

ECONOMIC SECURITY OF THE STATE AND ECONOMIC ENTITIES

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SOLAR ENERGY IN UKRAINE: ANALYSIS AND ITS ROLE IN ENSURING ECONOMIC SECURITY

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Introduction. Energy security is one of the most vulnerable but at the same time promising areas of economic security. The solution to the issue of increasing the level of energy security of Ukraine is possible only through using the potential of the alternative energy sources market.

The COVID-19 pandemic has led to significant economic damage, declining social protection and the stable functioning of the world as a whole. Nevertheless, it has raised the issue of information and computer technology and increased the need for alternative energy.

In recent years, the prospects for the development of alternative energy are extremely relevant, due to the reduction of natural resources around the world and the negative impact on the environment from their usage.

Ukraine has a significant natural, geographical and investment potential for the renewable energy sources development and therefore it is the main direction in the implementation of state energy saving policy of Ukraine. One of the promising alternative energy sources is solar energy.

Analysis of recent research and publications. A significant contribution to the study of alternative energy development, its generation sources and energy sector was made by Belopolsky M. [1], Borokhov I. [2], Burda V. [3], Girmik L. [4], Kurmaev P. [5], Kudrya S. [6], Matviychuk L. [7], Naraevsky S. [8], Nemish P. [9], Onyshchenko V. [10], Pavlik A. [11], Reichenbach T. [12], Sivitska S. [13], Stoyka S. [14].

The aim of the article is to analyze the results of alternative energy usage, prospects for the development of the solar electricity generation system and the economic feasibility in industry further development.

Research results. One of the main tasks of ensuring the sustainable economic development of the state is its energy policy and energy supply system. A high result in energy development, and hence economic growth, depends on the level of renewable energy sources development and implementation.

At this stage of renewable energy sources development, Ukraine is significantly inferior to the advanced countries of the world, which started the active process alternative energy usage 10 years ago. However, given its potential, geographical location and climatic conditions, Ukraine is an attractive investment project in the European space for the development of the solar energy industry and the solar power plants construction.

Alternative energy [15] – the field of energy, which provides the production of electrical, thermal and mechanical energy from alternative energy sources.

Solar energy is used all over the world and is becoming increasingly popular for generating electricity. Solar energy can be generated in two main ways [16]:

1. Photovoltaic (PV)/solar cells are semiconductor devices that convert sunlight directly into electricity. This technology is the fastest growing in using renewable energy sources and plays an important role in future global electricity generation.

2. Concentrated solar energy systems (CSP), use mirrors to concentrate sunlight. CSP technology is used to generate electricity at large power plants, which usually have a field of mirrors that redirects the rays to a tall, thin tower.

Solar energy is one of the most promising and powerful renewable energy sources (RES) and the growth of these capacities is growing every year. Ukraine is gradually taking important steps to expand solar energy usage, developing a regulatory framework for the usage, implementation, optimization and incentives for households to implement and build solar power plants.

According to the statistics of the Unified National Information Agency of Ukraine UKRINFORM [17], there are 15,665 (875 industrial and 14,790 SES of households) renewable electricity facilities in Ukraine, which have a «green» tariff and have 10 powerful SES on its territory (Table 1).

The State Agency for Energy Efficiency and Energy Saving [18] reports that in the first half of 2021, the total capacity of renewable electricity facilities increased by 8,3% or 709 MW. From them for 6 months are entered: wind power plants – 278,4 MW; solar power plants – 257,4 MW; SES of private households – 156 MW; biomass power plants – 10,4 MW; biogas power plants – 6 MW; small hydropower facilities – 1,6 MW.

About 530 million euros have been invested in the installation of 709 MW of renewable electricity capacity. In general, as of the end of the first half of 2021, 9225 MW of capacities producing electricity from renewable sources were introduced in Ukraine, namely: 6,351 MW – solar power plants; 1,593 MW – wind power plants; 933 MW – SES of households; 119 MW – capacity on solid biofuel; 118 MW – small hydropower; 111 MW – biogas plants [18].

Investments in solar energy are one of the most profitable, reliable and promising projects. Thanks to «green» tariffs, investors from all over the world enter the Ukrainian solar energy market.

The State Agency for Energy Efficiency and Energy Saving [18] noted that «green» energy has attracted more than 1,24 billion euros of investment in Ukraine in 2020, even in difficult times of the pandemic. In particular, last year € 46 million was invested in energy efficiency projects through the «warm loans» program (€ 35 million in loans) and energy services (122 ESCOs worth € 11 million).

Table 1

10 most powerful SES of Ukraine

№	Name	Power, MW	Area, ha	Year of launch	Owner
1	Pokrovska Solar Power Plant	240	437	2019	Implemented by Ukrainian companies and specialists
2	Nikopol Solar Power Plant	200	400	2019	According to investors, the Agreement was signed by the Ukrainian company DTEK and the Chinese China Machinery Engineering Corporation (SMECS)
3	Yavoriv-1 Solar Power Plant	72	115	2018-2019	Eco-Optima LLC
4	Kamyanets-Podilsky Solar Power Plant	63,8	110	2019	Podilskenergo, the investor of the project was the American fund VR CAPITAL GROUP
5	SES Tokmak Solar Energy	50	96,4	2018	Tokmak Solar Energy, investors were investment company Astra Capital Group in partnership with Ukrgasbank
6	Danube Solar Power Plant	43,14	80	2013	CNBM New Energy Engineering Co
7	Old Cossack Solar Power Plant	43	80	2012	Chinese state-owned company CNBM
8	SES Ternovytsia	20	12	2017	ENERGY SPACE LLC with Greenville Energy investments.
9	SES Modus Group	14	18,3	2019	Modus Group International Holding
10	Kalinovskaya solar power plant	13,5	20,22	2019	TIU Canada

* Compiled by the author

According to the Government Portal [19], in the second quarter of 2021 3,480 households installed solar power plants with a total capacity of 98 MW, which is 1,7 points more than in the first quarter. Thus, today in Ukraine there are more than 35,400 families which have switched to electricity from solar energy. The total capacity of such SES is 933 MW, and investments amounted to about 730 million euros.

Three regions of Ukraine are the most promising and have the largest number of solar stations compared to other areas (Fig. 1).

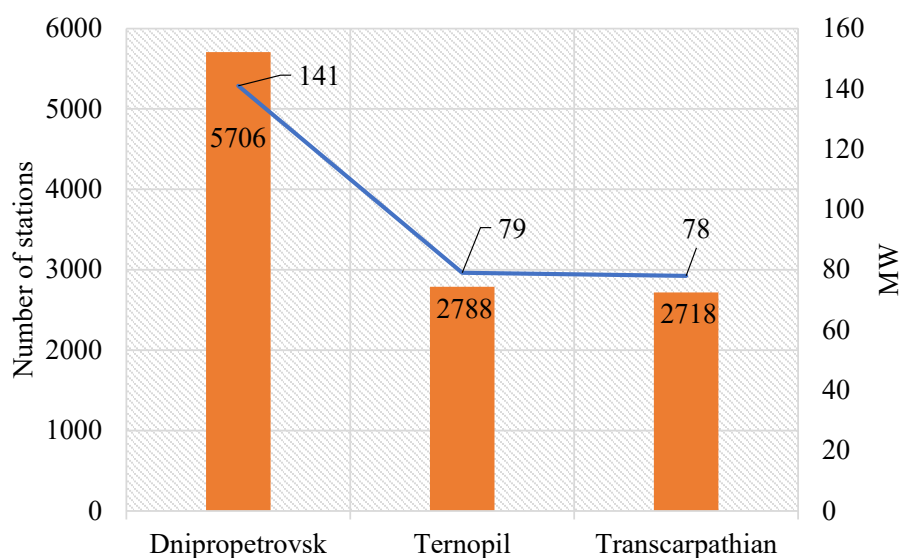


Fig. 1. Areas with the largest number of solar stations in households (SES)

The National Power Company Ukrenergo [20] reports that the total volume of electricity exports to Ukraine in 2020 exceeds imports by 2,1 times – 4754,1 million kWh and 2284,9 million kWh, respectively. In particular, in the trade zone of the UES of Ukraine (Poland, Belarus, Russia and Moldova) exports are 8,4 times higher than imports – 1734 million kWh against 205,7 million kWh, and in the «Island of Burshtyn TPP» (Hungary, Slovakia and Romania) 1,45 times – 3020 million kWh and 2079,2 million kWh, respectively (Fig. 2).

The development and widespread of solar power plants usage is important from domestic and global consumers point of view. Thus, according to [20], the volume of electricity exports in December 2020 decreased by 31,2% compared to the previous month. At the same time, the largest reduction in exports took place in Romania – 5,6 times to 23,2 million kWh. In addition, exports to Poland decreased by 16% to 103,4 million kWh and Hungary – by 20,2% to 169,8 million kWh (31,4% and 51,5% of total exports, respectively). At the same time, exports to Slovakia increased 7,8 times to 22 million kWh and Moldova – by 3,2% to 11,1 million kWh.

According to official IRENA data [21] dated April 4, 2021, the total capacity of solar power plants in the world in 2020 increased by 21,6% – up to 714 GW. In particular, all European countries (including non-EU countries) in 2020 increased the capacity of solar power plants by 14,5% – up to 163,5 GW.

In terms of total solar energy capacity in 2020 (7.33 GW), Ukraine ranks 6th in Europe, and in terms of growth in 4th place with a rate of + 23.5%. (Fig. 3).

According to the forecast of the IB Center [22], in 2021 the total investment in solar energy projects may exceed \$ 80 billion globally.

Thus, according to statistics and long-term plans, solar energy in Ukraine has a high rate of development, each year establishing itself in the energy services market and contribute to the following factors:

- alternative energy is a relatively new industry in energy security but has a stable, gradual development;
- geographical location makes it possible to generate energy continuously throughout the year;
- significant investment potential for international partners;

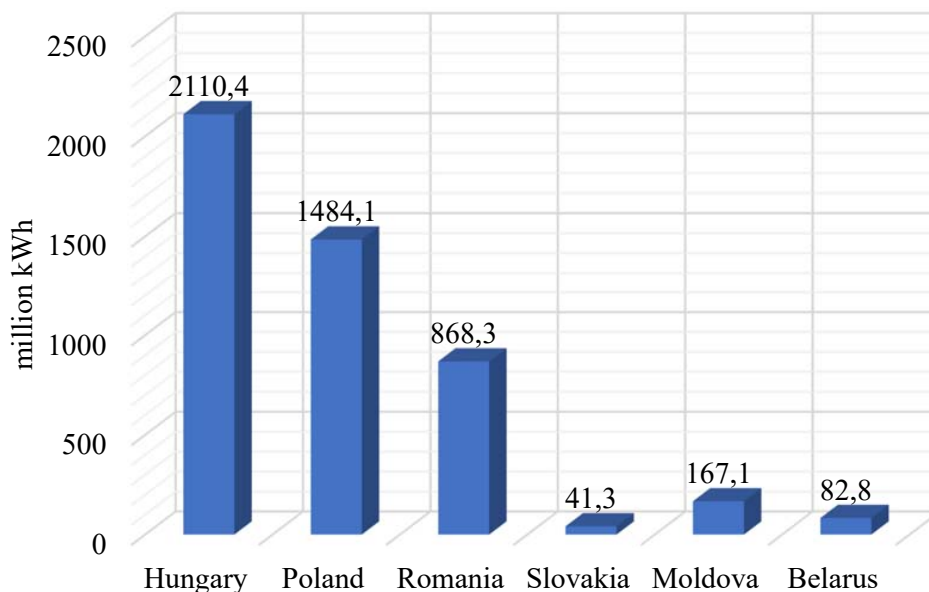


Fig. 2. Electricity exports in 2020

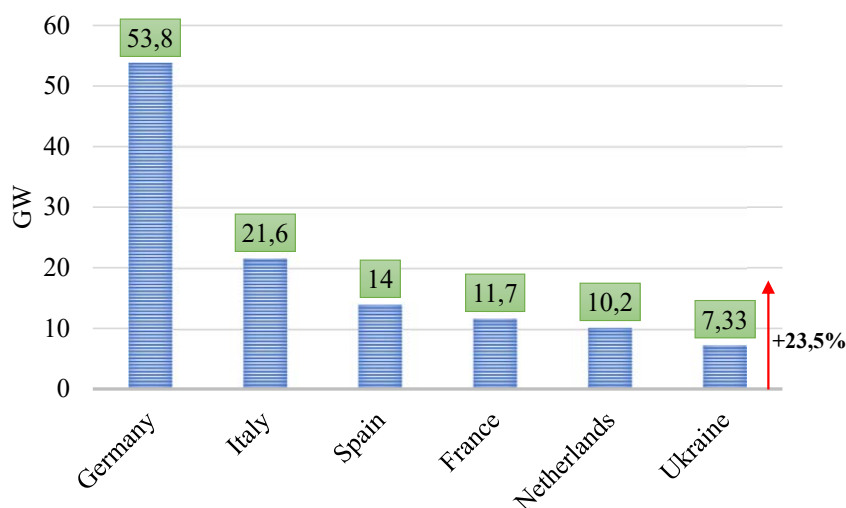


Fig. 3. TOP-6 European countries in terms of total solar energy capacity in 2020

- high level of specialists’ professionalism, which will expand the needs of the domestic labor market and further skills improvement;
- social protection of the population;
- in the development of project financing policy at the state level – a long-term economically sound profit plan with further development of the investment direction;
- creating favorable conditions for investment, will create the preconditions for investing in related industries.

Solar power plants have a positive economic effect not only for households but also for private businesses. Such advantages include the following:

- reduction of maintenance costs, as the cost of solar energy is lower than the network;
- energy independence of production (business);
- formation of a positive image of an innovative, socially responsible company that cares about the ecological situation in the world;
- payback period is not significant, on average 10 years;

- low operating costs;
- the development of providing alternative technologies system will contribute to the further development of technologies in this area and other joint projects.

Foreign investment is becoming a major factor in the development of the country's economy and a necessary condition for the implementation of structural adjustment of the national economy. This in turn provides scientific and technological progress and in general the improvement of important macro- and microeconomic indicators of economic activity of the country. An effective investment policy helps the country out of the crisis, stimulates manufacturing enterprises and accelerates the country's economic growth, and as a result – the

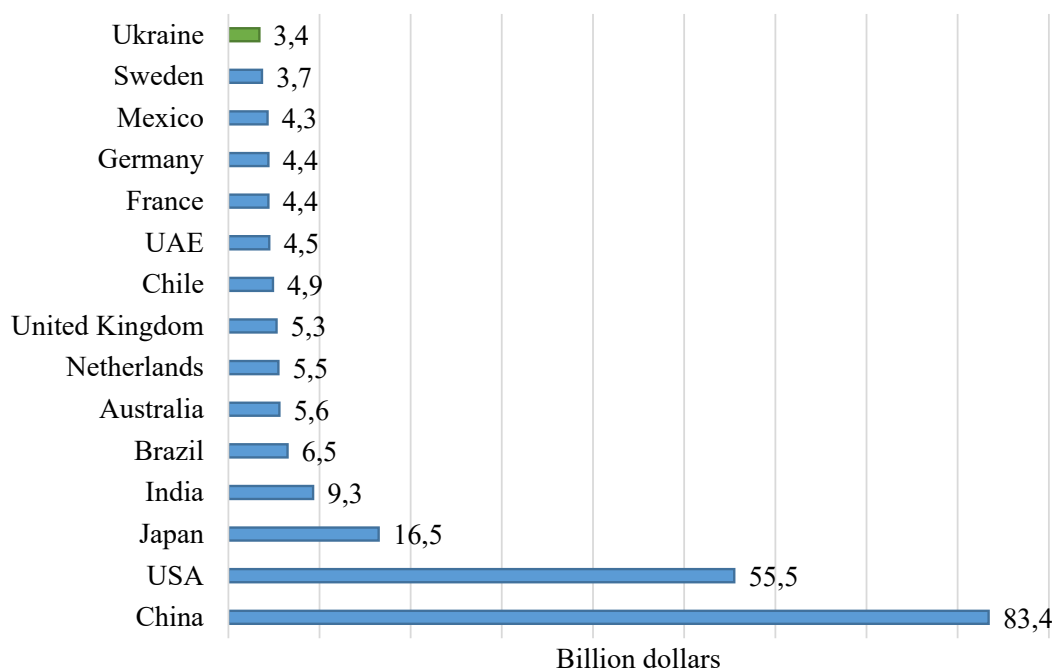


Fig. 4. Investments in renewable energy sources in 2019

These achievements have enabled Ukraine to improve the investment climate and take 15th place in the world ranking of RES investments in 2019.

Improving Ukraine's regulatory framework for green tariffs has strengthened investor confidence in the state system for supporting green energy. According to the research organization BloombergNEF [23], the total amount of direct investment in RES in Ukraine since the introduction of the «green» tariff in 2008 is estimated at \$ 12 billion, where \$7,2 billion falls on the period 2015–2020.

Conclusion. The constant growth of the electricity cost, dependence on suppliers, energy-intensive economy leads to a decrease in the level of economic development, social protection and investment attractiveness in general. That is why renewable energy sources are the basis for the development of an energy-independent and economically stable state.

Through the implementation of measures to implement solar power plants and renewable energy sources in general will contribute to making Ukraine more energy efficient. It in turn will have a positive effect on the country's environmental and economic security.

The energy independence that Ukraine aspires to consists not only in the rational consumption of energy, but also in the development of energy in general. Today, the development is an investment in renewable energy. The development of the alternative energy sector is a long-term energy and environmental priority for Ukraine, as provided by domestic legislation and participation in international agreements. In the long run, the use of RES is a guarantee of Ukraine's energy independence and stable economic development.

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Onyshchenko Volodymyr, DSc (Economics), Professor. **Shchurov Igor**, Doctoral Student of Finance, Banking and Taxation Department. **Datsenko Volodymyr**, Postgraduate of Finance, Banking and Taxation Department, National University "Yuri Kondratyuk Poltava Polytechnic". **Solar energy in Ukraine: analysis and its role in ensuring economic security.**

The current state of renewable energy sources in Ukraine is studied. The growth rates of the introduction of alternative types of energy have been determined. Statistical data on the number of commissioned power plants and the amount of electricity produced by them had been analyzed. The issue of Ukraine's investment potential for the development of the solar energy generation system taking into account the existing powerful solar power plants is considered. Geographical prospects of development of alternative energy on the territory of Ukraine from the point of view of export relations with the countries of the world were investigated. The indicators of the total capacity of solar energy of Ukraine were analyzed and the rating was determined in Europe by growth rates. Factors influencing the market of energy services, which contribute to the rapid pace of development of alternative energy were described. The advantages of commissioning solar power plants for private business were presented.

Key words: renewable energy sources, solar energy, energy independence, economic stability.

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Досліджено сучасний стан відновлюваних джерел енергії в Україні. Визначено темпи приросту впровадження альтернативних видів енергії. Проаналізовано статистичні дані з кількості введених в експлуатацію електростанцій та вироблених ними обсягів електроенергії. Розглянуто питання інвестиційного потенціалу України для розвитку системи генерації сонячної енергії з врахуванням існуючих потужних сонячних електростанцій, де охарактеризовано їх інвестиційну складову в економіку країни. Досліджено географічні перспективи розвитку альтернативної енергетики на території України з точки зору експортних відносин з країнами світу. Здійснено порівняння сумарного обсягу експорту електроенергії у відношенні до імпорту, що показало перевищення обсягів експорту. Визначено сонячну енергетику однією з найперспективніших та потужних відновлюваних джерел енергії. У результаті аналізу було зроблено висновок, що Україна поступово здійснює важливі кроки для розширення використання сонячної енергетики, розробляючи нормативно-законодавче підґрунтя з використання, впровадження, оптимізації та стимулювання домогосподарств до впровадження і будівництва сонячних електростанцій. Охарактеризовано актуальність та доцільність використання сонячної енергії у зв'язку з постійним зростанням вартості електроенергії та перспективним прогнозом збільшення загальних інвестицій у галузь на глобальному рівні. Аргументовано вагомe значення розвитку та застосування сонячних електростанцій для вітчизняного та світового споживача. Проаналізовано показники загальної потужності сонячної енергетики України та визначено рейтингове місце в Європі за темпами зростання. Згідно з проведеного аналізу статистичних даних та перспективних планів розвитку сонячної енергетики, визначено високі темпи її розвитку в Україні. Охарактеризовано фактори впливу на ринок енергетичних послуг, які сприяють швидким темпам розвитку альтернативної енергетики. Визначено позитивний економічний ефект сонячних електростанцій та наведено переваги від їх експлуатації для приватного бізнесу.

Ключові слова: відновлювані джерела енергії, сонячна енергетика, енергетична незалежність, економічна стабільність.