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The present intellectual work, which has been conducted and submitted as part of my master's thesis, is my exclusive intellectual property. All information and material included in this diploma thesis that originate from other sources have been properly cited and acknowledged. I am fully aware that any false statement in relation to this declaration may result, at any time, in the immediate revocation of the academic degree.

Eleni Kontogouri

Abstract

Amid intensifying geopolitical instability in Eastern Europe, Moldova's energy security has emerged as a critical issue—not only for its internal resilience but also for the strategic equilibrium of the wider Black Sea and Eastern Partnership region. This thesis examines how Moldova is navigating this complex energy landscape, focusing on its accelerated alignment with European frameworks, its disengagement from Russian energy dependence, and its broader geopolitical reorientation.

The research is structured into three chapters, each addressing a distinct analytical layer. The first chapter provides an in-depth assessment of Moldova's current energy profile, market structure, regulatory landscape, and emergency response mechanisms, while evaluating the impact of the Russia–Ukraine war on its energy system.

The second chapter analyzes the country's infrastructure investments and long-term strategic planning aimed at energy independence. It engages with Moldova's 2030 Energy Strategy and examines integration into regional systems like ENTSO-E, cooperation with NATO in areas of hybrid and cyber threats, and policy instruments for the green transition. These dynamics are explored through the lens of energy transition theory, particularly the Multi-Level Perspective, highlighting the interdependence of technological change, institutional reform, and geopolitical pressure.The third chapter introduces an empirical dimension through a structured survey. It captures public perceptions regarding Moldova's energy vulnerability, European integration, renewable energy development, and crisis preparedness.

The thesis ultimately argues that Moldova's energy strategy is not a matter of mere technical adaptation. It is a comprehensive project of national sovereignty, institutional resilience, and democratic alignment. As such, Moldova represents a test case for how small, strategically located states respond to energy insecurity, authoritarian leverage, and the imperatives of sustainable development in an increasingly polarized geopolitical environment.

To my grandfather, Jean –

Your strength, wisdom, and quiet encouragement have been a guiding light throughout my life.

This thesis is a small reflection of the values you have instilled in me: perseverance, humility, and curiosity.

Thank you for always believing in me.

Acknowledgements

I would like to extend my deepest gratitude to my academic supervisor, Professor Eirini Cheila, for her unwavering support, thoughtful guidance, and insightful feedback throughout the course of this research. Her expertise, patience, and continuous encouragement were instrumental in shaping both the direction and quality of this thesis.

I am also sincerely thankful to all individuals who devoted their valuable time to participate in the research questionnaire. Their willingness to contribute candidly and thoughtfully provided essential data that significantly enriched the findings of this study.

Finally, I wish to express my special appreciation to Mr. Papageorgakopoulos, whose kind assistance in facilitating my communication with the Ministry of Energy of Moldova was of great importance, substantially enhancing the scope and depth of the research.

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Methodology

This thesis adopts an interdisciplinary and mixed-methods approach, combining theoretical analysis, qualitative examination of institutional and policy documents, and the collection of primary empirical data through a structured questionnaire. Moldova serves as a pertinent case study due to its unique geopolitical position, its historic dependence on Russian energy, and its recent efforts to accelerate European integration in response to regional instability, particularly in the wake of the war in Ukraine.

Within this framework, the research includes an extensive review of secondary sources, such as Moldova's strategic energy documents (including the Energy Strategy 2030 and the National Energy and Climate Plan), reports from international institutions (IEA, Energy Community, NATO, European Commission), and relevant scholarly literature on energy transitions in Eastern Europe. The analysis of these materials contributed to a contextualized understanding of Moldova's energy vulnerabilities, reform trajectories, and external dependencies.

To supplement and empirically ground the theoretical insights, the study also incorporated a structured questionnaire as a key instrument of primary data collection. The questionnaire was disseminated online to a targeted sample of professionals, students, and researchers based primarily in Europe, with academic or professional interest in energy policy, geopolitics, or international relations. The purpose of this tool was twofold: first, to capture perceptions regarding Moldova's strategic relevance in the energy security landscape of Eastern Europe, and second, to assess respondents' attitudes on critical topics such as external energy dependence, institutional capacity, the role of renewable energy, and the country's integration into European energy frameworks.

The results of the questionnaire are not treated in isolation but rather interpreted through the lens of the study's analytical framework. In this way, the empirical findings serve not only to illustrate the conceptual issues at stake but also to validate key assumptions of the thesis concerning the political and strategic significance of Moldova's energy transition. The responses, while perceptual in nature, reveal patterns of understanding that align with broader regional discourses and policy narratives.

Naturally, the research is not without limitations. Although the sample is well-defined and relevant to the scope of the study, it is not statistically representative.The reliance on self-reported perceptions may also introduce subjectivity or bias. Furthermore, the lack of in-depth interviews with institutional actors limits the depth of qualitative insight into decision-making processes. Nonetheless, the integration of theory, documentary analysis, and empirical evidence allows for a robust and analytically coherent exploration of Moldova's evolving energy strategy, reinforcing the study's broader conclusions regarding sovereignty, interdependence, and regional resilience.

Theoretical Framework

The concept of energy security has evolved significantly over recent decades, moving beyond the mere technical assurance of energy supply. In contemporary academic and policy discourse, energy security is understood as a multidimensional phenomenon shaped by the interplay of economic, technological, institutional, and geopolitical factors. Its four main pillars—resource availability, affordability, technical reliability, and institutional stability—are being redefined under the pressures of energy transition, digitalization, and growing geopolitical tensions (Cherp and Jewell, 2014).

The case of Moldova highlights the vulnerabilities faced by countries with historically asymmetric energy relationships. The nation's dependence on Russian natural gas, coupled with a weak domestic production base and underdeveloped infrastructure, makes it particularly susceptible to external pressures. Russia's invasion of Ukraine in 2022 acted as a catalyst for transformation, prompting Moldova to seek stronger alignment with the European Union in search of alternative energy sources and regulatory convergence (IEA, 2023).

This strategic reorientation fits within the broader theoretical framework of energy transitions, as articulated by the Multi-Level Perspective (MLP). According to Geels (2002; 2011), transitions in energy systems are not driven solely by technological innovation. They require institutional restructuring, social acceptance, and sustained political support. Systemic change unfolds across three levels—macro-structural pressures (landscape), dominant systems (regime), and innovation niches—interacting dynamically over time. Moldova's energy transition thus necessitates not only a shift in its regulatory framework but also investment in renewables and grid integration.

However, energy policy cannot be examined in isolation from geopolitics. Energy is not merely a commodity; it is also a tool of power. The field of energy geopolitics underscores the role of energy as an instrument of foreign policy, used either as leverage or coercion (Yergin, 2006; Shaffer, 2009). From a geoeconomic perspective, states strategically employ energy policy to achieve political objectives without direct military intervention (Blackwill and Harris, 2016). Such dynamics create strategic interdependence, which may be symmetrical or asymmetrical, reinforcing the vulnerability of smaller states.

This is where historical theoretical analogies become relevant—particularly the Truman Doctrine. During the Cold War, the containment of communism relied on supporting strategically located satellite states. Today, energy sovereignty serves a similar function in preventing dependency on authoritarian regimes. Moldova's energy independence is not only a matter of technical self-sufficiency; it is a condition for maintaining national sovereignty, democratic stability, and alignment with the European identity (U.S. Department of State, 1947).

At the same time, the transition to a new energy model raises questions of social justice. The concept of energy justice reminds us that energy policies are not socially neutral: their effects are unevenly distributed across income groups, regions, and levels of institutional trust (Sovacool et al., 2016; Heffron and McCauley, 2017). Moldova faces significant energy poverty and low public confidence in institutions, making it imperative to adopt inclusive and transparent energy policies. Social inequalities, if not addressed, risk undermining the effectiveness and legitimacy of the transition.

In conclusion, Moldova's energy strategy is not simply a matter of technical regulation or economic optimization. It is a foundation of geopolitical stability, national sovereignty, and social cohesion. The country's shift toward the EU, its disengagement from Russian energy influence, and its investment in democratic energy governance are critical steps toward a sustainable, inclusive, and strategically autonomous energy future.

Moldova Today (Introduction)

The Republic of Moldova occupies a pivotal position between conflicting geopolitical spheres—those of the East and West. Since gaining independence in 1991, the country has faced the dual challenge of overcoming its Soviet legacy while navigating democratic transition and closer ties with Europe. These ongoing tensions continue to shape Moldova's evolving national identity, governance dynamics, and strategic orientation (Simionov, 2023a).

Moldova's progress has long been hampered by political turbulence, fragile institutions, and deep-rooted economic inefficiencies. Demographic shifts—driven by substantial youth emigration and declining birth rates—have contributed to a steadily shrinking population. In 2022, remittances made up 14.1% of GDP (IMF, 2023), offering short-term economic support but also exposing weaknesses in the labor force and social welfare systems (World Bank, 2019).

The onset of Russia's invasion of Ukraine in 2022 starkly highlighted Moldova's susceptibility to regional shocks. The country experienced severe energy supply disruptions and a surge in inflation—consumer prices rose by 30.2% that year (IMF, 2023). These developments fueled societal frustration and placed considerable pressure on governmental structures. The need to reinforce national sovereignty, improve energy independence, and enhance social cohesion became increasingly urgent.

Despite these significant challenges, Moldova has made consistent strides toward European integration. The 2014 signing of the Association Agreement, followed by the implementation of the Deep and Comprehensive Free Trade Area (DCFTA) in 2016, marked important milestones in this process (European Commission, 2022). By 2023, the European Union had emerged as Moldova's most significant economic partner, accounting for around 63% of its exports and 55% of its imports (Eurostat, 2023). The country's designation as an EU candidate in 2022 represented a clear signal of its western alignment—albeit with some caveats. Concerns regarding judicial independence, public administration effectiveness, and entrenched corruption remain central obstacles (European Commission, 2023; European Court of Auditors, 2023).

Moldova's engagement with NATO has evolved concurrently, though constrained by its constitutional commitment to neutrality (Constitution of the Republic of Moldova, 1994). Since entering the Partnership for Peace framework in 1994, Moldova has broadened cooperation in areas such as cybersecurity, civil emergency response, and institutional reform (NATO, 2023). Nevertheless, unresolved issues such as the Transnistrian conflict, the continued deployment of Russian troops on Moldovan territory, and the influence of domestic pro-Russian political forces continue to limit Moldova's strategic reorientation.

These risks are explicitly acknowledged in the National Security Strategy adopted in 2023, which identifies Russia as the most significant external threat to Moldova's national stability. The strategy highlights the presence of Russian forces in Transnistria, ongoing separatist tensions, and the rising influence of pro-Russian political actors as major impediments to the country's democratic and strategic ambitions (Government of the Republic of Moldova, 2023). In light of these threats, the document calls for expanded cooperation with both the European Union and NATO to bolster national defense and resilience (ibid.).

In the midst of these dynamic geopolitical developments, Moldova's future stability and progress will rely heavily on the strengthening of its institutions, the continuation of international support, and the pursuit of sustainable energy solutions. As the war in Ukraine continues to reshape the security environment of Europe, Moldova may serve as a revealing test case for the EU's capacity to promote stability and transformation along its eastern frontier.

1.1.1 Market Structure

Moldova's energy landscape is characterized by a significant reliance on imported fossil fuels, limited domestic generation capacity, and underdeveloped renewable energy deployment. In 2022, over 65% of the country's final energy consumption was met by natural gas and oil products (IEA, 2022; Energy Community Secretariat, 2023). Approximately 70% of electricity demand was satisfied through imports, primarily from Ukraine and Romania, while domestic generation heavily depended on the thermal power station at Cuciurgan, situated in the breakaway Transnistrian region (IEA, 2022).

Strategically, the Moldovan government aims to reduce its reliance on Russian energy supplies and enhance national energy autonomy through deeper integration with EU markets and the advancement of a cleaner energy mix. The country's Low Emission Development Strategy (LEDS) envisions increasing the share of renewable energy to 17% by 2030, improving energy efficiency by 30%, and achieving full integration into the European energy system by 2035 (UNDP, 2023).

Nevertheless, the implementation of these goals faces several structural obstacles. A chronic lack of long-term investments, limited access to expertise and financial resources, and geopolitical uncertainty contribute to framing Moldova's energy transition more as a defensive necessity than a proactive reform strategy. Furthermore, the continued reliance on power generation located in territories outside the effective control of the central government introduces inherent uncertainties in terms of supply security and long-term energy planning (World Bank, 2023).

Despite these challenges, Moldova stands at a strategic crossroads. The country's geographical proximity to Romania, technical progress toward interconnection with the EU grid, and the strategic imperative of energy sovereignty render the transition to a diversified and sustainable energy system not only feasible but essential. The future of Moldova's energy sector must be anchored in the triad of renewable energy expansion, enhanced storage capacity, and the widespread adoption of energy-saving policies—each element being critical to achieving long-term resilience, affordability, and environmental sustainability.

1.1.2 Electricity

Moldova's electricity sector is marked by structural vulnerabilities, regulatory challenges, and significant geopolitical sensitivities. The country's limited domestic electricity generation capacity and reliance on external suppliers—primarily the Russian-controlled Moldavskaya GRES (MGRES) thermal power plant located in the breakaway region of Transnistria—pose substantial threats to energy sovereignty and national security (IEA, 2022).

The market structure is officially semi-liberalized, comprising state-owned, private, and mixed-ownership entities. The state-owned transmission system operator, Moldelectrica, manages approximately 4,700 kilometers of high-voltage lines west of the Dniester River and nominally oversees an additional 1,746 kilometers in Transnistria. However, the Moldovan government lacks operational control over infrastructure within Transnistria (IEA, 2022).

Electricity distribution is primarily divided between two operators: Premier Energy, a privately owned company of Romanian origin serving central and southern Moldova, and RED Nord, which serves the northern regions. Together, they operate a network of approximately 56,850 kilometers, supplying electricity to around 1.3 million consumers (IEA, 2022).

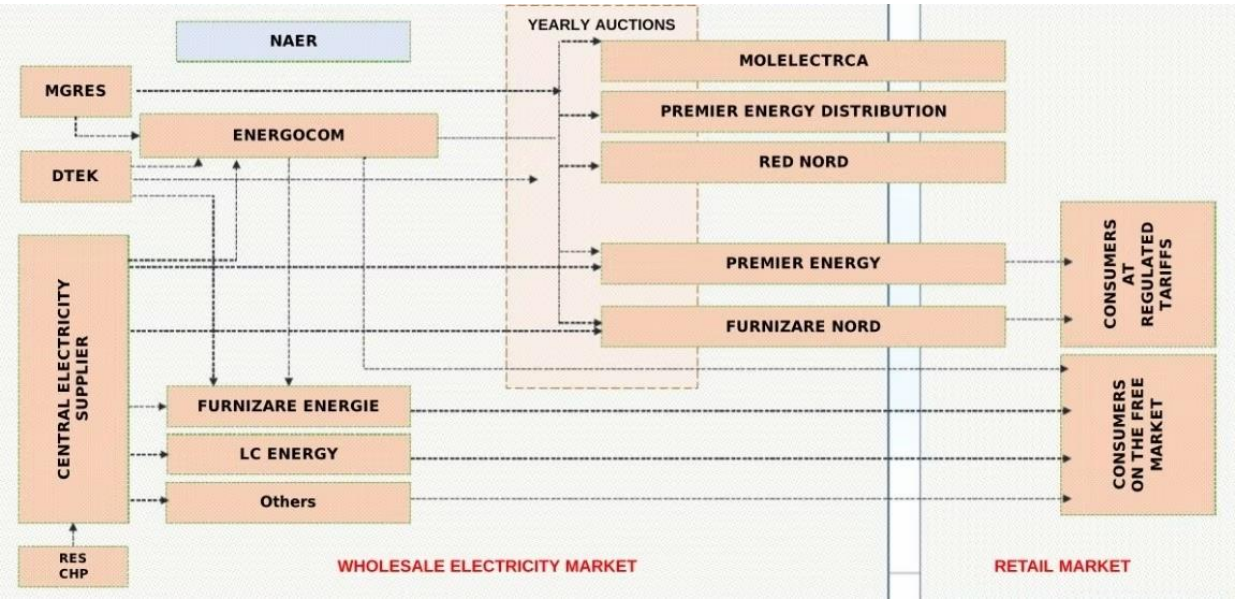

Figure 1.

IEA (2022) *Moldova Energy Profile: Market Design*. International Energy Agency. Available at: https://www.iea.org/reports/moldova-energy-profile/market-design

As illustrated in Figure 1, Moldova's electricity market operates through a layered structure encompassing generation, wholesale, and retail levels. At the center of this structure is Energocom, the state-designated central electricity buyer, which consolidates supply from both domestic and international producers—chiefly MGRES and DTEK. Energocom then redistributes this electricity via annual auctions to licensed suppliers and distribution operators.

This market configuration reveals a paradoxical setup: despite the presence of liberalized elements, central coordination remains dominant, producing a hybrid model marked by operational complexity and limited genuine competition (IEA, 2022).

Electricity generation remains highly concentrated. In 2023, approximately 70% of Moldova's consumed electricity originated from the MGRES plant, a thermal facility under Russian influence located in territory beyond the Moldovan government's control (IEA, 2023). The remainder was covered by imports from Romania and minor contributions from renewable energy sources, which still account for less than 10% of total generation (IEA, 2022).

Dependence on MGRES constitutes not only a technical vulnerability but also a strategic asymmetry. Energy deliveries from Transnistria are subject to the political discretion of a de facto administration operating outside Moldova's legal framework. During the 2022 energy crisis, electricity flows became contingent on political negotiations, illustrating how energy can be used as a tool of influence (IEA, 2022). This dependency introduces operational, regulatory, and geopolitical risks that cannot be mitigated through market reforms alone.

In March 2022, Moldova achieved a milestone by synchronizing with the European electricity grid via ENTSO-E, allowing real-time electricity exchanges under EU market rules. While this emergency synchronization opened new opportunities for imports from Romania, technical capacity remains limited. The current cross-border transmission capacity—approximately 600 MW—falls short of Moldova's winter peak demand, which regularly exceeds 900 MW (IEA, 2022). Strategic infrastructure projects, such as the Vulcănești–Chișinău and Bălți–Suceava 400 kV lines, are under development but not yet completed.

Despite legal harmonization with EU energy legislation, particularly through the adoption of the Third Energy Package—Directive 2009/72/EC, Article 9 and Regulation (EC) No 714/2009, Article 16—institutional weaknesses persist (EU, 2009; IEA, 2022). Although Moldova has committed to unbundling its energy sector and increasing market competition, the effective independence of Moldelectrica remains limited, and barriers to entry in electricity generation and supply markets continue to hinder liberalization.

Ultimately, Moldova's electricity sector exemplifies the intersection of energy, governance, and geopolitics. Beyond its technical dimensions, electricity policy in Moldova is fundamentally an issue of national sovereignty. Reducing dependence on MGRES and Transnistrian infrastructure, completing integration into the ENTSO-E market, investing in renewables, and enhancing domestic regulatory oversight are not only energy priorities but prerequisites for state resilience and long-term political autonomy.

1.1.3 Oil

Moldova's oil sector is marked by a high degree of external dependence and structural vulnerabilities. In 2019, the country consumed approximately 860 kilotonnes of petroleum products, nearly all of which were imported—primarily from Romania and Greece (IEA, 2020). With no domestic refining or oil production capacity, Moldova's energy system remains highly exposed to geopolitical disruptions and global market volatility.

At the heart of Moldova's petroleum logistics lies the Giurgiulești International Free Port, the country's only maritime terminal. It plays a vital role in facilitating oil imports, yet its infrastructure—comprising only eight storage tanks with a total capacity of 63,600 m^3—is insufficient to absorb supply shocks or maintain strategic reserves (Giurgiulești International Free Port, n.d.). This vulnerability became evident during the 2022 global energy crisis, when Russia's invasion of Ukraine disrupted regional trade flows. Moldova experienced delayed deliveries and fuel price increases exceeding 40% year-over-year (Bloomberg, 2022).

Adding to the sector's fragility is its highly concentrated market structure. According to the National Energy Regulatory Agency (ANRE), over 70% of Moldova's oil import market is controlled by just three companies: Lukoil Moldova, Rompetrol Moldova, and Tirex Petrol. These firms dominate both wholesale and retail distribution and have faced recurring allegations of price collusion—especially during periods of crisis (PYMNTS, 2024). Although Moldova passed legislation in 2021 mandating greater price transparency, enforcement has remained weak due to institutional limitations and regulatory politicization (World Bank, 2021).

Unlike EU member states, Moldova lacks strategic oil reserves and redundant infrastructure to diversify its supply routes. The country's heavy reliance on Giurgiulești—combined with limited storage facilities elsewhere and underdeveloped cross-border connections—hampers its ability to redirect imports via Ukraine or alternative EU terminals in emergencies. While there have been efforts to improve supply resilience via road and rail networks, they remain constrained by both geography and financing (IEA, 2020). Moldova's dependency on a narrow set of suppliers and a single logistical hub elevates oil security from a technical matter to one of national strategic importance.

1.1.4 Natural Gas

Natural gas occupies a critical place not only within Moldova's energy portfolio but also in its broader geopolitical positioning and institutional resilience. Unlike electricity or renewable sources, the gas sector is tightly linked to issues of national sovereignty and external leverage, a consequence of Moldova's post-Soviet legacy and its geographical location between Eastern and Western energy networks (CSIS, 2024).

Historically, Moldova has been almost entirely dependent on gas imports from Russia, provided through Gazprom and its local joint venture, Moldovagaz. Gazprom holds a 50% stake in the company, which effectively controlled supply, transmission, and distribution. This dominance extends beyond economics into political leverage. The unresolved situation in Transnistria further complicates matters: the breakaway region reportedly consumes gas without payment, with Gazprom effectively subsidizing this, deepening Moldova's debt burden and strategic vulnerability (Atlantic Council, 2024).

Such dependency is not unique to Moldova. Countries such as Bosnia and Herzegovina and North Macedonia also sourced 100% of their gas from Russia in 2020. Moldova's case highlights the structural weakness that has shaped its energy diplomacy.

The 2021 gas crisis brought this vulnerability into sharp focus. Gazprom threatened to suspend deliveries over unpaid debts, just as Moldova elected a pro-European government. According to CSIS (2024), the timing suggests the issue was more political than commercial, with energy used as a tool of pressure. Moldova ultimately signed a five-year supply deal under urgent conditions, while still attempting diversification through Romania.

Between 2021 and 2023, Moldova reduced its dependence on Russian gas from 100% to approximately 65%, thanks to increased LNG imports and reverse flows from Romania (Energy Community, 2024, p. 47). However, this transition remains fragile due to LNG price volatility and limited infrastructure. Residential gas prices rose over 45% during this period, with about 35% of Moldovan households classified as energy poor by 2023 (Energy Community, 2024, p. 51).

A key development occurred in 2024 with the certification of VestMoldTransGaz under EU Directive 2009/73/EC, formalizing Moldova's regulatory integration with the EU gas market. However, challenges remain: price rigidity, weak internal competition, and institutional fragility persist (Energy Community, 2024).

Gas storage is another critical vulnerability. Moldova lacks large-scale domestic storage and instead relies on bilateral agreements with Romania and Ukraine. While these arrangements offer short-term relief, they do not resolve the long-term structural challenge. In 2025, Moldova confirmed plans to use Ukraine's underground storage facilities to create national gas reserves, further strengthening regional energy resilience (Interfax, 2025).

Despite Moldova's legal alignment with EU energy legislation via the Energy Community Treaty, implementation capacity remains weak. Institutional strength, political continuity, and regional partnerships will be essential for true resilience (Energy Community, 2024).

In comparative perspective, Moldova lags behind regional peers like Ukraine and Georgia, who have diversified their gas sources, developed domestic storage, and secured long-term Western contracts. Moldova's slow infrastructure development and governance limitations leave it vulnerable.

Finally, the sector suffers from weak governance. Transparency International (2023) notes persistent issues of low transparency, corruption, and regulatory capture—problems that undermine public trust and delay reform.

1.1.5 Renewable energy sources

Moldova's renewable energy sector remains underdeveloped but increasingly central to its energy transition strategy. Although renewables account for less than 5% of total final energy consumption as of 2023, recent years have witnessed gradual institutional and legislative alignment with EU climate objectives. The country's installed renewable energy capacity stood at approximately 98 MW, dominated by solar photovoltaic systems and biomass heating applications in public and residential buildings (IEA, 2022; UNECE, 2022). Despite this modest progress, Moldova continues to rank among the lowest in the Energy Community in terms of renewable energy deployment.

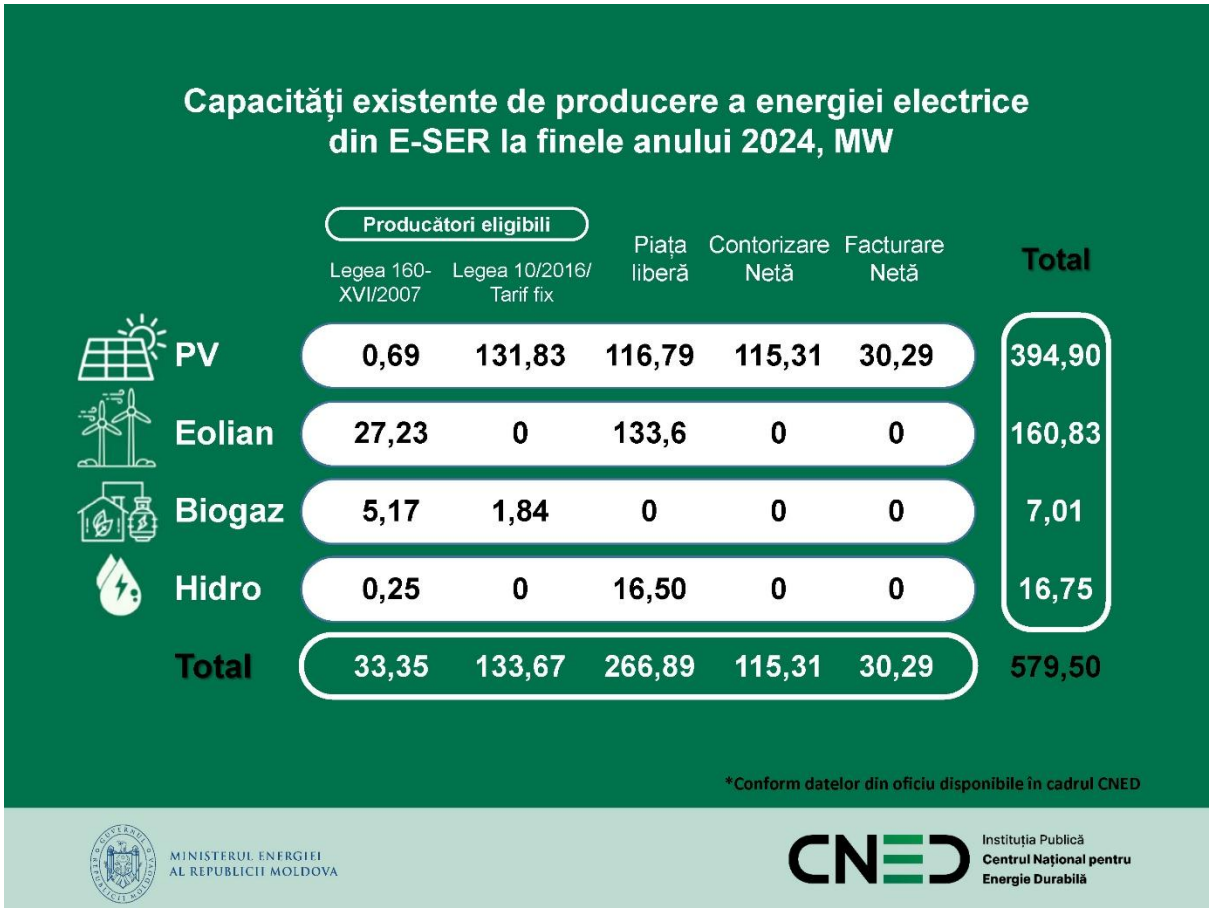

Figure 2:

Ministry of Energy of the Republic of Moldova. (2024) *Installed renewable power plants in Moldova reach a total capacity of 580 MW by end of December*. Available at: https://energie.gov.md/en/content/installed-renewable-power-plants-moldova-reach-total-capacity-580-mw-end-december

The legal framework supporting renewables has evolved significantly since the adoption of the Law on Promotion of Renewable Energy (2016), followed by the approval of the National Energy and Climate Plan (NECP), which targets a 17% renewable share by 2030. Moldova's obligations under the Energy Community Treaty, although non-binding as in the EU Member States, provide a structured pathway for harmonising domestic regulations with the European

acquis, particularly Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (Energy Community Secretariat, 2023).

Among Moldova's most promising renewable resources is solar energy. With an average annual solar radiation of 1,200 to 1,400 kWh/m², the country has significant technical potential, yet less than 1% of it is currently exploited (UNECE, 2022). Biomass also plays a substantial role in the heating sector, especially in rural areas. Between 2011 and 2018, over 200 modern biomass heating systems were installed in public institutions, mainly schools and hospitals, through EU and UNDP support (UNDP Moldova, 2023).

Wind energy remains at an early stage, hindered by weak market signals, licensing uncertainty, and a lack of grid infrastructure adapted for variable generation. While wind potential exists—particularly in the southern regions—only a few small-scale projects have reached operational status (IEA, 2022). Hydropower, mainly in the form of small hydro installations below 10 MW, contributes marginally and is subject to seasonal variability and geopolitical sensitivities, particularly regarding river flow management with upstream Ukraine (Ministry of Environment Moldova, 2023).

Theoretically, Moldova illustrates the limited leverage of small states in energy geopolitics. As Goldthau and Sitter (2015) point out, regulatory alignment with the EU offers a valuable normative framework, but without corresponding investments in infrastructure and diversification, such alignment risks remaining symbolic. Moldova's case also exemplifies the classic "energy trilemma"—the balancing act between energy security, affordability, and sustainability—in which political constraints often override market-based solutions.

1.1.6 Energy Efficiency

Energy efficiency stands as a pivotal element in Moldova's transition towards a sustainable and diversified economy. The country's energy intensity remains among the highest in Europe, with total energy supply per unit of GDP (PPP) reaching 651 MJ per 2015 USD in 2022, significantly surpassing the EU average (IEA, 2022).

This elevated energy intensity is not solely a result of technical inefficiencies but also reflects deeper structural challenges, including outdated industrial infrastructure, limited technological advancements, and remnants of centralized planning that continue to influence energy systems and institutional capacities (IEA, 2022; Ministry of Energy, 2025).

In response, Moldova has implemented the National Energy Efficiency Program 2022–2025, focusing on enhancing energy efficiency in public buildings, deploying smart metering systems, and promoting decentralized energy planning (Ministry of Energy, 2025). The Energy Efficiency Agency (EEA), restructured under the 2018 Energy Efficiency Law, is tasked with overseeing these initiatives (Law on Energy Efficiency No. 139/2018, Art. 5).

Despite these efforts, progress remains fragmented across sectors. The private sector, particularly in industry and agriculture, lags in adopting energy-efficient technologies. Moreover, the absence of a robust monitoring and evaluation framework hampers the assessment of long-term impacts. Energy transition policies also have socio-economic implications, potentially imposing disproportionate costs on lower-income households and limiting access for small enterprises (IEA, 2022; UNECE, 2022).

While Moldova's energy transition aligns with the National Energy and Climate Plan (NECP) and the European Green Deal objectives, it remains uncertain whether energy efficiency measures are effectively driving innovation and institutional reform or primarily serving as formal compliance with donor and EU expectations (Ministry of Energy, 2025; European Union, 2018).

1.2 Regulatory Framework and Tariff Policy

Moldova's energy sector has undergone significant transformation over the past decade, influenced heavily by its strategic alignment with the European Union (EU) and the commitments it has made under the Energy Community Treaty. This evolution has been marked by the transposition of key legislative instruments of the EU's Third Energy Package, including the Law on Electricity (2016), Law on Natural Gas (2016), and the Law on Energy (2017). These reforms aimed at liberalizing markets, ensuring transparent governance, and reinforcing consumer protection have laid a legal foundation for a competitive and resilient energy sector. However, while formal legal harmonization has largely been achieved, practical implementation remains inconsistent, highlighting an enduring gap between legislative ambition and regulatory functionality (IEA, 2022).

The legal foundations of Moldova's energy regulation are anchored in the Law on Energy (2017), which aligns national frameworks with EU Directive 2009/72/EC on the internal market in electricity and Directive 2009/73/EC on the internal market in natural gas. Article 15 of the Law on Energy (2017) assigns the National Energy Regulatory Agency (ANRE) the authority to approve and apply tariff methodologies independently, based on principles of transparency, non-discrimination, and consumer protection (Law No. 174/2017). This institutional architecture reflects core requirements of the EU energy acquis and mirrors the structure of regulatory autonomy outlined in the Energy Community Treaty.

Further legal grounding is found in the Law on Electricity (2016) and the Law on Natural Gas (2016), which set out the framework for market liberalization, third-party access, and unbundling of transmission and distribution system operators (Law No. 107/2016; Law No. 108/2016). These laws incorporate obligations from Directive 2009/72/EC and Directive 2009/73/EC, which require EU Member States and Contracting Parties to designate independent national regulatory authorities with adequate authority and resources to operate impartially (European Union, 2009a; European Union, 2009b).

Despite the existence of formal safeguards for ANRE's independence, including provisions for the non-political appointment of its leadership and protection from arbitrary dismissal, structural and functional limitations persist. Budgetary dependence on state allocations instead of dedicated levies creates financial vulnerabilities. The absence of judicial oversight mechanisms for regulatory decisions also undermines accountability, raising concerns echoed in successive Energy Community Implementation Reports (Energy Community Secretariat, 2022). Political influence in tariff-setting, particularly during periods of price volatility or electoral sensitivity, reveals an ongoing tension between regulatory autonomy and governmental discretion.

Academic and policy literature has noted the challenges of enforcing regulatory independence in transition economies. As Talus (2016) notes, the legal transposition of EU energy law is a necessary but insufficient condition for market transformation; effective implementation requires institutional resilience, professionalized staffing, and legal mechanisms to insulate regulators from political interference. The Moldovan case exemplifies the gap between de jure compliance and de facto autonomy, posing a persistent obstacle to full alignment with EU norms and to the establishment of investor confidence.

The National Energy Regulatory Agency (ANRE) plays a pivotal role in overseeing Moldova's energy governance. Established as an independent regulator, ANRE is tasked with licensing, market oversight, and tariff regulation across electricity, gas, district heating, and petroleum markets. The agency employs internationally recognized methodologies such as the Weighted Average Cost of Capital (WACC) model to ensure fair returns for regulated entities while maintaining cost-reflective tariffs for consumers. Multi-year regulatory periods, typically spanning five to seven years, allow for predictable pricing structures, with periodic adjustments for inflation, fuel costs, and currency fluctuations (IEA, 2022).

In terms of tariff methodology, ANRE follows a WACC-based revenue-cap model. This methodology sets allowed revenues by combining a return on capital employed, based on a sector-specific WACC, depreciation of regulated assets, operating expenditures, and the pass-through of uncontrollable costs. Such models are common in EU jurisdictions and provide predictable investment signals while also protecting end-users from unjustified cost increases. Moldova's application includes a multi-year regulatory period, allowing stability for both utilities and consumers. During these periods, regulated entities can apply for tariff revisions due to macroeconomic variables or infrastructure investments, through formal submission and public consultation processes (IEA, 2022).

Tariffs are designed to be cost-reflective and are differentiated by voltage and pressure levels, consumer category, and usage patterns. Cross-subsidies are legally restricted, except where necessary to support vulnerable groups under public service obligations. However, political pressures have occasionally delayed needed tariff adjustments, especially in pre-election periods or during price crises. This has led to distortions in market signals and created disincentives for private investment. Such interventions have raised concerns among both domestic regulators and international observers (Energy Community Secretariat, 2022; IEA, 2022).

Consumer protection remains a central pillar of the regulatory approach. Moldova has instituted social safety nets such as the Energy Vulnerability Reduction Fund, operational since 2023, which offers targeted subsidies, on-bill compensation, and appliance replacement vouchers to vulnerable households. With energy poverty affecting approximately one-third of Moldovan households during the winter season, such measures are crucial, yet raise concerns about long-term fiscal sustainability (European Commission, 2023).

While Moldova's regulatory framework guarantees third-party access to energy infrastructure, practical barriers persist. As of 2023, the wholesale electricity market is predominantly based on bilateral contracts, with minimal participation from alternative suppliers. In the gas sector, MoldovaGaz retains substantial control over both wholesale and retail markets, with the legal unbundling of transmission infrastructure not yet fully operationalized. These structural rigidities inhibit competition and deter new market entrants, thereby limiting consumer choice and slowing the pace of market transformation.

To bridge the gap between legislative frameworks and functional markets, Moldova must prioritize enhancing the operational independence of ANRE, developing digital monitoring infrastructure, and fostering competitive wholesale platforms. Additionally, investments in renewable energy, demand-side management, and cross-border interconnectivity will be essential to achieving a sustainable, secure, and inclusive energy future.

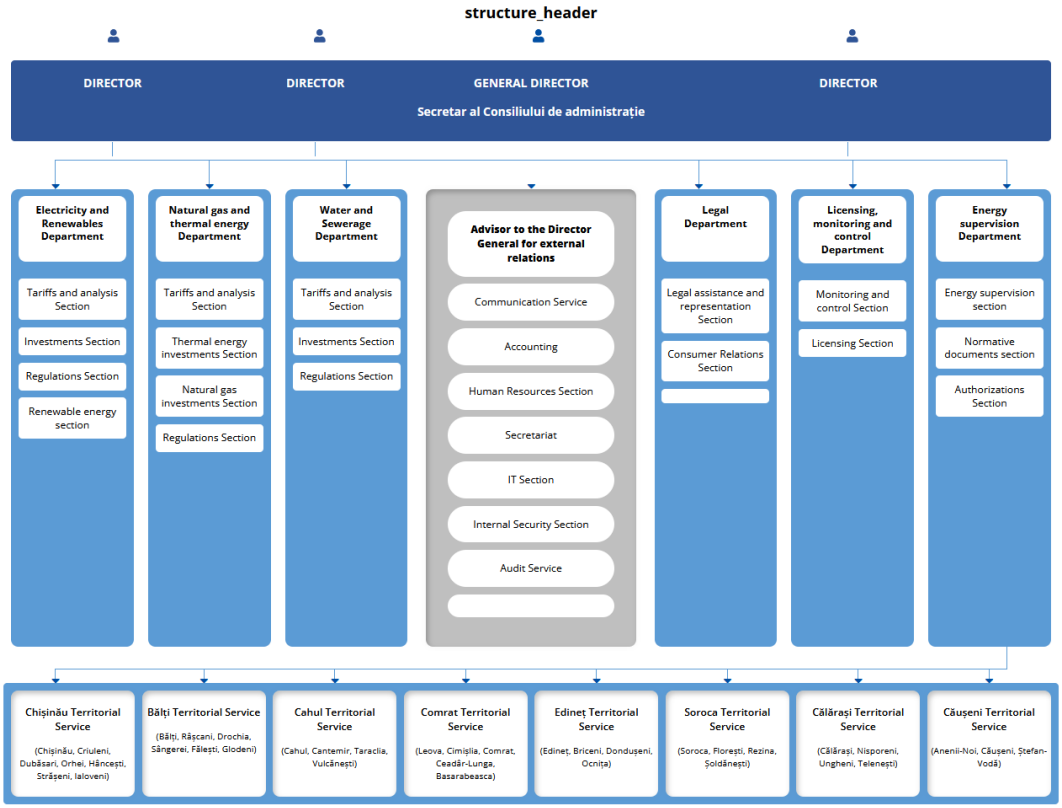

Figure 3 : Organizational Structure and Competencies of ANRE. This chart illustrates the hierarchical structure of Moldova's National Energy Regulatory Agency, including core departments, specialized sections, and regional services distributed across the country.

National Energy Regulatory Agency (ANRE), n.d. *Organizational Structure and Competencies of ANRE*. [online] Available at: https://www.anre.md/en/organigrama-2-8 [Accessed 8 Jun. 2025].

1.3 Emergency Response

The outbreak of the Russia–Ukraine war in 2022 marked a pivotal stress test for Moldova's energy sector, revealing the extent of its dependence on Russian imports. This dependence constituted a structural vulnerability, rendering the country acutely exposed to geopolitical shocks. In the terminology of Holling (1973), Moldova exemplified low systemic resilience—an inability to absorb disturbances while maintaining essential functions. This case also fits the archetype of high-risk mono-dependence described by Yergin (2006) and Goldthau and Sovacool (2012).

The geopolitical rupture of 2022 did not merely expose Moldova's infrastructural fragility but unveiled a multidimensional threat landscape. In October 2022, Gazprom unilaterally reduced gas deliveries by over 30%, citing vague technical issues widely interpreted as politically motivated. Concurrently, Moldova suffered distributed denial-of-service (DDoS) attacks on critical governmental digital infrastructure, including the Ministry of Infrastructure and Regional Development (National Cyber Security Agency, 2022). These cyber and kinetic disruptions were exacerbated by disinformation campaigns aimed at undermining public trust in energy diversification.

In response to this convergence of hybrid threats, Moldova adopted a multipronged strategy combining physical infrastructure adaptations, regulatory reforms, and institutional innovation. At the center of this response was the Iași–Ungheni–Chișinău gas pipeline, which became fully operational in autumn 2022. This enabled reverse gas flow from Romania, supported by emergency contracts signed on 13 October 2022 with OMV Petrom and Transgaz, ensuring Moldova's gas supply for the 2022–2023 winter.

Electricity agreements were also concluded with Romania's Hidroelectrica, and emergency cross-border electricity transfers via the Isaccea–Vulcănești interconnector were activated under ENTSO-E protocols following blackouts caused by Russian strikes on Ukrainian infrastructure (European Commission, 2023).

Institutionally, Moldova codified its crisis response with the National Emergency Plan for Energy Supply Disruptions (NEPESD) in December 2022. The plan introduced scenario-based planning for cyberattacks, infrastructure sabotage, and extreme weather. Responsibilities were assigned to the Ministry of Energy, the National Energy Regulatory Agency (ANRE), and emergency services, in alignment with adaptive governance frameworks proposed by Boin et al. (2005) and Folke et al. (2010).

Redundancy and diversification efforts included leasing 450 million cubic meters of gas storage in Romania (Sărmășel and Bilciurești), a move consistent with Comfort's (2001) concept of "resourceful resilience." This was supported by the deployment of mobile generators and "grid islanding" capabilities to enable autonomous operation during blackouts, in line with the design principles suggested by the International Energy Agency (IEA, 2022) and Sovacool (2013).

The digital modernization of Moldova's energy infrastructure also formed a cornerstone of resilience strategy. Supported by the EU4Energy Governance Project and EBRD funding, Moldova installed real-time diagnostics and predictive analytics in substations in Chișinău and

Bălți, significantly improving situational awareness and reducing response latency (Bruneau et al., 2003).

Crisis preparedness was further institutionalized through full-scale simulation exercises conducted under the EU Civil Protection Mechanism in March and October 2023. These exercises, based on scenarios involving blackouts and cross-border sabotage, revealed shortcomings in municipal readiness and inter-agency communication. Consequently, Moldova established energy crisis coordination cells at the county level and adopted a standardized national training program for emergency personnel.

At the international level, the European Union was instrumental in reinforcing Moldova's energy security. Through the Moldova Support Platform—co-hosted by Germany, France, and Romania—the EU pledged €250 million in grants and concessional loans for 2023 and 2024, supporting subsidies, grid modernization, and mobile infrastructure (European Commission, 2023). Additionally, via RescEU, the EU provided over 600 generators and other critical equipment. Regulatory alignment was facilitated by the Energy Community Secretariat (2023), culminating in the certification of Moldelectrica as an independent transmission operator in July 2023.

Further diversification was pursued through a memorandum of cooperation with Norway in February 2024. This included renewable energy investments in southern Moldova and a technology transfer initiative for integrating intermittent renewables into the grid, backed by the EU External Action Guarantee.

Despite significant progress, Moldova faces persistent challenges. These include the absence of domestic gas storage, aging infrastructure in the north, and fragmented municipal emergency protocols. Notably, Moldova lacks a centralized Energy Crisis Management Center with 24/7 operational capacity—an issue highlighted by the Energy Community (2023).

Going forward, Moldova's path to energy resilience will require an integrated risk governance framework addressing geopolitical, climate, and socioeconomic risks. Consolidating public-private partnerships, institutionalizing municipal participation in drills, and establishing strategic reserves will be key to ensuring long-term sovereignty and resilience.

In conclusion, Moldova's energy governance model is transitioning from reactive, infrastructure-centric approaches to a proactive, resilience-based paradigm. Through a combination of EU collaboration, digital modernization, and institutional innovation, Moldova is embedding flexibility, redundancy, and sovereignty into its energy security landscape.

1.4 Energy Security and Diversification

The Russian invasion of Ukraine in 2022 marked not only a turning point in the European security architecture but also served as a catalyst for a fundamental redefinition of the geopolitical logic underlying energy interdependence. For Moldova—a state with limited domestic energy resources, no national storage infrastructure, and a fragmented institutional landscape—this crisis dramatically exposed the vulnerabilities inherent in its energy dependency.

Within this framework, the model of energy interdependence adopted by Moldova evolved into what is defined as "weaponized interdependence": a form of asymmetric connectivity in which the more powerful actor controls strategic nodes of infrastructure and can thus exploit interdependence as a coercive tool (Farrell and Newman, 2019). Moldova, lacking alternative routes, reserves, and regulatory autonomy, exemplified a state experiencing energy interconnection as a form of political constraint.

The 2022 crisis, however, triggered a decisive strategic shift. Moldova moved from a reactive posture focused on risk management to an active reconfiguration of its energy geography. The suspension of Russian supplies and the extreme price volatility opened what has been conceptualized as a "policy window": a rare convergence of political will, problem awareness, and institutional opportunity that enables the adoption of a new strategic course (Kingdon, 1984). Moldova responded with a range of measures that went beyond administrative adaptation. It accelerated the use of the Iași–Ungheni–Chișinău interconnector, established electricity imports from Romania and Ukraine, completed synchronization with the ENTSO-E grid, and ultimately ceased all Russian gas imports by the end of 2023.

These developments should not be seen merely as technical accomplishments. They constitute, in the sense proposed by Goldthau and Sitter (2015), political acts of sovereignty embedded within a broader strategy of energy autonomy. Diversification thus functions not only as a mechanism for technical resilience but also as a political reassertion of Moldova's sovereign agency through the dismantling of a one-sided dependency framework.

Moldova's effort to achieve energy autonomy rests on a dual foundation: on the one hand, the geographic diversification of supply routes, and on the other, normative convergence with the European Union. The former ensures infrastructural redundancy, while the latter reinforces legitimacy and institutional predictability. Under this revised paradigm, energy and sovereignty are no longer oppositional concepts but mutually reinforcing. Strategic autonomy is not pursued through isolation but through embeddedness within rule-based multilateral systems (Zürn, 2018).

Taken together, Moldova's case illustrates that energy policy is no longer a domain of technical administration but a central pillar of statecraft and foreign policy. Energy self-sufficiency thus emerges not as an endpoint, but as a performative expression of sovereign capacity and regional repositioning.

The shift toward energy autonomy in Moldova has been facilitated and, to a large extent, driven by international financial institutions (IFIs) such as the European Bank for Reconstruction and

Development (EBRD), the European Investment Bank (EIB), and the World Bank. These institutions have not merely provided capital injections for infrastructure projects; they have operated as normative actors, embedding energy investments within a framework of governance reforms, transparency standards, and regulatory alignment (Van de Graaf and Colgan, 2016). In effect, they have conditioned access to finance upon progress in market liberalization, depoliticization of energy pricing, and the unbundling of energy companies—core principles of the EU's Energy Acquis.

This logic of conditionality mirrors patterns observed in other post-socialist or peripheral economies of the European neighborhood, where IFIs act as transmission belts between capital flows and institutional restructuring. Conditionality operates not merely through coercion, but through the strategic use of incentives—what is termed "reinforcement by reward" (Schimmelfennig and Sedelmeier, 2005). Moldova, facing domestic capacity constraints and geopolitical exposure, has found in conditional finance a path toward externally anchored reform, albeit one that also constrains policy autonomy.

The National Energy Strategy 2030 articulates these priorities explicitly, emphasizing the need to build a liberalized energy market, ensure non-discriminatory access to the grid, and create independent regulatory agencies. These objectives are not isolated technical goals but rather institutional prerequisites for credibility in the eyes of external partners.

Crucially, institutional reform has also involved decentralization and depoliticization, two processes essential for long-term resilience. Energy efficiency programs targeting municipal buildings, households, and industrial consumers have been rolled out with support from the World Bank's Moldova Energy Efficiency Fund, which links funding disbursements to performance indicators and independent audits (World Bank, 2022). These instruments exemplify a shift from discretionary public investment to results-based financing, strengthening administrative accountability and reducing the political capture of energy subsidies.
Beyond regulatory harmonization, Moldova's institutional modernization reflects an emerging logic of what is termed "reflexive governance"—a mode of governance that adapts to uncertainty and complexity through monitoring, benchmarking, and cross-sectoral coordination (Zürn, 2018).

Energy diversification in Moldova has often been discussed in terms of supply routes and geopolitical alignment. However, a more structural and long-term view reveals that diversification entails not merely who supplies energy or how it is transported, but also what kind of energy is produced and how energy markets are governed. In this deeper sense, diversification is less about redundancy and more about systemic transformation—a reorganization of Moldova's energy economy, regulatory framework, and environmental commitments in line with the European Green Deal and broader global decarbonization trends (Goldthau and Keating, 2009).

A key driver of this transformation is Moldova's progressive integration into EU energy and climate governance structures. Since joining the Energy Community in 2010, Moldova has aligned its legislation with the EU Third Energy Package and, more recently, with the Clean Energy for All Europeans Package. This legal harmonization has created both incentives and

constraints: while it opens access to funding and technical assistance, it also imposes compliance with complex regulations, including the liberalization of wholesale electricity markets and the phasing-out of state aid (Energy Community, 2023).

A major milestone in Moldova's diversification effort came in 2024, with the launch of its first competitive renewable energy auctions, replacing the earlier feed-in-tariff scheme. These auctions introduced market-based price discovery, thereby encouraging cost efficiency and reducing fiscal burdens on the state. By mid-2024, installed renewable capacity reached 400 MW, accounting for roughly 16% of national electricity consumption—a fourfold increase from 2021 (Reuters, 2024). While wind and solar dominate the landscape, emerging interest in biogas and small-scale hydroelectricity signals a broadening technological base.

Beyond capacity expansion, the renewable transition also reshapes ownership and participation models. New actors—local cooperatives, private investors, and foreign developers—are entering the Moldovan energy market, challenging legacy monopolies and diversifying the institutional ecosystem. This trend aligns with the EU's emphasis on prosumerism and decentralized generation, in which citizens become both producers and consumers of clean energy (Roberts et al., 2019).

However, systemic transformation entails more than technology and law. It requires institutional infrastructure capable of monitoring market behavior, enforcing contracts, and managing grid stability. The Moldovan Transmission System Operator (TSO), Moldelectrica, has been undergoing reforms to improve its capacity for balancing intermittent renewable flows and facilitating cross-border electricity exchange. These efforts are supported by the EU's Neighbourhood Investment Platform and coordinated through regional mechanisms such as ENTSO-E's Continental Europe zone (ENTSO-E, 2023).
Crucially, diversification also intersects with energy justice. As Moldova phases out subsidies and adopts cost-reflective pricing, there is growing concern about energy poverty and unequal access to new technologies. Addressing these distributional risks requires targeted social support, inclusive participation frameworks, and capacity-building programs at the municipal level. Without such policies, there is a risk that the energy transition will reinforce rather than reduce existing social inequalities (Sovacool et al., 2022).

The evolution of Moldova's energy strategy has not only involved infrastructure diversification and regulatory reform, but also a profound rethinking of how energy risks are conceptualized, institutionalized, and governed. Traditionally, Moldova's approach to energy risk was reactive—centered on short-term crisis management, price mitigation, and ad hoc diplomatic engagement. However, the multiplicity of disruptions since 2022, including price volatility, cyberattacks, and supply shocks, has accelerated the country's transition toward a model of anticipatory governance, aimed at systemic preparedness rather than contingent response (Sabel and Zeitlin, 2012).

This shift is part of a broader international trend, whereby energy security is no longer defined solely in terms of physical availability or price stability, but also in terms of institutional adaptability and infrastructural resilience (Sovacool, 2011). Anticipatory governance involves not only forecasting and risk detection, but also embedding foresight mechanisms, multi-actor

coordination, and real-time responsiveness into the state's governance architecture. In Moldova, this approach is emerging through new institutions, regulatory tools, and cross-sectoral collaboration.

A central element of this transformation is the establishment of a national Risk Monitoring Framework for the energy sector, launched in 2023 with the support of the Energy Community Secretariat. This framework integrates real-time data collection, vulnerability mapping, and scenario-based stress testing. Its primary function is to enable early identification of systemic risks—such as grid congestion, cyber vulnerabilities, or supply disruptions—and to facilitate coordinated responses across agencies and stakeholders (Energy Community, 2023).

The role of the Transmission System Operator (Moldelectrica) has also expanded beyond technical balancing to include strategic planning and risk mediation. The TSO now engages in grid simulations under extreme weather scenarios, manages energy flow optimization in conditions of market stress, and coordinates with Romanian and Ukrainian operators for mutual assistance in emergency situations. These practices reflect what is described as resilience-by-coordination—a mode of governance that prioritizes flexibility, cross-border redundancy, and shared control (Brutschin and Oei, 2021).

Moreover, Moldova is gradually moving toward integrating climate-related risk into its energy governance. With increasing pressure from international donors and alignment with the EU Taxonomy for Sustainable Activities, Moldova has begun to assess how climate shocks—such as droughts, floods, and heatwaves—might impact both energy demand and infrastructure performance.

Anticipatory governance also implies institutional learning. Moldova has established technical working groups within the Ministry of Energy, tasked with post-crisis review, international benchmarking, and forward-looking policy design. These bodies reflect the emergence of a learning state—one that adapts not only to external shocks, but also to evolving epistemologies of risk and resilience (Ansell and Boin, 2017).

In conclusion the normative direction is clear: Moldova is attempting to transform its energy system from a passive object of geopolitics into a strategically governed infrastructure regime, capable of navigating complexity, anticipating disruption, and institutionalizing adaptive capacity.

1.5 Moldova Energy Security Activity (MESA)

Launched in 2022, the Moldova Energy Security Activity (MESA) is a flagship international development program funded by USAID, designed to strengthen Moldova's resilience to energy shocks and accelerate its energy transition. More than just a technical support mechanism, MESA operates as a multi-dimensional partnership that integrates infrastructure modernization, institutional development, and market reform. It responds to Moldova's acute vulnerability to energy disruptions—particularly those stemming from its historic dependence on Russian gas and electricity imports—and aims to align the country's energy sector with European Union standards (USAID, 2023).

At its core, MESA represents a strategic response to the growing risks associated with energy insecurity. In academic terms, Moldova's situation illustrates the multidimensional nature of energy security, which includes not only the availability and affordability of supply, but also its geopolitical stability, environmental sustainability, and institutional governance (Cherp and Jewell, 2011). MESA seeks to address all of these aspects through a coordinated set of interventions.

Practically speaking, MESA is structured around four primary pillars: (1) strengthening institutional capacity, (2) fostering competitive energy markets, (3) supporting infrastructure and grid modernization, and (4) advancing decentralized and community-driven energy solutions. Its activities involve close coordination with Moldova's Ministry of Energy, the National Agency for Energy Regulation (ANRE), and the transmission operator Moldelectrica. The program has provided technical assistance for drafting the National Energy and Climate Plan (NECP) and updating the Ten-Year Network Development Plan (TYNDP), both of which are key instruments for long-term energy planning and EU alignment (Tetra Tech, 2024).

One of MESA's most visible impacts is in the promotion of investment frameworks that enable renewable energy development. In 2024, MESA supported Moldova's first competitive renewable energy auction, resulting in bids for 165 MW of wind and solar projects—a landmark for private sector engagement. The program has also introduced standardized Power Purchase Agreements (PPAs), feed-in tariffs, and transparent tendering procedures to attract investors and reduce regulatory uncertainty (Tetra Tech, 2024). From the perspective of transition studies, these interventions represent enabling mechanisms that help shift Moldova's energy system from a centralized, fossil-dependent regime to a more diverse, liberalized, and sustainable structure (Geels, 2002).

In parallel, MESA has initiated the rollout of a Super Energy Service Company (Super ESCO) model to improve energy efficiency in public buildings, particularly at the municipal level. This model seeks to unlock financing for efficiency retrofits and create scalable solutions for the public sector—an area where Moldova lags significantly behind EU averages (CND, 2024).

Modernizing Moldova's physical energy infrastructure is another key focus. MESA has facilitated investments in grid reinforcement and flexibility, including the preparation of a 2025 national tender for a 75 MW Battery Energy Storage System (BESS) and 22 MW of fast-start backup generation. These projects are critical to managing the intermittency of renewables and ensuring system stability—challenges that are increasingly central in the discourse of energy

transition and resilience (Sovacool et al., 2017). Moreover, MESA supports Moldova's cybersecurity capacity, delivering training on Operational Technology (OT) systems and helping to draft incident response protocols in line with EU Energy Community guidance (USAID, 2023).

One of the most innovative dimensions of MESA is its work on renewable energy communities. In partnership with the Ministry of Energy, MESA launched pilot programs in 2024 that empower local governments and citizen groups to produce and consume energy locally. These decentralized systems promote energy democracy by increasing citizen participation, reducing dependency on national grids, and creating energy sovereignty at the local level (Sovacool and Dworkin, 2015). They also reflect EU policy priorities around citizen energy communities as outlined in Directive (EU) 2019/944.

Beyond its technical outputs, MESA functions as a platform for strategic coordination between Moldova's government, international donors, and financial institutions. This convening role enhances coherence among various energy-related interventions and helps align Moldova's national strategy with broader geopolitical and climate objectives. In 2024, USAID increased MESA's funding by $85 million—raising the total envelope to $145 million—a clear indication of its perceived strategic importance (MarketWatch, 2024).

Nonetheless, it is important to critically reflect on the broader implications of MESA as a donor-driven program. While it delivers tangible benefits and accelerates Moldova's convergence with EU standards, it also reflects a broader pattern of policy transfer and institutional borrowing, where domestic reforms are shaped significantly by external actors (Dolowitz and Marsh, 2000). Scholars have warned that such arrangements can lead to technocratic dependency, particularly when local institutions are not adequately empowered to take ownership of reforms (Stone, 2004).

In this light, MESA's long-term impact will depend not only on the capital and expertise it provides, but also on its ability to cultivate local institutional capacity, democratic governance, and policy adaptability. If successful, MESA may serve as a model for how donor-supported initiatives can facilitate meaningful and lasting transformation in energy-vulnerable states.

The first chapter highlighted Moldova's heavy reliance on foreign energy sources and the extensive strain the Russia–Ukraine war has placed on its domestic energy systems. These developments have made it clear that short-term fixes are insufficient for ensuring long-term energy security. As the regional context grows more volatile, the need for structural reforms and long-range planning becomes increasingly urgent. The second chapter turns to these forward-looking efforts, examining the country's infrastructure projects, regulatory adjustments, and strategic alignment with European frameworks. Special attention is given to Moldova's 2030 Energy Strategy and its participation in regional and transnational energy systems, which together form the backbone of its pursuit of energy independence.

2. Policies Promoting Energy Independence – Energy Policy Agenda

2.1.1 The Energy Strategy of the Republic of Moldova until 2030

The Energy Strategy of the Republic of Moldova until 2030 outlines a comprehensive framework aimed at transforming the national energy sector. It is not merely a list of objectives but a structured policy architecture grounded in institutionalized strategic planning. The strategy marks a shift from reactive policymaking to goal-based governance, aligned with EU regulatory frameworks and international climate obligations (Government of Moldova, 2013).

It is organized around three strategic pillars: energy security, market functionality, and environmental sustainability. These are connected through cross-sectoral coordination mechanisms that ensure policy coherence and multi-dimensional governance. Energy security is redefined as strategic diversification, control over critical infrastructure, and resilience to external supply shocks. Market functionality refers to liberalization, transparency, competitive pricing, and consumer empowerment. Environmental sustainability is embedded in energy planning through binding targets on emissions, renewable energy, and efficiency (Government of Moldova, 2013).

This strategy is embedded in Moldova's Association Agreement with the European Union and aligned with legal obligations under the Energy Community Treaty, functioning as both a domestic policy document and a roadmap for European integration (Government of Moldova, 2013).

Moldova's energy governance system operates on multiple institutional levels. The Ministry of Energy, empowered especially since 2022, oversees strategic coordination and external engagement. The National Agency for Energy Regulation (ANRE) is responsible for implementing liberalization directives, regulating tariffs, and ensuring service quality. Local authorities are charged with implementing efficiency programs and decentralized renewable energy projects. External partners such as the EU, Energy Community Secretariat, UNDP, and international financial institutions support through technical assistance, benchmarking, and co-financing (Government of Moldova, 2013).

The governance model emphasizes both horizontal coordination and vertical coherence—essential principles in navigating complex transitions and addressing institutional fragmentation.

Implementation relies on regulatory tools such as the transposition of EU Directives and secondary legislation. Market-based tools include renewable energy auctions and incentives for energy efficiency. Performance monitoring is conducted via Key Performance Indicators (KPIs) with regular reporting to EU bodies. Tools such as Cost-Benefit Analysis (CBA), Multi-Criteria Decision Analysis (MCDA), and Integrated Energy Modelling (IEM) guide decisions under uncertainty (Government of Moldova, 2013).

The strategy is increasingly supported by digitalized governance platforms to enhance transparency and data-driven policy—particularly in areas like grid operations, forecasting, and emissions monitoring.

2.1.2 The National Energy and Climate Plan (NECP) 2025–2030

Environmental sustainability has moved from a peripheral topic to a core element of Moldova's national strategic planning, reflecting the global trend of integrating environmental targets into economic and sectoral frameworks.

Moldova's climate commitments are embedded in a multilayered legal architecture. Under the Paris Agreement, the country pledged to reduce greenhouse gas emissions by 70% by 2030 relative to 1990 levels. The National Energy and Climate Plan (NECP) 2025–2030 is the main vehicle for implementation, combining decarbonization, security, and efficiency in one integrated plan. It mandates the use of green finance, emissions tracking, and sectoral transition pathways (Government of Moldova, 2025).

The NECP sets ambitious goals: a 27% renewable energy share in final energy consumption, a cap of 2.8 Mtoe in total final consumption, and over 100 policy measures related to climate. These are backed by both vertical mechanisms (reporting to external partners) and horizontal inter-ministerial cooperation (Government of Moldova, 2025).

Environmental objectives are mainstreamed across the entire energy chain. On the supply side, renewable energy policies target both emission reductions and diversification of sources. On the demand side, energy efficiency is pursued as a dual solution to decarbonization and affordability—especially important given Moldova's high energy poverty. New infrastructure projects are subject to environmental impact assessments and climate risk screening, in accordance with international financial institution (IFI) standards (Government of Moldova, 2025).

The country is also building institutions to access climate finance, including green project taxonomies, blended financing tools, and application mechanisms for funds like the Green Climate Fund.

Nevertheless, implementation is not without tension. Moldova remains partially dependent on fossil energy from Transnistria, raising issues of territorial energy sovereignty. Efforts to internalize environmental costs through pricing may burden low-income households, while new regulations have met resistance from certain industrial sectors (Government of Moldova, 2025).

To address these challenges, the state is adopting targeted equity mechanisms, including subsidies, energy vouchers, and community energy programs, balancing climate objectives with social protection.

A central goal is to develop 165 MW of solar and 230 MW of wind capacity by 2030. These investments are framed as both a climate necessity and a security strategy—reducing reliance on electricity imports from politically sensitive regions such as Transnistria (Energy Community Secretariat, 2024). Tools such as auctions, fixed tariffs, and net billing are intended to decentralize generation and democratize access.

The draft Energy Strategy 2050 reinforces Moldova's commitment to long-term decarbonization. It envisions the country as a fully liberalized and interconnected clean energy

market by mid-century, implying expanded renewables, further market reforms, and regional integration (Government of Moldova, 2024).

Finally, the long-term vision outlined in the draft Energy Strategy 2050 includes aspirations for Moldova to become a clean energy hub aligned with EU goals, including participation in initiatives such as Horizon Europe (Government of Moldova, 2024). This forward-looking approach is designed to transcend short political cycles and sustain investor confidence.

2.2.1 Electricity Market Integration

Moldova's integration into regional electricity markets marks a strategic shift in its energy transition, moving away from historical dependencies on Russian supply systems and aligning with the European Union's legal and market norms. Geographically positioned between the EU and Eastern Partnership states, Moldova has the potential to become a key energy transit and regulatory convergence zone (Energy Community Secretariat, 2023).

The synchronous connection of Moldova's electricity grid with the Continental European Network (ENTSO-E) in March 2022 represents more than a technical upgrade. It marks the beginning of Moldova's alignment with the operational, legal, and market structures of the EU's Internal Energy Market (ENTSO-E, 2022). Synchronous operation at 50Hz allows for real-time power exchange, access to ancillary services from neighboring countries, and greater system reliability. Beyond its engineering significance, this interconnection establishes the technical basis for Moldova's market participation in coupled electricity platforms, opening pathways to both stability and liquidity.

This enhanced integration has been followed by a progressive increase in Moldova's technical capacity to contribute to the regional grid. The most recent example is the expansion of electricity export capacity from Moldova and Ukraine to the Continental European Network, which was raised from 550 MW to 650 MW as of 1 May 2025. This operational upgrade reflects both infrastructure reinforcement and legal compatibility with ENTSO-E standards (ENTSO-E, 2025).

This process is intrinsically linked to legal obligations stemming from Moldova's membership in the Energy Community. Under the Treaty establishing the Energy Community, Moldova is legally bound to transpose and implement core elements of the EU energy acquis. These include Directive (EU) 2019/944 on common rules for the internal market for electricity, which sets out provisions for consumer protection, market access, and the unbundling of transmission system operators. Moldova must also comply with Regulation (EU) 2019/943 on the internal market for electricity, which defines key mechanisms such as capacity allocation, congestion management, and balancing. Furthermore, Regulation (EU) No. 1227/2011 on wholesale energy market integrity and transparency (REMIT) imposes legal requirements to ensure market transparency and prevent manipulation (EUR-Lex, 2019).

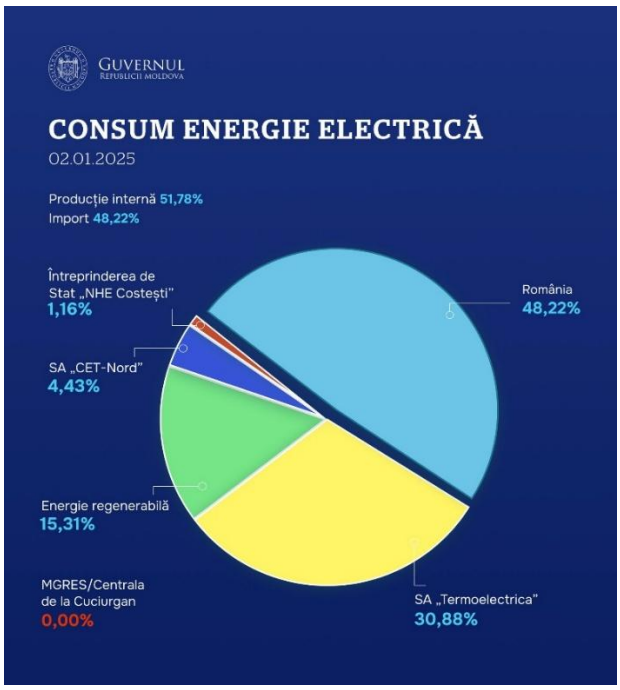

Figure 4: Structure of electricity consumption in Moldova (2 January 2025). Domestic production covered 51.78% of demand, while the remaining 48.22% was imported, primarily from Romania. The share of renewable energy sources amounted to 15.31%. (Source: Government of the Republic of Moldova)

Ministry of Energy of the Republic of Moldova, 2025. Moldova fully secured electricity supply. [online] Available at: https://energie.gov.md/en/content/moldova-fully-secured-electricity-supply

The Energy Community Secretariat actively monitors the implementation of these legal instruments through annual country-specific reports. In its 2023 review, it recognized Moldova's progress in transposing several of the aforementioned directives and regulations. However, it also identified persistent gaps in the application of third-party access rules, especially regarding smaller suppliers, and noted the limited independence of the regulatory authority, ANRE, in enforcing unbundling provisions (Energy Community Secretariat, 2023).

Market participation is equally subject to legal harmonization. Moldova's inclusion in the Local Implementation Project (LIP) in 2024 signified a commitment to adopt common mechanisms for cross-border electricity trading under the governance of the Euphemia algorithm (Eyl-Mazzega & Mathieu, 2022). Nevertheless, entry into such coupled markets necessitates full legal interoperability with EU Network Codes and Guidelines adopted under Regulation (EU) 714/2009, now succeeded by Regulation (EU) 2019/943. Moldova is expected to adopt and apply key network codes governing forward capacity allocation, congestion management, and electricity balancing, all of which require significant technical adaptation and institutional coordination.

This legal integration also manifests in bilateral and multilateral contractual instruments. Infrastructure projects such as the 400 kV Vulcănești–Chișinău transmission line, supported through EU-Moldova cooperation frameworks, are embedded within Memoranda of Understanding that stipulate regulatory reforms and technical compliance milestones (Ministry of Energy, 2024). These agreements extend the legal obligations beyond national law and embed Moldova's commitments in binding instruments of international energy cooperation.

From a strategic perspective, Moldova's legal convergence with the European energy framework enhances both its operational security and geopolitical leverage. Energy resilience, as conceptualized in recent literature, is not merely a matter of physical infrastructure but also one of regulatory predictability and institutional credibility (Goldthau & Sovacool, 2012). Moldova's ability to participate in EU solidarity mechanisms and crisis-response systems depends on the clarity and enforceability of its legal framework. However, there is a risk that integration, if pursued without domestic energy diversification and institutional autonomy, may replace one form of dependency with another, albeit within a more structured and transparent legal environment (Youngs, 2009 ; Victor, Jaffe & Hayes, 2006).

2.2.2 Natural Gas Interconnections and Diversification

In the context of Moldova's broader energy transition and decoupling from traditional eastern supply chains, the diversification of natural gas sources and transit routes constitutes a strategic imperative. The country's energy vulnerability, historically defined by its dependence on Gazprom and transit via Ukraine, has prompted a concerted shift toward regional integration, legal alignment, and supply pluralism. From both a technical and geopolitical standpoint, interconnectivity with the European gas network enhances Moldova's energy sovereignty, operational flexibility, and geopolitical resilience (Goldthau, 2011; Siddi, 2020).

At the core of this transformation lies the Iași–Ungheni–Chișinău pipeline, a 43-kilometre interconnector linking Moldova's capital directly to Romania's gas transmission system, operated by Transgaz and its Moldovan subsidiary, Vestmoldtransgaz. Fully operational since 2021, the pipeline provides a physical gateway for European gas to enter Moldova's distribution grid, displacing volumes traditionally imported through Ukraine and Russia. This infrastructure not only serves as a lifeline during supply crises but also constitutes a prerequisite for Moldova's integration into the EU's internal gas market (Energy Community Secretariat, 2023).

The broader Trans-Balkan corridor, initially designed for east-to-west flows of Russian gas, has undergone a strategic reversal of direction. Since 2020, under the reconfiguration enabled by the Greece–Bulgaria Interconnector (IGB) and expanded LNG import capacities in Revithoussa (Greece) and Marmara Ereğlisi (Turkey), the Trans-Balkan system has enabled reverse flows northward into Ukraine and Moldova. These developments are supported by cross-border transmission agreements and the unbundling of gas system operators, as required under Directive 2009/73/EC and Moldova's Energy Law of 2016 (European Union, 2009; Energy Community Secretariat, 2023).

The symbolic and strategic value of Moldova's first LNG shipment via Greece in early 2023 cannot be overstated. It demonstrated logistical feasibility, regulatory coordination with EU entry points, and Moldova's capacity to access global spot markets. LNG imports, though still marginal in volume, diversify the supply portfolio and decouple Moldova from the rigidities of bilateral pipeline contracts. As pointed out by Youngs (2022), LNG diversification, even in small markets, strengthens negotiation leverage and reduces political risk exposure.

In May 2025, Moldova signed a long-term supply agreement with OMV Petrom, Romania's leading energy company, securing 25% of its annual gas demand from 2027 onward. This contract, supported under the EU's REPowerEU framework, marks a shift from transactional purchases to structured bilateral partnerships based on shared regulatory and infrastructural standards. Such agreements promote price stability, investment in storage and balancing capacity, and reinforce Moldova's strategic alignment with EU energy diplomacy (European Commission, 2025).

The legal underpinnings of Moldova's gas diversification strategy are rooted in its obligations under the Energy Community Treaty, which mandates the full implementation of the EU's Third Energy Package. This includes third-party access (TPA), the unbundling of transmission and supply functions, and non-discriminatory tariff regimes. As of 2023, Moldova has implemented most of the core provisions, yet practical limitations persist in enforcement, capacity allocation

mechanisms, and the operational independence of Moldovagaz—still partially owned by Gazprom (Energy Community Secretariat, 2023).

Infrastructure and regulatory evolution aside, the strategic logic of gas interconnections extends to regional balance-of-power considerations. By participating in the Trans-Balkan gas flows and positioning itself as a potential transit route between LNG entry points in the South and Ukrainian storage fields in the North, Moldova acquires geopolitical utility. This is consistent with the concept of "small state energy leverage," where infrastructure control and market alignment substitute for production capacity (Konoplyanik, 2020).

In conclusion, Moldova's natural gas diversification is not merely a logistical reconfiguration but a strategic realignment with European regulatory, infrastructural, and diplomatic systems. Through interconnectivity, LNG access, and bilateral supply agreements, the country strengthens its resilience against coercive dependencies and positions itself as an increasingly integrated and flexible node within the European gas landscape.

2.2.3 Technical Bottlenecks

Despite Moldova's substantial progress in achieving regional integration through electricity and natural gas interconnections, a series of persistent technical and infrastructural limitations continue to hinder its full alignment with the European energy system. These physical bottlenecks compromise both the country's operational energy security and its potential to become a reliable node in the broader regional energy market.

In the electricity sector, the interconnection capacity with Romania—Moldova's only gateway to the ENTSO-E system—remains inadequate during peak seasonal demand. According to the National Agency for Energy Regulation (ANRE), the average available cross-border capacity is limited to approximately 600 MW, while winter consumption often exceeds 900 MW. This structural mismatch exposes the grid to potential load shedding, instability, or forced curtailment of industrial activity during high-demand periods. Moreover, the current configuration lacks sufficient redundancy. In the event of a fault in the Vulcănești–Chișinău corridor, there are no viable alternative transmission paths capable of handling the national load, increasing systemic vulnerability (Energy Community Secretariat, 2024).

Ongoing infrastructure projects aim to remedy these gaps but face delays and financing constraints. The 400 kV Vulcănești–Chișinău line, co-financed by the European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB), is expected to be completed by late 2025, but it alone will not provide full redundancy. The proposed 400 kV Bălți–Suceava and Străşeni–Gutinaș lines are still in the feasibility study phase, with completion not expected before 2028 (EBRD, 2024).

In the natural gas sector, physical bottlenecks are most evident in Moldova's limited reverse-flow capabilities and lack of domestic underground gas storage. While the Trans-Balkan corridor now allows for reverse flows from Greece and Turkey through Romania, these flows are contingent upon firm capacity reservations and cross-border balancing agreements, which remain partially implemented (Energy Community Secretariat, 2024). Moldova currently lacks any strategic gas storage facilities of its own, depending instead on access to Ukrainian underground storage—a dependency that is geopolitically and contractually uncertain (Interfax, 2025). As noted by Konoplyanik, access to storage is a key resilience factor in liberalized gas markets, enabling demand smoothing, price stabilization, and emergency preparedness (Konoplyanik, 2020).

Moreover, the Moldovan gas transmission system remains technically constrained by legacy infrastructure. Certain compressor stations and pipeline segments are outdated, not yet adapted for full bidirectional flows. This limits Moldova's ability to fully capitalize on LNG imports entering through the southern corridor, including the Revithoussa and Alexandroupolis terminals in Greece. Regulatory coordination on entry-exit tariffs and pressure compatibility with Romanian and Ukrainian networks also requires further harmonization (ENTSOG, 2024).

At the distribution level, rural and peripheral regions face chronic underinvestment in energy infrastructure, resulting in localized bottlenecks that hinder market liberalization and competition. Smaller suppliers often find it commercially or technically unfeasible to access certain parts of the country due to the absence of metering infrastructure or insufficient capacity

margins. These issues, although microeconomic in nature, have macro-level implications: they reinforce monopolistic tendencies and weaken Moldova's ability to meet EU directives on non-discriminatory third-party access and consumer choice (Directive 2009/73/EC, Arts. 32–34).

In summary, the physical and technical limitations embedded in Moldova's electricity and gas infrastructure pose a serious challenge to its regional integration efforts. While legal and contractual frameworks may be in place, the ability to act upon them is contingent on reliable, redundant, and interoperable infrastructure. Without addressing these structural bottlenecks, Moldova risks becoming a legally integrated yet physically constrained actor—formally part of the European energy system, but operationally limited in scope, resilience, and strategic autonomy.

2.2.4 Legal and Market Access Challenges

While Moldova has made substantial progress in transposing the European energy acquis, significant challenges persist in transforming legal alignment into effective and equitable market participation. These issues affect both the electricity and natural gas sectors and reflect a broader tension between formal legislative convergence and practical implementation deficits.

A central issue lies in the incomplete enforcement of third-party access (TPA) provisions. Although Moldova has transposed the relevant EU legislation—namely **Directive 2009/73/EC, Article 32**, concerning third-party access to gas transmission networks (European Parliament and Council, 2009), and **Directive (EU) 2019/944, Article 6**, which sets out similar principles for electricity markets (European Parliament and Council, 2019)—into national law, the regulatory environment still presents obstacles that disadvantage smaller suppliers. The **Energy Community Secretariat** (2023) highlights that the dominant market position of Moldovagaz, partly owned by Gazprom, undermines the unbundling of transmission and supply activities and continues to distort competition in gas procurement. In practice, access to the transmission network remains based on existing commercial agreements, rather than being governed by open and non-discriminatory capacity allocation mechanisms.

Similarly, in the electricity sector, although Moldelectrica is legally unbundled, its market operations are not fully aligned with the EU's network codes and congestion management procedures. Moldova's participation in the Local Implementation Project (LIP) for market coupling has not yet translated into active engagement in the Euphemia algorithm used for day-ahead market clearing in the EU. This delay stems in part from the lack of regulatory harmonisation with Regulation (EU) 2019/943, particularly Article 16, and related network codes on capacity allocation and congestion management (European Parliament and Council, 2019). Moreover, balancing responsibility remains centralised, and the absence of an operational balancing market restricts entry for flexible generation or demand response providers (ENTSO-E, 2023).

Another dimension of restricted market access lies in administrative and procedural complexity. Licensing, metering, and settlement processes are often non-harmonised and lacking transparency, creating high entry barriers for new participants. The institutional capacity of the national energy regulator (ANRE) is further constrained by budgetary dependence on the government, raising concerns about its operational independence—an essential criterion under Article 35 of Directive (EU) 2019/944 (European Parliament and Council, 2019). This constraint limits the regulator's ability to enforce competitive neutrality and to arbitrate disputes between incumbent operators and new market entrants (European Commission, 2023).

Furthermore, Moldova's alignment with Regulation (EU) No. 1227/2011 on wholesale energy market integrity and transparency (Article 4) remains primarily declarative in nature (European Parliament and Council, 2011). While market participants are formally registered, the monitoring and enforcement mechanisms concerning insider trading and market manipulation are still in nascent stages. This regulatory gap undermines investor confidence and weakens Moldova's attractiveness as a regional energy hub (Energy Community Secretariat, 2023).

The lack of interoperability with neighbouring balancing zones also limits Moldova's ability to integrate into cross-border mechanisms. For example, despite technical synchronisation with the ENTSO-E grid, Moldova is not yet a participant in the regional balancing platforms operated by SEEPEX or the Hungarian HUPX. Entry into these platforms requires full compliance with EU balancing guidelines, capacity reservation methodologies, and congestion revenue allocation principles—all of which Moldova has yet to fully implement (ACER, 2023).

These legal and market access challenges are compounded by geopolitical constraints. Legal disputes over gas debts, ownership structures in Moldovagaz, and regulatory conflicts with Transnistrian operators further complicate Moldova's ability to act as a neutral and open market. Without a functional legal environment that guarantees equitable access, energy reforms risk reinforcing existing monopolies under a veneer of EU compliance (Atlantic Council, 2024; CSIS, 2024).

In conclusion, Moldova's legal approximation to the EU acquis is a necessary but insufficient condition for genuine market participation. Structural reforms in regulatory oversight, enforcement capacity, market transparency, and cross-border harmonisation are essential. Only by bridging the gap between *de jure* alignment and *de facto* implementation can Moldova emerge as a fully integrated and competitive actor in the European energy system.

2.3 NATO and Moldova Strengthen Energy Resilience Against Cyber and Hybrid Threats

Moldova's cooperation with NATO in the field of cybersecurity emphasizes institutional capacity-building through technical assistance, strategic training, crisis simulation, and administrative restructuring (NATO, 2021). This collaboration actively involves the Ministry of Energy, the transmission operator Moldelectrica, and the national Computer Emergency Response Team (CERT), particularly targeting threats to transmission infrastructure and smart metering systems (ENISA, 2022).

A notable illustration of this cooperation was Moldova's participation in joint cyber-resilience exercises with the NATO Energy Security Centre of Excellence, which tested national responses to complex cyber crisis scenarios and fostered cross-sectoral operational coordination (NATO ENSEC COE, 2024). These exercises promote a multi-layered resilience model that combines technological safeguards with governance-based protocols to manage crises effectively (Obrist, Pfeiffer and Henley, 2010).

This model resonates with NATO's broader "whole-of-society" resilience doctrine, which asserts that critical infrastructure protection requires collaboration between state institutions, private operators, and civil society actors in a cohesive system of preparedness, recovery, and adaptation). For Moldova, the partnership signifies more than technical improvement; it represents a strategic shift toward preventive governance and cooperative deterrence, transcending traditional military defense (NATO, 2025).

Nonetheless, systemic challenges persist. Moldova continues to face fragmented cybersecurity responsibilities, limited institutional continuity, and a shortage of qualified specialists (DCAF, 2018). Moreover, its reliance on foreign technical support raises concerns about the long-term sustainability of its cyber reforms. Yet Moldova's engagement in NATO programs such as the Individual Partnership Action Plan (IPAP) illustrates a case of cyber diplomacy, where security outcomes are pursued as shared investments (NATO, 2017).

In March 2024, Moldova hosted the Coherent Resilience Exercise (CORE-24 M), bringing together over 100 participants from 10 countries and 32 organizations. The event served not only as a technical trial but also as a policy-testing arena that examined national preparedness under simulated cyber stress conditions (NATO ENSEC COE, 2024). These exercises enable experiential learning across institutional silos and highlight operational dependencies between sectors. CORE-24 M specifically focused on synchronizing energy operators with cybersecurity actors to close communication gaps and foster continuity mechanisms (Boin and Lodge, 2016).

Following the exercise, Moldova conducted a strategic review with NATO-affiliated experts, producing institutional recommendations that included updating national contingency plans, formalizing public-private coordination frameworks, and institutionalizing scenario-based planning across crisis agencies (OECD, 2020). Exercises of this nature align with resilience-as-practice paradigms, where legitimacy arises from responsive performance under stress rather than traditional deterrence capacity (Chandler, 2014).

The increasing prevalence of hybrid threats—including disinformation, cyberattacks, and energy coercion—has reinforced the urgency of cyber resilience for Moldova, a geopolitically exposed and digitally under-protected state. Drawing lessons from Ukraine's experience, Moldova paid close attention to the cyberattacks on its neighbour's energy grid in 2015 and 2016, during which malware such as BlackEnergy and Industroyer caused major disruptions, as documented by Zetter (2014). Similar vulnerabilities came to light following the cyberattack on Moldova's Central Electoral Commission in 2019, highlighted in Freedom House reporting (2020), and during the spyware phishing campaigns targeting government systems in 2023, analysed by Paganini (2023).

In response, Moldova adopted its National Cybersecurity Strategy in 2021, aiming to align its regulatory framework with the EU's NIS Directive and broader European cybersecurity policy principles (European Commission, n.d.). This effort drew conceptually from resilience-based governance approaches, with a central innovation being the definition of resilience as a system-wide, adaptive process rather than static compliance—a notion also highlighted by Cherp, Jewell and Goldthau (2011,). The strategy prioritizes inter-agency coordination, institutional learning, and infrastructure reinforcement.

The establishment of the National Cybersecurity Council in Moldova has centralized national efforts. This inter-institutional body, composed of representatives from intelligence services, the Ministries of Defence and Internal Affairs, and CERT, is tasked with coordinating cyber incident responses and overseeing legal harmonization (Moldova Ministry of Foreign Affairs and European Integration, 2023). Mandatory reporting of cyber incidents in critical sectors such as energy, finance, healthcare, and telecommunications has helped embed a risk-based approach to governance. In addition, Moldova has begun to integrate private operators into national cyber simulation protocols (Council of Europe, 2024), adapting EU models to its own institutional context. These initiatives reflect findings from broader research on the institutionalisation of cyber security in hybrid threat environments (Kostyuk and Zhukov, 2019).

2.4: Green Transition and Energy Security

The integration of climate and energy policy in Moldova is increasingly grounded in a consolidated legal and institutional framework. As a Contracting Party to the Energy Community Treaty and a signatory of the Paris Agreement, Moldova has committed to aligning its domestic legislation with the acquis communautaire in areas such as climate action, renewable energy, energy efficiency, and environmental governance (European Commission, 2021).

A cornerstone of this alignment is the 2024 Climate Law (Law No. 74/2024), adopted in accordance with EU Regulation (EU) 2021/1119 (European Climate Law). Article 1 of the law establishes a legally binding climate neutrality target for 2050 and sets intermediate goals, including a 70% reduction in greenhouse gas emissions by 2030, compared to 1990 levels. Article 3 defines the legal framework for monitoring, reporting, and verification (MRV) of climate-related measures, in line with the Enhanced Transparency Framework of the Paris Agreement.

The law establishes the National Council on Climate and Energy Transition (Article 5), responsible for coordinating inter-ministerial implementation, and mandates periodic updates to the National Energy and Climate Plan (NECP). Article 4 further introduces core principles such as the polluter pays, precautionary action, and intergenerational equity (Law No. 74/2024).

Complementary legislation includes the Energy Law (2016, amended in 2023), and the Law on the Promotion of Renewable Energy Sources (Law No. 331/2023), published in the Official Gazette on December 8, 2023. These laws implement provisions from the EU Renewable Energy Directive II and the Energy Efficiency Directive, such as competitive bidding, guarantees of origin, and legal frameworks for energy communities (World Bank, 2024; Ministry of Energy, 2024a).

The expansion of domestic renewable energy generation is a central pillar of Moldova's energy transition strategy. The 2023 Renewable Energy Law outlines a tiered support system: fixed feed-in tariffs for small producers, competitive auctions for larger projects, and net metering for households and SMEs (CEE Legal Matters, 2023). Secondary legislation for energy communities is under development.

Under the draft NECP, Moldova has committed to achieving renewable energy shares of 34.1% in electricity, 42.8% in heating and cooling, and 7.6% in transport by 2030 (Ministry of Energy, 2025). These targets are ambitious given infrastructure and institutional constraints, but align with the country's EU-oriented trajectory.

The National Energy Efficiency Program 2022–2025 outlines a multi-sector strategy focused on thermal insulation, heating modernization, smart metering, and behavioral change (Ministry of Energy, 2025). However, implementation has been uneven due to financing shortfalls and limited technical capacity.

In 2024, Moldova introduced a residential energy efficiency financing scheme and adopted the National Building Renovation Strategy (2024–2026), which aims to reduce energy consumption in public buildings by 30%, in accordance with the EU Energy Performance of Buildings Directive (Ministry of Energy, 2024b). The government is also drafting a national strategy for nearly-zero energy buildings (nZEBs) to define performance standards and certification schemes.

International financial institutions (IFIs) are key drivers of Moldova's green transition. The World Bank's E3 Program (Efficient, Effective, Equitable) has committed over $185 million for projects related to energy efficiency, grid access, and social inclusion. The European Bank for Reconstruction and Development (EBRD) supports Moldova via blended finance and risk-sharing instruments, while the Green Climate Fund (GCF) supports climate resilience and flood mitigation infrastructure.

At the national level, Moldova is working to develop a green finance ecosystem. The National Bank of Moldova launched its Sustainable Finance Roadmap 2024–2028, prioritizing green bonds, climate risk disclosures, and supervisory stress testing (National Bank of Moldova, 2024). Moldova's first green bond, issued in 2023, helped finance energy-efficient school renovations—an important milestone, though the market remains underdeveloped.

To close the investment gap, Moldova is exploring public-private partnerships (PPPs), results-based financing, and IFI-backed credit guarantees. Regulatory clarity and active investor engagement will be crucial for market maturation.
Modernization of Moldova's grid infrastructure is also a national priority. Transmission and distribution systems suffer from high technical losses and insufficient automation. The Electricity Development Plan 2023–2032 prioritizes substation upgrades, digital grid management, and flexible generation, with support from SE Moldelectrica.

Public awareness initiatives are expanding. In 2024, the "Green Moldova" education campaign, launched by the Ministry of Energy in partnership with civil society, targeted youth and schools. While early urban engagement has been positive, rural outreach remains limited due to disparities in digital access.

Finally, Moldova's green transition must be socially just. To ensure the fair distribution of burdens and benefits, the country is rolling out targeted subsidies, community-based programs, and social impact monitoring. Without these, climate policy may exacerbate inequality and erode public support.

2.5 Sustainable Development

The integration of sustainable development into Moldova's national energy and climate strategies marks a fundamental shift from sector-specific policy responses toward a holistic governance framework. Rather than treating sustainability as a secondary concern, Moldova now embeds it at the heart of its development agenda, reflecting a systems-based, long-term planning ethos (Sachs, 2015).

At the center of this shift lies the National Development Strategy "Moldova 2030", which is directly aligned with the UN Sustainable Development Goals (SDGs), especially SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action), and SDG 10 (Reduced Inequalities) (Government of Moldova, 2022). The strategy is informed by the concept of "transformational sustainability", which emphasizes institutional reform, cross-sectoral policy coherence, and societal resilience (Meadowcroft, 2009).

Social inclusion and energy equity now feature prominently in Moldova's transition agenda. Technological innovation alone is insufficient for a fair energy future; the institutions, regulations, and values that govern access and affordability must also evolve (Sovacool et al., 2010). Energy poverty remains pervasive, with nearly 30% of households spending more than 10% of their income on energy, a common threshold for energy poverty classification (UNDP Moldova, 2023).

To mitigate this, the government has introduced targeted social protection mechanisms, including direct subsidies for heating and incentives for decentralized renewable energy adoption. These initiatives are not only relief tools but also strategies for empowering citizens to participate actively in Moldova's sustainable energy future (Ministry of Labour and Social Protection, 2023).

A noteworthy development in this context is the gender mainstreaming of energy policy. Moldova, in line with UNDP and EU guidelines, has piloted programs supporting women's leadership in energy governance, gender-sensitive budgeting, and inclusive participation in local energy councils (UNDP Moldova, 2023). This approach is grounded in the recognition that women face disproportionate risks from energy poverty and are underrepresented in infrastructure and policy decisions (Clancy et al., 2019).

Territorial inequality also complicates Moldova's energy transition. Peripheral regions like Transnistria and Gagauzia are disproportionately affected by geopolitical instability and infrastructural neglect. Addressing these asymmetries requires integrated spatial and energy planning—an area still underdeveloped in Moldova's policy architecture.

Environmental integration is another critical dimension of Moldova's sustainability efforts. Through the Environmental Impact Assessment (EIA) mechanism—recently reformed in 2025—climate risks, biodiversity impacts, and public consultation are embedded in project approval processes. These reforms align Moldova's practice with EU Directive 2011/92/EU and its 2014 amendment via Directive 2014/52/EU (Ministry of Environment, 2023).

Additionally, Moldova has begun transposing EU directives on biodiversity (92/43/EEC, 2009/147/EC), water (2000/60/EC), and waste (2008/98/EC). Legislative amendments now support ecosystem-based planning and habitat protection under the EU Biodiversity Strategy 2030 (European Commission, 2020). Yet enforcement capacity remains weak, especially at the local level, where technical expertise and authority are lacking (UNDP Moldova, 2025; Lenschow, 2002).

Public participation is another area of notable progress. In line with the Aarhus Convention, consultations are now legally mandated for energy and environmental decisions. However, their quality varies: marginalized communities, especially in rural areas, often face barriers to timely and meaningful engagement (Bäckstrand et al., 2010).

Vocational education and training (VET) systems are being aligned with Moldova's green transition needs. In 2025, Moldova, in partnership with the UNDP and the European Training Foundation, introduced certifications in green construction, renewable energy, and energy auditing (UNDP Moldova, 2025). Despite progress, the reforms remain supply-driven, with limited coordination between training institutions and labor market demand (World Bank, 2022).

Institutional capacity building is also underway. The Ministries of Energy and Environment have expanded training for civil servants in EU compliance, sustainable procurement, and project management (Ministry of Infrastructure, 2024). Nevertheless, high turnover and limited budgets hinder long-term knowledge retention.

According to transition governance theory, sustainable change relies not just on technical skills but on "reflexive institutions" that learn, adapt, and include stakeholders in decision-making (Voß and Bornemann, 2011). In Moldova, reflexivity is still underdeveloped due to hierarchical structures and sectoral fragmentation.

2.6 Environmental Protection and Climate Change

The Republic of Moldova has made significant progress in aligning its environmental governance structures with international climate commitments and the European Union's environmental policy framework. This alignment is not merely technical—it reflects Moldova's geopolitical orientation towards Europe and its growing recognition of climate vulnerability as a national priority. The country's climate policy has evolved from a fragmented effort into a more integrated system consistent with global and regional standards.

Moldova ratified the Paris Agreement in 2017, committing to the global temperature goal of keeping the increase well below 2°C and pursuing efforts to limit it to 1.5°C. In its 2021 update to the Nationally Determined Contributions (NDCs), Moldova pledged a 70% reduction in greenhouse gas (GHG) emissions by 2030 compared to 1990 levels, conditional on international support, with a 64% unconditional reduction target (UNFCCC, 2021). These ambitious targets are among the strongest in the Eastern Partnership and reflect Moldova's intention to play a leadership role despite its resource constraints.

A major legal milestone was the adoption of the Climate Action Law (Law No. 74/2024), which sets a binding climate neutrality goal by 2050. It mandates integration of climate objectives across all government sectors and aligns Moldova's framework with the European Green Deal. The law introduces long-term climate risk planning, cross-sectoral coordination mechanisms, and enforcement provisions (Government of Moldova, 2024).

Institutionally, Moldova benefits from several EU-funded programs, notably EU4Climate, which support climate policy development, NDC updates, and MRV (Monitoring, Reporting and Verification) capacity. These programs, together with the European Neighbourhood Instrument (ENI), enhance Moldova's administrative convergence with EU norms (European Commission, 2023).

However, challenges remain. Energy and agriculture continue to dominate emissions, and policy coherence is hindered by weak inter-sectoral coordination. Moldova's dependence on imported fossil fuels creates tension between climate and energy security goals (IEA, 2023). Without integrated planning, Moldova risks undermining its own climate strategy.

Climate adaptation policy is centered on the Climate Change Adaptation Strategy 2020–2030 and the Low Emissions Development Strategy. These documents identify vulnerable sectors such as agriculture, water, health, and infrastructure, and propose adaptive measures. Nonetheless, implementation is uneven, constrained by weak local capacities and lack of funding mechanisms (Government of Moldova, 2020).

Efforts to green Moldova's energy and agriculture sectors have produced limited results. Renewable energy remains underdeveloped despite feed-in tariff schemes, and climate-smart agricultural practices remain confined to donor-funded pilot areas. National transport plans include some climate resilience elements but are not part of a comprehensive framework (IEA, 2023).

A key development has been the operationalization of a national MRV system, aligned with UNFCCC and IPCC guidelines. While the centralized system is managed by the Ministry of Environment, data collection remains inconsistent—particularly at subnational levels—due to lack of technological infrastructure, training, and local autonomy (UNECE, 2022). Moldova has yet to implement a real-time digital emissions tracking platform, limiting policymaking efficiency.

Capacity-building efforts under EU4Climate have introduced QA/QC (Quality Assurance/Control) protocols and legal reforms to align MRV with EU regulations, including the EU Monitoring Mechanism Regulation (European Commission, 2023). Yet, reliance on donor support and fragmented data practices remain critical weaknesses.

Nature-based solutions (NbS) have become a growing priority. Projects supported by the Green Climate Fund and UNEP focus on ecosystem restoration, including reforestation, buffer zone rehabilitation, and agroforestry in erosion-prone regions. Wetland restoration along the Dniester and Prut rivers supports flood protection and biodiversity goals (UNEP, 2021; WWF Moldova, 2022).

Moldova has received over €90 million in climate-related international assistance between 2016 and 2021, with 60% directed toward adaptation projects (UNFCCC, 2022). Despite this, concerns persist about over-reliance on external funding, limited national co-financing, and institutional fragmentation.

In conclusion, Moldova has taken notable steps in aligning with global and European climate standards. However, to secure long-term transformation, it must consolidate planning institutions, strengthen local capacities, and develop a sustainable domestic framework for climate finance and environmental governance.

2.7 Technology, Research, Development and Deployment

Institutional coordination in Moldova has notably improved in recent years, with key roles undertaken by the Ministry of Energy, the Ministry of Education and Research, and the National Agency for Research and Development. This cooperation is further reinforced through Moldova's active involvement in cross-border partnerships and EU-funded programmes, which provide both regulatory guidance and financial assistance, as noted by the IEA and OECD in their respective reviews (IEA, 2023; OECD, 2023).

Despite the strategic clarity, Moldova's technological transformation continues to face structural barriers. Limited public investment in research and development (R&D), a fragmented innovation ecosystem, and weak technological infrastructure place the country behind regional peers. However, Moldova's commitment to digital energy technologies and regulatory experimentation has positioned it as a country striving for structural modernization (World Bank, 2023; EBRD, 2023).

While the national energy and innovation strategies highlight the importance of applied research, actual investment remains low. Moldova's R&D spending, for instance, was around 0.22% of GDP in 2023—significantly below the EU average—illustrating long-standing structural and fiscal constraints (OECD, 2023; World Bank, 2023). The lack of strong linkages between academia and industry further exacerbates this gap.

In response, the Moldovan government is developing a National Innovation Fund aimed at catalyzing early-stage clean technology ventures through co-investment with the private sector (Ministry of Education and Research, 2023). At the same time, Moldova's participation in international research initiatives such as Horizon Europe and the MOST Programme has grown, bringing over €4 million in funding and exposing national institutions to international best practices (European Commission, 2023).

One area of tangible progress has been the deployment of automated load-balancing systems in urban electricity networks. These smart grid applications, implemented in Chișinău districts like Buiucani and Rîșcani, have contributed to peak demand reductions of up to 15%, according to EBRD assessments (EBRD, 2023).

In rural regions, donor-financed pilot projects have introduced modular lithium-ion battery storage systems. These interventions have significantly improved voltage stability and energy efficiency, addressing regional inequalities in energy access (UNDP, 2022).

The heating sector has also benefited from low-carbon innovation. Electric heat pumps deployed in public buildings in Edineț and Ocnița have led to notable reductions in both emissions and municipal energy costs—a result confirmed by the Ministry of Energy's recent pilot assessments (Ministry of Energy, 2024).

Nevertheless, these projects largely remain within the donor-funded pilot stage, without systemic uptake in national energy planning. This phenomenon, often referred to as the "pilot trap," has been identified as a persistent challenge across emerging economies (OECD, 2021).

To stimulate broader participation in innovation, Moldova has adopted instruments such as green innovation vouchers to help SMEs access external expertise and develop clean-tech prototypes (OECD, 2022). Complementing this, a regulatory Energy Sandbox was introduced under the supervision of ANRE in 2023, allowing companies to test new technologies in a controlled regulatory environment (IEA, 2023).

Through these institutional and policy efforts—combined with participation in Horizon Europe, regional electricity interconnection projects, and targeted UNDP interventions—Moldova is gradually building a foundation for innovation-led energy transformation.

3. Mapping Public Perceptions of Moldova's Energy Security and Geopolitical Trajectory

Understanding how Moldova's energy security is perceived by the public provides an important complement to technical and policy analyses. International public opinion, in particular, offers valuable insight into how Moldova's strategic energy issues are interpreted beyond its borders. This section draws on findings from a structured survey aimed at evaluating European perspectives on Moldova's energy vulnerability, policy direction, and integration into regional frameworks. These perceptions are analyzed in relation to the broader themes of this thesis: energy security, geopolitical realignment, and regional stability.

The survey, as outlined in the methodology, was distributed online to participants from various countries. The respondents included students, professionals, and researchers with academic or professional backgrounds in energy, international relations, or policy. The questionnaire consisted of closed-ended questions, using multiple-choice and Likert-scale formats. Although the sample is not statistically representative, it offers analytical value due to the participants' familiarity with relevant geopolitical and energy policy issues.

Responses revealed strong agreement that Moldova's energy security is vital to the stability of Eastern Europe. This reflects the perception that Moldova's energy landscape has regional implications and contributes to broader geopolitical dynamics. Many respondents endorsed the concept of energy interdependence, recognizing that instability in one country can have cascading effects beyond its borders.

Key threats to Moldova's energy security were identified, including heavy reliance on Russian energy, limited diversification of supply sources and transit routes, and outdated or inadequate infrastructure. These concerns reflect institutional assessments and reinforce the theoretical framework of this study. Most respondents viewed Moldova as either "very dependent" or "somewhat dependent" on foreign energy.

Support for Moldova's integration into European energy systems—particularly ENTSO-E—was notably strong. This integration was viewed not only as a technical step but also as a strategic reorientation toward institutional and political alignment with the European Union. Respondents linked this process to enhanced energy resilience and a reduction in geopolitical vulnerability.

Renewable energy development was almost unanimously rated as highly important for Moldova's energy future. However, perceptions of the country's current preparedness for energy crises were more skeptical. Many participants expressed concerns about Moldova's emergency response capacity, energy storage, and infrastructure reliability.

The war in Ukraine was seen by most as a critical turning point. It was widely believed to have intensified Moldova's energy vulnerability while also accelerating its pursuit of alternative energy partnerships. This finding supports the thesis' central argument that external shocks can act as catalysts for policy change and geopolitical repositioning.

Opinions about NATO's involvement in energy resilience were mixed but leaned positive. A significant number of respondents supported the alliance's potential role in cybersecurity and infrastructure protection, pointing to an expanded understanding of energy security as part of national defense and regional order.

Overall, the survey results paint a detailed and coherent picture of how Moldova's energy situation is perceived. Public opinion largely aligns with expert and institutional assessments, particularly in highlighting the risks of dependence and the strategic importance of diversification. These findings also underscore the relevance of energy justice and socio-technical transition theories. Support for renewables reflects concerns with equity and sustainability, while doubts about preparedness highlight institutional limitations.

Moreover, Moldova's energy strategy is widely interpreted as a reflection of its geopolitical orientation. For many, the country's energy reforms are not merely technical adjustments but symbols of sovereignty, adaptability, and alignment with the West under external pressure.

The perspectives captured through this survey contribute meaningful insights into how Moldova's energy security is understood across Europe. These views affirm the thesis's proposition that Moldova's energy trajectory is closely linked to issues of sovereignty, resilience, and regional stability. They also highlight the importance of transparent policymaking and inclusive communication in bridging institutional goals with public expectations. While the survey has its limitations, its findings offer valuable empirical support for the claim that Moldova's energy path serves as a litmus test for broader regional dynamics and democratic resilience in Eastern Europe.

5. Conclusion and Reflections

This study explored Moldova's evolving energy strategy within the wider context of regional instability, economic transition, and European integration. Drawing on policy analysis, institutional evaluation, and public opinion data, the research highlights a country navigating complex structural challenges while attempting to reposition itself within a shifting geopolitical order.

Moldova's energy vulnerability remains pronounced, particularly due to its historic reliance on Russian gas, limited diversification of supply routes, and fragile domestic infrastructure. Although major steps have been taken—including grid synchronization with ENTSO-E, the construction of cross-border pipelines, and the adoption of the National Energy and Climate Plan—implementation remains uneven. Institutional fragmentation, underinvestment, and limited regulatory capacity continue to constrain Moldova's ability to fully operationalize its energy transition goals.

The findings from the public opinion survey reinforce these concerns. While respondents across Europe expressed broad support for Moldova's integration into European energy systems and its increased cooperation with regional actors such as Romania and Ukraine, they also voiced skepticism regarding the country's preparedness for energy crises. There was strong support for renewables, but doubts about institutional readiness and crisis management were equally prominent. The war in Ukraine was seen as a pivotal moment that exposed Moldova's energy fragilities and pushed the country toward greater alignment with Western structures—politically and energetically.

A particularly salient insight was the consistent recognition that energy in Moldova is not perceived solely as a technical issue. Rather, it is understood as a barometer of political sovereignty, administrative capacity, and long-term developmental vision. Public perceptions confirmed that energy security is deeply intertwined with broader questions of identity, trust in institutions, and the credibility of external partnerships.

Moreover, the analysis suggests that Moldova's trajectory toward "energy independence" should not be framed as a pursuit of complete self-sufficiency—an unrealistic goal for a small, import-dependent state. Instead, it is better conceptualized as a process of managed interdependence: strengthening partnerships, diversifying sources, and building institutional resilience to absorb external shocks. In this light, Moldova's strategy hinges on transparency, regional solidarity, and the ability to align domestic reform with international support mechanisms.

Yet, an important dilemma remains. As energy policy becomes increasingly securitized, there is a risk of sidelining its social dimensions. Transition frameworks must do more than meet technical targets—they must also ensure equitable access, protect vulnerable groups, and foster public engagement. Without inclusive governance, the energy transition may reproduce existing inequalities rather than correct them.

Ultimately, Moldova's energy story is not one of infrastructure alone. It is a story about the struggle to define strategic direction in a contested region, about choosing between systems of dependence, and about asserting agency through credible reform. The country's path forward

will depend not only on donor support or regional agreements, but on the consistency of its internal governance and the inclusiveness of its societal vision.

Energy, in this context, becomes more than a policy field—it becomes a reflection of Moldova's evolving sense of self and its place in the European neighborhood.

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