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ENGLISH FOR POWER ENGINEERS

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ОБЩИЕ СВЕДЕНИЯ

Данное учебно-методическое пособие предназначено для студентов средних профессиональных учебных заведений, обучающихся по специальности 35.02.08 Электрификация и автоматизация сельского хозяйства и первых курсов высших учебных заведений сельскохозяйственного профиля.

Данное пособие состоит из 12 основных разделов, состоящих из нескольких текстов, отражающих общую тематику раздела, что соответствует реально существующим направлениям подготовки специалистов энергетического профиля. Конкурентоспособным специалистам совершенно необходимы навыки поиска, извлечения и обработки информации на английском языке как из научной периодики, так из материалов Интернета.

Цель данного пособия взаимосвязанное развитие у студентов коммуникативной компетенции, достаточной для осуществления общения в соответствии с программой, а также научиться ориентироваться в огромном потоке информации на английском языке, и выбирать самое главное и интересное в вопросах энергетики.

При разработке системы заданий положен принцип интегративности обучения иностранному языку, предполагающий комплексную тематическую организацию учебного материала для взаимосвязанного обучения всем видам речевой деятельности.

Каждый раздел, содержащий необходимый лексический минимум по теме, аутентичные тексты профессиональной направленности. Далее следует серия заданий, направленных на контроль понимания прочитанного материала и на отработку и закрепление тематической лексики при помощи упражнений репродуктивного и продуктивного плана.

INTRODUCTION

The industrial progress of mankind is based on power. Industrial plants, machines, heating and lighting systems, communications need power. In fact, power is required in all the spheres of life.

At present most of the power is obtained mainly from two sources. One is from the burning of coal, gas and oil. The second one is by means of generators that get their power from steam or water turbines. Electricity so produced is then run through transmission lines to houses, plants, etc.It should be noted, however, that the generation of electricity by these conventional processes is highly uneconomic. Actually, only about 40 per cent of heat in the fuel is converted =into electricity.

Modern technologies are aimed at the creation and usage of the alternative energy sources. Such directions become economically sound and perspective.

Vocabulary:
coal – уголь;
communication – связь;
conventional – традиционный;
to convert – преобразовывать;
fuel – топливо;
heat – тепло;
to heat – отапливать;
to light – освещать;
to note – замечать;
to obtain– получать;
to require – требовать;
power – энергия;
to run – направлять;
source – источник.

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ethanol as a winter oxidizer to reduce atmospheric pollution emissions.

In the current alcohol-from-corn production model in the United States, considering the total energy consumed by farm equipment, cultivation, planting, fertilizers, pesticides, herbicides, and fungicides made from petroleum, irrigation systems, harvesting, transport of feedstock to processing plants, fermentation, distillation, drying, transport to fuel terminals and retail pumps, and lower ethanol fuel energy content, the net energy content value added and delivered to consumers is very small. And, the net benefit (all things considered) does little to reduce un-sustainable imported oil and fossil fuels required to produce the ethanol.

Many car manufacturers are now producing flexible-fuel vehicles (FFV's), which can safely run on any combination of bioethanol and petrol, up to 100 % bioethanol. They dynamically sense exhaust oxygen content, and adjust the engine's computer systems, spark, and fuel injection accordingly. This adds initial cost and ongoing increased vehicle maintenance. Efficiency falls and pollution emissions increase when FFV system maintenance is needed (regardless of the fuel mix being used), but not performed (as with all vehicles). FFV internal combustion engines are becoming increasingly complex, as are multiple-propulsion-system FFV hybrid vehicles, which impacts cost, maintenance, reliability, and useful lifetime longevity.

Methanol is currently produced from natural gas, a non-renewable fossil fuel. It can also be produced from biomass as biomethanol. The methanol economy is an interesting alternative to the hydrogen economy, compared to today's hydrogen produced from natural gas, but not hydrogen production directly from water and state-of-the-art clean solar thermal energy processes.

Unit 1. ELECTRICITY

Electricity is considered to be the basis of our civilization. Electric energy is widely used in industry to power a great variety of mechanisms and directly in production processes, for transportation and residential purposes. Such modern means of communication as telegraph, telephone, radio, television depend for their operation on electric power.

The greater part of electricity goes to industrial usage. However, there has been a marked increase in residential and commercial usage of energy. In agriculture electric energy finds a great variety of applications, especially in electrification of mobile agricultural equipment, primarily tractors. Besides, electric energy is employed in agricultural processes, using high-frequency current, ultra-violet and infra-red rays, ultra-sound, etc.

In the past electricity was mainly used for lighting. The progress in electrical engineering has led to the development of such sophisticated and convenient household appliances as refrigerators, TV-sets, washing machines, etc. The wider use of these appliances has resulted in a growing consumption of electric energy.

The amount of electricity going to industrial and residential usage from the power system varies both during a day and during a year. In the morning, when work begins at enterprises, the light is turned on in apartments and public transport starts running, energy consumption considerably increases, which is referred to as the morning peak demand. During the day, the demand on the power system decreases. In the evening, the demand on the system is, as a rule, at maximum because this is the time when the electric vehicles of public transport run at the shortest interval, street and apartment lights are turned on as there are numerous electric appliances, such as TV and radio sets, heaters, etc. During the same hours some enterprises go on working. In the night-time most electric power us-

ers do not operate and the power demand «drops» low.

The change of seasons is another factor affecting the consumption of electric energy. For instance, in winter a larger amount of energy is used for lighting and heating. Energy usage is also dependent on weather conditions. A snowfall increases the amount of power used for transportation.

Vocabulary:

residential – жилой (потребительский);
ultra-violet – ультрафиолетовый;
infra-red rays – инфракрасные лучи;
ultra-sound – ультразвуковая техника;
to increase – увеличивать, возрастать;
sophisticated – сложный;
appliance – аппарат, прибор, устройство;
consumption – потребление;
to improve – совершенствовать, улучшать;
vary – менять, изменять;
countless – многочисленный.

I. Answer the following questions:

1. In what spheres of life is electricity widely used?
2. In what way is electric energy used in industry?
3. Is there the problem of electric power consumption?
4. How does the amount of electricity we use vary during a day and during a year?
5. Do the change of seasons and weather conditions affect the consumption of electric energy?
6. Why is it important to predict the number of factors affecting energy consumption in the power system?
7. Why is the information about time-variation of energy usage important?
8. What electric devices do you use at home (at work)?
9. What do the students of Electricity Supply specialty study?

the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose (which is more difficult). Biobutanol (also called biogasoline) is often claimed to provide a direct replacement for gasoline, because it can be used directly in a gasoline engine (in a similar way to biodiesel in diesel engines).

Butanol is formed by ABE fermentation (acetone, butanol, ethanol) and experimental modifications of the process show potentially high net energy gains with butanol as the only liquid product. Butanol will produce more energy and allegedly can be burned «straight» in existing gasoline engines (without modification to the engine or car), and is less corrosive and less water soluble than ethanol, and could be distributed via existing infrastructures. DuPont and BP are working together to help develop Butanol

Ethanol fuel is the most common biofuel worldwide, particularly in Brazil. Alcohol fuels are produced by fermentation of sugars derived from wheat, corn, sugar beets, sugar cane, molasses and any sugar or starch that alcoholic beverages can be made from (like potato and fruit waste, etc.). The ethanol production methods used are enzyme digestion (to release sugars from stored starches, fermentation of the sugars, distillation and drying. The distillation process requires significant energy input for heat (often unsustainable natural gas fossil fuel, but cellulosic biomass such as bagasse, the waste left after sugar cane is pressed to extract its juice, can also be used more sustainably).

Ethanol can be used in petrol engines as a replacement for gasoline; it can be mixed with gasoline to any percentage. Most existing automobile petrol engines can run on blends of up to 15 % bioethanol with petroleum/gasoline. Gasoline with ethanol added has higher octane, which means that your engine can typically burn hotter and more efficiently. In high altitude (thin air) locations, some states mandate a mix of gasoline and

less efficient petrol engines and are not as widely available.

Biodiesel can be used in any diesel engine when mixed with mineral diesel. The majority of vehicle manufacturers limit their recommendations to 15% biodiesel blended with mineral diesel. In some countries manufacturers cover their diesel engines under warranty for B100 use, although Volkswagen of Germany, for example, asks drivers to check by telephone with the VW environmental services department before switching to B100. B100 may become more viscous at lower temperatures, depending on the feedstock used, requiring vehicles to have fuel line heaters. In most cases, biodiesel is compatible with diesel engines from 1994 onwards, which use «Viton» (by DuPont) synthetic rubber in their mechanical injection systems. Many current generation diesel engines are made so that they can run on B100 without altering the engine itself, although this depends on the fuel rail design.

Since biodiesel is an effective solvent and cleans residues deposited by mineral diesel, engine filters may need to be replaced more often, as the biofuel dissolves old deposits in the fuel tank and pipes. It also effectively cleans the engine combustion chamber of carbon deposits, helping to maintain efficiency. In many European countries, a 5 % biodiesel blend is widely used and is available at thousands of gas stations. Biodiesel is also an oxygenated fuel, meaning that it contains a reduced amount of carbon and higher hydrogen and oxygen content than fossil diesel. This improves the combustion of fossil diesel and reduces the particulate emissions from un-burnt carbon.

In the USA, more than 80 % of commercial trucks and city buses run on diesel. The emerging US biodiesel market is estimated to have grown 200 % from 2004 to 2005.

Alcohol fuel

Biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by

10. What modern computer technology is used to design electricity supply systems?

II. Translate the following word combinations into Russian:

– residential usage;
– a great variety;
– modern means of communication;
– high-frequency current;
– an increasing rate;
– sophisticated;
– convenient household appliances;
– the consumption of electric energy;
– the countless number of factors;
– to improve the efficiency.

1.1. Electric Power

Electric power is generated by converting heat, light, chemical energy, or mechanical energy to electrical energy. Most electrical energy is produced in large power stations by the conversion of mechanical energy or heat. The mechanical energy of falling water is used to drive turbine generators in hydroelectric stations, and the heat derived by burning coal, oil, or other fossil fuels is used to operate steam turbines or internal-combustion engines that drive electric generators. Also, the heat from the fissioning of uranium or plutonium is used to generate steam for the turbine generator in a nuclear power plant.

Electricity generated by the conversion of light or chemical energy is used mainly for portable power sources. For example, a photoelectric cell converts the energy from light to electrical energy for operating the exposure meter in a camera, and a lead – acid battery converts chemical energy to electrical energy for starting an automobile engine.

Electric power produced in large power stations generally is transmitted by using an alternating current. The basic unit for measuring electric power is the watt – the rate at which

work is being done in an electric circuit in which the current is one ampere and the electromotive force is one volt.

Rating for power plants is expressed in kilowatts (1,000 watts) or megawatts (1 million watts). Electric energy consumption normally is given in kilowatts–hours – that is, the number of kilowatts used times the number of hours of use. Electricity is a clean, inexpensive and easily transmitted over long distances. Since the 1880s electricity has had an ever-increasing role in improving the standard of living. It now used to operate lights, pumps, elevators, power tools, furnaces, refrigerators, air-conditioners, TV sets, and many other kinds of equipment. It has been counted that in developed countries about 45 % of the electric power is generally used for industrial purposes, 32 % in homes, and more than 20 % in commercial enterprises.

Vocabulary:

conversion – преобразование, превращение;

to derive – извлекать, получать;

internal-combustion engine – двигатель внутреннего сгорания;

fission – деление, расщепление, фрагментация;

portable – портативный, переносной, транспортабельный;

exposure meter – экспонометр, счетчик выдержки

alternating current – переменный ток;

inexpensive – недорогой;

furnace – печь.

pump - насос

elevator - лифт

power tool – электрический инструмент

I. Answer the following questions:

1. Where is electric power used?
2. What is the basic unit for measuring electric power?

The most common first generation biofuels are listed below.

Vegetable oil used as fuel

Edible vegetable oil is generally not used as fuel, but lower quality oil can be used for this purpose. Used vegetable oil is increasingly being processed into biodiesel, or (more rarely) cleaned of water and particulates and used as a fuel. To ensure that the fuel injectors atomize the fuel in the correct pattern for efficient combustion, vegetable oil fuel must be heated to reduce its viscosity to that of diesel, either by electric coils or heat exchangers. This is easier in warm or temperate climates. Some companies offer engines that are compatible with straight vegetable oil, without the need for after-market modifications. Vegetable oil can also be used in many older diesel engines that do not use common rail or unit injection electronic diesel injection systems. Due to the design of the combustion chambers in indirect injection engines, these are the best engines for use with vegetable oil. This system allows the relatively larger oil molecules more time to burn.

Biodiesel and Biodiesel around the world

Biodiesel is the most common biofuel in Europe. It is produced from oils or fats using trans esterification and is a liquid similar in composition to fossil/mineral diesel. Its chemical name is fatty acid methyl (or ethyl) ester (FAME). Oils are mixed with sodium hydroxide and methanol (or ethanol) and the chemical reaction produces biodiesel (FAME) and glycerol. One part glycerol is produced for every 10 parts biodiesel. Feedstocks for biodiesel include animal fats, vegetable oils, soy, rapeseed, mustard, flax, sunflower, palm oil, hemp, field pennycress, and algae. Pure biodiesel (B100) is by far the lowest emission diesel fuel. Although liquefied petroleum gas and hydrogen have cleaner combustion, they are used to fuel much

to power certain automotive vehicles.

A current project for a 1.6 MW landfill power plant is projected to provide power for 880 homes (the USA). It is estimated that this will eliminate 3,187 tons of methane and directly eliminate 8.756 tons of carbon dioxide release per year. This is the same as removing 12,576 cars from the road, or planting 15,606 trees, or not using 359 rail cars of coal per year.

12.2. Liquid fuels for transportation

In some countries biodiesel is less expensive than conventional diesel.

Most transportation fuels are liquids, because vehicles usually require high energy density, as occurs in liquids and solids. Vehicles usually need high power density as can be provided most inexpensively by an internal combustion engine. These engines require clean burning fuels, in order to keep the engine clean and minimize air pollution.

The fuels that are easier to burn cleanly are typically liquids and gases. Thus liquids (and gases that can be stored in liquid form) meet the requirements of being both portable and clean burning. Also, liquids and gases can be pumped, which means handling is easily mechanized, and thus less laborious.

First generation biofuels

«First-generation biofuels» are biofuels made from sugar, starch, vegetable oil, or animal fats using conventional technology. The basic feedstocks for the production of first generation biofuels are often seeds or grains such as wheat, which yields starch that is fermented into bioethanol, or sunflower seeds, which are pressed to yield vegetable oil that can be used in biodiesel. These feedstocks could instead enter the animal or human food chain, and as the global population has risen their use in producing biofuels has been criticized for diverting food away from the human food chain, leading to food shortages and price rises.

3. How is electric power produced in large power stations transmitted?

4. Why is electric power considered to be the most widespread?

5. Why it has improved the standard of living?

1.2. Power Engineering

Power engineering is the subfield of electrical engineering that deals with power systems, electric power transmission and distribution, power conversion, and electromechanical devices. A power engineer supervises, operates, and maintains machinery and boilers that provide heat, power, refrigeration, and other utility services to heavy industry and large building complexes.

Power engineering was one of the earliest fields to be exploited in electrical engineering. Early problems solved by engineers include efficient and safe distribution of electric power. Nikola Tesla was a notable pioneer in this field.

Power Engineering deals with the generation, transmission and distribution of electricity as well as the design of a range of related devices. These include transformers, electric generators, electric motors and power electronics.

In many regions of the world, governments maintain an electrical network that connects a variety of electric generators together with users of their power. This network is called a power grid. Users purchase electricity from the grid. Power engineers may work on the design and maintenance of the power grid as well as the power systems that connect to it. Such systems are called on-grid power systems.

Power engineers may also work on systems that do not connect to the grid. These systems are called off-grid power systems and may be used in preference to on-grid systems for a variety of reasons. For example, in remote locations it may be cheaper for a mine to generate its own power rather than pay

for connection to the grid and in most mobile applications connection to the grid is simply not practical.

Today, most grids adopt three-phase electric power with an alternating current. This choice can be partly attributed to the ease with which this type of power can be generated, transformed and used. Often (especially in the USA), the power is split before it reaches residential customers whose low-power appliances rely upon single-phase electric power. However, many larger industries and organizations still prefer to receive the three-phase power directly because it can be used to drive highly efficient electric motors such as three-phase induction motors.

Vocabulary:

subfield –раздел, часть;
transmission – передача;
distribution – распределение;
to supervise – наблюдать, заведовать;
utility services – коммунальные службы;
to exploit – эксплуатировать, использовать;
range – линия, ряд;
power grid – энергосистема
to purchase – покупать;
maintenance – обслуживание;
remote locations – отдаленные районы;
to split – разделять.

1.3. Transformers

Transformers play an important role in power transmission because they allow power to be converted to and from higher voltages. This is important because higher voltages suffer less power loss during transmission. For these reasons, electrical substations exist throughout power grids to convert power to higher voltages before transmission and to lower voltages

waste. Biomass can come from waste plant material. The use of biomass fuels can therefore contribute to waste management as well as fuel security and help to prevent global warming, though alone they are not a comprehensive solution to these problems.

12.1. Energy from bio waste

Filtered waste vegetable oil. Using waste biomass to produce energy can reduce the use of fossil fuels, reduce greenhouse gas emissions and reduce pollution and waste management problems. A recent publication by the European Union highlighted the potential for waste-derived bioenergy to contribute to the reduction of global warming. The report concluded that 19 million tons of oil equivalent is available from biomass by 2020, 46 % from bio-wastes: municipal solid waste (MSW), agricultural residues, farm waste and other biodegradable waste streams.

Landfill sites generate gases as the waste buried in them undergoes anaerobic digestion. These gases are known collectively as landfill gas (LFG). This is considered a source of renewable energy, even though landfill disposal is often non-sustainable. Landfill gas can be burned either directly for heat or to generate electricity for public consumption. Landfill gas contains approximately 50 % methane, the gas found in natural gas.

If landfill gas is not harvested, it escapes into the atmosphere: this is undesirable because methane is a greenhouse gas with much more global warming potential than carbon dioxide.

It was recently discovered that living plants also produce methane.

Anaerobic digestion can be used as a waste management strategy to reduce the amount of waste sent to landfill and generate methane, or biogas. Any form of biomass can be used in anaerobic digestion and will break down to produce methane, which can be harvested and burned to generate heat, power or

unlike fossil fuels, which return carbon that was stored beneath the surface for millions of years into the atmosphere, biofuels can produce energy without causing a net increase of atmospheric carbon. This is because as new plants are grown to produce fuel, they remove the same amount of CO2 from the atmosphere as they will release as fuel.

Unit 12. BIOMASS

Sugar cane can be used as a biofuel or food.

Biomass is material derived from recently living organisms. This includes plants, animals and their by-products. For example, manure, garden waste and crop residues are all sources of biomass. It is a renewable energy source based on the carbon cycle, unlike other natural resources such as petroleum, coal, and nuclear fuels.

Animal waste is a persistent and unavoidable pollutant produced primarily by the animals housed in industrial sized farms. Researchers from Washington University have figured out a way to turn manure into biomass. In April 2008 with the help of imaging technology they noticed that vigorous mixing helps microorganisms turn farm waste into alternative energy, providing farmers with a simple way to treat their waste and convert it into energy.

There are also agricultural products specifically grown for biofuel production including corn, switch grass, and soybeans, primarily in the United States; rapeseed, wheat and sugar beet primarily in Europe; sugar cane in Brazil; palm oil in South-East Asia; sorghum and cassava in China.. Hemp has also been proven to work as a biofuel. Biodegradable outputs from industry, agriculture, forestry and households can be used for biofuel production, either using anaerobic digestion to produce biogas, or using second generation biofuels; examples include straw, timber, manure, rice husks, sewage, and food

suitable for appliances after transmission.

Power engineering is usually broken into three parts:

– Generation

Generation is converting other forms of power into electrical power. The sources of power include fossil fuels such as coal and natural gas, hydropower, nuclear power, solar power, wind power and other forms.

– Transmission

Transmission includes moving power over somewhat long distances, from a power station to near where it is used. Transmission involves high voltages, almost always higher than voltage at which the power is either generated or used. Transmission also includes connecting together power systems owned by various companies and perhaps in different states or countries.

– Distribution

Distribution involves taking power from the transmission system to end users, converting it to voltages at which it is ultimately required.

Electricity distribution is the penultimate stage in the delivery (before retail) of electricity to end users. It is generally considered to include medium-voltage (less than 50 kV) power lines, electrical substations and pole-mounted transformers, low-voltage (less than 1000 V) distribution wiring and sometimes electricity meters.

In the early days of electricity generation to about 1900, direct current DC generators were connected to loads at the same voltage. The generation, transmission and loads had to be of the same voltage because there was no way of changing DC voltage levels, other than inefficient motor-generator sets. Low DC voltages were used (on the order of 100 volts) since that was a practical voltage for incandescent lamps, which were then the primary electrical load. The low voltage also required less insulation to be safely distributed within buildings.

The losses in a cable are proportional to the square of the current, the length of the cable, and the resistance of the material, and are inversely proportional to cross-sectional area. Early transmission networks were already using copper, which is one of the best economically feasible conductors for this application. To reduce the current and copper required for a given quantity of power transmitted would require a higher transmission voltage, but no convenient efficient method existed to change the voltage level of DC power circuits. To keep losses to an economically practical level the Edison DC system needed thick cables and local generators. Early DC generating plants needed to be within about 1.5 miles of the farthest customer to avoid the need for excessively large and expensive conductors.

Electricity has been generated for the purpose of powering human technologies for at least 120 years from various sources of energy. The first power plants were run on wood, while today we rely mainly on petroleum, natural gas, coal, hydroelectric and nuclear power and a small amount from hydrogen, solar energy, tidal harnesses, wind generators, and geothermal sources.

Vocabulary:

power loss – потери электроэнергии
fossil fuels – полезные ископаемые
penultimate – предпоследний
pole-mounted station – (радио)станция, установленная на мачте
incandescent lamp – лампа накаливания
insulation – изоляция
inversely proportional – обратно пропорциональный
step-up – повышение, увеличение тока (напряжения)
excessively – чрезмерно
dependable – надежный

Unit 11. BIOFUELS

Biofuel is defined as solid, liquid or gaseous fuel derived from relatively recently dead biological material and is distinguished from fossil fuels, which are derived from long dead biological material. Theoretically, biofuels can be produced from any (biological) carbon source; although, the most common sources are photosynthetic plants. Various plants and plant-derived materials are used for biofuel manufacturing. Globally, biofuels are most commonly used to power vehicles, heating homes, and cooking stoves. Biofuel industries are expanding in Europe, Asia and the Americas. Recent technology even allows for the conversion of pollution into renewable bio fuel. Agrofuels are biofuels which are produced from specific crops, rather than from waste processes such as landfill off-gassing or recycled vegetable oil.

There are two common strategies of producing agrofuels. One is to grow crops high in sugar (sugar cane, sugar beet, and sweet sorghum) or starch (corn/maize), and then use yeast fermentation to produce ethyl alcohol (ethanol). The second is to grow plants that contain high amounts of vegetable oil, such as oil palm, soybean, and algae. When these oils are heated, their viscosity is reduced, and they can be burned directly in a diesel engine, or they can be chemically processed to produce fuels such as biodiesel. Wood and its byproducts can also be converted into biofuels such as wood gas, methanol or ethanol fuel. It is also possible to make cellulose ethanol from non-edible plant parts, but this can be difficult to accomplish economically.

Biofuels are discussed as having significant roles in a variety of international issues, including: mitigation of carbon emissions levels and oil prices, the «food vs fuel» debate, deforestation and soil erosion, impact on water resources, and energy balance and efficiency. The use of biofuels reduces dependence on petroleum and enhances energy security. Also,

6. to extract; 6. по сравнению с;
7. fluid pressure; 7. скорость ветра;
8. interface; 8.прямоугольный бетонный ящик;
9. absorber; 9. извлекать;
10. small height; 10. устройство;
11. submerged structure; 11. промежуток времени;
12. air chamber; 12. воздушная камера;
13. axial-flow turbine; 13.процесс преобразования;
14. rectifying air valves; 14.поглощающая структура;
15. rectangular concrete box; 15. длина по гребню волны;
16. device; ` 16. осевая гидротурбина;
17. in comparison with; 17.ректификационные воздушные клапаны

V. Read the text and say whether the statements are true or false according to the text:

1. Wave energy can be considered as a concentrated form of lunar energy.

2. Energy is stored in waves as both potential energy and kinetic energy.

3. Power is concentrated at each stage in the transformation process.

4. Wave energy converters extract energy from the Earth and convert it to a more useful form, usually as fluid pressure or mechanical motion.

5. There are over 1000 patents for very varied designs of wave energy converters.

6. Wave energy is mainly at the construction stage.

7. The water trapped in the reservoir flows back to the sea through a conventional collector.

8. Many energy and engineering companies are starting to show a growing interest in these technologies.

byproduct – побочный продукт
distinct from – отличный от (отличительный)
landfill – закапывание мусора и отходов
overhead power transmission lines – верхние линии передач
superconductor – сверхпроводник
reliable – надежный
deregulation – прекращение регулирования

I. Answer the following questions:

1. What are the main parts of power engineering?

2.Explain the processes of generation, distribution and transmission.

3. How can one achieve efficiency?

4. What is the main negative impact on the environment?

II. Complete the sentences according to the text:

1. Transformers play an important role in power transmission because …

2. Electricity generation is the first process in…

3. Electricity has been generated for the purpose of…

4. The first power plants were run on…

5. Electric power transmission is one process in …

6. Centralized power generation became possible when …

7. Electricity is usually transmitted over long distance …

8. Engineers design transmission networks to …

9. The capital cost of electric power stations is …

10. Efficiency is improved by …

III. Say whether the following statements are true or false according to the text:

1. As the voltage steps up, the current steps up too.

2. Power engineering is usually broken into three parts: generation, distribution, transmission.

3. The losses in a cable are proportional to the square of the current, the length of the cable, and the resistance of the material, and are inversely proportional to cross-sectional area.

4. Early transmission networks were already using copper, which is one of the worst economically feasible conductors for this application.

5. Transmission includes moving power over somewhat long distances, from a power station to near where it is used.

6. Electricity is usually transmitted over long distance through underground power transmission lines.

7. Overhead power transmission is used only in densely populated areas (such as large cities).

8. Transmission networks use components such as power lines, cables, circuit breakers, switches and transformers.

9. Electricity generation is the first process in the delivery of electricity to consumers.

10. The electric power transmission and electricity distribution are not important.

11. Typically, power transmission is between the power plant and a substation near a populated area.

12. A transmission grid is a network of power stations, transmission circuits, and substations.

IV. Speak on the interesting facts about distribution, generation and transmission of electricity. Express your point of view, using the following phrases and word combinations:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

8. When will wave energy start to play an increasingly important role complementing other renewable and conventional energy technologies?

II. Give the Russian equivalents to the following word combinations from the text:

– wave energy;
– wind speed;
– original solar power levels;
– wave energy converters;
– mean sea level;
– conventional low-head hydroelectric generator;
– self-rectifying air turbine;
– axial-flow turbine;
–steel pendulum flap;
– wave power generation.

III. Find in the text the synonyms to the following words:

a) to transmit
b) quantity
c) space of time
d) decrease
e) detailed
f) include
g) use
h) anticipate

IV. Find in the Russian equivalents to the English words and word combinations:

1. water particles;	1. небольшая высота;
2. wind speed;	2. поверхность;
3. the length of time;	3. давление жидкости;
4. transformation process;	4. поглотитель;
5. crest length;	5. частицы воды;

varied – различный, разнообразный;
comprehensive review – всесторонний, полный обзор;
to deploy – размещать;
shoreline – береговая линия;
in height – по высоте;
to comprise – включить;
to submerge – погружать (под воду);
incident wave – падающая волна;
to draw – тащить;
application – применение;
to hinge – прикреплять;
to envisage – рассматривать;
to complement – дополнять;
potable water – питьевая вода;
to swing – качаться, раскачиваться;
tapered channel – суживающийся канал;
to funnel – проводить через узкий проход;
to overtop – превышать;
to trap – удерживать;
low head – малый напор;
aperture – отверстие;
pivoting – вращающийся;
flap – заслонка.

I. Answer the following questions:

1. What is the process of wave forming?
2. What does the size of the resulting waves depend on?
3. What is the role of energy converters?
4. How many patents are there for very varied designs of wave energy converter?
5. What stage is wave energy mainly at?
6. What can you say about tapered channel?
7. What is the different between OWC and pivoting flap devices?

1.4. Thermal Power Station

A modern thermal power station is known to consist of four principal components, namely, coal handling and storage, boiler house, turbine house, switchgear.

Besides the principal components mentioned above there are many additional parts of the plant. The most important of them is the turbo-generator in which the current is actually generated.

A steam turbine requires boilers to provide steam. Boilers need a coal-handling plant on the one hand and an ash-disposal plant on the other. Large fans are quite necessary to provide air for the furnaces. Water for the boilers requires feed pumps. Steam must be condensed after it has passed through the turbines, and this requires large quantities of cooling water. The flue gases carry dust which must be removed by cleaning the gases before they go into the open air.

A modern thermal power-station is equipped with one or more turbine generator units which convert heat energy into electric energy. The steam to drive the turbine which, in its turn, turns the rotor or revolving part of the generator is generated in boilers heated by furnaces in which one of three fuels may be used – coal, oil, or natural gas. Coal continues to be the most important and most economical of these fuels.

Vocabulary:

thermal power station - тепловая электростанция;
coal handling – подача угля (топка);
storage – база, склад, хранилище;
boiler house – бойлерная; котельное помещение;
turbine house – турбинный (машинный) зал (электростанции или ГЭС);
switchgear – распределительное устройство, коммутационное оборудование;

I. Answer the following questions:

1. What are the main components of the thermal power station?

2. Where are thermal power stations economically sound?

3/ What can you say about environmental impact of these stations?

4. Name thermal power stations in your region and explain the great use of them.

II. Complete the sentences according to the text:

a) A modern thermal power station consists of …

b) The most important part is …

c) A steam turbine requires …

d) Boilers need two kinds of plants, they are …

e) The flue gases carry dust which …

f) The modern thermal power station is equipped with …

III. Name the famous thermal power stations in your region. Describe some peculiarities and their specifications. Express your point of view, using the following phrases and word combinations:

– In my opinion…

– To my mind…

– The fact is…

– To start with…

– I think/believe…

– The thing is that…

– As far as I know…

Unit 2. RUSSIAN ENERGY RESOURCES

Russia has enormous energy resources and deposits of many different minerals. Most of the raw materials required by modern industry are found within the country. Russia has the

(or pressure) of a wave causes relative motion between an absorber and a reaction point.

There are over 1000 patents for very varied designs of wave energy converters. However, several comprehensive reviews of wave energy show that wave energy is mainly at the R & D stage, with only a small range of devices having been tested or deployed in the oceans. Of these, the main types are:

Tapered Channel – this is a tapering collector which funnels incoming waves into a shoreline reservoir, which is set at a small height above mean sea level. The shape of the collector is such that, as it narrows, the wave traveling down it increases in height until it overtops the channel and flows into the reservoir. The water trapped in the reservoir flows back to the sea through a conventional low-head hydroelectric generator. The largest plant of this size was 350 kWe but there are currently plans for a 1.1 MWe scheme in Java.

Oscillating Water Column (OWC) – it comprises a partially submerged structure forming an air chamber, with an underwater aperture. This encloses a volume of air, which is compressed as the incident wave makes the free surface of the water rise inside the chamber. The compressed air can escape through an aperture above the water column which leads to a turbine and as the water inside falls, the air pressure is reduced and air is drawn back through the turbine. Both conventional and self-rectifying air turbines have been proposed. The axial-flow Wells turbine is the best known turbine for this kind of application and has the advantage of not requiring rectifying air valves.

Vocabulary:

mean – средний;
hence – следовательно;
transformation process – процесс преобразования;
to require – требовать;
to cause – вызывать, заставлять;
relative motion – относительное движение;

Vocabulary:

solar energy – солнечная энергия;
to vaporize – испаряться;
exhaustible sources – исчерпаемые источники;
solar technology – гелиотехнология;
to focus – собирать, фокусировать;
focusing device – фокусирующее устройство;
solar cooling – солнечное охлаждение;
photovoltaic power – фотоэлектрическая энергия;
concentrator – концентратор;
module unit – модульное устройство;
to reflect – преломлять лучи;
grid-connected PV system – фотоэлектрическая станция, соединенная с электросетью.

Unit 10. WAVE ENERGY

Wave energy can be considered as a concentrated form of solar energy. Winds are generated by the different heating of the earth and as they pass over open bodies of water, they transfer some of their energy to form of waves. Energy is stored in waves as both potential energy (in the mass of water displaced from the mean sea level) and kinetic energy (in the motion of the water particles). The amount of energy transferred and hence the size of the resulting waves, depends on the wind speed, the length of time for which the wind blows and the distance over which it blows. Power is concentrated at each stage in the transformation process, so that the original solar power levels of typically – 100 W/m2 can be transformed into waves with power levels of over 1000 kW per meter of wave crest length.

Wave energy converters extract energy from the sea and convert it to a more useful form, usually as fluid pressure or mechanical motion. This requires an interface where the force

largest coal reserves among the former Soviet republics. The biggest fields lie in the remote Tunguska and Lena basins of East Siberia and the Far East, but these are largely untapped, and the bulk of output comes from more southerly fields along the Trans-Siberian Railroad. About three-fourths of Russia's coal is produced in Siberia – some two-fifths from the Kuznetsk Basin alone and the remainder from the Kansk-Achinsk, Cheremkhovo, and South Yakut basins and numerous smaller sources. The production of hard coal in the European section is mainly in the eastern Donets Basin and, in the Arctic, in the Pechora Basin around Vorkuta; the large Moscow Basin (entirely) and the small Urals fields (mainly) are sources of lignite.

The Russian Federation is one of the world's leading producers of oil and natural gas. The great bulk of the supply comes from the huge fields that underlie the northern part of the West Siberia region. Another significant source is from the Volga-Ural zone, and the remainder is derived mainly from the Komi–Ukhta field (North region); the North Caucasus region, once the U.S.S.R.'s leading producer, is now of little importance. Extensive pipeline systems link the producing districts to all regions of the federation, the neighbouring former Soviet republics, and, across the western frontier, numerous European countries. Much of the fuel produced in Russia is converted to electricity, about three-fourths of which is generated in thermal stations; some two-thirds of thermal generation is from oil and gas. The remaining power output is produced by hydroelectric and nuclear plants. Most of the hydroelectricity comes from huge stations on the Volga, Kama, Ob, Yenisey, Angara, and Zeya rivers. Nuclear power production expanded rapidly before development was checked by the Chernobyl accident. Much of Siberia's electricity output is transmitted to the European region along high –voltage lines.

I. Answer the following questions:

1) Which is the richest region of raw materials in Russia?

2) What can you say about energy resources?
3) What is Siberia full of?
4) Where is the main production of hard coal?
5) What are the main deposits of natural gas?
6) Where does the most of the electricity come from?

II. Say whether the following statements are true or false according to the text:

1. Russia has limited energy resources and deposits of many different minerals.
2. Fuel and power Russia has by far the largest coal reserves among the former Soviet republics.
3. About three-fourths of Russia's coal is produced in Siberia.
4. Our country is one of the world's leading producers of oil and natural gas.
5. The great bulk of the supply comes from the huge fields that underlie the south part of the East Siberia region.
6. Much of the fuel produced in Russia is converted to electricity.
7. The remaining power output is produced by hydroelectric and nuclear plants.

Unit 3. FACTS ABOUT HYDROPOWER

Worldwide, about 20 % of all electricity is generated by hydropower. Hydroelectric power plants convert the kinetic energy contained in falling water into electricity. The energy in flowing water is ultimately derived from the sun, and therefore constantly being renewed. Energy contained in sunlight evaporates water from the oceans and deposits it on land in the form of rain. Differences in land elevation result in runoff, and allow some of the original solar energy to be captured as hydroelectric power.

England. By 1995, passenger boats incorporating PV (pressure-velocity) panels began appearing and are now used extensively. In 1996, Kenichi Horie made the first solar powered crossing of the Pacific Ocean, and the sun 21 catamaran made the first solar powered crossing of the Atlantic Ocean in the winter of 2006–2007. There are plans to circumnavigate the globe in 2010.

9.4. Energy storage methods

Solar Two's thermal storage system generated electricity during cloudy weather and at night.

Storage is an important issue in the development of solar energy because modern energy systems usually assume continuous availability of energy. Solar energy is not available at night, and the performance of solar power systems is affected by unpredictable weather patterns; therefore, storage media or back-up power systems must be used.

Thermal mass systems can store solar energy in the form of heat at domestically useful temperatures for daily or seasonal durations. Thermal storage systems generally use readily available materials with high specific heat capacities such as water, earth and stone. Well-designed systems can lower peak demand, shift time-of-use to off-peak hours and reduce overall heating and cooling requirements.

Phase change materials such as paraffin wax and Glauber's salt are another thermal storage media. These materials are inexpensive, readily available, and can deliver domestically useful temperatures (approximately 64 °C). The «Dover House» (in Dover, Massachusetts) was the first to use a Glauber's salt heating system, in 1948.

Solar energy can be stored at high temperatures using molten salts. Salts are an effective storage medium because they are low-cost, have a high specific heat capacity and can deliver heat at temperatures compatible with conventional power systems.

Sun. Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies.

9.3. Solar vehicles

Australia hosts the World Solar Challenge where solar cars like the Nuna3 race through a 3,021 km course from Darwin to Adelaide. Development of a solar powered car has been an engineering goal since the 1980s. The World Solar Challenge is a biannual solar-powered car race, where teams from universities and enterprises compete over 3,021 kilometers across central Australia from Darwin to Adelaide. In 1987, when it was founded, the winner's average speed was 67 kilometers per hour (42 mph) and by 2007 the winner's average speed had improved to 90.87 kilometers per hour. The North American Solar Challenge and the planned South African Solar Challenge are comparable competitions that reflect an international interest in the engineering and development of solar powered vehicles.

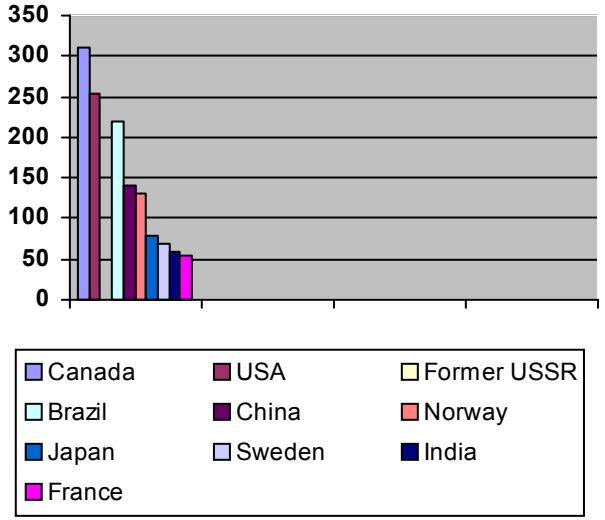
Some vehicles use solar panels for auxiliary power, such as for air conditioning, to keep the interior cool, thus reducing fuel consumption.

There is a new concept that may be developed by General Motors, Ford and Chrysler in a Manhattan Project approach in return for their Bail Out Money. In this approach Overhead Solar Panels and wires are installed above Diamond Lanes on the nation's freeways. Concurrently, new electric cars are produced that do not require batteries, but are recharged as they run down the Electrified Freeway. This system could also control the navigation of all electric vehicles allowing the driver and passengers to be connected to the Internet getting work done or being entertained.

In 1975, the first practical solar boat was constructed in

Hydropower is currently the world's largest renewable source of electricity, accounting for 6 % of world's electricity. In Canada, hydroelectric power is abundant and supplies 60 % of our electrical needs. The USA is the second largest producer of hydropower in the world. Canada is number one. Norway produces more than 99 % of its electricity with hydropower.

New Zealand uses hydropower for 75 % of its electricity.



Vocabulary:

hydropower – гидроэнергетика;
to evaporate – испарять;
runoff – объем;
to deposit – осаждаться;
to derive from – получать, извлекать;
to account for – насчитывать;
residential customer – бытовой потребитель;
abundant – имеющийся в изобилии;
a great deal of – большое кол-во.

I. Answer the following questions:

1. How much electricity is produced by hydropower?
2. Why is the energy in flowing water being constantly renewed?
3. What can you say about hydropower in Canada?
4. What country produces more than 99 % of its electricity with hydropower?
5. What is the second largest producer of hydropower in the world?

I. Match the English phrases corresponding to their Russian equivalents:

1. falling water	1. большое кол-во
2. ultimately	2. потребности в энергии
3. differences	3. падающая вода
4. land elevation	4. объем осадков
5. rainfall runoff	5. полностью
6. energy supply	6. имеющийся в изобилии
7. abundant	7. различия
8. electrical needs	8. поднятие земли
9. a great deal of	9. энергоресурсы
10. consumers	10. потребители

III. Express your own opinion about hydropower using the following phrases:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

5. It is the prime example of confluence, rather than conflict, of environmental and economic wellness.
6. Expensive, high-grade focusing devices could have been available by easy mass-production in the 70s.
7. That is not to say that working for SE can be dangerous.

9.1. Insolation and Solar radiation

Solar energy is the light and radiant heat from the Sun that influences Earth's climate and weather and sustains life. Solar power is sometimes used as a synonym for solar energy or more specifically to refer to electricity generated from solar radiation. Since ancient times solar energy has been harnessed by humans using a range of technologies. Solar radiation along with secondary solar resources such as wind and wave power, hydroelectricity and biomass account for most of the available renewable energy on Earth.

Solar energy technologies can provide electrical generation by heat engine or photovoltaic means; space heating and cooling in active and passive solar buildings; potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes.

9.2. Applications of solar technology

Solar energy refers primarily to the use of solar radiation for practical ends. All other renewable energies other than geothermal derive their energy from the sun.

Solar technologies are broadly characterized as either passive or active depending on the way they capture, convert and distribute sunlight. Active solar techniques use photovoltaic panels, pumps, and fans to convert sunlight into useful outputs. Passive solar techniques include selecting materials with favorable thermal properties, designing spaces that naturally circulate air, and referencing the position of a building to the

II. Find the Russian equivalents to the following English words and word combinations:

1. powerful obstruction;	1. во всем мире;
2. to drive;	2. отдавать себе отчет;
3. the thirst;	3. иметь доступ к;
4. prehistoric times;	4. сильное препятствие;
5. associated with;	5. особая враждебность;
6. especially;	6. побуждать;
7. to be aware of;	7. наличие;
8. widespread;	8. жажда;
9. to fear;	9. приводить в движение;
10. immediately;	10. бояться;
11. confluence;	11. обходить проблемы;
12. worldwide;	12. составлять проблему;
13. inexpensive;	13. особенно;
14. to induce;	14. доисторические времена;
15. to bypass the problems;	15. опасный;
16. dangerous;	16. связанный с;
17. to constitute a problem;	17. недорогой;
18. to have access to it;	18. пересечение мнений;
19. special hostility;	19. широко распространенный;
20. availability;	20. немедленно.

III. Read the text and say whether the statements are true or false according to the text:

1. The sun is our most important source of energy.

2. It could provide all the energy needed by a modern industrial society worldwide for the indefinite future; which no 'conventional' energy source could do.

3. In the 1970s, there was widespread enthusiasm, and a genuine grassroots movement emerged in the USA, in anticipation of an imminent transition to an economy based on the nuclear energy.

4. New solar technologies could easily have supplied a double-digit percentage of energy used by now.

3.1. Environment

Hydropower is clean. It prevents the burning of 22 billion gallons of oil or 120 million tons of coal each year. Hydropower doesn't produce greenhouse gases or other air pollution. Hydropower leaves behind no waste. Reservoirs formed by hydropower projects have expanded water-based recreation resources, and they support diverse, healthy, and productive fisheries. In fact, catch rates are substantially higher on hydropower reservoirs than natural lakes.

Hydropower is the most efficient way to generate electricity. Modern hydroturbines can convert as much as 90 % of the available energy into electricity. The best fossil fuel plants are only about 50 % efficient.

Hydropower is the leading source of renewable energy. It provides more than 97 % of all electricity generated by renewable sources. Other sources including solar, geothermal, wind and biomass account for less than 3 % of renewable electricity production.

Reservoirs formed by hydroelectric dams provide many water-based recreational opportunities including fishing, water sports, boating, and water fowl hunting. Hydro-operators own a significant amount of land around many reservoirs that is open to the public for uses including hiking, hunting, snowmobiling, and skiing. Hydro-operators provide many recreation facilities at their hydropower projects including boat landings, swimming beaches, restrooms, picnic and fishing areas, nature trails and parking facilities.

Hydroelectric power has always been an important part of the world's electricity supply, providing reliable, cost-effective electricity, and will continue to do so in the future. Hydropower has environmental impacts which are very different from those fossil fuel power plants. The actual effects of dams and reservoirs on various ecosystems are only now becoming understood. The future of hydroelectric power will de-

pend on future demand for electricity, as well as how societies value the environmental impacts of hydroelectric power compared to the impacts of other sources of electricity.

Vocabulary:

environmental impacts – воздействие на окр. среду;
to weigh – взвешивать;
pollutant – загрязняющий агент;
to submerge – подгружать под воду, затоплять;
to decay – разрушаться, разлагаться;
flooding – затопление;
hazard – опасность;
to threaten – угрожать;
to assess – оценивать;
to result in – приводить к ;
to refurbish – подновлять, освежать;
hydroplant – ГЭС, работающая в естественном режиме реки.

I. Give the Russian equivalents to the following English word combinations from the text:

– hydroelectric power plants;
– standard atmospheric pollutants;
– fossil fuel fired power plants;
– greenhouse gases;
– hydroelectric facilities;
– high water periods;
– health hazard;
– hydroelectric power construction;
– low head turbines.

II. Say whether the following statements are true or false according to the text:

a) Until recently there was an almost universal belief

nies tied to them have access to it, it can be an advantage for many more people than associated with those companies.

Without first concentrating the sunlight, however, it would really be too diffuse for important uses such as solar (absorption) cooling, thermal electricity generation or substantial cost-effective photovoltaic power. That explains the special hostility to availability of inexpensive concentrators by those in control. It could have led to major solar proliferation long ago.

Vocabulary:

deliberate - намеренный, хорошо обдуманный;
obstruction – помеха, препятствие;
to drench – орошать, загрязнение;
profitably – с выгодой, прибылью промачивать;
pollution –;
sacrifice – жертва;
genuine – истинный;
anticipation – ожидание, предчувствие;
imminent – неизбежный;
grassroots – база, начало;
to confine – ограничивать;
niche markets – рыночные ниши;
phony – фальшивый;
boon – благо;
diffuse – рассеянный.

I. Answer the following questions related to the text:

1. What is the sun for our life?
2. What could the sun provide for the mankind nowadays?
3. When and why was a widespread enthusiasm concerning solar energy?
4. What is the main key to serious direct solar energy?
5. What are the problems associated with solar progress?

effort is expended to make them believe that it would require economic sacrifices rather than benefits.

In the 1970s, there was widespread enthusiasm, and a genuine grassroots movement emerged in the USA, in anticipation of an imminent transition to an economy based on the solar sources of energy that came in the wake of the first «oil shock» (1973). There are some, who fear a transition to solar power, and they are very powerful and determined.

Instead of being confined to a few small «niche markets», new solar technologies could easily have supplied a double-digit percentage of energy used by now. All that we maintained at the time was that it could be very substantial starting profitably almost immediately. It is the prime example of confluence, rather than conflict, of environmental and economic wellness. It is essential for sustainable development worldwide, i.e. also in industrial countries. The main key to serious direct solar energy is that the sunlight first be focused, concentrated. Inexpensive, high-grade focusing devices could have been available by easy mass-production in the 70s.

There have been problems associated with solar progress. Of those generally cited, some are real, some phony. The former can induce easy rejection or a search for solutions or ways to bypass the problems. An example for direct solar energy (SE) is that the sun doesn't always shine even in California. There are various ways to tackle that problem. A claim made that solar energy is more dangerous than the nuclear fission power, because installers fall off ladders, is a good example of the phony kind. That is not to say that working for solar energy can't be dangerous.

Some aspects of SE constitute a problem for some but a boon to others. Probably the main example cited as problem is its «diffuse» nature. To the extent that means the sun shines on every field and roof, rather than concentrating its blessings onto where only giant regional utilities and polluting energy compa-

that hydropower was a clean and environmentally safe method of producing electricity.

b) Hydroelectric power plants emit the standard atmospheric pollutants such as carbon dioxide or sulfur dioxide.

c) Hydroelectric power plants result in the risks of radioactive contamination.

d) The most obvious impact of hydroelectric dams is the flooding of vast areas of land, much of it previously forested or used for agriculture.

e) The actual amount of electricity which will ever be generated by hydropower will be much more than the theoretical potential.

III. Express your own opinion about environment using the following phrases:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

3.2. Hydroelectricity

Hydraulic turbine and electrical generator.

Hydroelectric power now supplies about 19 % of world electricity. Large dams are still being designed. Apart from a few countries with an abundance of hydro power, this energy source is normally applied to peak load demand, because it is readily stopped and started. It also provides a high-capacity, low-cost means of energy storage, known as «pumped storage».

Hydropower produces essentially no carbon dioxide or other harmful emissions, in contrast to burning fossil fuels, and is not a significant contributor to global warming through CO_2.

Hydroelectric power can be far less expensive than electricity generated from fossil fuels or nuclear energy. Areas with abundant hydroelectric power attract industry.

The chief advantage of hydroelectric dams is their ability to handle seasonal (as well as daily) high peak loads. When the electricity demands drop, the dam simply stores more water (which provides more flow when it releases). Some electricity generators use water dams to store excess energy (often during the night), by using the electricity to pump water up into a basin. Electricity can be generated when demand increases. In practice the utilization of stored water in river dams is sometimes complicated by demands for irrigation which may occur out of phase with peak electrical demands.

Not all hydroelectric power requires a dam; a run-of-river project only uses part of the stream flow and is a characteristic of small hydropower projects.

There are some considerations in a micro-hydro system installation. The amount of water flow available on a consistent basis, since lack of rain can affect plant operation. The more head, the more power that can be generated. There can be legal and regulatory issues, since most countries, cities, and states have regulations about water rights and easements.

Over the last few years, the U.S. Government has increased support for alternative power generation. Many resources such as grants, loans, and tax benefits are available for small scale hydro systems.

In poor areas, many remote communities have no electricity. Micro hydro power, with a capacity of 100 kW or less, allows communities to generate electricity. This form of power is supported by various organizations such as the UK's Practical Action.

Micro-hydro power can be used directly as «shaft power» for many industrial applications. Alternatively, the preferred option for domestic energy supply is to generate electric-

near it but the lives of the whole world's population generations ahead. This must not happen again. But if we take precautions, build the power plants in a place without risk of earthquakes and most importantly make sure it is properly funded we can narrow the risk down to almost nothing.

No source of energy is without problems and we have to ask ourselves – do we want to choose nuclear power or do we want oil and coal, that isn't instantly as harmful as nuclear power, but which can't be solved at all.

Express your own opinion about fossil fuels using the following phrases:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

Unit 9. SOLAR POWER

The sun is our most important source of energy. It warms the earth's atmosphere, vaporizes water from the oceans, drives the resulting clouds by means of winds to the continents, where they cause rains and rivers. These drench the thirst of people, animals and of plants, which draw their energy directly from the sun and pass it on to us when we eat them. That has been going on since prehistoric times. Now it can do a little more. It could provide all the energy needed by a modern industrial society worldwide for the indefinite future; which no «conventional» energy source could do. It could do easily, without the population and hazards associated with those exhaustible sources. Most people still would like that, especially if they knew that it can be done profitably.

They are not supposed to be aware of that, and a major

I. Answer the following questions:

1. How is nuclear power considered in the US in last decade?
2. What does the near-term impetus for this turn-around stem from?
3. What are extensive monitoring and surveillance testing of plant systems performed for?
4. Will nuclear power prosper in our country?
5. What can you say about an accident in Chernobyl?

II. Find the Russian equivalents to the following English words and word combinations:

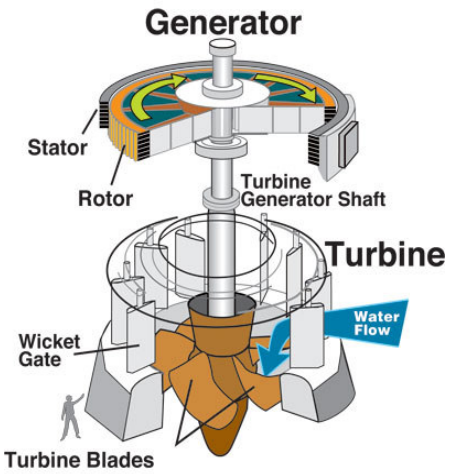
1. energy mix;	a) ошибка;
2. long-term;	b) уступать;
3. to cancel;	c) основные средства СМИ;
4. mainstream media;	d) структура энергетики;
5. to stem from;	e) происходить от;
6. premium;	f) падать;
7. gains;	g) в отличном состоянии;
8. safety indicators;	h) отменять;
9. to drop;	i) более высокая цена;
10. to solidify;	j) твердеть;
11. to squeeze;	k) вынуждать;
12. design margins;	l) предельное значение;
13. in excellent condition;	m) показатели безопасности;
14. to rank second;	n) прибыли.

8.1. Pro and Against

Nuclear power is a very clean source of energy and none of our other energy sources are at present time as clean and efficient. But there is always the risk of leaks, explosions and so forth.

It seems that the horror story of Chernobyl still haunts our minds whenever this topic is brought up. And it was a terribly tragic accident that destroyed the life of not only the people

ity with a generator or a reversed electric motor which, while less efficient, is likely to be available locally and cheaply.



Unit 4. GEOTHERMAL ENERGY

Natural hot springs have been used by man for bathing and cooking, and there is some evidence of piped systems as early as the 14th century, but the second age – the managed exploitation of heat from the Earth – really began about one hundred years ago with the first piped heating systems in Europe and USA.

Geothermal resources range from shallow ground to hot water and rock several miles below the Earth's surface, and even further down to the extremely hot molten rock called magma. Wells over a mile deep can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications.

Geothermal technologies include:

Conventional Geothermal

Binary cycle power plants, which pass moderately hot

geothermal water by a secondary fluid with a much lower boiling point than water. This causes the secondary fluid to flash to vapor, which then drives the turbines.

Hot dry rock geothermal energy: Using deep wells into hot rock, a fluid is heated and used to generate power. Also known as EGS or Enhanced Geothermal Systems.

Dry steam plants, which directly use geothermal steam to turn turbines; flash steam plants, which pull deep, high-pressure hot water into lower-pressure tanks and use the resulting flashed steam to drive turbines; and geothermal heat pump: Almost everywhere, the upper 10 feet of Earth's surface maintains a nearly constant temperature between 10 and 16 °C. A geothermal heat pump system consists of pipes buried in the shallow ground near a building, a heat exchanger, and ductwork into the building. In winter, heat from the relatively warmer ground goes through the heat exchanger into the house. In summer, hot air from the house is pulled through the heat exchanger into the relatively cooler ground. Heat removed during the summer can be used as no-cost energy to heat water.

Direct exchange geothermal heat pump: A heat pump without a heat exchanger, which circulates the working fluid through pipes in the ground.

Direct Heat: Hot water near Earth's surface can be piped directly into facilities and used to heat buildings, grow plants in greenhouses, dehydrate onions and garlic, heat water for fish farming, and pasteurize milk. Some cities pipe the hot water under roads and pavements to melt snow. District heating applications use networks of piped hot water to heat buildings in whole communities.

Advantages:

Geothermal power requires no fuel, and is therefore virtually emissions free and insusceptible to fluctuations in fuel cost. And because a geothermal power station doesn't rely on transient sources of energy, unlike, for example, wind turbines

equally impressive improvements in safety indicators. The challenge for individual nuclear stations is to continue this idea by solidifying competitive gains already achieved and squeezing further improvements from each unit.

US nuclear plants have done an excellent job of maintaining and improving plant design margins and operating reliability. Extensive monitoring and surveillance testing of plant systems, structures and components such as containment building, reactor vessel, reactor cooling system pressure boundary, steam generators, pressurizer, piping, pump casings and valve bodies are performed yearly to verify the plant is maintained in excellent condition. Few if any nuclear plant components will require replacement specifically to achieve extended operations for an additional 20 years.

Vocabulary:

favorable consideration – благоприятное мнение;

in the wake of – под влиянием чего-либо;

harsh treatment – жесткое отношение;

renaissance – возрождение;

impetus – толчок, стимул;

performance improvements – улучшение рабочих характеристик;

unusual events – чрезвычайные события;

reactor vessel – бак ядерного реактора;

reactor cooling system pressure boundary;

steam generator – парогенератор;

pressurizer – компенсатор давления;

piping – трубопровод;

pump casing – корпус насоса;

valve bodies – корпус вентиля;

containment building –защитная оболочка ядерного реактора;

energy mix – структура энергетики.

o) gas production and processing;
p) to encourage;

15) очень важно;
16) технические усовершенствования.

III. Give the Russian equivalents to the following English word combinations from the text:

– market penetration;
– solid fuel sector;
– environmental and thermal performance;
– large scale conventional power plants;
– net thermal efficiencies;
– climate change debate;
– theoretical annual cost cutting potential;
– offshore production structures;
– deep water storage;
– natural gas exploration;
– natural gas technologies.

Unit 8. NUCLEAR POWER

The EU is producing not only more electricity than ever, but also more favorable consideration as a viable part of the nation's energy mix. Consider that, for the first time, political leaders are proposing nuclear power as an important, long-term energy solution. Even the mainstream media – known for its harsh treatment of the industry – has begun talking in terms of a nuclear industry «renaissance».

The near-term impetus for this turn-around stems from recent events – regional power shortages, increased natural gas costs, and premium market prices for electricity. However, the fact that nuclear power is in the position to be favorable considered is a result of the substantial performance improvements achieved at US plants during the past decade.

Most important, these performance gains came with

or solar panels, its capacity factor can be quite large; up to 90 % in practice.

It is considered to be sustainable because the heat extraction is small compared to the size of the heat reservoir. While individual wells may need to recover, geothermal heat is inexhaustible and is replenished from greater depths.

Geothermal has minimal land use requirements; existing geothermal plants use 1-8 acres per megawatt (MW) versus 5-10 acres per MW for nuclear operations and 19 acres per MW for coal power plants. It also offers a degree of scalability: a large geothermal plant can power entire cities while smaller power plants can supply more remote sites such as rural villages.

Disadvantages:

From an engineering perspective, the geothermal fluid is corrosive and, worse, is at a low temperature compared to steam from boilers. By the laws of thermodynamics this low temperature limits the efficiency of heat engines in extracting useful energy during the generation of electricity. Much of the heat energy is lost, unless there is also a local use for low-temperature heat such as greenhouses, timber mills, and district heating. However, since this energy is almost free once the plant is established, the efficiency of the system is not as significant as for a coal or other powered plant.

There are several environmental concerns behind geothermal energy. Construction of the power plants can adversely affect land stability in the surrounding region. This is mainly a concern with Enhanced Geothermal Systems, where water is injected into hot dry rock where no water was before. Dry steam and flash steam power plants also emit low levels of carbon dioxide, nitric oxide, and sulphur, although at roughly 5 % of the levels emitted by fossil fuel power plants. However, geothermal plants can be built with emissions-controlling systems that can inject these substances back into the earth, thereby reducing carbon emissions to less than 0.1 % of those from fossil

fuel power plants. Hot water from geothermal sources will contain trace amounts of dangerous elements such as mercury, arsenic, and antimony which, if disposed of into rivers, can render their water unsafe to drink.

I. Answer the following questions:

1. What geothermal resources do you know?
2. What geothermal technologies are mentioned in the text?
3. What technology is considered to be the most effective and explicit costs?
4. Why doesn't a geothermal power station rely on transient sources of energy?
5. Name the main disadvantages of this kind of energy.
6. What are the environmental concerns behind geothermal energy?
7. What are the positive sides of geothermal energy?

II. Translate the following word combinations and make the sentences using them:

– environmental concerns; – shallow ground;
– hot molten rock; – can be drilled into;
– flash steam plants; – to be injected into;
– dangerous elements; – high-pressure hot water;
– the surrounding region; – timber mills;
– the laws of thermodynamics; – transient sources of energy;
– carbon dioxide; – a degree of scalability;
– to dehydrate; – unsafe to drink;
– a constant temperature; – coal power plants.

Unit 5. TIDAL ENERGY

Over the past three decades the feasibility of using ocean tides to generate electric power has been investigated at many sites. Results suggest that the potential for economic de-

to implement – выполнять, осуществлять;
dissemination – распространение;
liquefy – превращать в жидкое состояние;
multi-dimension – многомерный.

I. Answer the following questions:

1. Why has much attention been paid to the so-called 'clean coal technologies'?
2. What thermal efficiencies do most large scale conventional power plants have?
3. What does increased efficiency lead to?
4. What are the most important new technologies in oil and gas sector?
5. What will the project GATE 2020 assess existing and emerging technologies for?

II. Find the Russian equivalents to the following English words and word combinations:

a) technical improvements; 1) признание;
b) thermal efficiency; 2) процесс сгорания;
c)a vital role in; 3)теплопроизводительность;
d) recognition; 4) важная роль;
e) continuing importance; 5) поощрять;
f) thermal performance; 6) растущая важность;
g) combustion process ; 7)добыча и переработка газа;
h) conventional power plants; 8) приведет к;
i) net efficiency; 9) практический КПД;
j) lower fuel costs; 10) природные ресурсы;
k) are related to; 11) более низкие цены на топливо;
l) indigenous resources; 12) стратегия исследования и разработки;
m) research and development strategy; 13) связаны с;
n) would result in; 14) электростанция на традиционных источниках энергии;

reduce the environmental impact of the same. Some of the most important new technologies that have contributed to the objectives are related to: new drilling and completion techniques, new seismic methods such as multi-component and multi-dimension seismic, offshore production structures and facilities. New technologies for deep water storage; and new technologies for natural gas exploration and production. Demonstration and market deployment of such technologies will allow not only a better exploitation of European indigenous resources but also an increased competitiveness of European service and supply companies.

GATE 2020 – Gas Advanced Technology for Europe

This project will assess existing and emerging technologies for the supply and utilization of natural gas in Europe. A research and development strategy will be identified which, if implemented, could accelerate the trend of increasing use of natural gas. Increased use of natural gas would result in reductions in emissions of CO_2; this project will assess the possible benefits of such a scenario to the economy, the environment and industry. The technology areas that will be studied include: gas production and processing, gas transportation, liquefied natural gas, vehicles powered by natural gas, gas liquids and underground storage. Dissemination of the results of the research will encourage cooperation among European companies and organizations to develop natural gas technologies and take part in industrial initiatives.

Vocabulary:

vital role – жизненная роль;
to foster – поощрять, одобрять;
to aim – направлять, нацеливать;
to equate – уравнивать;
exploration – исследование;
deployment – развертывание;

velopment is small. Of the approximately 22,000 TWh per year dissipated by the tides, 200 TWh is now considered economically recoverable and less than 0.6 TWh is produced by existing plants.

Six areas account for well over half of the potentially developable energy:

The headwaters of the Bay of Fundy (Canada);
The Severn estuary (UK);
The Gulf of St. Malo (France);
The south-east coast of China;
Russian coasts bordering the White Sea and Sea of Okhotsk.

Other potentially feasible sites include the Irish Sea and Bristol Channel (UK), The Gulf of Kachch (India), the west coast of Korea, the north-west coast of Australia and others.

Most designs, existing or proposed, have opted for a single tidal basin to create hydraulic heads and propeller turbines to extract energy therefrom. Linked and paired basins have also been considered. Innovative approaches have included extraction of energy directly from tide races using a variety of prime movers. The main obstacle to development is economic. Capital costs are high in relation to output: a consequence of the low and variable heads available at even the best sites. Heads available at the turbine vary throughout each tidal cycle, averaging less than 70 % of the maximum. As a result, installed capacity is underutilized, typical capacity factors tending to fall. Low heads imply that civil as well as mechanical engineering components must be large in comparison to output. For such reasons, tidal plants are likely to be practicable only where energy is concentrated by large tides and where physical features permit construction of tidal basins at low cost.

Significant capital-cost reductions through improved design and construction techniques have been achieved over the past three decades. In China a different approach has been tak-

en: tidal plants have been built as part of broader schemes of resource utilization – typically land reclamation or aquaculture.

In a world increasingly sensitive to environmental factors, tidal plants must avoid unacceptable impacts. Tidal power is non-polluting and in this respect superior to thermal generation. Beyond that, it is difficult to generalize. In recent years, commercial acceptance of combined-cycle generation based on combustion turbines has reduced the potential economic and environmental costs of meeting future capacity and energy demands through thermal plants wherever natural gas is available at competitive prices. This has tended to increase the economic bias against tidal power.

Another development with adverse implications for tidal power is the trend in many countries to adopt market pricing of electric energy and dispense with regulatory pricing. This is almost every case entails competition in the generation function. Under such conditions, competitors will be under strong compulsion to choose plant types having the shortest construction times and the lowest unit capital costs.Such factors render construction of new tidal generation capacity unlikely during the near future, unless strong incentives such as emission caps or carbon taxes are imposed.

Vocabulary:

feasibility – осуществимость, выполнимость;
to investigate – исследовать;
estuary – дельта, устье реки;
to exceed – превышать;
therefrom – оттуда;
to extract – извлекать
innovative approach – новаторский подход;
obstacle – препятствие;
to imply – подразумевать;
to predict – предсказывать;

- advanced wind turbine technology;
- future generation technology;
- wind energy development;
- wind electric potential;
- turbine hug height;
- energy losses;
- wind resource assessment.

Unit 7. FOSSIL FUELS

1. Solid Fuels

In this field, technical improvements in terms of thermal efficiency play a vital role in fostering market penetration of new systems. In the solid fuel sector much attention has been paid to the so-called «clean coal technologies». This is due to recognition of the continuing importance of this fuel, especially in developing countries, but coupled with the need to improve the environmental and thermal performance of the combustion process.

Most large scale conventional power plants have net thermal efficiencies in the order of 38 % for hard coal and 35 % for brown coal. New systems are being developed which are aimed at increasing this, over the medium-term, to at least 50 %. This will result in a reduction of 0.21 kg of CO_2 per kWh generated per hard coal, and 0.34 kg/kWh generated for brown coal. In the EU countries, this equates to a CO_2 reduction of 180 million per year; in line with targets set in the context of the climate change debate. This increased efficiency leads to lower fuel costs per unit of output, thought to equate to a reduction of 2.5 EU/MWh in generating costs.

2. Oil and Gas

The key priorities in this sector are to improve the efficiency of exploration and production of hydrocarbons and to

ure of large generating units requires reserve capacity that can also regulate for variability of wind generation.

In particular geographic regions, peak wind speeds may not coincide with peak demand for electrical power. In California and Texas, for example, hot days in summer may have low wind speed and high electrical demand due to air conditioning. Some utilities subsidize the purchase of geothermal heat pumps by their customers, to reduce electricity demand during the summer months by making air conditioning up to 70 % more efficient; widespread adoption of this technology would better match electricity demand to wind availability in areas with hot summers and low summer winds. Geothermal heat pumps also allow renewable electricity from wind to displace natural gas and heating oil for central heating during winter, when winds tend to be stronger in many areas.

I. Answer the following questions:

1. In what countries are wind turbines a relatively common sight?

2. What generators are often used for wind power projects? What do they require?

3. What is grid management system?

4. What are the essential timescales?

5. What points and aspects should be taken into consideration before installation of the project?

6. What ecological impact is noticeable?

II. Give the Russian equivalents to the following English words and word combinations:

- wind areas;
- current electricity consumption;
- wind energy recourses;
- wind energy applications;
- mean wind power density;

to perturb – нарушать;
head – напор;
bias – наклон, уклон;
to dispense – распределять;
to entail – вызывать, влечь за собой;
to render – изменить состояние чего-либо;
capital-cost –капитальные затраты;
combustion – сжигание;
combined cycle – комбинированный цикл;
reclamation – освоение, повторное использование.

I. Find in the text the English equivalents to the following Russian word combinations:

– экономически возместимый
– потенциально возможные площадки станций
– быстрое приливо-отливное течение
– малый и переменные напоры
– капитальные затраты
–усовершенствованные методы проектирования и строительства
– выработка с комбинированным циклом

II. Read the text and say whether the statements are true or false according to the text:

a) Results suggest that the potential for economic development is large.

b) Five areas account for well over half of the potentially developable energy.

c) Linked and paired basins have not been considered.

d) The main obstacle to development is economic.

e) Tidal power is polluting and in this respect not superior to thermal generation.

III. Find the passages in the text where the following ideas are expressed. Translate the passages into Russian:

1. The feasibility of using ocean tides to generate electric power has been investigated at many sites.

2. Innovative approaches have included extraction of energy directly from tide races using a variety of prime movers.

3. Commercial acceptance of combined-cycle generation based on combustion turbines has reduced the potential economic and environmental costs.

5.1. Tide and Tidal acceleration

Tidal power is the only form of energy which derives directly from the relative motions of the Earth – Moon system, and to a lesser extent from the Earth – Sun system. The tidal forces produced by the Moon and Sun, in combination with Earth's rotation, are responsible for the generation of the tides. Other sources of energy originate directly or indirectly from the Sun, including fossil fuels, conventional hydroelectric, wind, biofuels, wave power and solar. Nuclear is derived using radioactive material from the Earth, geothermal power uses the heat of magma below the Earth's crust, which comes from radioactive decay.

Variation of tides over a day

Tidal energy is generated by the relative motion of the Earth, Sun and the Moon, which interact via gravitational forces. Periodic changes of water levels, and associated tidal currents, are due to the gravitational attraction by the Sun and Moon. The magnitude of the tide at a location is the result of the changing positions of the Moon and Sun relative to the Earth, the effects of Earth rotation, and the local shape of the sea floor and coastlines.

Because the Earth's tides are caused by the tidal forces due to gravitational interaction with the Moon and Sun, and the Earth's rotation, tidal power is practically inexhaustible and classified as a renewable energy source.

A tidal energy generator uses this phenomenon to gen-

banks for power factor correction. Different types of wind turbine generators behave differently during transmission grid disturbances, so extensive modeling of the dynamic electromechanical characteristics of a new wind farm is required by transmission system operators to ensure predictable stable behaviour during system faults. In particular, induction generators cannot support the system voltage during faults, unlike steam or hydro turbine-driven synchronous generators (however properly matched power factor correction capacitors along with electronic control of resonance can support induction generation without grid). Doubly-fed machines, or wind turbines with solid-state converters between the turbine generator and the collector system, have generally more desirable properties for grid interconnection. Transmission systems operators will supply a wind farm developer with a grid code to specify the requirements for interconnection to the transmission grid. This will include power factor, constancy of frequency and dynamic behaviour of the wind farm turbines during a system fault.

B. Capacity

Electricity generated from wind power can be highly variable at several different timescales: from hour to hour, daily, and seasonally. Annual variation also exists, but is not as significant. Because instantaneous electrical generation and consumption must remain in balance to maintain grid stability, this variability can present substantial challenges to incorporating large amounts of wind power into a grid system. Intermittency and the non-dispatchable nature of wind energy production can raise costs for regulation, incremental operating reserve, and (at high penetration levels) could require an increase in the already existing energy demand management, load shedding, or storage solutions or system interconnection with HVDC (high-voltage direct current – line) cables. At low levels of wind penetration, fluctuations in load and allowance for fail-

given location does not alone indicate the amount of energy a wind turbine could produce there. To assess the frequency of wind speeds at a particular location, a probability distribution function is often fit to the observed data. Different locations will have different wind speed distributions.

Because so much power is generated by higher wind speed, much of the energy comes in short bursts. The consequence is that wind energy from a particular turbine or wind farm does not have as consistent an output as fuel-fired power plants; utilities that use wind power provide power from starting existing generation for times when the wind is weak thus wind power is primarily a fuel saver rather than a capacity saver. Making wind power more consistent requires that various existing technologies and methods be extended in particular the use of stronger inter regional transmission to link widely distributed wind farms since the average variability is much less; the use of hydro storage and demand-side energy management.

6.4. Electricity Generation

A. Grid management system

Electricity generated by a wind farm is normally fed into the national electric power transmission network. Individual turbines are interconnected with a medium voltage (usually 34.5 kV) power collection system and communications network. At a substation, this medium-voltage electrical current is increased in voltage with a transformer for connection to the high voltage transmission system. The surplus power produced by domestic microgenerators can, in some jurisdictions, be fed back into the network and sold back to the utility company, producing a retail credit for the consumer to offset their energy costs.

Induction generators, often used for wind power projects, require reactive power for excitation so substations used in wind-power collection systems include substantial capacitor

erate energy. The stronger the tide, either in water level height or tidal current velocities, the greater the potential for tidal energy generation.

5.2. Tidal Classification

Tidal power can be classified into two main types:

Tidal stream systems make use of the kinetic energy of moving water to power turbines, in a similar way to windmills that use moving air. This method is gaining in popularity because of the lower cost and lower ecological impact compared to barrages.

Barrages make use of the potential energy in the difference in height (or head) between high and low tides. Barrages are essentially dams across the full width of a tidal estuary, and suffer from very high civil infrastructure costs, a worldwide shortage of viable sites, and environmental issues.

Tidal lagoons, are similar to barrages, but can be constructed as self contained structures, not fully across an estuary, and are claimed to incur much lower cost and impact overall. Furthermore they can be configured to generate continuously which is not the case with barrages.

Modern advances in turbine technology may eventually see large amounts of power generated from the ocean, especially tidal currents using the tidal stream designs but also from the major thermal current systems such as the Gulf Stream, which is covered by the more general term marine current power. Tidal stream turbines may be arrayed in high-velocity areas where natural tidal current flows are concentrated such as the west and east coasts of Canada, the Strait of Gibraltar, the Bosporus, and numerous sites in South East Asia and Australia. Such flows occur almost anywhere where there are entrances to bays and rivers, or between land masses where water currents are concentrated.

5.3. Environmental impact

The placement of a barrage into an estuary has a considerable effect on the water inside the basin and on the ecosystem. Many governments have been reluctant in recent times to grant approval for tidal barrages. Environmental impacts of tidal plants in the United States are difficult to measure because there are currently no US tidal plants. However, through research conducted on tidal plants in other parts of the world, it has been found that tidal barrages constructed at the mouths of estuaries pose similar environmental threats as large dams. The construction of large tidal plants alters the flow of saltwater in and out of estuaries, which changes the hydrology and salinity and possibly negatively affects the marine mammals that use the estuaries as their habitat. The La Rance plant, off the Brittany coast of northern France, was the first and largest tidal barrage plant in the world. It is also the only site where a full-scale evaluation of the ecological impact of a tidal power system, operating for 20 years, has been made.

French researchers found that the isolation of the estuary during the construction phases of the tidal barrage was detrimental to flora and fauna, however; after ten years, there has been a «variable degree of biological adjustment to the new environmental conditions».

Some species lost their habitat due to La Rance's construction, but other species colonized the abandoned space, which caused a shift in diversity. Also as a result of the construction, sandbanks disappeared, the beach of St. Servan was badly damaged and high-speed currents have developed near sluices, which are water channels controlled by gates.

I. Answering the following questions:

1. What is the main negative effect on the water?
2. How does the government try to solve ecological problems?

6.1. Water-pumping windmill

Humans have been using wind power for at least 5,500 years to propel sailboats and sailing ships, and architects have used wind-driven natural ventilation in buildings since similarly ancient times. The use of wind to provide mechanical power came somewhat later in antiquity.

In the United States, the development of the «water-pumping windmill» was the major factor in allowing the farming and ranching of vast areas of North America, which were otherwise devoid of readily accessible water. They contributed to the expansion of rail transport systems throughout the world, by pumping water from wells to supply the needs of the steam locomotives of those early times. The multi-bladed wind turbine atop a lattice tower made of wood or steel was, for many years, a fixture of the landscape throughout rural America.

6.2. Energy of wind

The Earth is unevenly heated by the sun resulting in the poles receiving less energy from the sun than the equator does. Also, the dry land heats up (and cools down) more quickly than the seas do. The differential heating drives a global atmospheric convection system reaching from the Earth's surface to the stratosphere which acts as a virtual ceiling. Most of the energy stored in these wind movements can be found at high altitudes where continuous wind speeds of over 160 km/h (100 mph) occur. Eventually, the wind energy is converted through friction into diffuse heat throughout the Earth's surface and the atmosphere.

The total amount of economically extractable power available from the wind is considerably more than present human power use from all sources.

6.3. Distribution of wind speed

The strength of wind varies, and an average value for a

a) применение энергии ветра;
b) сегодняшнее потребление электричества;
c) энергия ветра;
d) оценка ресурсов энергии ветра;
e) высота корпуса турбины;
f) средняя плотность энергии ветра;
g) передовая технология разработки ветряков;
h) применение энергии ветра.

III. Read the text and say whether the statements are true or false according to the text:

1. The potential electric power from wind energy is surprisingly small.
2. Technology under development today will be capable of producing electricity economically from good wind sites in few regions of the country.
3. Estimates of wind turbine efficiency and power losses are based on data from existing turbines.
4. The increasing cost of wind power and the growing interest renewable energy sources should ensure that wind power will become a viable energy source in the USA and worldwide.

IV. Express your own opinion about wind energy using the following phrases:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

3. What consequences may be on flora and fauna?
4. Explain why the water is one of the most important elements in chemical and physical processes on the surface of the earth.

II. Give the Russian equivalents to the following English word combinations from the text:

1. fresh water consumption;
2. world water balance;
3. Earth's entrails;
4. annual fresh water discharge;
5. renewable fresh water resources;
6. tight water balance;
7. unlike other natural resources;
8. in daily industrial life;

a) в повседневной промышленной жизни;
b) недра Земли;
c) в отличие от других природных ресурсов;
d) потребление чистой воды;
e) ежегодный сток чистой воды;
f) мировое равновесие воды;;
g) обновляемые запасы чистой воды
h) жесткий водный баланс.

III. Express your own opinion about ecological impact using the following phrases:

– In my opinion…
– To my mind…
– The fact is…
– To start with…
– I think/believe…
– The thing is that…
– As far as I know…

Unit 6. WIND ENERGY

Estimates of the electricity that could potentially be generated by wind power and of the land area available for wind energy have been calculated for the United States. The potential electric power from wind energy is surprisingly large. Good wind areas, which cover 6 % of the U.S. land area, have the potential to supply more than one and a half times the current electricity consumption of the U.S. technology under development today will be capable of producing electricity economically from wind sites in many regions of the country.

The price of the electricity produced from wind by these advanced turbines is estimated to be competitive with conventional sources of power, including fossil fuels. Because of the increasing competitiveness of wind energy, wind resource assessment will become essential in incorporating wind energy into the nation's energy mix.

Wind turbines are now a relatively common sight across Europe, with countries such as Denmark, the Netherlands, Germany, UK, Spain and latterly France, all investing in wind farms. Offshore wind development, although far less advanced, is the greatest prize in this field. However, relative costs of offshore compared to onshore are higher.

This project is aimed to demonstrate the economic as well as technical viability of offshore wind energy. The former was achieved through the innovative use of a floating jack-up barge which reduced the time and costs of installation. The latter was achieved mainly through the incorporation of new electronic control systems which improved the compatibility with grid network, and reduced the need for expensive grid strengthening measures.

Five turbines were installed, about 4 km off the coast of Gotland. Each turbine is rated at 500 kw. The average annual output is some 8 GWh/y, from mean wind speeds of 8 m/s.

rock-socketed steel monopole foundations, to water depths of 5 to 6,5 m were used to secure the turbines. Total construction time was only 35 days. Monitoring of impacts on local flora and fauna, such as the seal population, is also being carried out.

Vocabulary:

onshore – береговой;
a floating jack-up – самоопрокидывающийся;
compatibility – совместимость;
Gotland – о-в Готланд (Балтийское море; Швеция);
estimates – калькуляция, сметные предположения;
to range – классифицировать;
range – область, сфера;
competitiveness – конкуренция.

I. Answer the questions using the information from the text:

1. Why is wind energy available in the USA?
2. In what countries are wind turbines a relatively common sight?
3. What is the aim of the project?
4. How many turbines were installed?
5. What was total construction time?

II. Find the Russian equivalents to the following English words and word combinations:

1. wind power;
2. current electricity consumption;
3. wind energy applications;
4. mean wind power density;
5. advanced wind turbine technology;
6. wind power classification;
7. turbine hub height;
8. wind resource assessment;