

ENERGY EFFICIENCY OF ENTERPRISES AS A KEY FACTOR IN THE DEVELOPMENT OF THE COUNTRY'S ECONOMY

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Abstract. The transition to alternative energy sources requires a long period, attracting significant investments in the process of creating and developing environmentally friendly fuels. Creating an environmentally safe, energy-efficient economy is a prerequisite for sustainable development of each country. The above-mentioned factors determine the relevance of the study of the problems of the functioning and development of energy, which is mainly due to the economic expediency of renewable energy and the requirements of the country's energy independence. The objective of the article is to determine the features of ensuring the energy efficiency of the Ukrainian economy using alternative energy sources. Research shows that the development of alternative energy will allow us to move away from the use of traditional fuels and create the prerequisites for the energy independence of countries. Taking into account the natural factors and the significant dependence of Ukraine on imported primary energy sources, it is determined that solving the problem of increasing energy efficiency of the economy is possible only with the stimulation of the use of alternative energy sources. The most promising sources of energy are identified, namely: biofuels, wind energy, geothermal energy, solar energy, solar thermal, controlled thermonuclear fusion, energy of tides and effluents. The recommendations for realization of such directions of the policy of the state regulation in the energy sphere as energy security, energy efficiency, energy saving are given.

Keywords: energy efficiency, energy security, energy resources, renewable energy, alternative energy sources.

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Introduction

In the modern world, the issue of increasing energy shortages is important. The need for resources is almost proportionally increasing with the growth of the global population, so it is likely that by 2030 the energy demand may increase several times. At the global level, overall energy needs are growing, primarily due to the growing needs of countries such as China, India, the United States, as well as Russia, which are important on the world stage. It is known fact that the most common share in the overall structure of energy is traditional sources, which reach 80% (21% - natural gas, 24% - coal, 35% - oil), alternative sources of energy in the general structure occupy only 14% (11% - biomass, 2% - water, 1% - others), and nuclear energy accounts for about 6%. Therefore, today's challenge is the rational use of traditional energy sources and the search for alternatives that can fully provide humanity in the future.

Increasing energy efficiency is an overriding priority, the solution of which strengthens energy security, enhances the environment, improves the quality of life and contributes to overall economic well-being. Energy efficiency is called "the first fuel" of the economy, because it is in it the best opportunities for more full use of available resources, support for economic growth and reduction of energy costs. Adapting the economies of many countries to global economic change requires modern scientific approaches to research and implementation of advanced energy saving methods at enterprises. After all, an increase in the energy efficiency of the economy as a whole, including industrial enterprises, is of a state nature and is a task of paramount importance due to the modernization of the economy, the requirements of socio-economic development, the need to improve the state of the environment.

Features of ensuring energy efficiency of the Ukrainian economy

The academic community has made a significant contribution to solving the problem of energy efficiency of the economy, the search for alternative energy sources, energy saving methods and their implementation at the level of the countries: V.Ghalvani, A.B. Lovins, E. F. Schumacher, J. Cornilli, V. Ohinomo, B. Laponche, V. Heyets, A. Tsapko-Poddubna, G. Gelotukha, G. Kaletnik G., M. Kovalko, S. Denisyuk, V. Zhovtyansky and others. The general problems of energy supply and the individual issues affecting them are under the constant attention of world and regional international organizations, and first of all - energy. Achievements in addressing the issue of improving the energy efficiency of the economy have also been reflected in the work of the International Energy Agency (IEA), the World Energy Council (CEA), the International Atomic Energy Agency (IAEA), the European Commission's State Administration (EUROSTAT), the CIS Electricity Council, the Energy Policy Center (Switzerland), European Commission articles within the framework of the "Smart Energy for Europe" Program, the World Bank (WB), the European Bank for Reconstruction and Development (EBRD), the Ukrainian Association of Renewable Energy.

However, despite the thoroughness and depth of scientific research, the various developments in the theoretical and applied direction, the issues of energy efficiency, the systematization of trends in the development of alternative energy sources, and the definition of priority development directions for ensuring energy security require further research.

Today, Ukraine faces the historic task of accelerating the growth of living standards, and this requires the search and implementation of "breakthrough" innovations for a sharp

increase in the efficiency of the economy. First, it concerns the basic branches of the economy - such as the fuel and energy complex. Today, the radical reduction of the energy resources of the gross product and, as a result, the strengthening of independence and the increase of the competitiveness of the economy is extremely urgent. (*Shevtsov et al., 2008:4*).

As practice shows, Ukrainian enterprises are among the most energy-intensive in the world. This is primarily because the conditions of the command-planned economy, which was inherent in Ukraine until the period of gaining and in the first stage of independence, enterprises did not have free funds for investing in equipment upgrades, could not introduce energy-saving technologies, or build own power plants. Due to the high consumption of fuel and energy resources per unit area (i.e. energy efficiency) and low household income, the following regions of Ukraine appeared in the critical area: Dnipropetrovsk, Ivano-Frankivsk, Mykolayiv, Poltava, Khmelnytsky and Cherkasy regions. (*Pysar et al., 2018*).

Market mechanisms that have begun to spread and develop in the Ukrainian economy have opened new opportunities for Ukraine: entering the world arena, increasing the share of international trade, the possibility of cooperation with foreign companies and multinational corporations. Such positive changes in the economy required a significant reorganization of the activities of enterprises, improving the quality of products, the introduction of innovative technologies. Enterprises faced the problem of insufficient funds for energy purchases. The problem was aggravated in 2008, when the economic crisis began around the world. One of the reasons for this was the oil supply problem. Speculative actions on raw materials led to an increase in oil prices almost threefold in just a year and a half. Thus, the price of oil in early 2007 was \$ 55 per barrel, while in mid-2008 it rose to \$ 143 a barrel. The global crisis has led not only to the deterioration of the overall economic situation of countries in the world, but also to the negative changes in energy development. Since oil is used not only to meet energy needs as one of the most demanded fuels, but also as a raw material for the chemical industry, rising prices for this resource have led to an aggravation of the global crisis (*Heletukha et al., 2012*).

The global financial crisis, the absence of its own market mechanisms for regulating the economy, the lack of a regulatory framework and proper technological support have led to the fact that for Ukraine, very high energy intensity indicators of GDP are typical of Ukraine, which testify to the low efficiency of economic development. The indicator of energy intensity of GDP in Ukraine exceeds the indicators that are typical for industrialized countries. Such negative factors are a significant incentive for Ukrainian enterprises to upgrade equipment and production mechanisms, search for sources of funding for innovation, and the introduction of energy-saving technologies. Another way to increase the level of energy security of enterprises is to introduce incentive mechanisms for rational use of available energy resources, implementation of measures to avoid their losses, as well as re-treatment based on non-waste production. Such measures are important for increasing the energy independence of the country, reducing the threat of the energy danger of all forms and levels and ensuring sustainable economic development.

Energy efficiency and energy conservation are extremely important factors for the development of enterprises and their maintenance of energy security. It is worth moving away from traditional energy resources such as oil and gas, and accumulating funds for the search and introduction of new energy sources that will be lower than the cost, but will have the same heat output. The circumstances that determine energy conservation as a factor for improving the efficiency of the industrial enterprise are presented in table 1.

Table 1

Circumstances affecting energy saving

Energy saving as a factor in increasing efficiency		
increasing the competitiveness of products in terms of reducing the cost of its production, reducing the share of energy costs	additional attraction of investments, which promotes updating of technological equipment and increase of quality of production, let out by industrial enterprises	stabilizing demand for energy resources in the direction of its reduction, which contributes to reducing the environmental load in the areas of industrial enterprises

Source: (Haidutskiy, 2004)

The search and introduction of alternative energy sources is one of the most promising and priority areas of energy security at enterprises. The search for non-traditional and renewable energy sources can be a key factor in the success of enterprises, which will increase profits, reduce production costs and energy dependence. Alternative energy sources at Ukrainian enterprises began to develop since the independence of Ukraine. Currently, their share in the overall balance of energy reaches only 3%, but by 2020, the priority task is to increase this figure to 11%. In general, by 2030, the share of renewable energy sources is projected to increase to 30%, as this is also the task of the European Union, an association agreement that was signed in 2014. Scientists suggest that even an increase in the share of renewable energy sources relative to traditional ones by 15% will help stabilize and increase the country's energy security by 3.5%.

Alternative energy is also important in order to reduce the negative impact of the enterprises of the fuel and energy complex on the ecology, which is mostly manifested in the imperfect structure of the construction in industrial enterprises, in obsolete technologies and equipment, as well as in the mostly absence, accepted at the enterprises of reverse logistics improvements.

For a long duration, it was considered that the electricity supply generated by the operation of nuclear power plants is a completely rational replacement of the traditional resources of the fuel and energy complex (oil, gas, peat, shale, coal, etc.). Nevertheless, such terrible accidents as the explosion at the Chernobyl Nuclear Power Plant on April 26, 1986 and at the Fukushima-1 NPP in March 2011 triggered an active discussion of the energy problem at the global level. A country like Germany, in general, has decided to abandon nuclear energy and plans completely replace it with an alternative to 2022. Moreover, as practice has shown, the use of nuclear power for many decades has still not been able to replace the efficiency of combustion of carbohydrate fuels (*Ekspres-vypusk Derzhavnoi sluzhby statystyky Ukrainy, 2016*).

The problem of saving energy appears only at the level of an individual state, but also reaches the world scale. Traditional sources of energy associated with the use of natural resources such as oil, gas, black and brown coal, peat, combustible shale, etc. tend to exhaust their stocks. Therefore, an important global issue and enterprise-level question is the search for alternative energy sources that can initially partially, and then completely replace, traditional ones. At the end of the 70s of the twentieth century, measures were taken to introduce new energy sources due to the very high oil prices. The countries that have decided to modernize their own energy complex are those of Central and Eastern Europe, such as Poland, Hungary, and the Czech Republic. Subsequently, Ukraine joined them. In our opinion, the introduction of alternative energy sources is extremely relevant, which is what

will help enterprises to strengthen their energy security and minimize the negative impact of economic downturn at the country level.

Major challenges in the energy sector, such as increasing countries' dependence on energy imports, are significant for the future of the world community; the growing demand for energy resources while reducing the reserves of traditional energy sources and increasing their prices; need for big investments; the need to protect the environment and solve the problem of climate change; political instability in supplier countries and transit of energy resources. All these challenges require the development and implementation of a coherent global energy policy that takes into account the specific features of the regions and technological progress in the energy supply (*Shevtsov et al., 2008:11*).

Today in the world there is a rapid development of alternative energy. According to the results of the monitoring, global investments in alternative energy totaled one trillion dollars. Based on the research of Ukrainian scientists, energy clusters, green public procurement, removal of barriers to authorization, project tenders (*Kravtsiv et al., 2017*).

In December 2008, the European Parliament has obliged the EU countries to bring renewables to 20% of the overall balance by 2020, and up to 40% by 2040. The leading countries have declared the goal to achieve an average of 15-25% of renewable energy production by 2020 (*Pidlisna et al., 2013:59*).

Among the world's renewable energy trends, there should be a rejection of carbon investments in energy in favor of renewable energy sources, global growth in sector investment, reducing the introduction of new generation capacities, and the creation of decentralized networks - smart-grids. It should also be noted that the theoretically possible annual potential of renewable energy resources of the planet significantly exceeded the potential supply of organic and nuclear fuel by almost 15 times and almost 80 times exceeded all possible known reserves of energy resources of traditional sources (Table 2). (According to data (*Ukrainska asotsiatsiia vidnovliuvanoi enerhii, 2016*)).

Table 2

Energy potential of renewable energy resources of the planet

Renewable energy resources	Energy potential of renewable energy resources, billion tons of oil equivalent per year		
	Theoretically possible	Technically feasible	Economically viable
Radiation energy of the sun	86000	5	1
Thermal energy of seas and oceans	7500	1	0,1
Wind energy	860	5	1
Hydropower, in particular:	6,065	3	1,52
The energy of watercourses	3	2,91	1,5
The energy of the waves	3	0,05	0,01
The energy of the tides	0,065	0,04	0,01
Biomass energy, in particular:	40	2,55	2,0
forests	15	1,5	1,5
plants	10	1,0	0,5
algae	15	0,05	0
Geothermal energy	16	0,4	0,2
Total	94422,065	16,95	5,82

Source: formed by the author according to the statistics of the stations for (*Ukrainian Hydrometeorological Center, 2019*)

The potential of renewable energy sources in Ukraine is significant (Table 3). The installed capacity of RES in Ukraine has a tendency for annual growth (the fall in 2014 is due to the loss of energy facilities in the Autonomous Republic of Crimea and in the zone of ATU). The average annual growth rate of the installed capacity of RES is 31% (*The development of renewable energy sources in Ukraine, 2017*).

Table 3

Potential of renewable energy sources in Ukraine

Areas of development of RES	Annual technically achievable energy potential	
	billion kWh / year	million tons per year
Wind power	79,8	28,0
Solar power	38,2	6,0
Small hydropower	8,6	3,0
Bioenergy	178	31,0
Geothermal heat energy	97,6	12,0
Energy environment	146,3	18,0
Total volumes of replacement of traditional fuel and energy resources due to RES	548,5	98,0

Source: formed by the author according to the statistics of the stations for (*Ukrainian Hydrometeorological Center, 2019*)

In 2018, 742.5 MW of power generating power from renewable sources was put into operation in Ukraine, which is 2.8 times the volume of capacities introduced in the previous year. Solar (SES) and wind power plants (WPPs) make up 96% of the installed capacity. Regarding the development of the renewable energy sector (RES), in 2018 the NCRECP has set a green tariff for 202 electricity objects, including SES - 163 objects, wind power plants - 11 objects, biogas / biomass - 16 objects, small hydroelectric power stations - 12 objects. The average unit power commissioned in 2018 by the objects of electric power industry is 3 MW. (Fig. 1) (According to data (*UNIAN, 2017*)).

According to the practice of the leading countries, a state policy should be aimed at the production greening and stimulation of energy saving at industrial enterprises. The state policy of Ukraine is aimed at the implementation and improvement of new mechanisms of nature use and improvement of nature protection activities. The key aspects of this government policy direction are: control over established prices for the use of non-renewable natural resources (minerals, water and land resources); also, the eco-tax on environmental pollution, which is regulated by the tax code in Ukraine and which rates vary according to the name of the pollutant as of 01.01.2018. It is also important that state policy in Ukraine is aimed at encouraging enterprises that are involved in the development and implementation of low-cost and resource-saving technologies. In particular, Ukraine has a "green tariff". This is a special price set by the government for purchasing electricity from enterprises that implement alternative energy sources in production.

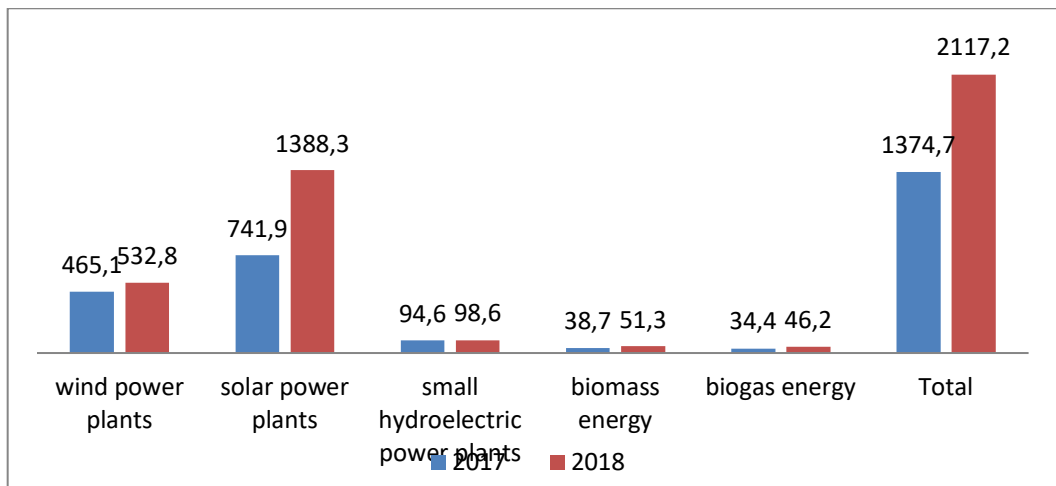


Fig.1. Dynamics of commissioning of renewable energy sources, MW

Source: according to data (*Review of the development of the renewable energy sector, 2018*)

Ukraine also operates the Electricity Act, according to which the "green tariff" is the price at which the wholesale market should buy the electricity generated by installations that are operating on alternative energy sources at the plant. It is also important to understand that companies that supply electricity at the "green tariff" should purchase electricity at a specific volume and price set up by the NEURC (National Energy and Utilities Regulatory Commission) only in certain cases, in order to avoid speculation. Thus, the establishment of "green tariffs" in Ukraine is a mechanism of state policy aimed at the interest of the population in the direction of the implementation and development of alternative energy sources. Both physical and legal entities (enterprises of different activity area), which use solar energy, wind energy, hydro power plants, bioenergy, etc., have the opportunity to sell the produced electricity to the government at favorable prices fully or partially.

As of January 1, 2019, the installed capacity of renewable energy facilities in Ukraine, which operate under the "green" tariff, has reached 2117 MW (*UNIAN, 2017*). In 2018, the dynamic development of Ukrainian "green" energy was recorded. During the year, 813 MW of new power generation from renewable sources was installed. This is almost 3 times more than the volume of capacity introduced in 2017, namely, about 300 MW. In particular, in 2018 additionally established: 646 MW - solar power stations, 70 MW of SES - private households (for 9 months); 68 MW - wind farms; 13 MW – stations that generates electricity from biomass; 12 MW – stations that generates electricity from biogas, 4 MW - small hydroelectric power stations. Over 730 million euros were invested in the installation of 813 MW of renewable energy facilities. Totally, the country has 2,240 MW of power supplies, that generate "clean" electricity, which is 1.5 times higher comparing to year 2017 (about 1500 MW). Mentioned results demonstrate the rapid growth of renewable energy, supported by the legislative framework and incentives, beneficial for investors and businesses, as well as the global tendency to cheapening "green" technologies (Fig. 2, Fig. 3).

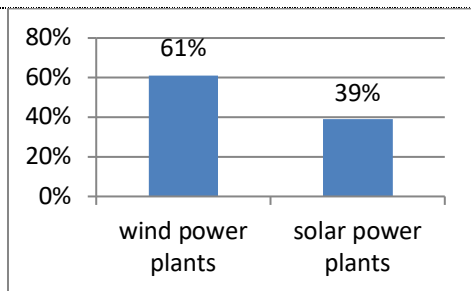


Fig. 2. The share of power facilities renewable energy, working on "green" tariff in Ukraine in 2009

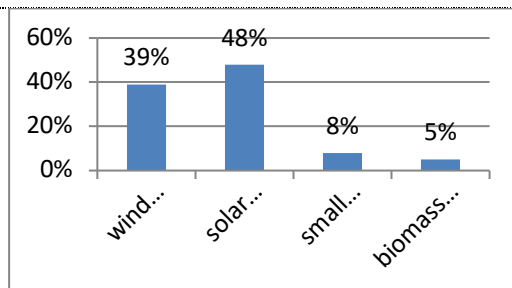


Fig. 3. The share of power facilities renewable energy, working on "green" tariff in Ukraine in 2018

Source: (Zvit v ramkakh proektu «Sekretariat ta Ekspertnyi khab z enerhoefektyvnosti», 2017; UNIAN, 2017)

Alternative energy in its essence involves the receipt and use of energy from renewable sources. Renewable sources of energy include the energy of seas, rivers, tributaries, solar radiation, biomass or even secondary energy resources. Most developed countries are actively implementing alternative energy sources in practice. This reduces the use of traditional sources, and, equally important, enables the conservation of the environment (Shergina et al., 2018).

Therefore, it is worth analyzing and highlighting the key trends in the development of alternative energy in the world and in Ukraine, in particular, the systematic implementation of which will allow us to move away from the use of traditional fuels and create the conditions for energy self-sufficiency. One of the most advanced are the following:

- Biofuels. One of the fuels, that is obtained by processing organic materials such as wood, stems of sugar cane, energy willow, waste from production activities, alcohols, etc. Unlike the traditional resources of the fuel and energy complex (oil, gas, nuclear energy), biofuel is a renewable alternative resource. At the beginning of the 21st century biofuel production has been expanding rapidly in the EU and in the US. Some scholars assumed that this would help completely oust the "petrol" that is produced from oil. Indeed, in contrast to "gasoline", "biofuel" is environmentally friendly and is produced by processing such plants of the agro-industrial complex as sugar cane, corn seeds, rapeseed and soya. However, as we see, "gasoline" is still used as a car oil. This is primarily due to the fact that not everyone is ready to switch to biofuels due to its rather high price and relatively lower heat transfer effect. Also, opponents of biofuels emphasize that, although it is an environmentally friendly fuel, its production needs to attract quite a significant amount of renewable natural resources, which in turn leads to deforestation for the sowing of fuel corn or sugar cane. Creation of plantations for agro-industrial crops for biofuels has a negative impact on a soil quality and reduces their fertility.

Scientists at Stanford University conducted a research and came to the conclusion that if 385-472 million hectares of land were used not for traditional crops but for agri-industrial crops for biofuels, then the share of biofuels in the global energy balance could reach 8% . While the use of biofuels as a fuel for road transport can reach even 25%. As for Ukraine, it has a significant potential for biofuel production. In particular, we grow a lot of such

agricultural crops as oil (sunflower), sugar, starch, cereals (biofuels from such crops are used in combination with traditional gasoline). More information on the dynamics of changes in the usage of biofuels in the world is shown in Fig. 4.

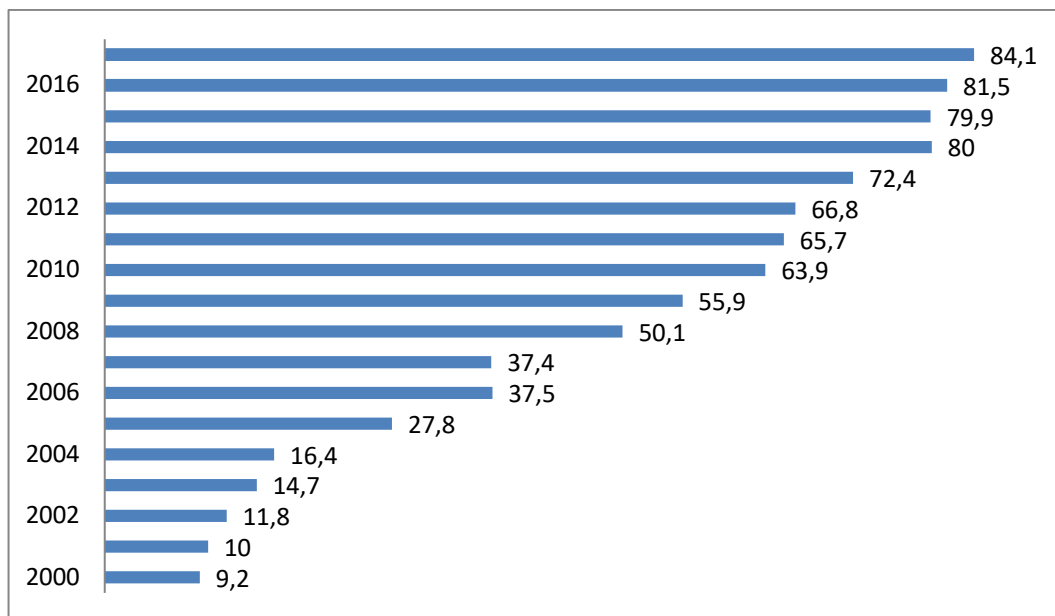


Fig. 4. Dynamics of biofuel production in the world in 2000-2017 (mln. t)

Source: (Analytical portal "Word and Business", 2018)

- Wind energy. The most fast-growing non-combustible RES in the world is wind energy, which is considered as a set of air masses that move in the atmosphere and have a certain kinetic energy, and is accumulated with the help of special installations and converted into electricity. Wind power engineering is also one of the promising directions for the implementation of alternative energy sources.

According to various estimates, its annual growth rate ranges from 25% to 50%. Significant growth of wind energy takes place due to the fact that it requires the lowest specific capital investments comparing to other types of RES. The total world installed capacity of large wind turbines and wind farms, according to various estimates, is 10-20 GW. Not only the total capacity of wind turbines is increasing, but their unit capacity, which exceeded 1 MW. Nowadays, wind power is used in more than 30 countries. World leaders in wind energy use are the United States, Germany, the Netherlands, Denmark, India. In many countries, there is a new industry - wind power engineering. Obviously, in the nearest future the wind power will keep its leading positions (*Shevtsov et al., 2008:4*).

The annual technically feasible energy potential of wind energy in Ukraine is presented in Table 4, which in turn is equal to 28 million tons of standard fuel, and its use will save about 24 billion cubes of natural gas. One of the most powerful wind power plants in Ukraine is located in the village of Botiev, Zaporizhia region. It consists of 65 windmills, which accumulate the kinetic energy of the wind on the height of about 100 meters. During 2016, 600 million kilowatt-hours were produced by this wind power plant. This amount of

electricity is enough to meet the needs of a million population city within 5 months. (Kaletnik et al., 2010: 320).

Table 4

Specific energy potential of wind energy in Ukraine

Average (annual) wind speed, V_a , m/s	Height, m	Theoretically possible potential wind, kWh / m ² year	Technically achievable wind potential kWh / m ² year
< 4,25	15	1120	200
	30	1510	280
	60	2030	375
	100	2530	460
4,5	15	2010	390
	30	2710	520
	60	3640	700
	1000	4540	850
5,0	15	2810	520
	30	3790	690
	60	5100	860
	100	6350	975
5,5	15	3210	620
	30	4320	830
	60	5810	1020
	100	7230	1150

Source: formed by the author according to the statistics of the stations for (Ukrainian Hydrometeorological Center, 2019)

- Solar energy. The construction of a solar power plants in the world are going mainstream. According to the energy experts, by the year 2060 solar power plants will produce about 25% of the energy needed by human to meet needs. The construction of solar power plants involves installing solar cells that heat up, accumulating solar energy, and create the conditions for a significant amount of electricity. One of the disadvantages of solar energy is the high cost of solar power plants, health hazards, and the lack of mass application. At present, Germany is leading the number of installed solar energy storage facilities. The potential of solar energy in Ukraine is quite significant, because according to experts, Ukraine can produce 6 million tons of conventional fuel per year by solar power plants, which can be used instead of 5 billion cubic meters of natural gas (Table 5). According to the Association of Solar Energy in Ukraine, from 2015 to the first quarter of 2018, the amount of electricity produced by Ukrainian solar power plants increased by almost 560 MW, while investments amounted to 550 million Euros (Laskoryn, 2004).

Table 5

Energy potential of solar energy in Ukraine*

Regions	Potential of solar energy, t / c / year		Regions	Potential of solar energy, t / c / year	
	Theoretically possible potential ($\times 10^9$)	Technically achievable potential ($\times 10^5$)		Theoretically possible potential ($\times 10^9$)	Technically achievable potential ($\times 10^5$)
Vinnytsia	3.7	2.5	Mykolaiv	4	2.6
Volyn	2.6	1.8	Odesa	5.6	3.7
Dnipropetrovsk	4.5	3.2	Poltava	3.8	2.6
Donetsk	2	1.3	Rivne	2.6	1.7
Zhytomyr	4	2.6	Sumy	3.2	2.2
Zakarpattia	1.8	1.4	Ternopil	2	1.5
Zaporizhia	4.3	2.8	Kharkiv	4.3	2.9
Ivano-Frankivsk	2	1.3	Kherson	4.7	3.1
Kyiv	3.8	2.6	Khmelnyskyi	3	2
Kirovohrad	3.4	2.3	Cherkasy	3.8	2.1
Luhansk	2.8	1.8	Chernivtsi	1.2	0.9
Lviv	3.1	2.2	Chernihiv	4.2	2.8
Total	Theoretically possible potential ($\times 10^9$)		Technically achievable potential ($\times 10^5$)		
	80.4		53.9		

* Presented without taking into account territories - annexed Crimean Autonomous Republic, separate districts of occupied part of Donetsk and Luhansk regions

Source: formed by the author according to the statistics of the stations for (*Ukrainian Hydrometeorological Center, 2019*)

- Controlled thermonuclear fusion (CTF). Nuclear energy has high risks for emergencies. Unlike the atomic bomb decay, a significant potential for further research has a hydrogen bomb synthesis. The production of electricity through controlled thermonuclear fusion is to synthesize heavy nuclei of the atom from the lungs. In the long run, energy can be produced from water, with the fact that waste from controlled thermonuclear fusion will be harmless to human - hydrogen and helium. Fuel for controlled thermonuclear fusion can be accumulated on the seas and oceans. However, the development of such a research direction is rather expensive. Establishing capacities, namely the thermonuclear reactors for the synthesis of hydrogen nuclei, requires capital investment in the development of the project, so most countries in the modern world prefer already-developed alternative sources of energy such as solar and biofuels ones.

- Tidal energy. A rather promising area is research of tidal energy and offshore areas as an alternative source of energy. The disadvantage of such energy source is significant capital expenditure and low heat output. However, given that construction of such power plants can not damage traditional sources of energy and will not affect the price of oil and gas, governments at the global level invest in further research of the tidal energy.

Availability of funding is one of the decisive factors for the development of RES. In the EU countries with the largest development of RES, the required ratio of debt to equity for obtaining credit financing is 80/20, and the cost of borrowed capital is less than 5% per annum. In Ukraine today there is a small number of institutions and programs aimed at financing RES projects. Due to the inconsistent government policy on RES regulation in Ukraine, financial institutions typically require twice as much equity capital to provide loans for RES projects, with an average cost of such loans of 8-10% per annum (for loans in US dollars). According to the estimates of the international agency IRENA, Ukraine has one of the largest technical potential of using RES among the countries of Southeastern Europe - 408.2 GW (without taking into account large hydroelectric plants). The biggest opportunity is the technical feasibility of using wind and solar power stations: 321 GW and 71 GW, respectively.

The economic feasibility of introducing RES in Ukraine by 2030 is estimated at 16-22 GW, in comparison with 1.1 GW, acquire in 2016. The potential for implementation of RES in the heat power sector is even higher, and according to expert estimates, it can completely replace traditional energy sources by 2030. Thus, according to IRENA estimates, in the year 2030, about 57 million Gcal of thermal energy can be produced from RES, of which a significant portion (32.7 million Gcal) is biomass. Fulfilling this forecast will save about 7 billion cubic meters of natural gas annually. It is expected that in the next 10 years the cost of WEEE and SES technologies will decrease by 13% and 57% accordingly, which will significantly contribute to the implementation of RES in Ukraine. Given the stable economic and political environment and the improvement of the conditions for financing RES projects, Ukraine will be able to significantly modernize and ensure the energy independence of electric and heat generation through renewable energy technologies (*The development of renewable energy sources in Ukraine, 2017*).

Conclusions and suggestions

Qualitative energy supply is a key factor in improving the efficiency of the functioning of all spheres of the national economy. The volume and efficiency of energy production and energy consumption determines the level of enterprises' development. In the last decades, the dynamic segment of the world energy market has become renewable energy, which plays a compensatory role in global energy consumption, in the context of growing exhaustion of non-renewable sources. The key factors for its development are a significant reduction of expenses for developing technologies in this area, prices increase for traditional energy resources, a sharp environmental taxation increase for the business sector, and large-scale government support of energy-efficient projects. This will significantly increase the competitiveness of Ukrainian industries on the world market and supply domestic products to the EU markets.

Performing the objectives marked at the beginning of the research allow us to draw the following conclusions:

- 1) Energy supply plays a key role in reducing the energy intensity of the national economy and significantly influences the GDP growth rate. The main driving force behind energy saving policy is the public sector, and its economic basis is the cost-recovery of energy-efficient projects included in energy saving programs.

- 2) A well-designed energy saving system at domestic enterprises will allow an annual reduction of energy costs by 35%. To achieve maximum efficiency, the primary task is to

systematically set up a system for managing energy consumption in the technical equipment of enterprises, creating a structure and procedure for energy management, training of a personnel.

3) The search and implementation of alternative energy sources is one of the most promising and priority directions of energy security of the country and enterprises, in particular. Namely, the use of non-traditional and renewable energy sources can become a key factor in the success of modern enterprises and will allow them to increase profits, reduce production costs and energy dependence.

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