

SOLAR PANEL LANDFILLS – OUR FUTURE?

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Анотація.

This article explores the state of Solar Energy Systems (SES) in Ukraine, focusing on their popularity, efficiency, affordability, and impending disposal problem. Currently, the country boasts a total installed capacity of 8.4 GW of Renewable Energy Sources (RES), with industrial solar power plants (SPPs) contributing 6.1 GW and domestic SPPs 0.8 GW. The most popular are grid-tied SES, which generate and deliver electricity to the power grid, and their payback times are inversely related to their power capacity. Solar panel prices in Ukraine have dropped significantly due to market structure changes and technological advances, with monocrystalline solar panels emerging as the most popular choice despite their higher cost. However, with solar panels' lifespan exceeding 30 years and limited options for their disposal, Ukraine faces an impending environmental problem. As the composition of solar panels evolves with advancing technology, experts predict the challenge of solar waste will worsen. This issue is further complicated by the nascent state of solar panel disposal legislation worldwide. Despite these challenges, Ukraine, like the EU, is taking steps to develop waste management policies for photovoltaic waste, driven by its energy strategy and international climate commitments. The article concludes by underscoring the urgent need to address the issue of SES component disposal as solar energy takes up an increasingly significant role in everyday life.

Ключові слова: відновлювальна енергетика, сонячні панелі, ринок, монокристалічні панелі, сучасні технології, способи утилізації.

Abstract.

У статті досліджується стан сонячних енергетичних систем (СЕС) в Україні, зосереджуючись на їх популярності, ефективності, доступності та майбутній проблемі утилізації. Наразі країна може похвалитися загальною встановленою потужністю 8,4 ГВт відновлюваних джерел енергії (ВДЕ), з яких промислові сонячні електростанції (СЕС) складають 6,1 ГВт, а побутові СЕС – 0,8 ГВт. Найпопулярнішими є мережеві СЕС, які виробляють і постачають електроенергію в електромережу, а термін окупності обернено пропорційний їх потужності. Ціни на сонячні панелі в Україні значно впали через зміни структури ринку та технологічний прогрес, причому монокристалічні сонячні панелі стають найпопулярнішим вибором, незважаючи на їхню вищу вартість. Однак, оскільки термін служби сонячних панелей перевищує 30 років і обмежені можливості їх утилізації, Україна стикається з неминучою екологічною проблемою. Оскільки склад сонячних панелей змінюється разом із розвитком технологій, експерти прогнозують, що проблема сонячних відходів погіршуватиметься. Це питання ще більше ускладнюється зародженням законодавства про утилізацію сонячних панелей у всьому світі. Незважаючи на ці виклики, Україна, як і ЄС, вживає заходів для розробки політики поводження з відходами фотоелектричної енергії, керуючись своєю енергетичною стратегією та міжнародними кліматичними зобов'язаннями. На завершення статті наголошується на гострому вирішенні питання утилізації компонентів СЕС, оскільки сонячна енергетика займає все більшу роль у повсякденному житті.

Keywords: renewable energy, solar panels, market, monocrystalline panels, modern technologies, methods of disposal.

Introduction

The Ministry of Energy indicates that the total installed capacity of RES facilities is 8.4 GW, of which industrial SPPs – 6.1 GW, and domestic solar power plants – 0.8 GW.

The so-called network SES are currently the most popular on the market. They not only generate electricity, but also deliver it to the grid. The station is a whole complex of equipment: network inverter, protection and monitoring system, energy storage systems, etc. But the most important element is the solar panels. The payback time of the SES and the ability of the farm to meet its own energy needs depend on their efficiency. A low-power 5 kW station has a payback of 5.5 years, a medium-power (10 kW) – 4.7 years, a high-power (30 kW) – a little more than 4 years.

Research results

In recent years, solar panels have become much more affordable for Ukrainians. Their price fell 2.5-3 times. The reason lies not only in technology, but also in the structure of the market. If earlier solar panel manufacturers were many small enterprises all over the world, now this profitable business is 80% concentrated in the hands of TOP-10 large companies. They are actively increasing the pace of production, and gradually the leaders are taking control of the entire production chain, which reduces the cost of production.

The market offers consumers three types of solar panels: silicon (monocrystalline and polycrystalline) and thin film. The first have a number of advantages (more productive, reliable, durable, save space). Their cost is higher than polycrystalline panels, but they are currently the most popular. In addition, with the development of technology, the price gap is gradually reducing.

The efficiency of monocrystalline solar panels is 19-21%. Over the past few years, it has grown by 3%, which shows the progress in the quality of production. The power of solar panels is also increasing, the upper limit of which already reaches 650 W and above.

As a rule, manufacturers give a 10-year warranty on solar panels, but they can successfully perform their function for 30 years. And even after that they are used, but with less efficiency. However, sooner or later, all SES owners will have to face the problem of disposing of solar panels. And the state did not do anything to outline ways to solve it.

The most common monocrystalline panels contain 76% glass, 10% polymer, 8% aluminum, 5% silicon, 1% copper, less than 0.1% silver and other elements. Modern technologies make it possible to achieve up to 90% recycling rate. However, it is still economically unprofitable. That is why, for example, in the USA, most of the used panels are sent to landfills. By 2050, they will make up 10% of all electronic waste in the world and will be a real threat to soils and groundwater.

The development of disposal methods is complicated by the fact that over time the production technology and composition of the panels themselves changes. Experts predict that the share of silver, silicon and aluminum in them will decrease.

Legislation on the disposal of solar panels in most countries of the world is in its infancy, because trouble has not yet knocked on the door. So far, solar energy waste accounts for only 0.6% of global electronic waste.

The best system is formed in the European Union. The Electrical and Electronic Equipment Directive 2012 places extended responsibility for disposal on the manufacturer. To implement the directive, a whole department called "Stiftung EAR" was created in Germany, which registers manufacturers of solar panels and coordinates waste collection.

In Ukraine, the first step towards the settlement of this issue is draft law 2350 "On waste electrical and electronic equipment" (WEEE). It includes photovoltaic panels in the category of WEEE and also introduces a system of extended liability. But, unfortunately, the draft law cannot be adopted before the final vote on the framework bill 2207-1-d on waste management. It is preparing for the second parliamentary reading.

The Ministry of Energy has already announced the need to form a comprehensive policy for the management of photovoltaic waste from SPPs. This will fully correspond to the Energy Strategy of the state, which envisages a share of renewable energy of 25% by 2035 (today - 11%).

The incentive to worry about the disposal of solar panels is also the Paris climate agreement. In order to fulfill its obligations, Ukraine needs to increase the share of RES in electricity generation to 30%. And, accordingly, its base will be solar energy, which is based on the operation of solar panels.

That is, the whole logic of the development of the energy sector prompts us to think about the issue of disposal of SES elements. After all, every year the energy of the sun will have more and more weight in our everyday life.

Conclusion

Solar Energy Systems (SES) have undoubtedly revolutionized the energy sector in Ukraine, providing an affordable, efficient, and renewable alternative to traditional energy sources. The swift technological advances and market structure changes have made solar power increasingly accessible, contributing significantly to the nation's energy mix.

Despite the benefits, it is crucial to recognize and address the challenges posed by the end-of-life management of solar panels. While the technology and production methods for solar panels continue to evolve, effective disposal and recycling strategies lag. This disconnect could lead to substantial environmental problems as the number of expired panels rises.

As such, it is commendable that Ukraine is proactively addressing this issue, as demonstrated by the initiation of draft laws concerning the management of Waste Electrical and Electronic Equipment (WEEE), which includes photovoltaic panels. This aligns with international efforts, like those in the EU, to implement extended producer responsibility for solar panel disposal.

In conclusion, while solar energy represents a significant opportunity for Ukraine to meet its energy needs sustainably and fulfill its international climate commitments, it is paramount that the country continues to develop and implement comprehensive policies for photovoltaic waste management. This will ensure that solar energy's growth doesn't become a source of environmental harm but remains a truly sustainable, long-term solution for Ukraine's energy future.

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