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«Комсомольский-на-Амуре государственный технический университет»

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«Комсомольский-на-Амуре государственный технический университет»

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Содержит аппарат разнообразных упражнений, направленных на формирование у студентов различных переводческих умений. Пособие основано на аутентичных технических текстах и оригинальных аудиоматериалах.

Пособие предназначено студентов 3-4 курсов специальности «Перевод и переводоведение».

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PREFACE

Учебное пособие «Научно-технический перевод» предназначено для студентов-лингвистов, студентов технических специальностей широкого профиля, в особенности специалистов-энергетиков, и всех, кто занимается переводом в учебной или профессиональной деятельности и кто желает самостоятельно или под руководством преподавателя овладеть навыками устного и письменного перевода в рамках контекста изучения энергетических систем.

Спецификой данного пособия является попытка одновременного решения задач обучения письменному и устному переводу, а также изучения энергетических систем и альтернативных источников энергии на основе разнообразного материала.

Предлагаемые в пособии материалы частично отобраны из хрестоматийных пособий по энергетике, а в большинстве – из современных источников США и Великобритании, включая Интернет, что позволяет отразить лексико-грамматические особенности современной англоязычной научно-технической литературы.

Структура пособия позволяет не только детально изучить ряд основных вопросов и проблем современной мировой энергетики, но и закрепить при помощи тренировочных упражнений лексические и грамматические вопросы перевода. Все задания направлены не только на формирование необходимых переводческих навыков, но и на расширение лексического запаса и общего кругозора по затрагиваемой проблематике.

Пособие состоит из нескольких разделов и охватывает следующие темы:

1. Энергия. Основные положения.
2. Гидроэнергетика.
3. Атомная энергия.
4. Альтернативные виды энергии:

- солнечная энергия;
- энергия волн;
- ветровая энергия;
- геотермальная энергия;
- энергия биомасс.

Все разделы имеют единую структуру, что облегчает работу с пособием как преподавателя, так и студента. Каждый раздел имеет следующее наполнение:

- словарь, состоящий из слов и словосочетаний, предназначенный для самостоятельной работы студентов;
- текст для перевода с листа;
- текст для полного письменного перевода;

- текст для реферативного перевода;
- упражнения для аудирования и проведения последовательного перевода.

Пособие может использоваться не только как базовый учебник по переводу, но и как дополнительный источник для занятий студентов технических специальностей.

INTRODUCTION

Упр. 1. Переведите термины. Подготовьтесь к диктанту.

- Coal;
- Dominant fuel;
- Power plant;
- Town-gas;
- To be commissioned;
- High voltage;
- Transmission;
- Distribution;
- Network;
- Gas-fired central heating;
- Fossil fuel;
- Geothermal energy;
- Greenhouse effect;
- Kinetic energy;
- Magnetic energy;
- Generator;
- Heat exchanger;
- Solar cell;
- Tidal barrage;
- Water works;
- Solar energy;
- Wind energy;
- Biomass energy;
- Nuclear energy;
- Hydro energy;
- Radiator heating;
- Flat plate solar collector;
- Steel tube;
- Heat transfer fluid;
- Glass cover;
- Air duct;
- Depletion.

Упр. 2. Переведите с листа.

Understanding Energy

What is energy? Is it strength, speed, or motion? Actually, energy is the ability to do work. Nature does not usually give us energy in a form we can use directly. It is as if the energy were hiding – waiting for someone to find it. For example, coal is a source of energy, but it is just a black rock. Technology makes it possible to find and release the energy hidden in the rock, and then put that energy to work. Technologists are always looking for new and better ways to use nature’s energy.

Forms of Energy

As you go through an average day, you use many different forms of energy. Electrical energy powers light bulbs. Thermal, or heat, energy from your home’s furnace keeps you warm. Mechanical energy, used by buses or cars, might get you to school.

All energy in nature can be grouped into these six forms:

1. Mechanical energy, or energy of motion – pedaling a bicycle.
2. Thermal, or heat.
3. Electrical energy – a bolt of lightning.
4. Chemical energy – a battery in a cell phone.
5. Nuclear energy – a submarine engine.
6. Light, or radiant, energy – solar cells.

Energy cannot be created or destroyed, but it can be changed from one form to another. For example, to use coal to produce useful electricity, the form of the energy must change many times before it becomes electricity.

Упр. 3. Переведите устно.

Energy Resources

Let's take a closer look at today's sources of energy. They can be divided into three groups: renewable, nonrenewable, and unlimited.

Renewable Sources

Renewable energy sources come from plants and animals. They can be replaced or renewed when we need more. Two examples include food and alcohol.

Пища

Наше тело нуждается в пище для того, чтобы вырабатывать энергию, которая нам необходима для движения, умственной и других видов деятельности. Энергия, которую мы получаем с пищей, измеряется в калориях.

Alcohol

Alcohol is a liquid made from crops such as corn and sugar cane. It can be used as fuel in special automobile and truck engines. These engines can operate with regular gasoline, an alcohol-gasoline mixture, or pure alcohol. They are called "flexible-fuel" vehicles.

Automobiles that run on alcohol fuel produce less air pollution than those that use gasoline. When added to gasoline, an alcohol called "ethanol" can extend fuel supplies. A mixture of 10 percent ethanol and 90 percent gasoline is sold at some service stations. All ordinary car engines can run on this fuel.

Невозобнавляемые ресурсы

Nonrenewable sources of energy cannot be replaced once they are gone. Coal, oil, natural gas, and uranium are examples of these sources.

Coal, oil, and natural gas are fossil fuels, or fuels made from fossils. A fossil is what remains from a plant or animal that lived long ago. Coal, oil, and natural gas are formed from these once living plants and animals.

Уголь

Миллионы лет назад растения погибали и опадали на землю, по прошествии времени под воздействием давления эти погибшие растения сформировали плотные слои, которые затем превратились в угольные пласты. Эти пласты обычно толщиной не более трех футов и залегают между другими горными породами. Уголь используется для производства электричества.

Oil

You can thank animals that lived millions of years ago for the gasoline used in today's cars. When these animals died, their remains combined with the remains from plants to form crude oil. The fuels for cars, trucks, locomotives, airplanes, and ships come from oil. More of our energy comes from oil than from any other source. Oil is also turned into products, such as plastics, paint, and asphalt.

Упр. 4. Дайте определения терминам.

Barrage	
Gas	
Non-renewable	
Produce	
Water	
Wave	
Fossil fuels	
Power stations	
Generators	
Renewable	
Tidal	
Coal turbine	

Упр. 5. Вставьте вместо пропусков слова из упражнения 4. Переведите текст.

Most large power stations burn **1**___________ which were formed from the remains of plants and animals that lived on the earth millions of years ago. The first type of fossil fuel to be used in large quantities was **2** _________.

Today, it is increasingly expansive to mine, however, many **3**________ still burn it to **4**_________ electricity. Oil and natural **5**_________ have now largely replaced coal. These fuels are all **6**________ and will eventually run out. Wood is used by 2 billion people in the developing world and unlike fossil fuels, it is a **7**_____________ energy source. Alternative energy sources include **8**______________ power technology. In hydro schemes, water from a reservoir or from a river powers **9**___________ which drive **10**____________________. **11**_________________________ power systems use the energy from wind and sea or take mechanical energy from wave movement. The UK offers a good position to exploit wave energy. The movement of the sun, moon and earth combine to produce **12**__________ power. Electricity can be generated when tidal water passes through turbines positioned in a **13**__________.

Упр. 6. Переведите устно.

Power and Work

Although the words energy and power are related to each other, the two words have different meanings. Power is a measure of the work done over a certain period of time. It is a way of rating how quickly the work is done. You can cut grass more quickly by using a riding lawn mower than you can using a push-type lawn mower. In both cases, the goal of the work is the same: cutting the same area of grass. However, the engine in the riding mower allows you to do it more quickly, so it is more powerful.

One common measure of power is horsepower. A three-horsepower lawn mower engine produces as much power as three horses. If you are in very good physical condition, you might be able to develop about 0.2 horsepower for several minutes.

Forms of Power

What are the most common forms of power? We commonly use three forms of power: mechanical, electrical, and fluid. The photo below illustrates these forms of power as they are used every day.

Mechanical Power

Mechanical energy is the energy that is involved in motion. When you pedal a bicycle, you convert mechanical energy to power. You use the up-and-down motion of your leg muscles to provide the mechanical power that moves the bicycle.

Electrical Power

We convert fossil fuel energy into electrical power in power plants. That power is then used for things such as lighting our homes, operating air conditioners, and running electric motors.

Fluid Power

When gases or fluids, such as air or water, are put under pressure, they can control and transmit fluid power. An electric motor is often used to pressurize the fluid. The greater the pressure they are under, the greater the force they exert. Fluid power that is produced by using pressurized gases is called pneumatic power. Pneumatic power operates tools in some automobile repair shops and factories. Compressors are used to pressurize air for power tools and paint sprayers, and to inflate tires. Putting liquids under pressure results in hydraulic power. Hydraulic power is popular for heavy construction equipment and factories because it provides more force than pneumatic power can produce.

Power Systems

Power systems drive and provide propulsion (motion or force) to other technological products and systems. Power systems must have a source of energy, a process, and a load. The energy source is part of the input in a power system. The process converts the energy into a form that can do work. The load is the output force. For example, your uncle might use a small pickup truck to carry 500 pounds of mulch for a flower garden. The load is the force that the truck must exert to carry that much mulch. Power systems have been important to the development and growth of our culture. For example, 100 years ago, it took months to travel around the world. Ideas, customs, and products moved slowly to reach people. Today, thanks to machines (airplanes) that fly very fast, almost every city on our planet is only hours away from every other city. As a result, ideas, customs, and products spread quickly.

Упр. 7. Переведите письменно.

Impacts of Energy and Power Technology

The Effects of Using Energy

Besides air pollution, what other negative effects are caused by misusing technology? The use of technology can have unintended consequences. For example, Americans have good transportation systems, countless electrical devices, good housing, and food. This way of life and a successful economy have been the result in part of advancements in technology. The use of energy has made technology possible. Unfortunately, not all results have been good. Our energy consumption has created some serious problems. People are striving to find ways to balance financial needs with protecting the earth’s environment.

Pollution

Pollution results when contaminants – unwanted elements – get into our environment, whether in our air, our water, or our land.

Fossil Fuels

More than 90 percent of our energy comes from burning fossil fuels. You may already know that burning produces a great many pollutants. Burning fills the air with haze and sometimes makes your eyes burn. It can also be a serious health threat. Each fuel produces many pollutants, but there is usually one pollutant that is particularly serious in each case.

Acid Rain

All coal has a small amount of sulfur. When coal burns, it creates sulfur dioxide (SO_2). The sulfur dioxide combines with water vapor and oxygen in the air to form a weak sulfuric acid. This acid mixes with nitric acid (NO_2), another pollutant, and falls to the earth as acid rain. It can kill fish, crops, and trees. Acid rain also damages monuments and statues.

Carbon Monoxide

Gasoline forms carbon monoxide when it burns. Carbon monoxide is an odorless, colorless, and poisonous gas. When you breathe it into your lungs, it reduces the ability of your blood to carry oxygen. If a person has a lung problem, too much carbon monoxide can make the problem worse.

Reducing Acid Rain

There is no complete solution to the problem. However, acid rain can be reduced if power companies and industries use coal containing less sulfur. They can also install special equipment to remove up to 90 percent of the sulfur dioxide from their smoke. The Greenhouse Effect Burning fossil fuels also contributes to the greenhouse effect – the heating of the earth's atmosphere. This occurs when too much carbon dioxide builds up in the air. The carbon dioxide prevents heat from escaping. If we produce too much heat, and it cannot escape, the temperature of the earth's atmosphere may increase, creating the greenhouse effect. Warmer temperatures might mean longer growing seasons for crops. More food could possibly be produced for the world's increasing population. However, the polar ice caps would melt significantly. That melted ice would raise the ocean level and cause flooding of some seacoast cities. The changing climate also affects ecosystems and plant and animal life. These effects of "global warming" have already occurred in some areas of the world.

Waste Heat

Waste heat is also a water pollutant. Heat produced by power plants is discharged into lakes, rivers, and oceans. Water plants and animals can be harmed. Nuclear Waste Nuclear pollution may be the most threatening pollution of all. Nuclear, or radioactive, waste is a solid left over after nuclear fuel is used up. The waste remains dangerous for many years and can cause serious health problems. Proper disposal of this material is difficult and is an important social issue. The waste is placed in special concrete containers. The area where they are stored is constantly checked for radioactive leakage. Some people think that nuclear waste should be sent into space with rockets. What do you think? Future generations may be able to figure out how to use this waste in a positive way.

Depletion of Resources

What can we do to maintain a supply of energy for our future needs? Our earth has a limited supply of some energy sources like fossil fuels. However, people need more and more energy as the world's population grows. Also, each person uses more energy now than in the past, partly because there are so many technological conveniences available for us to use. We have to be sure that there is enough energy to provide for human needs. One way to do that is to develop alternate sources, such as solar energy. Another way is through energy conservation. Energy conservation is the management and efficient use of energy sources. Energy can be conserved if we recycle the materials and products we use. To recycle means to use again. Metal, glass, paper, and some plastics can be recycled. Reusing aluminum cans is one of the best ways to save energy. Recycled cans require 80 percent less energy to produce than cans made from raw materials. All glass can be recycled. Paper is usually recycled into bags, paper towels, and packaging materials. Materials that can be recycled have a special triangular symbol on them. Recycling reduces our use of natural resources. It also reduces the amount of solid waste sent to landfill.

Supplementary materials

Упр. 1. Переведите устно.

Unlimited Sources

Solar Energy

Solar energy comes from the sun. Unlike coal, oil, wood, or many other sources of energy, solar energy is available all over the world. We use the sunlight, or sun's rays, for light, electricity, and heat. Many homes today are practicing energy conservation by using solar heating systems. One type of system uses large flat panels called "solar collectors," which are mounted on a roof. Water flows through tubes in the solar collectors and is warmed by the sun. The heated water continues moving into the building and heats the home's interior. Another type of system uses only special windows and walls to take advantage of the sun's warming rays. Sunlight streams in and warms the interior. Some of the warmth is absorbed by the walls. Then the walls radiate the heat back into the room at night. Solar energy can also produce electricity. This happens when sunlight strikes wafer-thin solar cells. These cells are also known as photovoltaic cells, or photocells. Orbiting satellites above Earth get their electricity from solar cells built on the satellites. Solar cells are not used as much because their electricity costs much more to produce than electricity from a power plant.

Wind

The motion of air across the earth has filled the sails of ships and turned windmills for centuries. More recently wind has been used to turn propellers connected to generators that produce electricity. The wind spins the bladed rotors of large wind turbines at about 15-17 revolutions per minute. The blades capture the energy of the wind, which is channeled to a gearbox in the “nacelle” (the turbine housing). From there, the energy flows to a generator, where it is converted into electricity. The wind turbine is controlled by advanced computers. Wind farms consist of a group of many wind turbines. They exist in many states and countries. Wind farms are located in areas known to have fairly constant winds. Certain regions of the country provide enough wind for wind turbines to operate regularly. Wind turbines and other necessary equipment (like large batteries for storing electricity) can be expensive. It is not usually practical for one house to have its own wind turbine, although in earlier days, people used simple windmills for pumping water lowing.

Water

We use flowing water to generate hydroelectric power. Hydro means “water.” A controlled amount of water flows through pipes in a dam and into a turbine. A turbine resembles a pinwheel. A spinning turbine, connected to a generator, creates electricity. About 7 percent of our electricity comes from hydroelectric dams. The Grand Coulee Dam in Spokane, WA, is the largest source of U.S. water power.

Geothermal Energy

Molten rock lies far beneath the earth’s crust. This is where we get geothermal energy – heat produced under the earth. Hot water or steam is created when underground water comes in contact with hot materials and surfaces as a spring. The steam can be used to produce electricity. Some geothermal electric power plants are located along the west coast of the United States.

Упр. 2. Переведите письменно.

The Future of Alternative Energy

Residential energy use in the United States will increase 25 percent by the year 2025, according to U.S. Department of Energy (DOE) forecasts. A small but increasing share of that extra power will trickle in from renewable sources like wind, sunlight, water, and heat in the ground.

Last year alternative energy sources provided 6 percent of the nation's energy supply, according to the DOE.

"The future belongs to renewable energy," said Brad Colllins, the executive director of the American Solar Energy Society, a Boulder, Colorado-based nonprofit. Scientists and industry experts may disagree over how long the world's supply of oil and natural gas will last, but it will end, Collins said.

While renewable energy is generally more expensive than conventionally produced supplies, alternative power helps to reduce pollution and to conserve fossil fuels.

"People sometimes get caught up in cost-effectiveness," said Paul Torcellini, a senior engineer at the DOE's National Renewable Energy Laboratory (NREL) in Golden, Colorado. "But it can be a question of values and what we spend our money on."

Below, a look at some recent developments in renewable-energy technology.

Solar Power

Photovoltaic, or solar-electric, systems capture light energy from the sun's rays and convert it into electricity. Today these solar units power everything from small homes to large office buildings.

Technological improvements have made solar-electric modules more cost-effective. In the 1980s the average price of energy captured with photovoltaics was 95 U.S. cents per kilowatt-hour. Today that price has dropped to around 20 cents per kilowatt-hour, according to Collins, of the American Solar Energy Society.

The cheaper rate is still more expensive than the average national price of electricity, which in 2003 was a little over 8 cents per kilowatt-hour, according to the U.S. Department of Energy's Annual Energy Review.

Other recent advances include "thin film" photovoltaic technology, a high-tech coating that converts any surface covered with the film into a solar-electric power source.

Boats and RVs that use the film are now on the market. Engineers have also developed a roofing material coated with the electricity-producing film. "The guy who puts on the roof [on a house now] puts on the [solar] panels at the same time," Torcellini said. The roofing material withstands inclement weather and, on bright days, taps sunshine for electricity.

NREL researchers, meanwhile, are working to devise more efficient and cheaper solar-electric systems. Most traditional photovoltaic solar units on the market today convert between 11 and 13 percent of the sun's light into energy. Engineers think they can improve on that.

Jeff Mazer, a Washington, D.C.-area photovoltaic engineer, notes that most thin-film photovoltaic systems today have a 7 to 11 percent efficiency rating. But he estimates that thin films could surpass that rating within three years. He also notes that some new traditional solar modules achieve 15 percent efficiency and believes that figure can climb to 17 percent in the near future.

In the last two decades solar-thermal panels (units used to warm household hot water, pools, and spas) have become highly efficient. Energy costs have decreased from 60 cents to 8 cents per kilowatt-hour since the 1980s, Collins said.

Solar-powered water heaters are typically more expensive than conventional ones, but, as with other products that harness alternative energy, consumers benefit by knowing their energy costs up-front, Torcellini said. "Otherwise, you're hedging your bets about the future cost of [traditional] energy [sources] by using standard appliances," he said.

Wind Power

Compared to other renewable energy sources, wind power competes with conventional energy at a price less than 4 cents per kilowatt-hour, Collins said.

Wind energy projects around the world now generate enough energy to power nine million typical U.S. homes, according to the American Wind Energy Association, a Washington, D.C.-based trade group.

One of the newest trends in wind power is the construction of offshore wind farms, clusters of electricity-generating turbines erected in open-water areas with strong winds.

Europe now has 17 wind farms spinning offshore. The Arklow Bank Offshore Wind Park, 8 miles (13 kilometers) off the eastern coast of Ireland, is one such project. Its seven turbines generate enough electricity to power 16,000 homes.

While few homes generate their own wind power in the U.S., many power companies allow consumers to opt for power generated at a wind plant or other renewable source.

On Tuesday, Colorado voters will consider a ballot initiative that would require power companies to provide 10 percent of their electricity from wind and other renewable sources by 2015.

"If that passes, power companies will offer more rebates to homeowners" to encourage renewable energy production, said Sheila Hayter, an NREL senior engineer.

Ground Heat

Tapping into the ground offers another option to regulate household heating and cooling.

In most areas of the United States, the ground below the frost line maintains an average temperature between 50 and 54 degrees Fahrenheit (10 to 12 degrees Celsius).

Ground-source heat pumps, also called geo-exchange systems, use this relatively constant temperature to keep homes at comfortable temperatures.

The devices employ a series of underground, liquid-filled tubes or wells. Liquid flows through the pipes into the home, where a heat exchanger either adds or subtracts heat from indoor air, depending on the season. In winter, that means added warmth captured from the ground.

"If you can [do that], your furnace doesn't have to work so hard," Hayter said.

A U.S. Environmental Protection Agency study found that geo-exchange systems can save up to 70 percent of home-heating costs. (*Cameron Walkerfor, National Geographic News*)

1. HYDRO ENERGY

Упр. 1. Переведите термины и подготовьтесь к диктанту.

- Hydroelectric Power Plant;
- Power-production capacity;
- Silt;
- Tributary;
- High voltage;
- Transmission line;
- Penstock;
- Impulse-turbine;
- Nozzle;
- Fast-moving jet;
- Conventional;
- Intake;
- Coil;
- Stator.

Упр. 2. Переведите с листа.

Among the variety of renewable-energy resources, hydroelectric power is the most desirable for utility systems that have successful and proven track records. Power generated from hydroelectric plants can exceed 10 GW. On the European continent, Norway generates 98 percent of its electrical energy from hydroelectric power. It is estimated that at this time, only about 10 percent of the world's hydroelectric potential has been exploited. The remaining untapped potential is in Africa and Asia.

Presently, the world's total installed hydropower capacity is about 630,000 MW. Annual worldwide power production is estimated to be 2200 billion kWh, which means that power plants are running at 40 percent of their rated power-production capacity.

One of the world's largest hydroelectric projects is currently under construction in China. The project, with a capacity of 18.2 GW, has been named the Three Gorges Dam and has entered into the second phase of the three-phase construction. On completion of phase 3, the power station will be providing full power generation. The estimated construction cost of the dam is projected to be about $25 billion (US).

However, the construction of such a hydroelectric project comes with negative side effects. Construction of the dam has created serious environmental and social problems, including water pollution along the Yangtze River, with numerous pollutants from mining operations, factories, and human settlements that have been washed out to sea by the strong currents of the river.

In coming years, silt in the river is expected to be deposited at the upstream end of the dam, which inevitably will clog the major tributaries. According to recent reports, an estimated 2 million people have been resettled, and 1300 archaeological sites will be moved or flooded. Construction of the dam also has resulted in the destruction of the natural habitats of several endangered species and rare plants.

Упр. 3. Переведите устно.

Hydroelectric Plant Equipment

Major components and machinery used in hydroelectric plants are dam water-flow controls, reservoir controls, turbine controls, electric generator controls, power-transformation equipment required for converting electricity from low to high voltages, transmission lines required to conduct electricity from the plant to the electric distribution system, and finally, penstock systems that carry water to the turbines. Turbines used in hydroelectric power systems are classified in several ways related to their method of functional operation, such as impulse and reaction turbines. Another classification is related to the way the turbine is constructed, such as shaft arrangement or feed-of-water arrangement. Turbines are also designed in a manner that allows them to operate as a pump or as a combination of mechanisms.

For example, impulse-turbine design employs a special nozzle that converts the water under pressure into a fast-moving jet. The jet of water then is directed at the turbine wheel, or runner, which converts the kinetic energy of the water into shaft rotational power. Another example is a Francis turbine, which uses the full head of water available to generate rotational power. Most hydraulic turbines consist of a shaft-mounted water wheel or runners that are located within a water passage that conducts water from higher elevations to lower ones below the dam. Without exception, all hydraulic turbine generators are designed to turn at a constant speed. Constant speed is achieved by a device called a governor, a rotating ball mechanism that is balanced by the rotational centrifugal force and keeps each generator operating at its proper speed through the operation of flow-control gates in water passage.

Упр. 4. Переведите письменно.

Цепь гидротехнических сооружений обеспечивает необходимый напор воды, поступающей на лопасти гидротурбины, которая приводит в действие генераторы, вырабатывающие электроэнергию. Необходимый напор воды образуется посредством строительства плотины и, как следствие, концентрации реки в определенном месте или деривацией – естественным током воды. В некоторых случаях для получения необходимого напора воды используют совместно и плотину, и деривацию. В здании гидроэлектростанции располагается всё энергетическое оборудование. В зависимости от назначения оно имеет свое определенное деление. В машинном зале расположены гидроагрегаты, преобразующие энергию тока воды в электрическую энергию. Также там расположены всевозможное дополнительное оборудование, устройства управления и контроля над работой ГЭС, трансформаторная станция, распределительные устройства и многое другое.

Мощность ГЭС зависит от напора и расхода воды, а также от КПД используемых турбин и генераторов. Из-за того что по природным законам уровень воды постоянно меняется в зависимости от сезона, а также еще по ряду причин, в качестве выражения мощности гидроэлектрической станции принято брать цикличную мощность. К примеру, различают годичный, месячный, недельный или суточный циклы работы гидроэлектростанции. В состав гидроэлектрических станций в зависимости от их назначения также могут входить дополнительные сооружения, такие как шлюзы или судоподъемники, способствующие навигации по водоему, рыбопропускные, водозаборные сооружения, используемые для ирригации, и многое другое. Ценность гидроэлектрических станций состоит в том, что для производства электрической энергии они используют возобновляемые природные ресурсы. Ввиду того что потребности в дополнительном топливе для ГЭС нет, конечная стоимость получаемой электроэнергии значительно ниже, чем при использовании других видов электростанций.

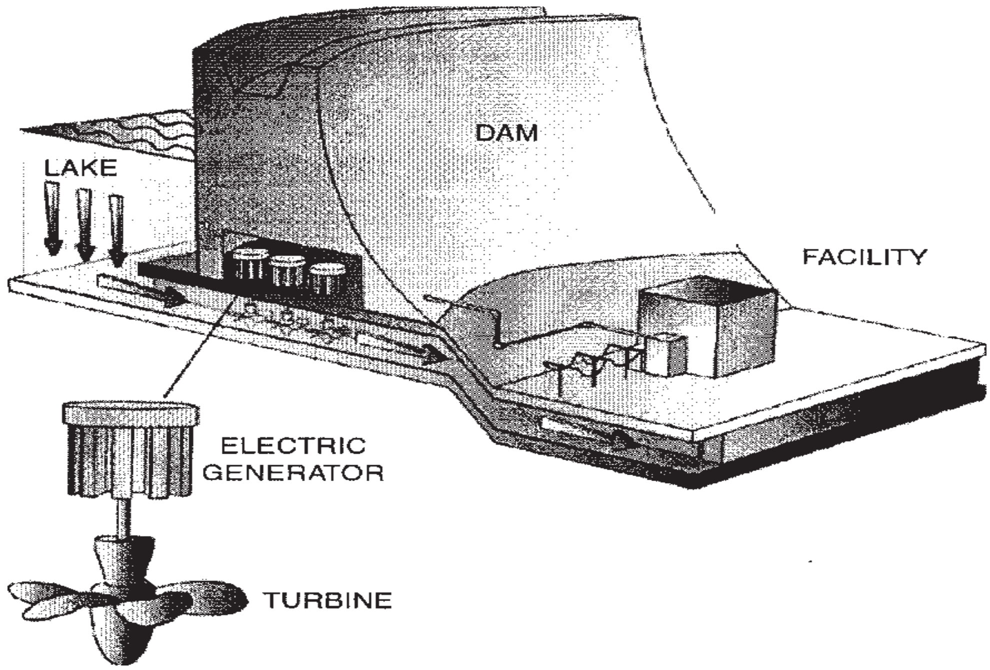
Упр. 5. Прослушайте текст «Hydroelectric power – how it works?» (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar). Переведите последовательно.

Упр. 6. Переведите устно.

Hydropower technologies are classified into two types of operational categories: conventional and pumped-storage types. Power plants, in turn, are rated for power capacity. This includes large or small; low, medium, or high head of water; type of turbine used, such as Kaplan, Francis, or Pelton; and finally, the location and type of dam or reservoir.

Conventional hydropower systems

Conventional hydropower plants derive energy from rivers, streams, canal systems, and reservoirs. This category of power-generating station is further divided in two subcategories: impoundment and diversion. Impoundment-type hydropower generating stations use dam structures to store water. Water from reservoirs is released, and flow is controlled by vanes that maintain a constant water level. In diversion-type hydropower technology, a portion of a river's water is diverted through a canal or penstock. Some installations require a dam.



Pumped-storage hydropower systems

A pumped-storage hydropower plant is constructed from two reservoirs built at different altitudes. During periods of increased electric demand, water from the higher reservoir is released to the lower reservoir to generate electricity. Power generation results from the release of kinetic energy, which is created by discharge through high-pressure shafts that direct the water through turbines connected to generator motors. On completion of the power-generation period, which occurs during the daytime when the demand for and cost of energy are high, water is pumped back to the upper reservoir for storage, when the demand for and cost of energy are low. Even though pumped-storage facilities consume more energy than they generate, they are used by power utility companies to provide peak power production when needed. In some installations, pumped-storage plants operate on a full-cycle basis.

Упр. 7. Переведите письменно.

В зависимости от принципа использования природных ресурсов и образующейся концентрации воды, гидроэлектрические станции разделяются:

- на русловые и приплотинные ГЭС. Это наиболее распространенные виды гидроэлектрических станций. Напор воды в них создается посредством установки плотины, полностью перегораживающей реку или поднимающей уровень воды в ней на необходимую отметку. Такие гидроэлектростанции строят на многоводных равнинных реках, а также на горных реках, в местах, где русло реки более узкое, сжатое;

- плотинные ГЭС. Строятся при более высоких напорах воды. В этом случае река полностью перегораживается плотиной, а само здание ГЭС располагается за плотиной, в нижней её части. Вода в этом случае подводится к турбинам через специальные напорные тоннели, а не непосредственно, как в русловых ГЭС;
- деривационные гидроэлектростанции. Такие электростанции строят в тех местах, где велик уклон реки. Необходимая концентрация воды в ГЭС такого типа создается посредством деривации. Вода отводится из речного русла через специальные водоотводы. Последние спрямлены, и их уклон значительно меньший, нежели средний уклон реки. В итоге вода подводится непосредственно к зданию ГЭС. Деривационные ГЭС могут быть разного вида: безнапорные или с напорной деривацией. В случае с напорной деривацией водовод прокладывается с большим продольным уклоном. В другом случае в начале деривации на реке создаются более высокая плотина и водохранилище – такая схема еще называется смешанной деривацией, так как используются оба метода создания необходимой концентрации воды;
- гидроаккумулирующие электростанции. Такие ГАЭС способны аккумулировать вырабатываемую электроэнергию и пускать её в ход в моменты пиковых нагрузок. Принцип работы таких электростанций следующий: в определенные периоды (не пиковой нагрузки) агрегаты ГАЭС работают как насосы от внешних источников энергии и закачивают воду в специально оборудованные верхние бассейны. Когда возникает потребность, вода из них поступает в напорный трубопровод и приводит в действие турбины.

2. GEOTHERMAL ENERGY

Упр. 1. Переведите термины. Подготовьтесь к диктанту.

- insulation;
- cooling water heat exchanger;
- compressor;
- natural-gas or diesel engine;
- evaporator;
- pressure release valve;
- condenser;
- waste-gas heat exchanger;
- flow pipe;
- vent pipe;
- chimney;
- boiler;
- fan;
- radiator;
- sink;
- liquid;
- heat;
- condensed;
- emission;
- generator;
- exchangers;
- reservoirs.

Упр. 2.Сопоставьте термины с их определениями

1. Energy	A. the energy transferred as a result of a difference in temperature
2. Heat	B. any of the rigid layers of the earth's lithosphere of which there are believed to be at least 15
3. Crust	C. any long narrow cleft or crack, esp in a rock
4. Mantle	D. a natural or artificial lake or large tank used for collecting and storing water, esp for community water supplies or irrigation
5. Plate	E. the capacity of a body or system to do work
6. Magma	F. to rotate or cause to rotate rapidly, as on an axis
7. Fissure	G. the solid outer shell of the earth, forming the upper part of the lithosphere and lying immediately above the mantle
8. Reservoir	H. energy, in the form of heat, light, radio waves, etc., emitted from a source
9. To spin	I. to change or cause to change into vapour or into the gaseous state
10. Emission	J. hot molten rock, usually formed in the earth's upper mantle, some of which finds its way into the crust and onto the earth's surface, where it solidifies to form igneous rock
11. To vaporize	K. the part of the earth between the crust and the core, accounting for more than 82 % of the earth's volume (but only 68 % of its mass) and thought to be composed largely of peridotite

Упр. 3. Переведите устно.

Geothermal Energy

Energy contained in intense heat that continually flows outward from deep within Earth. This heat originates primarily in the core. Some heat is generated in the crust, the planet's outer layer, by the decay of radioactive elements that are in all rocks. The crust, which is about 5 to 75 km (about 3 to 47 mi) thick, insulates the surface from the hot interior, which at the core may reach temperatures from 4000 to 7000 °C (7200 to 12,600 °F). Where the heat is concentrated near the surface, it can be used as a source of energy.

Geothermal geology

The distance from Earth's surface to its center is about 6,500 km (about 4,000 mi). From Earth's surface down through the crust, the normal temperature gradient (the increase of temperature with increase of depth) is 10 to 30 °C per km (29 to 87 °F per mi). Underlying the crust is the mantle, which is made of partially molten rock. Temperatures in the mantle may reach 3700 °C (6700 °F). The convective (circulating) motion of this mantle rock drives plate tectonics – the 'drift' of Earth's crustal plates that occurs at a rate of 1 to 5 cm (0.4 to 2 in) per year. Where plates spread apart, molten rock (magma) rises up into the rift (opening), solidifying to form new crust. Where plates collide, one plate is generally forced (subducted) beneath the other. As the subducted plate slides slowly downward into the mantle's ever-increasing heat, it melts, forming new magma. Plumes of this magma can rise and intrude into the crust, bringing vast quantities of heat relatively close to the surface. If the magma reaches the surface it forms volcanoes, but most of the molten rock stays underground, creating huge subterranean regions of hot rock.

Geothermal reservoirs

In certain areas, water seeping down through cracks and fissures in the crust comes in contact with this hot rock and is heated to high temperatures. Some of this heated water circulates back to the surface and appears as hot springs and geysers. However, the rising hot water may remain underground in areas of permeable hot rock, forming geothermal reservoirs. Geothermal reservoirs, which may reach temperatures of more than 350 °C (700 °F), can provide a powerful source of energy.

Упр. 4. Переведите письменно

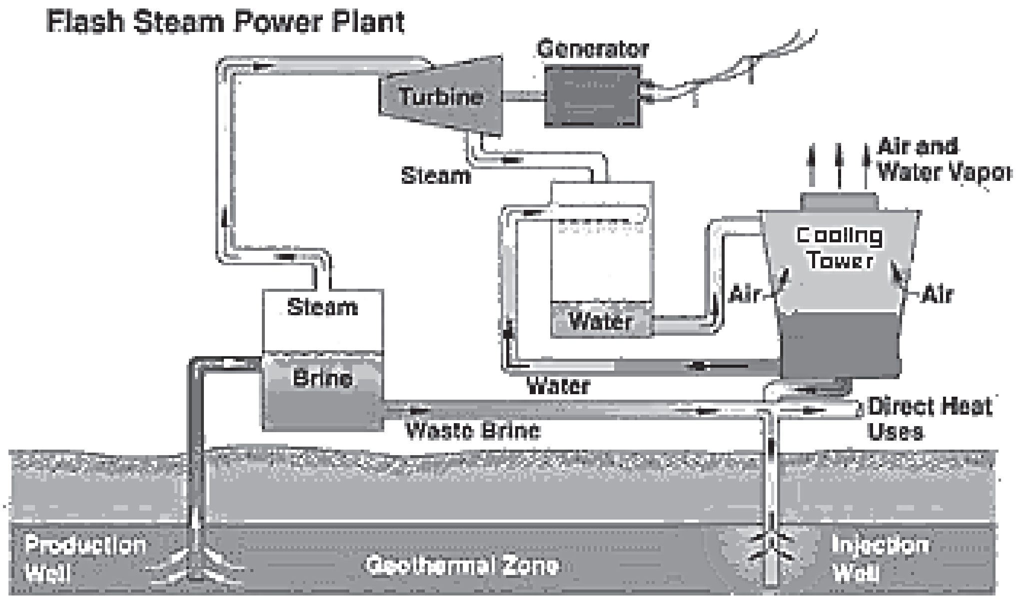
Geothermal power plants

Geothermal reservoirs within about 5 km (about 3 mi) of Earth's surface can be reached by drilling a well. The hot water or steam from wells can be used to turn turbine generators to produce electricity. A power plant that uses this natural source of hot water or steam is called a geothermal power plant.

At the beginning of the 21st century, there were some 380 geothermal power plants in 22 countries around the world with a combined installed capacity of about 8,000 megawatts. Geothermal energy provided 1.6 percent of the world's total electricity, serving the electricity needs of about 60 million people, mostly in developing countries. About 2.5 percent of the electricity produced in the United States came from geothermal power plants. The electricity produced from geothermal power in the United States represented about 37 percent of the world's output of electricity from geothermal power. The United States, the Philippines, Italy, Mexico, Indonesia, Japan, New Zealand, and Iceland are the largest producers of geothermal energy. There are three types of geothermal power plants: flash steam plants, dry steam plants, and binary plants.

Flash Steam Plants

Most operating geothermal power plants are flash steam plants. In a flash steam plant, hot water from wells is piped into the plant, where, released from the high pressure of its underground location, some of the hot water boils (flashes) to steam. The force of the expanding steam is used to spin a turbine generator, which produces electricity. After turning the turbine, the geothermal water, along with the condensed steam, is piped back down into the reservoir to be reheated so it can be used again.



Dry Steam Plants

While most geothermal reservoirs produce hot water, a small number produce mostly steam. Steam from such a reservoir is used in a dry steam plant. In such a plant, the steam is piped directly through a turbine generator.

The first geothermal power plant, built at Larderello, Italy, in 1904, was a dry steam plant. The Larderello steam field is still producing electricity today. The largest producing dry steam geothermal reservoir in the world is located at The Geysers Geothermal Field in northern California. This dry steam geothermal reservoir, which supports 20 operating power plants, produces about 1,000 megawatts of electricity, enough to supply power to nearly 2 million people.

Упр. 5. Вставьте пропущенные слова и переведите текст.

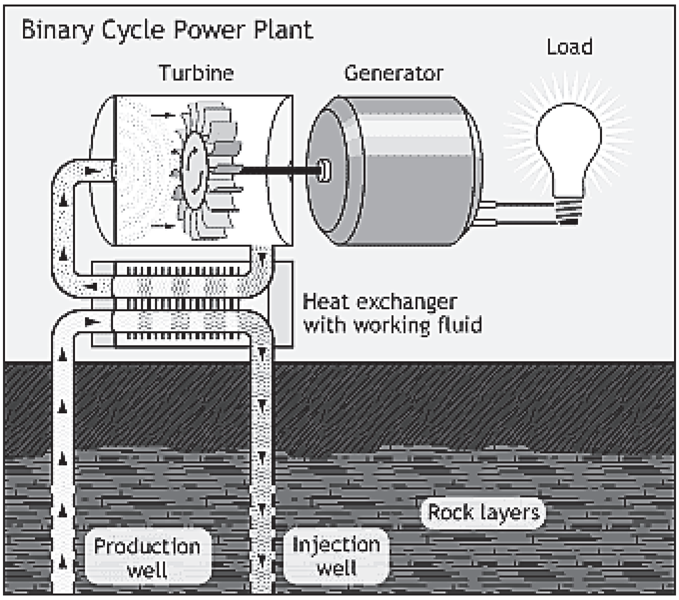
Geothermal, liquid, heat, condensed, electricity, emissions, binary, generator, exchangers, reservoirs.

Binary Power Plants

In a **1**________ power plant, heat from **2**_______ water is transferred through heat **3**__________ to a second liquid (called a working fluid, usually isobutane) contained in adjacent but separate pipes. **4**_______ transferred from the geothermal water converts this low-boiling point working fluid into vapor, which powers a turbine **5**________. After turning the turbine generator, the working fluid is **6**_________ back into liquid, which is repeatedly vaporized by the geothermal heat. After heating the working **7**__________, the geothermal water is piped back into the reservoir.

The binary working fluid vaporizes at temperatures lower than is necessary to vaporize water. As a result, binary power plants can generate **8**____________ using geothermal reservoirs of lower temperature, increasing the number of geothermal **9**_________ in the world that can potentially be used for generating electricity. Binary power plants are generally more expensive to build and operate than flashed steam plants. However, binary power plants use geothermal heat and water more efficiently and have no **10**____________.

Упр. 6. Переведите схему. Подготовьте краткое описание схемы.



Упр. 7. Послушайте полилог (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и ответьте на следующие вопросы.

1. Which wind turbine component do the engineers discuss?
2. What is the big problem with offshore installations?
3. Which two types of construction material are being compared?
4. Why are coastal defences mentioned?
5. What point does Hanif make about, regular maintenance?
6. What comparison needs to be made with regard to lifespan?

Упр. 8. Переведите с листа.

Direct use of geothemal water

In addition to generating electricity, geothermal water is used directly in spas (balneology), to heat greenhouses (agriculture), and to speed the growth of fish and prawns. The heat from geothermal water is used for industrial processes and for space heating in homes and other buildings. People in over 35 countries have developed geothermal water for such purposes.

Industrial uses of the heat from geothermal water include manufacturing paper, pasteurizing milk, and drying timber and other agricultural products. Geothermal waters are used in mining to speed the extraction of gold and silver from ore, and are also piped under sidewalks and roads to keep them from icing over in freezing weather.

Geothermal energy is a renewable resource: Earth's heat is continuously radiated from within, and each year rainfall supplies new water to geothermal reservoirs. Production from individual geothermal reservoirs can be sustained for decades and perhaps even centuries.

Compared to other types of power plants, geothermal plants have relatively little effect on the environment. Geothermal power plants have been successfully operated in farm fields, in sensitive desert environments, and in forested recreation areas.

Hydrogen sulfide gas (H_2S), which can be toxic at very high concentrations, is sometimes present in geothermal reservoirs. However, this gas is removed from geothermal water with antipollution "scrubbing" equipment.

Geothermal reservoirs contain higher concentrations of minerals and chemicals than do aquifers used for drinking water. Therefore, wells drilled into geothermal reservoirs have several layers of pipes, or casing, cemented into the ground nearly the entire length of a well. The pipes and cement prevent the deep geothermal water from mixing with freshwater aquifers.

Geothermal reservoirs contain some carbon dioxide (CO_2) which is released when the hot water turns into steam. Some scientists believe that the buildup of carbon dioxide in the atmosphere – partially the result of burning fossil fuels – is contributing to what may be a gradual increase in global temperatures, because carbon dioxide traps heat from the Sun that is reradiated by Earth. The amount of carbon dioxide released from geothermal power plants, however, ranges from zero to 4 percent of the carbon dioxide released by an equivalent power plant fueled by coal or petroleum.

Supplementary materials

Переведите устно.

How does geothermal drilling trigger earthquakes?

Seismologist David Oppenheimer of the U.S. Geological Survey Earthquakes Hazards Team explains (as told to Katherine Harmon):

Traditional geothermal drilling bores into hot rock such as sandstone that has water or steam trapped in its pore spaces and natural fractures. When a drilled hole intersects these fractures, the water flashes into steam because of the sudden drop in pressure – like bubbles that come out of a soda bottle when the cap is removed. The steam surges into the well hole, and the steam pressure at the surface spins a turbine to generate electricity. Sometimes the plant returns some of the water back into the reservoir to keep water levels up. The drilling itself does not cause earthquakes, but the steam removal and water return can do so, by producing new instability along fault or fracture lines.

At a long-term geothermal project in northern California known as the Geysers, the USGS has been monitoring seismic activity since 1975. Even though the area does not appear to have any large faults running through it, we record about 4,000 quakes above magnitude 1.0 every year. We know they result from steam withdrawal or injection because when operators begin geothermal production in a new area, earthquakes begin and when production ends, the earthquakes stop. Many minor tremors occur, but quakes as large as magnitude 4.5 have been recorded. Residents of nearby Anderson Springs often feel tremors as small as magnitude 2.0 because the town sits only a couple of kilometers above the rock fractures.

Geologists suspect that even larger earthquakes could occur on nearby faults such as the Maacama, which is adjacent to the Geysers fields. The extraction of water and heat from the porous sandstone causes it to contract, much as a sponge shrinks when it dries out. When a large earthquake does occur, the public will ask whether the geothermal projects might have played a role in causing the rocks to shift along other faults. And researchers will have to use geodetic monitoring and other data to try to figure out whether it really was a factor in changing key stress dynamics.

In addition to the traditional geothermal plants at the Geysers, a pilot project, which was suspended last September, intended to draw steam directly from the volcanic, nonporous rock called felsite that lies below the sandstone and is its heat source. Because the felsite has no natural pores, it also contains no water. To recover the heat, the project's operators would have needed to fracture the rock and circulate water through it.

First, in the short phase of the project, they would have drilled into the felsite and injected water to fracture the rock, most likely generating earthquakes in the process. Then, aided by borehole cameras revealing in which direction the fractures formed, they would have drilled a second hole to intersect the new fractures and would have produced steam by pumping water through the hot fractures linking the wells. This dry-rock geothermal approach has the potential to harness much more heat than the traditional sandstone techniques, but it can also mean more earthquakes.

To control the earthquake risk, drillers would have tried to keep the size of the fractures small and to maintain steady water flow rates. The threshold goal for earthquakes is 2.0 or lower on the Richter scale. Such deep-drilling operations would not want a repeat of events in Basel, Switzerland, where a widely felt magnitude 3.4 quake in 2006 ultimately stopped a similar geothermal project.

Unfortunately, areas that are less tectonically active also have less accessible subterranean heat sources. California, for example, has more heat (because of its location near tectonic plate margins) than, say, Texas. The whole country has some geothermal potential if we wanted to draw warmth for heating. But the resulting heat would not necessarily have the energy to spin large turbines for electricity generation. (*David Oppenheimer*)

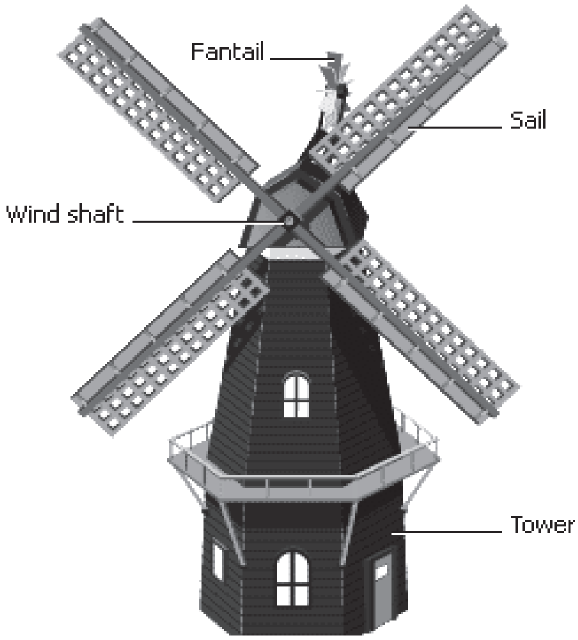
3. WIND POWER

Упр. 1. Дайте определение следующим понятиям. Подготовьтесь к диктанту.

Windmill	
Blade	
Shaft	
To mill	
Wind power plant (wind generator)	
Truss tower	
Guy wire	
Rotor blades (propeller)	
To pump	
To generate	
Turbine	
Sail	
Fantail	
To protrude	
Propelled	
Torque	
Brake	

Упр. 2. Переведите устно.

A windmill is a machine that converts wind into useful energy. Windmills consist of a horizontal wind shaft that protrudes from the upper portion of the mill tower. Four to eight wind sails radiate from the wind shaft. The wood frames of the sails are either covered with canvas or fitted with wood shutters. The fantail automatically rotates the sails into the wind.



Besides milling grain and irrigating farmland, windmills developed from the 15th century to the 19th century were adapted to a variety of tasks, including pumping seawater from land below sea level, sawing wood, making paper, pressing oil from seeds, and grinding many different materials. By the 19th century the Dutch had built about 9000 windmills. Of the major improvements on the windmill, the most important was the fantail, a mechanism invented in 1745 that automatically rotates the sails into the wind. In 1772 the spring sail was developed. This type of sail consists of wood shutters, the openings of which can be controlled either manually or automatically to maintain a constant sail speed in winds of varying speeds. Other improvements include air brakes to stop the sails from rotating and the use of propellerlike airfoils in place of sails, which increases the usefulness of mills in light winds. Water-pumping windmills were widely employed during the settlement of the western United States. The use of wind turbines for generating electricity was pioneered in Denmark late in the 1890s. Small wind turbine generators supplied electricity to many rural communities in the United States until the 1930s, when power lines were extended across the nation. Large wind turbines were also built during this time. The largest was the Smith-Putnam generator, installed in 1941 at Grandpa's Knob, near Rutland, Vermont.

Упр. 3. Переведите текст письменно

Modern wind turbines

Modern wind turbines are propelled by one of two effects: drag, by which wind pushes the blades; and lift, by which the blades are moved in the same way an airplane's wing rises on an air current. Turbines operated by lift turn more rapidly and are inherently more efficient. Wind turbines can be classified as horizontal-axis machines, with their main shafts parallel to the ground, or vertical-axis machines, with shafts perpendicular to the ground. Horizontal-axis turbines used to generate electricity have one to three blades; those used for pumping may have many more. The most common vertical-axis machines, named after their designers, are the Savonius, used primarily for pumping, and the Darrieus, a higher-speed machine resembling an eggbeater.

Water Pumper

The water pumper is a high-torque, low-speed windmill common in rural areas of the United States. Water pumpers are used mainly to draw water from underground. These machines use a rotor, usually from 2 to 5 m (from 6 to 16 ft) in diameter, with a number of oblique blades radiating from a horizontal shaft. The rotor is mounted on a tower high enough to catch wind. A large, rudderlike vane directs the wheel into the wind. The wheel turns gears that operate a piston pump. When wind velocities become excessive, safety devices automatically turn the rotor out of the wind to prevent damage to the mechanism.

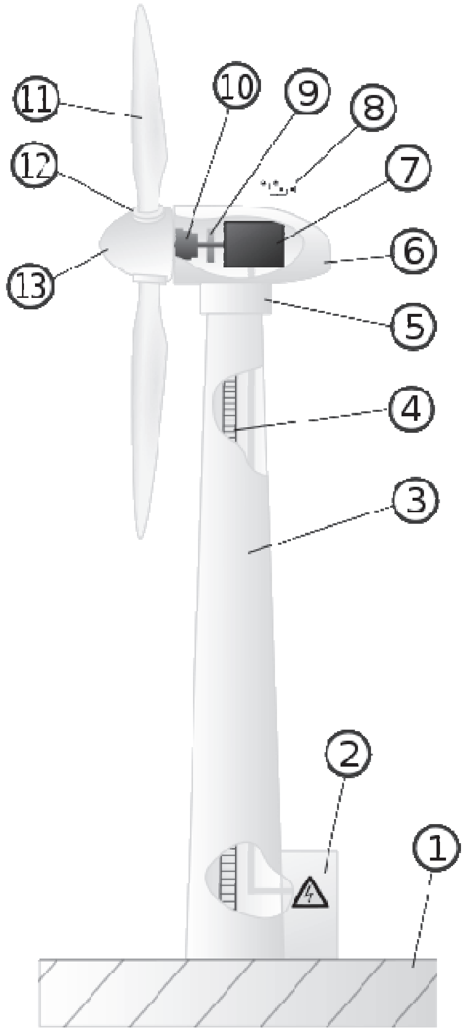
Wind turbine generators consist of a variety of components. The rotor converts the power of the wind to the rotating power of the shaft; a gearbox increases speed; and a generator converts the shaft power into electrical power. In some horizontal-axis machines, the pitch of the blades can be adjusted to regulate the speed during normal operation and also to shut down the machine when wind speeds are excessive. Others use stall, an aerodynamic phenomenon that naturally limits the power at high wind speeds. Usually, modern machines start operating when wind speeds reach about 19 km/h (about 12 mph), achieve their rated power at about 40 to 48 km/h (about 25 to 30 mph), and shut down in wind speeds of about 100 km/h (about 60 mph).

Упр. 4. Изучите схему. Переведите термины.

Строение ветряной установки:

1. Фундамент.
2. Силовой шкаф, включающий силовые контакторы и цепи управления.
3. Башня.
4. Лестница.
5. Поворотный механизм.
6. Гондола.
7. Электрический генератор.
8. Система слежения за направлением и скоростью ветра (анемометр).
9. Тормозная система.
10. Трансмиссия.
11. Лопасти.
12. Система изменения угла атаки лопасти.

13. Колпак ротора.



Упр. 5. Образуйте антонимы с использованием префиксов in- or un-.

1. adequate – ________________.
2. efficient – ________________.
3. appropriate – ________________.
4. reliable – ____________________.
5. consistent – __________________.
6. sufficient – __________________.
7. economical – __________________.
8. suitable – ____________________.
9. effective – __________________.

Упр. 6. Заполните пропуски словами из упражнения 5 и переведите текст.

The fact that wind turbines consume no fuel and waste very little energy is clearly a fundamental advantage. But just how____________are they?

Clearly, wind turbines need to be located on relatively windy sites in order to function. From a meteorological standpoint, what kinds of geological location are the most_______________?

Turbines are generally placed at the tops of tall towers, where wind speeds are higher, thus making them more___________. What other positioning factors influence performance? Wind turbines rarely function continuously, due to the fact that wind speeds are____________.

How significant is the impact of variable weather conditions on power generating capacity?

Transmitting electricity over long distances is inherently_____________, due to power loss from overhead or underground power lines.

The generating capacity of wind turbines is generally_____________for it to be relied upon 100 %.

What percentage of total generating capacity can wind turbines realistically provide? Some early wind turbines were _____________, suffering breakdowns caused by inaxial stresses stemming from higher wind loads on the upper blade. However, this problem has been overcome on modern units.

Упр. 7. Прослушайте текст «UK plans huge wind farm programme» (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и переведите его последовательно.

Упр. 8. Переведите текст письменно.

Британцы намерены сохранять энергию ветра под водой

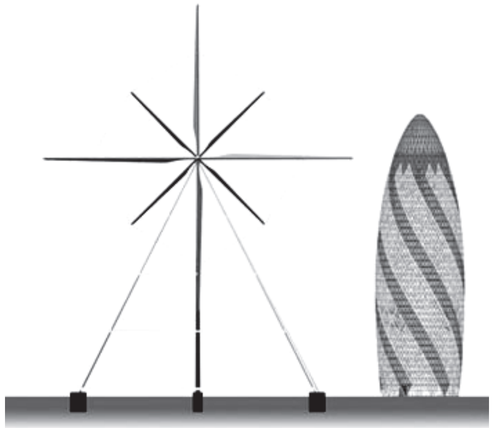
Оригинальный способ решения проблемы неравномерности выработки ветровой энергии нашёл профессор Симус Гарви (Seamus Garvey) из университета Ноттингема.

По замыслу Симуса, ветряки морского базирования не должны оснащаться электрогенераторами непосредственно. Мол, такие мощные машины, дающие ток при малых оборотах вала, слишком тяжелы и очень дороги.

Вместо этого британский инженер предлагает делать лопасти ветряка полыми. Внутри должен свободно двигаться довольно тяжёлый поршень. Когда лопасть находится внизу, поршень расположен в самом её кончике, когда она медленно поднимается вверх, поршень скользит вниз, сжимая воздух. Последний подаётся в мешки из гибкой синтетической ткани, плавающие на глубине 500 метров!

Эти хранилища, удерживаемые от разрыва давлением воды, служат буферами, гарантирующими электростанции ровную работу при неравномерном ветре. Из подводных баллонов воздух отправится по трубам к компактным турбинам-генераторам. И его запаса должно хватать на несколько дней штиля.

Такая «Интегрированная возобновимая энергетическая система на сжатом воздухе» (Integrated Compressed Air Renewable Energy Systems – ICARES) отличается размахом. Гарви посчитал: чтобы поршни работали, а не зависали в кончиках лезвий из-за центробежных сил, турбина должна двигаться медленно и быть очень крупной – от 230 метров в диаметре, в идеале – все 500 м. Что до подводных хранилищ – это настоящие грозди мешков по 20 метров в диаметре каждый.



В отличие от родственных систем накопления энергии в виде закачки воздуха в подземные полости подводный вариант обеспечивает неизменное давление как при малом, так и при предельном заполнении хранилища, что гарантирует оптимальный режим работы турбогенераторов.

Над проектом Гарви работает с 2006 года, а теперь университет создал компанию Nimrod Energy для коммерциализации технологии. Система ICARES должна появиться на рынке в мае 2011 года. Но первоначально предназначаться она будет для накопления энергии, выработанной другими типами электростанций. А морские турбины-гиганты от Nimrod, по прогнозу учёного, будут построены в течение 15 лет.

Упр. 9. Переведите с листа

New Record: World's Largest Wind Turbine

The world's largest wind turbine is now the Enercon E-126. This turbine has a rotor diameter of 126 meters (413 feet). This new turbine is officially rated at 6 megawatts, but will most likely produce 7+ megawatts (or 20 million kilowatt hours per year). That's enough to power about 5,000 households of four in Europe. A quick US calculation would be 938 kwh per home per month, 12 months, that's 11,256 kwh per year per house. That's 1776 American homes on one wind turbine.

The turbine being installed in Emden, Germany by Enercon. They will be testing several types of storage systems in combination with the multi-megawatt wind turbines.These turbines are equipped with a number of new features: an optimized blade design with a spoiler extending down to the hub, and a pre-cast concrete base. Due to the elevated hub height and the new blade profile, the performance of the E-126 is expected to by far surpass that of the E-112.

[The E-126]… has no gearbox attaching the turbine blades to the generator, in fact, the generator is housed just at the widest part of the nose cone, it takes up the entire width of the nacelle to generate power more efficiently, and provide longer service life with less wear.

Also like small turbines, these have inverters instead of synchronous generators, that is to say, a separate controller that converts the wild AC generated into something the grid can use. This means the rotor can run at more optimum and varied speeds.

Again like small turbines, this one does not shut right off at a predetermined speed due to gusts or just very high wind speeds. It simply throttles down by turning the blades slightly away from the wind so as to continue to generate power though at a lower production rate. Then the instant the wind is more favorable, it starts back up again. Many smaller wind turbines do something similar except have no blade pitch control, they use a technique called something like "side furling" where the whole machine, excepting the tail, turns "sideways" to catch less wind but continue operating.

Упр. 10. Переведите письменно.

По прогнозам ученых, мировые запасы нефти и угля могут закончиться уже к 2080 году. Но даже если это произойдет, человечество не останется без электроэнергии. Рано или поздно мы вступим в новую эру не запасенных природой, а возобновляемых ресурсов. И наряду с водой и солнцем энергию нам будет давать такой неиссякающий источник, как ветер.

Казалось бы, это чисто техническая деталь. Но она изменит многое в нашей жизни – возможно, даже геополитику. Ведь ветер принадлежит всем. Это нефть продают и покупают, а когда не могут купить – пытаются отвоевать... С ветром этого, к счастью, сделать пока нельзя. Пока ветер воспринимается только как альтернативный источник энергии. Однако некоторые страны хотят превратить его в основной. Например, в Дании к 2030 году планируют получать «из воздуха» уже половину всей добываемой электроэнергии.

Идея использовать ветер для получения энергии в прямом смысле слова стара как мир. Самые древние из известных нам ветряных сооружений относятся к 3000 году до н. э. Китайцы качали с их помощью воду на рисовые поля.

Возвращение к ветроэнергетике в XX веке было продиктовано не только экологическими проблемами, но и желанием освободиться от нефтяной зависимости. В 1973 году входящие в организацию экспортеров нефти ОПЕК страны ввели в отношении США и их союзников эмбарго на нефть. Последовавший за этим энергетический кризис и экономический спад побудили западные страны осваивать альтернативные источники энергии. Вспомнили о так называемых возобновляемых ресурсах: воде, солнце, биомассе и ветре. Ветер – самый дешевый из них. Строить ветропарки первыми стали Германия, Голландия и Дания. Один из первых мощных ветряков возле датского городка Ульфборг соорудили местные жители.

В последние годы ветряная энергетика развивается динамичнее всех остальных отраслей. Отчасти это связано с ее дешевизной: себестоимость составляет 4-5 центов за 1 кВт/ч. В Дании многие ветропарки находятся в частном или кооперативном владении. Иногда их покупают вскладчину.

Ветряки достаточно просты в эксплуатации. Срок их службы – в среднем 25 лет. За это время некоторые детали, естественно, изнашиваются. Чтобы остановить ветряк и перебрать механизм, требуется всего несколько дней. Башню при этом не трогают. Ветряк мощностью 500-600 кВт/ч с избытком перекрывает потребности даже очень большого фермерского хозяйства. Тогда ветряки подключают к электросети, владелец которой – государство или частная компания – по фиксированной цене приобретает у фермера всю произведенную энергию. А потом из этой же сети фермер покупает столько, сколько ему нужно.

Ветропарки породили новую концепцию локальных электросетей. Число потребителей в них невелико, зато удается обойтись без потерь энергии. Ведь электричество с гигантских ГЭС и АЭС передается потребителю за сотни и тысячи километров. И потери при этом неизбежны.

При всех очевидных плюсах у использования энергии ветра есть свои противники. Чаще всего в качестве главного минуса ветроэнергетики называют ее нестабильность. Действительно, погода от нашего желания не зависит. Сегодня лопасти исправно вращаются, а завтра – полный штиль. Но и здесь можно найти выход.

В последние годы ветряные станции начали связывать в единую сеть с соседними ветропарками и станциями, работающими на других источниках энергии. В конечном счете какое-нибудь звено такой комбинированной системы обязательно должно сработать. Без света, тепла и утренней чашечки горячего кофе потребитель никогда не останется. Возможно, такие локальные смешанные сети – идеальная форма для снабжения населения электричеством в ближайшие несколько десятилетий.

Второй минус – энергию ветра можно использовать далеко не везде. Поэтому для каждого региона специалисты вначале составляют атлас ветров. Наиболее перспективными считаются прибрежные районы. Там за счет разницы температур над сушей и морем ветры дуют почти постоянно. Хорошо также ставить ветряки на возвышенностях и в степи.

Минимальная скорость ветра, необходимая для включения ветряка, – 3-5 м/с. Запуск происходит автоматически – по сигналу датчика на вершине башни. При слишком высокой скорости – около 25 м/с – турбины автоматически отключаются. И только ветротурбины на море способны выдерживать шквальные ветра до 30 м/с.

А насколько ветряки безопасны? Защитники природы утверждают, что лопасти представляют опасность для птиц. Столкновения действительно случаются, но в последние годы при размещении ветропарков проектировщики стали учитывать маршруты миграции пернатых. Еще один аргумент противников – «шумовое загрязнение» – также не выдерживает критики: стоя прямо под ветряками, можно разговаривать не повышая голоса.

Но самыми активными противниками ветропарков обычно становятся люди, живущие по соседству. Они считают, что ветропарки портят пейзаж. Неужели коптящие небо трубы тепловых электростанций более привлекательны?

В опубликованном всемирной организацией Greenpeace докладе «Wind Force 12» утверждается: к 2020 году ветроэнергетика сможет обеспечить 12 % мировой потребности в электричестве. И это при том, что человечеству к тому времени будет нужно на две трети больше электроэнергии, чем сейчас! Но растут и мощности ветроагрегатов: уже действуют парки с сотнями ветряков по 2 МВт каждый, а мощность отдельных устройств достигает 5 МВт.

В 2003 году прирост мощностей ветроэнергетики в мире составил 30 %. Таких темпов развития не было даже у атомной энергетики. Наступает эра ветра?

Supplementary materials

Упр. 1. Переведите письменно.

У берегов Уэльса появится огромная ветроэлектростанция

Сейчас крупнейший ветроэнергетический комплекс в Уэльсе – Rhyl Flats.

Строительство самого большого в мире прибрежного комплекса ветряных электростанций начнется в следующем году у северного побережья Уэльса.

Детали проекта под названием Gwynt y Mor стоимостью в 2,2 млрд фунтов стерлингов (более 3 млрд долларов) были обнародованы в пятницу.

План предусматривает установку в море – в 10 милях от берега – 160 турбин и создание около тысячи новых рабочих мест. Ожидается, что в полную силу комплекс заработает в 2014 году.

Некоторые местные жители выступают против реализации проекта: ветряки, по их словам, совершенно испортят великолепный вид на морскую гладь, за которым, в частности, приезжают люди в курортный городок Ландидно на северном берегу Уэльса.

Кроме того, скептики критикуют британское правительство за выдачу лицензий на строительство еще и потому, что они считают ветряную энергию ненадежной. В Лондоне, однако, с этим не согласны.

«Это будет один из крупнейших проектов прибрежной ветровой энергетики в Европе, который будет обеспечивать нас чистым, зеленым электричеством в объемах, которых в эквивалентном исчислении хватит на обеспечение жизнедеятельности 400 тысяч семей. Мы в Уэльсе находимся в идеальном положении для того, чтобы получать экономические выгоды от зеленых технологий, – заявила британский министр по делам Уэльса Черил Гиллан. – Окруженные ветрами, волнами и приливными ресурсами, мы можем извлечь преимущества из инвестиций в зеленую экономику и в то же время внести существенный вклад в реализацию устремлений [британского] правительства по сокращению выбросов углекислоты при помощи безопасных, чистых возобновляемых источников энергии».

Это тот редкий для Соединенного Королевства случай, когда проект вызвал одинаково воодушевленный отклик и у правительства, и у оппозиции. Хотя, говоря о проекте Gwynt y Mor, теневой министр по делам Уэльса лейборист Питер Хэйн не преминул покритиковать консерваторов.

«Двухмиллиардные инвестиции в северный Уэльс, чему раньше противился [премьер-министр Великобритании] Дэвид Кэмерон, осуществляются только благодаря той новаторской работе, которую выполнил Эд Милибанд, когда он был лейбористским министром энергетики, – заявил Хэйн. – Gwynt y Mor будет крупнейшей в Уэльсе ветряной электростанцией, способной обеспечить энергетические нужды около 400 тысяч семей и предотвратить выброс в атмосферу 1,7 млн тонн двуокиси углерода в год».

Упр. 2. Переведите устно.

String of offshore turbines along East Coast could provide steady supply of wind power

The problem with generating electricity by harnessing the wind is that it doesn't always blow (though it may seem that way at times). And, typically, consumers remain intolerant of power interruptions.

But there may be a way to ensure a steady supply of wind, according to a new study in the April 5 Proceedings of the National Academy of Sciences. The key? Sea breezes (and a lot of expensive wiring).

Willett Kempton, director of the University of Delaware's Center for Carbon-Free Power Integration, and his colleagues analyzed wind patterns from 11 sites on the U.S. East Coast, along the 2,500 kilometers from Maine to Florida. By wiring together hypothetical offshore wind turbines along this coastline, the researchers found that they could guarantee a steady supply of electricity. In fact, according to their model, there would never be a time when the wind wasn't producing some electricity – and previous research by Kempton has shown that offshore wind power alone could supply the needs of coastal states.

Of course, no offshore wind turbines exist anywhere off the U.S. East Coast – and reactions from coastal residents have been as mercurial as the wind, depending on whether one resides in Cape Cod or Cape Hatteras – so this exercise remains entirely theoretical. As it stands, the roughly 2 gigawatts of offshore wind turbines proposed along the East Coast are largely planned to operate independently. And the longest (and most expensive) high-voltage direct current cable ever laid spans just 580 kilometers. The researchers estimate the cost of the cable alone for this plan at $1.4 billion (though that is only 15 percent of the cost of all the offshore wind turbine installations).

But should this abundant resource be tapped, a unified grid of offshore turbines could help make wind power reliable. After all, as Kempton et al. wrote: "There is almost always a pressure gradient somewhere, and cyclonic events move along the coast." (*David Biello*)

4. TIDE ENERGY

Упр. 1. Переведите термины. Выучите их.

- tidal power plant;
- reversible turbine;
- turbine inlet for water;
- heat pump system;
- source water inlet.

Упр. 2. Сопоставьте термины с их определениями. Переведите. Подготовьтесь к диктанту.

1. Tide	A. the widening channel of a river where it nears the sea, with a mixing of fresh water and salt (tidal) water
2. Harness	B. a mass of air, body of water, etc., that has a steady flow in a particular direction
3. Estuary	C. the cyclic rise and fall of sea level caused by the gravitational pull of the sun and moon.
4. Current	D. to flow back or recede
5. Gravitation	E. the total system of electrical leads for a vehicle or aircraft
6. Dam	F. any process or result caused by this interaction, such as the fall of a body to the surface of the earth
7. Gearbox	G. a barrier of concrete, earth, etc., built across a river to create a body of water for a hydroelectric power station, domestic water supply
8. To ebb	H. this metal casing and its contents, esp in a motor vehicle

Упр. 3. Переведите с листа.

Introduction

The tide moves a huge amount of water twice each day, and harnessing it could provide a great deal of energy – around 20 % of Britain's needs. Although the energy supply is reliable and plentiful, converting it into useful electrical power is not easy. There are eight main sites around Britain where tidal power stations could usefully be built, including the Severn, Dee, Solway and Humber estuaries. Only around 20 sites in the world have been identified as possible tidal power stations.

Tide Energy

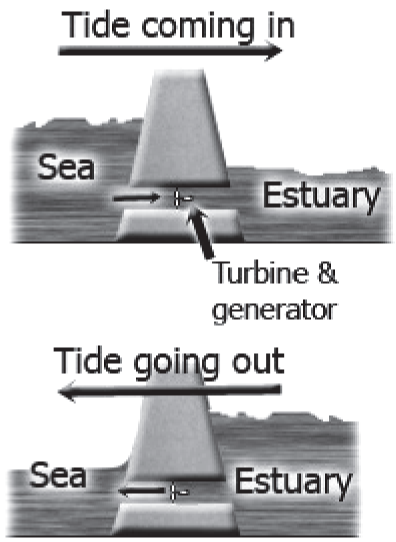
Tides are twice-daily rises and falls of water level relative to land. Ocean tides can produce strong currents (a steady flow of ocean waters in a prevailing direction) along some coastlines. Humans have sought to harness the kinetic (motion-induced) energy of the tides for hundreds of years. Residents of coastal England and France have used tidal energy to turn water wheels and generate mechanical energy for grain mills since the eleventh century. In modern day, tidal currents are used to generate electricity. Tidal energy is a non-polluting, renewable energy source. Modern day technologies for exploiting tidal energy are, however, relatively expensive and are limited to a few coastlines with extremely high and low tides. Tidal energy may, in the future, become more widely used and economically practical.

Упр. 4. Переведите устно.

The Power in tides result from the gravitational pulls of the Moon and Sun on the surface of the spinning Earth. Gravity is the force of attraction between all masses. The shape of the shore and adjacent seafloor affects the tidal range (difference between high and low tides) along specific coastlines. Some places, like the English Channel between France and England, and the Bay of Fundy in Nova Scotia, Canada, experience very high and low tides. The tides protected Medieval monasteries in the English Channel since the eighth century. Mont-St.-Michel in western France and Lindisfarne (Holy Island) in northern England are churches built on small islands surrounded by miles of tidal flats (a broad, flat area of coastline alternately covered and exposed by the tides). Today, they are connected to the mainland by roadways but in Medieval times, only devout pilgrims rushed to make the hurried trip across miles (kilometers) of shifting sand between roaring tidal pulses. For tidal energy to be a practical source for electricity generation, the tidal range in a coastal area must be at least 16.5 feet (5 meters). The greater an area's tidal range, the more electricity will be produced. Although tidal energy is reliable and plentiful, only a handful of suitable tidal power station locations have been proposed worldwide. Two large tidal power plants are in operation today at La Rance in Brittany, France, and in the Canadian town of Annapolis Royal, Nova Scotia. In the United States, tidal energy as a power source is realistic only in Alaska and Maine.

Упр. 5. Переведите письменно.

How it works: Tidal Barrages



These work rather like a hydro-electric scheme, except that the dam is much bigger. A huge dam (called a "barrage") is built across a river estuary. When the tide goes in and out, the water flows through tunnels in the dam. The ebb and flow of the tides can be used to turn a turbine, or it can be used to push air through a pipe, which then turns a turbine. Large lock gates, like the ones used on canals, allow ships to pass. If one was built across the Severn Estuary, the tides at Weston-super-Mare would not go out nearly as far – there'd be water to play in for most of the time. But the Severn Estuary carries sewage and other wastes from many places out to sea. A tidal barrage would mean that this stuff would hang around Weston-super-Mare an awful lot longer! Also, if you're a wading bird that feeds on the exposed mud flats when the tide goes out, then you have a problem, because the tide won't be going out properly any more.

The largest tidal power station in the world (and the only one in Europe) is in the Rance estuary in northern France. It was built in 1966. A major drawback of tidal power stations is that they can only generate when the tide is flowing in or out – in other words, only for 10 hours each day. However, tides are totally predictable, so we can plan to have other power stations generating at those times when the tidal station is out of action.

There have been plans for a "Severn Barrage" from Brean Down in Somerset to Lavernock Point in Wales. Every now and again the idea gets proposed, but nothing has been built yet. It may have over 200 large turbines, and provide over 8,000 Megawatts of power (that's over 12 nuclear power station's worth). It would take 7 years to build, and could provide 7 % of the energy needs for England and Wales. There would be a number of benefits, including protecting a large stretch of coastline against damage from high storm tides, and providing a ready-made road bridge. However, the drastic changes to the currents in the estuary could have huge effects on the ecosystem. Another option is to use offshore turbines, rather like an underwater wind farm. This has the advantage of being much cheaper to build, and does not have the environmental problems that a tidal barrage would bring. There are also many more suitable sites. The University of Wales Swansea and partners are also researching techniques to extract electrical energy from flowing water. The "Swanturbines" design is different to other devices in a number of ways. The most significant is that it is direct drive, where the blades are connected directly to the electrical generator without a gearbox between. This is more efficient and there is no gearbox to go wrong. Another difference is that it uses a "gravity base", a large concrete block to hold it to the seabed, rather than drilling into the seabed. Finally, the blades are fixed pitch, rather than actively controlled, this is again to design out components that could be unreliable.

Упр. 6. Переведите письменно.

В Шотландии готовится к установке приливная турбина

Крупнейшая в мире турбина для приливной гидроэлектростанции впервые предстала миру в шотландской бухте Инвергордон.

Турбина АК-1000 производства компании Atlantis Resources будет в ближайшие дни отбуксирована для установки на экспериментальном полигоне Европейского центра морской энергетики у побережья Оркнейских островов. Ее конструкторы считают турбину простой и надежной. По словам главы компании Тима Корнелиуса, она была создана в расчете на трудные условия эксплуатации в бурных и холодных водах северной Атлантики.

Турбина достигает в высоту 22,5 метра и весит 1300 тонн. Она имеет два лопастных узла, установленных на едином валу, и в состоянии развивать электрическую мощность в 1 Мвт – этого достаточно для обеспечения энергией 1 тысячи семейств.

По данным компании, эта турбина является крупнейшим устройством такого рода в мире благодаря диаметру своих лопастей, который достигает 18 метров. «Мы сталкиваемся на шельфе Оркнейских островов с самыми жесткими погодными условиями на планете, – сказал Тим Корнелиус на демонстрации турбины. – Нам пришлось пойти на самое простое, но при этом и самое надежное конструкторское решение». Лопасти турбины будут вращаться с очень низкой скоростью – всего 6-8 оборотов в минуту, что исключит вредное воздействие на морские организмы.

После сборки на верфи в Эвантоне турбина АК-1000 была перевезена в соседний док в Инвергордоне в заливе Кромарти Фирт.

Компания Atlantis, которая имеет отделения в Лондоне и Сингапуре, предложила план использования приливной энергии для снабжения энергией компьютерного центра данных на севере Шотландии. Этот центр будет оказывать услуги ряду компаний и не должен быть подключен к национальной энергосистеме Британии.

По словам Корнелиуса, его компания собирается принять участие в тендере на аренду нескольких площадок на шельфе Оркнейских островов.

Упр. 7. Прослушайте текст «Wave energy innovator» (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar). Ответьте на вопросы. Переведите текст.

1. What does the company make?
2. How much power will the wave farm produce when finished?
3. What names have people given to the previous wave converters?
4. Why was it called Pelamis?
5. What are the objectives of the company?

5. SOLAR ENERGY

Упр. 1. Переведите термины. Подготовьтесь к диктанту.

- Solar (solar-heated) house;
- Solar radiation (sunlight);
- Collector;
- Hot reservoir (power supply);
- Heat pump;
- Water outlet;
- Air supply;
- Flue;
- Hot water supply;
- Motion;
- Transient;
- Magnesium;
- Rotor;
- Frictional;
- Potential energy;
- Kinetic energy;
- Bending;
- Centrifugal force;
- Compression;
- Contraction;
- Expansion;
- Pressure;
- Shear;
- Tension;
- Torsion/torque.

Упр. 2. Переведите термины. Заполните пропуски в тексте. Переведите текст.

Motion, gained, projectile, induction, heat, transient, magnesium, rotor, frictional, potential, circuits, kinetic, interconvertible, energy.

Energy, capacity of matter to perform work as the result of its **1**___________ or its position in relation to forces acting on it. **2**___________ associated with motion is known as **3**___________ energy, and energy related to position is called **4**____________ energy. Thus, a swinging pendulum has maximum potential energy at the terminal points; at all intermediate positions it has both kinetic and potential energy in varying proportions. Energy exists in various forms, including mechanical, thermal, chemical, electrical, radiant, and atomic. All forms of energy are **5**______________ by appropriate processes. In the process of transformation either kinetic or potential energy may be lost or **6**___________, but the sum total of the two remains always the same.

A weight suspended from a cord has potential energy due to its position, in as much as it can perform work in the process of falling. An electric battery has potential energy in chemical form. A piece of **7**_____________ has potential energy stored in chemical form that is expended in the form of heat and light if the magnesium is ignited. If a gun is fired, the potential energy of the gunpowder is transformed into the kinetic energy of the moving **8**___________. The kinetic mechanical energy of the moving **9**___________ of a dynamo is changed into kinetic electrical energy by electromagnetic **10**___________. All forms of energy tend to be transformed into **11**____________, which is the most **12**_____________ form of energy. In mechanical devices energy not expended in useful work is dissipated in **13**____________ heat, and losses in electrical **14**____________ are largely heat losses.

Упр. 3. Переведите с листа.

Radiation produced by nuclear fusion reactions deep in the Sun's core The Sun provides almost all the heat and light Earth receives and therefore sustains every living being. Solar energy travels to Earth through space in discrete packets of energy called photons. On the side of Earth facing the Sun, a square kilometer at the outer edge of our atmosphere receives 1,400 megawatts of solar power every minute, which is about the capacity of the largest electric-generating plant in Nevada. Only half of that amount, however, reaches Earth's surface. The atmosphere and clouds absorb or scatter, the other half of the incoming sunlight. The amount of light that reaches any particular point on the ground depends on the time of day, the day of the year, the amount of cloud cover, and the latitude at that point. The solar intensity varies with the time of day, peaking at solar noon and declining to a minimum at sunset. The total radiation power (1.4 kilowatts per square meter, called the solar constant) varies only slightly, about 0.2 percent every 30 years. Any substantial change would alter or end life on Earth.

Упр. 4. Переведите письменно.

Indirect collection of solar energy

People can make indirect use of solar energy that has been naturally collected. Earth's atmosphere, oceans, and plant life, for example, collect solar energy that people later extract to power technology. The Sun's energy, acting on the oceans and atmosphere, produces winds that for centuries have turned windmills and driven sailing ships. Modern windmills are strong, light, weather-resistant, aerodynamically designed machines that produce electricity when attached to generators. Approximately 30 percent of the solar power reaching Earth is consumed by the continuous circulation of water, a system called the water cycle or hydrologic cycle. The Sun's heat evaporates water from the oceans. Winds transport some of the water vapor from the oceans over the land where it falls as rain. Rainwater seeps into the ground or collects into streams or lakes and eventually returns to the ocean. Thus, radiant energy from the Sun is transformed to potential energy of water in streams and rivers. People can tap the power stored in the water cycle by directing these flowing waters through modern turbines. Power produced in this way is called hydroelectric power. The oceans also collect and store solar energy. A significant fraction of the Sun's radiation reflects or scatters from the water's surface. The remaining fraction enters the water and rapidly diminishes with depth as the energy is absorbed and converted to heat or chemical energy. This absorption creates differences in temperature between layers of water in the ocean called temperature gradients. In some locations, these differences approach 20 °C (36 °F) over a depth of a few hundred meters. These large masses of water existing at different temperatures create a potential for generating power. Energy flows from the high-temperature water to the low-temperature water. The flow can be harnessed, to turn a turbine to produce electricity for example. Such systems, called ocean thermal energy conversion (OTEC) systems, require enormous heat exchangers and other hardware in the ocean to produce electricity in the megawatt range. Almost all of the major United States OTEC experiments in recent years have taken place in Hawaii. Plants, through photosynthesis, convert solar energy to chemical energy, which fuels plant growth. People, in turn, use this stored solar energy through fuels such as wood, alcohol, and methane that are extracted from the plant life (biomass). Fossil fuels such as oil and coal are derived from geologically ancient plant life.

Упр. 5. Вставьте пропущенные слова и переведите текст.

The generating capacity; horsepower; the wind turbine; capture; a huge margin; Donkey's years; enclosure; pressure; altitude;stack effect; the airflow; sun's rays; renewable energy; solar chimney; expansion.

Solar towers

The need to develop **1**_____________ is widely seen as a futuristic technological challenge. In reality, some of the most effective ways of harnessing **2**_____________ from nature are based on concepts that have existed for **3**_____________. **4**____________ is an obvious example. Another – less well known, but conceived almost a century ago – is the solar tower or **5**____________. And if the Australian company EnviroMission completes an ambitious solar tower project in the New South Wales desert, the technology could **6**_____________ not just the **7**____________ but the public's imagination worldwide. The firm is planning to construct a tower a colossal one kilometre high. If built, it will be the world's tallest structure by **8**_____________.

How it works? A large glass **9**_____________ is built, with a chimney at its centre. The sun heats the enclosure, causing **10**_____________ of the air inside. At the top of the chimney, the lower temperature and lower **11**___________ due to the higher **12**_____________ create a pressure differential known as **13**____________. This causes air to flow up the chimney. Electricity is generated by turbines at the bottom of the chimney, which are driven by the flow of air. The bigger the area of glass and the taller the chimney, the greater **14**_____________ and the higher **15**_________________.

Упр. 6. Переведите письменно. Выпишите из текста новые термины.

Photovoltaics

Photovoltaic solar cells, which directly convert sunlight into electricity, are made of semiconducting materials. The simplest photovoltaic cells power watches and calculators and the like, while more complex systems can light houses and provide power to the electrical grid.

Fabricating solar cells and modules

A variety of technical issues are involved in the fabrication of solar cells. The semiconductor material is often doped with impurities such as boron or phosphorus to tweak the frequencies of light that it responds to. Other treatments include surface passivation of the material and application of antireflection coatings. The encapsulation of the complete PV module in a protective shell is another important step in the fabrication process.

Advanced solar cells

A variety of advanced approaches to solar cells are under investigation. Dye-sensitized solar cells use a dye-impregnated layer of titanium dioxide to generate a voltage, rather than the semiconducting materials used in most solar cells. Because titanium dioxide is relatively inexpensive, they offer the potential to significantly cut the cost of solar cells. Other advanced approaches include polymer (or plastic) solar cells (which may include large carbon molecules called fullerenes) and photoelectrochemical cells, which produce hydrogen directly from water in the presence of sunlight.

Concentrator collectors

Concentrating photovoltaic collectors use devices such as Fresnel lenses, mirrors, and mirrored dishes to concentrate sunlight onto a solar cell. Certain solar cells, such as gallium arsenide cells, can efficiently convert concentrated solar energy into electricity, allowing the use of only a small amount of semiconducting material per square foot of solar collector. Concentrating collectors are usually mounted on a two-axis tracking system to keep the collector pointed toward the sun.

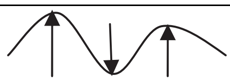
Building-integrated photovoltaics

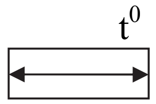
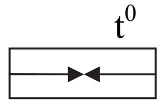
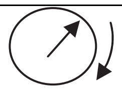
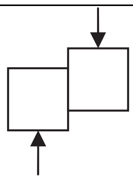
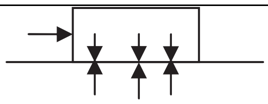
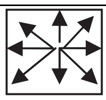
Building-integrated photovoltaic materials are manufactured with the double purpose of producing electricity and serving as construction materials. They can replace traditional building components, including curtain walls, skylights, atrium roofs, awnings, roof tiles and shingles, and windows.

Упр. 7. Прослушайте текст (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и отметьте, какие физические силы говорящий называет.

Упр. 8. Сопоставьте термины с обозначениями.

Bending; centrifugal force; compression; contraction; expansion; friction; pressure; shear; tension; torsion/torque.

Упр. 9. Переведите устно.

Concentrating Solar Power

Concentrating solar power technologies use reflective materials such as mirrors to concentrate the sun's energy. This concentrated heat energy is then converted into electricity.

Parabolic trough systems use curved mirrors to focus sunlight on an absorber tube filled with oil or other fluid. The hot oil boils water to produce steam, which is used to generate electricity. Since 1985, nine power plants in the Mojave Desert called the Solar Electric Generating Systems (SEGS) that use parabolic trough technology have been in full commercial operation.

Power tower systems use a large field of sun-tracking mirrors, called heliostats, to concentrate sunlight onto a receiver on the top of a tower. The sun heats a fluid inside the receiver. An early U.S. demonstration plant, Solar One, used water as the fluid, generating steam in the tower to drive a turbine to generate electricity. The plant was later converted to Solar Two, which used molten salt as the fluid. The hot salt could be stored, then used when needed to boil water into steam to drive a turbine.

Concentrators use reflective surfaces of aluminum or silver on the front or back surface of thin glass or plastic. Researchers are developing new reflective materials, such as advanced polymer films, that are less expensive to produce than glass. Stretched membranes are thin reflective membranes stretched across a rim or hoop. Another membrane stretched on the back creates a partial vacuum. This forces the membranes into a spherical shape, which is the ideal concentrator shape.

Researchers are working with utilities on experimental hybrid power towers that run on solar energy and natural gas. A similar solar/fossil fuel hybrid is being developed for dish/engine systems. The advantage of hybrid systems is that they could run continuously.

Concentrating solar power is the least expensive solar electricity for large-scale power generation, and has the potential to make solar power available at a very competitive rate. As a result, government, industry, and utilities have formed partnerships with the goal of reducing the manufacturing cost of concentrating solar power technologies.

Упр. 10. Прослушайте текст «Scientists use windows to trap solar energy» (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и переведите его последовательно.

Упр. 11. Сделайте реферативный перевод текста.

Энергия Солнца слишком дорога для России?

В России уже через год может начаться строительство первой солнечной электростанции. Местом для СЭС выбран Кисловодск – один из самых «солнечных» городов страны. Но в необходимости развивать альтернативные источники энергии уверены не все эксперты.

Проект СЭС был разработан еще 25 лет назад, рассказал Русской службе Би-би-си главный специалист института «Ростовтеплоэлектропроект» Адольф Чернявский. Возможность осуществить его появилась только сейчас – уже выделена земля, подрядчик, найдены спонсоры. Именно они предоставят на строительство большую часть необходимых трех миллиардов рублей, недостающие 30 % потребуются из бюджета.

От государства потребуется также компенсировать разницу в конечной стоимости солнечной и традиционной энергии, которая, как известно, гораздо дешевле.

Соответствующий закон о поддержке проектов альтернативной энергетики принят в 2007 году, напомнил Чернявский. Однако пока нет подзаконного акта, без которого непонятно, каким способом из бюджета можно получать деньги. Подготовить его в министерстве энергетики должны были еще в мае.

Президент Центра по эффективному использованию энергии Игорь Башмаков считает, что медлительности чиновников есть вполне логичное объяснение. По его словам, сейчас ресурсы природного газа в значительной степени не задействованы.

«Спрос на природный газ в Западной Европе упал, внутренний спрос из-за кризиса тоже несколько упал, и у нас есть свободные мощности по природному газу», – объясняет эксперт.

Кроме того, система добычи традиционных видов топлива отлажена, а солнечная энергия в России только делает первые шаги. Эти шаги, утверждает Башмаков, обернутся для государства дополнительными расходами. Пока еще в стране нет системы обслуживания СЭС, нет опыта эксплуатации подобных объектов, слишком мало специалистов. На все это в первое время тоже придется раскошелиться.

В то же время, поясняет эксперт, ветровая энергетика в Западной Европе сейчас конкурентоспособна с топливной. Чтобы добиться этого, потребовались годы наработок и существенная финансовая поддержка властей.

Стоимость добычи традиционного топлива также не всегда очевидна. Такие катастрофы, как авария в Мексиканском заливе, увеличивают цену традиционной энергетики в разы, а аварии, подобные той, что произошла в Кузбассе, делают ее просто неокупаемой. Экологические ущербы и человеческие жертвы нельзя не принимать в расчет, говоря о будущем энергетики, считает Башмаков.

Начинать освоение энергии солнца и ветра в России нужно, учитывая климатические особенности страны. С этим мнением согласен эксперт по климату российского отделения Greenpeace Игорь Подгорный. В интервью Би-би-си он привел пример малонаселенного острова Ольхон на озере Байкал, на который несколько лет назад была проведена дорогостоящая линия электропередачи.

Исследования показали, что эффективнее было бы в этом месте построить солнечные и ветровые станции, которые, с небольшой страховкой дизельными станциями, полностью бы обеспечили остров энергией, отмечает Подгорный. Линия электропередачи оказалась не просто убыточной, она разрушила уникальный рельеф острова, популярного и у российских, и у иностранных туристов, сетуют в Greenpeace.

По словам Подгорного, сейчас меньше 1 % всей энергии в России добывается из возобновляемых источников. К 2020 году эту долю планируется увеличить до 4,5 %. При этом в Евросоюзе к этому же времени на альтернативные источники будет приходится 20 % – именно так обозначила задачи в этой сфере Еврокомиссия.

Активно солнечные и ветряные проекты реализуются в США и Китае. Площадь солнечных водонагревателей в КНР составляет 125 миллионов квадратных метров, что является самым большим показателем в мире, а к 2019 году здесь планируется построить самую большую в мире солнечную электростанцию.

География России позволяет ей легко включиться в освоение «зеленой» энергетики, и строительство СЭС в Кисловодске может стать первым шагом. Однако уверенно сказать, что даже этот, первый пока проект будет осуществлен, по-прежнему нельзя. (*Татьяна Оспенникова*)

Supplementary materials

Упр. 1. Переведите текст письменно.

Солнечная электростанция будет построена в Ставрополье

В Москве в рамках III международного форума по нанотехнологиям правительство Ставропольского края и ООО «Хевел» (совместное предприятие ГК «Ренова» и ГК «Роснанотех») подписали соглашение о сотрудничестве в реализации инвестпроекта по строительству Кисловодской солнечной электростанции стоимостью 3 млрд рублей. Как сообщается, в церемонии приняли участие гендиректор «Роснанотех» Анатолий Чубайс, губернатор Ставропольского края Валерий Гаевский и гендиректор компании «Хевел» Евгений Загородний. В ходе церемонии Чубайс отметил, что инвестпроект предполагает строительство первой в России солнечной электростанции с промышленным уровнем генерации энергии 12,3 МВт. В свою очередь глава Ставропольского края Валерий Гаевский подчеркнул значимость подписанного соглашения. «Подписываемый документ – больше, чем старт строительства Кисловодской солнечной электростанции. Это принципиально новый этап развития российской энергетики и науки. Мы коммерциализируем разработки, реально воплощаем новаторские идеи. Это лучшее подтверждение способности экономики региона к инвестиционному и инновационному росту – практическая реализация краевой Стратегии – 2020», – отметил Гаевский. По информации пресс-службы, построить электростанцию намечено в трехлетний срок. Под Кисловодском уже выделен земельный участок площадью больше 20 га, имеется необходимая транспортная и инженерная инфраструктура. При строительстве станции будут использованы тонкопленочные фотопреобразовательные модули, произведенные на базе инновационной микроморфной технологии швейцарской компании Oerlikon. Завод по выпуску этих фотоэлементов компания «Хевел» уже строит в Чувашии.

Упр. 2. Переведите текст письменно.

Passive Solar Heating, Cooling and Daylighting

Buildings designed for passive solar and daylighting incorporate design features such as large south-facing windows and building materials that absorb and slowly release the sun's heat. No mechanical means are employed in passive solar heating. Incorporating passive solar designs can reduce heating bills as much as 50 percent. Passive solar designs can also include natural ventilation for cooling. Windows are an important aspect of passive solar design – for information on window technologies, see the Building Envelope section of the EREN Buildings page.

Design Principles

Proper building orientation, so the longest walls run from east to west, allows solar heat to enter the home in winter, while allowing in as little sun as possible during summer. Shading and overhangs also reduce excessive summer heat, while still permitting winter sun. In passive solar designs, the optimal window-to-wall area ratio is 25-35 percent.

Passive Solar Heating

In cold climates, south-facing windows designed to let the sun's heat in while insulating against the cold are ideal. In hot and moderate climates, the strategy is to admit light while rejecting heat. Interior spaces requiring the most light, heat, and cooling are located along the south face of the building, with less used space to the north. Open floor plans allow more sun inside.

The simplest passive design is the direct gain system in which the sun shines directly into a building, heating it up. The sun's heat is stored by the building's inherent thermal mass in materials such as concrete, stone floor slabs, or masonry partitions that hold and slowly release heat. With indirect gain systems, thermal mass is located between the sun and the living space. An isolated gain system is one where the system is isolated from the primary living area, such as a sunroom or solar greenhouse with convective loops into the living space.

Passive Solar Cooling

Many passive solar designs include natural ventilation for cooling. By installing casement or other operable windows for passive solar gain and adding vertical panels, called wing walls, perpendicular to the wall on the windward side of the house, you can accelerate the natural breeze in the interior. Another passive solar cooling device is the thermal chimney, which can be designed like a smoke chimney to vent hot air from the house out through the roof.

Daylighting

Daylighting is using natural sunlight to light a building's interior. In addition to south-facing windows and skylights, clerestory windows – a row of windows near the peak of the roof – can let light into north-facing rooms and upper levels. An open floor plan allows the light to reach throughout the building. Daylighting in businesses and commercial buildings can result in substantial savings on electric bills, and not only provides a higher quality of light, but improves productivity and health. Daylighting in schools has improved student grades and attendance.

Technologies

Sunrooms

South-facing sunrooms are often added on as a way to retrofit a home to take advantage of the sun's heat and light. It is also possible to use a sunroom to help ventilate the rest of the house. Lower vents from the sunroom to the interior rooms draw air through the living space to be expelled out the upper vents to the outside along the top of the sunroom.

Trombe Walls

A Trombe wall consists an 8- to 16-inch thick masonry wall coated with a dark, heat-absorbing material and covered by a single or double layer of glass, placed from about 3/4" to 6" away from the masonry wall. Heat from the sun is stored in the air space between the glass and dark material, and conducted slowly to the interior of the building through the masonry. Adding a Trombe wall and south-facing windows is an easy way for a home to take advantage of solar heat.

Solar Cookers

Passive solar is not just a design technique for using the sun to heat and cool a home. Passive solar heating is also a common way to heat water (see the section on Solar Hot Water), and, particularly in developing nations where the electrical grid is undeveloped, passive solar heat is sometimes captured to cook food. Solar cookers can cook just about any food a conventional oven can. A basic cooker consists of an insulated box with a glass top. Heat from concentrated sunlight gets trapped in the box and can be used to heat food enclosed in the box.

6. NUCLEAR ENERGY

Упр. 1. Переведите термины. Выучите их.

- Fast-breeder (reactor);
- Primary circuit;
- Fuel rods (fuel pins);
- Primary sodium pump;
- Secondary circuit;
- Steam line;
- Feedwater line;
- Feedpump;
- Transmission line;
- Condenser;
- Cooling water;
- Concrete shield;
- Reactor building;
- Steel containment;
- Reactor pressure vessel;
- Control rods;
- Primary coolant pump;
- Fuel storage;
- Coolant flow passage;
- Feedwater line;
- Prime steam line;
- Manway;
- Turbogenerator;
- Exhaust gas stack;
- Polar crane;
- Cooling tower;
- Pressurized-water system;
- Circulation pump;
- Coolant system;
- Storage chamber;
- Protective screen;
- Lead glass window;
- Drum containing radioactive waste;
- Charging chamber.

Упр. 2. Дайте определение следующим понятиям.

Fission	
Nucleus	
Fuel	
Loop	
Generator	
Turbine	
Rod	
Pellet	
Reaction	
To refuel	
Reactor	
Enrichment	

Упр. 3. Переведите текст письменно.

Introduction to Nuclear Power

To provide the power for a dynamo-electric machine, or electric generator, nuclear power plants rely on the process of nuclear fission. In this process, the nucleus of a heavy element, such as uranium, splits when bombarded by a free neutron in a nuclear reactor. The fission process for uranium atoms yields two smaller atoms, one to three free neutrons, plus an amount of energy. Because more free neutrons are released from a uranium fission event than are required to initiate the event, the reaction can become self sustaining – a chain reaction – under controlled conditions, thus producing a tremendous amount of energy.

In the vast majority of the world's nuclear power plants, heat energy generated by burning uranium fuel is collected in ordinary water and is carried away from the reactor's core either as steam in boiling water reactors or as superheated water in pressurized-water reactors. In a pressurized-water reactor, the superheated water in the primary cooling loop is used to transfer heat energy to a secondary loop for the creation of steam. In either a boiling-water or pressurized-water installation, steam under high pressure is the medium used to transfer the nuclear reactor's heat energy to a turbine that mechanically turns a dynamo-electric machine, or electric generator. Boiling-water and pressurized-water reactors are called light-water reactors, because they utilize ordinary water to transfer the heat energy from reactor to turbine in the electricity generation process. In other reactor designs, the heat energy is transferred by pressurized heavy water, gas, or another cooling substance.

Because the water used to remove heat from the core in a light-water reactor absorbs some of the free neutrons normally generated during operation of the reactor, the concentration of the naturally fissionable 235U isotope in uranium used to fuel light-water reactors must be increased above the level of natural uranium to assist in sustaining the nuclear chain reaction in the reactor core: the remainder of the uranium in the fuel is 238U. Increasing the concentration of 235U in nuclear fuel uranium above the level that occurs in natural uranium is accomplished through the process of enrichment, which is explained below.

The fuel core for a light-water nuclear power reactor can have up to 3,000 fuel assemblies. An assembly consists of a group of sealed fuel rods, each filled with UO_2 pellets, held in place by end plates and supported by metal spacer-grids to brace the rods and maintain the proper distances between them. The fuel core can be thought of as a reservoir from which heat energy can be extracted through the nuclear chain reaction process. During the operation of the reactor, the concentration of 235U in the fuel is decreased as those atoms undergo nuclear fission to create heat energy. Some 238U atoms are converted to atoms of fissile 239Pu, some of which will, in turn, undergo fission and produce energy. The products created by the nuclear fission reactions are retained within the fuel pellets and these become neutron-absorbing products (called "poisons") that act to slow the rate of nuclear fission and heat production. As the reactor operation is continued, a point is reached at which the declining concentration of fissile nuclei in the fuel and the increasing concentration of poisons result in lower than optimal heat energy generation, and the reactor must be shut down temporarily and refueled.

The amount of energy in the reservoir of nuclear fuel is frequently expressed in terms of "full-power days", which is the number of 24-hour periods (days) a reactor is scheduled for operation at full power output for the generation of heat energy. The number of full power days in a reactor's operating cycle (between refueling outage times) is related to the amount of fissile 235U contained in the fuel assemblies at the beginning of the cycle. A higher percentage of 235U in the core at the beginning of a cycle will permit the reactor to be run for a greater number of full power days.

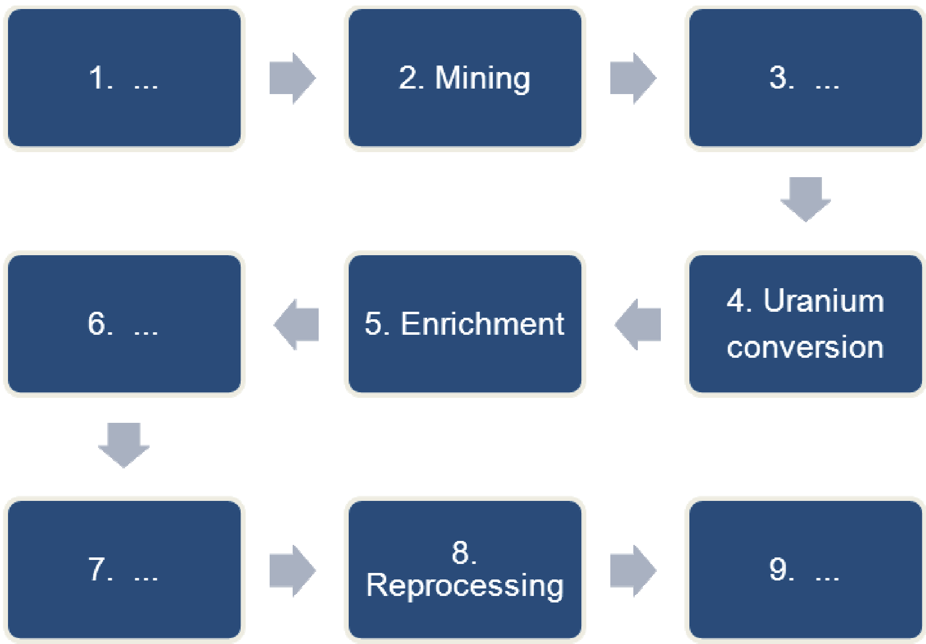
At the end of the operating cycle, the fuel in some of the assemblies is "spent", and it is discharged and replaced with new (fresh) fuel assemblies. The fraction of the reactor's fuel core replaced during refueling is typically one-fourth for a boiling-water reactor and one-third for a pressurized-water reactor.

The amount of energy extracted from nuclear fuel is called its "burn up", which is expressed in terms of the heat energy produced per initial unit of fuel weight. Burn up is commonly expressed as megawatt days thermal per metric ton of initial heavy metal.

Упр. 4. Ознакомьтесь со схемой и текстом. Соотнесите данные схемы с текстом и заполните пропуски. Переведите текст.

The Nuclear Fuel Cycle

The cycle consists of "43" steps that lead to the preparation of uranium for use as fuel for reactor operation and "back end" steps that are necessary to safely manage, prepare, and dispose of the highly radioactive spent nuclear fuel. Chemical processing of the spent fuel material to recover the remaining fractions of fissionable products, 235U and 239Pu, for use in fresh fuel assemblies is technically feasible. Reprocessing of spent commercial-reactor nuclear fuel is not permitted in the United States. The front end of the nuclear fuel cycle commonly is separated into the following steps.



1. Exploration. A deposit of uranium, discovered by geophysical techniques, is evaluated and sampled to determine the amounts of uranium materials that are extractable at specified costs from the deposit. Uranium reserves are the amounts of ore that are estimated to be recoverable at stated costs.

***2.* ____________.** Uranium ore can be extracted through conventional mining in open pit and underground methods similar to those used for mining other metals. In situ leach mining methods also are used to mine uranium in the United States. In this technology, uranium is leached from the in-place ore through an array of regularly spaced wells and is then recovered from the leach solution at a surface plant. Uranium ores in the United States typically range from about 0.05 to 0.3 percent uranium oxide (U_3O_8). Some uranium deposits developed in other countries are of higher grade and are also larger than deposits mined in the United States. Uranium is also present in very low grade amounts (50 to 200 parts per million) in some domestic phosphate-bearing deposits of marine origin. Because very large quantities of phosphate-bearing rock are mined for the production of wet-process phosphoric acid used in high analysis fertilizers and other phosphate chemicals, at some phosphate processing plants the uranium, although present in very low concentrations, can be economically recovered from the process stream.

3. Milling. Mined uranium ores normally are processed by grinding the ore materials to a uniform particle size and then treating the ore to extract the uranium by chemical leaching. The milling process commonly yields dry powder-form material consisting of natural uranium, "yellowcake," which is sold on the uranium market as U_3O_8.

4. Uranium __________. Milled uranium oxide, U_3O_8, must be converted to uranium hexafluoride, UF_6, which is the form required by most commercial uranium enrichment facilities currently in use. A solid at room temperature, UF_6 can be changed to a gaseous form at moderately higher temperatures. The UF_6 conversion product contains only natural, not enriched, uranium.

5. __________. The concentration of the fissionable isotope, 235U (0.71 percent in natural uranium) is less than that required to sustain a nuclear chain reaction in light water reactor cores. Natural UF_6 thus must be "enriched" in the fissionable isotope for it to be used as nuclear fuel. The different levels of enrichment required for a particular nuclear fuel application are specified by the customer: light-water reactor fuel normally is enriched up to about 4 percent 235U, but uranium enriched to lower concentrations also is required. Gaseous diffusion and gas centrifuge are the commonly used uranium enrichment technologies. The gaseous diffusion process consists of passing the natural UF_6 gas feed under high pressure through a series of diffusion barriers (semiporous membranes) that permit passage of the lighter $235UF_6$ atoms at a faster rate than the heavier $238UF_6$ atoms. This differential treatment, applied across a large number of diffusion "stages," progressively raises the product stream concentration of 235U relative to 238U. In the gaseous diffusion technology, the separation achieved per diffusion stage is relatively low, and a large number of stages is required to achieve the desired level of isotope enrichment. Because this technology requires a large capital outlay for facilities and it consumes large amounts of electrical energy, it is relatively cost intensive. In the gas centrifuge process, the natural UF_6 gas is spun at high speed in a series of cylinders. This acts to separate the $235UF_6$ and $238UF_6$ atoms based on their slightly different atomic masses. Gas centrifuge technology involves relatively high capital costs for the specialized equipment required, but its power costs are below those for the gaseous diffusion technology. New enrichment technologies currently being developed are the atomic vapor laser isotope separation (AVLIS) and the molecular laser isotope separation (MLIS). Each laser-based enrichment process can achieve higher initial enrichment (isotope separation) factors than the diffusion or centrifuge processes can achieve. Both AVLIS and MLIS will be capable of operating at high material throughput rates.

6. Fabrication. For use as nuclear fuel, enriched UF_6 is converted into uranium dioxide (UO_2) powder which is then processed into pellet form. The pellets are then fired in a high temperature sintering furnace to create hard, ceramic pellets of enriched uranium. The cylindrical pellets then undergo a grinding process to achieve a uniform pellet size. The pellets are stacked, according to each nuclear core's design specifications, into tubes of corrosion-resistant metal alloy. The tubes are sealed to contain the fuel pellets: these tubes are called fuel rods. The finished fuel rods are grouped in special fuel assemblies that are then used to build up the nuclear fuel core of a power reactor.

The back end of the cycle is divided into the following steps:

7. Interim Storage. After its operating cycle, the reactor is shut down for refueling. The fuel discharged at that time (spent fuel) is stored either at the reactor site or, potentially, in a common facility away from reactor sites. If on-site pool storage capacity is exceeded, it may be desirable to store aged fuel in modular dry storage facilities known as Independent Spent Fuel Storage Installations (ISFSI) at the reactor site or at a facility away from the site. The spent fuel rods are usually stored in water, which provides both cooling (the spent fuel continues to generate heat as a result of residual radioactive decay) and shielding (to protect the environment from residual ionizing radiation).

8. __________. Spent fuel discharged from light-water reactors contains appreciable quantities of fissile (U-235, Pu-239), fertile (U-238), and other radioactive materials. These fissile and fertile materials can be chemically separated and recovered from the spent fuel. The recovered uranium and plutonium can, if economic and institutional conditions permit, be recycled for use as nuclear fuel. Currently, plants in Europe are reprocessing spent fuel from utilities in Europe and Japan.

9. Waste Disposal. A current concern in the nuclear power field is the safe disposal and isolation of either spent fuel from reactors or, if the reprocessing option is used, wastes from reprocessing plants. These materials must be isolated from the biosphere until the radioactivity contained in them has diminished to a safe level. Under the Nuclear Waste Policy Act of 1982, as amended, the Department of Energy has responsibility for the development of the waste disposal system for spent nuclear fuel and high-level radioactive waste. Current plans call for the ultimate disposal of the wastes in solid form in licensed deep, stable geologic structures.

Упр. 5. Прослушайте текст «Nuclear energy» (http://www.knas-tu.ru/images/stories/GF/LMK/audio_lessons.rar) и переведите его.

Упр. 6. Переведите письменно.

Light-water reactors and boiling-water reactors

A variety of reactor types, characterized by the type of fuel, moderator and coolant used, have been built throughout the world for the production of electric power. In the United States, with few exceptions, power reactors use nuclear fuel in the form of uranium oxide isotopically enriched to about three percent uranium-235. The moderator and coolant are highly purified ordinary water. A reactor of this type is called a light-water reactor (LWR).

In the pressurized-water reactor (PWR), a version of the LWR system, the water coolant operates at a pressure of about 150 atmospheres. It is pumped through the reactor core, where it is heated to about 325 °C (about 620 °F). The superheated water is pumped through a steam generator, where, through heat exchangers, a secondary loop of water is heated and converted to steam. This steam drives one or more turbine generators, is condensed, and is pumped back to the steam generator. The secondary loop is isolated from the water in the reactor core and, therefore, is not radioactive. A third stream of water from a lake, river, or cooling tower is used to condense the steam. The reactor pressure vessel is about 15 m (about 49 ft) high and 5 m (about 16.4 ft) in diameter, with walls 25 cm (about 10 in) thick. The core houses some 82 metric tons of uranium oxide contained in thin corrosion-resistant tubes clustered into fuel bundles.

In the boiling-water reactor (BWR), a second type of LWR, the water coolant is permitted to boil within the core, by operating at somewhat lower pressure. The steam produced in the reactor pressure vessel is piped directly to the turbine generator, is condensed, and is then pumped back to the reactor. Although the steam is radioactive, there is no intermediate heat exchanger between the reactor and turbine to decrease efficiency. As in the PWR, the condenser cooling water has a separate source, such as a lake or river.

The power level of an operating reactor is monitored by a variety of thermal, flow, and nuclear instruments. Power output is controlled by inserting or removing from the core a group of neutron-absorbing control rods. The position of these rods determines the power level at which the chain reaction is just self-sustaining.

During operation, and even after shutdown, a large, 1,000-megawatt (MW) power reactor contains billions of curies of radioactivity. Radiation emitted from the reactor during operation and from the fission products after shutdown is absorbed in thick concrete shields around the reactor and primary coolant system. Other safety features include emergency core cooling systems to prevent core overheating in the event of malfunction of the main coolant systems and, in most countries, a large steel and concrete containment building to retain any radioactive elements that might escape in the event of a leak.

Although more than 100 nuclear power plants were operating or being built in the United States at the beginning of the 1980s, in the aftermath of the Three Mile Island accident in Pennsylvania in 1979 safety concerns and economic factors combined to block any additional growth in nuclear power. No orders for nuclear plants have been placed in the United States since 1978, and some plants that have been completed have not been allowed to operate. In 1996 about 22 percent of the electric power generated in the United States came from nuclear power plants. In contrast, in France almost three-quarters of the electricity generated was from nuclear power plants.

Supplementary materials

Упр. 1. Переведите текст письменно.

Propulsion Reactors

Nuclear power plants similar to the PWR are used for the propulsion plants of large surface naval vessels such as the aircraft carrier USS Nimitz. The basic technology of the PWR system was first developed in the U.S. naval reactor program directed by Admiral Hyman G. Rickover. Reactors for submarine propulsion are generally physically smaller and use more highly enriched uranium to permit a compact core. The United States, the United Kingdom, Russia, and France all have nuclear-powered submarines with such power plants.

Three experimental seagoing nuclear cargo ships were operated for limited periods by the United States, Germany, and Japan. Although they were technically successful, economic conditions and restrictive port regulations brought an end to these projects. The Soviet government built the first successful nuclear-powered icebreaker, Lenin, for use in clearing the Arctic sea-lanes.

Research Reactors

A variety of small nuclear reactors have been built in many countries for use in education and training, research, and the production of radioactive isotopes. These reactors generally operate at power levels near one MW, and they are more easily started up and shut down than larger power reactors.

A widely used type is called the swimming-pool reactor. The core is partially or fully enriched uranium-235 contained in aluminum alloy plates, immersed in a large pool of water that serves as both coolant and moderator. Materials may be placed directly in or near the reactor core to be irradiated with neutrons. Various radioactive isotopes can be produced for use in medicine, research, and industry. Neutrons may also be extracted from the reactor core by means of beam tubes to be used for experimentation.

Упр. 2. Переведите текст письменно.

Breeder Reactors

Uranium, the natural resource on which nuclear power is based, occurs in scattered deposits throughout the world. Its total supply is not fully known, and may be limited unless sources of very low concentration such as granites and shale were to be used. Conservatively estimated U.S. resources of uranium having an acceptable cost lie in the range of two million to five million metric tons. The lower amount could support an LWR nuclear power system providing about 30 percent of U.S. electric power for only about 50 years. The principal reason for this relatively brief life span of the LWR nuclear power system is its very low efficiency in the use of uranium: only approximately one percent of the energy content of the uranium is made available in this system.

The key feature of a breeder reactor is that it produces more fuel than it consumes. It does this by promoting the absorption of excess neutrons in a fertile material. Several breeder reactor systems are technically feasible. The breeder system that has received the greatest worldwide attention uses uranium-238 as the fertile material. When uranium-238 absorbs neutrons in the reactor, it is transmuted to a new fissionable material, plutonium, through a nuclear process called β (beta) decay. The sequence of nuclear reactions is in beta decay a nuclear neutron decays into a proton and a beta particle (a high-energy electron).

When plutonium-239 itself absorbs a neutron, fission can occur, and on the average about 2.8 neutrons are released. In an operating reactor, one of these neutrons is needed to cause the next fission and keep the chain reaction going. On the average about 0.5 neutron is uselessly lost by absorption in the reactor structure or coolant. The remaining 1.3 neutrons can be absorbed in uranium-238 to produce more plutonium via the reactions in equation.

The breeder system that has had the greatest development effort is called the liquid-metal fast breeder reactor (LMFBR). In order to maximize the production of plutonium-239, the velocity of the neutrons causing fission must remain fast – at or near their initial release energy. Any moderating materials, such as water, that might slow the neutrons must be excluded from the reactor. A molten metal, liquid sodium, is the preferred coolant liquid. Sodium has very good heat transfer properties, melts at about 100 °C (about 212 °F), and does not boil until about 900 °C (about 1650 °F). Its main drawbacks are its chemical reactivity with air and water and the high level of radioactivity induced in it in the reactor.

In one design of a large LMFBR power plant, the core of the reactor consists of thousands of thin stainless steel tubes containing mixed uranium and plutonium oxide fuel: about 15 to 20 percent plutonium-239, the remainder uranium. Surrounding the core is a region called the breeder blanket, which contains similar rods filled only with uranium oxide. The entire core and blanket assembly measures about 3 m (about 10 ft) high by about 5 m (about 16.4 ft) in diameter and is supported in a large vessel containing molten sodium that leaves the reactor at about 500 °C (about 930 °F). This vessel also contains the pumps and heat exchangers that aid in removing heat from the core. Steam is produced in a second sodium loop, separated from the radioactive reactor coolant loop by the intermediate heat exchangers in the reactor vessel. The entire nuclear reactor system is housed in a large steel and concrete containment building.

The first large-scale plant of this type for the generation of electricity, called Super-Phénix, went into operation in France in 1984. The LMFBR produces about 20 percent more fuel than it consumes. In a large power reactor enough excess new fuel is produced over 20 years to permit the loading of another similar reactor. In the LMFBR system about 75 percent of the energy content of natural uranium is made available, in contrast to the one percent in the LWR.

7. ELECTRIC POWER

Упр. 1. Переведите термины.

- Strain insulator;
- Transformer tank;
- Primary voltage terminal;
- Low-voltage terminals;
- Oil-circulating pump;
- Gas flue;
- Boiler feed pump;
- Arcing horn;
- Transport lug;
- Master switch;
- Water preheater;
- Chimney (smokestack);
- Signal light;
- Feeder panel;
- Transformer;
- Breather;
- Oil gauge (am. Gage);
- Yoke;
- Steel tower;
- Primary winding;
- Core;
- Star connection;
- High-pressure cylinder;
- Low-pressure cylinder;
- Hydrogen cooler;
- Jet nozzle;
- Cable box;
- Boiler house;
- High voltage cable;
- A circuit breaker;
- Compressed-air tank;
- Control valve;
- Interrupter;
- Resistor;
- Auxiliary contacts;
- Turbine house;
- Cooling water pipe;
- Surge diverter;
- Busbars;
- Power transformer;
- Stay poles (guy poles);
- High-voltage transmission line;
- High-voltage conductor;
- Air-blast circuit breaker.

Упр. 2. Дайте определения следующим понятиям. Составьте предложения с данными словами.

Transformers	
High voltage	
Insulator	
Pole	
Cable	
Transmission line	
To convert	
Current	
Voltage	

Упр. 3. Переведите устно.

Electric Power Systems

Electric Power Systems, components that transform other types of energy into electrical energy and transmit this energy to a consumer. The production and transmission of electricity is relatively efficient and inexpensive, although unlike other forms of energy, electricity is not easily stored and thus must generally be used as it is being produced.

A modern electric power system consists of six main components: 1) the power station, 2) a set of transformers to raise the generated power to the high voltages used on the transmission lines, 3) the transmission lines, 4) the substations at which the power is stepped down to the voltage on the distribution lines, 5) the distribution lines, and 6) the transformers that lower the distribution voltage to the level used by the consumer's equipment.

The power station of a power system consists of a prime mover, such as a turbine driven by water, steam, or combustion gases that operate a system of electric motors and generators. Most of the world's electric power is generated in steam plants driven by coal, oil, nuclear energy, or gas. A smaller percentage of the world’s electric power is generated by hydroelectric (waterpower), diesel, and internal-combustion plants.

Упр. 4. Прослушайте разговор (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar). Запишите 5 факторов, влияющих на потребление энергии.

1. ____.
2. ____.

3. ____.
4. ____.
5. ____.

Упр. 5. Заполните отрывки из разговора глаголами в нужной форме. Переведите предложения.

Decrease, fall, increase, rise.

1. During periods of very cold or very hot weather, demand increases.
2. The ____________ in demand is obviously due to millions of electric radiators coming on ...
3. ... a key factor which _________ or __________ demand, is whether or not it's light or dark ...
4. ... on cold, dark, winter evenings, the _________________ in demand is significant ...
5. Generally, demand ________________ during the week, when factories and offices are operational ...
6. So demand _______________ at the weekend.
7. There can be a sudden ____________ when people rush to switch kettles on, or heat up snacks in microwaves, and then a sudden ____________ shortly afterwards.

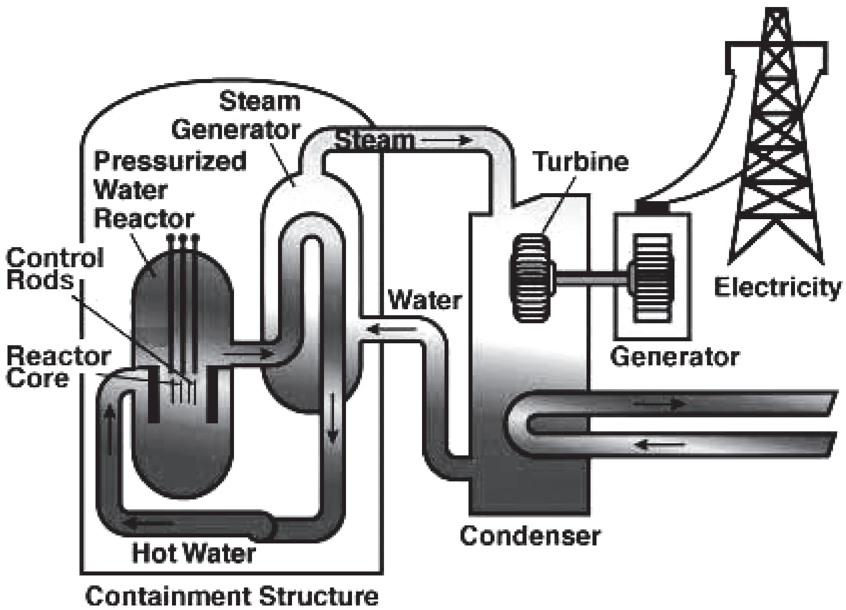
Упр. 6. Послушайте вторую часть текста из упражнения 4 (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и ответьте на вопросы.

1. Why does the company often have significant spare generating capacity?
2. What ideal situation does Helen describe?
3. Why is this ideal situation difficult to achieve?

Упр. 7. Сопоставьте слова с определениями. Составьте предложения.

1. Continuous	A. without interruption
2. Fluctuations	B. amount between an upper and lower limit
3. Peaks and troughs	C. a maximum power requirement at a given time
4. Peak demand	D. high points and low points on a graph curve
5. Range	E. regular and repetitive
6. Band of fluctuation	F. momentary rises followed by a fall
7. Blips	G. changes, movements in general
8. Continual	H. zone of up-and-down movement

Упр. 8. Изучите схему. Опишите процесс выработки энергии в соответствии со схемой.



Упр. 9. Переведите текст письменно.

Modern electric power systems use transformers to convert electricity into different voltages. With transformers, each stage of the system can be operated at an appropriate voltage. In a typical system, the generators at the power station deliver a voltage of from 1,000 to 26,000 volts (V). Transformers step this voltage up to values ranging from 138,000 to 765,000 V for the long-distance primary transmission line because higher voltages can be transmitted more efficiently over long distances. At the substation the voltage may be transformed down to levels of 69,000 to 138,000 V for further transfer on the distribution system. Another set of transformers step the voltage down again to a distribution level such as 2,400 or 4,160 V or 15, 27, or 33 kilovolts (kV). Finally the voltage is transformed once again at the distribution transformer near the point of use to 240 or 120.

The lines of high-voltage transmission systems are usually composed of wires of copper, aluminum, or copper-clad or aluminum-clad steel, which are suspended from tall latticework, towers of steel by strings of porcelain insulators. By the use of clad steel wires and high towers, the distance between towers can be increased, and the cost of the transmission line thus reduced. In modern installations with essentially straight paths, high-voltage lines may be built with as few as six towers to the kilometer. In some areas high-voltage lines are suspended from tall wooden poles spaced more closely together.

For lower voltage distribution lines, wooden poles are generally used rather than steel towers. In cities and other areas where open lines create a safety hazard or are considered unattractive, insulated underground cables are used for distribution. Some of these cables have a hollow core through which oil circulates under low pressure. The oil provides temporary protection from water damage to the enclosed wires should the cable develop a leak. Pipe-type cables in which three cables are enclosed in a pipe filled with oil under high pressure (14 kg per sq cm/200 psi) are frequently used. These cables are used for transmission of current at voltages as high as 345,000 V (or 345 kV).

Упр. 10. Переведите устно.

Any electric-distribution system involves a large amount of supplementary equipment to protect the generators, transformers, and the transmission lines themselves. The system often includes devices designed to regulate the voltage or other characteristics of power delivered to consumers.

To protect all elements of a power system from short circuits and overloads, and for normal switching operations, circuit breakers are employed. These breakers are large switches that are activated automatically in the event of a short circuit or other condition that produces a sudden rise of current. Because a current forms across the terminals of the circuit breaker at the moment when the current is interrupted, some large breakers (such as those used to protect a generator or a section of primary transmission line) are immersed in a liquid that is a poor conductor of electricity, such as oil, to quench the current (see dielectric). In large air-type circuit breakers, as well as in oil breakers, magnetic fields are used to break up the current. Small air-circuit breakers are used for protection in shops, factories, and in modern home installations. In residential electric wiring, fuses were once commonly employed for the same purpose. A fuse consists of a piece of alloy with a low melting point, inserted in the circuit, which melts, breaking the circuit if the current rises above a certain value. Most residences now use air-circuit breakers.

Long transmission lines have considerable inductance and capacitance. When a current flows through the line, inductance and capacitance have the effect of varying the voltage on the line as the current varies. Thus the supply voltage varies with the load. Several kinds of devices are used to overcome this undesirable variation in an operation called regulation of the voltage. The devices include induction regulators and three-phase synchronous motors (called synchronous condensers), both of which vary the effective amount of inductance and capacitance in the transmission circuit.

Inductance and capacitance react with a tendency to nullify one another. When a load circuit has more inductive than capacitive reactance, as almost invariably occurs in large power systems, the amount of power delivered for a given voltage and current is less than when the two are equal. The ratio of these two amounts of power is called the power factor. Because transmission-line losses are proportional to current, capacitance is added to the circuit when possible, thus bringing the power factor as nearly as possible to 1. For this reason, large capacitors are frequently inserted as a part of power-transmission systems.

Much of the world's electricity is produced from the use of nonrenewable resources, such as natural gas, coal, oil, and uranium. Coal, oil, and natural gas contain carbon, and burning these fossil fuels contributes to global emissions of carbon dioxide and other pollutants. Scientists believe that carbon dioxide is the principal gas responsible for global warming, a steady rise in Earth's surface temperature.

Consumers of electricity can save money and help protect the environment by eliminating unnecessary use of electricity, such as turning off lights when leaving a room. Other conservation methods include buying and using energy-efficient appliances and light bulbs, and using appliances, such as washing machines and dryers, at off-peak production hours when rates are lower. Consumers may also consider environmental measures such as purchasing "green power" when it is offered by a local utility ."Green power" is usually more expensive but relies on renewable and environmentally friendly energy sources, such as wind turbines and geothermal power plants.

8. BIOMASS ENERGY

Упр. 1. Переведите термины и выучите их.

- Bark;
- Manure;
- Lumber;
- Wood chips;
- Scraps;
- Hoppers;
- Low-carbon biomass;
- Carbohydrates;
- Carbon;
- Hydrogen;
- Oxygen;
- Terrestrial;
- Switchgrass.

Упр. 2. Переведите устно.

Biomass is matter usually thought of as garbage. Some of it is just stuff lying around – dead trees, tree branches, yard clippings, left-over crops, wood chips, and bark and sawdust from lumber mills. It can even include used tires and livestock manure.

Trash, paper products that can't be recycled into other paper products, and other household waste are normally sent to the dump. Your trash contains some types of biomass that can be reused. Recycling biomass for fuel and other uses cuts down on the need for "landfills" to hold garbage.

This stuff nobody seems to want can be used to produce electricity, heat, compost material or fuels. Composting material is decayed plant or food products mixed together in a compost pile and spread to help plants grow.

How biomass works is very simple. The waste wood, tree branches and other scraps are gathered together in big trucks. The trucks bring the waste from factories and from farms to a biomass power plant. Here the biomass is dumped into huge hoppers. This is then fed into a furnace where it is burned. The heat is used to boil water in the boiler, and the energy in the steam is used to turn turbines and generators.

Biomass can also be tapped right at the landfill with burning waster products. When garbage decomposes, it gives off methane gas. Pipelines are put into the landfills and the methane gas can be collected. It is then used in power plants to make electricity. This type of biomass is called landfill gas.

A similar thing can be done at animal feed lots. In places where lots of animals are raised, the animals – like cattle, cows and even chickens – produce manure. When manure decomposes, it also gives off methane gas similar to garbage. This gas can be burned right at the farm to make energy to run the farm.

Using biomass can help reduce global warming compared to a fossil fuel-powered plant. Plants use and store carbon dioxide (CO_2) when they grow. CO_2 stored in the plant is released when the plant material is burned or decays. By replanting the crops, the new plants can use the CO_2 produced by the burned plants. So using biomass and replanting helps close the carbon dioxide cycle. However, if the crops are not replanted, then biomass can emit carbon dioxide that will contribute toward global warming.

So, the use of biomass can be environmentally friendly because the biomass is reduced, recycled and then reused. It is also a renewable resource because plants to make biomass can be grown over and over.

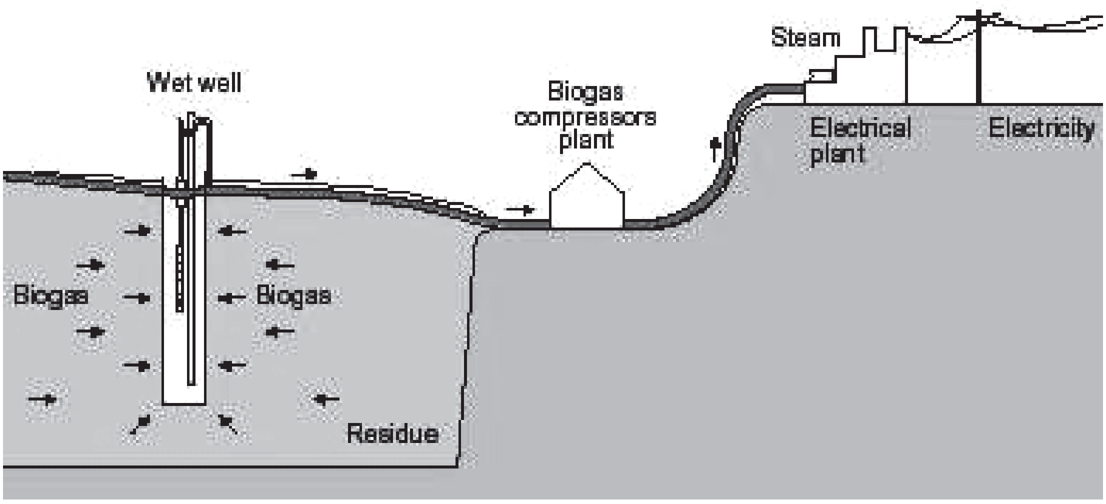
Today, new ways of using biomass are still being discovered. One way is to produce ethanol, a liquid alcohol fuel. Ethanol can be used in special types of cars that are made for using alcohol fuel instead of gasoline. The alcohol can also be combined with gasoline. This reduces our dependence on oil – a non-renewable fossil fuel.

Упр. 3. Переведите с листа.

What Is Biogas

Biogas is generated from the anaerobic digestion of organic matter. Biogas is generated in landfill sites since organic matter such as domestic food and garden waste is buried and compressed in a dark oxygen free environment. For decades after a landfill site is filled biogas continues to be generated and released into the atmosphere.

Biogas is made up primarily of Methane and Carbon Dioxide, but can also contain small quantities of Nitrogen, Hydrogen, Hydrogen Sulphide, and even Oxygen. With processing biogas can be cleaned up to make a substitute for natural gas which can therefore be pumped to homes and businesses for cooking and heating etc.



Biogas has to be collected from landfill sites by drilling gas wells. Historically it was just flamed (i.e. burnt off) but now more and more landfills are collecting the gas generated for power generation. Some sites have even built dedicated Anaerobic Digesters to generate larger quantites of methane-rich biogas more quickly and to reduce the volume of the waste to be buried.

Biogas can be used to power vehicles. There is a biogas powered train in Sweden running between Linkoeping and Vaestervik which is powered with gas generated from cow waste and sewage. From well to the vehicle diesel generates 20 times more carbon dioxide than biogas. Biogas also has no pariculate emissions and generates one-fifth as much nitrous oxide emissions as diesel.

Упр. 4. Переведите письменно.

How Biomass Energy Works

Biomass (plant material and animal waste) is the oldest source of renewable energy, used since our ancestors learned the secret of fire. Until recently, biomass supplied far more renewable electricity – or “biopower” – than wind and solar power combined.

Sustainable, low-carbon biomass can provide a significant fraction of the new renewable energy we need to reduce our emissions of heat-trapping gases like carbon dioxide to levels that scientists say will avoid the worst impacts of global warming. Without sustainable, low-carbon biopower, it will likely be more expensive and take longer to transform to a clean energy economy.

But like all our energy sources, biopower has environmental risks that need to be mitigated. If not managed carefully, biomass for energy can be harvested at unsustainable rates, damage ecosystems, produce harmful air pollution, consume large amounts of water, and produce net greenhouse emissions. However, most scientists believe there is a wide range of biomass resources that can be produced sustainably and with minimal harm, while reducing the overall impacts and risks of our current energy system. Implementing proper policy is essential to securing the benefits of biomass and avoiding its risks.

Biomass is a renewable energy source not only because the energy it comes from the sun, but also because biomass can re-grow over a relatively short period of time. Through the process of photosynthesis, chlorophyll in plants captures the sun's energy by converting carbon dioxide from the air and water from the ground into carbohydrates – complex compounds composed of carbon, hydrogen, and oxygen.

When these carbohydrates are burned, they turn back into carbon dioxide and water and release the energy they captured from the sun. In this way, biomass functions as a sort of natural battery for storing solar energy. As long as biomass is produced sustainably – meeting current needs without diminishing resources or the land's capacity to re-grow biomass and recapture carbon – the battery will last indefinitely and provide sources of low-carbon energy.

Упр. 5. Сделайте реферативный перевод текста.

Types of Beneficial Biomass

Most scientists believe that a wide range of biomass resources are "beneficial" because their use will clearly reduce overall carbon emissions and provide other benefits.

Beneficial biomass use can be considered part of the terrestrial carbon cycle – the balanced cycling of carbon from the atmosphere into plants and then into soils and the atmosphere during plant decay. When biopower is developed properly, emissions of biomass carbon are taken up or recycled by subsequent plant growth within a relatively short time, resulting in low net carbon emissions.

Beneficial biomass sources generally maintain or even increase the stocks of carbon stored in soil or plants. Beneficial biomass also displaces carbon emissions from fossil fuels, such as coal, oil or natural gas, the burning of which adds new and additional carbon to the atmosphere and causes global warming.

Among beneficial resources, the most effective and sustainable biomass resources will vary from region to region and also depend on the efficiency of converting biomass to its final application, be it for biopower, biofuels, bioproducts, or heat.

Energy Crops

Energy crops can be grown on farms in potentially large quantities and in ways that don't displace or otherwise reduce food production, such as by growing them on marginal lands or pastures or as double crops that fit into rotations with food crops. Trees and grasses that are native to a region often require fewer synthetic inputs and pose less risk of disruption to agro-ecosystems.

Grasses

Thin-stemmed perennial grasses used to blanket the prairies of the United States before the settlers replaced them with annual food crops. Switchgrass, big bluestem, and other native varieties grow quickly in many parts of the country, and can be harvested for up to 10 years before replanting. Thick-stemmed perennials like sugar cane and elephant grass can be grown in hot and wet climates like those of Florida and Hawaii.

Switchgrass is a perennial grass that grows throughout the Great Plains, the Midwest and the South. Switchgrass is a hardy species – resistant to floods, droughts, nutrient poor soils, and pests – and does not require much fertilizer to produce consistent high yields. Today, switchgrass is primarily cultivated either as feed for livestock or, due to its deep root structure, as ground cover to prevent soil erosion. However, this prairie grass also has promise for biopower and bio-fuel production (see profile of Show-Me Energy below). If demand for switchgrass outstrips the capacity of marginal lands, it could, however, compete with other crops for more productive land.

Crop Residues

Depending on soils and slope, a certain fraction of crop residues should be left in the field to maintain cover against erosion and to recycle nutrients, but in most cases some fraction of crop residues can be collected for renewable energy in a sustainable manner. Food processing also produces many usable residues.

Woody biomass

Bark, sawdust and other byproducts of milling timber and making paper are currently the largest source of biomass-based heat and renewable electricity; commonly, lumber, pulp, and paper mills use them for both heat and power. In addition, shavings produced during the manufacture of wood products and organic sludge (or "liquor") from pulp and paper mills are biomass resources. Some of these "mill residues" could be available for additional generation of renewable electricity.

Beyond these conventional types of woody biomass, there are additional sources of woody biomass that could be used for renewable energy. With the proper policy (see below), these additional sources could be sustainably harvested and make a significant contribution to renewable energy generation.

Forest residues

It is important to leave some tree tops and branches, and even dead standing trees, on-site after forest harvests. Coarse woody debris left on the soil surface cycles nutrients, especially from leaves, limbs and tops, reduces erosion and provides habitat for invertebrates.

Dead standing trees provide bird habitat. Provided that appropriate amounts of residues are left in the forest, the remaining amounts of limbs and tops, which are normally left behind in the forest after timber-harvesting operations, can be sustainably collected for energy use. Often, limbs and tops are already piled at the "landing" – where loggers haul trees to load them unto trucks. Using these residues for biomass can be cheaper than making additional trips into the woods and reduce impacts on forest stands, wildlife and soils.

Urban wastes

People generate biomass wastes in many forms, including "urban wood waste" (such as tree trimmings, shipping pallets and clean, untreated leftover construction wood), the clean, biodegradable portion of garbage (paper that wouldn't be recycled, food, yard waste, etc.). In addition, methane can be captured from landfills or produced in the operation of sewage treatment plants and used for heat and power, reducing air pollution and emissions of global warming gases.

Converting Biomass to Biopower

From the time of Prometheus to the present, the most common way to capture the energy from biomass was to burn it to make heat. Since the industrial revolution this biomass fired heat has produced steam power, and more recently this biomass fired steam power has been used to generate electricity. Burning biomass in conventional boilers can have numerous environmental and air-quality advantages over burning fossil fuels.

Advances in recent years have shown that there are even more efficient and cleaner ways to use biomass. It can be converted into liquid fuels, for example, or "cooked" in a process called "gasification" to produce combustible gases, which reduces various kinds of emissions from biomass combustion, especially particulates.

Direct combustion

The oldest and most common way of converting biomass to electricity is to burn it to produce steam, which turns a turbine that produces electricity. The problems with direct combustion of biomass are that much of the energy is wasted and that it can cause some pollution if it is not carefully controlled. Direct combustion can be done in a plant using solely biomass (a "dedicated plant") or in a plant made to burn another fuel, usually coal.

Co-firing

An approach that may increase the use of biomass energy in the short term is to mix it with coal and burn it at a power plant designed for coal – a process known as "co-firing." Through gasification, biomass can also be co-fired at natural gas-powered plants.

The benefits associated with biomass co-firing can include lower operating costs, reductions of harmful emissions like sulfur and mercury, greater energy security and, with the use of beneficial biomass, lower carbon emissions. Co-firing is also one of the more economically viable ways to increase biomass power generation today, since it can be done with modifications to existing facilities.

Repowering

Coal plants can also be converted to run entirely on biomass, known as "re-powering" (Similarly, natural gas plants could also be converted to run on biogas made from biomass; see below).

Combined heat and power (CHP)

Direct combustion of biomass produces heat that can also be used to heat buildings or for industrial processes. Because they use heat energy that would otherwise be wasted, CHP facilities can be significantly more efficient than direct combustion systems. However, it is not always possible or economical to find customers in need of heat in close proximity to power plants.

Biomass gasification

By heating biomass in the presence of a carefully controlled amount of oxygen and under pressure, it can be converted into a mixture of hydrogen and carbon monoxide called syngas. This syngas is often refined to remove contaminants.

Equipment can also be added to separate and remove the carbon dioxide in a concentrated form. The syngas can then be run directly through a gas turbine or burned and run through a steam turbine to produce electricity. Biomass gasification is generally cleaner and more efficient that direct combustion of biomass. Syngas can also be further processed to make liquid biofuels or other useful chemicals.

Anaerobic digestion

Micro-organisms break down biomass to produce methane and carbon dioxide. This can occur in a carefully controlled way in anaerobic digesters used to process sewage or animal manure. Related processes happen in a less-controlled manner in landfills, as biomass in the garbage breaks down. A portion of this methane can be captured and burned for heat and power. In addition to generating biogas, which displaces natural gas from fossil fuel sources, such collection processes keep the methane from escaping to the atmosphere, reducing emissions of a powerful global warming gas.

Energy density

Another important consideration with biomass energy systems is that unprocessed biomass contains less energy per pound than fossil fuels – it has less “energy density”. Green woody biomass contains as much as 50 % water by weight. This means that unprocessed biomass typically can't be cost-effectively shipped more than about 50-100 miles by truck before it is converted into fuel or energy.

It also means that biomass energy systems may be smaller scale and more distributed than their fossil fuel counterparts, because it is hard to sustainably gather and process more than a certain amount of in one place. This has the advantage that local, rural communities will be able to design energy systems that are self-sufficient, sustainable, and adapted to their own needs.

However, there are ways to increase the energy density of biomass and to decrease its shipping costs. Drying, grinding and pressing biomass into “pellets” increases its energy density. Compared to raw logs or wood chips, biomass pellets can also be more efficiently handled with augers and conveyers used in power plants. In addition, shipping biomass by water greatly reduces transportation costs compared to hauling it by truck.

Thus, hauling pelletized biomass by water has made it economical to transport biomass much greater distances – even thousands of miles, across the Atlantic and Pacific, to markets in Japan and Europe. In the last few years, the international trade in pelletized biomass has been growing rapidly, largely serving European utilities that need to meet renewable energy requirements and carbon-reduction mandates. Several large pellet manufacturers are locating in the Southern US, with its prodigious forest plantation resource, to serve such markets.

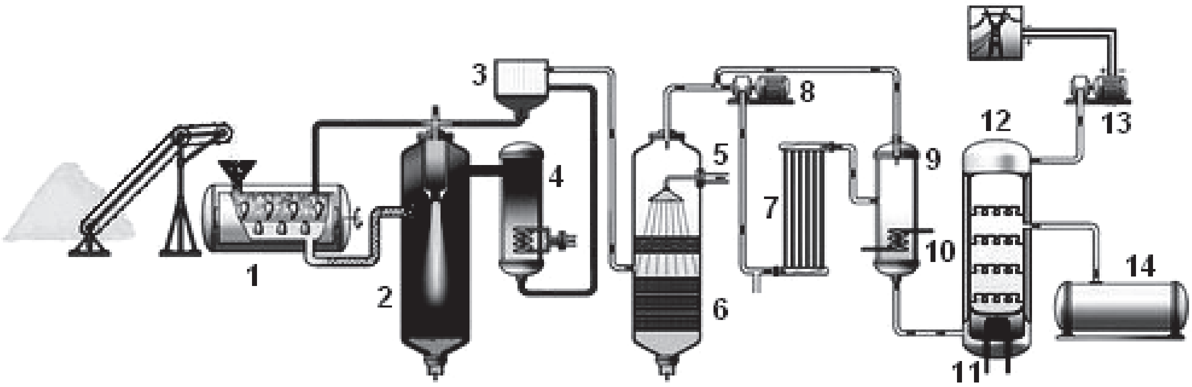
Упр. 6. Прослушайте текст «Bloom Box – Clean Energy For Our Future» (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и переведите его последовательно.

Упр. 7. Переведите текст письменно.

Технологии биотоплива

Технологий производства биотоплива несколько. Одна из них – это переработка сельскохозяйственных отходов в топливо. Сырьем для этого процесса могут служить и куски древесины, и солома, и навоз.

После сушки отходы нагреваются до 400-500 °С, выделившийся газ проходит ряд превращений в присутствии катализатора – и на выходе из реактора получается дизельное топливо без содержания серы и других вредных примесей. Кроме того, биодизельное топливо «CO_2-нейтрально» по отношению к окружающей среде – при его сгорании в атмосферу возвращается та углекислота, что была поглощена растениями при росте. Еще один способ получения биологического дизельного топлива – растительное сырье. Основой для биодизельного топлива служат различные компоненты, чаще всего соя, рапс, хлопок, а в последнее время ятрофа – это южноамериканское растение еще называют бутылочным деревом. Технология такова: семена растений проходят через маслобойку, в которой масло отделяется от шрота – отходов маслоэкстракционного производства. Затем масло смешивают с метанолом, применяя в качестве катализатора метоксид натрия. Полученную смесь очищают – горючее готово.



В процессе производства «биодизеля» из сырья выжимают масло, очищают от вкраплений; полуфабрикат нагревают, охлаждают и дистиллируют. В установку входят: 1 – низкотемпературный газовый генератор; 2 – высокотемпературный реактор; 3 – пылевой фильтр; 4 – теплообменник; 5 – подача воды; 6 – сепаратор; 7 – многотрубочный реактор; 8 – газовый компрессор; 9 – конденсор; 10 – система охлаждения; 11 – нагреватель; 12 – дистилляционная емкость; 13 – газовый электрогенератор; 14 – резервуар с готовым топливом.

В данный момент наиболее предпочтительным сырьем для производства биодизеля является рапс, который как сорняк растет где угодно, единственный нюанс – его надо вовремя собрать. Но пока его только добавляют в дизельное топливо, поскольку рапсовое масло в чистом виде как топливо не используется. Из-за более высокой вязкости (почти в 20 раз выше по сравнению с дизельным горючим) требуется другая топливная аппаратура и изменение камеры сгорания. Масло смешивают с метанолом и получают метиловый эфир, иначе называемый «маслометанольная смесь». Из тонны рапса получается 350 килограммов такой смеси. Для получения биодизеля в солярку добавляют 30 % маслометанольной смеси. Вместо ядовитого метилового спирта рапсовое масло можно смешивать с этиловым (пищевым) спиртом.

Интересно, что в ходе переработки масла в биодизель получают ряд дополнительных продуктов, пользующихся спросом (например, глицерин, сульфат калия).

Третий вид биологического топлива – синтетическое горючее. Современные технологии переработки углеводородов позволяют производить синтетическое дизельное топливо и синтетический бензин. В качестве сырья используются отходы деревообрабатывающей промышленности, сельского хозяйства и даже бытовой мусор. Особенности разработанных технологических процессов заключаются в том, что из одного и того же сырья могут получаться различные виды топлива.

Первое в мире синтетическое дизельное топливо, в 2003-м году, разработала корпорация DaimlerChrysler. Новое топливо, которое разработчики назвали BIOTROLL, производится из древесных отходов, а при его сгорании в атмосферу вообще не выбрасывается углекислый газ. Биотопливо можно смешивать с обычной соляркой, улучшая экологические показатели дизельных двигателей, однако пока не получены точные данные о том, возможна ли эксплуатация современных дизельных двигателей только на новом виде топлива без проведения каких-либо доработок. Первая заправка, на которой можно пополнить баки новым топливом, уже функционирует в Штутгарте.

Упр. 8. Прослушайте текст (http://www.knastu.ru/images/stories/GF/LMK/audio_lessons.rar) и переведите его последовательно.

Supplementary materials

Упр. 1. Переведите с листа.

China to Focus on Renewable Energy

China is battling air pollution and high costs for imported energy with an aggressive focus on renewable energy. China's government says it will have 100 gigawatts of wind-power capacity by 2020 – enough to power more than 60 million homes. That figure is more than three times the target the government laid out just 18 months ago.

Steve Lyons is the director of CWE Renewables, a wind energy company based in Hong Kong. His company is setting up wind farms in Inner Mongolia, funded mainly by Chinese investors. Despite the global economic crisis, the company has seen continued interest from investors and from provinces. "There are provinces that have good wind resources, no wind capacity, and have asked us to help them put in place what needs to be put in place for a wind developer to come in," he said.

China's government has vowed to increase the use of alternatives to oil and coal for energy, such as wind, solar and nuclear power. The goal is to reduce the thick air pollution that blankets its cities and to reduce expensive imports of oil.

Companies from start-ups to well established businesses such as General Electric, see China's drive to clear the air as an opportunity. They are tapping the market hoping to capitalize on Beijing's push to for cleaner energy sources.

Adrian Ho is the director of CWE Renewables. He thinks China's use of renewable energy will increase in coming years to play a significant role in meeting the nation's energy needs. "There is a high chance that I believe China will go to 25 percent some day and that 25 percent will keep expanding," he said. Today, renewable sources produce just eight percent of China's total energy. But Beijing aims to increase that to 15 percent by 2020. In comparison, the United States hopes to generate 10 percent of its energy from renewable sources by 2012.

The roots of China's push for renewable energy are in a 2005 law that gives incentives such as fixed rate tariffs and carbon credits to renewable-energy companies. The law also makes clear that provinces are expected to meet new clean energy guidelines.

Chris Flavin is the president of the Worldwatch Institute, a U.S. environmental group. He says the law works thanks to China's entrepreneurs and a government that is making the move to clean energy a priority.

"The Chinese government, I guess in part of the fact that it does not have some of the kind of democratic complexities that Western countries do, is able to do things quicker and without the kind of resistance from narrow economic interests that might make it more difficult," said Flavin. (*Kari Cameron*)

Упр. 2. Переведите с листа.

US Fighter Jet Powered by Plant Fuel

The roar of jet engines splits the air over the U.S. Navy's testing grounds in Patuxent River, Maryland, as an F-18 fighter plane takes to the skies. Powering this supersonic jet fighter is a fuel that is 50 percent petroleum-based and 50 percent derived from a seed called camelina.

Amid concerns about climate change, volatile oil prices and, most recently, a massive spill in the Gulf of Mexico, the U.S. Navy and the commercial aviation industry are testing biofuels derived from camelina and other sources as an alternative to crude oil.

Rick Kamin, heads of the Navy's alternative-fuel testing program, has nothing against petroleum.

"Petroleum is great", he says. "We've developed all our systems forever to operate on petroleum. The issue with petroleum is, importing the petroleum, price volatility of petroleum, and shipping a lot of our dollars to buy the petroleum overseas."

Kamin says domestically produced biofuels could help make the Navy's fuel supply more secure – and less dependent on imported oil – while helping farmers and workers at home.

Massage oil to jet fuel

Powering supersonic jets is just the latest use for this ancient oilseed.

"If you were a Roman senator, after a hard day at the Forum, you may have walked home and stopped in with your masseuse for a little relaxation and a good massage, and he may have used camelina oil as the lubricant", says Scott Johnson, president of the biofuel company Sustainable Oils. Johnson says in the 19th century camelina oil was a popular lamp fuel.

Today, Kamin says, it works just as well as petroleum fuel to power jet airplanes. "Every test we've put these fuels into our systems, everything has looked no worse than petroleum and sometimes performed even better than our petroleum fuel," he says.

Chemically speaking, it's not surprising, says renewable fuels chief Jim Rekoske at refinery equipment maker Honeywell UOP, because the camelina-based fuel "is not that different from a diesel fuel or a jet fuel."

And fighter plane fuel is not that different from passenger plane fuel. Japan Airlines was one of several that successfully flight-tested biofuels last year.

High cost of petroleum

Recent spikes in oil prices are a big factor driving the interest in biofuels. The airlines still reeling from the 2008 spike in crude oil prices.

"I think with crude oil prices as high as they are, it incentivizes a lot of people to look for the alternative," says John Rau, head of fuels management for American Airlines. "When crude is at 100 dollars a barrel, it changes things pretty dramatically."

But environmental concerns are a factor, too. Burning fuel creates carbon dioxide, a greenhouse gas. Growing plants absorb carbon dioxide as they grow.

Rekoske says the increasing interest in biofuels has created an opportunity to,"number one, extend our business into something that's very important for the environment, and number two, to extend it in an impactful and meaningful way."

In the next decade, Rekoske's goal is for up to one-third of all U.S. transportation fuels to be biofuels, including camelina oil.

Food vs. fuel

But Jim Bartis at the RAND Corporation is not convinced that growing camelina to replace crude oil is such a good idea. According to a study he co-authored at RAND, "Producing just one percent of the oil used in the United States would require 10 percent of all the crop land in the United States," he says. "All crop land. Not just crop land devoted to seed crops. That's a huge amount of displacement."

Displacing all that crop land would affect food production. And if camelina displaces wheat, for example, he says, "That means somewhere else in the world, someone's going to be clearing a forest or grassland so wheat can grow."

Clearing a forest releases large amounts of greenhouse gases that may cancel out the benefits of replacing petroleum.

Right now, the question is moot, because very few farmers grow camelina.

$15 per liter

And, says the Navy's Rick Kamen, "There are no full-scale production plants to make this type of fuel. So there needs to be a commercial investment."

Kamin says commercial investment would bring down the price. The Navy paid about $15 per liter to test camelina fuel, compared to about $1 per liter for petroleum fuel.

Camelina is just one candidate for the biofuel of the future. Others range from animal fats to algae. Honeywell UOP's Jim Rekoske says we'll need them all.

"Those can all provide, by themselves, only a small fraction. But in aggregate, they can now start to make, again, an impactful difference."

A difference that may help change what powers the Navy's fighters, as well as the American economy. (*Steve Baragona, Washington, DC 07*)

Упр. 3. Переведите устно.

Alternative Fuel – Is Green the New Black?

Researchers in Senegal have created what is described as a clean substitute for charcoal that not only helps protect the environment, but costs far less. The alternative fuel has just gone on sale in the markets of northern Senegal.

The new environmentally friendly charcoal is made from vegetable waste mixed with a binding substance, such as clay, to produce small balls that resemble black charcoal, which is traditionally used for heating and cooking. But unlike it's darker cousin, green charcoal is efficiently produced, burns cleanly and is made from renewable local materials.

This innovative product was developed by the French environmental NGO ProNatura International. It is expected to be available soon in Mali, Niger, Madagascar, China, India and Brazil using such diverse raw materials as cotton stems, peanut shells and coffee bean husks.

"What's really new is our technology – it's groundbreaking – because we are the only ones having developed the technology where the machines run on a continuous basis," said Guy Reinaud, director of ProNatura International. "Normally when you carbonise material you use a batch process like the one used for producing charcoal. But if you apply that simple technology to biomass – to reeds or rice husks – the efficiency is very low."

Now, after 14 years of research and development, green charcoal is on sale for the first time in Senegal's northern region of St. Louis, an area where traditional charcoal is hard to come by.

Abdoulaye Fall, manager of the green charcoal factory in Ross-Bethio, 25km from the Mauritanian border, says they make the green charcoal with rice husks because there are many rice mills in the area that throw out the husks. Ross-Bethio is also an area with clay soil, so that's the binding agent. Fall says the raw materials are virtually free.

Reinaud believes the technology has a huge potential in a country where over half the population relies on charcoal or wood for cooking and heating. Ibrahima Niang, a renewable and sustainable energy specialist at Senegal's Ministry of Energy, says the main problem with charcoal consumption is deforestation. Imagine, he says, that you must cut down five kilos of wood to produce only one kilo of charcoal. Thirty years ago charcoal came from only 70 km outside of Dakar, now you must go hundreds of kilometers to find a forest.

The U.N. food and agriculture agency says 45,000 hectares of forest disappear every year in Senegal.

In Ross-Bethio there are few trees and traditional charcoal is trucked up from southern Senegal. So green charcoal could be a welcome alternative for many cash-strapped households. One kilo of green charcoal costs just 20 cents, whereas a kilo of black charcoal is three times as much.

Mame Diop Mbaye runs the bustling Yayu Seex restaurant in the center of town that serves lunch to rice factory workers. She cooks on three huge pots boiling over charcoal stoves. Mbaye says the green charcoal works for her because it cooks quickly and the food tastes good. It takes less than an hour to make a meal. Sometimes, she says, she adds some black charcoal because it makes the green charcoal last longer.

Fatou Camara cooks for her family of 10 with the green charcoal briquets. She says the green charcoal is more economical because one kilo will cook a whole dinner. And it is cheaper than normal charcoal. She says she used to use butane gas, but with gas being so scarce, she switched to green charcoal. Reinaud says using green charcoal fights climate change because it reduces emissions and cuts back on deforestation. The project aims to prevent 1,400 tons of carbon dioxide equivalent from spilling into the atmosphere every year. (*Fid Thompson, Dakar*)

Potential power?

When talking about the UK's renewable energy potential, the amount of renewable energy that may be achieved by exploiting the 20,000 weirs and watermill sites in the country – possibly 600-1000 MW – is often overlooked.

The Domesday Book apparently records more than 5000 mill sites in the 10th and 11th Centuries. Many more were developed between the 12th-20th Century. Between 1850 and 1940 numerous companies and foundries were both manufacturing and/or importing and installing turbines in the British Isles. Local foundries in every area were producing their own variation of Francis Turbines for low head installations. There is historical evidence in the archives showing manufacturers and sites where these turbines were installed.

It has been suggested that “experience is yesterday' s answer to today's problem”. One might take this a stage further and suggest that “today's answer has yet to be tried and proven”. Today's students seem to have little knowledge of past technologies and what has happened to the full time five year apprenticeship? In the not too distant past education allowed for both experience and qualifications. Today's graduates have qualifications but the computer screen is all too often the horizon of their experience. To understand small and micro hydro power they might well benefit from reading technical information from 1850-1950. By 1960 technical colleges were disposing of hydraulic turbine test rigs – I personally bought some of these redundant units. Water companies were also taking out energy recovery turbines and replacing them with electric motors.

In the past 10 years or more there has been a move in the reverse direction. Many universities are spending money on renewable energy/hydro power. Water companies are installing energy recovery turbines. However, graduates involved still appear to lack the historical knowledge and the practical understanding of the subject. The priority seems to be low cost installations rather than quality that will last a lifetime.

Today we are confronting a new, very serious, battle to save our planet. Renewable energy is our best hope. It has to be said that hydropower of any size has a high up front cost which may take perhaps 8-15 years to recover, but thereafter pays excellent dividends. Large hydro provides us with the vast majority of renewable energy currently being generated from any source but even small or very small installations are competitive. Unfortunately there are several examples of low cost solutions, installed by those lacking experience, that have failed even before costs have been recovered and such botched attempts are used to support the efforts of others who wish to deny this significant source of renewable energy to the UK.

With the aforementioned in mind, I would like to refer you to a recent 139 page report by TV Energy, who are an independent not-for-profit energy agency partly funded by different bodies, one of whom is the Environment Agency (EA). The report may be downloaded on www.tvenergy.org.

Entitled “Hydropower in South East England”, the report starts by high-lighting the fact that the south east of England is “festooned” with mill sites but goes on to dismiss the great majority of them and downsizes the rest – in doing so demolishing the power potential even for these remaining sites. For instance, the table on page 118 for Thames weirs has used minimum flows for the basis of their calculations and has come up with power outputs very significantly smaller than the useful potential of each weir.

The requirements of the EA handbook “Hydropower for Agency Staff” occupies a significant number of pages (18) of the TV Energy report. The EA has no remit to be interested in hydro power. It derives no income from hydro power (Act of Parliament April 8 1981). They are not allowed to charge for the water passing through small and micro hydro power schemes.

The EA claim to purchase all their electricity from renewable sources. In the past I have queried why the EA does not use the potential 25 MW on the above mentioned 44 Thames weirs over which it has complete control. The Thames drops some 76 m between Lechlade and Teddington and has, for example, flows at Sandford Weir near Oxford suitable for a turbine passing up to 30 m^3/sec (dry summer flow less than 10 m^3/sec, winter flows sometimes in excess of 350 m^3/sec. Further downstream the flows naturally increase with an even greater potential). The possibilities here are typical of run of river installations all over the world, particularly in France and Europe where successful schemes are common place on heads as low as 1.4 m.

Sandford Weir had a papermill until the 1970's and two vertical shaft turbines on 2.69 m head which produced two to three times the expectation of power presented in the TVEnergy report. The report concludes that Sandford weir has the potential for just 135 kW installed capacity – why when with modern turbines it is capable of producing upwards of four times this amount? More than likely it is because of the fixed output of the turbine type they have selected to recommend.

Since the south east is festooned with mill sites why did the report identify only 1400 sites, then downsize this to 900 and then consider just 400 which it then suggests have a total installed capacity of just 6 MW? Furthermore to dismiss certain types of turbine technology by saying that the Francis and Crossflow type turbines are inappropriate below 3 m head is also incorrect – there are numerous examples to prove otherwise. One of the many continental manufacturers has a list of some 140 successful installations of crossflow turbines on from 1.4 m to 3 m head that they have carried out in recent years on the continent and individually generating up to 100 kW+.

Our country's present aim is to achieve 10 % of our renewable energy by 2010. Exploiting run of river hydro power has the potential to make a major contribution. Failing to identify the theoretical potential and/or downsizing this potential without giving good reasons is misleading if not irresponsible.

CONCLUSION

В данном ученом пособии представлен широкий спектр различных упражнений, направленных на развитие навыков устного и письменного переводов, в рамках контекста изучения энергетических систем.

Данное пособие отличает многофункциональность. Помимо главного назначения текстов – способствовать развитию навыков перевода – они могут также служить основой для активной дискуссии по проблеме, затрагиваемой в конкретном материале.

Предлагаемые в пособии материалы в своем большинстве отобраны из современных источников США и Великобритании, что позволяет отразить лексико-грамматические особенности современной англоязычной научно-технической литературы. Студенты имеют возможность не только детально изучить ряд основных вопросов и проблем современной мировой энергетики, но и закрепить при помощи тренировочных упражнений лексические и грамматические вопросы перевода.

В заключении хотелось бы высказать надежду, что предполагаемое пособие окажется своевременным и полезным для тех, кто занимается переводом и практическим изучением языка.

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