fossil fuels going to be depleted in the future?
3. In what order are they going to be depleted?
4. What is environmental pollution?
5. In what way can pollutants affect the health of living beings?
6. What kinds of pollution do you know?
7. What are the sources of environmental pollution?
8. What is acid rain?
9. What is a greenhouse effect?
10. Can a greenhouse effect cause any serious changes in the environment?
11. How can energy use cause water pollution?
12. Energy activities can also be connected with destroying large areas of land, can't they?
13. In what way does the accumulation of solid wastes contribute to the problem of environmental pollution?
14. Do you agree with the conclusion at the end of the text?
15. What are the most acute problems of energy production and use in Ukraine?

Ex. 8. Memory Test: do you remember the following word combinations from the text above.

Вичерпність паливних ресурсів, величезна кількість, швидкий ріст, перетворення викопного палива в енергію, завдавати шкоди навколишньому середовищу, шкідливі частинки, забруднювати запаси прісної води, нешкідливий газ, видобуток вугілля, виснажувати світові запаси, споживання природного газу, нагромадження вуглекислого газу в атмосфері, танення льодовиків, відкриті гірські роботи, викидати в атмосферу, видаляти радіоактивні відходи, проблема зберігання.

Ex. 9. ***Pair work.*** *Do you agree or disagree with the following statements? Give your reasons.*

1. Producing and using energy is a particular cause of the disastrous environmental situation in some areas of the world and Ukraine.
2. Ukraine is quite self sufficient with energy provided by national deposits.
3. Excessive and wasteful consumption of resources produces a kind of environmental stress: the use of more and more energy and raw materials without regard for the future.
4. The greenhouse effect is a direct result of our modern industrialized society and demonstrates the destructive impact of our activities.

5. Nuclear power is not a sustainable means of generating electricity considering all the indirect costs it requires and long term threats.

Ex. 10. Write and get ready to speak on.

1. The problem of depletion of fuel reserves in the world and in Ukraine.
2. Environmental problems caused by converting fossil and nuclear fuels into energy.
3. Our society is prepared to face the threatening exhaustion of fossil fuels reserves.

Unit 4. **Solving Problems. Alternative Energy Sources**

Ex. 1. Warm up discussion.

1. Why is the problem of energy supply so important?
2. Do you think there are many ways to solve problems of producing and using energy? What are they?
3. Do you know any examples of using alternative energy sources in the world and in Ukraine?

Ex. 2. Complete the sentences with the following -ing forms. Pay attention to their function and meaning.

a) nonpolluting; *b*) becoming; *c*) heating; *d*) waste-burning; *e*) being; *f*) drilling; *g*) joining; *h*) absorbing.

1. New deposits of petroleum are … more and more difficult to find.
2. The major problem with … plants is air pollution.
3. Scientists hold high hopes for hydrogen as a potential source of abundant, … energy.
4. Energy from biomass is released by … or chemical reaction.
5. The abundant heat of Earth can be tapped at many locations by … deep enough.
6. The Earth's atmosphere filters sunlight by … most of the ultra-violet and some of the infra-red light.
7. By … their efforts scientists of the world could be able to solve the energy problems.
8. There are several alternatives to fossil fuels, wind power … one of them.

Ex. 3. Read text 1 and complete it with the following phrases:

a) oil, natural gas and coal; *b*) by electric transport; *c*) find other new sources; *d*) saving fuel; *e*) have provided power; *f*) unneeded lights.

Text 1. **Challenges**

Challenges presented by the earth's diminishing energy supply include developing new energy sources; improving the efficiency of energy production, transportation, and use; and conserving energy.

Developing new energy sources. Scientists have many problems to solve before new sources of energy become practical. Nuclear physicists have not yet produced a reliable fast breeder or controlled nuclear fusion. To turn solar energy into a practical power source, scientists must find better ways to gather, concentrate, and store it. They also must find new ways to recover the energy contained in solid and liquid wastes, and eventually [1] … .

The development of a safe, clean transportation fuel to replace petroleum is a high priority in energy technology. Hydrogen could replace fossil fuels if power companies could produce it cheaply. Fuel cells and solar cells [2] … for space programs, but they cost too much for individuals to use. Much research is needed to develop these and other resources into practical sources of energy for the future.

Improving efficiency. To make our existing energy resources last longer, scientists and engineers are working to develop more efficient methods of recovering, transportation, and using energy. Petroleum and mining experts are investigating more economical ways of removing [3] … from the earth. In addition, engineers are designing more efficient transportation systems to reduce the loss of energy as fuel is transported.

Engineers also can make our shrinking fuel reserves last longer by designing more efficient power plants and engines. Despite great improvements in the energy efficiency of automobiles and trucks, a gasoline engine still uses only about 20 per cent of the total energy available in gasoline. The rest of the energy becomes wasted heat. Power-plant designers are developing plants that can turn more of the energy in fuel into electricity, thereby [4] … .

Conserving energy and using it wisely will also make the energy supply last longer. Such simple acts as lowering the temperature of water used for heating when it is getting warmer, and turning off [5] … help conserve energy. Improved building construction and insulation could save up to half the energy used for heating and cooling. For example, reducing heat loss from buildings helps conserve energy, the installation of fiberglass insulation along walls controls the loss of heat and thus reduces the amount of fuel needed to heat the house. Travel by bus or [6] … can reduce energy consumption. The recycling of paper and of aluminum, glass, and plastic containers greatly reduces the amount of energy used in manufacturing new products.

Ex. 4. Answer the following questions.

1. What do challenges presented by the earth's diminishing energy supply include?
2. What problems do scientists have to solve to make new sources of energy more practical?
3. What new methods are specialists developing to improve efficiency of recovering, transportation and using energy?
4. How can engineers, petroleum and mining experts help conserve energy and use it more efficiently?
5. What steps can people take to conserve energy?

Ex. 5. ***Pair work****. Using the information in the text, complete these statements.*

1. Challenges presented by the earth's diminishing energy supply include ….
2. To turn solar energy into a practical power source … .
3. Much research is needed to … .
4. To make our resources last longer scientists and engineers are working to ….
5. A high priority in energy technology is … .
6. People can take the following steps to conserve energy … .

Ex. 6. Read and translate the following sentences paying attention to the function and meaning of the infinitive.

1. People use wind to power sailboats and windmills.
2. Groups of windmills were built to generate electricity in areas where the winds are steady and strong.
3. They developed advanced solar energy systems to be used for heating homes and generating electricity.
4. Our scientists designed more efficient wind turbines to be manufactured by a specialized company.
5. The company offered new energy saving technologies to be introduced in our country.
6. Geothermal power is known to be used in Iceland, California and Italy.
7. The world's supply of coal is expected to last about 250 years.
8. Bituminous sand are considered to be used for producing oil or gas.

Ex. 7. Read text 2 and name the alternative energy sources which are described in it.

Text 2. **Alternative Energy Sources**

The enormous demand for energy in the modern world is exhausting the planet's known resources. And unfortunately, new energy sources have become increasingly difficult to find. Current research and development are

investigating alternate sources of clean, inexpensive power that may eventually supply much of the energy.

Solar power is often mentioned as the logical and proper alternative to exhaustible sources of energy. And indeed, the amount of radiant energy that strikes the Earth's surface is far more than is needed. For the generation of electricity, however, there are serious problems to be solved. To collect and concentrate the energy by reflectors and converters of present efficiency is the major difficulty. Obvious problems come to mind, related to unfavourable weather conditions, energy storage requirements, and the use of the shadowed space. The desert is a logical place to locate solar devices because of open space, isolation, and the frequency of sunny days, but transmission costs for electrical power to urban centres would be excessive. We can hope to develop converters from heat energy to electrical energy and perhaps exploit superconductivity of metals at a very low temperatures to reduce transmission costs, but it is clear that there remain many technological problems in this area.

A recently advanced concept for harnessing solar energy is intriguing. It is proposed to place collectors of the Sun's rays in synchronous orbit, 22,300 miles out in space, with the energy that is absorbed by solar cells transmitted to the Earth by microwaves that would easily penetrate the atmosphere. The radiation would then be collected, rectified, and transmitted through superconducting lines. The feasibility of the idea is uncertain at this time.

Scientists from industry, and from universities are studying various ways to wrest energy from **biomass** – land and water plants, farm crops, garbage, manure, and sewage. They employ heat and chemical changes produced by bacteria – a process called fermentation – to convert these materials into steam, liquid fuels, and gaseous fuels.

A result of biomass conversion familiar to many people is gasohol – a fuel that is a mixture of 90 percent gasoline and 10 percent alcohol. Sugar, corn, wheat, potatoes, farm wastes, and other materials can be fermented and distilled to produce ethanol, or ethyl alcohol. Methanol, made from coal or wood, also can be used as an alcohol fuel.

In the United States, alcohol fuel is produced primarily from corn. But corn, sugar, and other crops usually have more value as food than as fuel. This is not the case with garbage. Many cities around the world solve their waste-disposal problem by burning trash to make steam for heating and for generating electricity. Wastes can produce almost as much energy as can burning coal.

Garbage can also be chemically converted to a gas fuel by the action of bacteria. This occurs naturally in landfills. Anaerobic bacteria, which do not

need oxygen to survive, convert the waste to methane gas. The process is made more efficient by removing metals and glass and allowing the refuse to ferment under controlled conditions.

Wind power available throughout the Earth is considered to be equivalent to 100 billion watts per year. For centuries, windmills have converted the energy of the winds into useful forms of power chiefly to pump water, grind grain or generate electricity. Although they play a small role in industrialized countries, modern efficient windmills are being used in some areas where strong winds prevail to produce power.

Most windmills have a wheel of blades or sails that is turned by the wind. Typically, wind turbines have two or three blades, and other windmills have more. In most cases, the wheel is set on a horizontal shaft. The shaft is mounted on a tower, mast, or other tall structure. The shaft is turned by the movement of the wheel, and it transmits power, through a series of gears, to a vertical shaft. The shaft then carries power to a water pump, flour mill, electric generator, or other device.

Tides, like the wind, will always be with us, and people have utilized the energy in their ebbs and flows since at least the 12th century. For hundreds of years, the moving waters of the tides turned mills that ground grains. Utilizing tidal power to generate electricity, however, did not begin on a grand scale until 1966, when France began full operation of the world's first tidal-power plant, located on the Rance River.

The ideal site for a tidal-power plant requires that a large difference exist in the volume of water flowing in and out with each tide, and a narrow bay or river that can be closed off by a dam. High tides raise water in the bay or river, which is closed by the dam before the water begins to ebb. During low tide, the water level outside the dam drops below the level in the day or river. Gates are opened, and as the stored water falls to a lower level, it drives turbines that generate electricity. To maintain the flow of electricity, the falling water operates pumps that put water into storage ponds for release between tidal cycles.

Geothermal energy is known to be used for heating at a number of places around the world. Heating with geothermal waters, by transferring their heat through a heat exchanger to fresh water, was applied in Hungary and Iceland. Cost of such heating proved to be much cheaper than heating by any other known fuel. Because heat dissipates rapidly, hot water or steam from the depths of the Earth cannot be transported very far but has to be utilized at the point where it is produced. The farthest distance in Iceland, for instance, to which hot water from wells is piped for heating is less than 15

miles. For electric energy generation piping should be less than one or two miles.

The most important characteristic of geothermal energy is its potential availability in truly enormous quantities – possibly on an inexhaustible basis – wherever it can be located, tapped, and utilized.

Researchers studying the feasibility of tapping the heat contained in **magma** – subterranean molten rock – believe that this virtually inexhaustible source of energy could be utilized in the 21st century. Most magma is located more than 32 kilometers below the surface of Earth, but it is much closer to the surface in some places, particularly in volcanic craters. With temperatures in excess of 1,090 °C magma could become an important source of energy.

Oil, coal, natural gas, and nuclear power currently provide about 80 percent of the world's energy needs. For the next 25 to 50 years, only solar power, and perhaps nuclear fusion show promise of replacing a large slice of the energy pie. As nonrenewable energy sources are depleted, alternative sources will become increasingly important to keep the lights on and the wheels turning.

Ex. 8. Answer the following questions.

1. Why is solar power considered the logical and proper alternative to exhaustible sources of energy?
2. What are the major difficulties and problems of collecting and concentrating solar energy?
3. What is the best logical place to locate solar devices and why?
4. What is the main idea of the advanced concept for harnessing solar energy?
5. What kind of fuel can be produced from biomass?
6. What materials make up biomass?
7. What do you know about fermentation?
8. How do many cities solve their waste-disposal problem?
9. How have windmills been used for hundreds of years?
10. What do most windmills consist of? How do they operate?
11. What features should be taken into consideration to make a tidal power plant efficient, reliable and economical?
12. What is the possible application of geothermal energy and why?
13. What features make the application of geothermal energy limited for heating?
14. Where is magma located and what is it?
15. What may fossil fuels be replaced by in future?

Ex. 9. Make up adjectives adding the following prefixes: il-, im-, un-, in-, sub-, non- and translate them into your native language, e.g.: fortunate – unfortunate.

expensive	important	probable
certain	expected	legal
efficient	complete	terranean
exhaustible	experienced	marine
limited	possible	sufficient
common	direct	proper
available	favourable	renewable

Ex. 10. Make up as many expressions as possible and use them in your own sentences.

to convert	energy
to conserve	heat
to save	planet's resources
to recover	paper
to store	energy consumption
to employ	solar energy
to investigate	the waste
to rectify	biomass
to reduce	heat and chemical changes
to utilize	alternate sources of power
to recycle	the radiation
to tap	the loss of energy
to exhaust	economical ways
to harness	efficient methods
to develop	

Ex. 11. ***Pair work****. Decide if the following statements are true or false. Give your reasons.*

1. As the energy sources of the world are decreasing, the scientists have to find new sources of energy in the nearest future.
2. Developing more efficient methods of recovering, transporting and using energy could help energy resources last longer.
3. There aren't so many efficient ways to save energy at home which could help reduce energy consumption.
4. There are several natural sources of energy, all of them are exhaustible.
5. It is the sun that is an unlimited source of energy. The energy from the sun may be converted into heat to warm buildings.

6. The idea of producing gas fuel from biomass and garbage can't find wide applications in the world.
7. Modern windmills are efficient enough to be erected everywhere around the world.
8. To construct a tidal-power plant one should take into consideration the locality requirements.
9. Geothermal energy can provide an inexhaustible source of power.
10. Renewable energy sources are abundant in all the regions of Ukraine.

Ex. 12. Write and get ready to speak on the following points.

a) energy of the future;
b) the possible uses of solar energy;
c) using alternate energy sources in Ukraine;
d) advantages and disadvantages of alternate energy sources;
e) challenges presented by the earth's diminishing energy supply.

Ex. 13. **Project work.**

Role Play. You are going to take part in the International Conference on Energy Policy. Choose one of the directions listed below and get ready to present the topic to the participants.

1. Energy and Environment.
2. Fossil Fuel Use.
3. Nuclear Power Outlook.
4. Energy Saving Programme.
5. Energy Efficiency.
6. Renewable Energy.
7. Energy Picture in Ukraine.

Think of the organizational activities (roles, illustrative materials, public polls, invitation cards, badges, etc.), the motto of the conference and draft resolution appealing the world's community.

Supplementary Reading

Ex. 1. Read the text and divide it into 5 passages, choose the following headlines for them.

1. Uses of coal.
2. The abundant fossil fuel.
3. Environmental effects.
4. Composition and origin.
5. Types (classification) of coal.

Text 1. Coal

People have known since prehistoric times that coal is a rock that burns. Today coal is one the most widely used sources of power in the world, particularly as a fuel for the steam turbines that generate electricity; it is also used for heating purposes. One particularly important coal by-product, called coke, is used in the manufacture of steel and in the processing of many other metals.

Coal is actually a mixture of substances, such as: volatile matter (material that can be easily vaporized), moisture, and a varying amount of fixed carbon – the solid material that burns after the volatile matter and moisture have been driven off. There is also a certain percentage of ash – the material that remains after burning has occurred. Coal was formed from the remains of plants that have undergone a series of far-reaching changes. When small pieces of coal are viewed under the microscope, evidence of fibers, spores, and other elements of plant-cell structure can be identified.

There are four ranks, or types, of coal. Ranging in the order of their development from peat, they are lignite, subbituminous coal, bituminous coal, and anthracite.

Their composition varies widely depending on where they are found. The lowest rank of coal, lignite, retains most of the structure of the original plant matter, including the woody element. Lignite has the lowest percentage of fixed carbon of all the four ranks, and therefore represents the least efficient fuel source. It also has the highest content of volatile matter and moisture. Lignite ranges in color from light brown to very dark brown. The light-brown variety is sometimes called "brown coal".

Subbituminous coal is black and shows no traces of the woody substances from which it originally derived. (The name "bituminous" comes from the Latin bitumen, meaning "pitch"). Today the word "bitumen" refers to several inflammable substances such as asphalt, tar, and various other hydrocarbons, but it is no longer officially applied to coal and may have up to 40 percent fixed carbon and as much as 25 percent moisture.

The fixed-carbon content of bituminous coal may exceed 70 percent. Bituminous coal, also known as soft coal, catches fire easily and burns with a yellow flame, giving off smoke and odor.

Anthracite (from the Greek anthrax, meaning "coal") is the highest rank of coal. This hard black rock has very little moisture, and may contain over 90 percent fixed carbon. It ignites with some difficulty, but burns longer than do the other kinds of coal. Anthracite produces a blue flame that emits little smoke or odor, thanks to its low ash and sulfur content.

In one important area – electricity – the use of coal as a fuel is important. Many electric generators are run by coal rather than by all other fossil fuels and hydropower combined. For example, in the USA 57 percent of all electricity is generated by burning coal.

Unfortunately, the by-products of coal combustion still include various

toxic gases that are often vented into the atmosphere. These gases, when combined with moisture in the air, are one of the primary sources of acid rain. The mining and burning of coal involve certain problems. Accidents in coal mines and diseases that result from breathing coal dust make coal mining a dangerous occupation. When burned, coal releases sulfur and other impurities that pollute the air. To reduce pollution, many large factories that burn coal have installed filters and other cleaning devices.

Ex. 2. Answer the following questions.

1. What kind of mineral is coal?
2. What substances does coal contain?
3. What is coal used for?
4. How many ranks of coal are there? What are they?
5. What is the least/most efficient type of coal? Why?
6. What type of coal is known as a soft coal?
7. What kind of problems are connected with mining and using coal?

Ex. 3. Read the text bellow and arrange the following headlines to its parts.

1. Manufactured gas and deposits of natural gas.
2. Ways of storage.
3. Obtaining energy nowadays.
4. The formation of natural gas.
5. The invention of the Chinese.
6. Environmental effects.
7. Natural gas composition and its transportation.

Text 2. **Natural Gas**

Since early in the 19th century fossil fuels have supplied humanity with sources of energy. Nowadays people in a lot of European countries rely on obtaining energy from the vast stores of natural gas trapped within the rock layers of Earth.

Scientist are still not sure how natural gas came to be stored in the crust of the planet. According to one widely accepted theory, countless tiny marine plants and animals, called plankton, were deposited on the ocean floor many millions of years ago. Eventually their remains were covered by layers of mud that had been washed into the sea from shore. As thousands of years passed and more layers of mud were added, the sediments were subjected to extreme pressures and intense heat. Often they were folded and squeezed by movements of Earth's crust. Different layers of sediment turned into various kinds of

rocks, some of which were porous. The remains of the once-living animals and plants were converted into gas and oil. Not surprisingly, these, two forms of petroleum occur together.

Eventually people learned that the gas that seeped from the ground was flammable. The Chinese were known to have made use of this property as early as 940 B.C. They piped natural gas through hollow bamboo rods to the ocean shore, whey they burned it to evaporate seawater and produce salt.

In the 19th century manufactured gas, made from coal and, later, from coke and oil, was the chief gaseous fuel. Natural gas became a serious competitor of manufactured gas in 20th century when immense natural gas deposits were discovered. All over the world prospectors were searching for rock layers with natural gas in deserts, on mountains, in swamps under snow and ice, along the sea cost or offshore. The largest reserves were found in Russia, Iran, the United Arab Emirates, Saudi Arabia, Iraq and the USA.

From that time on, the consumption of natural gas increased greatly. Nowadays natural gas in found and released as a result of oil-drilling operations. It is a mixture of such gases as methane, ethane, propane, butane and pentane. The heavier gases, propane and butane, are separated by liquefaction and are termed "petroleum gases". The remainders consisting largely of methane are known as "natural gas". When seamless, electrically welded pipes became available to the industry, long distance natural gas transmission lines began transporting gas bringing it t the cities. Natural gas is used in homes for a variety of applications, including cooking, heating water, central heating.

Natural gas can be stored in transmission pipelines under high pressure; sometimes it can be forced back into the ground, into the layer of porous rocks, or in above ground tanks. One way to store a grate of gas in a relatively small place is through liquefaction. Natural gas can be changed into liquid form by cooling it to –256 °F (–160 °C). Once liquefied, natural gas fills less then 1/600th of the storage space required by gaseous natural gas. Liquid natural gas is often shipped long distance in tankers.

Of all fossil fuels, natural gas has the cleanest environmental record. When it is burned, it emits only carbon dioxide and water. Although there is concern about the production of carbon dioxide – the primary greenhouse gas thought to be responsible for global warming – other environmental consequences are minimal. Unlike coal and oil, natural gas emits no sulfur

dioxide, and thus does not add to the formation of acid rain; nor does it contribute to smog or solid waste problems.

Ex. 4. Answer the following questions.

1. What source of energy do people rely on in a lot of European countries?
2. What is the widely accepted theory of natural gas?
3. How did the Chinese extract natural gas and produce salt?
4. What was the chief gaseous fuel in the 19th century and what was it made from?
5. Where were prospectors searching for rock layers with natural gas?
6. What is the composition of natural gas?
7. How do you understand the term "petroleum gas"?
8. How is natural gas used in homes?
9. What are the ways of natural gas storage?
10. What are environmental of the natural gas connected with the burning?

Ex. 5. Read the text and answer the question: What are the three ways to use water power?

Text 3. **Water Power**

Some of the ways in which Britain gets its energy are often dangerous and dirty. They are also unsustainable. Water power from the tides and the waves is one way to reduce pollution and create energy safely and cleanly. More than 70 % of the earth's surface is water. It is impossible to know exactly how much energy could be produced from this, although as an example 4-metre high waves in storms could produce up to 700 kilowatts per metre. While it is not practical to use stormy seas as a resource, even relatively calm seas and tidal rivers can be exploited for their energy potential. Nowadays, machinery can be used to convert the power of moving water into electricity.

Hydro-electricity is the most common use of water power in Britain, although even then it only accounts for 2 % of all the electricity generated in Britain. A huge body of water, the reservoir, is held back by a dam so the water is fed through pipes at great speed, to a turbine which generates electricity. There are major advantages to this system. First, it is a clean source of power, which uses only natural renewable resources. It is safe, too, if it is well-constructed, although there have been disasters when dams have burst. It is also possible to control how much power is generated. The major disadvantage, especially in Britain, which is comparatively small and

overpopulated, is that hydroelectric power uses lots of land, which has to be flooded to make reservoirs. It also has very high start-up costs.

However, small-scale hydroelectric projects have fewer disadvantages than the huge schemes such as the Hoover Dam in the USA. They are cheaper to build and less potentially dangerous. This kind of smaller project uses turbines, which work on a similar principle to old-fashioned waterwheels, but are smaller and more efficient.

With impulse turbines, water is forced through pipes at speed. It hits specially-designed sections of a wheel, which spin. The kinetic energy thus produced is transferred to the engine. There are various kinds of impulse turbines, including the Pelton Turbine, which is a single or double width of cup-shaped devices on a narrow wheel, and the Cross-Flow Turbine, which consists of thin paddles on a long shaft, and which is suitable for wider areas.

There are also reaction turbines such as the Francis Turbine, which looks rather like a ship's propeller. They consist of a series of blades mounted inside the pipe, which is carrying the water under great pressure. These blades are turned by the flow of water across them.

Small water turbines are only ever about 80 % efficient, as some efficiency is inevitably lost in the transfer of energy. But this should not prevent us exploiting the power of water further. The small-scale systems described here are cheap and clean, and, once set-up costs have been met, will provide power for years to come without much maintenance and at no permanent cost to the environment.

Ex. 6. Answer the questions.

1. What kinds of sustainable power are used in Ukraine to generate electricity?
2. Are there many hydroelectric plants operating in Ukraine? Can you name them?
3. What are the advantages and disadvantages of using hydropower?
4. Describe the process of transforming water power into electric energy at a hydroelectric plant.

Ex. 7. Read text 4 and answer the question: What are the most common applications of direct solar energy?

Text 4. **Solar Energy**

People have devised a number of ways to make direct use of the sun's energy. These uses include heating water, heating and cooling buildings, generating electricity, and cooking food.

Solar heating. Many people in warm climates heat water with simple, inexpensive batch heaters. A batch heater consists mainly of an insulated tank with several layers of clear glass covering the side of the tank that faces south. Manufactures blacken the outside of the tank because black absorbs more sunlight than any other color. The black surfaces convert the sunlight to heat and thus warm the water. The glass prevents most of the heat from escaping from the tank. The hot water rises to the top of the tank and flows from there directly to a faucet.

Devices called flat-plate collectors are used to heat water and the air inside buildings. A flat-plate collector consists chiefly of an insulated box covered by one or more layers of clear glass or plastic. Inside the box is a plate of black metal or black plastic. The plate absorbs sunlight and converts it to heat, which becomes trapped under the glass. Air, water, or some other fluid circulates through tubes welded to the plate and absorbs heat from the plate. The heated fluid then flows to a heat exchanger, where it transfers its heat to water. The heated water is stored in a tank and is pumped from the tank to faucets in the house.

Many buildings use passive solar energy systems for heating air. In most cases, these buildings have large south-facing windows to trap heat. During the day, sunlight passes through the windows and heats walls and floors made of stone or brick. At night, the walls and floors release the heat. Additional heat may be stored by placing water or special phase-change materials inside the walls. These phase-change materials melt at about room temperature. As they melt, the materials store large amounts of heat. The materials later release the heat as they become solid again. In buildings with passive solar energy systems, special insulating shades or shutters help keep heat from escaping through the windows at night.

Solar air conditioning. Most solar air conditioning systems use solar collectors and special materials called desiccants that can absorb large amounts of water. The air conditioning process begins when fans force air from outdoors through a desiccant, which removes heat. Next, the air passes over a surface soaked with water. As the water comes into contact with the dry air, it evaporates, and absorbs more heat from the air. The cooled air then passes through the building. After the air leaves the building, the solar collectors reheat it. The desiccant is dried out by blowing the reheated air through it, and the process begins again.

Creating electricity. Direct solar energy can also be used to create electricity. Two basic types of devices used for this purpose are photovoltaic cells and high-temperature collectors.

Photovoltaic cells, also called solar cells, consist of thin slices of semiconductor materials. When the sun shines on a photovoltaic cell, electric current flows from one side of the cell to the other. Photovoltaic cells power most artificial satellites. These cells also power many small electronic devices.

High-temperature collectors, also called solar furnaces, generate large amounts of electricity. In one type of high-temperature collector, many flat or slightly curved mirrors focus the sun's rays on a target, such as a piece of metal. A fluid such as water is pumped inside the target, where it is heated. The steam or gas that results from heating the fluid carries heat energy to turbines that generate electricity.

Solar cooking can be done by using parabolic (dish-shaped) reflectors to focus sunlight on the food or on a pot that contains the food. Another method uses a solar oven. A solar oven is an insulated box with a window and several reflective inner surfaces. The oven heats up when the window is pointed toward the sun.

During the 1990's, shortages of oil and natural gas led to the development of more efficient solar technology. In some areas, new solar homes have become an economical alternative to new homes heated with gas or electricity. Experts believe that as people use direct solar energy more and more, the mass production of solar equipment – and the development of better equipment – will steadily improve the economic advantages of using direct solar energy.

Ex. 8. Answer the following questions.

1. What devices enable people to use solar energy for heating water and air inside buildings? How do they operate?
2. What kind of process is used to cool air inside the building with the help of solar power?
3. What types of devices are used to create electricity from solar energy?
4. Do you think a solar power plant can effectively produce electricity? Give your reasons.
5. What do you think about idea of solar cooking? Could it be helpful in our life?
6. Are there any future prospects for using direct solar energy in Ukraine and other countries?

Ex. 9. Read text 5 and answer the question: What kind of alternative energy source does this article deal with?

Text 5. **Golden Dumps**

Paris streets were an incredible sight on September 8, with all citizens riding bicycles, roller skates, battery-driving vehicles, or street cars, getting to work, school, or college. This was no publicity stunt or Greenpeace or something similar. It was the Automobile-Free Day celebrated in France. Experts later estimated that the pollution level had dropped by 25 % that day, and this prompted the French to make the event a tradition. This April Ukraine marked two ecological dates: Day of the Environment and Earth Day. The conference, "Wastes: a New Vision", came a logical sequel. The ecologists and physicians present discussed Ukraine's second highest priority after Chernobyl: industrial, agricultural, household, and pharmaceutical waste management. Unfortunately, no constructive solutions to the problems were offered. Meanwhile, such regulations and criteria have long been worked out. In the West some auto companies produce ecologically safe vehicles consuming less than four liters of gasoline per 100 km. Biodiesels, cars using plant fuel, are increasingly popular in Germany. Alternative (renewable) sources of energy – wind, sun, geothermal – are also listed in that number. And there is a very popular waste-sorting method (nonexistent in Ukraine), which does not call for heavy investment.

In Ukraine, considering its geographic and weather factors, biogas technologies seem most acceptable. They are semifunctional, allowing waste disposal without damaging the population and environment, and an additional source of energy. Such a universal purpose technique (known in China several thousand years ago) consists in decomposing organic matter in the absence of air. Biogas is mostly known to Ukrainian ecologists in its negative manifestations, because its wrong and uncontrollable usage often causes fires at dumps and on proving grounds of solid wastes, with grave consequences for the environment; personnel poisoning risk is also high. At the same time biogas combustion in boilers three kilometers from the proving ground more often proves that it is the most effective disposal method. Biogas can be used in central heating and industrial boilers in the construction industry. Another option is biogas enrichment, converting it into natural gas for pipeline and using it as auto fuel.

There are over 500 dumps in Ukraine, lacking most essential facilities to prevent the pollution of underground waters and the atmosphere. Meanwhile,

methane discharged from these dumps constitutes 6...18 % of its overall emission in the atmosphere. Some 140 solid waste storage sites are proving grounds fit for the collection and further utilization of biogas. Interestingly, installations for biogas technologies are available in Ukraine (albeit not many), so the only thing missing is a desire to move forward.

(From "The Day")

Ex. 10. Answer the following questions.

1. What event took place in Paris on September 8? What was it aimed at?
2. What issues were discussed at the conference in Ukraine?
3. How are the problems of using ecologically safe power sources solved in other countries?
4. Why do biogas technologies seem most acceptable in Ukraine?
5. What are the benefits of using biogas as a source of energy?
6. Do you agree with the author's conclusion concerning producing and using biogas in Ukraine? Give your reasons.

Ex. 11. Read text 6 and answer the question: What are the main trends in renewable energy development in Denmark?

Text 6. **Sustainable Energy Development: Danish Experience**

A popular movement for renewable energy in Denmark led to the foundation of the Folkcenter for Renewable Energy, an independent institution supported by the Government and local authorities, in 1983. Its aim is to work for a resource and environment conscious energy policy and for self-sufficiency from renewable energy sources. The Folkcenter develops renewable energy technologies designed for local energy production, conducts experiments, provides training courses as well as information and know-how dissemination. The area of dissemination of information includes publications, a bi-monthly magazine and regional campaigns for wind and solar energy. In the technical area the Folkcenter organizes meetings where involved professionals at many levels exchange knowledge and experience. The main topics are: wind power, solar energy, biogas, energy conservation, low energy houses, green cities and combination of renewable energy and local cogeneration utility plants. In the political area the Folkcenter tries to ensure that the renewable energy movement had influence on state initiatives: research programmes, testing arrangements, educational efforts, subsidy and financing conditions as well as energy planning. The international division organizes training programmes, conferences,

international cooperation projects and develops national and international contacts between enterprises.

The activities of the wind division expanded significantly over the years. Today, wind power is well established in Denmark as a reliable and environmentally friendly source of electricity. This has resulted in a competitive wind turbine industry that employs more than 2,000 people, and Denmark has for many years held a dominant position on the global wind technology market. A series of technically advanced wind turbines rated from 20 to 525 kW, known as the Denmark series, are sold to both private owners and small wind-power cooperatives in Denmark and abroad. In this field the Danish technical resource is based on: 1) turbines for extreme climatic conditions; 2) turbines for developing countries; 3) individual household units for electricity and heat.

In many places around the globe the power supply still is based on diesel generators. This kind of power generation is polluting, demands a lot of resources and is expensive. Power from wind turbines combined with gas engine can effectively compete with diesel generators. When the wind turbine meets the demand, the engine closes down, operating mostly in no-wind periods.

For example, FC 4000 Wind Motor installed in Zambia is applied for grinding, water pumping, cooling, hand-tools operation, battery charging, lighting etc. FC 3200 wind turbine was designed in cooperation with Greenland Telecommunication Company for telecommunication in arctic conditions, in mountain regions and other remote areas. It was developed to survive wind speeds up to 90 m/s and temperatures down to –50 °C.

Out of 3,500 wind turbines installed in Denmark, a little over 500 are utility owned, and out of the privately owned turbines 2,000 belong to cooperatives consisting of 5–50 households or farms. It is estimated that in future the installed capacity of wind power will amount to 1,500 MW, and 10 percent of electricity consumption will come from the wind.

The Folkcenter is among forerunners of biogas plants developments. Nowadays biogas is considered an important source of ecologically safe energy. The Folkcenter contributed to the construction of efficient, low-cost co-generation plants, in which biogas is transformed into electricity and heat, securing significant savings on the heating bills. These units are suitable both for large farms and small villages. In future environmentally sound co-generation plants will be fitted with different types of gas engines based on the combustion of biogas, manufacturing gas, natural gas and hydrogen. The Folkcenter is

spearheading the development and construction of pre-fabricated solar water heaters for both small household systems and large high temperature district heating plants. Danish solar water heaters feature high efficiency in spite of relatively few hours of sunshine available. Denmark's largest solar water heating plant operates in the town of Ry, the collector surface being 3,000 sq.m. The plant substitutes 500 tonnes of coal annually. In summer 20 per cent of the heat consumption by 1,300 households of Ry is supplied by the this solar heating plant.

In order to pave the way to increased application of renewable energy the Folkcenter's future plans include the construction of extensive complex of buildings and facilities called the Green Village. The Green Village is aimed to demonstrate that a community can be self-sufficient with energy from non-polluting sources of renewable energy. The objective is also to integrate different green technologies for low energy housing, sewage water treatment, agriculture, creating a recycling system, with installed demonstration plants that all together can form a model of safe ecological settlement. No other types of fossil fuel power such as oil or natural gas will be used in the Green Village. In addition to demonstration purposes, activities will include research, development and testing ecologically safe systems and technologies for housing, sewage water treatment and organic farming. The most important institutions in the Green Village will be Green Technologies Center and Training Center, the latter providing training courses and accommodation for trainees mainly from Eastern Europe and developing countries.

Thus, a wide range of the Folkcenter's activities contribute to the transition process from a resource intensive and environmentally harmful society to a sustainable future.

Ex. 12. Answer the following questions.

1. What is the aim of the Folkcenter for Renewable Energy?
2. What divisions does it consist of?
3. What do its main activities include?
4. What kinds of wind turbines are developed and built in Denmark?
5. What can they be used for?
6. What percentage of electricity consumption will come in future from the wind energy in Denmark?
7. What kinds of fuel can be combined for the operation of co-generation plants?
8. What percentage of heat consumption in Ry is supplied using solar energy?

9. What is the aim of establishing the Green Village in Denmark?
10. What kind of Danish experience in renewable energy developments can be used in Ukraine?

KEY ANSWERS

Unit 1

Ex. 3. 1) C; 2) E; 3) B; 4) A; 5) D.

Unit 2

Ex. 2. 1g; 2h; 3b; 4a; 5e; 6j; 7d; 8c; 9f; 10i.

Ex. 3. 1d; 2c; 3h; 4j; 5e; 6i; 7b; 8f; 9a; 10g.

Ex. 6. A. 1) will be used; 2) is removed; 3) can be transported; 4) is produced; 5) is refined; 6) is called; 7) are split; 8) can be processed; 9) is burned; 10) have been developed and built; 11) are combined; 12) will have to be replaced.

Unit 3

Ex. 2. 1d; 2a; 3g; 4e; 5b; 6f; 7c.

Unit 4

Ex. 2. 1) b; 2) d; 3) a; 4) c; 5) f; 6) h; 7) g; 8) e.

Ex. 3. 1) c; 2) e; 3) a; 4) d; 5) f; 6) b.

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ЛУК'ЯНОВА Світлана Григорівна
ШЛЯХТІНА Олена Семенівна

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ДЛЯ НОТАТОК

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