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THE DEVELOPMENT OF SOLAR ENERGY AND ITS EFFECTS ON REDUCING IMPORT DEPENDENCY IN THE REPUBLIC OF MOLDOVA

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Abstract: *The purpose of this study is to analyze the evolution and current state of solar energy development in the Republic of Moldova, with a particular focus on its role in reducing dependence on imported energy resources. The study identifies two key findings: (1) the implementation of 434 MW of solar capacity could reduce electricity imports by approximately 16.5%, and (2) domestic production could increase from 27% to 39% of national consumption, strengthening energy security. A review of recent literature highlights that while Moldova has made progress in developing solar energy capacities, practical applications of decentralized and hybrid systems remain limited, with significant potential for expansion. The actual level of research and achievements in the field shows that Moldova is at an early-to-intermediate stage, with ongoing pilot projects, emerging regulatory frameworks, and increasing public and private investments. This research evaluates Moldova's solar energy potential based on climatic and geographic data, examines existing policies and regulatory frameworks, and analyzes current investments and projects in the photovoltaic sector. The paper proposes concrete measures to stimulate the expansion of solar infrastructure, including financial incentives, public-private partnerships, and technological innovation. Ultimately, this study contributes to the development of a more sustainable, resilient, and energy-independent future for the Republic of Moldova*

Keywords*: solar energy, energy independence, energy imports, sustainability, energy efficiency, climate change.*

JEL Classification*: Q42, Q43, Q48, O13, H54*

UDC: 620.92(478)

Introduction

In the current context of climate change and growing concerns about energy security, the development of renewable energy sources has become a global priority. The Republic of Moldova, being a state with a significant dependence on energy imports, faces major challenges in ensuring a sustainable and resilient energy system. In this sense, solar energy represents a viable solution for diversifying the national energy mix, reducing economic vulnerabilities and increasing energy independence.

Diversification of the national energy mix. The integration of solar energy into the energy mix of the Republic of Moldova contributes to reducing the share of imported fossil sources (currently about 70-73% of electricity comes from imports) and to increasing the share of renewable sources. By the end of 2024, solar energy accounted for 68% of the total

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renewable energy sources in the country, with a capacity of 394.90 MW. Thus, solar energy adds a domestic, renewable, and stable component to the national energy mix.

Reducing economic vulnerabilities. Solar energy helps reduce costs associated with energy imports, thereby lessening the negative impact on the trade balance and the national budget. For example, the implementation of photovoltaic mini-parks with a capacity of 434 MW would reduce electricity imports by approximately 16.5%, lowering dependence on international price fluctuations for gas and electricity. As a result, the economy becomes more resilient to external shocks.

Increasing energy independence. By increasing domestic production capacity from solar sources (from 27% to 39% of national consumption, according to the analyzed scenario), the Republic of Moldova reduces its dependence on external sources, strengthening its energy security. Solar energy, being local and inexhaustible, provides a greater degree of national control over the energy source, reducing exposure to external geopolitical and economic risks.

The massive dependence on imports constitutes a considerable financial burden: the costs of purchasing natural gas, petroleum products and electricity from abroad have a direct impact on the trade balance and the national budget.

The massive dependence on imports constitutes a considerable financial burden: the costs of purchasing natural gas, petroleum products and electricity from abroad have a direct impact on the trade balance and the national budget. For example, in 2023, the Republic of Moldova consumed approximately 4.33 TWh of electricity, of which only 1.17 TWh (around 27%) was produced domestically, while the remaining 3.16 TWh (approximately 73%) was covered through imports. Assuming an average import price of 100 EUR per MWh, this resulted in an annual expenditure of about 316 million EUR solely for imported electricity.

In addition, natural gas imports represented an even larger financial burden. During the 2022–2023 period, Moldova paid prices that sometimes exceeded 1,000 USD per 1,000 cubic meters of natural gas. Given the country's annual consumption of around 1 billion cubic meters, the total cost for imported gas alone could reach approximately 1 billion USD per year.

These expenditures contribute significantly to the trade deficit. In 2023, Moldova's trade balance deficit exceeded 4 billion USD, with energy imports (including electricity, gas, and petroleum products) accounting for an estimated 25% to 30% of this deficit. As such, the reliance on imported energy sources not only strains the national budget but also amplifies the country's economic vulnerability to external price fluctuations and geopolitical risks.

Reducing imports by replacing part of consumption with domestically produced energy (from solar sources) could reduce national energy expenditure and vulnerability to the volatility of external markets.

Recent energy crises have demonstrated how exposed the Moldovan economy is to international price shocks; for example, record gas price increases in Europe in 2022 have generated major pressures. By diversifying energy sources by adding photovoltaic

capacities, Moldova can gradually decouple the economy from fluctuations in fossil fuel prices and increase the resilience of the energy system (Tetra Tech ES, Inc.,2023).

In addition, the costs of solar technology have fallen globally over the past decade, making photovoltaics increasingly affordable and competitive. Thus, from an economic point of view, investments in solar energy can lead in the medium and long term to lower local production costs compared to energy imports, especially if advantageous international support schemes and financing are capitalized.

From a strategic perspective, the development of solar energy directly responds to the need to improve the energy security of the Republic of Moldova. The more intensive use of a locally abundant resource, solar radiation, can gradually diminish the critical dependence on external sources and the risks associated with it. A national energy strategy that includes the expansion of photovoltaic capacities will lead to a more diversified and robust energy mix in the face of disruptions. As long as three-quarters of the energy needs are imported, any external shock (economic or geopolitical) poses a threat to the country's stability (Tetra Tech ES, Inc., 2023).

By contrast, domestically produced solar energy provides a safe and inexhaustible source that is nationally controllable. This takes on increased geopolitical importance in the current context, in which the security of energy supply has become a central element of the economic defense strategy. Moreover, Moldova's alignment with EU practices and standards in the field of renewable energy (through the treaties concluded within the Energy Community and the Association Agreement with the EU) also has a strategic component: the integration of the Moldovan energy market with the European market. Investments in solar energy facilitate this integration by reducing the domestic production deficit and can transform the Republic of Moldova from a simple importer into a potential seasonal exporter of green energy on the regional market, in the long term.

The use of solar energy in the Republic of Moldova has seen a significant increase in recent years, due to technological advances, decreasing implementation costs, and support from public policies and private investments. This renewable energy source not only reduces greenhouse gas emissions, but also contributes to stabilizing energy prices and creating a more self-sufficient energy sector. However, there are still barriers related to storage infrastructure, legislation and access to finance, which require effective solutions for an accelerated energy transition (Ministry of Energy of the Republic of Moldova, 2025).

The present study analyzes the impact of solar energy development on reducing dependence on energy imports in the Republic of Moldova. The research is based on updated data on solar energy production, the country's potential in this field and the measures necessary to increase the contribution of this resource to national energy security. Also, the paper explores the existing challenges and opportunities in the process of implementing photovoltaic technologies, providing recommendations for optimizing development strategies.

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Materials and methods

This study is based on a diverse set of materials, including official data on electricity production, consumption and imports in the Republic of Moldova, as well as reports from government agencies, national statistics and energy regulatory bodies. It also integrates studies and analyses carried out by international organizations, academic institutions and research centres, aimed at the development of renewable energy, the efficiency of photovoltaic technologies and global trends in the energy sector (IRENA, 2023). In addition, policy documents and strategies developed by national and international authorities are analysed to understand the regulatory framework on renewable energy and energy security. Economic reports and feasibility studies on the implementation of solar energy projects provide insight into their impact on the economy, the environment and national energy security.

The methodology of this study involves an extensive literature review to collect accurate and up-to-date information from official sources, academic literature, and policy documents. A comparative approach is used to assess the costs and efficiency of solar energy in relation to other energy sources available in Moldova, taking into account investment requirements, technological performance and environmental impact. The study also looks at existing solar energy projects to assess their contribution to reducing import dependency and identify good practices that could be scaled up at national level. In addition, mathematical modeling and statistical forecasting are applied to estimate the potential contribution of solar energy to the country's energy security in the medium and long term. An analytical and critical perspective is adopted in the evaluation of current energy policies, identifying strengths, limitations and opportunities for advancing solar energy development in Moldova. Through this approach, the study aims to provide a comprehensive understanding of the role of solar energy in reducing dependence on imports and strengthening national energy security.

Results and discussions

Analysis of renewable energy data in the Republic of Moldova reveals a significant increase in installed solar energy capacity. According to data from the National Center for Sustainable Energy (CNED), by the end of 2024 (figure 1), photovoltaic installations, with a summary installed capacity of 394.90 MW, are the most widespread technology and represent 68% of the total installed capacities. These are followed by wind farms, whose summary power reached 160.83 MW, accounting for 28% of the total. The capacities of hydro and biogas plants register values of 16.75 MW (3%) and 7.01 MW (1%) respectively (CNED, 2025).

This substantial growth was supported by investments in infrastructure and the implementation of support policies for renewables. Thus, the Republic of Moldova has made remarkable progress in the development of the solar energy sector, contributing to reducing dependence on electricity imports from external sources and increasing national energy security.

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The evolution of renewable electricity production capacities in the Republic of Moldova reflects the country's commitment to the energy transition and the integration of alternative sources of electricity production into the national energy mix.

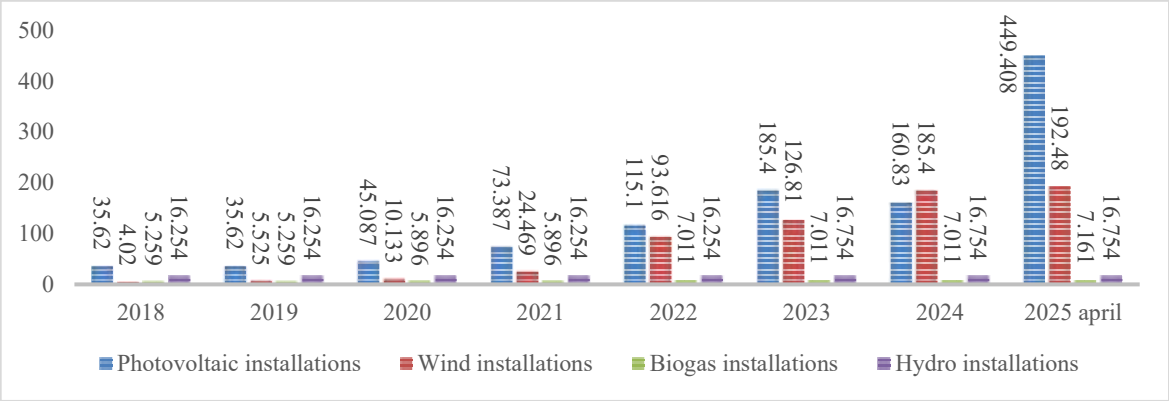

Figure 1. Annual evolution of installed capacities of renewable energy sources

Source: Developed by the authors based on the source National Energy Council of Moldova (2025).

Following this analysis, we can mention that the integration of solar energy into the national energy mix has contributed to the reduction of electricity imports. In 2023, the final energy consumption of the Republic of Moldova was 2853 thousand tons of oil equivalent, and the total imports of electricity were 88433 TJ. Compared to previous years, this represents a slight decrease in dependence on imports due to the increase in the capacity of renewable sources, including solar energy (National Bureau of Statistics of the Republic of Moldova (NBS), 2024).

The increase in the share of E-SER renewable energy confirms the progress towards achieving the target of at least 27% of renewable energy in the energy balance by 2030, an objective that aligns with both European Union policies and international agreements for reducing greenhouse gas emissions and promoting energy sustainability (CNED, 2025).

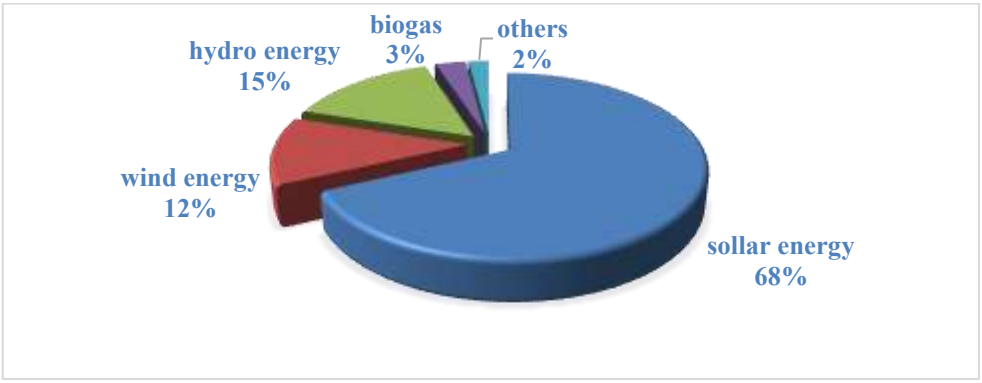

Figure 2. Weighted distribution by type of technology of the E-SER capacities installed at the end of January 2025

Source: Developed by the authors based on the source National Energy Council of Moldova (2025).

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In this context, the development of a photovoltaic power plants intended to supply 2-4 communities, totaling approximately 10000 inhabitants, represents an innovative and sustainable solution for diversifying energy sources and reducing CO_2 emissions. The implementation of such a project requires a rigorous assessment of energy requirements, implementation costs, energy storage solutions and integration into the national electricity grid.

To ensure the energy needs of these communities, it is essential to estimate the average energy consumption per household and community. According to statistics, a typical household consumes about 300 kWh per month, and the total number of households varies between 3000 and 3500. Therefore, the monthly energy requirement is between 900000 and 1050000 kWh (Corbu, 2024, p.52).

Taking into account the average annual solar radiation in the Republic of Moldova, which is about 1200-1300 kWh/m²/years, and the efficiency of modern solar panels, a photovoltaic power plants with an installed capacity of 5-6 MW would be enough to meet the energy demand of the targeted communities.

Table 1. Investment estimate and funding sources for a 5 MW photovoltaic system

Component	Estimated cost (EUR/MW)	Total estimated cost (EUR) for 5 MW
Panouri Solar	500,000 – 700,000	2,500,000 – 3,500,000
Inverters	150,000 – 200,000	750,000 – 1,000,000
Mounting structures	100,000 – 150,000	500,000 – 750,000
Storage batteries (optional)	300,000 – 500,000	1,500,000 – 2,500,000
Network connection and infrastructure	200,000 – 300,000	1,000,000 – 1,500,000
Administrative costs and installation	100,000 – 200,000	500,000 – 1,000,000
Total	1,350,000 – 2,000,000	6,750,000 – 10,000,000

Source: Elaborated by the authors based on the source Ministry of Energy of the Republic of Moldova (ME), (2025).

The investment estimate presented in Table 1 highlights the financial structure required for the implementation of a 5 MW photovoltaic system. The total cost ranges between 6.75 million EUR and 10 million EUR, depending on the chosen technologies, inclusion of optional storage systems, and specific infrastructure requirements. The detailed breakdown by components provides transparency regarding the main cost drivers, with solar panels and storage batteries representing the most significant shares of the total investment.

This analysis underlines the importance of precise project planning and cost optimization, as well as the necessity to secure diverse sources of funding (state, private investors, international grants/loans) to ensure financial sustainability. A well-balanced financing strategy, combined with careful technological choices, can significantly reduce long-term operational costs and contribute to achieving national energy security objectives through the expansion of solar energy capacities.

Table 2. Sources of funding and contribution shares

Source of funding	Possible contribution (%)	Estimated contribution (million EUR)
State	20 - 40	1.35 – 4
External funding (grants, loans)	30 - 50	2 – 5
Private investors	20 - 50	1.35 – 5

Source: Elaborated by the authors based on the source Ministry of Energy of the Republic of Moldova (ME), (2025).

The project involves the installation of high-efficiency photovoltaic panels on an area of approximately 10-12 hectares, depending on the technology used. As highlighted in the analyzed article, the land area required for installing Photovoltaic power plants varies according to the technical configuration of the system. For example, East-West oriented systems are designed so that the panels can be installed more compactly, requiring less space per unit of installed capacity compared to traditional south-oriented systems.

This approach allows for more efficient use of land, being particularly advantageous in areas where land availability is limited or where minimizing the impact on productive agricultural land is desired. The article emphasizes the importance of identifying unproductive land or distributing photovoltaic capacities across multiple communities precisely to reduce the impact on agricultural land and local ecosystems.

In addition, to ensure a continuous supply, it is necessary to implement an energy storage system, based on lithium-ion batteries or alternative technologies, such as redox flow batteries. This photovoltaic power plants can also operate efficiently without an energy storage system (batteries), relying on optimized integration into the electricity grid and alternative solutions for balancing production and consumption.

The Photovoltaic power plants planned in the Republic of Moldova, located in the localities of Negureni (Telenesti district) and Rădeni (Straseni district), (HG 83/2025, HG 84/2025) will be integrated into the national electricity grid through transformer stations and distribution lines. This infrastructure will enable an efficient integration of renewable energy into the country's energy system. In addition, an intelligent monitoring system will be implemented to optimize the production and distribution of electricity (Ministry of Energy, 2025).

To ensure the sustainability and safety of these projects, a detailed analysis of the impact on the environment and use of agricultural land is necessary. The photovoltaic power plants in Negureni will occupy an area of 44 hectares of agricultural land, and the one in Rădeni will be located on 54 hectares of arable land. Although solar energy is a renewable and environmentally friendly source, the conversion of large areas of agricultural land into areas for energy production can influence local ecosystems, biodiversity and microclimate. In this context, it is essential to adopt measures to mitigate the impact on the environment and local communities.

A more balanced solution would be to distribute these photovoltaic panels in several communities, instead of concentrating them in a single village. For example, instead of

allocating 44 hectares in a single locality, it would be more appropriate to identify 2-4 communities in which solar systems are located on smaller areas, of a maximum of 15 hectares each. There are both advantages and disadvantages in the development and integration of solar energy into the national energy system. The advantages include reducing dependency on imports, lowering long-term costs, protecting the environment, and increasing energy security. On the other hand, disadvantages relate to the intermittency of production, the need for investments in storage and distribution infrastructure, and the risk of occupying agricultural land. The management of the entire infrastructure, including the dispatchable part, falls to system operators and authorized distributors, especially Moldelectrica, in partnership with the state and private investors, with efficient coordination being essential for the optimal integration of new capacities. It is true that for the system it is better for energy to be generated where it is consumed, as this reduces transport losses and increases efficiency, which is why the net metering/billing mechanism was proposed, supporting local production and self-consumption integrated into the grid.

This strategy would reduce the negative impact on agricultural land and distribute the benefits of renewable energy more equitably among several localities. In addition, to protect agricultural resources, photovoltaic panels should be installed on unproductive land, such as hills, degraded land, or areas that are not used for agriculture. Thus, spaces that otherwise do not have a high economic return could be capitalized, avoiding the transformation of fertile land into industrial areas.

This approach would allow for the sustainable development of the energy sector, while maintaining the ecological balance and supporting local communities without negatively affecting their economic and livelihood activities.

Next, the implementation and financing costs are analyzed to estimate the costs needed to supply 20% of the population of the Republic of Moldova with solar energy, focusing on the southern districts of the country, where the solar irradiation conditions are more favorable. It is true that the wind potential is more favorable in the southern part of the Republic of Moldova, where the average wind speed and orographic conditions are more suitable for the installation of wind turbines. In contrast, the solar potential is advantageous across the entire territory of the country, due to relatively uniform solar radiation, which allows photovoltaic energy to be efficiently harnessed both in the north, center, and south. However, an important technical aspect to consider is that photovoltaic systems gradually reduce their efficiency at temperatures above 20°C. The increase in ambient temperature leads to a decrease in the performance of the panels, as solar cells are sensitive to overheating. For this reason, the design and location of installations must take into account not only solar radiation but also average annual temperatures and solutions for ventilation or technologies that mitigate thermal effects on energy production.

To calculate the installed capacity requirement, an average annual consumption of 1000 kWh per person was considered, resulting in a total need of 434 MW of photovoltaic energy.

Table 3. Distribution of the required capacity for each district, as well as estimates of minimum and maximum costs for the implementation of the project

Raion	Population	Required capacity (MW)	No. of mini-parks (5 MW each)	Maximum occupied land (ha)	Minimum estimated cost (EUR)	Maximum estimated cost (EUR)
Cahul	124600	107.0	21	252	144 450 000	214 000 000
Cantemir	62100	53.3	11	132	71 955 000	106 600 000
Causeni	90800	78.0	16	192	105 300 000	156 000 000
Cimislia	60400	51.9	10	120	70 065 000	103 800 000
Leova	53000	45.5	9	108	61 425 000	91 000 000
Stefan Voda	70700	60.7	12	144	81 945 000	121 400 000
Taraclia	43700	38.6	8	96	52 110 000	77 200 000
Total	124600	107.0	21	252	144 450 000	214 000 000

Source: Elaborated by the authors based on the source of the Institute of Energy Research of Moldova.

The implementation of mini-photovoltaic systems capable of supplying 20% of the population of the Republic of Moldova is feasible with sustainable financing and a well-planned strategy. Through efficient resource management, this project could significantly contribute to the country's energy independence and reduce CO2 emissions. It is recommended to strengthen partnerships with international financial institutions and attract private investment to accelerate the process.

Effective coordination between government authorities and renewable energy investors is also essential so that implementation is carried out in a sustainable manner, with minimal environmental impact and maximum benefits for the economy and the population (Agenția pentru Eficiență Energetică, 2021).

In 2023, the total electricity consumption of the Republic of Moldova was approximately 4.333 TWh (terawat-hours), i.e. ~4.33 billion kWh. Of this demand, domestic production covered only 1.169 TWh (~1.17 billion kWh), highlighting the limited generation capacity domestically. Therefore, the difference was ensured by electricity imports in a volume of approximately 3.164 TWh (about 3.16 billion kWh). In other words, more than 70% of the electricity consumed in 2023 came from imports, highlighting a very high external dependence and a vulnerability of national energy security (Government of the Republic of Moldova, 2024).

In order to reduce the deficit of domestic production, it is proposed to build mini-photovoltaic power plants of 434 MW in the south of the Republic of Moldova. Such solar capacity is considerable, especially considering the current level of renewable energy investment in the country.

The estimated average annual production for this project is around 520,800 MWh, equivalent to 0.521 TWh per year.

The contribution of a production of 0.521 TWh per year from the mini photovoltaic power plants would have a significant effect on the import needs. If we relate this production to the volume of imports in 2023 (approx. 3,164 TWh), we see a potential reductionin imports of

~16.5%. (Calculation: 0.521 TWh / 3.164 TWh × 100% ≈ 16.5%.) In other words, given an annual consumption similar to that of 2023, the solar energy produced by the new installation could replace about a sixth of the electricity that the country would otherwise have to import.

In terms of consumption coverage, domestic production would increase from ~1,169 TWh to ~1,690 TWh annually thanks to this project. Thus, the share of domestic productionin meeting demand would rise from about 27% (without the project) to about 39% with the implemented project.

Implicitly, dependence on imports (the proportion of consumption covered by imports) would decrease from ~73% today to about 61%. This substantial decrease in the share of imports in the energy mix would reduce the country's exposure to import-related risks (such as price fluctuations in foreign markets or supply disruptions).

The development of solar energy in the Republic of Moldova has had a significant impact on reducing dependence on imports, but the intermittent nature of photovoltaic production imposes the need to implement efficient solutions for energy storage. In this regard, capitalizing on the hydropower resources of the country's large rivers is a strategic option.

The exploitation of the hydropower potential began in 1954, with the commissioning of the Dubasari power plant, with a capacity of 48 MW. Also, the use of the Prut River for energy production was made possible by the construction of the Coste şti-Stânca hydropower complex, in collaboration with Romania, with a capacity of 16 MW.

Between 1985 and 2010, the average annual electricity production in the Republic of Moldova was approximately 59.5 GWh. In the current context, the integration of pumped storage hydropower plants (CHE-PAs) on the Prut and Dniester rivers offers an optimal solution for balancing the production fluctuations of renewable sources, such as solar energy, and ensuring a continuous supply of electricity (Nicolaev, Bînzari, 2016).

The CHE-AP plants are equipped with reversible hydro aggregates, which work through an energy storage process: outside peak hours, they use electricity from the system, at low prices, to pump water from the lower tank to the upper one. Subsequently, during peak energy demand hours, the plants generate electricity to sell it on the balancing market. Their flexibility is guaranteed by the short start-up time and the high speed of loading/unloading of the hydro aggregates, aspects that make them essential for sustaining the stability of the electricity grid.

Pumped storage hydropower plants allow the storage of surplus electricity generated by photovoltaic power plants during the day and its release at night or during periods of peak demand. This technology can perfectly complement Moldova's renewable energy production, contributing to the stability of the national energy system.

According to a study carried out, such a plant with a capacity of 100 MW could operate with an efficiency of 80% in generation mode and 70% in pumped mode (Arion & Efremov, 2021). Therefore, the location of two such plants on the Prut and Dniester rivers would bring multiple benefits:

- Reducing dependence on energy imports: Stored energy can be used during periods of high consumption, reducing the need for imports;
- Efficient integration of renewable sources: surplus solar energy during the day can be converted into stored hydraulic energy to be used at night.

The construction of a pumped storage hydropower plant involves a high initial cost, but in the long run it becomes a cost-effective solution. Studies indicate that the investment required for a 100 MW plant would be around €200 million, with a payback time of around 26 years, taking into account current energy tariffs. At the same time, the existence of already built reservoirs or favorable land near the Prut and Dniester rivers could reduce infrastructure costs.

To maximize the efficiency of the project, it is proposed to combine the CHE-AP with solar and wind energy projects, thus allowing the use of energy during periods when renewable production fluctuates. A hybrid approach, combining solar, wind, and hydropower, could reduce dependence on fossil fuels by more than 50% by 2035 (Arion & Efremov, 2021).

Another advantage of the CHE-AP is their use for irrigation in agricultural areas in the south and center of the Republic of Moldova. Pumping systems can be used not only for generating electricity, but also for transporting water in irrigation networks during periods of drought. This solution would contribute to the development of agriculture and reduce farmers' vulnerability to climate change.

The construction of these plants, in combination with the development of solar and wind energy, would allow the Republic of Moldova to become energy independent, reducing imports and creating a sustainable, stable energy system that is resistant to foreign market fluctuations.

Conclusions

The development of solar energy in the Republic of Moldova is a strategic solution to reduce dependence on electricity imports, within the global energy transition and the need to diversify energy sources. The present study highlights the positive effects of the implementation of photovoltaic technologies on the country's energy security, highlighting the long-term economic, ecological and strategic benefits.

The analysis of data on the installed capacity of solar energy in the Republic of Moldova indicates a significant increase in recent years. According to the National Center for Sustainable Energy (CNED), by the end of 2024, solar energy will account for about 68% of the total renewable energy sources in the country, reaching a total capacity of 394.90 MW. This evolution is due to both private investments and government programs that have supported access to finance for the development of photovoltaic power plants (Ministry of Energy of the Republic of Moldova (ME), 2025).

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In addition to increasing installed capacities, an important challenge remains the efficient integration of solar energy into the national distribution grid. Due to the intermittent nature of solar energy, it is necessary to implement energy storage solutions, such as high-capacity lithium-ion batteries or pumped storage hydroelectric power plants (CHE-AP). These would allow the surplus energy generated during the day to be stored and used during peak hours (International Renewable Energy Agency (IRENA), 2023).

The implementation of a program to develop mini- photovoltaic power plants with a total capacity of 434 MW could reduce dependence on imports by about 16.5%. Thus, the share of domestic production in covering consumption would increase from 27% to 39%, strengthening the country's energy security.

The use of solar energy would also help stabilise electricity prices by reducing the long-term costs associated with energy imports. Unlike fossil fuels, which are exposed to the volatility of international markets, solar energy offers a stable and predictable cost, favouring the national economy (World Bank, 2023). Another key aspect of solar energy development is the economic and environmental benefits. Economic benefits include attracting investment in energy infrastructure, creating new jobs in the renewable energy sector, and reducing government spending on purchasing electricity from external sources.

On the ecological level, solar energy contributes to the reduction of CO2 emissions and to the achievement of the environmental objectives assumed by the Republic of Moldova within the policies of the European Union and the Paris Agreement. Solar energy projects can significantly reduce air pollution and support the transition to a sustainable economic model based on renewable resources.

A concrete example of the implementation of solar energy with a positive impact is the construction of photovoltaic power plants in the localities of Negureni (Telenești district) and Rădeni (Straseni district). They will have a considerable installed capacity and will contribute to the electricity supply of several local communities.

In order for the Republic of Moldova to maximize its energy potential and become more energy independent, a series of strategic measures are needed:

- expanding photovoltaic capacities, by supporting decentralised projects for households and small and medium-sized enterprises.
- modernisation of the electricity grid, to improve the integration of renewables and reduce energy losses.
- development of efficient energy storage solutions, including the implementation of pumped storage hydroelectric power plants (CHE-PA) on the Prut and Dniester rivers, which ensure a stable supply of electricity during periods of high consumption.
- the adoption of supportive government policies, including tax incentives and subsidies for solar energy investments.
- diversifying the energy mix, by combining solar energy with other renewable sources, such as wind energy and biogas.

Through well-implemented strategic measures and effective collaboration between the government, the private sector and international investors, the Republic of Moldova can take an important step towards energy independence and a sustainable future based on renewable energy. Thus, the country will not only ensure a more stable energy system, but will also contribute to environmental protection and reducing the impact of climate change.

In conclusion, the development of solar energy in the Republic of Moldova is not only a necessity, but also an opportunity to reduce dependence on imports, stabilize energy prices and stimulate the national economy. Increasing photovoltaic capacities and implementing effective policies to integrate them into the national grid could turn solar energy into a central pillar of the country's energy system.

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