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TYPES OF ALTERNATIVE ENERGY AND PROSPECTS FOR THEIR USE IN UKRAINE

Shch. Argun, Ph. D. (Eng.), Asst. Prof.,
Kharkiv National Automobile and Highway University

Abstract. Analysis of the existing unconventional forms of energy with the purpose of determining the state of this industry in Ukraine is conducted. The advantages of alternative energy sources and the need for their further development in Ukraine have been shown.

Key words: alternative energy, power, unconventional energy.

ВИДИ НЕТРАДИЦІЙНОЇ ЕНЕРГІЇ ТА ПЕРСПЕКТИВИ ЇХ ВИКОРИСТАННЯ В УКРАЇНІ

Щ.В. Аргун, ст. викладач, к.т.н.,
Харківський національний автомобільно-дорожній університет

Анотація. Проведено аналіз існуючих нетрадиційних видів енергії з метою визначення стану даної галузі в Україні. Показано переваги альтернативних джерел енергії та необхідність подальшого їх розвитку в Україні.

Ключові слова: альтернативна енергетика, електростанція, нетрадиційна енергія.

ВИДЫ НЕТРАДИЦИОННОЙ ЭНЕРГИИ И ПЕРСПЕКТИВЫ ИХ ПРИМЕНЕНИЯ В УКРАИНЕ

Щ.В. Аргун, ст. преподаватель, к.т.н.,
Харьковский национальный автомобильно-дорожный университет

Аннотация. Проведен анализ существующих нетрадиционных видов энергии с целью определения состояния данной отрасли в Украине. Показаны достоинства альтернативных источников энергии и необходимость дальнейшего их развития в Украине.

Ключевые слова: альтернативная энергетика, электростанция, нетрадиционная энергия.

Introduction

Any state needs its power branch to be taken care of to fully develop its economy. For Ukraine this issue has acquired vital importance due to the termination of gas delivery from Russia. But it should be noted that this fact is not the only stimulus for power engineering development, our pursuit to approach European standards is also the reason. In particular, there are the issues of environment and energy saving involved. That is why we can say that development of unconventional sources of energy is paramount for Ukraine.

Analysis of the Publications

Unconventional (alternative) energy is a set of promising ways to obtain, transfer and use energy, which are not so common as traditional ones, but are of great interest because their use is profitable bearing at the same time the low risk to harm the environment [1–2].

That's why development of unconventional types of energy is given great consideration throughout the world [3–15].

The Purpose and the Task

The purpose and the task of the work are the analysis of the alternative types of energy with the aim of determining the prospects and possibilities of their further development in Ukraine.

Power Engineering in Ukraine

According to the State Statistics Service (the structure of consumption of the primary energy) the energy balance in Ukraine looked like this in 2012 [1]: natural gas is – 34,8%; coal and peat – 34,6 %; nuclear energy – 19,2%; oil and oil products – 9,4 %; other types of energy resources – 2 %.

That is, the first place was occupied by the consumption of natural gas. Currently the situation with gas supplies in the country is critical. So both big and small consumers should be refocused on using electricity instead of gas as soon as possible. And this can be done by increasing the capacity of the hydro- and nuclear power-plants and by active development of alternative energy sources (solar and wind power stations, small hydropower plants, tidal and wave power plants, geothermal power plants, non-traditional combustion).

It's should be noted that an alternative source of energy is a renewable resource. It replaces the traditional energy sources operating on oil, produced natural gas and coal, which, when burned, emit carbon dioxide, contributing to the greenhouse effect and global warming [2].

Solar Power

Solar power is the conversion of sunlight into electricity, either directly using a photovoltaic systems (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to concen-

trate a large area of sunlight into a small beam. A photovoltaic systems convert light into electric current using the photovoltaic effect [3], fig. 1,a.

Solar power plants are divided into several types: tower type; plate type; those using photocells; those using parabolic concentrators; combined ones; balloon and solar-vacuum power plants.

For a complete analysis the advantages of solar energy should be noted: inexhaustibility, ecological compatibility, widespread availability; high thermodynamic quality – the ability to convert (directly, in the thermodynamic, thermal and photo-chemical cycles) into the useful forms of energy (heat, electricity, synthesis of new materials and energy, laser radiation, etc.) with high efficiency.

The disadvantages include: low density of energy flow; daily, seasonal, weather instability, and, as a consequence – the high cost of equipment (receivers, batteries, etc.) and the high cost of power generation; the possibility of concentrating only of the direct component of solar radiation; dependence on the geographical coordinates. By the climatic conditions Ukraine is a region with an average intensity of solar radiation. The amount of solar energy per unit of the area during the year is 1000–1350 kWh/m². According to the intensity of solar radiation the country can be divided into four regions: West, Central, Southeast and South region. The pilot projects implemented during the recent years, have shown that the annual heat production in the conditions of Ukraine is 500–600 kWh/m² [4].

Thus, annual resources of the solar hot water supply and heating can make 28 billion kWh of the thermal energy. Implementation of this potential would make possible to save 3,4 million tons of oil equivalent per year.

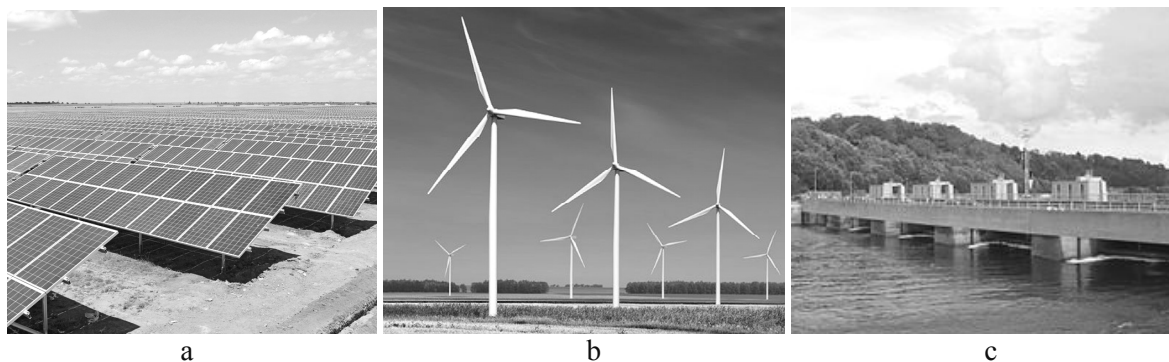


Fig. 1. An alternative sources of energy: a – Solar Power Plant; b – Wind Power Plant; c – Tidal Power Plant

Wind Power Plants

Wind Power Plant (WPP) is several wind turbines assembled in one or more locations and combined into a single network. Large WPP may consist of 100 or more wind turbines [5], fig. 1,b. WPP are built in the areas with high average wind speed – 4,5 m/s and more.

There are five types of WPP: ground, coastal, shelf, floating, soaring. Also, they are divided into two types: those with a horizontal axis of revolution and those with a vertical one. The latter are less popular, because for their work stronger winds and external source for triggering are required.

The advantages of the WPP are many: they do not pollute the environment, they do not need fuel and, under certain circumstances, they can compete with traditional sources of power. Minuses are, unfortunately, not few either: the nature of the wind is unstable and it hinders their work. The initial wind speed at which the wind turbine starts power generation is 1–3 m/s. The nominal output is achieved only when the wind speed is 10–12 m/s.

During the period from January 1 to December 31, 2013 95,3 MW of new wind power were implemented in Ukraine. Thus, on December 31, 2013 the total installed capacity of wind energy sector in Ukraine amounted to 371.2 MW compared to 276 MW in 2012, which corresponds to the sector growth rate of 56% [6]. In general, by the end of 2013 the total capacity of physically installed wind turbines in the country had amounted to 472.9 MW, of which 101,7 MW are now at the stage of accession to the power grid. In 2013, all WPPs of Ukraine produced more than 630 million kW/h of electricity, accounting for 0,33 % of total electricity production in the country. Due to «green» electricity, generated from wind, CO₂ emissions were reduced by 512 thousand tons [6].

Thus, the development of wind power engineering in Ukraine is very important and promising. It may be the next step toward energy independence of our country.

Tidal Power Plants

Tidal power plant (TPP) is the kind of hydroelectric power station using tidal energy, in fact, the kinetic energy of rotation of the Earth, fig. 1,c.

TPPs are built on the shores of the seas, where the gravitational forces of the moon and the sun change the water level twice a day. Fluctuations of water level near the shore can reach 18 meters [7].

Advantages of TPP are: ecological compatibility and the low cost of energy production. The drawbacks are the high cost of construction and change of power during a day; as the result, the TPP can only work as a part of the power system which has the sufficient capacity of power plants of the other types. Due to the geographical position of Ukraine it is possible to use the energy of tides to produce electricity.

Wave Power Plants

The wave power plant (WPP) is a plant, located in the aquatic environment, with the aim to generate electricity from the kinetic energy of waves [8]. There is a problem concerning the fact that when you build a wind power plant storm waves bend and even crush steel blades of water turbines. Therefore, it is necessary to apply the methods of artificial reduction of the power drawn from the waves. Advantages of WPP are as follows: they can serve as wave absorbers protecting ports, harbors and shores from destruction; several types of power plants for low-power wind can be mounted on the walls of the piers, bridge abutments, reducing the impact of waves on them, as the specific power of disturbance is 1-2 degrees more in magnitude than the specific power of the wind, the wave energy can be more profitable than wind energy. The disadvantage of wind power plants is the fact that in terms of socio-economic problems, the wave energy (or rather certain types of generators) can cause the displacement of fishermen from productive fishing areas and may pose a risk to safe navigation [9]. WPPs are at the stage of development in Ukraine. For example, the Ukrainian Scientific-Production Firm «Krok-1» in co-authorship with the scientists from the National Aviation University (Kyiv) and the Admiral Makarov National University of Shipbuilding (Mykolaiv) has created and is actively implementing the project of modern marine hydro power plant up to 20 MW with a flexible energy absorbing element [10].

Uniqueness of the developed plant is that it can operate effectively at any fluctuations of the sea surface at the expense of self-regulation of the form of an energy absorbing element under the influence of waves and the necessary depth of

the station immersion in accordance with the weather conditions on the surface. The cost price of electricity that is generated by the station does not exceed 0,1 cents/kWh [11]. Thus, huge prospects of development of power engineering are being opened for Ukraine.

Geothermal Plants

Geothermal energy (GT) is the branch of power engineering based on producing electricity, at the expense of the energy contained in the bowels of the earth, at the geothermal plants [12]. The main advantage of GT is its practical inexhaustibility and full independence on environmental conditions, time of day and a year. The design of the station depends on the source of geothermal energy to be used.

The main problem emerging when using underground thermal waters is the need for renewable cycle of supply (pumping) with water (usually waste) into the underground aquifer. Thermal waters contain large amounts of salts of various toxic metals (boron, lead, zinc, cadmium, arsenic), and chemical compounds (ammonia, phenols), which fact prevents the discharge of such water into the natural water systems, located on the surface [12].

Ukraine has considerable resources of geothermal energy at its disposal whose potential reserves estimated value is 1022 J. According to different estimates the resources of geothermal heat considering the proven reserves and conversion efficiency of geothermal energy will be able to provide operation of a geothermal power plants with total capacity of the work up to 250 million kW (at the depths of drilling wells up to 7 km and periods of station operation up to 50 years) and geothermal heating systems with a total capacity up to 1,5 billion kW (at the depths of drilling boreholes up to 4 km and periods of the system work up to 50 years) [14].

Biofuel

Biofuel is the fuel from vegetable or animal primary product, from waste products of organisms or organic industrial waste [15].

In the energy sector three generations of biofuel are distinguished: **1st generation**. From biological materials obtained typically as a result of processing biological waste. The following types are distinguished: solid biofuel (energy wood: firewood, briquettes, pellets, wood chips,

straw, husk), peat; liquid biofuel (for internal combustion engines, such as bioethanol, biomethanol, biobutanol, dimethyl ether, biodiesel); gaseous (biogas, biohydrogen, methane).

2nd generation. Various types of the fuel produced by pyrolysis of the biomass, or other fuels, along with methanol, ethanol, biodiesel, produced from raw material sources of the «second generation». Fast pyrolysis allows converting the biomass into a liquid, which is easier and cheaper to transport, store and use. Motor fuel or fuel for power plants can be produced from liquid. Lignocellulosic compounds are the sources of primary products. The plants as the source of second-generation primary products include algae; camelina (a plant growing in rotation with wheat and other crops); *Jatropha* (growing in arid soils).

3rd generation. Produced from algae. Do not require land, may have a higher concentration of biomass and high speed of reproduction.

According to the data on the energy balance of Ukraine, of the total primary energy supply, Ukraine has over 130 million tons of oil equivalent, wherein biofuel comprises only 1,48 million tons, which is 1,14% of the energy supply. For comparison – in the EU, this figure is 6,72 %. With 1759 million tons of oil equivalent, representing the total primary energy supply in the EU, biofuel makes 118 million tons. That is why the development of this area of energy is very promising for Ukraine. It can also partly help solve the problem of waste disposal, which is a very serious problem for our country.

Conclusions

The analysis of the existing unconventional types of energy showed that in Ukraine this industry is in its infancy and requires serious expansion of applications in the future up to the partial replacement of traditional energy sources by non-traditional ones.

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Рецензент: Ю.В. Батыгин, профессор, д.т.н., ХНАДУ.

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