



**ECOLOGY & RECOVERY 2026**

**ЕКОЛОГІЯ, ОХОРОНА НАВКОЛИШНЬОГО  
СЕРЕДОВИЩА ТА ЗБАЛАНСОВАНЕ  
ПРИРОДОКОРИСТУВАННЯ:  
ОСВІТА – НАУКА – ВИРОБНИЦТВО – 2026**

*Матеріали XXVIII Міжнародної науково-практичної конференції*

Харків  
2026



**ECOLOGY & RECOVERY 2026**  
**XXVIII Міжнародна науково-практична конференція**  
**«Екологія, охорона навколишнього середовища та збалансоване**  
**природокористування: освіта – наука – виробництво – 2026»**

**ЗБІРКА ТЕЗ ДОПОВІДЕЙ**  
**23–24 квітня 2026 року**

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ  
імені В. Н. КАРАЗІНА**

**Навчально-науковий інститут екології, зеленої енергетики  
та сталого розвитку**



**ЕКОЛОГІЯ, ОХОРОНА НАВКОЛИШНЬОГО СЕРЕДОВИЩА ТА  
ЗБАЛАНСОВАНЕ ПРИРОДОКОРИСТУВАННЯ:  
ОСВІТА – НАУКА – ВИРОБНИЦТВО – 2026**

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Харків

2026

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**V. N. KARAZIN KHARKIV NATIONAL UNIVERSITY**

**Institute of Environmental Sciences, Green Energy and  
Sustainable Developments**



**ECOLOGY, ENVIRONMENTAL PROTECTION AND  
SUSTAINABLE MANAGEMENT:  
EDUCATION – SCIENCE – PRODUCTION – 2026**

***ABSTRACTS OF THE XXVIII INTERNATIONAL SCIENTIFIC AND  
PRACTICAL CONFERENCE***



Kharkiv

2026

*Посвідчення Укр. ІНТЕІ № 947 від 10 грудня 2025 року  
Затверджено розміщення в мережі Інтернет  
рішенням Вченої ради Харківського національного університету  
імені В. Н. Каразіна (протокол № 9 від 25 травня 2026 р.)*

**Екологія, охорона навколишнього середовища та збалансоване природокористування: освіта – наука – виробництво – 2026 : зб. мат. XXVIII Міжнародної науково-практичної конференції (м. Харків, 23-24 квітня 2026 року). Харків: ХНУ імені В. Н. Каразіна, 2026. – (PDF 262 с.)**

Збірник складають матеріали доповідей, у яких розглядаються питання збалансованого природокористування, менеджменту довкілля, техногенної безпеки, природоохоронної діяльності та заповідної справи, а також найкращі практики екологічної освіти та питання міжнародного співробітництва задля охорони навколишнього середовища.

**Ecology, environmental protection and balanced environmental management: education – science – production – 2026 : Abstracts of XXVIII International scientific conference (Kharkiv, April 23-24, 2026). Kharkiv: V. N. Karazin Kharkiv National University, 2026. – (PDF 262 p.)**

The book contains abstracts on innovative approaches for environmental problem solutions, balanced nature management, environmental management, safety, environmental protection and conservation, best practices on environmental education and international cooperation for environmental protection.

*Автори опублікованих матеріалів несуть повну відповідальність за добір, точність, достовірність наведених даних, фактів, цитат, інших відомостей .*

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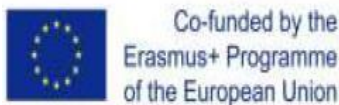
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**СЕКЦІЯ 5. ВІДНОВЛЮВАНА ЕНЕРГЕТИКА, ЕНЕРГОЕФЕКТИВНІСТЬ І**  
**КЛІМАТИЧНО НЕЙТРАЛЬНІ ТЕХНОЛОГІЇ**  
***RENEWABLE ENERGY, ENERGY EFFICIENCY AND CLIMATE-NEUTRAL***  
***TECHNOLOGIES***

UDC 504.062; 621.316

**SOLAR ENERGY: DEVELOPMENT OPPORTUNITIES IN UKRAINE**

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One of the most pressing and painful problems for Ukraine in the context of prolonged military aggression by Russia is the provision of energy resources. And this is not only an economic problem, it is a problem of creating normal living conditions for the country's population. The aggressor's targeted attacks on our country's energy infrastructure are a key component of military actions aimed at destroying the life support system. As a result of damage to energy facilities in many regions of Ukraine, power supply, as well as water and heating, were cut off for a long time, and communication disruptions occurred.

Electricity supply in Ukraine is mainly centralized. The Unified Energy System of Ukraine is a set of power plants, electric and thermal energy transmission networks and other electric power facilities that are united by a common mode of production, transmission and distribution of electric and thermal energy. Electricity production is mainly based on the use of thermal and hydroelectric power plants, as well as nuclear power plants. During active hostilities, enemy attacks are directed not so much at energy transmission facilities as directly at facilities that produce electricity. As a result, during the war years, Ukraine lost a significant part of its thermal power plants, since they are mainly located in the Donbas. In June 2023, the Kakhovka HPP was destroyed, in March 2024 the Dnipro HPP was significantly damaged, the Dniester HPP, Kyiv HPP, Kaniv HPP and Kremenchug HPP were damaged, and the Zaporizhian NPP is under Russian occupation. As of the beginning of 2026, Ukraine had lost more than 27 GW of generating capacity, of which about 15.5 GW were lost due to the occupation of power facilities (including the Zaporizhian NPP). Thus, the share of electricity produced by traditional methods has significantly decreased. Although electricity consumption has decreased by almost a third, the issue of developing alternative energy sources is becoming increasingly pressing.

In peacetime, the development of “green energy” was considered mainly as a way to protect the environment, since solar energy uses an inexhaustible source of energy, does not produce harmful waste, and is environmentally friendly [1]. In addition, for Ukraine, solar energy production is quite efficient, since a large number of days during the year are rich in sunlight [2]. In times of war, the development of solar energy becomes a guarantee of stability. And several factors contribute to this. First, it is the dispersion of energy facilities. The traditional energy system consists of large facilities and that is why it is vulnerable. Solar power plants are panels on the roofs of houses, therefore, thousands of small facilities. Secondly, it is

the speed of deployment. If the construction of a new power unit of a thermal power plant or nuclear power plant lasts for years, then a solar power plant can be installed on the roof of an enterprise or a private house in a few days or weeks. Third, energy autonomy. Using solar panels allows for power to be supplied during power outages. This is especially important for ensuring the uninterrupted operation of critical infrastructure as a whole or for maintaining the most frequently used home appliances.

Currently, the share of electricity generated by households using private solar power plants and other types of “green energy” is very small in the country’s overall balance. Thus, the total share of electricity from renewable energy sources (RES) – solar power plants, wind power plants, bioenergy and small hydropower – in the overall electricity generation structure in 2020 was 6.8% (versus 3.3% in 2019). The report of NPC Ukrenergo [3], which is the only operator of the electricity transmission system in Ukraine, emphasizes that positive trends in the renewable energy market are observed due to the adoption of the Law of Ukraine “On Amendments to Certain Laws of Ukraine on the Restoration and “Green” Transformation of the Energy System of Ukraine” No. 3220-IX [4]. The results of monitoring by the consulting company ExPro Consulting show that in 2024 the share of all types of “green” energy in the energy balance of Ukraine increased to almost 11% [5]. Unfortunately, the increase in the share of renewable energy is due not so much to the commissioning of new capacities, but to a significant reduction in the share of thermal generation due to massive shelling of the energy system. In January 2025, electricity production from renewable sources decreased by 8% compared to January 2024 [4], but compared to January 2023, it increased by 14.5%.

Let's consider what obstacles prevent the spread of solar energy in Ukraine. It is clear that during hostilities there are certain financial difficulties, since any investment is associated with risks. Due to the high probability of new shelling, investors are afraid to invest in large facilities, and this is one of the main deterrent factors. There is also a shortage of personnel - there are not enough qualified installers and designers. However, there are also technical problems associated with equipment. Solar generation is an unstable process, as it depends on the weather and time of day. Therefore, in addition to solar panels, it is necessary to have sufficiently powerful batteries to be able to store and accumulate energy. Typically, the battery capacity should be sufficient to create a reserve of energy for 4–8 hours of operation of critical devices. This is necessary to ensure the autonomy of a business, critical infrastructure facilities or a house. It should be noted that the cost of the battery is from 40% to 60% of the cost of the entire solar station. While the panels themselves have become much cheaper in recent years, the price of high-quality lithium batteries remains at a high level. At the same time, batteries have a limited resource. Lead-acid AGM/Gel batteries are cheap, but they can withstand 300–500 charge cycles, that is, they work for 1.5–2 years. They are also afraid of deep discharge. Lithium iron phosphate LiFePO<sub>4</sub> batteries better meet the modern standard. They can withstand 4000–6000 cycles, that is, they work for 10–15 years, but they cost 3–4 times more than AGM/Gel [7]. It should be borne in mind that batteries for solar power plants are sensitive to both high and low temperatures, which also creates problems during their operation. So, as for the technical problems of operating a solar power plant, they are related to the operation of

batteries, and solar panels are quite reliable and durable, and their cost is also gradually decreasing. In addition, a significant problem is the disposal of used panels.

If we are talking about creating an industrial-type solar power plant, then another problem arises. The location of such a solar power plant requires large areas of land. When calculating the area of a land plot for installing a solar power plant of a certain capacity, it is first necessary to determine the type of photovoltaic panels, their electrical characteristics and physical size. So, the first step is an energy audit. You need to measure how many kWh your facility consumes per day, and determine which devices you need to choose to provide this capacity. A modern panel, which is capable of producing 550–600 W, has an area of about 2.6 m<sup>2</sup>. For example [8], for the installation of a 100 kW solar power plant, we will take monocrystalline solar panels, which are characterized by high efficiency. To provide the required power of the solar power plant, 153 such panels will be needed. Taking into account their size and angle of inclination (the optimal angle is 30–35 degrees for summer or 45+ for winter), an area of 485.2 m<sup>2</sup> will be required for their installation. In the event that you choose polycrystalline batteries, which are characterized by average efficiency, you will need 299 panels, and for their installation you need to allocate a land plot with an area of 581.26 m<sup>2</sup>. And this land plot must be free from trees, chimneys or neighbouring buildings. In general, the vastness of Ukraine and its climatic conditions allow for the allocation of such areas for the construction of solar power plants.

Therefore, despite the existing problems, the successful development of solar energy is possible, it is both the need of the hour and, in the future, the key to the recovery of the Ukrainian economy.

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