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RESTORATION OF UKRAINE'S ENERGY SYSTEM USING RENEWABLE SOURCES OF GENERATION: FOREIGN EXPERIENCE

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Abstract

The article assesses the development of renewable sources of generation in European countries and the prospects for their development in Ukraine.

Keywords: *energy, fossil, renewable sources.*

Анотація

У статті оцінено розвиток відновлюваних джерел генерації в країнах Європи та перспективи їх розвитку в Україні.

Ключові слова: *енергія, викопні, відновлювані джерела.*

Introduction

In recent years, Ukraine's energy system has suffered significant damage. As a result of enemy shelling, many generation facilities, including thermal power plants, have been destroyed. These challenges also create opportunities. According to the draft National Action Plan for the Development of Renewable Energy by 2030, it is planned to increase the share of energy from renewable energy sources in gross final energy consumption by 3 times - from 9% in 2020 to 27% in 2030 [2]

Destroyed classic generation facilities can be replaced with renewable generation sources. The purpose of this research is to study the European experience of transitioning from traditional means (fossil) of electricity generation to the new "green" ones – renewable.

In accordance with purpose, the corresponding tasks were formed: to investigate the transformation of the European Union's energy system, to determine whether this experience is effective in Ukraine.

In the context of international experience, the most valuable for Ukraine is the European Union. Since March 16, 2022, the Ukrainian power system has been synchronized with ENTSO-E (European Network of Transmission System Operators for Electricity). Now we have a common system and a common energy market.

Main part

In many countries (Germany, Denmark, the Netherlands), renewable sources of generation can already compete with traditional energy (for example, nuclear or coal).

The European Green Deal is the European Union's strategy aimed at achieving climate neutrality by 2050. [7] It encompasses a set of measures aimed at reducing greenhouse gas emissions, developing renewable energy sources, and greening the economy. The widespread introduction of renewable energy sources is key to achieving such ambitious goals.

The diagrams (Fig. 1) show how the structure of generation sources in the European Union has changed over the past 20 years.

Energy produced by **fossil** accounted for 53.7% in 2000, 40.8% in 2018 and only 29% in 2023. This is a big decrease, almost twice. Energy produced by **renewable** made up from 15.2% in 2000 to 42% in 2023. +8% only for last 5 years. The share of renewable sources is successfully growing.

The most stable indicator is for **nuclear power**, which is considered as a relatively clean source of energy. The indicator decreased from 31.1% to 25%.

So we can conclude that half of the energy produced from fossil resources in Europe has been replaced by energy from renewable sources. Its up 25% of the fossil and up 40% of the total energy.

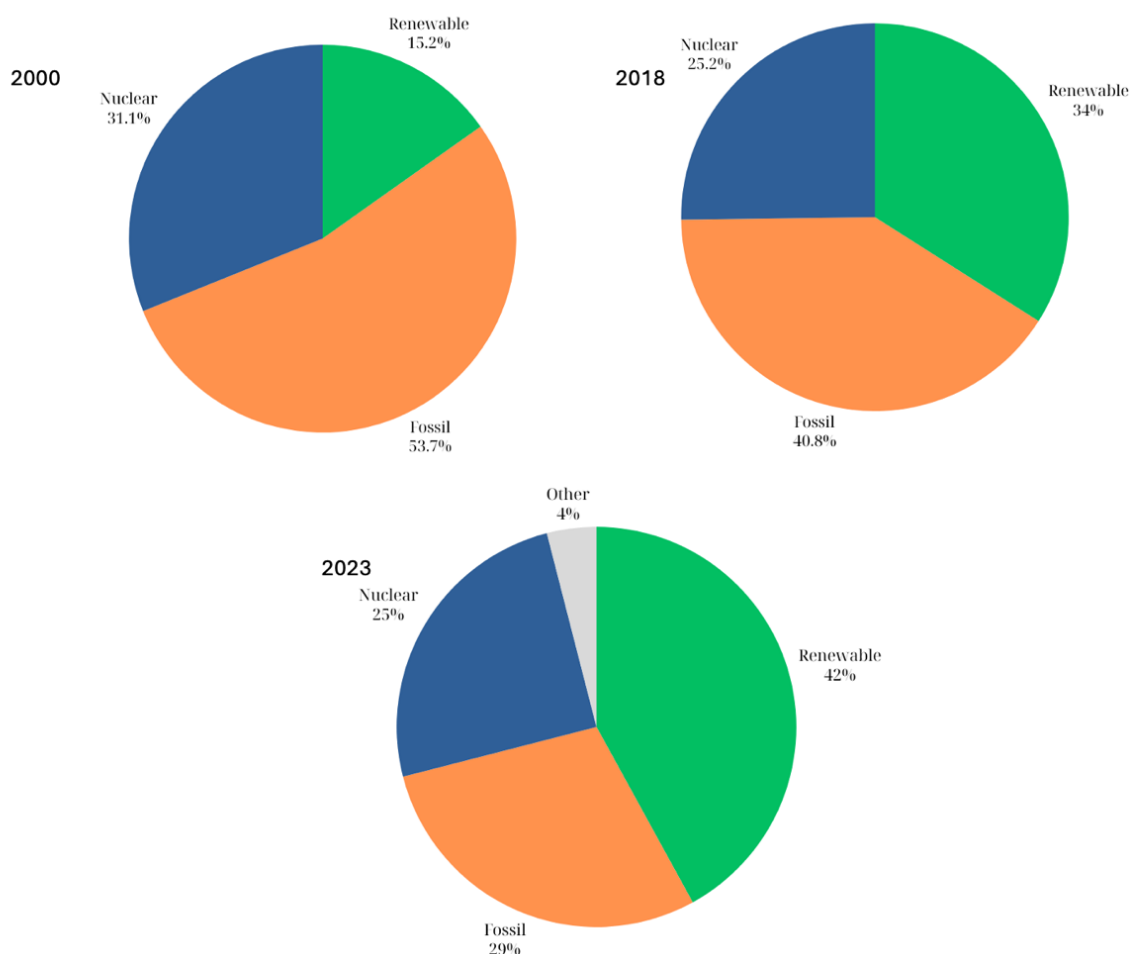


Fig. 1 – Energy sources in Europe IEA Database 2020, 2023 [1]

On the path of such transformation, the European Union has faced a number of difficulties, such as: the high cost of switching to renewables and modernizing infrastructure; business opposition due to tightening environmental standards; the need to modernize electricity grids to integrate a large number of renewables; energy security in the context of abandoning fossil fuels. The EU energy system transition is extremely expensive. The «Just Transition Fund» alone has spent over €100 billion to support the regions most dependent on fossil fuels.

In Ukraine, as of 2023, the structure of energy generation sources is completely different.

Nuclear energy is the main energy source in Ukraine. Nuclear power remains one of the most efficient and environmentally friendly energy sources, but it has significant risks, especially in terms of safety and waste management. Nuclear power plants can operate 24/7 and are not affected by weather conditions (unlike solar and wind power). They provide base load power in the power system. But this is not enough. Thermal power plants and hydroelectric power plants are needed to balance the grid.

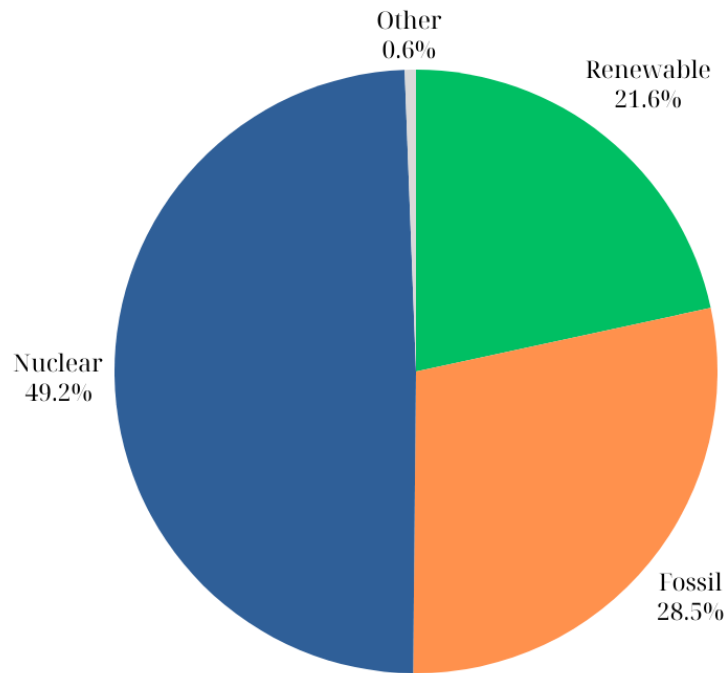


Fig. 2 – Energy sources in Ukraine, 2023 [1]

The thermal power plant and hydroelectric power plant suffered the greatest losses due to enemy shelling. The Kakhovka hydroelectric power plant was completely destroyed.

The key to solving the problem can be decentralized generation. The main advantage of decentralized generation is the placement of new generating capacities at a large number of sites that are connected to distribution networks. At the same time, the defeat of a large number of relatively low-power power plants and energy storage facilities is a much more difficult task than the destruction of a relatively limited number of thermal power plants and hydroelectric power plants of significant capacity, which will allow minimizing power losses in the unified energy system of Ukraine. In addition to increasing resistance to missile strikes, decentralized generation will contribute to an increase in the share of renewable energy sources in the country's energy balance, which, in turn, will help attract financing and technologies from Europe and promote European integration.

Conclusion

The European experience in the development of renewable sources is very important and useful. However, it is necessary to understand the specificity and uniqueness of the situation that Ukraine finds itself in today. Security challenges are unprecedented. We can replace energy produced by fossil fuels with a large number of renewable generation plants: solar, wind, biomass. This will allow us to comply with the European "green" policy and increase the security of the energy system in the context of war.

REFERENCES

1. Ukraine invest. Reneveble energy. [Електронний ресурс]. – Режим доступу: URL. – https://ukraineinvest.gov.ua/en/industries/energy/renewable-energy/?utm_source=chatgpt.com. - дата звернення: 17.02.2025.
2. Валерій Безус. Яким має бути розвиток ВДЕ України — Національний план дій до 2030 року. Економічна правда [Електронний ресурс]. Режим доступу: URL. - <https://epravda.com.ua/columns/2023/02/21/697267/> - дата звернення: 17.02.2025.
3. Земельний довідник України 2020 – база даних про земельний фонд країни. Agropolitcom [Електронний ресурс]. – Режим доступу: URL. – https://agropolit.com/spetsproekty/705-zemelniy-dovidnik-ukrayini--baza-danih-pro-zemelniy-fond-krayini?utm_source=chatgpt.com
4. Сонячні електростанції України на мапі [Електронний ресурс]. – Режим доступу: URL https://eenergy.com.ua/solar/sonyachni-elektrostantsiyi-ukrayiny-na-mapi/?utm_source=chatgpt.com - дата звернення: 09.03.2025.
5. John Twidell. Renewable energy resource. в Taylor & Francis 2021. с. 774
6. Kamil Kaygusuz. Renewable Energy: Power For a Sustainable Future. ENERGY EXPLO RATION & EXPLO ITATION· Volume 19 · Number 6 · 2001 с. 603– 626
7. Європейський Зелений Курс [Електронний ресурс]. – Режим доступу: URL https://ukraine-eu.mfa.gov.ua/posolstvo/galuzeve-spivrobitnictvo/klimat-yevropejska-zelena-ugoda?utm_source=chatgpt.com - дата звернення: 09.03.2025.

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