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Current European Energy Architecture

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ABSTRACT: The current European energy architecture is in continuous evolution, considering environmental and climate priorities, but also the need to ensure energy security and accessibility for all citizens. Within this architecture, Romania and the Republic of Moldova face specific challenges and opportunities. Romania has rich natural resources, including oil, natural gas, coal, and hydropower. However, there is still a need to modernize and diversify the energy mix to make it more environmentally sustainable and reduce dependence on fossil sources. In recent years, Romania has made progress in the development of renewable energy, such as wind and solar energy, but there is still a long way to go to achieve the European goals of reducing carbon emissions and increasing the proportion of renewable energy in total consumption. As for the Republic of Moldova, the country faces significant energy challenges, including heavy dependence on energy imports, aging infrastructure and the need for modernization. The Republic of Moldova aims to diversify its energy sources and improve its energy efficiency to become more independent and sustainable from an energy point of view. Partnerships with other states and international institutions, such as the European Union, play an important role in supporting these efforts. In the European context, both countries are motivated to align themselves with European energy objectives and regulations, to facilitate their integration into the European energy market and to benefit from financial and technical support in the process of modernization and energy transition. Regional projects and collaboration between neighboring countries can also play a crucial role in developing energy infrastructure and ensuring greater energy security for the entire region.

KEYWORDS**:** energy transition, renewable energies, energy security, energy diversification, regional collaboration

1. Introduction

In recent years, against the backdrop of geopolitical changes and tensions in the Eastern European region, the global and regional security system has become increasingly complex and fragile. In the current context, the war in Ukraine is one of the major aspects influencing the dynamics and balance of power in this part of the world. This confrontation has caused significant changes in the way states, international organizations and non-state actors perceive and approach security. Today's security system faces multiple threats and challenges, both traditional and new, which can be categorized into a variety of domains, including political, military, economic, cyber, and others. Despite international efforts to promote peace and security, tensions and conflicts persist in many regions, and Ukraine is at the center of such a crisis.

The war in Ukraine began in 2014 when Russia annexed the Crimean peninsula, sparking an armed conflict in Ukraine's eastern regions known as Donbas. This escalation resulted in massive human losses and material destruction, having a devastating impact on the local population and destabilizing the entire region. Attempts at mediation and negotiations between Ukraine and Russia, under the auspices of the Organization for Security and Cooperation in Europe (OSCE) and other international actors, have made limited progress in resolving the conflict and restoring peace. As a result, the war in Ukraine has led to renewed debates and concerns about European and global security. The military incidents in the region have caused a reassessment of the defense and security policy of many states, including members of NATO and the European Union. Strengthening defense capabilities and developing military alliances have become priorities to deal with threats from aggressive state and non-state actors.

Moreover, this conflict has once again underlined the importance of international cooperation and diplomacy in promoting peace and security. Diplomatic dialogue and negotiations remain essential tools in addressing security issues and avoiding the escalation of conflicts in the Eastern European region. At the same time, the crisis in Ukraine highlighted the complexity of international relations and the interdependence of states in terms of security. The events in Ukraine had repercussions not only in the Eastern European region, but also globally, influencing the foreign policy, economy and energy security of many countries.

From an energy perspective, what happened to the electro-energy system in Ukraine should give us food for thought. It has been shown that there are critical points of the energy system that have been attacked by the Russian military in order to cut off the energy supply and that forces us to analyze the national system and identify the vulnerabilities and limitations in the most serious way. In this context of direct threats to Romania, in the conditions in which the European Union (EU) actively campaigns for the transition to green energy, there are opinions and analyses of the energy architecture that show that "not all the countries of the Union are alike in terms of consumption and production of energy because they have different geographical location, they have different resources, they have a different economic history that results in a different industrialization, with different transport networks, with different development of localities resulting from the life habits of the population (Pacuraru 2021). Also, each country has a different geography and different resources. Thus, a short and synthetic analysis emerges from the mentioned article: "Poland and Germany are rich in coal resources. Norway, Sweden, the Netherlands, Denmark, the UK (out of the EU) and Germany are near the North Sea's offshore oil and gas reserves. Romania has reserves on its continental shelf in the Black Sea as well as onshore resources. Romania or France, having agricultural land, have agrobiomass (Cosmin Gabriel Pacuraru, 2021)." As elements of national impact but also of differentiation of the energy system, the different levels of economic history and industrialization, the national networks of highways, railways, naval or air transport or the different energy mix determined by urban or predominantly rural development should be taken into account and the lifestyle of the majority population. The EU is implementing the Green Deal which tells us that coal power generation will be curtailed to shutdown in the coming years. Coal represents approximately 17% of the electrical energy mix (a few years ago, it was over 33%) and about 18% of the primary mix. How will we produce electricity?

2. The energy system of the Republic of Moldova

The energy system in the Republic of Moldova faces numerous challenges, but there are also significant opportunities to make the transition to a more sustainable and safer model. Investments in infrastructure, promotion of renewable energies and energy efficiency,

integration into the European energy market and regional collaboration can play a crucial role in improving energy security and ensuring a sustainable future for the country. However, the analysis of the energy system in the Republic of Moldova reveals a series of specific challenges and opportunities, in the context of which the country is trying to improve its energy security and make the transition to a more sustainable and efficient model in terms of resources. A somewhat more detailed analysis brings to our attention the fact that the Republic of Moldova relies to a large extent on energy imports, especially natural gas, oil and electricity. This dependence exposes the country to risks related to international price fluctuations and political instability in supplier countries. Diversifying sources and reducing dependence on imports is an important objective for strengthening energy security.

Also, the energy infrastructure in the Republic of Moldova is outdated and requires modernization and significant investments to be efficient and resilient. Problems related to energy losses in distribution and transmission networks and high levels of inefficient consumption are important obstacles to a sustainable and robust infrastructure. On the strength side, we can quantify the fact that in recent years, the Republic of Moldova has started investing in renewable energies and promoting energy efficiency as part of its efforts to diversify the energy mix and reduce dependence on traditional energy sources. The development of the renewable energy sector, such as solar and wind energy, can contribute to increasing energy autonomy and reducing carbon emissions. The Republic of Moldova aims to strengthen its integration into the European energy market and align itself with European energy standards and regulations. This can bring benefits in terms of energy security, access to finance and technical cooperation, but requires sustained efforts to harmonize national legislation and policies with those of the European Union. In the regional context, collaboration and partnerships with other states and international organizations can play an important role in improving the energy security of the Republic of Moldova. Regional energy projects, exchange of expertise and experience, and financial and technical support from external partners can contribute to strengthening the capacities and resilience of the energy system of the Republic of Moldova.

In this sense, a general legal framework was established and adapted for the organization, regulation, ensuring the efficient and safe operation of the energy sectors and the monitoring of the electricity sector as well as for the efficiency of energy consumption (Law no. 107/2016 on electricity; Law no. 174/2017 on energy efficiency). According to the official website (Ministry of Energy of the Republic of Moldova n.d.), currently, approximately 20% of electricity demand is covered by domestic production, but the respective plants are dependent on gas for production energy and the interconnection with the electric power system in the west of the country is insufficient. Also, a series of investment projects in the electric power system are in the implementation period. Thus, the project for the development of the energy system in the period 2020-2027, worth 61 million dollars and 77 million euros, financed by the World Bank Group, with the main objective of increasing the capacity and improving the reliability of the electricity transmission system, is underway; the project for the development of the electrical transmission network of Î.S. Moldelectrica, in the amount of 45 million euros, financed by the European Union, EBRD, EIB for the rehabilitation of the internal energy transport network, the consolidation of regional networks and the development of the regional energy market completed with another major Energy Security project, in the amount of 59, 8 million dollars, financed by the US Agency for International Development (USAID) and which runs from 2022 to 2026.

We can conclude that the investments in the previously mentioned major projects should have positive effects on the energy system of the Republic of Moldova, materialized in increasing the capacity and reliability of the electricity transmission system, in the rehabilitation of transport networks and the consolidation of regional networks, thus

allowing a more efficient distribution of electricity and better load management in the development of the regional energy market. Finally, the projects will contribute to the creation of an interconnected and integrated system at the regional level, which will increase the country's energy security. Also, improvement through projects dedicated to energy security, such as the one funded by USAID, will determine actions to reduce dependence on vulnerable or unstable energy sources, which will strengthen the resilience of the energy system in the face of unforeseen events or geopolitical disturbances.

The electricity interconnection between Moldova and Romania will accelerate the development of regional integration, given that Moldova will introduce a new route for the exchange of electricity and gain potential transit fees from transactions between Romania and Ukraine by building a new interconnection line with Our country. These investments will significantly contribute to the modernization and improvement of the energy infrastructure of the Republic of Moldova, bringing benefits, both in terms of operational efficiency and energy security.

3. The Romanian energy system

In traditional energy systems, fuels represent the largest share of costs. In future smart renewable energy systems, technology investments are a priority. The analysis of efficiency and costs (SEEnergies n.d.) shows that investments of over 5 trillion euros are needed in efficiency measures in buildings, transport and industry, out of a total of approximately 9 trillion euros. More than €2 trillion should be dedicated to renewable energy and over €1 trillion should be spent on system redesign measures. While investments are higher in energy efficiency compared to redesigning the supply and measures system, it is important to note that all investments should be initiated and implemented simultaneously or almost simultaneously. Thus Europe will focus on energy conservation and energy efficiency, changes in energy supply and resource security, and will become fully decarbonised by 2050, using 100% renewable energy. The study concludes that a 40% reduction in final energy demand can be achieved by saving approximately 2 PWh in both - buildings and transport sectors - and 1.5 PWh in industry, out of a total final demand of 13.6 PWh , and the costs in the field of health, caused by air pollution, can be reduced to approximately 71 billion euros/year.

The transport sector can offer the same magnitude of energy savings (2 PWh) as the buildings sector or a reduction of around 50% in total expenditure. This also requires energy-efficient urban development with high levels of electrification and includes improving energy inefficiency in the use of hydrogen fuel (electric fuel) for heavy transport in aviation and shipping. This will reduce primary energy demand for Europe's transport sector by around 50% compared to the 2050 baseline.

On the other hand, although Romania currently has nuclear energy, it is not considered an option in the energy efficiency scenario, this type of energy not being a solution when the focus is energy efficiency. Nuclear fission processes produce large amounts of heat that cannot be harnessed. Thus, only one-third of it can be collected as electricity, the remaining two-thirds being the heat that cannot be used energetically for the time being. On the other hand, renewable energy from wind or solar sources has no such losses, is simpler to install and is cheaper than nuclear energy. These sources of renewable energy can thus reduce the number of operating hours for thermal power plants and implicitly the amount of fuel required when wind and solar production is insufficient. We can argue considering that because most of the costs of a classic energy system, like today's, is dedicated to fuels (Korberg 2024b).

From the Electric Transport Network Development Plan (RET) for the period 2016-2025 (Transelectrica n.d.) it follows that one of the main objectives is to ensure the necessary transport infrastructure for the good functioning of the electricity market, along

with the correlation of the European Plan for the development of the electricity transport network for ten years - "Ten-Year Network Development Plan (TYNDP), with the National Plan for the development of the electricity transport network for ten years (ENTSO-E)[1]. Within ENTSO-E, six regional groups were created within which the European network development plan is analyzed and finalized, and Romania is part of the Continental Center East and Continental South East Regional Groups. In the last three decades, Romania has managed to reduce its fuel consumption, compared to 1989, by approximately 50%, most of this percentage coming from the massive restructuring of Romanian industry, and less from energy efficiency. However, until the year 2050, so in approximately three decades, Romania has the potential to reduce the consumption of primary energy by another 55% and that of final energy by 47% until the year 2050, according to the energy efficient scenario (Korberg 2024a).

From this perspective, the Ten-Year European Plan for the development of the electricity transmission network—"Ten-Year Network Development Plan (TYNDP) 2014," elaborated by ENTSO-E—includes the projects of European interest "The RET Development Plan - the period 2014–2023", elaborated by CNTEE Transelectrica SA and, respectively, the current edition of the Development Plan - period 2016-2025 and Project 138 "Black Sea Corridor" which integrates into the harmonized effort of all European Transport and System Operators, of to develop trans-European networks and ensure their interoperability.

4. Research methods

In order to achieve a maximum generalization analysis of the European electricity system, adapted to the current context, we used the following research methods: a comparative case study between EU member states and non-member states to evaluate policies, strategies and progress in the field of energy and energy security; an analysis of the geopolitical and regional impact of recent events by investigating the effects of geopolitical changes and tensions in the Eastern European region on the European energy system; a study of energy infrastructure projects and investments with a focus on electrical interconnectivity and the development of energy transmission networks. We have studied the financing, international partnerships and government policies that influence the development of energy infrastructure; we assessed the impact of these projects on energy security, the diversification of energy sources and the integration of the European energy market, which can provide insights into the evolution of the European electricity system.

5. Conclusions

In conclusion, through the new major projects for the development of the electrical system in the Republic of Moldova, a significant improvement in the capacity, reliability and efficiency of the energy infrastructure is anticipated. Investments in the modernization of transmission networks, the strengthening of the regional energy market and energy security measures should help create a sustainable platform for a more robust electricity system and more resistant to external disturbances. These projects can represent an important step in the direction of diversifying energy sources, strengthening energy security and improving the quality of energy services in the Republic of Moldova, for the benefit of all citizens and the national industry. The development of the energy system of the Republic of Moldova, together with the efforts to improve its interconnection with regional networks, promotes a

[1] The establishment as a cooperation group of European TSOs aims to promote the completion and operation of the internal electricity market and cross-border trade, as well as to ensure optimal management, coordinated operation and a sound technical evolution of the European energy transmission network electricity - established under the name "TenYear Network Development Plan" – TYNDP.

more robust, efficient and resistant energy system. The development of energy infrastructure and increased interconnectivity allow the diversification of energy sources, ensuring greater security of supply and reducing dependence on vulnerable energy sources. By strengthening interconnectivity, the Republic of Moldova can benefit from a better management of energy resources and the possibility to collaborate within regional energy markets, which contributes to its long-term stability and prosperity.

The energy interconnectivity between Romania and the Republic of Moldova represents a crucial aspect of the development of the energy system in the region. Through electrical interconnections between the two countries, a series of opportunities and benefits are opened: increased energy security, diversification of energy sources, facilitation of energy exchange, promotion of European integration. The energy interconnection between Romania and the Republic of Moldova is part of the broader European integration efforts of both countries in terms of the energy market. This can facilitate their participation in European energy markets and contribute to the harmonization of energy regulations and standards.

Overall, the energy interconnectivity between Romania and the Republic of Moldova can play a significant role in strengthening energy security, diversifying energy sources and promoting a sustainable and integrated development in the region.

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