COMPUTER-AIDED DESIGN SYSTEMS

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ACHIEVEMENTS IN THE FIELD OF CREATION SOLAR POWER STATION (analytical review)

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Abstract*—*An overview of publications in the field of creating power plants using solar radiation energy - solar stations is given. It is shown that solar energy is the source of energy of the future, an exceptionally clean, simple and natural way of generating electricity, which is very little associated with biological danger. Solar energy practically does not cause any harm to the environment, is an environmentally friendly source, does not expend mineral resources and does not violate the thermal balance of the planet. In the next decade, solar energy will become commercially viable. In the future, solar energy may become the main source of continuously renewable energy in the Earth's biosphere.

Index Terms—Power plants; solar energy; solar stations; energy source of the future; environmentally friendly source; continuously renewable source of energy.

I. INTRODUCTION

It is well known that the energy problem is one of the main for mankind. The main sources of energy, at present time, are gas, coal and oil. According to scientists, oil and gas reserves will run out in the coming decades, and there will be enough coal for several hundred years. As a result, humanity is facing an acute challenge.

One of the energy problems is the electrical energy production, directly related to the creation and use of various power plants.

The power plants main types currently are thermal, hydraulic and nuclear. As a result of the natural energy carriers rapid depletion, the finding new sources and energy production methods task comes to the fore. Such, among the currently used, can be called wind, solar, geothermal, tidal, hydrogen energies power plants, using biomass energy, etc. Scientists say that by 2050, nontraditional energy sources will become the main ones, and ordinary ones will lose their dominant role.

Among the listed, of great interest are the power plants, using the energy of solar radiation – helliostations.

As the energy source of the future [1], solar energy is an extremely clean, simple and natural way to generate electricity, which is very little associated with biological hazards.

Solar energy practically does not cause any harm to the environment, is an environmentally friendly source, does not consume mineral resources and does not violate the planet's thermal balance.

The solar radiation use is especially important in space. The sun energy is one of the few energy sources to ensure the satellites, automatic interplanetary stations and spacecraft efficiency.

II. THE SUN – INEXHAUSTIBLE ENERGY SOURCE

The sun has a huge energy reserve. The Earth receives only a small fraction of solar energy, but it is quite enough to ensure all the diversity of life forms on Earth.

Celestial body gives us a huge amount of energy for free [2]. In just 15 minutes, the star gives our planet the amount of energy that will be enough for humanity to provide electricity for one year.

The incoming solar radiation power in the Earth's upper atmosphere layers [1] is 174 PW (1 PW = = 106 GW). About 30% is reflected back into space, and the rest is absorbed by the oceans, clouds and land. This is tens of thousands of times more than the well-known power indicators of all power plants on the planet. The solar energy's power exceeds the mankind's modern needs a thousand times.

As a result, only 27% of direct solar radiation (solar constant) reaches the Earth's surface [3] (Figs 1 and 2). The earth receives [1] about 1366 W of direct solar radiation per square meter.

At the same time, the range of solar energy's input to the Earth [3] varies quite significantly, both in time and in its territory.

A large proportion of this energy on the planet's surface [2] is converted into heat. It heats the earth and water, and from them the air is heated. Heat from the Sun determines ocean currents, water cycle

in nature, air flows, etc. Heat gradually radiates into space and is lost there. In the planet's ecosystem, energy goes through a long and difficult transformation path, but only a small part of its amount is used. As a result, the ecosystem works, does not pollute the environment and uses a small part of the energy reaching the Earth. From this we can conclude that the constant flow of solar energy to the Earth is constant and reaches in excess.

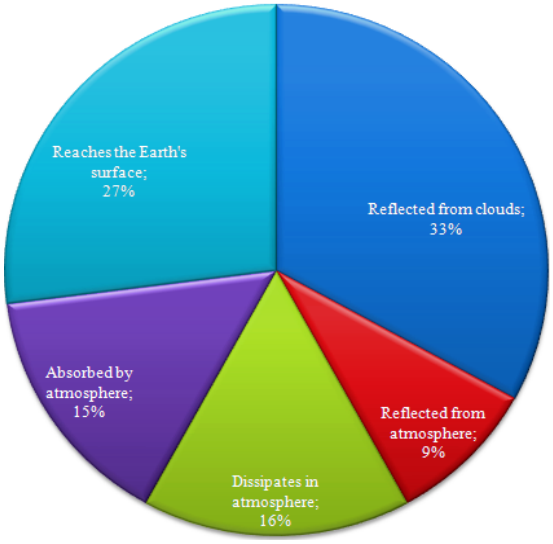


Fig. 1. Solar energy dispersion

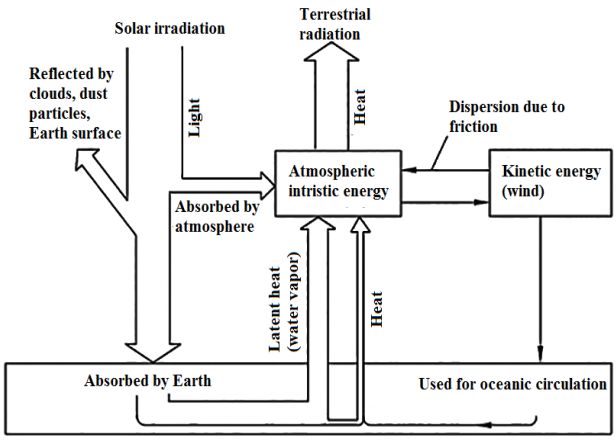


Fig. 2. Ways of spending solar energy on the Earth's surface

Plants on Earth consume only 0.5% of the energy reaching the Earth. Therefore, even if humanity will exist only due to the sun energy, it will consume only a small fraction of it. The Sun energy on Earth is quite enough for the energy needs of civilization. In this case, we will take only a small part of the energy, and it will not affect the biosphere. The Sun sends a huge amount of energy to the Earth. In a few days, its amount exceeds the energy potential of all proven fuel reserves. Even a third of this amount, which falls on the Earth, is thousands of times higher than all traditional energy sources.

The main problem is that the incoming energy is highly dissipated. One land's square meter gets about 100–200 W. The exact amount depends on the location on the Earth. In addition, the Sun shines during the day, and the power at this time reaches 400–900 W per square meter. At night, the energy does not come, and cloudy weather – comes much less. That is, at some moments, it is needed to collect all this energy flow and accumulate. And when the sunlight does not fall on the earth, use the accumulated energy.

The potential of energetic, which is based on the use of direct solar radiation [4], is extremely high. Note that the use of only 0.0125% of solar energy amount could provide all the current world energy needs. Unfortunately, it is unlikely that these huge potential resources will ever be realized on a large scale. One of the most serious obstacles to this implementation is the solar radiation low intensity. Even under the best atmospheric conditions (southern latitudes, clear sky), the solar radiation flux density is relatively low. Therefore, in order for solar collectors to "collect" the energy, needed at least partially to meet the needs of the population, it is necessary to place them on a huge territory.

III. ACHIEVEMENTS IN THE HELIOENERGY

In recent decades, solar energy has been developing rapidly all over the world in variety directions. Solar energy programs [4] are being developed in more than 70 countries – from northern Scandinavia to the scorched deserts of Africa.

Even the Northern Europe [5], which by the number of sunny days and the intensity of sunlight is significantly inferior to southern countries (Spain, Italy), actively conducts research in this area.

Solar devices [4] are used for heating and ventilation of buildings, water desalination, electricity production. Such devices are used in various technological processes. Have appeared the vehicles with the "solar drive": solar bikes, solar helicopters, motor boats, yachts, sun-cages and airships with solar panels. The sunmobiles, compared yesterday with a funny autotraction, today cross countries and continents at a speed almost equal to the speed of a normal cars. For the past three years, the German village of Franitzchütte, located on the outskirts of the Bavarian forest is fully powered by solar power from 840 flat solar panels with a total area of 360 sq. m. Power of each battery – 50 W. At night and in cloudy weather, the current is provided by a battery of lead-acid accumulators, charged at hours when the sun is in excess.

Today, renewable heat sources are used in the following areas:

– in the agricultural sector, in order to provide electricity and heating the greenhouses, hangars and other buildings;
– for sports facilities and medical institutions power supply;
– in the aviation and space industry field;
– in the lighting of streets, parks and other urban facilities;
– for settlements electrification;
– for residential buildings heating, electricity and hot water supply;
– for household needs.
– Advantages of solar power plants:
– they are completely free and inexhaustible;
– have complete safety in use;
– autonomous;
– cost-effective, as the cost is carried out only for the purchase of equipment for installations;
– their use ensures the voltage surges absence, as well as stability in power supply;
– durable;
– are easy to use and maintain.

IV. Principles of Helio Powerplants Construction

Solar power plants use the sunlight's thermal energy with the help of two types of receivers [6]:
– flat, trapping the sun's rays directed perpendicular to the plane (receivers track the direction of the sun's rays, automatically expanding its plane);
– concentrating, in which the sun's rays with the help of mirror spherical surfaces are concentrated in focus, where the thermal elements are located (for example, steam boiler).

V. The Solar Radiation Concentrators

The concentrator [7] can be constructed on the basis of a collective lens. In industrial plants lenses are not used: they are heavy, expensive and difficult to manufacture. Sun's rays can be focused with the help of a concave mirror. It is the main part of the solar concentrator – a device, in which parallel sunlight is collected by means of a concave mirror. If to place the pipe with water in the mirror focus, it will heat up. This is the direct-acting solar converters operation principle.

They can be used most effectively in southern latitudes, but they are also used in the middle lane. Mirrors, used in such power plants, are either traditional – glass, or from polished aluminum.

Technically, the concentration can be carried out with the help of various optical elements – mirrors, lenses, light guides, etc. – however, at concentrated radiation power high levels, it is practically advisable to use only mirror reflectors.

The main energy indicator of the solar radiation concentrator is the concentration coefficient, which is defined as the ratio of the concentrated radiation's average density to the density of the radiation flux incident on the reflecting surface under the condition of accurate orientation to the Sun.

High-potential concentration systems should have a configuration close to the shape of second-order surfaces of revolution – a paraboloid, an ellipsoid, a hyperboloid or a hemisphere. Only in this case can be achieved the radiation density, hundreds and thousands of times higher than the solar constant.

The most effective solar radiation concentrators have the form of: cylindrical paraboloid; paraboloid of rotation; flat-linear Fresnel lens. Paraboloid configuration has a clear advantage over other forms of the magnitude of the concentrating ability. Therefore, it is so widespread in solar systems.

VI. Helio Powerplants Types

Currently, solar power plants (SPP) are being built mainly of two types [7]: tower type SPP and distributed (modular) type SPP.

The idea underlying the work of the tower type SPP was expressed more than 350 years ago, but the construction of this type of SPP began only in 1965, and in the 80s a number of powerful solar power plants were built in the United States, Western Europe, the USSR and other countries.

In 1985, in the village of Shelkino of the Crimean region, the first in the USSR solar power plant SPP-5 was put into operation, with an electric capacity of 5 MW; 1600 heliostats (flat mirrors) with an area of 25.5 m^2 each having a reflection coefficient of 0.71, concentrate solar energy on the Central receiver in the form of an open cylinder mounted on a tower with a height of 89 m and serving as a steam generator.

VII. Heliostations and their Types

In the southern regions with high insolation, not just individual solar plants are being built, but entire stations producing energy on an industrial scale [8]. The amount of solar energy produced by them is very large, and many countries with a suitable climate have already begun a gradual transfer of the entire power system to such an alternative. According to the principle of the station is divided into photothermal and photovoltaic. The first work according to the method of collectors and supply the consumer with heated water for hot water supply, the second produce electricity directly.

There are several types of solar stations:

Tower type. They allow to get superheated water vapor supplied to the generators. A tower with a water reservoir is based in the center of the station, heliostats (mirrored) are placed around it, which focus the rays on the reservoir. These are quite effective stations, their main drawback is the difficulty of accurate mirror positioning.

Disc-shaped. Consist of a solar energy receiver and a reflector. Reflector – a dish-shaped mirror, which is concentrating radiation on the receiver. Such solar energy concentrators are located at a small distance from the receiver, and their number is determined by the required capacity of the power plant.

Parabolic. Tubes with a coolant (usually oil) are placed in the focus of a long parabolic mirror. The heated oil gives off heat to the water, it boils and rotates the generators.

Aerostatic. In fact, it is the most efficient and mobile heliostation on Earth. Their main element is a balloon with a photoelectric layer, filled with water vapor. It rises high into the atmosphere (usually above the clouds). The heated steam from the ball is fed through a flexible steam line to the turbine, at the outlet of it is condensed and the water is pumped back into the ball. Once in the ball, the water evaporates and the cycle continues.

On photo batteries. This is already familiar to all the installation of solar panels, which are used for private homes. They provide electricity generation and water heating in the required volumes.

VIII. Advantages and Disadvantages of Creating Helio Electric Power Stations

Fields with abandoned objects of industrial development have recently become quite common [9]. According to the USA environmental protection Agency, only in this country we are talking about 20 000 square kilometers of such fields, most of which are located within the city limits. Often, industrial developments reduce the price of the land on which they are located, and may cause fears of health and safety issues. Therefore, it is very difficult to sell such plots now. Proponents of renewable energy sources conducted research, according to which such fields can be used to produce energy from renewable sources.

They can also be used to create "solar farms," they are usually located near power lines, so they can be used without unnecessary financial costs. Exelon began the experiment on the field with an area of 166 000 sq m on the South side of Chicago. Previously, this land belonged to the manufacturer of brake linings. Construction work began in July 2009. Exelon has carried out work to prepare the territory for the installation of photovoltaic plants. The site was cleared of debris and leveled. 7 300 metal poles were placed on the entire surface of the field.

SunPower planned and built a solar power plant. It consists of 32 292 single-crystal modules with a rated power of 310 W. At the same time, SunPower reports that its developments have already gone ahead and that it is possible to manage a smaller area, while receiving the same amount of energy.

A solar power plant with a capacity of 10 MW can be built on 13 hectares using the latest technologies. The power plant uses a 500 series inverter from Satcon Technology corporation.

This area is located near the central office of Exelon. Therefore, power lines are qualitatively converted. A special topic is the financing of such projects. Exelon asked the USA Department of energy for a loan of 45 million euros for this project, but never received the money.

According to Exelon calculations, the solar power plant produces 14,000 MWh of solar current annually. However, experts believe that it is still necessary to collect and supplement the information provided by the firm, since it is too early to talk about the final figure.

The solar power plant is essentially a demonstration plant, therefore it is necessary to study how it will work in practice. Exelon and SunPower emphasize that this plant has a number of advantages, and that the transformation of such territories is necessary.

Exelon City Solar project is part of the big strategic plan "Exelon 2020". This strategy will allow the company to reduce the emission of harmful gases into the atmosphere by 15 million tons. They will also be able to offer more pure electric current to the consumer market.

Exelon is now the largest producer of nuclear energy. In addition, it has 36 wind power plants and intends to expand the use of wind energy.

IX. World Experience of Creation the Heliopower Station

The first attempts to use solar energy on a broad commercial basis date back to the 80s of XX century [7]. The biggest success in this area was achieved by Loose Industries company (USA). It put into operation a solar gas station with a capacity of 80 MW in December 1989.

Here, in California, in 1994, another 480 MW of electric power was introduced, with the cost of 1 kWh of energy – 7...8 cents. This is lower than

most traditional stations. (USA nuclear power plants ~ 15 cents per 1 kWh). At night and in winter, energy is mainly provided by gas, and in summer during the day – by the sun. Firm Loose Industries on solar-gas power plant in California uses a system of long parabolotsilindricheskih reflectors in a trough. In its focus is a pipe with a coolant – diphenyl, heated to 350 °C. The trough is rotated to follow the sun around only one axis (instead of two for flat heliostats). This made it possible to simplify the system of tracking the sun.

On the island of Sicily in the early 80-ies gave the current solar power plant with a capacity of 1 MW. The principle of its operation is also a tower. The mirrors focus the sun's rays on the receiver, located at a 50-meter height. It produces steam with a temperature of more than 600 °C, which drives a traditional turbine with a current generator, connected to it. It is undeniably proved that such a principle can operate power plants with a capacity of 10–20 MW, as well as much more, if you group such modules, connecting them to each other.

A slightly different type of power plant is in Almeria in southern Spain. Its difference is that focused on the top of the tower solar heat drives the sodium cycle, and he already heats the water to form steam. This option has a number of advantages. The sodium heat accumulator provides not only continuous work of power plant, but also gives the chance to accumulate partially excess energy for work in cloudy weather and at night. The capacity of the Spanish station is only 0.5 MW. But on its principle can be created much larger – up to 300 MW. In installations of this type, the concentration of solar energy is so high that the efficiency of the steam turbine process is no worse than in traditional thermal power plants.

According to experts, the most attractive idea regarding the conversion of solar energy is the use of the photoelectric effect in semiconductors.

The power plant in California has demonstrated that gas and the sun, as the main sources of energy of the near future, can effectively complement each other. Therefore, it is not accidental conclusion that as a partner of solar energy should be different types of liquid or gaseous fuels.

The Exelon City solar power plant in Chicago is a record-breaking photovoltaic power plant in the United States [9], developed in conjunction with SunPower Corporation, and is the largest photovoltaic power plant in the United States, located within the city limits. Its capacity is 10 MW of DC, respectively, 8 MW of AC. This joint project of two large firms aims to show how it is possible to use large production areas within the city for renewable energy processing.

The largest solar power plant in the world began operating in Switzerland [4]. The area of its solar cells is 4,500 m^2, with full plants lighting the power reaches 500 kW. This is enough for a village of two hundred single-family cottages. In the University of Stuttgart (Germany) designed the aircraft, the motor is powered by solar panels located on its wings with a span of 25 m. With a load of up to 90 kg, it takes off from a grass-covered take-off platform and speeds up to 120 km/h. Swiss scientists have patented transparent solar panels that can be inserted into window frames instead of glass. Between the two layers of glass, coated with a thin film of titanium dioxide with an equally thin layer of light-sensitive pigment, there is a layer of electrolyte with iodine content. Light, falling on the pigment, knocks out electrons from it, which fall through the electrolyte on the titanium dioxide layer. All layers of such solar panels are so thin that the transparency of the glass is not practically reduced. These glasses are cheaper than silicon solar panels.

The rapid development of solar energy in Switzerland was made possible by reducing the cost of photovoltaic converters per 1 W of installed capacity, from 1,000 $ in 1970 to 5–8 $ in 1990 and increasing their efficiency, from 5–6 to 20–30%. In the near future, it is proposed to reduce the cost of solar power by 50%, which will allow solar installations to compete with other autonomous energy sources, for example, with diesel power plants. One of the world leaders in the practical use of solar energy was Switzerland: more than 700 solar installations on silicon photovoltaic cells with power from 1 kW to 1 MW and solar collector devices for solar energy. The helioelectric program of Switzerland will make a significant contribution to the solution of environmental problems and to the energy independence of the country, which imports today more than 80% of energy from abroad.

Solar power plants on silicon photoconverters, often with a power of 2–3 kW, are usually mounted on roofs and facades of buildings (20–30 sq. m). Such an installation produces an average of 3,000 kWh of electricity per year, which is enough to provide for household needs, and sometimes charging on-board batteries of an electric vehicle. The daily excess of energy in the summer time is directed to the electric network of general use. In winter, energy can be returned to the owner of the solar station for free. Large firms are mounted on the roofs of the production buildings of the solar power plant with a capacity of up to 300 kW. However, such a station can cover the energy needs of the enterprise only by 55–70%. In the areas of the Alpine highlands, where it is unprofitable to lay power lines, autonomous solar power plants with energy storage batteries are built.

According to the experience of operation and according to some calculations, the Sun is able to meet the energy needs of at least all residential buildings in the country. A solar power plant, located on the roofs and walls of buildings, noise protection fences of roads, transport and industrial buildings, do not require to embed expensive agricultural or urban area.

Autonomous solar installation near the village of Grimsel provides electricity for round-the-clock lighting of the road tunnel. Near the city of Shur, solar panels mounted on a 700-meter section of noise protection fence annually provide 100 kW of electricity. Solar panels with a capacity of 320 kW, installed on the roof of the production building, almost completely cover the technological needs of the enterprise in heat and electricity. The efficiency of silicon photovoltaic cells with strong heating is significantly reduced, and therefore under the solar panels are laid ventilation ducts for pumping outdoor air. The heated air acts as a coolant collecting device. One of the major sections helicobacteraceae program Switzerland – the development of vehicles that use solar energy, since the vehicle consumes about a quarter of the energy resources necessary for the country. Every year in Switzerland, an international rally of sun cars is held.

Unique solar power plant created in Spain [10]. This solar power plant with a maximum capacity of 19.9 MW produces 110 GW/h of energy per year.

Gemasolar solar power plant looks very impressive (Fig. 3) it is a tower with a height of about 200 m surrounded by 2 650 mirrors for 96 sq. m each. The total area of the "mirror field" is about 185 hectares.

(a) (b) (c) (d) (e) (f)

Fig. 3. Solar power plant in Spain

Gemasolar solar power plant consists of a huge mirror field and towering in the center of the tower. On the field there are many heliostats – mirrors that track the movement of the Sun and catch its light.

This light, reflecting from the heliostats, is directed to the top of the high tower. The focused beam heats the water, turning it into steam, which is then fed through the pipes to the turbines, turns them, and thus causes the electric generators to produce current.

How can a solar power plant work at night without the sun? The secret is in two molten salt tanks that collect the heat energy produced during the day. Thus, it can generate electricity 24 hours a day.

The world's largest solar power plant of tower type was launched in the United States [11].

A 3-hour drive East of Los Angeles, in the Mojave desert, located megaelectronvolt Ivanpah solar electric Systems (Ivanpah Solar Electric System) [12].

A huge solar power plant, which uses about 350 thousand mirrors to reflect the sun's rays, began to supply electricity to consumers in California. Americans decided to use an excess of solar heat in Southern California – the world's largest tower-type solar power plant began operating in this state.

Construction of the power plant began in October 2010 and cost 2.2 billion dollars. It was recently put into operation. The energy produced by this power plant is clean – with no need to burn any fuel.

The Ivanpah Solar Electric Generating System power plant, jointly owned by NRG Energy, Google and BrightSource Energy, can generate up to 392 MW of energy at design capacity. According to NRG Energy, this is enough to provide 140 thousand households in California with clean electricity for a year or to avoid carbon dioxide emissions weighing 400 thousand tons per year (this is equivalent to removing 72 thousand gasoline cars from the country's roads) (Fig. 4).

The temperature around the towers of Ivanpah Solar Electric Generating System can reach 600 °C.

The station covers an area of over 1,300 hectares of federal land and is located in the Mojave desert. It, as already noted, includes about 350 thousand software-controlled mirrors (heliostats), which concentrate the sun's rays on water tanks located on the tops of huge 140-meter towers.

Focused sunlight converts water in tanks into steam, which drives a turbine generator that produces clean energy. Power plants of the tower type can achieve a fairly high rate of energy conversion (about 20%) and high operating power.

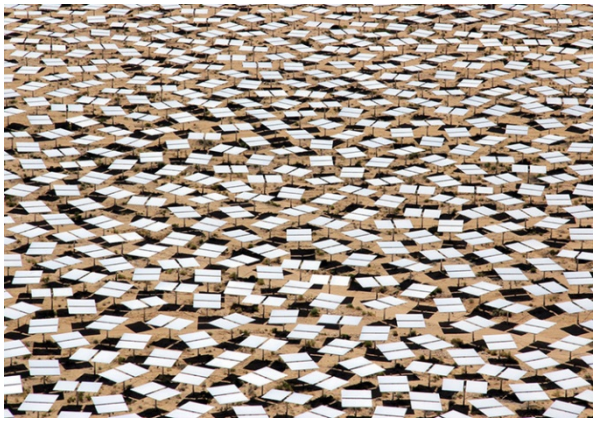
(a)

(b)

(c)

(d)

Fig. 4. The world's largest solar tower-type power plant



(e)

(f)

Fig. 4. Ending. (See also p. 71)

For Google, which has invested $ 168 million in the project (out of a total of $ 2.2 billion), investing in clean energy sources is not a fundamentally new step. The Internet giant is actively investing in a number of wind and Solar energy projects – currently, according to the company reports, it covers more than 34% of the needs of its data processing centers from renewable energy sources.

However, although the companies that created the power plant strongly emphasize the benefits of clean energy, the construction of such facilities raises new questions about the harm to the environment. For example, according to the Wall Street Journal, some birds flying through the intense heat around the towers (the temperature near them can reach 600 °C), die or scorch their feathers. The relevant authorities of the States and the Federal government of the United States began a study of the impact of the power plant on birds-in two years, the results should be published.

Despite the fact that the energy station Ivanpah receives from the sun, it does not use photovoltaic modules (solar panels) [12]. Instead of this, special mirror modules the size of garage doors are operated, they are also called heliostats. There are 173 thousand such mirror modules at Ivanpah station. In the center of the solar power plant there are three high towers, on the tops of which the mirrors-heliostats reflect the sun's rays – the computer controls the moving mirrors, so that they always turn behind the sun.

There are about 100 similar stations in the world, and about 50 are planned to be put into operation in the near future. Some of these stations are capable of generating energy even at night.

An important place in the construction of this power plant was occupied by the program of environmental protection around it. After the construction of the station Ivanpah threatened the life of rare turtles living in the desert. In order to keep them, the owner company bought a vast area away from the station, where about 200 of these turtles were moved. The company spent $ 22 million to buy land, hire biologists and relocate animals.

The us state of California plans to provide a third of all energy consumption due to the sun, geysers and wind by 2020 year.

IV. Conclusion

According to many analysts and media, the era of alternative energy has already begun [12 – 19]. How do you like the fact that solar panels can already be bought in ordinary urban stores? And according to TIME magazine, every 3 minutes at least one American house installs a panel on its roof, thereby switching to the energy of the sun. And this dynamic is growing!

So far, the electric energy, generated by sunlight, is much more expensive than that generated by traditional methods [4]. Scientists hope that the experiments carried out at pilot plants and stations will help to solve not only technical but also economic problems of widespread use of solar energy.

When using simpler in design, and hence less expensive heliostats, the cost of electricity, produced by solar power plants, should significantly decrease [13].

In the next decade, solar energy will become commercially viable.

Modern developments and researches in the field of solar energy with the use of nanotechnology in the future will reduce thecosts and increase the solar radiation into electricity conversion’s efficiency.

Solar energy in the future may become the main source of continuously renewable energy in the Earth's biosphere.

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І. Ю. Сергеєв, О. Б. Проценко. Досягнения в галузі створення сонячних електростанцій (аналітичний огляд)

Представлено огляд публікацій в області створення електростанцій, що використовують енергію сонячного випромінювання – геліостанцій. Показано, що сонячна енергія – джерело енергії майбутнього, виключно чистий, простий і природний спосіб отримання електроенергії, який дуже мало пов'язаний з біологічною небезпекою. Сонячна енергія практично не завдає жодної шкоди довкіллю, є екологічно чистим джерелом, що

не витрачає ресурси корисних копалин і не порушує тепловий баланс планети. У найближче десятиліття сонячна енергетика стане комерційно рентабельної. Сонячна енергія в майбутньому може стати основним джерелом безперервно відновлюваної енергії в біосфері Землі.
Ключові слова: електростанції; енергія сонячного випромінювання; геліостанції; джерело енергії майбутнього; екологічно чисте джерело; джерело безперервно відновлюваної енергії.

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И. Ю. Сергеев, О. Б. Проценко. Достижения в области создания солнечных єлектростанций (аналитический обзор)

Представлен обзор публикаций в области создания электростанций, использующих энергию солнечного излучения – гелиостанций. Показано, что солнечная энергия – источник энергии будущего, исключительно чистый, простой и естественный способ получения электроэнергии, который очень мало связан с биологической опасностью. Солнечная энергия практически не наносит никакого вреда окружающей среде, является экологически чистым источником, не расходует ресурсы полезных ископаемых и не нарушает тепловой баланс планеты. В ближайшее десятилетие солнечная энергетика станет коммерчески рентабельной. Солнечная энергия в будущем может стать основным источником непрерывно возобновляемой энергии в биосфере Земли.
Ключевые слова: электростанции; энергия солнечного излучения; гелиостанции; источник энергии будущего; экологически чистый источник; источник непрерывно возобновляемой энергии.

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