

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ УКРАЇНИ
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»**

ФАКУЛЬТЕТ ЛІНГВІСТИКИ

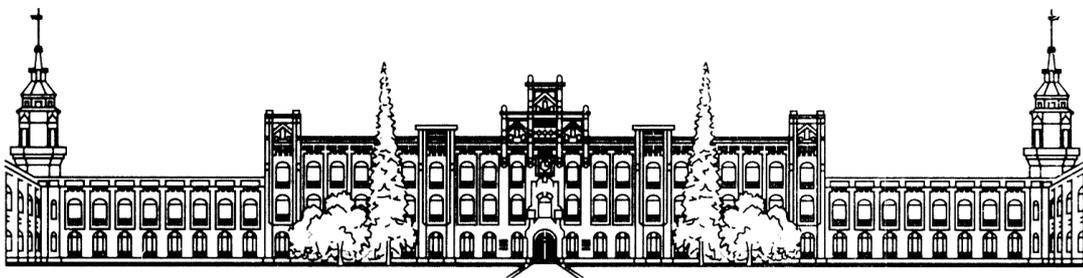
**СУЧАСНІ ПРОБЛЕМИ СВІТЛА ТА
СВІЛОТЕХНОЛОГІЙ В УКРАЇНІ ТА СВІТІ**

Матеріали

Студентської науково-практичної конференції

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Сучасні проблеми світла та світлотехнологій в Україні та світі : Матеріали Студентської науково-практичної конференції, 18 листопада 2015 року [Електронне видання]. – Київ, 2015. – 123 с.

У збірнику представлено матеріали Студентської науково-практичної конференції «Сучасні проблеми світла та світлотехнологій в Україні та світі», яка відбулася у Києві 18 листопада 2015 року і була присвячена сучасним проблемам світла й світлотехнологій в Україні та світі. Матеріали конференції призначено для студентів, випускників ВНЗ та усіх, хто цікавиться актуальними питаннями сучасної науки та техніки.

Відповідальність за достовірність фактів, цитат, імен та інших відомостей несуть автори публікацій

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ALTERNATIVE SOURCES OF ENERGY

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Needles to say, modern society demands energy in large amount, but its production affects environment negatively. Therefore, we have to use energy resources rationally and effectively. Despite the fact that traditional energy production prevails, alternative energy is becoming more and more important. Scientists think that increased energy efficiency leads to demand growth on energy source that perform such efficiency and have a purpose to increase Ukrainian energy safety in general and encourage investment in energy-saving technologies and usage of renewable energy [3].

Renewable energy is available with surplus in comparison to human's demand. Sources of renewable energy are energy of tides, sun and hydrothermal energy, wind power, energy of biomass incineration. Nevertheless, there are advantages and disadvantages of renewable energy that influence their expansion.

Solar energy is highly advantageous, since it is inexhaustible. Today, humans use just small portion of solar energy due to the low coefficient of performance of solar batteries and respectively high costs of their production. For instance, during one hour in summer day sun produces more energy than world consumes during the year. Therefore, the main problem is not availability of solar energy, but technologies for transforming it. Due to high costs and low efficiency, those technologies cannot compete with existing energy corporations.

There are two approaches for “proceeding” solar energy. First is to build boiler plant that works on solar energy. Such boiler plants usually is a part of off-seasonal heating. It means that they work simultaneously with boiler on wood chips incineration. Solar boiler plant works in the following way: system of mirrors directs solar energy for boiling and steaming of water and received steam moves turbine.

In practice, disadvantage of solar boiler is a demand of big space. Vacuum solar collector with capacity for 1400kWt requires 1100m². Boilers have electronic filters to avoid air pollution.

The other approach is to use panels with elements which transforms solar energy into electrical one. Those panels do not pollute environment, but the subject to ecological hazard in the end of useful time when it is time for utilization.

Increase of solar panels coefficient of performance is possible via their installation on the roofs of residence houses or near them for heating. High energy-costly productions for getting required amount of energy use powerful helioplants which are placed on large wastelands and deserts. Such energy production (as every renewable one) does not harm environment and does not pollute atmosphere but requires proper utilization [1].

Another type of renewable energy is wind power, but it is not so practically useful, because we can use it only at certain type of territory. Another disadvantage is changing wind intense and low capacity of stand-alone wind turbine. Wind power is very non-concentrated, so we need wind power plant that will be able to work with high performance. Wind turbines are not harmful but noisy. Due to this, wind turbines always are built far from residence places. Such requirement decreases possible territory for wind power plant placement and possible amount of wind power energy goes down as well.

Nevertheless, from the other prospective wind turbine has its advantages. Firstly, at windy territories wind could be inexhaustible source of energy. Secondly wind power plant produces energy without harmful air pollution. This type of energy is rapidly developing [2].

However, Ukraine still has low tendency to renewable energy consumption. Therefore, we have to increase amounts of production and consumption of renewable energy. Implementation of this is possible via launching programs of development of alternative energy for providing such energy for enterprises and house holdings. As a result, renewable energy has a significant market and requires high investment for development.

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SPECTRAL ANALYSIS AND IT'S TYPES

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The chemical composition of substance is the most important characteristics of the materials used by humanity. Without his exact knowledge is impossible to planning processes in industrial production with any reasonable accuracy. The requirements for the determination of the chemical composition of matter have recently tightened. Because of all these trends more progressive methods of determining the chemical composition of substances are developed. These include the method of spectral analysis, which provides accurate and rapid means of research of the materials chemistry.

Spectral analysis is the complex of determination methods for elementary and molecular composition of substances by their spectrum. Using spectral analysis it's possible to define the main components comprising 50 to 60% of the analyzed substance and insignificant impurities therein (up to 10^{-5} – $10^{-8}\%$ and less). Spectral analysis is the most common analytic method, 20- 30% of the assays performed using this method, including the control of the alloy composition in metallurgy, automobiles and aircraft industry, ore processing technology, analysis of ecological

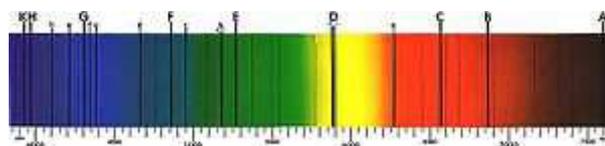
objects and materials of high purity, chemical, biological and medical research. Spectral analysis has a particular importance in the research of minerals.

Types of spectral analysis.

There are emission and absorption spectroscopy. Emission spectroscopy is based on ability of the elements to emit light. To excite the atoms of the material used high-temperature heating is used, equal to several hundred or even thousands of degrees. For this purpose, the sample is placed in a flame or in the field of powers electric discharges. Under the influence of the highest temperature, the solute molecules are split into atoms. Having obtained excess energy, atoms emit it in the form of a light photon of different wavelengths, which are recorded by spectral devices - depicting the resulting light spectrum. Spectral devices also servers separating element of spectroscopy, because the light beam is a sum of all substances present in the sample, and its task is to split the light beam into the light spectra of individual elements and determine their intensity which will allow to draw conclusions about the value of an element in total bulk of substances in the future.

Spectral analysis.

After registration, light spectrum is subjected to careful analysis. Certain wavelengths and their position in the spectrum are determined. Further, the relation of their position with belonging to the desired material. This is done by comparing the position data of the waves location with the information, given in the teaching table, which indicate the typical wavelengths of the spectra of the chemical elements.



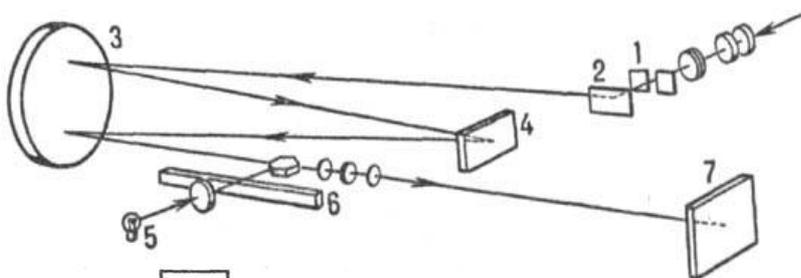
An example of a linear absorption spectrum

Absorption spectroscopy is carried out like emission. Spectral in this case, the material is placed between the light source and a spectral apparatus. Passing through the analyzed material, the emitted light reaches the spectral apparatus with "gaps" (absorption lines) for some wavelengths. It's they which make up the spectrum of the material absorbed. Further research is similar to the sequence of the above emission spectroscopy process.

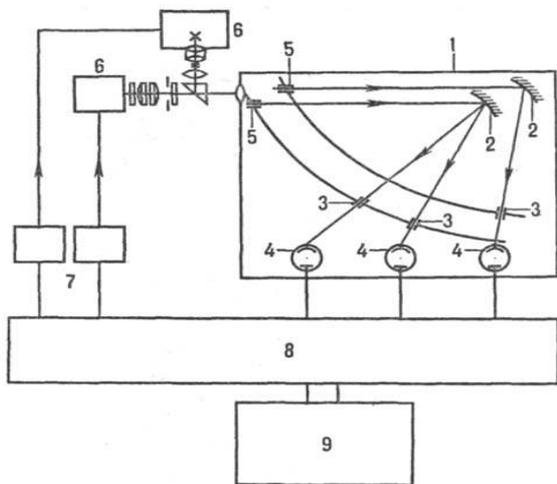
Devices.

The spectra are recorded using spectrographs and spectrometers (quantometer). There are many types of these devices with different aperture, dispersion, resolution and range. Large aperture is required for detection of weak radiation, a large dispersion is necessary for separation of emission lines with close wavelengths during the analysis of substances with multiple emission lines spectra. Among the devices dispersing the light diffraction gratings are used which have several hundred to several thousand lines per millimeter, rarely - quartz or glass prisms are used.

Spectrographs (picture 2) registering the spectra on special photographic plates, or (rarely) on the film, are more preferable in the qualitative spectral analysis, because it's possible to study the entire spectrum of the sample immediately (in the working area of the device). However, they are used for quantitative analysis due to the relatively low cost, availability, and ease of service. Blackening of the emission lines on the photographic plates is measured by microphotometer. Using a computer or microprocessors provides possibilities for automatic measurements, processing of the results and giving final results of the analysis.



Pic.2. Optical scheme of the spectrograph: 1 entrance slit; 2 rotating mirror; 3-spherical mirror; 4-diffractive grating; 5-light illumination of the scale; 6-scale; 7-photoplate.



Pic. 3. Scheme of quantometer(out of 40recording channels only 3are shown): 1-polychromator; 2-diffraction gratings; 3-outlet slits; 4 photo-electronic multiplier; 5-input slot; 6 tripods with light sources; 7 generators spark and arc discharge; 8-electron-recording device; 9-managing computing system.

Photoelectrical registration of analytical signals is made in spectrometers by photoelectrical multipliers (PEM) with automatic data processing on computer. Photoelectrical multichannel (up to 40 channels and more) polychromators allow simultaneous registration of analytic lines of all defined elements in quantum meters (pic. 3). By using scanning chromatographs multi-element analysis provides high scanning speed range in accordance with a predetermined program.

Vacuum spectrometers are used for determination of elements (C, S, P, As and other) the most intense analytic lines of which are located in UV range of spectrum at wavelengths smaller than 180-200 nm.

In case of quantum meters, duration of analysis is defined largely by preparation processes of the starting material for the analysis. Considerable reduction of time is reached by automation of the longest stages – dissolving, mixing solvents to obtain standard composition, oxidation of metals, grinding and mixing of powders, sampling of a given weight. In many cases multi-element spectral analysis is performed within several minutes, e.g. solution analysis with the use of automated photoelectric spectrometers with high-frequency plasmatrons or the analysis of metals by smelting process with automatic feed of samples into the radiation source.

Express semi-quantitative (the relative standard deviation of 0.3-0.5 and more) techniques for the content determination of the basic and the most characteristic alloy components are quite common in the ferrous and nonferrous metallurgy at different production stages. For this purpose simple, compact, and cheap visual and photoelectrical devices (steeloscopes and steelometer) together with spark generators are used. Quantities that can be determined lie in the range of several tenths of a percent to tens of percents.

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BIOMASS ENERGY PRODUCTION

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As a matter of fact, biomass power generation is a branch of electric power engineering which is concerned with producing biofuels from biomass. Biological renewable substances of organic origin having undergone biological decomposition, such as agricultural, forest, industrial, and domestic waste, are considered as biomass. The annual growth of biomass in the world is estimated to be 200 billion tons of dry substance, which is an equivalent to energy of 80 billion tons of oil.

Firstly, it is important to point out some special features of biomass, including the facts that the biomass properties depend on humidity of storage conditions, the amount of biomass is determined by the harvest of crops, and biomass is reproduced in periodical natural cycles. For these reasons, the reliability of using biomass as a fuel must be secured by power supply from traditional sources of energy. Moreover, to produce the same quantity of heat we must burn two times greater amount of biomass than that of natural gas.

Solid, liquid and gas fuels produced from biomass can be used as a fuel, or as a fuel component of biofuels. Thus, biogas, landfill gas, biodiesel, biomass pellets and cubes are referred to as biofuels.

Secondly, burning biomass requires specially designed boilers, which are to possess definite thermal capacity, to be equipped with safe and reliable facilities for accumulation and supply of biomass of different humidity as well as fire-extinguishers, and to have the heating surfaces regularly cleaned from ash.

It is also necessary to be able to connect biofuel boilers to the existing heat supply system with ease. In this respect, reconstruction of the boilers operating on traditional fuels is the most favorable option of biomass boiler arrangements.

Using biomass in electric public utility can be achieved not only by a direct combustion of biomass in boilers. Also, it can be used for receiving biogas as a product of biomass fermentation, and using biogas as a fuel.

In general, the main motive of introducing heat-generating capacities of biomass is to avoid dependence on imported energy sources, which contributes to country's independence in terms of political and economic activity.

In Ukraine, energy of wind, sun and water makes up about 98% of all the power generated from renewable sources of energy. Experts predict biomass energy production to be rapidly developed in our country, as this is a common trend now all over world. Although the share of biomass is only 2% of the alternative sources of energy used in Ukraine at present, it has a great potential and is one of the most promising sources of clean energy in Ukraine. Biofuels are viewed as an effective alternative to traditional fuels. It is believed that biofuel production will be the most profitable aspect of the Ukrainian economy in the coming years. In fact, it is much more profitable for Ukraine to produce biofuels than to export raw materials, for example to Poland and Germany. The energy strategy of Ukraine forecasts an increasing production of fuel ethanol and biodiesel to substitute for 1.8 million tons of traditional fossil fuels by 2030, and to represent 19.5% of all the sources of biomass power.

To sum up, biomass energy includes domestic biomass, industrial and agricultural waste materials, as well as dry and wet waste materials and grains, each of which can serve as fuel for powerful steam generators and some of them even could be used to produce liquid and gas fuels. A number of transportation fuels can

be produced from biomass, helping to reduce the demand for petroleum products, and improve the greenhouse gas emissions profile of the transportation sector.

I think that biomass energy is the oldest source of energy; however, up to now it has been used only for direct combustion in stoves and furnaces, with very low efficiency. Now it is time to greatly increase the efficiency of biomass, which is a clean renewable source of energy.

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LIGHTING TECHNOLOGY IN UKRAINE

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Lighting technology is a science. Its subject is research of the principles and development of generating, distribution and measurement of optical radiation spatial characteristics. In addition, it covers transformation its energy into other forms of energy and its usage for different purposes. Lighting technology includes the design and technological development of radiation sources and systems management, lighting, Irradiation and lighting devices, gadgets and installations, rationing, design, installation and operation of lighting installations.

Ivan Pavlovich Puluj is the founder of lighting technology in Ukraine. He is the author of about 50 scientific and popular articles on physics and electrical

engineering. In addition, Ivan Puluj was the first who had been championed as an early developer of the use of X-rays for medical imaging.

Nowadays, the shops filled with goods that are manufactured abroad. Most of them have no analogues in Ukraine, nevertheless they are produced, have high quality and good price, so they are competitive.

Ternopil is the capital of homeland lighting technology. This is the city where leader in the production of lighting in CIS has been working for more than fifty five years. It is company "Varta corporation", which is engaged in elaboration and manufacturing of lighting (lamps and spotlights). The word "Varta" is the name of the Carpathian fire that in the best way symbolizes the nature and specificity of the team, which works in the company.

In 1992 Ukrainian Lighting - technology institute was found. It deals with electrical and lighting technology testing and certification. "Varta corporation" covers a wide range of lighting development and production, including almost all areas of applications, namely: explosion-proof lighting devices, floodlight, outdoor lighting, administrative, office, public lighting and fixtures for premises, transport lighting, exclusive vip-class fixtures.

Thus, products of Ukrainian producer are widely representative, as its quality is quite high. That is why buying these products will lead to support of our manufacturer and scientists and encourage them to develop current technologies.

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FROM THE HISTORY OF ARTIFICIAL LIGHT

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Artificial light sources are technical devices of various designs to transform energy in numerous ways. Their main purpose is to obtain a light emission (visible one, and with different wavelengths).

The first light source that people used in their activities was the flame of fire. In the course of time due to increasing experience of burning various fuels people found out that a greater amount of light could be obtained by burning any resinous wood species, natural resins, oils and waxes. Later on, the technologies of processing metals resulted in the creation and great improvement of the first independent light sources that could be installed in any position, carried, and recharged with the fuel.

Then, the further progress of knowledge in chemistry, physics and materials science also allowed people to use a variety of combustible gases that are produced during the combustion of a larger amount of light. Gas lighting was quite well developed in the UK and several European countries. One of the most important components of illuminating gas, which gave the highest amount of light, was benzene. Another gas that found significant application in industry was acetylene, but in view of its significant propensity to ignite at relatively low temperatures and a large flammable limit, it did not find wide application in street lighting and was used only in the mines.

In the 19th century the invention of light sources were greatly associated with the discovery of electricity. It became obvious that it was necessary to increase the brightness of light sources to increase the temperature of the area that radiates light. When an electric current was seen to heat different conductive materials to high melting temperatures, materials radiated visible light and could serve as the sources of light of different intensity. Such materials appeared to be graphite (coal thread), platinum, tungsten, molybdenum, rhenium and their alloys. As soon as designers of lamps chose the working material, they paid attention to maximum operating temperatures of the heating spiral, the main priority being given to carbon and thereafter to tungsten. Nowadays tungsten and its alloys with rhenium are the most widely used materials to produce electric bulbs because under the favourable conditions they can be heated to temperatures of 2800-3200 ° C.

At present, the best light sources are based on arcing-krypton, xenon and mercury lamps as well as on a glow discharge in inert gases (helium, neon, argon, krypton and xenon). Nowadays the most powerful and brightest light sources are lasers. Powerful light sources are also known to be lighting pyrotechnic compositions used in photography and to light large military objects.

Light sources are very often accompanied with the presence of dangerous factors, the main of which are as follows:

- bright light radiation that is dangerous for eyes and exposed skin;
- high intensity of light radiation, which can cause fire, burns and injuries (e.g., light lasers, arc lamps);
- combustible gases or liquids;
- high voltage power supply;
- radioactivity.

In conclusion, one should note that in all areas of human activities various types of light sources are necessary. They are a reflection of development human civilization and an integral part of our existence.

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ANOTHER VIEW ON ENERGY SOURCES

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Alternative energy is a set of promising ways to obtain, transfer and use of energy that is not widely spread but is of significant interest. The reason is of the profitability of their use in the usually low risk of harm to the environment [1].

These sources include [1]:

- solar;
- wind energy;
- tidal energy;
- geothermal energy;
- fuel from biomass.

The humanity has already exploited three types of solar energy: energy fluid heated by sunlight; direct photovoltaic conversion of solar energy into electricity and the use of mirrors focusing solar heat energy on the surface of the boilers of thermal power stations [3]. The photoelectric cell is used to convert light energy into electricity. Photoelectric cell operates on the basis of internal photoelectric effect. A photon of light falling on the negatively charged semiconductor passes energy to the electron. Thus, the photon energy transfers into electrical energy of directed motion of electrons [3].

Wind energy is very efficient. Its reserves are (estimated by the World Meteorological Organization) 170 trillion kWh per year [3]. This energy can be

obtained without polluting the environment. The principle of the wind turbines is very simple: the blades that revolve through the force of the wind pass through the shaft mechanical energy to electrical generators. Instead of converting electrical energy into mechanical energy, wind energy becomes electricity [3].

Biomass is used to produce electricity, heat, bio fuels, biogas (methane, hydrogen). Manure can be converted to renewable energy through anaerobic digesters, combustion or gasification [4]. The anaerobic digesters produce biogas which can directly substitute natural gas or propane or be used to generate biopower [4].

The most popular form of biomass is wood. It can be simply cut and chopped in firewood. Wood can also be recycled. This briquettes manufactured by molding the crushed wood pellets or fine granules. Then wood dust is comminuted into particles [2]. Pellets and briquettes are not polluting. They are completely burnt and their ashes can be used as fertiliser. Due to its high density and low moisture content, they have a higher heat than unprocessed wood. For efficient combustion of pellet boilers are used with the appropriate burner [2].

From oilseeds using dedicated esterification of vegetable oil people produce a variety of diesel fuel (biodiesel) [4]. By fermentation of sugary and starchy foods (cereals, potatoes, sugar beet) ethanol is obtained (bioethanol) [4]. Ethanol is used as a fuel in pure form and in mixture with gasoline, used to produce ethyl tert-butyl ether – high quality fuel for gasoline engines, which is partly biofuel unlike methyl tert-butyl ether [4]

In conclusion, we can say that alternative energy is our future. Such sources as coal or petroleum are expensive, non-renewable and environmentally harmful unlike alternative, that are almost free, absolutely renewable and definitely don't harm the eco system. Alternative resources of energy the best way to prevent ecological and economical problems that may appear in case of usage and production of energy.

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NANOTECHNOLOGIES IN LIGHT PRODUCTION

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Nanotechnology is a useful science that can find its application in such different fields as natural sciences, transportation, energy, food safety, and homeland security. A great advantage of using nanotechnologies is that we can develop different characteristics in materials by dealing with the structure on its basic level. So, in the article we will focus on how nanotechnologies are used to produce light.

Our environment is almost out of fossil fuels and different green energy sources, the need to discover lighting origins that are not harmful to our ecology but still are efficient is vital now to let humanity still exist on the Earth.

Light-emitting diode (LED) is just one, frequent precedent of green sources of light.

Nanotechnology plays a great role in developing LED that is a two-lead semiconductor light source. It is a p-n junction diode, which generates light while working. The light that occurs belongs to a certain spectrum. So it is an exact diversity between a frequent lamp and diode. The emitting area of a common lamp is much wider and the hue of the light can be changed by the application of the external filter. While dealing with LED, the hue of light is determined by a chemical formula of a semiconductor that we are using for light generation.

Quantum dot – is a crystal of semiconductor material the radius of which has the size of several nanometers – a size which results in its free charge carriers experiencing "quantum confinement". So the characteristics of quantum dots are defined by their size and shape. So it is possible to increase the frequency of the light that emits by making quantum dots are tinier in measures and switch the color of light.

We will list a few advantages in LED application:

1. LED lamps are of a better quality than incandescent light bulbs. And the shape and measures do not influence on that;
2. If we need a certain color, LEDs can be the origin of a specific one without using any external optical filters, so it may cost less;
3. The size of LED is really tiny (their measures can be even smaller than 2mm);
4. LED doesn't need lots of time for warming up, as usual, to achieve its full brightness it takes only a microsecond;
5. The amount of heat which LED produces is not as big as other common light sources have, so using LED means using less power;
6. For LEDs, it is possible to work for plenty of hours. One report takes 35,000 to 50,000 hours of useful life; however, they still are able to work for some time more until they're done;

7. LEDs, which consist of solid compounds, are not easy to damage with external shock, unlike fluorescent and incandescent bulbs, which are fragile.

Nanotechnology is about to create semiconductors of diverse measures based on chemical composition. Just a small number of colors of LEDs have been already obtained. It is a field for perspectives, also to make it cheap and spread all over the world is a very perspective direction. These researches can make LEDs common green energy source in the world market.

Thus, by developing different ways of obtaining LEDs, we are looking forward to get new text, video displays, and sensors. It can be used in so many important fields as biology, medicine, chemistry, computers, etc.

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ALTERNATIVE SOURCES OF ENERGY

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Electricity production in Ukraine is provided by 46.9% NPP, 11.2% HPS; 39.1% TPP.

Environmental impacts TPP. Energy production in thermal power plants is accompanied by a large amount of heat. Given the limited world reserves of fossil fuels, scientists and engineers continue to work on improving the parameters of power, increasing their Coefficient Of Performance (COP), the introduction of so-called cryogenic generators, which are cooled with liquefied helium. Burning fossil fuels is accompanied by strong pollution. Consider the main ones.

Air pollution by dust and gas emissions. During the combustion of hydrocarbon fuels in thermal power plants, furnaces carbon dioxide concentration in the atmosphere increases by about 0.25% per year. This causes atmospheric warming due to the greenhouse effect. From the pipes of TPP are released into the atmosphere as sulphur and nitrogen oxides, which cause acid rains that fall. The atmosphere is polluted and small solid particles of ash, slag, not completely burned fuel (soot).

Radioactive contamination. In fossil coal and empty rocks contained impurities of natural radioactive elements. After the burning of coal, these elements are concentrated in the ash, which is more radioactive than coal and empty rocks. Thus there is contamination of the atmosphere and Earth's surface. Contamination of the earth's surface slag dumps and quarries. After burning coal in thermal power plants currents remains much solid waste (slag, ash). They take large areas of land, pollute groundwater and surface water with harmful substances. Another big piece of land broken by huge coal quarries. Yes, slag heaps and heaps of empty rocks occupy a large area, which increases every year. Environmental impacts NPP. In 26 countries operated 416 nuclear reactors that produce about 16% of all electricity. The main

thing is that nuclear power is so detrimental effect on the biosphere, and the potential danger of an accident at the plant so large that defend this method of energy extraction unacceptable and immoral. Energy nuclear cycle involves extraction of uranium ore and extract uranium from it, processing of raw materials to nuclear fuel (uranium enrichment) fuel in nuclear reactors, chemical regeneration of the spent fuel processing and radioactive waste. All these operations are accompanied by a dangerous radioactive contamination of the environment. Contamination begins at the stage of extraction of raw materials, radioactive waste is growing at the stage of enriching uranium ore. Radiation has a very negative feature: all in contact with the radioactive substance itself become radioactive, and therefore dangerous. The above fully applies to most NPP. After 25-30 years of service all their equipment, hardware, capacity, facilities, vehicles, etc., become so radioactive that they should be dismantled and buried in a hundred years. For burial only one reactor need about 40 hectares of land. NPP produced hundreds of radioactive substances, which did not exist in the biosphere, and which living creatures are not adapted to. The accumulation in nature of inappropriate amounts of these highly radioactive substances have a harmful effect on the biosphere. It should be added that the NPP is also a great cause of thermal pollution, particularly hydrosphere. Only a small part of the heat released during reactor can be utilized and converted into electricity. Extraction and processing of uranium ores and air related to unfavorable environmental effects. But the main problem remains the disposal of high level waste activity. Among which are highly toxic chemical elements and stable connection.

Developed methods of concentration, reliable binding and placing in stable geological formations where they can abstain for thousands of years. This significantly increases the cost of energy produced by nuclear power plants to nuclear fusion. This requires a protection rizocho type of radiation that znachno increases the cost of energy produced by nuclear power plants. In addition, another disadvantage of nuclear power plants are thermal pollution of water, ie its heating. These data indicate that for the normal operation of power plants environmental impact of nuclear energy is ten times lower than the heat. In general, the real impact of nuclear radiation on the

natural seredovysche is much (10 times or more) smaller prypustymoho. The risk of nuclear workers normalno minimum for workers whose activity air "connected with yadernoho different stages of the fuel cycle and to the public. Nuclear energy became a separate branch of power. Today, it plays an important role in the electricity around the world. Fusion energy. Due to the huge potential injury to the biosphere nuclear scientists and Energy hopes to present another way of obtaining energy, namely by means of fusion power plants (TYAES). Although the world is still one TYAES are convinced that this method of obtaining energy will be a key in 1 century. In TYAES dobuvatymetsya energy not by splitting uranium nuclei, and nuclei of light by the merger and the formation of hydrogen isotopes are nuclei of helium. Such reactions fed by solar energy and countless number of other stars in the universe. Environmental impact HPP. Nowadays produce about 20% of electricity in the world. Compared to the hydroelectric power station and nuclear have several advantages:

- They do not pollute the atmosphere;
- Improve working conditions for river transport;
- Working in tandem with the TPP take the load during maximum (peak) power consumption;
- hydroelectric units are entered in place very quickly, in contrast to TPP units.

At the same GES, especially those built on lowland rivers, causing harm to the environment:

- Flooding of vast areas of fertile land;
- In areas near reservoirs, groundwater level rises, , derived from the rotation large areas of land;
- In the last reservoirs falls banks, which in some areas has retreated hundreds of meters.

Dams have transformed Dnipro stagnant for a number of lakes. Very residents affected by dams rivers - plankton and fish. Fish can not pass through the dam to the places of their usual spawning grounds, which also become unsuitable for spawning through the recess. Many fish and plankton die in turbine blades. Reservoirs polluted by sewage, fertilizers washed from fields that, in the summer often "bloom", causing

mass death of fish and other water inhabitants. That loss of hydroelectric and quite significant. Wind power station Wind energy installation is that converts the kinetic energy of the wind flow into electricity. Wind energy is, in fact, limitless. This energy is renewable, unlike thermal power plants, wind power is not using the wealth of mineral resources. During the WEC environment not exposed to contamination. The only negative consequences: - a low-frequency noise (buzz and death of birds that fall).

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ALTERNATIVE AND RENEWABLE ENERGY TECHNOLOGIES

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The humanity lives in a world, where the amount of energy consumption is growing every day. Developers and researchers are constantly trying to create more energy-efficient technologies that enhance the productivity and minimize energy consumption. Nevertheless, despite all these technologies, the total amount of energy consumed is growing every day. However, scientists continue developing alternative technologies with the use of renewable sources of energy. This paper deals with the most effective technologies that people should consider as promising ones. These alternative energy sources may be used in various spheres of life, which is why they are worth investing in them.

First of all, let us consider *the use of solar thermal energy in buildings*. Using solar heating constructions in buildings is becoming increasingly popular in the world. Design and construction of such buildings may be performed in two types: by using passive solar heating systems and the active ones. Passive solar heating systems use thermal properties of the building, which allow accumulating and retaining heat.

The transformation of solar energy into electricity may be accomplished with heat engines or with a photocell – an electronic device that converts the photon energy into electrical energy. It's worth noticing that houses like cottages, which are built with solar heating systems, are able to provide themselves with heat, electricity and hot water from 50% to 100%.

It is interesting to know how *solar panels* can be used *in public places*. These structures are simple and may be installed, for example, at public transport stops. In this case, the solar cell is installed on the roof of the bus stop shelter. During the day, the solar panels accumulate energy, which is then used to illuminate the area at night. Just three hours are enough to charge a power-saving setting fully, if the day is sunny. In case the day is cloudy, the time of charging is doubled. One should note that such a fully charged battery can illuminate the stop during four nights. The battery design is simple. It has two sensors: a light sensor and a motion sensor. As twilight comes, first sensor element switches off the charging process and the light turns on. If there is no movement at the stop for a certain period of time, the second sensor turns off the light. This system allows spending solar energy in the most efficient way.

We cannot but mention *geothermal energy*. Geothermal energy means obtaining thermal or electric energy out of the heat from the earth's depths. This technology is cost-effective in the areas where hot water is located closely to the surface of the earth's crust. Near-surface geothermal resources are spread almost everywhere. They are absent only in the permafrost areas, or in the areas with no local sources of fossil fuels. Extracting geothermal energy out of the near-surface soil does not require substantial investment, because the depth is small. This energy source may guarantee enough energy for the operation of the widest range of facilities, whose energy consumption is small or medium. Sometimes geothermal energy source may be used in an individual house or even in a multistoreyed complex. Another promising but still costly trend of geothermal energy is to obtain the energy, which is stored in solid hot rocks at the depth of 4-6 km, where the temperature may range from 180 to 400°C.

Nowadays, *the use of biofuels* is becoming more and more popular. Biogas is a

high-grade energy carrier, which can be used as a fuel in the households, in small and medium-sized businesses. Biofuels are usually created from cattle or poultry waste, as well as from alcohol plants waste or from biomass of different plants. After the use of this mass for energy, the residual biomass is used in field fertilizing and production composting. Thus, it looks like a closed-loop system: plants – food – waste – plants. It is important to note that biofuel does not pollute the environment. Biogas can also be produced from waste in the landfills. At present, many countries have already implemented the specially equipped storage of solid waste produced by a city in order to extract biogas from it.

It is worth noting here *the wind energy*. Wind turbine converts kinetic energy of wind into electrical flow. This construction consists of a wind turbine, electric generator, automatic devices to control the operation of a wind turbine and a generator. In most cases, the installation of wind turbines are used as a power source with a relatively small capacity in the areas with good wind conditions, where the average annual wind speed exceeds 5 m/s.

Small hydroelectric power stations combine the advantages of a large hydroelectric power station and the possibility of decentralized power supply. The use of small amount of hydropower is a decentralized use of electricity, which contributes to the development of the whole region mainly based on self-sufficiency and the usage of local resources. A small or micro hydroelectric plant generates electric power if the natural water level in the river is sufficient. During the periods of a dry river or the low flow level, the generation of power is known to be suspended. Despite the high capital costs and long payback period (around 7-10 years), small hydroelectric power stations are profitable due to their long life (over 70 years) and low maintenance costs. "Micro" stations operate in the range from 3 to 100 kW. The "environmental friendliness" of small hydropower plants is manifested, above all, in smaller flooded areas than it happened in the conventional hydro power stations. In addition, small hydro power station flooding almost does not disturb normal natural habitat of wildlife and people.

To sum up, alternative and renewable sources of energy are of great

importance in the modern world. In the course of time, the interest towards alternative energy sources is growing as the energy consumption constantly increases. That is why these technologies as well as the whole area of alternative and renewable energy sources require further investigations and investments.

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LIGHTING ANALYSIS OF SUBSTANCES

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Needless to say that scientific investigations and inventions have changed our life. Scientists carry out the investigations every day to improve the conditions of existing. Due to the fast development of molecular technologies, humanity got a chance to explore chemical substances as deep as it's possible. Furthermore, scientists have improved the way of analysis using the light energy. It was established that the rays of light which come through the substance cause the emission of energy. So what does it mean and how does it work?

Electrons exist in energy levels. Electrons may move between orbitals. For these movements they must absorb or emit energy equal to the energy difference between orbitals they move.

The absorption of light is a very important fact because of the meaning of this. When atoms or molecules(or another particles) absorb light, they get to a higher energy level. Excitation kind has a great influence on the wavelength. Visible light like an ultraviolet helps electrons to promote to the higher level. The spectrum is made up of set which includes waves with certain frequency or wavelength. It depends on its energy level structure, and absorption spectrum is the most common method for identifying chemical elements which can exist in each compound.

Another example of interaction between substances is light emission. After the excitation electrons can decay to lower levels by emitting radiation(emission or luminescence). That is the reason of waves which are made up by emitting. The intensity of an emitting substance is related to definite concentration at low concentrations, and is useful for identifying emitting species. It helps to determine new properties of well-known elements. Consequently- the number of new compounds is increasing and this fact opens new opportunities for scientists which are trying to invent new technologies to make life easier.

General way to identify the composition of the substance by the light absorption or emission is called molecular spectroscopy. Each atom has own unrepeatable spectrum and it allows scientists to identify the atoms which this substance is composed of.

According to this method, the main property of a line spectrum is that the wavelengths (or frequencies) of the spectrum depend on the atomic properties of substance and it doesn't depend on excitation method. The atoms of any chemical element give the spectrum unlike the other atoms do. They are able to emit a strictly-defined set of wavelengths.

Taking everything into consideration, molecular spectroscopy is a proof that humanity has done a great step in scientific development. A lot of medicine

inventions are based on this method. The abundance of light properties allows to apply it almost in every area of science.

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THE FUTURE OF TIDAL ENERGY

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With the rapid development of power engineering over the last century dozens of new types of renewable sources of power have appeared. One of such newly discovered sources is tidal energy, which has drawn attention of many leading companies and countries, despite its being in infancy. Its most important advantage in comparison to other alternative sources is that it doesn't require back-up plants. This is a consistent source of kinetic energy, mainly affected by different positions of the moon. Special turbines extract energy from moving tidal water, being mostly installed at locations with immense tidal velocities or strong currents.

Tidal turbines might remind you typical windmills, even though there are some essential differences. Blades are set in motion by heavy and fast currents. The water-immersed rotors are used to operate power generators, which in return produce electricity. The size of submerged rotors can be several times less than the ones used

in windmills due to the density of water. This allows placing tidal turbines much closer to each other, and still having the same amount of produced energy.

The best place for placing the turbines is in shallow waters, which permits us to raise the effectiveness of power production, and lets the nearby sailing ships navigate around the stations.

On the other hand, current harnessing devices are unique in their process of installation, structure and usage. For example, the force of the tidal current called Strangford Lough is comparable to the wind with the speed of almost 555 kilometers per hour. As a consequence, the rotors undergo a 100 ton thrust during the maintenance. But that is not the only problem. In addition, the procedure of placing the large turbines might cause tidal current to be disrupted.

Using a barrage is another away of producing electricity from tidal energy. The process is very similar to the standard river-dam stations. During the tidal rise the water flows into the opened gates. At high tide the barrage is closed, which creates a lagoon. After that the gates are opened and water flows through barrage turbines creating an easily controlled production of energy. It is worth mentioning here that this might be a cause of significant disruption of environment, such as the decrease of salinity level, or barrages being a trap for fish and other animals. However, thanks to the latest scientific achievements more efficient generators can be constructed, so that with improved logistics tidal turbines can be placed in regions with less marine life concentration.

To sum up, tidal energy holds a great potential, although today it fails to compete with traditional sources of energy, like oil or natural gas, because of the high cost price. There is still every reason to believe that we should keep an eye on development of tidal energy as it might be the future of modern power engineering.

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INTRODUCTION TO LIGHTING TECHNOLOGY: LED AND OLED

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The light-emitting diode, or LED, is the basis for future lighting technology. This two-lead semiconductor produces light when being activated, and it is a very important device, because it finds wide application in the everyday life. Numerous indicators in our household appliances, for example, in remote controls, games-consoles, lamps, computers, etc. help us do work, communicate, and entertain ourselves. Many modern cars are equipped with LED indicators and brake lights. Also, we should not forget about traffic lights, signs, street lighting and so on. These diodes reveal the interconnection between electronics and photonics. In fact, the LED is a vital link to understanding these fields of science. The main reason why LED are so domination in these branches is that they are commonly used in broadband communication.

Nowadays most people think that LED-technology has been recently discovered by US scientists. However, the light-emitting diode was actually invented by Henry Round, and Oleg Losev, one of the Russian scientists that are now forgotten, almost 100 years ago.

There are two main types of the light-emitting diodes – LEDs and OLEDs. There are also EL lamps (Electroluminescent Lamps), but there is a difference in the construction. The LED has special reflectors and other parts to make the light brighter and to focus it on one point. The OLED is different, because it's a compound. The abbreviation OLED stands for “organic LED” and its layer consists of a mix of substances, just like in EL lamps, but it uses carbon molecules.

A lot of people do not know that the LED is quite an old technology and as a matter of fact it was created over 50 year ago. We should thank such people as Robert Hall, Nick Holonyak from Syracuse, Marshall Nathan from IBM and Robert Rediker from MIT for being able now to apply it in practice.

This technology has some advantages and disadvantages.

The pros:

1. It requires only 30-60 volts for proper work. That makes the LED one of the most efficient sources of light for areas with small space.
2. Extended life time duration in contrast to glass bulb lamps.
3. It can help to reduce stray light pollution of streetlights.

The cons:

1. Sensitive semiconductor may be damaged by the heat. As a result, the complete lighting system may go out because of problems with one LED. That makes us provide heat sinks to protect the lamps. In its turn, this reduces efficiency of using LEDs, and costs more money.
2. The LEDs include some rare components. Their price can be monopolized by some countries.
3. It sometimes reduces lumen output.
4. The LEDs may get cracked because of the specific strict construction with thin cooper connections.
5. There is a great gap between summer and winter temperatures, so it may cause whole sections of streetlights o go out, but this problem will be solved in a few years because a lot of work has already done in this research area.

The organic LED's layer is made of molecules, including carbon, providing electroluminescent effect. Nowadays, we use them for small and large displays, and lamps. The OLED can make a revolution in our world, and may become an important part of subjects in which we have never used the lighting technology before. If we compare an organic LED to its previous generation, we will find out that the first one is more efficient on the market of displays, it produces more light, it responds quicker and it is thinner. Unfortunately, the price of lighting devices of a new generation is higher than that of LEDs, but this problem is common for all new technologies that are at the stage of development. Another goal for today's scientists is to make OLEDs' time life duration longer, because at present organic materials may crack just in a few years.

The most perspective way for OLEDs' development is in display production. Now we all have some kinds of monitors in our houses and workplaces, for example, computer, television and phone screens. The OLED is the best device to replace LCD in these products. The OLED display is made of a few different layers along with transistor that sends the signal to each pixel to turn on or off. This display may be thinner and more efficient than LCD. It also has better contrast and displaying blacks. With flexible shell, this monitor will make a revolution in appearance of our gadgets. We will be able to roll up it like a newspaper. Despite the fact that OLED monitors are not so bright as LCD or EL, they work better in less lit areas and have bigger watching angle.

In the future OLEDs will become the basis of full colour, flexible and thin displays.

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RENEWABLE ENERGY IN AGRICULTURAL AND INDUSTRIAL COMPLEX OF UKRAINE

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The stable development of agricultural enterprises is a key to food security, and one of the sources that allow us to attract foreign exchange resources through exports. However, a significant proportion of production costs of agricultural enterprises is energy resources the cost of which imposes a heavy burden on farmers today. That is why the search for alternative sources of energy for such enterprises is an important task that requires finding immediate solutions.

The use of renewable energy sources allows us to solve the energy problems of the agricultural and industrial complex of Ukraine as it gives the companies an opportunity not only to save money but also to solve some ecological questions in their locations. Among these resources of power are sun’s heat, wind, geothermal energy, and biomass.

The total amount of energy resources consumption in Ukraine is about 200 million tons of equivalent fuel, 55% of these being imported, and only 45% being obtained from country’s own sources [1].

Ukraine has a significant energy potential of renewable energy sources. The total annual attainable level of power measured in the equivalent fuel is about 98

million tons. Renewable energy sources have found wide application in the enterprises of agricultural and industrial complex.

An average annual amount of total solar radiation arriving at 1 m sq. area of Ukraine is 1,070 kW*h/m² in the North, and reaches 1,400 kW*h/m² in the South of the country. This enables using solar power equipment for solar heating, cooling, getting fresh water, air conditioning, drying of products and materials.

If the centralized network of power supply is too distant from the loads, they have a relatively small capacity, and investment into laying transmission lines are too high, the power supply of enterprises may be economically unprofitable. Under such conditions the agricultural complex can use wind energy for such needs as:

- electricity supply of small villages, hamlets, farms (wind turbines of up to 20 kW);
- power supply of small and mid-sized farms (wind turbines of about 7.5 kW);
- electricity supply of private family agricultural businesses (wind power of about 3-4 kW);
- power supply of private houses, holiday houses (wind power of about 1 kW);
- for water supply, water aeration, micro-irrigation of agricultural crops.

Significant saving of fuel energy resources in the agricultural sector of Ukraine can be achieved through the use of biomass energy for the following purposes:

- installation of industrial boilers for burning wood in the state forestry and wood processing mills;
- installation of boilers for combustion of straw, and small heating systems in farms, district heating stations;
- use of biogas plants for cattle farms, pig farms, poultry farms and food industries;
- installation of micro-stations for production and use of biogas from landfills.

According to experts of the scientific and technical center "Biomass", Ukraine annually produces 52 million tons of manure, from which you can obtain 2,207 million m³ of biogas. Its energy potential is equal to 1.59 million tons of equivalent

fuel. The potential of landfill gas generated at large Ukrainian landfills is 288 million m³ (0.19 tons of equivalent fuel) [2].

Technology of methane fermentation of livestock waste and plant biomass allows us to get biogas with the methane content of the order of 60-70%. Therefore, it can be used to provide household fuel in non-gasified settlements and facilities, electricity production and, and replace fuel in the internal combustion engines. The benefits of using biogas include the following aspects:

- the production of biogas is based on renewable energy sources – biomass;
- a wide range of materials can be used for biogas production;
- the stability of electricity production level from biomass during the year;
- improvement of soil composition, regeneration and amelioration of soil fertility through fertilizers of organic nature obtained from fermented mass in biogas reactors.

To sum up, the problem of power supply of agricultural enterprises in Ukraine can be solved by using renewable energy. Moreover, these technologies are environmentally friendly, and can solve a lot of ecological problems. In my opinion, it is necessary to create an appropriate investment climate in the agricultural industry, providing clear legislative regulation and affordable credit resources. Furthermore, the government assistance programs for industrial companies which are willing to use renewable energy sources could sufficiently mitigate the country's dependence on traditional sources of energy.

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USAGE OF ALTERNATIVE ENERGY SOURCES AROUND THE WORLD

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Scientists warn about the possible exhaustion of known and available for use resources of oil and gas and other key resources: iron ore and copper, nickel, manganese, aluminum, chromium, etc. Of course, the full (or absolute) resource depletion is still far away (with the extension of prospecting proven reserves certain resources are even increased), but this is a little consolation.

Today, world's energy is based on non-renewable energy sources. The main advocates of energy are oil, gas and coal. Nearest energy development prospects are of finding energy of a better value and, above all, trying to reduce the share of liquid fuels. But we can say that mankind today has entered a transition period – from energy based to organic natural resources, which are limited to the almost inexhaustible energy basis.

Great expectations of the world rely on so-called alternative energy sources, which are environmentally friendly sources of energy.

Alternative source of energy is any energy source that is an alternative to fossil fuels. Such renewable sources include solar energy, wind, seas, rivers, biomass, earth heat and secondary energy resources that are permanently or periodically occur in the environment.

The increasing popularity in the world is gained by alternative energy sources. Their advantage is that they are renewable energy resources. These sources include:

- solar

- wind energy
- tidal energy
- geothermal energy
- biomass fuel

There is a solar pump station built in the USA (California). It has the economic indicators which are not inferior to other types of stations. In some countries there are created geothermal station – in the US (in the US Heyzers station has a capacity of 1mln. KWh), Russia, the Philippines and Italy; tidal – in France, Canada, Russia and China; wind - in the US and of Denmark [1].

The creation of biofuels is popular almost everywhere and even there are countries that have already switched to this type of fuel in some way (Finland needs are supplied by biofuels for 20%, and Germany is a leader in the EU in the use of biomass as a source of energy) [1]. Of course, we must understand that the complete replacement of the same amount of oil biofuels will take some time. In the meantime, it is necessary to conduct further research in this area. But we can already see the main benefits of biodiesel:

- there are much less toxic waste, carbon black (50%) and CO and CO₂ in the exhaust;
- it is cheaper than petroleum products;
- can be used in pure form or mixed with the usual fuel;
- a mixture is suitable for any diesel engine with little or no processing;
- it is much safer for the environment than conventional fuels (less toxic than common salt);
- readily biodegradable (90% in 3 weeks);
- prolongs the life of the engine;
- has no unpleasant smell.

In addition, a lot of people also consider nuclear power as an alternative energy source. Nuclear energy (as well as biofuel) is the most advanced type of energy. For example, Western Europe leads in its development.

We know that these power plants do not harm nature – their emissions are zero (as opposed to TPP which poison the atmosphere with millions of tons of toxic emissions). But this type of energy is not researched yet. The fact is that possibility of accidents is high and the problem of disposal of nuclear power plants is still not solved.

As a result, now our future is in our hands and depends on whether we can change the situation for the better.

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NANOTECHNOLOGY AND ENERGY

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Over the past few decades, the field of science and technology have been committed to developing new and improved types of energy technologies that are able to improve lives around the world. To take the next step forward compared to the current generation of scientists and engineers developing the energy use of nanotechnology. Nanotechnology, new fields in science, is any technology includes components smaller than 100 nanometers. For scale, a virus particle is about 100 nanometers wide.

The use of nanotechnology in energy production

Here are some interesting ways that are being explored using nanotechnology for more efficient and cost-effective energy.

Creating steam from sunlight. The researchers demonstrated that sunlight, concentrated on nanoparticles, can produce steam with high energy efficiency. "Solar steam device" intended for use in areas of developing countries without electricity applications such as water purification or disinfection of dental instruments. Another study group develops nanoparticles intended for use sunlight to generate steam for use in the management of power plants.

Production of highly efficient lamps. Nano-engineered polymer matrix used in the same style highly efficient lamps. New lamps have the advantage that bezoskolkovoho efficiency and double compact fluorescent light bulbs. Other researchers, using LED arrays developing the highest performance in nanoscale structures, called plasmon resonators.

Increasing electricity produced by windmills. Epoxy containing carbon nanotubes used to make windmill blades. Stronger weight and lower knives made possible through the use of nanotubes epoxy. The resulting long blades increase the amount of electricity generated by each mill.

Creating electricity from waste heat. The researchers used nanotubes to create letters thermocells, which generate electricity when the parties are cells at different temperatures. These nanotube sheets can be wrapped around hot pipes, such as the exhaust pipe of your car, to generate electricity from heat that is usually wasted.

Storing hydrogen for fuel cells operating machines. Researchers have produced graphene layers to increase the energy of hydrogen with graphene surface in the fuel tank, leading to an increase in hydrogen storage and therefore less dense fuel tank. Other researchers have shown that nanoparticles sodium borohydride can efficiently store hydrogen.

Reducing friction to reduce power consumption. Scientists have developed lubricants using inorganic fullerenes, which significantly reduced friction.

Reducing power losses in electric power cables. Researchers at Rice University are developing wires containing carbon nanotubes, which have much lower resistance than the wires currently used in electrical transmission network. Richard Smalley provided the use of nanotechnology to radically change the power distribution grid.

Concept Smalley these upgraded transmission wires that can transmit electricity thousands of miles with little loss of power, local storage capacity of electric power in the form of batteries in each building, which can store power for 24 hours of use.

Reducing the cost of solar cells. The company has developed nanotechnology solar cells that can be produced at much lower cost than conventional solar cells. See page Nanotechnology in the solar cells for details.

Increased productivity batteries. The Company is currently developing batteries using nanomaterials. One of these batteries will be as good as new after sitting on the shelf for decades. Even the battery can be recharged faster than conventional batteries. See page Nanotechnology in batteries for details.

Increase efficiency and reduce the cost of fuel cells. Nanotechnology is used to reduce the cost of catalysts used in fuel cells. These catalysts with hydrogen ions fuels like methanol. Nanotechnology is also used to improve the effectiveness of the membranes used in fuel cells to separate hydrogen ions by other gases such as oxygen. Check Nanotechnology in Fuel Cells page for details.

Reducing energy consumption

Reduced energy consumption can be achieved by improvement of insulation, using more efficient lighting systems or combustion, and the use of lighter and durable materials in the transport sector. Currently used light bulbs convert only about 5% of electricity to light. Nanotechnological approaches like quantum or atomic cell (QCAS) can lead to a strong reduction in energy consumption for lighting

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BENEFITS AND PROBLEMS OF USING LED SMART BULBS

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Intelligent lighting devices are very popular among modern consumers. While some developers represent the new LED devices others are engaged in the development of the other ones [4]. It is a rather competitive field.

Highly intelligent devices can transform an ordinary house into the most comfortable nest. Modern LED developers all the time create truly unusual things the functionality of which surpass all expectations [2].

The main advantages of using LED instead of ordinary incandescent bulbs are that they use less energy, generate less heat and run much longer. Also smart lighting is very convenient for many of today's LED. The user can easily install and configure the lighting in different rooms of his house as well as remotely control it or program to turn on and off at a certain time using phone or tablet. It can even function as an alarm clock which wakes you up in the morning [1].

But still there are some negative sides of using LED. The problem is that the LED lights are still significantly more expensive than the conventional incandescent bulbs. The user will save money by consuming less electricity and buying fewer replacement bulbs, but how long will it take to return on? The answer to this question will depend on how much the user consumes electricity and what kind of bulbs are used to illuminate the house. Consumer will be surprised how much money he will save if he starts using the LED devices instead of the ordinary bulbs [1].

There are also cheaper LEDs, but light, brightness and illumination of them are of the less quality. To ensure the quality while choosing a LED, you should pay attention to the famous brands as well as models with a guarantee. Do not forget that no one is able to ensure that the LED will operate successfully on a specific dimmer or transformer [1].

To select a suitable LED you should pay attention to the fact that the colour temperature should be in the range of 2700 to 3000 K. In this range the colour of light will be very pleasant to look at. The higher the temperature, the cooler is the shade of light. Conversely, the lower the temperature is, the warmer the shade will be. The brightness of the LED should be larger than the previous brightness of the bulb. It is quite important to take into account the beam angle which determines the spread of light. The illuminator angle should be about 40 degrees and for incandescent bulbs [1].

Modern smart lamps are still not available for the majority of the consumers in the CIS. In addition, they are unadapted for our reality. The reason is the frequent outages in electric grids. This leads to the breakage of expensive smart LED devices [3].

LED bulbs nearly won the fight with incandescent bulbs and fluorescent light bulbs. The energy savings and the absence of toxic materials in LED help to protect the environment. They are also very economical so the use enables the user to save money.

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ENGINEERING PERSPECTIVE ON THE CONCEPT OF HEAT PUMP

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One of the devices operating on alternative energy is the heat pump. The purpose of this paper is to consider what the heat pump actually is, how it can contribute to heat supply industry, and where it is used at present.

The heat pump is a thermodynamic plant in which heat of low potential energy sources is transmitted to the consumer at a higher temperature, and mechanical energy is spent on this process [1; 7]. In other words, the operating principle lies in transferring heat from one place to another. Using heat pumps in hot water supply systems of buildings is an important area of research. An example of the building which uses heat pumps for hot water supply system is the multi-apartment building constructed in Moscow in Nikulino-2. In this building it is the earth heat and heat of industrial ventilation air that are used as a source of low potential thermal energy.

The source of low potential heat energy can be heat, both of natural and artificial origin. Among the natural sources of low potential heat one finds heat from the ground, underground water, outside and exhaust air. The artificial sources of low

potential heat include industrial ventilation air, sewerage wastewater, industrial wastes, heat of technological processes, etc [4; 5].

One of the benefits of this technology is actually the opportunity of selecting the most effective heat pump design, depending upon the resources available. However, one should know that ground seems to be the most common source of heat, while underground water is a practicable alternative if heating load is about 10 kW, and air can be adopted if it is up to 30 kW only. Ground-source heat pumps have already found wide application in Germany and some other European countries, achieving the thermal capacity of 5-70 kW [8].

Earlier the heat pump was used mostly for air-conditioning. The system was able to provide heating capacity that could more or less effectively meet the needs of warming the houses in the winter. However, the characteristics of this equipment are rapidly changing. Today, in many European countries heat pumps are used in heating and hot water supply systems. This situation is associated with the search for solutions to environmental problems, and the necessity of using alternative energy sources, e.g. solar power, instead of fossil fuels. In fact, for the mass consumer one of the most preferred options of alternative energy sources is the use of low potential heat via heat pumps [2; 3].

Thus, there is a great potential for harnessing natural sources of energy around us, and the heat pump is the most successful way of realization of this potential.

At present the basic type of heat pump equipment is turbo-compressor heat pumps, but absorption, electrochemical and thermoelectric heat pumps are applied as well. Although the term "heat pump" is a newly coined one, the mechanism itself acts like an ordinary refrigerating machine, consuming energy to implement a thermodynamic cycle [7]. The coefficient of performance of a heat pump, which represents the ratio of heat productivity to electricity consumption, depends on the temperature in the condenser and evaporator, which serve for heat-rejecting and heat-absorbing processes respectively. In practice, the temperature of heat supplied by heat pumps can vary from 35°C to 62°C, which allows us to use almost any kind of heating system, the economy of energy resources being 70%. As a matter of fact, the

highly industrialized countries produce a wide range of turbo-compressor heat pumps having the capacity of 5 to 1,000 kW. At present 13.5 million heat pumps are reported to be in operation in the USA, and so far 10 million systems have been installed in the PRC [6].

There are different kinds of heat pump classification. Most usable approach is to divide heat pumps by the operating functions into two main classes:

- heat pumps intended for heating and/or hot water purposes, which provide comfortable indoor temperatures and/or supply sanitary hot water;
- integrated systems based on heat pumps, which provide space heating, cooling, hot water, and sometimes even air cleaning.

In the latter case water can be heated by removal of steam superheat, supplied from the compressor, or by a combined use of waste-gas heat and recovered heat from the condenser [4].

In conclusion, the heat pump engineering is a very promising area of alternative energy industry. The heat pump is ecologically friendly, because it runs without fuel combustion, and produces no harmful emissions. Today, the problem of high costs for heating and hot water supply during long and severe winters is rather relevant in our country. Using the heat produced by traditional energy sources obviously requires a lot of financial costs. On the other hand, using 75% of heat coming from the environment, and only 25% of the electric power, you can get 100% of energy you need for heating purposes. Moreover, this will save not only your money, but also the nature. Thus, I believe that heat pumps are the most advantageous source of alternative energy we could use in the near future to solve the problem of increased costs for heating in Ukraine.

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ERGONOMETRIC LANTERNS WITH SUN BATTERIES

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Power cut occurs very often in the suburb, and in the settlement of newly constructed cottages it may take a long time until all the communications will be comfortable enough for high-standard living conditions. Therefore, it is common to

see such areas plunged into darkness, and one has to walk there lighting the way with a pocket flashlight. Solar batteries, which can be installed anywhere you need, can completely solve this problem. The paper considers the advantages of installing solar lanterns outside the houses.

The source of light in this sun-powered device is a light-emitting-diode lamp, and the source of supply is a solar battery, which transforms energy of the sun into electric energy. The accumulator is charged in the daytime, and at twilights it supplies the lamp with power, and lights up the territory. If the day was sunny, the charging is enough for the lantern to operate for 10 hours, and when the weather is gloomy the time of operation is almost twice shorter.

The only expenses involved are buying the lamps, as you do not have to pay for the electric power. Also, there is no need for cable installation, so you have no problems purchasing the necessary materials, digging a cable ditch, and calling out an electrician. Installation of the lantern is very simple. It is just put into the ground with the pointed tip down, and can be easily removed, so you can do experimenting with decorative lighting whenever required.

Maintenance consists only in cleaning the lamp with a soft tissue. Bulbs themselves do not need replacing. Being in the open air all the time, the lantern still does not lose the original appearance and functional qualities.

Solar lanterns create an original landscape design. One can choose the models in the shape of flowers, butterflies, dwarfs, and animals for the flowerbeds and lawns. In the daytime lanterns can be practically unnoticeable, and in the evening they become the decoration of the landscape.

The body of the lamps is made of plastic, metal and wood. Special treatment of the material allows it to save original properties for a long time. Metal body is treated with a powdery paint, wood is covered with a fluid against wet rot, crack, and rodents. Plastic does not require any additional treatment.

By the type of accumulators solar lanterns can be nickel-cadmium, and nickel-metal-hydride. These models are expensive, but they are actually more economically viable because of a long useful life.

In a word, solar lantern is a real treasure for people who would like to have economical illumination. Advantages of using solar batteries for lighting are obvious.

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COLLECTING ENERGY FROM THE RADIO FREQUENCY SIGNALS

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Alternative energy sources are those that offer an alternative to energy of fossil fuels, namely the energy of the sun, wind, seas, biomass, and secondary energy resources. This paper discusses the newly developed system called Freevolt, which is able to collect energy from the wireless networks, such as Wi-Fi and 2G-4G, and digital television networks.

Until recently, the idea of obtaining energy from the air has been considered as a fantasy. But today there have been invented ways of making it possible for us to power low-power electrical devices by means of different types of waves, which are literally flying around in the air [1].

Freevolt was developed by Drayson Technologies Ltd, an electronic hardware & software company based in London, and introduced by the company’s chairman and former UK science minister Lord Paul Drayson on September 30, 2015 [2]. The device is a multi-layer antenna being capable of absorbing the energy of several radio

frequencies at the same time, and a rectifier, which converts AC power to DC power. Freevolt requires no additional infrastructure, and does not remove the charge from other devices in operation as it absorbs only the energy that is not being used [1; 4].

It should be emphasized that the amount of energy collected by this technology depends on the dimensions of antenna with a built-in rectifier, and the areal density of wireless devices. For example, Freevolt is able to give off energy of up to 100mkW so that to power devices as small as a credit card. The software developers claim that by combining several antennas into a single array you can obtain up to 3 MW [2].

The first commercial application of Freevolt technology is the personal air quality sensor CleanSpace Tag. It allows collecting and analyzing data from air quality sensors, and thus building a highly efficient network of air pollution control, which can be installed in a variety of house monitoring and smart home systems [5].

The potential of Freevolt technology cannot be overestimated. In the nearest future it is planned to release a kit of parts which will enable design engineers to integrate this technology into electronic devices, which are sure to be a success. In fact, by 2020 the number of these devices is estimated to reach 50 billion items in the world market [3].

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THE ADVANTAGES OF SMART GRIDS APPLICATION

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The traditional grid is based on centralized power plants that supply electricity to end users through a conventional unidirectional transmission and distribution system. But times are changing; the networks of current infrastructure cannot meet the growing demands for electricity, and consumers are interested in a reliable energy supply, renewable sources being the most preferred option. In fact, the world needs an intelligent energy system that is able to receive all types of energy from all sources available – both centralized and distributed – and to ensure a reliable supply of power to different types of consumers.

The concept of smart grid measures up to this description of power system. The smart grid can detect and automatically respond to damages or changes to the balance between power supply and power consumption; it then restores the balance, and maintains stability, required by both individual consumer’s and state regulating standards.

In this paper we will consider the advantages of using smart grids in terms of power generation, efficiency, and allocation.

First of all, the key factor of development of smart grids is to partially shift from centralized to distributed power generation, and to harness renewable energy. In addition to meeting the needs for solving the problems of environment protection, these changes will have a great impact on network stability (Table 1).

Table 1. Electrical networks vs. smart grids.

<i>Traditional Electrical Networks</i>	<i>Smart Grids</i>
<ul style="list-style-type: none"> - generation of electric power is centralized; - energy flow is unidirectional; - power generation depends on the load; - network is operated on the basis of outdated data; - the availability of network for new consumers is limited. 	<ul style="list-style-type: none"> - power generation is centralized, and distributed - energy flow is multidirectional; - power supply depends on generation; - operation of network is based on the data received from real-time transmission; - consumers are becoming players on the power market; - there is a steady generation of electricity from renewable sources of energy.

Most of the energy networks around the world have been already equipped with the systems of management of energy transmission SCADA/EMS (Energy Management System), substation automation systems, interfaces grid connection and flexible transmission systems AC FACTS (Flexible AC Transmission System). Some networks are even provided with monitoring systems in conjunction with phase-shifting transformers to detect failures in lines, and give a rapid response.

Furthermore, the intelligent network will change our perception of distribution of electricity, and it is in this area that there will be major changes. Even though electricity is more distributed, and more energy comes from renewable sources, distribution network should be more capable of managing power quality fluctuations, changes in consumer demand, and control of energy flow. Operation of such a complex system depends on reliable communication systems and systems of management. These systems provide energy distribution companies with real-time information on the efficiency of network elements, energy flow, and consumer demand. They enable intellectual automated devices to respond to imbalances of the system, and improve equipment management thanks to the implementation of diagnostic and operative programs, which respond to emergencies. The use of information systems that cover the operation of the whole power company, and

systems of customer relationship management (CRM) will enhance the work of network operators, and help them offer specialized service, and thus build better relationships with consumers. The introduction of intelligent monitoring and increase in the number of automated substations and power lines in distribution networks will optimize the performance, improve network reliability, availability, safety, and energy efficiency.

In general, the advantages of smart grids indicate that the evolution of electric power systems by using the most advanced and modern computer technology leads to intelligent automation and better optimization of the networks. This will help power companies meet various regulatory requirements and customer needs, providing a sustainable power supply from conventional and renewable sources of energy. They could optimize "hot reserves" of power due to the maximum use of renewable energy, increase the stability and reliability of the supply system, and reduce transmission losses. Distribution networks will become not only a means of supplying power to end users, but also a source of energy. End users will be able to choose the energy supplier. Consumers can also benefit from efficient demand management, and in future they will be able to optimize their energy consumption by using private generating capacity, and building automation systems.

In conclusion, implementation of smart grids is not going to be a revolution. This will be a gradual transformation of the power system that have served us for years into a more intelligent, efficient and environmentally friendly network that will satisfy our future needs for energy supply.

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THE SIGNIFICANCE OF NUCLEAR POWER IN UKRAINE

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Nuclear power is the use of nuclear reactions that release nuclear energy to generate heat that is used in steam turbines to produce electricity for a nuclear power station. The term includes nuclear fission, nuclear decay and nuclear fusion[4]. Presently, the nuclear fission of elements in the actinide series of the periodic table produce the vast majority of nuclear energy [4].

There is a renewed global interest in nuclear power generation all around the world and also in Ukraine. This source of energy offers important advantages compared to other sources of electricity[2 с.4890]. Ukraine has a powerful industrial complex, which needs electricity as an integral part of its development. It is impossible for industrial complex to operate without electricity. It should be noted that to overcome the crisis it is necessary to maintain the energy sector by looking for resources of energy. The building of new plants affects all projects of power plants [2].We can not ignore these problems because the future of Ukraine depends onenergy [3 с.1220].

The basis of the country's electricity is the United Energy Systems of Ukraine (UESU) which provide consumers with centralized electricity[1]. UESU interact with theenergy systems of neighboring countries and provideboth export and import of electricity [4].

An urgent issue now is the nuclear power plants [1]. Because the majority of thermal power plants are idle for lack of fuel [2]. Centralized UESU include 14 heat power plants, 8 hydroelectro and 4 nuclear power plants. These plants are the part of

the National Nuclear Energy Generating Company of Ukraine "Energoatom". As a result of Chernobyl decommissioning (December 2000) the number of the nuclear power plants was reduced to four [4].

There are two main nuclear processes that provide energy production, separation and merger [4]. The Ukraine reserves of uranium and zirconium should provide enough nuclear fuel in the short and medium term even if Ukraine nuclear reactors will work with single main cycles [3]. It will provide a disposal of spent fuel. The problem with the supply of fuel for nuclear power may appear until 2030 in case of the development and increased capacity of nuclear energy in Ukraine [2].

To sum it up, nuclear energy is one of the most promising sources of energy in our time so consideration of this problem in Ukraine is very important. But we must remember that nuclear energy is inextricably linked to the energy use.

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ADVANTAGES AND DISADVANTAGES OF LAMPS AS LIGHT RESOURCES

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We know that even natural sunlight overdose can cause unpleasant effects including excessive ultraviolet radiation which can result in skin diseases, eye injury. However, the manufacturers of compact fluorescent lamps produce a series of compact (lamps that have a small part of the controlled ultraviolet light in the spectrum).

Controlled optical radiation has beneficial physiological and psychological effects on the endocrine, autonomic and the nervous system of humans and the whole body [6]. The use of the controlled UV-radiation (ultraviolet) fluorescent lamps solves the problem of: «light hunger» for city residents who spend up to 80% of the time indoors. Thus, the fluorescent type Biolux (produced by OSRAM Company) has a range of radiation close to the sun radiation and saturated dose of near ultraviolet. There is also a special fluorescent type CLEO (Philips Company) intended for making «solar» bath in a room for cosmetic purposes. [1;2].

The most common cause of failure of the conventional light bulbs is blowing the filament. Structure and working principle of fluorescent lamps are completely different. An average run life of such lamp is 6-15 times higher than of incandescent lamps and range from 6,000 to 13,000 hours. The manufacturers of expensive energy saving lamps guarantee that their products will work 12000-15000 hours. But energy-saving lamps need to be replaced less frequently. It is convenient to use them in lamps at offices and houses/ flats with high ceilings [1;3;5].

In case of less power consumption, energy saving lamps also emit less heat than incandescent light lamps (IL). Therefore, they can be safely used in lamps and chandeliers. The advantage of compact lamps is that they are small and resistant to

mechanical damages. The luminous efficiency of energy saving lamps is about 5 times higher than of conventional [1;3].

IL is the most unpretentious of all light sources. Ambient temperature does not have any influence on ILs. Even the European Union attempting to abandon the ILs made an exception for such applications. IL is able to shine without problems in the cold and unheated areas [2;4].

Apart from visible light (400-700 nm) any lamp emits infrared radiation, ultraviolet and also electromagnetic radiation. Infrared radiation results in the heating of a lamp [4;6].

CFLs are also characterized by emitting infrared radiation, ultraviolet and electromagnetic radiation. UV-radiation harmful effects are well known: the destruction of collagen and elastin, accelerated aging, the probability of growth of cancer cells [1;2].

Consumers should know that the fluorescent tube is filled with mercury vapor. Under the influence of electricity mercury vapor starts to generate ultraviolet light that turns phosphor coated on the inner surface of the bulb. However, in working condition they cause no harm to health and the environment.

If we compare mercury in energy-saving lamps it will be between 2 and 5 mg which is 1000 times less than in a medical thermometer (mercury thermometer contains 2g). This number bears to cause no direct threat to human health but increases human negative impact on the environment and leads to pollution of soil, groundwater and air [1-3;5]. It is a well known fact that the precise use of any thermometer can not be harmful or dangerous. A similar situation is with CFLs. In case of a lamp failure one must necessarily open all the windows and arrange the intensive ventilation. Leading manufacturers of energy saving lamps have already announced plans to reduce mercury in their products.

As a conclusion, we must mention that the best option for illumination – is a hybrid combining all the types of light bulbs. The issue of energy security is a national problem and every citizen should be conscientious use and conservation of resources of the country.

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IS SMALL-SCALE NUCLEAR FUSION A NEW ENERGY SOURCE?

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Today nuclear power generation provides over 11% of the world's electricity, but people are still afraid of atomic energy because of health risks and environmental costs it may bring along [1]. The possibility of accidents, like at Fukushima Daiichi (2011), Chernobyl (1986) and Three Mile Island (1979), the hazard of nuclear terrorism, nuclear proliferation, the damaging effects of the total nuclear cycle, from

uranium production to nuclear waste, all indicate that the dangers of nuclear energy can outweigh the benefits.

However, the science does not stand still, and small-scale nuclear fusion may become a new energy source, allowing generating clean heat and electricity at a low-cost from fuels found in water. Fusion power, which is able to drive the sun, seems to be a possible solution to power shortage problems. This nuclear fuel is available in sea water, and there is hardly any waste of fusion reaction except for the walls of the containment vessel becoming a little radioactive. If the appropriate methodology is applied, the risk of accidents is expected to be low. What is more, fusion is likely to be suitable for both heat and electricity generation. In fact, heat and electricity generators of 20 times higher energy gain can be devised in the near future [4].

In general, nuclear fusion is known to be a process in which atomic nuclei are combined to release energy. It is a high-energy reaction. Due to the low forced energy of the minute atomic nuclei, energy is released by linking a couple of small nuclei with a heavier one. As scientists say, the projects conducted in the University of Gothenburg and University of Iceland could be a stepping stone for fusion energy to be developed at low cost from water by small-scale power stations in the next few years.

The modern fusion process can occur in quite small laser-fired fusion reactors fueled by deuterium, that is heavy hydrogen, which has already been demonstrated to provide more energy than required to start the process. The good thing is that heavy hydrogen is found in large amounts in usual water and is easy to extract. Also, there is no unsafe procedure of processing radioactive tritium, which would be necessary to operate hazardous large-scale fusion reactors with a magnetic enclosure. Another great advantage of this reaction is that it briskly produces heavy electrons that are charged and may produce electrical energy immediately. In fact, the energy in neutrons accumulated by other types of nuclear fusion is hard to handle as the neutrons are not charged. These high-energy neutrons can cause damage to living matter while the fast heavy electrons are much less dangerous.

In contrast to fission reactors, nuclear fusion reactors are quite safe, and in case of an accident there will be no radioactive emissions or injury of the maintenance staff. No neutrons are produced, which should oversimplify reactor design and operation excessively, making the entire process safer than many other approaches to fusion. The fact is that fusion reaction requires extremely precise and controlled parameters of temperature, pressure, and magnetic field, so if the reactor is damaged or loses control it would immediately stop heat generation [2].

This new approach to fusion enables producing electricity directly from the fusion products without having the troubles associated with neutron production. To understand how important it is we should remind ourselves of the severe accidents in the 50-year history of civil nuclear power generation, which were briefly mentioned above. Even though nuclear power plants are designed to be safe, none of these are entirely risk-free when being in operation. Small-scale nuclear fusion, on the other hand, may be safe enough to avoid all the accidents possible.

It is worth saying that today some environmentalists do not like current nuclear technology because the waste is to be stored underground for hundreds of thousands of years. Fusion technology does not have this drawback, although may have its own set of problems. For example, opponents of fusion technology consider it to be a large utility money pit, which deprives individuals of the freedom to produce and control their own energy. They feel it involves too much money and “intellectual capital”, which should be spent on development of solar, wind, and battery storage. As a matter of fact, solar, wind, and battery storage are improving in efficiency and decreasing in cost by about 10% per year [5]. It is reasonable to believe that when fusion gets commercially viable in about 15-30 years it will be accepted as well.

To sum up, the recent research has shown that much smaller, cleaner, safer and more easy-to-operate fusion reactors can be constructed [3]. The very next step in this field would be to design a generator to produce instant electrical energy.

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ALTERNATIVE SOURCES OF ENERGY

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Nowadays discovering of alternative sources of energy is an extremely urgent question. People keep on using fossil fuels. But we cannot do it forever, one day they will eventually run out. Moreover, using of fossil fuels is damaging our environment.

Alternative energy embraces such objects that do not use fossil fuel. They are widely available and environmentally safely. They produce little or almost no pollution. There are different kinds of alternative sources of energy.

Firstly, it is necessary to refer to solar energy. Sun was the first energy source in the world. Humans used it much earlier before they even learnt how to light a fire. Every living organism is dependent on solar energy accumulated in plants, aquatic life and the animals. Solar energy can be used for heating, cooling or electrical power generation. Electricity can be produced by collecting sunlight and direct conversion. For doing it people use large flat panels made up of many individual solar cells, which are called solar panels. Another way of converting solar energy uses mirrors for collecting sun rays on the surface of steam generator, and then steam rotates the turbine. In fact, scientists distinguish between two kinds of energy: the active solar energy and the passive solar energy. The first one is characterized by using electrical and mechanical technology such as collection panels in capturing, converting and storing of energy for future application. When we are talking about second kind of energy, first of all we must say that it basically uses duration, position and sun's rays intensity. The advantage of this way is in heating a particular area and inducing airflow from an area to the next. Solar energy does not create any pollution or harmful substances and is widely used throughout the world. Sun will continue to emit its radiation all the years long, consequently, this source of energy is absolutely constant and renewable.

Secondly, it is important to mention wind energy. People have taken advantage of wind power for thousands of years. The first known use was about 5000 BC when ancient Egyptians used sails to navigate the Nile River. Wind energy was also used for grinding grain and watering fields. Today, everyone is undoubtedly realizing that wind power becomes one of the most promising new energy sources that can serve as one of the possible alternative to fossil fuel-generated electricity. Wind power is produced by using wind generators to harness the kinetic energy of wind. It is gaining worldwide popularity, although it still provides less than one percent of total energy consumption.

Afterwards, we should not forget about biomass energy. People started using it in ancient by burning wood, peat and coal for heating their habitats and cooking food. Nowadays, this is the process by which an alternative energy is produced through conversion of biological materials and garbage into combustible gas and diesel fuel that can be used as energy sources for heating, power generation and have transportable form.

Next, needless to say about the advantages of hydro power. Hydro power is generated by using hydraulic turbines which rotates electricity generators to extract energy from moving water. People used energy of moving water for ages. In ancient times it was used in mills and forges. Also they used the power of rivers for agriculture and wheat grinding. Nowadays, rivers and streams are re-directed through hydro generators to produce energy.

Furthermore, the issue of hydrogen energy. Hydrogen is the most abundant element available on earth. It is one of two natural elements that combine to make water. Hydrogen has tremendous potential and can be used to power up homes, vehicles and even space rockets, while it is true to say that it takes a lot of energy to separate hydrogen from other elements and therefore it proves to be quite expensive to extract it.

Finally, I need to say that there a lot of different sources of alternative energy. Some of them are already well developed, some still require further investigations. In my opinion, everyone must think of our future. Everything depends only on us. Alternative energy is not the cheapest one, but probably it is more important to save the environment for our children?

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TECHNOLOGICAL ADVANCES IN ELECTRIC CAR DESIGN

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The electric car is a vehicle driven by one or more electric motors. At present electric cars are becoming more and more popular in different corners of the globe because of a positive effect they have on the environment, producing no carbon dioxide emissions.

In fact, the main benefits of the electric car include the facts it does not give off any harmful emissions, is of simple construction and control, and is characterized by high reliability and durability of the vehicle (up to 20-25 years). Moreover, it can be charged from household electrical network, although it takes 5-10 times longer than from a special high-voltage charging device. The electric car is the only vehicle that runs on the energy that is generated at conventional power plants, and thus is cheaper than petroleum or hydrogen fuels. They say that using electric vehicles widely could also help solve the problem of "peak load" by recharging the batteries at night.

Instead of a fuel tank the design of electric car features a battery, consisting of two hundred cells, and an electric motor. There is no need for having a gearbox as the motor shaft can rotate with the same speed as the wheels.

The main electrical car components are:

- an electric motor,
- a controller,
- rechargeable batteries.

The electric car is driven by an electric motor, which is powered by traction battery, consisting of a set of batteries. An inverter converts the direct current of the battery into alternating current. The controller is responsible for motor control and driving motion. It processes the pulses coming from the gas pedal's potentiometer, which say how much power is required, and adjusts the power of the motor accordingly. When the car stops, the controller does not supply current to the motor, but during the movement, when the gas pedal is pressed, the controller supplies the electric current to the electric motor. Electric motors are mounted on the rear wheels and consist of a rotor and stator. There are a few coils in the stator, supplied with alternating current, so that a magnetic field is set up, which spins the rotor.

An electric car is known to have a battery charging system. This charging system allows the vehicle to be powered in almost any user-friendly place where there is an electric outlet. The battery charger can be a separate part of the vehicle, or be integrated into the electric car itself.

Some AC motors during deceleration can operate in the regenerative mode, when electric power is generated and stored in the batteries, being later used to drive the vehicle (regenerative braking function). In fact, the regenerative braking system can increase the range of an electric vehicle mileage up to 15%.

Very soon electric cars will be able to use an inductive charging, meaning that to charge your car you will need just to leave it in a specific parking lot. The charging device under development will look like a floor mat. When parking, the driver has to stop the car so that the mat is between the two rear wheels of the electric car. On-board instruments and sensors will help achieve the exact positioning of the car. The operating principle of the car charger is just as in other similar devices intended for consumer electronics products. A special coil located in the mat produces a magnetic field which in its turn induces an electric current in the other coil, located in the car. This current charges the internal battery. However, this method of charging involves quite large power losses (10-20%).

Meanwhile, there are new developments of electric cars, such as solar car designs. The latest models of solar car are equipped with light brushless DC motors having the efficiency of up to 98 percent, in which magnets from rare-earth metals are used. The system of motor control is provided with highly efficient microprocessors, which greatly reduces power losses. The other improvements of components of electric cars can be found in solar car wheels, whose tyres have the minimal coefficient of rolling resistance. What is interesting to know, the inventions made in the solar car design are also used to increase the comfort of conventional cars. For example, solar cells may serve as the source of power for radio and television devices, navigators, air-conditioners, and charge the battery during parking.

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ALTERNATIVE ENERGY SOURCES

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It is commonly known that most energy sources we use are exhaustible, and the demand for them is growing. It is connected with technical progress and may result in the global energy problem in the near future. That is the reason why the scientists are increasingly interested in alternative sources of energy. Hydropower, solar power and wind energy are the most popular, though it is not a complete list of promising sources of energy.

It should be mentioned that one of the most promising sources of energy is the energy generated by the human body. For instance, the average walking human body produces 40 watts of mechanical energy in the form of heat, and a standard phone charges about 20-50 watts in accordance to its passport. That is, the energy produced by our body is sufficient to charge a standard energy-intensive phone. We do small calculations and take into account the following facts: a) the phones are mainly recharged every day, rounding to 300 days; b) nearly 90% of Ukrainians have got mobile phones. It turns out that only Ukrainians charging their gadgets spend 0, 5 billion kWh of electric energy for the year, moreover, this energy could be saved.

During the year the entire population of the earth is able to generate 102 billion kWh of energy, the number is more than the number of energy produced by Ukraine. This source of energy may not be a global solution to the energy problem, and it can not be the main method of producing electricity at a national scale, but it has the right to exist as an additional one. What is more, it can also encourage people to lead an active lifestyle, and instead of playing with the phone, while it is being charged, they will have to walk to do it.

A bicycle can be considered a similar source of energy. For example, a cyclist is able to produce energy at a rate of 35 watts during an hour. Thus, this way of producing energy is worth attention in the countries where bikes are gaining their popularity. For instance, one long six- to eight-hour cycling can produce a weekly charge for the phone, but energy-intensive accumulator is likely to be charged instead of the phone itself.

This kind of generating energy is not particularly promising in Ukraine; since bicycles are slightly used as there are no roads and parking areas, are not equipped. However, for such countries as Norway (~ 60.7%), Germany (~75.8%), Denmark (~ 80.1%), the Netherlands (~ 99.1%), where bicycles are used as the main means of transport, there is sense to use this energy potentially. However, the use of bicycles in our country would contribute to improving the environment, the physical condition of the population and it may bring us closer to solving the energy problem.

Thus, it is necessary to think about the loss of precious energy and constant burning of oil and gas in order to charge a simple gadget. It is time we used the energy of our bodies, and changed from usual transport to bicycles, saving the planet and following progress.

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ADVANTAGES OF USING THE WILLOW FAMILY IN ALTERNATIVE ENERGY

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Energy security is extremely acute problem for Ukraine as it is one of the decisive factors of international competitiveness. In a sharp reduction in stocks of conventional fuels search for new effective renewable and carbon-neutral energy sources is urgent. One of the most promising sources of renewable energy is biomass woody plants that effectively accumulate solar energy during photosynthesis.

It is advisable to create bioenergy plantations on unproductive and degraded lands that are unsuitable for growing agricultural products. According to the Law of Ukraine "On State Program of national ecological network of Ukraine for 2000-2015" area of degraded and contaminated land is about 2.3 million hectare. Years of experience of foresters from Sweden, Norway, Finland, UK, Germany and the United States suggests that for the creation of plantations promising woody plants are willows and poplars, which are differed by intense growth and have a high ability to coppice. In Ukraine, these include *Salix viminalis*, a hybrid of *Populus nigra* × *Populus balsamifera*, which are characterized by high productivity. However, the use of traditional methods of vegetative propagation of these plants can't provide most of the significant number of aboveground mass in the first year of growth, due to the long period of formation of the root system. Therefore, a method of culture of

isolated cells, tissues and organs of plants, which now is the main component of modern biotechnology cloning in vitro in forestry is of considerable interest. In comparison with traditional methods of reproduction it has a number of advantages. This method gives a possibility to realize completely the potential of plant organism renewal. Theoretical index of reproduction can reach a figure of one million plants annually from one meristem.

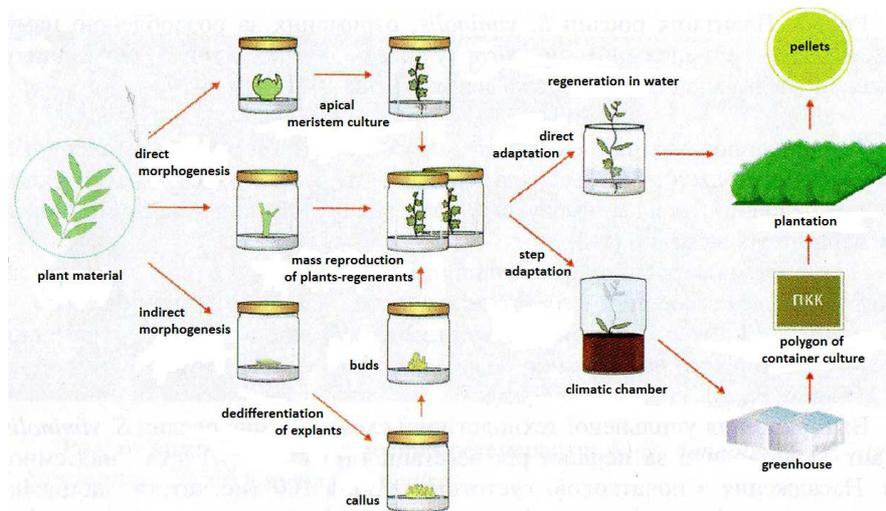


Fig. 1. The general scheme of mass reproduction of plants in vitro
Populus nigra × *Populus balsamifera*

The heat of combustion of raw materials and pellets plant

Samples	Higher calorific value of the sample kJ*kg ⁻¹	Net calorific value of the sample kJ*kg ⁻¹
Raw	9697±80	8500±80
Pellets	19900±80	18100±80

Consequently, pellets *Salix viminalis* have a sufficiently high calorific value exceeding 2.1 times the figure of raw materials. Cost of adapted to the conditions of open ground plants-regenerants is 72 Ukrainian coins. The feature of using willow as a fuel lies in the fact that this is a rapidly renewable and environmentally friendly resource. So, it is profitable to create bioenergetical plantations and process raw materials into the solid biofuel.

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ALTERNATIVE SOURCES OF ENERGY

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From the moment we wake up in the morning or at night, our life depends on electricity. Energy sources take many forms, e.g. fossil energy and renewable sources.

All types of fossil energy have disadvantages: atmospheric pollutants, greenhouse gases and fossils have limited supply. Nuclear reactors are expensive to run. Nuclear waste is highly toxic and needs to be safely stored for many years and their storage is extremely expensive. That's why we need to improve renewable sources of energy for example: wind, solar, geothermal and other.

Biomass energy generated from decay of plant or animal waste is one of the alternatives. After treatment with chemicals it can be used as a fuel in diesel engines. It is cheap and readily available source of energy. Biomass is a long-term sustainable energy source.

Wind turbines (modern windmills) turn wind energy into electricity. The term *wind energy* describes the process in which the wind is used to generate mechanical power into electricity. Implementation of wind farms can be expensive. Some local people object to on-shore wind farms, arguing that it spoils the countryside.

In volcanic regions it is possible to use the natural heat of the earth. Cold water is pumped underground and comes out as steam. Steam can be used for heating or to power turbines generating electricity, potentially infinite energy supply. It is used successfully in some countries, such as New Zealand and Iceland. It can be expensive to set up and it can work only in areas of volcanic activity.

One of the solutions to improve the situation is solar energy. Solar panels is one of the easiest ways to get energy. Sunlight generates energy on the surface of solar panels. A solar module can produce a limited amount of power that's why most installations contain many panels (minimum 5). Energy from sunlight is captured in solar panels and converted into electricity. It is a potentially infinite energy supply, but usage of solar panels can be costly. Efficiency depends on the construction of solar panels. Several companies try to introduce smart panels. For example: on telephone, computers or even backpacks. Some of them use power optimizers that compensate effect of shadow. In the nearest future some companies will introduce solar panels on roads. These solar roads will support the force of vehicle driving on it. These roads will have special lights visible at night. The solar road will have heat radiating from it. That's why there will be fewer problems in cold weather.

The main problem of renewable resources is to find a good place to construct a power plant. Spacious area is needed for wind turbines, volcanic activity – for geothermal, etc. To sum up, renewable energy sources are our future. Only this can help us to improve our planet.

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ARTIFICIAL LIGHTING

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Artificial light was developed from simple fire to modern lamps. There is a variety of such lamps. The first type is discharge lamp. It is the most economical light source because it combines high luminous efficacy and long life. It can be of 3 types: low pressure, high, high-intensity. The best-known are:

1. Incandescent lamps.

Their lifetime is nearly 1000 hours. Such lamps work well on direct current or either alternating current and have a low price. Incandescent lamps can be used in household and commercial lighting, for portable lighting and decorative lighting [1]. Also some kinds of incandescent bulbs can be used for the heat generation such as industrial heating, incubators infrared heating and drying processes. World production of incandescent lamps is only 5.13 billion units. It is 39.6% of all light sources.

2. Compact fluorescent lamps (CFLs).

Such kind of lamps was created as efficient replacement for previous variant [2]. So if we compare these two kinds of lightning we can distinguish such advantages: lower power consumption and longer lifetime. There are also some disadvantages: the price and recycling. World production of compact fluorescent lamps is 6.02 billion which is 46.5% of lightning industry.

3. Fluorescent tubes.

Fluorescent lamps are more expensive than incandescent lamps but the lower energy cost offsets this spending. These lamps are good for office use and commercial buildings.

Another kind of artificial lightning is a Light Emitting Diode (LED). The Light Emitting Diodes can be used almost everywhere. For example, for automotive headlamps, aviation lighting, traffic signals, general lighting, camera flashes. It has such a variety of applications because of such advantages as efficiency, size, lifetime, color, cool light, warmup time and shock resistance [2]. But all great inventions have disadvantages and LED is not an exception. There are such disadvantages as high initial price, temperature dependence, electrical polarity and efficiency droop [2]. The efficiency of LEDs grows together with the increasing of production. Bigger efficiency means lower costs and higher savings.

To sum it up, if we compare all these types we can say that incandescent lamps are cheaper than others. CFL is the best variant for home using and fluorescent tubes – for offices. LEDs are very money-consuming, efficient and it can be the best solution for outdoor lightning. Incandescent and compact fluorescent lamps are more useful in everyday life among other modern types of light sources.

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THE IMPACT OF SCIENCE AND TECHNOLOGY ON SOCIETY

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Scientific and technical progress - an integral and important part of modern life. Technique takes more time and space develops like living organisms, except that all these processes are controlled by man in the art. The main problem that developers set themselves - is to improve the living standards, the elimination of human involvement in routine, repetitive, monotonous work. However, the reality is not so good, do not all go to the benefit of achieving. There are negative aspects of progress which oblige society to reflect on the problems befuddling, alienation, and depersonalization of man. Consider some of the problems identified.

1. People have forgotten how to think.

Thinking - that small, but significant part of that distinguishes humans from animals. All the time we were trying to create their own kind, and now, in the era of computerization, it is becoming more real. Increasingly, attempts are made to create an artificial human mind. But while it is not, then we can only use the knowledge obtained by people. Most of this knowledge is available through a global network, the Internet, which is not only the world's storehouse of knowledge, but also enormous "dump" information to entertainment, recreation, communication, and so on. D.

Who does not need to know when, for example, was born Alexander Pushkin, just type in the search "When Pushkin was born," and you will get the answer. When such knowledge is needed, the person performs the following actions:

- 1) gaining a search query;
- 2) receives the necessary information;
- 3) use the result to the destination;
- 4) ... and forget.

The rapid development of technology significantly lags behind the development of information technologies, which may lead to the fact that the computer system will become smarter than all of humanity already in 2050.

2. People are no longer communicate directly with each other

In the last few years we have seen the rapid development of social networks. Originally, they were supposed to help people to have a dynamic address and phone book, where users themselves add information about yourself, which provides a convenient means of communication.

But, like any other part of human life, they began to take less idealistic and more vital features. Games and frank trash. The worst thing - the fact that social networks are now very popular and trendy, as many chose them as an alternative to real life, spending "in the network" more than 10 hours a day.

You can see that social networks have become a stronghold frankly nizkointellektualnoy information that promotes drugs, violence and other negative issues. And since they are considered fashionable, then this information many "immature minds" idealize, and is considered quite normal for his own "implementation" in life.

Man ceased to be a person on the internet, all of individuality erased, and thinking becomes monotonous and simple. It comes down to pressing a button. Button – a central part of the social network. She thinks for you, with the help of your "friends" will show you what they liked your picture. She asked to press, so as someone often push button, that has a place in society. People with time to forget how to communicate in real life directly, because the network can do what in reality never you currently do not allow: a complete lack of control expressions, illiterate letter - the norm, because itself can represent a different person, with a different name than it actually is.

3. People no longer work

Even at the dawn of industrialization and mechanization of humanity is faced with conflicting results of the implementation of machines. On the one hand they get

rid of people from hard work, and on the other - replacing the human machine, laid-off workers lose their jobs and livelihood.

Of course, if the robots perform faster and better his work, the entrepreneur will not even think about, who take to it, human or robot. But at the same time, we must consider what will be doing billions of people? Of course, engineers are developing new and innovative solutions will not be left without a job yet. But the emergence of artificial intelligence, and save mankind from this work. Here there is one amazing thing: people work hard to make in the future work. It turns out that with the development of artificial intelligence surpassing the human person the first time in its history will cease to monitor progress, and will only draw information obtained by artificial intelligence. This is the real picture of the art.

4. People are no longer people ...

After analyzing the preceding paragraph, the question naturally arises:

What is the essence of man that distinguishes him from other creatures? We can say that he is able to think, to reason, to communicate, to build, to create a second nature; able to work, and it ennobles, develops and releases a person from the surrounding reality; he feels survive, loves, hates, suffers, rejoices.

But he is gradually losing all this with the development of science! And therefore - and it ceases to be a man in the classic sense of the word. Modern man no longer thinks - it tells the computer solution, it is no longer communicating, and just press the button, it does not work - for it is done by robots.

5. Society 2.0

Why 2.0? Firstly: it is now fashionable to call it an example of software versions (1.0, 2.0, 2.2, and so on. D.). Second: the society of the second version combines the achievements of modern science and technology and cultural level of the past. Science in the modern society should take the same role as the culture, but not anymore, but nevertheless, it must continue to evolve. Science must learn much more than she knows at any given moment.

For a long time humanity went to the level of science and technology that is available today, and throughout this time, it does not notice that destroyed from the

inside: lost those qualities of the man who made it so. Direct communication is increasingly relegated to the background, giving way to a remote, thinking boils down to is that "computer knows best," and as a consequence, the full confidence of electronic sources.

At the same time, all the shortcomings and negative effects of technology overlap positive: the growth of science, growing and universal human knowledge, saves resources, time, money. Also, an increasing number of people taking the path of enhancing cultural values, using the latest advances in technology.

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MODERN PROBLEMS OF LIGHT AND LIGHT TECHNOLOGIES IN UKRAINE AND ABROAD

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Once upon a time electricity started its implementation in every house. And it became more and more important in our life. So we should have more energy for our needs.

Modern people can't live without light. We use it every day and almost every second. There are problems we cannot easily determine which are associated with the light. On the one hand our planet uses light and light technologies, but on the other hand we have many ecological, economical and resources problems. For example, if

a lamp with power of 100W will burn 12 hours every day for a year, it would necessary burn 180 kg of coal, so that it will be emitted 425 kg of CO₂ in the atmosphere. It is one of the biggest problems in Ukraine and around the world [3].

To solve this problem we should implement alternative sources of energy such as energy of sun, wind or water. We know that these kinds of energy aren't used at full power. And we have to share our thoughts with the government because we have only two solutions for this situation.

First is the increase in a number of our wind, solar and water power plants. Now alternative sources of energy are almost not used in Ukraine, but many European countries started to provide power plants, which use energy of wind and sun. For example, the Czech government plans to allocate subsidies for the installation of domestic solar power plants on the roofs of private houses. Funding of individual solar power plants will be carried out in the framework of the "new green economy" [3]. At the moment, the Republic's authorities are considering the size of subsidies. Also in 2014, 39% of electricity in Denmark was produced from wind power. And March 22, 2008 in Spain 40.8% of the country's electricity was generated from wind energy [2, p. 1558]. It can be in our country too, because we have territory for providing such alternative technologies. Yes, Ukraine is using the energy of water, but to us it is not enough.

Second solution is the reducing of our energy costs. To reduce the cost of electricity we can use LED lamps, which are considerably cheap. And as these lamps can illuminate objects, which are around us, almost as well as the sunlight. Also LED lamps have long lifetime – from 30,000 to 100,000 hours. If it works 8 hours a day it will work for 34 years [1, p.128]. LED lamps are environmentally friendly. They contain no mercury, phosphor and ultraviolet radiation unlike fluorescent lamps. These lamps are used almost in every country. Our government now doesn't provide LED lamps in every house, it only plans to provide electricity meters in Kyiv by autumn 2016.

In conclusion, I want to say, that the new generation should think seriously about problems of light and light technologies in Ukraine and how we can solve this.

May be our grandchildren will live in our country without problems of light and light technologies.

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ARTIFICIAL LED LIGHTING

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Over the past few years, energy conservation in Ukraine acquired special urgency.

The country is dependent on energy carriers and can not fully provide itself despite the huge number of nuclear power plants and rich deposits of coal in the country.

In the current situation of economic crisis, one of the most effective measures to support the economy and concern for the citizens can be the transition from the conventional sources of artificial light to the LEDs technology.

Today, street lighting and roads use lamps MVL (mercury-vapor lamp), SVL (sodium-vapor lamp) having a narrow emission spectrum more widely, which does not provide acceptable color reproduction. Their light has a characteristic yellow

color, which is a significant disadvantage of this class of lamps. At the present stage of development of the country LEDs are being adopted in many areas of their possible use, including different types of its lighting.

Their advantages are clearly superior to all previous sources of artificial light.

- Energy savings: the use of LED lamps directly allows replacement of existing lamp used to obtain energy savings to 50%.

- Durability: the service life of this lamp up to 25 years in a continuous operation for 8 hours.

- No flicker: excludes stringent stroboscopic effect, under the influence of which human eyes are tired and, as a consequence, Corollary reduced his ability to work.

- Environmentally friendly: because the LEDs do not include mercury, it is easier to dispose it, and ensure environmental safety during the production.

There are also other economic benefits. It is known that in the night time, may be the reduction of lighting streets twice for additional power savings. LED lamps allow you to adjust brightness by reducing the supply voltage (Traditional lamps can not afford that. At lower voltage they will turn off.

The disadvantages of these devices are:

- LED Street lighting is subjected to thermal degradation. For normal work such lamp needs high quality heat dissipation. This function is performed by the substrate on which LEDs are soldered. But if they are poorly soldered, it will lead to the formation of cavities disturbing heat removal and, as a consequence, damage of a lamp.

- Devices are very sensitive to voltage drops . If a power failure occurs, the work of the lamp may be broken due to overheating of the body.

- LED Street lamp may may be broken due to disfunction of electrodes. The metal from which they are made, is subjected to diffusion. If it happens, there is a great risk of getting metal particles to the action of the semiconductor. This can lead to device failure.

Despite the fact that LEDs are more expensive, they are paying off in 3-4 years. In accounting for the exploitation period of 20-25 years, energy saving is huge. In 2012 Austria and Germany refused sodium lamps, totally going to the LED lamps for street lighting.

In 2009 a new highway (A29) was inaugurated in Aveiro, Portugal, and it included the first European public LED-based lighting highway.

In Ukraine there are several manufactures of LEDs that can be engaged in the creation and installation of lighting for the country. For example, Kharkiv factory "Light of Ukraine" has received orders for 10 million US dollars for the supply of LED products.

The benefits are obvious. If Ukrainian companies will receive funding they will be able to upgrade equipment at their enterprises. The country will be able to save energy.

Large-scale (the scale of a country or region at least) introduction of energy-efficient LED luminaries for indoor lighting as well as for the transport networks, will significantly reduce the electricity shortage and provide ecological safety.

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ALTERNATIVE ENERGY STORAGE

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For today, the main problem of renewable energy is not so much to obtain energy as to save it. Really despite the fact that we live in the age of high technology accumulators and batteries are still very weak, for example, to travel far by electric car, to provide the city with power when electric station is idle or to set your smartphone to charge not every day.

Well, scientists are really trying to get the opportunity to save more energy. One of the promising areas is supercapacitor (SC) (sometimes it is called ultracapacitor, formerly electric double-layer capacitor (EDLC)) [2]. What is it? It is improvement of capacitors, which in the future will replace the batteries. Supercapacitor is a hybrid capacitor and chemical current source. In contrast to conventional capacitors, supercapacitors have a capacitance about tens and even hundreds and thousands of farad.

Benefits of supercapacitor:

- Greater maximum charge and discharge currents.

- Easy charging.
- Minor degradation even after hundreds of thousands of charge / discharge cycles. Research was conducted to determine the maximum number of charge-discharge cycles. After 100 000 cycles wasn't observed degradation.
- Electric double layer capacitors have a long service life (at 0.6 Un. 40,000 hours with a slight decrease in capacity).
- Lightweight compared to electrolytic capacitors with similar capacity.
- Low toxicity of the materials (except organic electrolytes).
- Nonpolar (although supercapacitors are marked "+” and “-”, it is to indicate the polarity of the residual voltage after charging it at the factory).

Disadvantages of supercapacitor:

- The high price of supercapacitors with high discharge currents prevents their widespread use.
- Specific energy symmetric supercapacitors are less than that of the battery (4-6 Wh / kg versus 180-240 Wh / kg for lithium-ion batteries).
- The voltage depends on the degree of charge.
- High internal resistance of the majority of commercially available supercapacitors.
- The ability to burn internal contacts during a short circuit for the supercapacitors with high capacity and low internal resistance.
- Low operating voltage in comparison with other types of capacitors.
- Considerably larger than the self-discharge battery with current about 1 mA at supercapacitor $2 \text{ F} \times 2,5 \text{ V}$.

Although supercapacitors is far from ideal as a result we can hope that we will be able to store clean energy here more freely.

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BIOMASS ENERGY

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It is assumed today that biomass has become one of the most perspective sources of alternative energy.

Usage of biomass is so widespread because of its organic origin and accessibility. In other countries applying rates of biomass energy reach 15% and the most developed countries increased this number to 35%.

Biomass is elaborated to be the most common wasteless renewable energy source. It is produced in the process of light photosynthesis. There is huge variety of biomass sources but the most prevalent of them is wood from trees.

Unlike fossil fuels whose amount is very limited, biomass energy sources posses the ability to renew itself. Furthermore, biomass energy conversions don't make much harm to the environment and emit greenhouse gases.

Humans can provide themselves with efficient amount of energy produced using only one eighth of the all total biomass energy.

The most widespread sources of biomass energy are kitchen scraps, sewage, wastes of the food processing industries, paper, sad west and lawn clipping. All this material may be used for producing electricity and heating our houses. In our days, power plans widely apply farm remnants, wood remnants or food processing remnants. It is also hoped to start using wood and grasses as appropriate sources of biomass.

Biomass is considered to be the oldest type of biofuel. Modern technologies involve producing biodiesel from old cooking oil or other organic materials which are not useful anymore.

Ethanol is produced by distilling plant materials (e.g. corn) into grain alcohol which is mixed with a small amount of fossil fuel. Being finished, this biofuel is applied in cars, trucks and vans. That is why the farming industry shouldn't utilize this already prepared source of energy. It is much easier and environmentally friendlier to grow crops for making ethanol fuels than to look for some other alternative sources of energy.

However, there are some drawbacks that don't allow replacing the common sources of energy with biomass energy.

Firstly, when we use wood as a source of alternative energy, it can lead to deforestation. The issue of denuding forests is urgent and we cannot deny that a vast wood consumption will affect groundwater pollution and may lead to irretrievable erosion patterns. Secondly, the substitution of coal with biomass may result in an impressive decrease in net carbon dioxide emissions. It is also true that if the investment in biomass to the world energy increases, we will need technological innovations.

We should keep in mind that biomass is a great alternative source of energy because it is renewable and considerably safe. Although tree plantations have "considerable promise" in supplying the energy source, "actual commercial use of plantation-grown fuels for power generation is limited to a few isolated experiences". [6] Biomass cannot be a worthy replacement of nuclear or heat energy, but it can unhesitatingly replace solar or wind energy. The main reason for biomass being runner-up at this energy competition is that prices of coal, oil and gas are low enough to continue using them. Consequently, our government doesn't pay much attention to development of alternative sources of energy. Biomass energy is not fully investigated and it is not capable of sustaining the whole world's energy needs on its own.

To sum up, we will have an effective form of alternative energy when it is supported with government. But as long as coal, oil and gas have comparatively low prices it will be very challenging to replace them with biomass. Our aim should be to find more efficient, less polluting and most cheap ways of converting biomass to usable energy.

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TOPOLYAROTON, A NEW QUASIPARTICLE

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The development of the quantum calculations and communications, based on the quantum properties of the particles of light and substance is impossible without new discoveries of quantum particles, without studying the properties and the technological elaboration of the practical use. A significant step in this area has been done by the group of the scientists - physicists of the City Collage of New York with Dr. Vinod Menon at the head. These scientists have discovered absolutely new quantum particles which are half the light and half the substance. These particles were found in the thin pellice, which sickness of it was million times less than the sickness of the paper sheet, semiconductor substance of disulfide molibden (MoS₂). A thin layer of this “flat” material was enclosed inside the structure of the special optical trap, where these mysterious complex quantum particles appeared in it. According to Dr. Menon the discovery of the new quantum particles is not only a scientific breakthrough in the branch of the fundamental physics, but it also enables us to think about the creation of new devices, which function on the verge contiguity of the substance and light.

However, another professor of the theoretical physics and the theory of the condensed substance from Caltech (California Technological Institute) suggested the explanation of the possible existence of a new type of quasiparticle – a topolyariton. This particle is half the light and half the substance. The particles should possess some exotic properties. If the scientists are able to create and to operate such particles, it will help to improve the efficiency of a great number of photo-electric devices, optical boosters, photo-galvanic cells of the solar batteries, sensor cameras etc.

The topolyariton is a complex formation, showing some properties of the common elementary particles, such as electrons and quarks. They appear as a result of the abrupt changes of the dynamic state of the system. They exist only in the medium of the hard materials. Such particles as phonons, solitons and excitons belong to quasi particles too. The absorption of the light photon by exciton in some conditions can lead to the formation of a new quasiparticle, which is called polyariton. The electrons which are moving through the semiconductor materials lose its energy because of the electric resistance of the material. This energy becomes the undesirable warmth. But here are some reasons of losing the level of the signal in optics. It's connected with the objectionable reflection and the diffusion of photons. Jill Rafael confirms that the use of the topolyaritons which move at the edge of the semiconductor material as a signal medium allows to diminish the signal attenuation in the electronic systems and to increase the photons stability in the optic electronic devices.

In J. Refael's opinion, the topolyaritons are like polyaritons. But the topolyaritons are able to move only along the edges of the "potential pit" in the semiconductor material. The topolyariton control can be realized with the help of the optical reflectors or photons' prohibited zones. They are formed in the optical medium, where the common photons can't move. Besides, the control of the topolyarotons movement can be realized with the help of the magnetic field. It will allow to create the exotic optical devices, e.g. one-way filter which transmits the light into one side with minimum losses.

Although, the transition from theory to practice will be long and difficult enough, J. Refael believes that the new kinds of interfaces between the photon and electronic worlds are to be created soon.

But the international group of scientists from Japan, Singapore and Germany with the scientists of the ANU (Australian National University) at the head created the quantum system which looks like the billiard game. Their aim was to penetrate into the kernel of a branch of the fundamental quantum physics. It is called the physics of exceptional points. This quantum system is large-scale enough. It offers

Boze-Einstein's condensate which consists of bound and free quasiparticles: topolyaritons, polyaritons, excitons. The research being done with help of this system can lead to the discovery of the new principles, which may become the base for the future electronics, where the unique properties of the polyaritons are used.

The quasiparticles: polyaritons, topolyaritons and excitons are hybrid particles which contain both substance and light. The accumulation of a great number of such quasiparticles can function as a single entity. All the particles function the same way in it. Such behavior can be used for the formation of the "quantum waves" in the substance, which is in a special quantum condition called Boze-Einstein's condensate.

Consequently, the researchers developed a quantum analogue of the billiard game, illuminating the surface of the semiconductor material with the laser light. It is the "table" which has the size of about 10 micrometers. The polyaritons (topolyaritons) used in this game instead of traditional balls form exceptional points (EP). They reveal in the correspondent spectrum of the electromagnetic range. The loop is formed around these points. It is called Bery's topological phase. Any object, which enters the sphere of this loop, causes the changes of its quantum condition.

So, the work of the quantum system resembles the billiard game. The balls' position changes after every kick. But the balls' position in the quantum system doesn't change under the influence of the laser light. It is the quantum condition which changes and it defines the quantum system as a whole.

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VARIANT OF PROVIDING BROADBAND INTERNET ACCESS TO UNDERGROUND TRANSPORT

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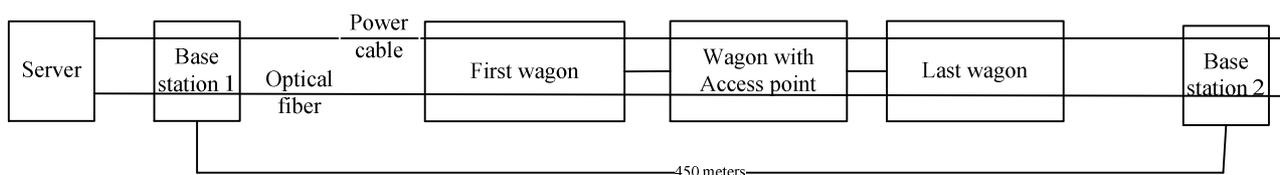
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Broadband internet is provided by a number of technologies that allow users to send and receive information in large quantities and with high speeds. However, attempts to create a free broadband access via Wi-Fi in the subway of Ukraine are ineffective comparing with other countries. Free internet accesses through Wi-Fi network are available now only at three stations in Kiev subway. Although, abroad there is internet access in the metropolitan even in those places, where mobile connection doesn't work.

Despite the problems, associated with a huge volume of work and expensive project, free network is real and over some period of time can achieve great results not only in speed, but although in the quality of communication.

Consider one example of broadcast access to the internet in an underground transport. First of all, to use a reliable and uninterrupted connection at high rate one should select fiber optics cables. Server units should be set up at metro stations and they are used as units for joining base stations via cable. These base stations are located at the distance of 450 meters from each other. Power cable should be placed parallel to fiber optics (picture 1).



Picture 1 – scheme of realization Wi-Fi in the subway

The router with aerials are set up on the last train`s wagons. These routers are switched slowly from one base to another. During train`s movement, which allows maintaining a network without connection lose. A cable is laid between two main aerials (in the first and the last train wagons) on the entire train length. These each wagons have their own access point that are combined in single network.

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FLUORESCENT LIGHT AS FIRE INITIATIVE OR TOMORROW'S COLD LIGHTS

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We live in the era of the light. Our planet has become so bright that it is expediently not to compare it with the heavenly body, rather with Christmas tree, which is hanging with garlands and sequins. It's so bright and wonderful that we do not think of the cost. ‘Electricity is flowing from our outlets’, – that’s all that an average user knows about nature of the light.

Lighting of large areas and surfaces is not easy to deal with. Thousands of various nuclear, thermal, hydroelectric, wind and photovoltaic power stations produce a million kilowatts of energy per day. Common incandescent lamps have been improved and upgraded over time and progress, but their efficiency is only 5-15%. When we are talking about a decreased efficiency of one lamp it is possible to

close our eyes but a gradual waste of a billion kilowatts of energy through the whole planet should make us think over the problem.

The interesting alternative to the aforesaid power sources is Bioluminescent light. It is a type of luminescence or “cold light”. Unfortunately, this technology is not studied properly and a few people know about it. But its advantages are obvious. Due to this technology, an efficiency of an ordinary “flashlight” can fluctuate within 85-95%.

Luminescence is an emission of light by a substance which is not resulting from heat; thus, it is a form of cold body radiation. It can be caused by chemical reactions, electrical energy, subatomic motions, or stress on a crystal. This phenomenon was opened by Nicolás Bautista Monardes (1565), involving Astek experience in the field of botany. The first explanation was made by José de Acosta (1590) [1].

Evident proof of bioluminescent efficiency we can observe in nature being of different species of plants and animals (bioluminescent mushrooms *Omphalotus nidiformis*, jellyfish *Aequorea victoria* / *Aequorea*, etc.), which use this effect for protection, communication, luring, etc. We use it to our own benefit, just to take lessons from nature.

If we want to achieve our dreams we need such two things as donor and genes acceptor. The first donor was the jellyfish *Aequorea Victorii* and the laboratory rat was used as an acceptor. A lot of new variants of the protein had been discovered based on GFP genetic engineering, which have a much greater quantum output of fluorescence and differ in colors (blue, blue-green, yellow, red and other). Proteins may change color during the time or depending on the conditions of the intracellular environment.

Nowadays thousands of modified genes of many species of bacteria, yeast and other fungi, plants, insects and several species of mammals have been using GFP as a marker.

A team of scientists from California is developing a new generation bioluminescent plants, making changes in their genetic code. Funds for the

implementation of this research project have been collected through donations of Kickstarter users. Such researchers will allow creating “trees that replace street lights” and even “ornamental plants that are bright enough for reading” [2].

The creators of the project notice: “We are using synthetic biology techniques and software Genome Compiler for implementation bioluminescent genes in Arabidopsis, a small plant of the cabbage family, for creating glowing plants (not suitable for food). The printed our DNA is introduced into a special bacterium that will make this DNA into the plant” [2].

Thus, we stand on the threshold of significant discoveries and achievements. We have achieved great progress but still have many obstacles. Scientists from all over the world are working to solve the last questions of the aforesaid puzzle and some of them are reaching indisputable success. The only thing that we are able to do is to keep pace with them.

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ALTERNATIVE SOURCES OF ENERGY

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Geothermal energy (natural heat of the earth), accumulated in the first ten kilometers Earth’s crust, according to scientists reach 137 trillion tons, which is 10 times geological resources exceed all fuels combined.

Of all the types of geothermal energy have the best economic performance hydrothermal resources - hot water, steam and natural mixture of steam. In Ukraine, the projected operational resources thermal water reserves equivalent heat uses about 10 million tons per year. Among the promising areas for exploration geothermal resources is Donets Basin.

Advantages:

– Geothermal energy obtained from heat sources with high temperatures, it has several features: the coolant temperature is much lower than the temperature of the combustion fuel and best use of geothermal energy – combined (extraction electricity and heating) [1].

Disadvantages:

- Low quality of thermodynamics;
- The need for heat extraction near the place;
- The cost of construction of wells grows with increasing depth.

Urgent steps towards improving Ukraine's energy situation, reducing its energy dependence and further integration into the European community, should be comprehensive government support the development and implementation of alternative energy systems in regions with the highest economic feasibility. This can be achieved by perform the following actions:

- improve a number of existing legislation on renewable energy that would help improve the economic efficiency of alternative energy;
- the development of investment projects to attract additional investments in the industry;
- state guarantees producers of "clean" energy for its purchase at fixed tariffs;
- ensuring the energy security of Ukraine due to the modernization of the existing network;
- power plants, improving their reliability and continuity of work;
- informing people of Ukraine on the use of alternative prospects
- energy sources, the need to preserve the environment and reduce greenhouse gas emissions;

- protection of atmosphere from burning traditional fuels.

During the period of 1997-2005 years Ukraine has replaced more than 84 mln. tons of standard fuel traditional fuel and energy resources by energy generated by facilities alternative energy [2]. That is advisable to extend the development program non-conventional renewable energy sources by 2030.

Overall, implementation of energy efficiency programs, including programs to create of alternative energy (ARES program) has the potential to provide for Ukraine the following [3]:

- strengthening the statehood of Ukraine by increasing energy and economic independence;
- reducing the energy intensity of gross domestic product;
- to achieve world-class efficient use of energy resources;
- reduction in imports of energy resources;
- creating a market of energy saving and scientific equipment and related materials technology;
- technical and technological re-equipment of energy-intensive industries;
- competitiveness of domestic products;
- improving the welfare of citizens;
- increasing employment;
- increasing employment;
- improving safety and cultural production;
- improvement of human health;
- reduction of harmful emissions into the environment;
- restoration of natural resources;
- implementation of international agreements to enhance environmental safety.

In conclusion we can say that there is a constantly growing awareness of the urgent need for enterprises to improve energy efficiency in combination with environmental security, to reduce harmful combustible wastes and use emissions as an additional source of energy.

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THE MAIN ALTERNATIVE RESOURCES OF ENERGY

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Non-renewable fossil resources such as coal, gas and oil give 85% of the energy used on the Earth. As examples of alternative energy resources can be wind energy, solar energy and geothermal energy. These alternative resources are not widely used as the primary energy generation today. Although their role is growing.

Scientists estimate that only resources which can be renewed will be used until the end of the twenty-first century [1]. (It is known that the oil reserves for active use will satisfy the needs of humanity only until 2055). In such a case, more extensive use of renewable energy is considered by many organizations as a solution for global economic stability. In 2002 15 countries of the EU proclaimed the goal to abandon fossil fuels with the initial purpose of obtaining 12% and approximately 22% of the total energy generated from renewable energy sources by 2010 [2].

Wind energy is one of the earliest forms of energy produced by humans. Wind is usually harvesting energy by windmills that can either provide the mechanical

energy directly to the machine or drive generators to produce electricity [3]. The kinetic energy of the wind is proportional to its velocity. The ideal place for the mills location, with constant, rapid wind and lack of obstacles such as tall buildings or trees. The effective mill can produce 175 Watts of power per m² of the propeller blades at a 25 m height. Approximate cost of energy generated by one kilowatt-hour of wind is about eight cents compared to 15 cents for nuclear energy.

Solar energy can be used directly or indirectly by the heat after conversion into electrical power using solar cells. Greenhouses and solariums are regular cases of direct use of solar energy. Another direct method includes flat plate solar collectors, which can be installed on the roof to harvest the energy needed for heating system. The windows and collectors considered passive solar power systems. Active solar systems use fans, pumps and other apparatus for processing the generated heating into other forms of power.

Geothermal energy is the energy of heat that is released from the inner zones of the earth for hundreds of millions of the years. Geothermal energy is divided into hot dry steam, wet hot steam and hot water. Thus, there are four basic types of geothermal resources:

- shallow ground heat, used by heat pumps;
- steam energy resources , hot and warm water at the surface of the earth, which are now used in the production of electric energy;
- heat focused deep under the ground surface (possibly in the absence of water);
- energy magma and heat that collects beneath volcanoes [4].

To sum it up, we can mention that renewable sources of energy are very important for the future of humanity. The main types of nowadays renewable sources of energy are wind energy, solar energy, and geothermal energy. An important task is the further development and implementation of these types of alternative energy in everyday life.

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ALTERNATIVE FUELS

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Let's start with the fact that the modern world is literally drowning in a pile of waste tires. Number of vehicles is increasing every day, so the amount of generated waste and tires also increases.

During ordinary combustion process mass of rubber products released toxic waste that adversely affects the ecological system. But if you apply the right equipment, the process can be even useful. Currently, there are many modern technologies that recycle tires into raw materials that can be used in production. This can solve several problems. On the one hand there is recycling of rubber products, while maintaining ecological system. On the other hand the products obtained by recycling can be used in production, while the price of these materials is much lower than of the original ones.

One radical way to reduce fuel oil consumption is to increase the use of alternative (alternative) fuels.

Alternative fuel is a liquid or gaseous fuel, which is a corresponding replacement of traditional fuels and produced from unconventional sources of energy and some types of raw materials.

There are a few ways to determine what the alternative fuel should be:

- fully produced (extracted) from non-traditional sources of energy and types of raw materials or a mixture of traditional and alternative fuels in proportions established in accordance with state standards;

- produced (extracted) from oil, gas, oil deposits of non-industrial value, exhausted deposits of heavy grades of oil etc. and their features differ from requirements for traditional fuel.

Rise in the cost of oil and gas leads to a search for alternative sources of energy, and we have come back to heating of buildings with coal, wood and peat. Abroad, alternative fuels have been used for a long time. In many European countries, in particular, Denmark, Austria, Sweden and France, an important place in the energy balance takes straw. Burning straw, which is not used in feed or bedding for animals, is rational and ecological way for generating energy.

Alternative fuels are using wider in different production processes in Ukraine, so it makes enterprises much more effective [1, p.51].

Recently, in Lviv region the program of production and use of coal-water fuel has already been launched as one of the most promising types of alternative fuel. The use of coal-water fuel as an alternative fuel, given first preference in terms of environmental safety – there is much less dust and soot. Consequently, water-coal fuel can be effectively used for gasification [2, p.43].

In conclusion we would like to say, that alternative fuel is an effective substitution for petroleum fuels and in future it will provide not only the reduction of petroleum fuels consumption, but at the same time it will improve environmental safety of power plants.

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ALTERNATIVE SOURCES OF ENERGY FOR HOMES: ZERO-ENERGY BUILDING

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Now, there are thousands of ways to provide the house with electricity, but only some of them will allow you to save on your bills and also make you energy-independent. However, in our country, very few people know how to use them correctly. Therefore, the aim of this work is to demonstrate that there exists a ready-to-use method of dealing with the energy crisis, and to discuss advantages and disadvantages it brings.

The technology under consideration is the so-called house with zero energy consumption – a building that has high energy efficiency, can generate on-site renewable energy, and consumes it in equal amounts during the year. Zero energy consumption houses do not use fossil fuels, and get the energy they need from renewable sources. These can be traditional buildings with large solar collectors and solar panels. Most of these houses are built on the following principles: reduction of

the energy required, the use of surplus energy, reduced needs for artificial cooling, ensuring high-efficiency climate control and other systems, including lighting, supply of renewable energy from the sun, wind and other renewables.

Nevertheless, there are also some dangers in the construction of such buildings. The main risk is that the winter will be dark and cold, and the summer will be sunny and bright, that is at different times of the year the electricity will flow into the house evenly. That is why zero energy houses are equipped with an inverter which in turn controls the energy storage and power supply. Another important factor is the profitability of such an "upgrade" for your home. There is always a chance that the construction of such a system may not be paid off. However, studies show that the cost of maintaining such a house is 60% lower than that of standard homes. These studies have been conducted in Canada; and this country is a world leader in the promotion of the idea of building zero energy houses. Since our country's climate is similar to the climate of Canada, it can be assumed that the profitability of such a project would be very high.

To sum up, we would like to point out that there are both advantages and disadvantages of this method, but it can still help tackle the present-day energy crisis. In fact, we hope that this technology could help our country cope with a difficult situation on the energy market.

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HEALTH EFFECT OF ARTIFICIAL LIGHT

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As we all know, the first source of artificial light was fire. And even now, fire still remains our main source of light. Incandescent light bulbs are considered to be the first electrical light sources. Their work is based on heating a substance until it glows.

The new type of lamps is halogen lamps which contain the tungsten filament inside a tube with a mixture of gases. It is important to remember that lamp must have a halogen gases which doesn't allow the tungsten to melt while being heated. This gas provide gas with more efficiency and brightness. It also makes artificial light look almost the same as daylight.

The task to determine the “typical” spectrum which is emitted by each type of lamps is hard enough. Scientists invented the lamp classification to solve this problem. All lamps are divided into four risk groups.

RG0-no risk

RG1-minor risk

RG2-medium risk

RG3-high risk

The majority of lamps that are in our homes are RG0. Nevertheless, some lamps can emit blue light and ultraviolet radiation. This emission can cause the development of symptoms such as chronic actinic dermatitis or solar urticaria.

But if someone uses lamps in non-distant quarters for considerable amounts of time, he can get his skin or retinal damaged because of the extension of safety limits. it was researched that the lamps with a second glass envelope emit considerably smaller amount of UV.

Areas which are considered to be the richest on UV emissions are schools and offices. Fortunately, the lamps we use in our homes emit comparatively low quantities of UV emissions.

However, human's major problem is that the eternal summer made by central heating and artificial lighting could strongly affect human circadian cycles and their hormonal system. It took more than millions of years for human beings adapt to seasonal changes. Our genes switch on and off in different time of year.

In winter season our genes awake and begin helping our body to struggle with infections. But central heating and artificial lights confuse our genes, making them to assume the summer season came. Nevertheless, during the 20th century these signals were neglected. Everyone can have efficient amount of light and heat at their homes.

Today people have a lot of opportunities to heat and light their homes, to make nature rhythms appropriate for their lifestyle. That is why our immune system considers itself needless.

To sum up, we should keep in our minds that excessive usage of artificial lights can lead skin cancer, affect sleep, digestion and cardiovascular health and possible increase the risk of the breast cancer. Humans need to find additional ways of creating comfort conditions which will not provide such serious consequences.

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ARTIFICIAL SOURCES OF LIGHT

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Light is a visible light of electromagnetic waves in the frequency range perceived by the human eye (7.5 · 10¹⁴ - 4.3 · 10¹⁴ ... 10¹⁶ - 10¹⁶ Hz). Lighting devices are the devices for lighting, exposure, light signaling and light projection.

Light sources are emitters of electromagnetic energy in the optical part of the spectrum. There are natural sources of light (sun, atmospheric electrical discharges) and artificial that convert any energy into optical radiation (incandescent lamps, fluorescent lamps, high pressure discharge lamps and others).

Light sources used for artificial lighting are divided into two groups: discharge lamps and incandescent lamps. Among incandescent lamps the special place is taken by halogen lamps. They have the better light output than conventional lamps. There is a mixture of inert gas with halogen, iodine or bromine inside the bulb. The essence of the use of halogen comes down to tungsten recovery. Halogen bulbs are based on the concept of two parallel metal wires transmitting an electrical current to a tungsten filament that connects them, heating the filament to a point where its heat is reflected as light. As a result, the light output will be higher. Quartz glass is used

for halogen lamps. Moreover, fat destroys the glass. Therefore, it must be treated carefully.

The "heart" of the incandescent lamp is tungsten spiral that is called "body glow". The incandescent body is made of a thin tungsten wire made in the shape of a spiral. Incandescent bulbs are less efficient than halogen bulbs; they use about 90% of the energy that they consume to produce heat and turn less than 5% of it into light. If the voltage is 10% higher than the rated one, the incandescent lamp will serve only a few days. Incandescent lamps have a few disadvantages, such as: low luminous efficiency and relatively low life. The dominating colors are yellow and red. Discharge lamps of low pressure are called fluorescent lamps. As a result of gas discharge there appears ultraviolet radiation (absolutely invisible to the human eye), which is converted into visible light due to phosphor coating. The fluorescent lamp is a cylindrical tube with electrodes, which roll mercury vapor. The main advantages of fluorescent lamps are as follows very high luminous efficiency and a long service life. A lot of consumers choose this type of lamp because of the possibility of light sources to have different spectral composition with the best color reproduction. One more advantage is the relatively low brightness that doesn't dazzle the eye very much.

For the spectral composition of visible light one can a few kinds of distinguish fluorescent lamps (LD): lamps of natural light with improved color rendition (LDTS) of cool white (LHB) of warm white (LTB) and of white (LB) colours.

DRL lamps are mercury vapor gas-discharge lamps of high pressure. This is one of the varieties of electric lamps, which are widely used for general lighting volumetric areas, such as: factory workshops, streets, playgrounds, etc. Table 1 represents both advantages and disadvantages of DRK lamps

Table 1. The advantages and disadvantages of DRL lamps.

<i>The advantages of DRL lamps</i>	<i>The disadvantages of DRL lamps</i>
- high luminous efficacy ; -ability to work at subzero	- low color rendering; - pulsation of luminous flux;

temperatures; - long life (about 15 thousand hours).	- critical to fluctuations in the mains voltage.
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Taking everything into account, all types of lamps have both advantages and disadvantages, so choosing light sources should be careful nowadays, the great attention is paid to energy efficiency which forces people to use more efficient lighting.

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THE POTENTIAL OF ALTERNATIVE SOURCES OF ENERGY

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The further development of humanity, the more important is the use of alternative renewable energy sources. The development of alternative energy and the search for new sources of energy are the two main global trends of our millennium. The reasons for this are numerous, including the depletion of natural resources, an

increasing danger of energy crisis, the negative environmental impact of using traditional sources of energy, and thus the threat of ecological catastrophe.

Harnessing the energy of earth, water, wind, and sun will enable us to stop polluting the environment, and save valuable mineral resources. Instead of using conventional sources of energy, such as oil, gas and coal, scientists are developing, designing, and constructing alternative energy power plants. So far we have learned to produce energy from ocean waves and streams, hot underground waters, sunlight, wind, etc. The energy can even be produced from rice husks, chicken manure and banana peels. There is no doubt that the future generations will ultimately turn to alternative energy sources, and energy will be clean and absolutely safe for man and nature.

One of the most promising areas is the use of wind energy. Scientists estimated that the total wind energy potential of Earth is thirty times as much as the annual electricity consumption worldwide. However, only a tiny part of this energy is used. It is interesting to know that according to statistics there were windmills almost in every village of Ukraine in the past. However, later the steam engine and the internal combustion engine replaced these machines.

In fact, using wind energy is possible not in all parts of the Earth. For a normal wind engine to operate the wind speed should not be below 4.5 m/s on average during a year, the most appropriate speed being 6-8 m/s. On the other hand, too high wind speeds (e.g. hurricanes) are also harmful for the wind turbines as they could get broken. The most suitable areas for harnessing wind energy are coastlines of seas and oceans, and mountains, of course. In Ukraine such areas can be found along the Black Sea coast, particularly in the Crimea, in the Carpathians, and in the southern steppe regions.

Today, in Denmark and the United States small wind turbines of 1.5 to 100 kW are commercially available, and several experimental wind power turbines to generate up to 30,000 KWh have been built.

Also, an engineering concept of Yu. Kondratyuk is being under development. He once proposed to build a wind farm with facilities for the production of hydrogen

by water electrolysis. When the demand for electricity is lower, "excessive" power of the wind farm is directed to the production of an extremely valuable energy product, i.e. hydrogen. Hydrogen can be used as fuel for cars, and other machines, producing only water vapor, rather than any harmful substances, when being burnt.

Another promising alternative source is the energy of the seas and oceans. Oceans contain a huge energy potential. First of all, this is the sun's energy absorbed by ocean water, which can be found in the energy of ocean currents, waves, tides, the temperature difference between the different layers of seawater, etc. Secondly, this is the energy of the sun and moon gravity, which causes high and low tides. Unfortunately, at present the use of this great and environmentally friendly potential is extremely small.

All types of sea wave power plants in operation today are built on the same principle: under the force of waves water level fluctuates in the special reservoir, leading to air compression in it, which drives the turbine. In experimental power plants even small wave (35 cm high) force the turbine to gain the speed of over 2,000 rpm. One meter wave can generate 25-30 kW, and in some parts of the oceans, for example, in the Pacific ocean, you can obtain up to 90 kW.

Another type of marine power plants is the installations that convert the power of tides into useful energy. Besides the "floating" principle mentioned above they apply the principle of pumping sea water at high tides into the tank, located above sea level. From there the water goes down, spinning the turbine of the power plants.

The tidal power plants in operation today can be seen in the Canadian Gulf of France (the tides height is 17m), the English Channel (15m), Penzhin Gulf of the Sea of Okhotsk (13m), and others. The tides height in the Black Sea is too low to build there a tidal power plant.

The engineering calculations indicate that in the near future more renewable power plants will be constructed since they do not cause environmental pollution, and are able to convert energy accumulated in waves, tides, and other types of energy available in nature into other forms of energy, including electricity.

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NANOTECHNOLOGY IN NUCLEAR ENGINEERING AND RADIATION SCIENCE

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Nowadays nanotechnology is one of the major fields for further development, so it is worth conducting large-scale projects on application of nanomaterials in the engineering and nuclear power industry. The purpose of this paper is to present a general perspective of creation of nanostructural materials for building blocks in nuclear power plants and future atomic reactors with improved mechanical characteristics and increased radiation resistance. There are also numerous problems to be considered, associated with developing methods for nuclear fuel upgrade and dispersion-strengthened steels.

Nuclear power is one of the main sources of heat and electric energy in Ukraine. In our country there are a lot of nuclear fuel cycle elements that must be developed in future, and so we need to conduct intense fundamental and applied research. A very important issue now is upgrading of fuel and constructional materials for the reactor core. The fuel materials consist of a variety of transuranium and uranium elements and their components. The nuclear reactor constructional

materials include ferritic, ferritic-martensitic, austenitic and other steels, carbon and graphite materials, zirconium alloys and different ceramic materials.

The main objective today is the progress of theoretical and applied investigations in the fields of radiation materials science and radiation technology, and discovery of new fuels. Nowadays nanotechnology is used in every sphere of science and engineering, and in the nuclear industry it had been used even before the word “nano” became popular [1].

There are quite different areas of using nanotechnology in the nuclear power industry, as it covers a wide range of problems, such as

- new nuclear fuel creation, the one that is high-density, and contains nano-sized additives;
- creation of nano-disperse functional and construction materials, creation of MOX fuel (mixed oxide fuel), that is nuclear fuel that contains more than one oxide of fissile material, and usually consists of plutonium blended with different types of uranium;
- development of metrological guarantee for using nanomaterial-based constructional and functional units of nuclear facility;
- research and development of materials that will be used for creation of nuclear fusion reactors;
- multi-scale modeling of nanostructures, processes and materials and so on.

In Ukraine the energy strategy on implementation of new mixed oxide fuel nuclear power technology is rather slow and stepwise. Further development of nuclear power industry requires installing fast neutron reactors into the nuclear power plants. Needless to say, the sodium loop reactor is the only type of reactors that is commercially manufactured.

Increasing burn-up fraction of nuclear fuel is one of the ideas how to improve the efficiency of nuclear power plants. For making it possible, we need to produce nuclear fuel macrocrystalline structures with controlled porosity since they limit gaseous and volatile fission products, and prevent fission products from moving to

grain boundaries towards the fuel element jacket. As a result, there is a greatly lower degree of damageability of the fuel element jacket.

Use of nanomaterials and nanostructures becomes more efficient and widespread, especially in developing ODS (oxide dispersion strengthened) steels [2-3]. ODS steels are diverse chromium steels of the ferritic-martensitic class, which are fortified with nano-sized oxide particles. The content of chromium in steels can be from 9 to 18 percent, and the other alloying elements (Al, W, Mo, Nb, Ti, Zr, etc.) content is just a few percent or even less. Oxides of titanium, aluminium and other metals are also used. Improvement of efficiency and length of exploitation of advanced fast neutrons reactors requires an increase in the burn-up fraction up to 18-20 percent without degradation of heat-carrying medium. Finding a solution to these problems depends on the development of radiation resistant constructional/engineering/ structural materials, which are used in fast neutron reactor cores.

Irradiation-induced swelling, irradiation creep, high- and low-temperature irradiation embrittlement, and stability of the material structure properties in the neutron irradiation field are the main parameters which determine radiation resistance of constructional materials in fast neutrons reactors [4]. Solving this problem requires generation of a new type of radiation resistant metallic materials reinforced with metal oxides nano-particles [5].

All in all, at present nano-structural materials play an important role in the nuclear power industry as construction and functional materials are widely used in the nuclear fuel cycle. The perspective of using nanotechnology in the nuclear power industry is related to the possibility of producing structural and functional elements of nuclear and thermonuclear installations with the necessary combination of mechanical, corrosion and radiation resistance characteristics. Properties of ODS steels offer a great opportunity to plan the application of this kind of materials in the thermonuclear power industry. Thus, the main task of research people is to speed up the development of projects on nanotechnology and nanomaterials as they can help to achieve economic stability and lead to cutting-edge industrial transformations.

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BIOMASS AS ALTERNATIVE SOURCE OF ENERGY

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Biomass is one of the renewable alternative sources of energy. It has some important benefits: ecological, energetical, economical. It is very perspective form of

resource of energy. It is very topical to use in our time, when traditional energy sources are expensive to use.

Eco fuels allow getting energy from plants and changing its configuration to generate electricity or fill the cars. During the photosynthesis hydrocarbons (sugar and starch) appear in plants [1]. Energy which is stored in bonds of carbohydrates is emitted when plants are buried or eaten [1]. The reaction of oxygen with carbon in plants leads to the release of power, carbon dioxide and water. This energy is used to transform water into steam [1]. The steam turns the turbines and electricity is produced in such a way.

There is the second way of releasing energy of plants. Sugar is converted into alcohol in course the fermentation [1]. The alcohol in the liquid or gaseous state can be combusted to obtain energy. Fuels derived from biomass are biological fuels. One very powerful advantage of biomass is in transformation from plants, which are easily renewed - they can grow again [1].

The potential of using biomass is very large. On factories are used hydrogen and carbon elements as fuel. So, biomass can replace petroleum. These substances are used to produce many products like plastic materials, paints and adhesives. Biomass is now not so popular renewable source of energy [1].

All kinds of plant wastes are biomass: wood, agricultural wastes, some types of grain, which are grown especially for biofuel use. Industry means waste: deforestation, construction, paper production, farms and solid waste from city dumps and methane, which is produced in landfills, some types of herbs after the fermentation [1].

The future of biomass is in replacing the petroleum which is as a source of many of chemicals used in our time. Such things as plastic paint and glue can be produced from the biomass [2, p. 1].

In Ukraine there is a great number of barriers in development of bioenergy. Subsidizing internal prices for natural gas for the population makes biomass uncompetitive; lack of subsidies for buyers of bioenergy equipment; absence of the government program for the development of bioenergy; opportunities of the

bioenergy sector are almost ignored in the drafting of the updated Energy Strategy of Ukraine until 2030; there is no development of the market of biomass as fuel [2, p. 2].

In conclusion, using biomass energy is very perspective because we can use wastes to release energy. So it can replace petroleum. In our time not every country has a significant development of bioenergy. The use of biomass boilers is very advantageous and economical. The development of bioenergy has many barriers. It needs a radical and immediate state intervention in order to improve it.

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ALTERNATIVE SOURCES OF ENERGY IN PRACTICAL USE

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Because of energy crisis the issue of substituting traditional energy sources for new alternative ones has become of great importance. Alternative energy sources include wind power, geothermal energy, solar power, tidal energy, and biomass fuel. These energy sources are said to replace about 2.5 billion tons of fuel in 2020.

The most promising source of alternative power is the energy of the sun, as the solar energy brought to Earth's surface is 14-20 thousand times greater than all the power produced by man on the planet [1].

Solar power plants are able to help us save valuable fossil fuels through intelligent use of solar energy. There are three types of solar energy: a) energy fluid heated by sunlight; b) direct photovoltaic conversion of solar energy into electricity; c) use of mirrors focusing solar thermal energy to the surface of boilers of thermal power plants. Solar installations can be used for heating and hot water supply houses.

In the late 80ies the most common household appliance operated by solar energy was a "solar kitchen", a special portable solar dish (produced in France and Switzerland) that you could take with you when going on a voyage, or mountain trip. At the same time there were created solar cameras, radios, portable solar panels, and solar lamps in Japan.

Another source of alternative energy is wind power. Over 1,000 years ago people used wind for sailing ships, for grinding grain and pumping water. Since the end of XVIII century more than 8 million wind generators have been set up in the USA. The machines stopped operating in the 40ies due to inexpensive energy obtained by burning fossil fuels, but in the 70ies the use of wind power restored because of oil shortage. Today the installed capacity of US wind turbines is 1,600 MW, producing about 3 billion kilowatt / hours of electricity annually. In general, the total capacity of the wind on the planet is about 2,000 billion kWh. At present there are wind power installations of 1-1,000 kW

Wind turbines consist of rotor (blades), and energy axis wind generator to convert kinetic energy into electricity. To increase the capacity of wind turbines they are placed on high masts of up to 30 meters high where wind speed is at least 5 m/s. National programs of wind power development are implemented in Canada, Germany, USA, France, Sweden and other countries.

Despite large monetary investments, wind turbines are more economical than thermal plants due to 6 times lower maintenance costs. Thus, the initial expenses can be recovered in 1-1.5 years. In addition, the service life of wind turbines is much longer than that of heat engines.

It is known that at the depth of 10 km the temperature reaches 140-150°C, and this geothermal energy can be used for heating purposes.

There are geothermal resources are of two types: steam, water, gas, and heated rocks. Geothermal power stations are design for generating power using steam, or overheated geothermal water [3]. A geothermal heat pump system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger, that is a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger [4].

Biomass has great advantages over other types of energy sources because it is relatively cheap and virtually harmless to the environment. Of course, many countries are actively involved in doing research in this area. For example, due to a continuous growth in oil prices in Cyprus the possibility of using biodiesel produced from biomass as an alternative to oil is being discussed. Biodiesel is planned to be obtained from corn, soybeans, cotton cake etc. Meanwhile, in Japan a method of transforming vegetable oil into biodiesel using quite cheap catalysts has been patented [2].

Personally I think that harnessing alternative sources of energy is the best solution to the problem of energy crisis. Moreover, for two centuries the mankind has made enough damage to the ecology, so now we need to treat earth's resources with more care and responsibility.

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