Republic of Moldova: National Roadmap for Critical Infrastructure Resilience

UNDRR
UN Office for Disaster Risk Reduction

Ministry of Infrastructure and Regional Development of the Republic of Moldova

Polish aid

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Foreword

Vladimir Bolea

Deputy Prime Minister,
Minister of Infrastructure
and Regional Development

On behalf of the Ministry of Infrastructure and Regional Development, I have the honor to present the Final Report of the project “Strengthening the Resilience of Critical Infrastructure in the Republic of Moldova”, implemented with the financial support of the Government of Poland and in partnership with UNDRR. We thank all those who contributed to this effort for a safer future.

The report marks a key moment in strengthening the capacity of the Republic of Moldova to respond to the increasingly frequent and severe risks generated by climate change. It is both a tool for reflection and a call to action - a strategic document intended to become a true Roadmap for national resilience.

Critical infrastructure - roads, energy systems, communication and water supply networks - is the backbone of our society, yet it remains vulnerable to extreme events and earthquakes. The most exposed are the energy supply and road transport sectors. The report proposes concrete and systemic measures to reduce risks and improve inter-institutional cooperation.

For the first time in the Republic of Moldova, the global methodology for infrastructure resilience reviews, developed by UNDRR and CDRI, was applied. The document is aligned with the Sendai Framework, the Sustainable Development Goals and the National EU Accession Plan 2024–2027, providing a coherent and applicable vision for strengthening essential infrastructure.

I sincerely call for close collaboration between government institutions, international partners, technical experts and civil society. With the Roadmap and the proposed action plans, we are better prepared to build a resilient Moldova in the face of the challenges of a constantly changing world.

I thank once again all those who contributed their time, knowledge and support to the preparation of this report. Let us continue to work together to ensure a more resilient, secure and sustainable future for the Republic of Moldova.

Natalia Alonso Cano

Chief, UNDRR Regional
Office for Europe
and Central Asia

Moldova faces increasing risks from natural hazards such as floods, storms, and droughts, further intensified by the impacts of climate change. These threats place critical infrastructure systems, which are essential for the delivery of services and sustaining key economic sectors, at significant risk.

Launched in July 2024 with generous support from the Government of Poland, the “Strengthening Critical Infrastructure Resilience in the Republic of Moldova” initiative marks a major step in addressing these challenges. By applying a global methodology developed by UNDRR and the Coalition for Disaster Resilient Infrastructure, the project provided an interactive, cross-sectoral and multi-stakeholder approach to assessing Moldova’s critical infrastructure resilience, identifying gaps, and developing a roadmap to guide policy, governance, and investments in line with national priorities.

This final roadmap report reflects the depth of collaboration and expertise behind the project. Driven by the leadership of the Ministry of Infrastructure and Regional Development and supported by a Technical Working Group co-chaired with UNDRR, the initiative brought together six ministries, the State Chancellery, the General Inspectorate for Emergency Situations, the Agency for Geodesy, Cartography and Cadastre, UN agencies, civil society, as well as experts from the European Bank for Reconstruction and Development and other partners.

Informed by regulatory reviews, multi-hazard risk assessments, stress testing, and interactive consultations, the roadmap outlines actionable steps to strengthen resilience in the energy, ICT, transport, and water sectors, in alignment with Moldova’s National Disaster Risk Reduction Strategy and EU Accession Plan, the Sendai Framework for Disaster Risk Reduction, and Sustainable Development Goals.

As Moldova advances on its resilience journey, UNDRR remains committed to supporting the government and its partners in transforming this roadmap into tangible, lasting outcomes that safeguard lives, livelihoods, and sustainable development.

1.

Introduction

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Executive summary

Scope and approach

The Republic of Moldova is exposed to numerous meteorological, hydrological, geological and climatological hazards – particularly floods, storms and droughts – that disproportionately impact vulnerable groups and women, with climate change intensifying these risks. Critical infrastructure is especially exposed to natural hazards, with key functions highly disrupted by (1) summer storms that bring heat waves, strong winds and heavy rains triggering flash floods; (2) winter storms marked by extreme cold, heavy snowfall, and frost; and (3) earthquakes, particularly in the southwest and central parts of the country.

In this context, taking proactive measures to make infrastructure systems capable of withstanding disruptions from a wide range of hazards will minimize economic and human losses and create significant economic benefits. To achieve this, Moldova is encouraged to establish effective legal and policy frameworks and strengthen institutional arrangements.

This Roadmap is based on the global methodology for infrastructure resilience reviews developed by the United Nations Office for Disaster Risk Reduction (UNDRR) and the Coalition for Disaster Resilient Infrastructure (CDRI). It outlines the key findings of the assessment of Moldova's critical infrastructure resilience, focusing on energy, ICT, transport, and water and wastewater management sectors, identifies areas for improvement, and provides priority actions for each critical infrastructure sector. The findings are based on stakeholder consultations, research, and assessments using the stress testing tool and Principles of Resilient Infrastructure, in line with the global methodology. Moldova is the first country in Europe and Central Asia to apply this methodology.

Building on prior analyses of infrastructure policies, legislation, regulatory frameworks, and data on infrastructure vulnerabilities and disaster risk exposure, a Stress Test and Resilience Scorecard Workshop was held in Chisinau on 12-13 November 2024. It brought together 30 participants from the Technical Working Group (TWG) formed by UNDRR and the Ministry of Infrastructure and Regional Development (MoIRD), including representatives from key government ministries and institutions in energy and ICT sectors, UN agencies, civil society organizations, and the European Bank for Reconstruction and Development. TWG members provided technical inputs throughout the process and validated the outcomes.

This Roadmap lays the foundation for developing detailed cross-sectoral and sector-specific national programs and strategies. It also enhances the understanding and awareness of critical infrastructure resilience by providing a concrete baseline for action plans and investment priorities for each sector to draw on.

In alignment with the Principles for Resilient Infrastructure – developed by UNDRR and consulted with over 100 countries – this Roadmap promotes a holistic approach to embedding resilience into infrastructure planning and implementation. It addresses the growing risk of complex and cascading disaster impacts across the entire infrastructure system. The principles also support the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 and Sustainable Development Goal (SDG) 9 on resilient infrastructure.

Resilience governance

Moldova's legal framework includes a comprehensive set of policies to support resilient infrastructure development at the national level, particularly in the power sector. However, several regulations and sector-specific normative acts need updating to align with international standards and frameworks, including the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations Office for Disaster Risk Reduction [UNDRR], n.d.), the 2030 Agenda for Sustainable Development, and the Paris Agreement as well as EU directives related to Moldova's EU National Accession Program. This includes legislation on national risk assessment methodology and disaster loss data, where infrastructure owners and operators play a critical role.

A disconnect between existing legislation and implementation requirements has been identified, along with challenges related to effective implementation, enforcement mechanisms and the clarification of roles and responsibilities. For example, Moldova's legislative framework for disaster risk management (DRM) primarily focuses on the disaster response phase (European Union Civil Protection Mechanism [UCPM], 2023, p. 40). The DRM legislation under development offers an opportunity to improve the country's DRM system, align terminology and fine tune its institutional framework to also take into preparedness needs related to critical infrastructure, emphasizing coordinated, multi-sectoral approaches to mitigate potential systemic risks.

Policy implementation faces additional challenges due to financial limitations of state-owned infrastructure operators to comply with existing maintenance and rehabilitation regulations: e.g., the National Agency for Energy Regulation of Moldova in the energy and water sectors, and the Ministry of Infrastructure and Regional Development (MoIRD) in the transport sector.

The new National Disaster Risk Reduction Strategy, approved by the Government of the Republic of Moldova on 4 December 2024 (Government of the Republic of Moldova, 2024), provides clear directions for enhancing critical infrastructure resilience across sectors, including transport, energy, water, ICT, health, emergency services, and educational infrastructure. However, implementing these provisions will require the development and implementation of sector-specific programs by 2030.

Institutional arrangements

Moldova's institutional framework for critical infrastructure resilience is well defined at the central government level. Key policymakers include the Ministry of Infrastructure and Regional Development, Ministry of Interior, Ministry of Energy, Ministry of Environment, and Ministry of Finance, all of which can develop and implement national strategies and programs impacting critical infrastructure resilience.

Regulators, such as the National Agency for Energy Regulation (ANRE) and National Regulatory Agency for Electronic Communications and Information Technology (ANRCETI) implement state policy in infrastructure sectors, ensure market regulation and monitoring, and provide regulatory oversight of both state-owned and private operators. They introduce new regulations and standards, enforce compliance and can suspend licenses for regulatory breaches. For example, the Agency of Geodesy, Cartography and Cadastre (Government Decision No. 959/2023) is the central administrative authority that ensures the implementation of state policies in the fields of geodesy, cartography, geoinformatics, remote sensing, and spatial data infrastructure, all of which are key areas for strengthening critical infrastructure resilience.

Infrastructure and public utility operators and owners (OST/ OSD) are responsible for implementing infrastructure resilience standards and continuously assessing potential hazards. They include public authorities at both central and local levels, state-owned enterprises such as Moldovagaz or the Sewage Company Chișinău, and private companies, particularly in the energy sector, such as Premier Energy or Red Nord.

Civil Society and community-based organisations (CBOs) should play a more prominent role and collaborate with infrastructure operators as well with GIES to prepare local communities for emergencies and participate as trained volunteer civil-protection forces when available.

To enhance coordination across all these actors, the establishment of a **permanent National DRR Platform** is recommended in alignment with Sendai Framework. This platform would improve vertical and horizontal collaboration among key entities involved in disaster risk management, provide policy guidance on disaster risk reduction that is multi-sectoral and inter-disciplinary in nature, with public, private and civil society participation involving all concerned entities in Moldova. The role of the platform is to provide an umbrella support for coordination which can be set up and administered by the Ministry of Environment, with involvement of GIES as well responsibilities for MoIRD referring to the critical infrastructure.

Systemic challenges and key recommendations

The analysis revealed significant vulnerabilities in Moldova's critical infrastructure, particularly in the energy, transport, ICT, and water sectors. Key critical infrastructure functions essential for the country's economic and social stability – electricity generation, power supply, water distribution, and voice and data transmission – are especially exposed to natural hazards such as droughts, floods, and storms, resulting in severe economic and infrastructural impacts.

The stress-testing analysis and assessment against the Principles for Resilient Infrastructure highlighted how these vulnerabilities create complex, systemic interdependencies, underscoring the need for improved coordination, updated regulations, and enhanced preparedness plans across all sectors and stakeholders.

Furthermore, the review process also identified several priority actions, including on:

- Develop multi-hazard infrastructure maps to identify areas exposed to risks including floods, storms, and earthquakes.
- Improve access to GIS data on critical infrastructure networks for water, transport, and power systems, while enhancing performance data collection to better monitor and evaluate system functionality under stress.
- Strengthen enforcement of environmental legislation to protect infrastructure from degradation.
- Invest in alternative communication solutions and renewable energy sources as backup systems to maintain essential services during major disruptions, supporting emergency response operations, critical public services in government buildings, and other key infrastructure sectors.
- Prioritize harmonizing building codes with Eurocodes 7 and 8 to enhance structural resilience of major infrastructure assets such as bridges, dams, national road corridors, and power stations—critical given Moldova's exposure to multiple hazards and the vulnerability of aging infrastructure.
- Increase public awareness and develop modern early warning systems that integrate critical infrastructure considerations and ensure inclusion of marginalized groups in disaster preparedness plans, while understanding impacts on human mobility and social protection systems.

Strategic alignment

The report also maps infrastructure resilience initiatives to key national strategic frameworks, including the National Disaster Risk Reduction Strategy and the EU National Accession Plan (NAP) provisions relevant to strengthening resilience. Therefore, the Action Plan is presenting activities and interventions both during the short and long term, in alignment with the above two policy frameworks.

The EU NAP 2024-2027 is the main national strategic planning document, which defines the priorities, actions, dynamics and resources needed to harmonize national legislation with the EU acquis, as well as the activities required to adapt national institutions to the administrative structures of the European Union.

Conclusion

Enhancing infrastructure resilience in Moldova requires a coordinated alignment of stakeholders with updated legislation to ensure (1) efficient prevention, (2) shock absorption, (3) recovery, (4) adaptation and (5) transformation of essential structures and critical functions of national infrastructure, which are exposed to existing and future hazards. Implementing infrastructure resilience with anticipatory action approach requires coordinated (1) planning, (2) financing, (3) design, (4) development, and (5) operation across all disruption phases. This should be achieved through collaborative multi-risk management, multi-hazard assessments, and methods that account for the interconnected nature of national infrastructure systems.

2.

Institutional governance, key stakeholders and policy frameworks

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Key stakeholders

Moldova's disaster risk management and infrastructure resilience in the water, energy, transport and ICT sectors

Moldova has a well-defined institutional framework for governing critical infrastructure, with clear roles and responsibilities for policymakers, regulators, and operators. Each group plays a key role in shaping policy, updating regulations and standards, and directing investments towards strengthening infrastructure resilience.

In addition, Moldova has also functional disaster risk management (DRM) systems with clearly defined leadership and coordination roles across national, sectoral, and local levels. However, there are gaps in coordination among infrastructure operators for preventing critical function failures and mitigating risks to vulnerable assets. Challenges also include sectoral silos, a lack of formal frameworks for regional-central coordination, and limited financial resources for small municipalities and decentralized infrastructure ownership.

Key findings

- There are specialised coordination bodies which focus on specific areas of responsibility such as the National Commission for Climate Change (SNSC) which is an inter-institutional body at the Government level, without legal personality, with the role of coordinating climate change policies, public capital investment projects, in the context of climate change mitigation and adaptation, and natural disaster risk management.
- Leadership and coordination responsibilities are clearly defined across administrative and sector levels. The main components of the Moldova`s DRM Institutional Framework are the following:
  - Intersectoral bodies (commissions) responsible for the coordination and management of risk reduction actions and the management of emergencies and disasters at central and territorial levels.
  - Central specialized bodies of the central public administration with the authorities, services and institutions with responsibilities in the field of risk reduction and management of emergencies and disasters under their jurisdiction, local public administrations, decentralized public services, early warning systems and Civil Protection formations.
  - At the infrastructure sector level, national infrastructure and economic coordination is exercised by the head of the central specialized body of the central public administration authority, e.g., MoIRD for transportation, Ministry of Energy for the power sector.
  - At the economic enterprise and infrastructure owners' institutional level, including infrastructure operators, disaster management is the responsibility of the organization's leadership.
- However, there is no clearly defined framework for coordinating efforts among infrastructure operators to assess together the cascading risks in case one critical function (e.g., energy transmission failure) leads to failure of other functions (e.g., traffic road traffic security).
- Stakeholders involved in critical infrastructure resilience include central and local governments, state-owned enterprises, and private companies (particularly in the energy and telecommunications sectors), with a high degree of centralization.
- The unbundling of large infrastructure sectors (transport, gas, electricity) creates opportunities to incorporate resilience measures into core sectoral operations.

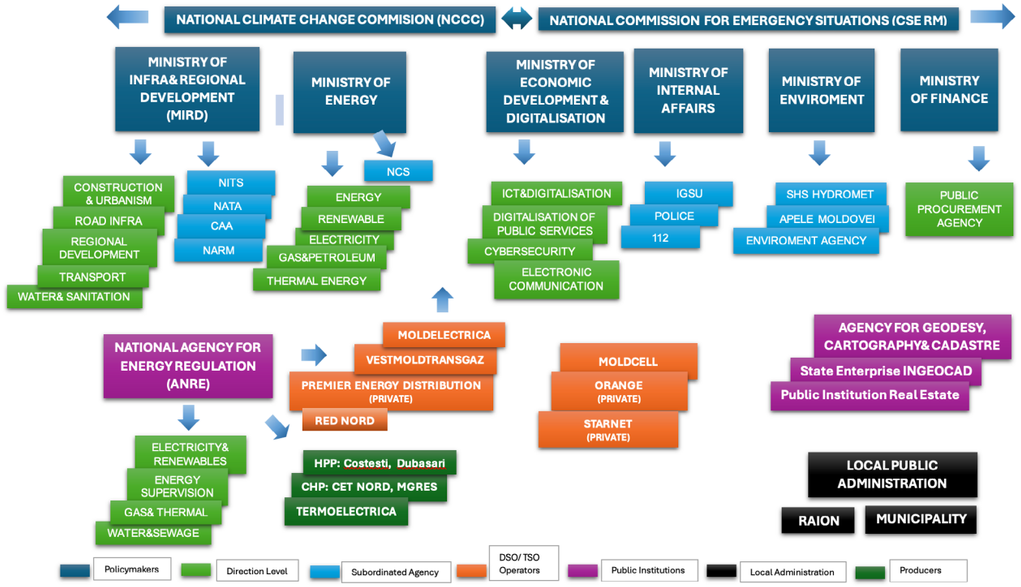
- Small municipalities rely on central government budget allocations for operating, maintaining, and repairing local public utility services after disasters.
- Different sectors operate in silos, focusing on specific responsibilities without a comprehensive, whole-of-government approach.
- There is no formal regulatory framework to guide coordination between regional (rayon) and central authorities on infrastructure resilience.
- The decentralized ownership of infrastructure, particularly local roads and bridges within municipality perimeters, complicates funding for emergency repairs and recovery efforts.

Key recommendations

- Improving stakeholder coordination in these areas is essential for enhancing the resilience of Moldova's critical infrastructure, as effective coordination, clear responsibilities, and sustainable financing are crucial to preventing and responding to disruptions.
- Without better alignment among infrastructure operators, vulnerabilities in key sectors—such as energy, transport, water, and ICT—remain unaddressed, increasing the risk of cascading failures during disasters.
- Strengthening intergovernmental collaboration and establishing a comprehensive regulatory framework will ensure more efficient resource allocation, faster emergency response, and better protection of essential services.
- Furthermore, addressing the financial challenges faced by small municipalities and decentralized infrastructure owners is vital to maintaining and restoring public services after disasters.

By improving these areas, Moldova can reduce infrastructure-related risks, minimize economic losses, and safeguard the well-being of its population.

Figure I. Mapping of institutional governance and key stakeholders relevant to critical infrastructure resilience in Moldova



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Moldova's policy and regulatory framework

Moldova must direct policy, regulatory, strategy development, and programs toward risk reduction in critical infrastructure sectors.

A strong policy and regulatory framework are essential for reducing disaster risks and enhancing the resilience of Moldova's critical infrastructure sectors. While Moldova has made progress in establishing legal frameworks for disaster management and international cooperation, significant gaps remain in proactive risk reduction, private sector engagement, and addressing seismic hazards. Strengthening these areas is crucial for protecting essential public services, aligning with EU standards, and ensuring long-term resilience in the face of natural and human-made risks.

Improving the regulatory framework for disaster risk reduction and management is essential for enhancing the resilience of Moldova's critical infrastructure. Effective sectoral regulations, coordinated by regulatory bodies such as ANRE, translate investments into concrete disaster risk reduction measures and establish clear obligations for both public and private operators.

Looking ahead, Moldova`s polices relevant to disaster risk reduction and management should also consider aligning the existing regulatory framework with international standards and approaches to increase understanding of disaster risks that affect the most critical infrastructure and the level of disruption they can trigger, as well as to increase the level of resilience of the country and society.

Beyond enhancing the resilience regulatory framework, Moldova must prioritize the development of sectoral programs and plans for disaster risk reduction and management that address infrastructure-specific resilience needs. Following the national disaster risk reduction strategy, authorities should create targeted programs and plans (territorial, sectoral, local, etc.) aligned with their specific mandates and responsibilities.

Key findings

- **Gaps in seismic risk management:** Despite facing significant earthquake risks, Moldova lacks a dedicated national law or governmental strategy addressing seismic hazards. The country has not developed comprehensive micro-zonation maps that would enable risk-informed design, planning, and upgrades for critical infrastructure such as roads, energy networks, and utility pipelines. Furthermore, Moldova has no national program to assess and reduce seismic risks in public buildings essential for service continuity and needs technical support to adopt and implement Eurocode construction standards, particularly Eurocode 7 for geotechnical design and Eurocode 8 for earthquake-resistant structures (European Commission, 2018, 2020).
- **Reactive approach to disaster management:** Historically, Moldova's legal and regulatory frameworks for disaster management have emphasized emergency response over proactive risk reduction strategies, including for climate-related hazards. The recently adopted DRR Strategy 2030 addresses this gap by implementing a multi-hazard approach to national risk assessments, preparedness, prevention, and risk reduction. This new strategy aligns Moldova with the Sendai Framework for Disaster Risk Reduction and EU standards while ensuring that proactive risk mitigation becomes an integral component of national development programs.

- **Limited private sector involvement:** There is limited regulation encouraging private sector participation in resilient infrastructure development. Corporate sustainability disclosure is only mandatory for Public Interest Entities (PIEs). Private banks and insurers provide limited financing for infrastructure investment or disaster insurance, particularly in small municipalities.
- **International cooperation:** Moldova's legislative framework allows the country to engage in regional and international cooperation, including cross-border agreements with Romania and Ukraine on emergency response and flood management. Moldova is also in the process of implementing the EU Directive on Flood Management and participates in international cooperation related to transportation and energy.
- **Inclusion and social equality:** The National DRR strategy explicitly incorporates principles of gender equality, disability rights, and social inclusion. These principles are also partially addressed in the National Climate Change Action Plan (NCCAP) and reinforced through other legislative frameworks—notably Law 5/2006 and Law 60/2012—which mandate the integration of gender and inclusion considerations across all sectoral policies.

Key recommendations

Strengthen Seismic Risk Management:

- Adopt a **national law and strategy** on seismic risk.
- Implement **micro zonation mapping** for risk-informed infrastructure planning.
- Establish a **program** to assess and reduce seismic risk in **public buildings**.
- **Adopt Eurocode standards** to improve infrastructure resilience.

Adopt Proactive Disaster Risk Management:

- Implement the **DRR Strategy 2030** with a **multi-hazard** approach.
- Incorporate **risk mitigation** into national development programs.

Increase Private Sector Involvement:

- Introduce **incentives** for private investment in **resilient infrastructure**.
- Expand **sustainability disclosure** requirements.
- Improve **access to financing** for small municipalities.

Enhance International Cooperation:

- Strengthen cross-border agreements with **Romania and Ukraine**.
- Continue aligning with **EU directives** on flood and disaster management.

Promote Inclusion and Social Equality:

- Ensure the **National Sectorial Programs having DRR components as required by the NDRR Strategy** will integrate **gender and social inclusion**.
- Increase participation of **vulnerable groups** in disaster planning.

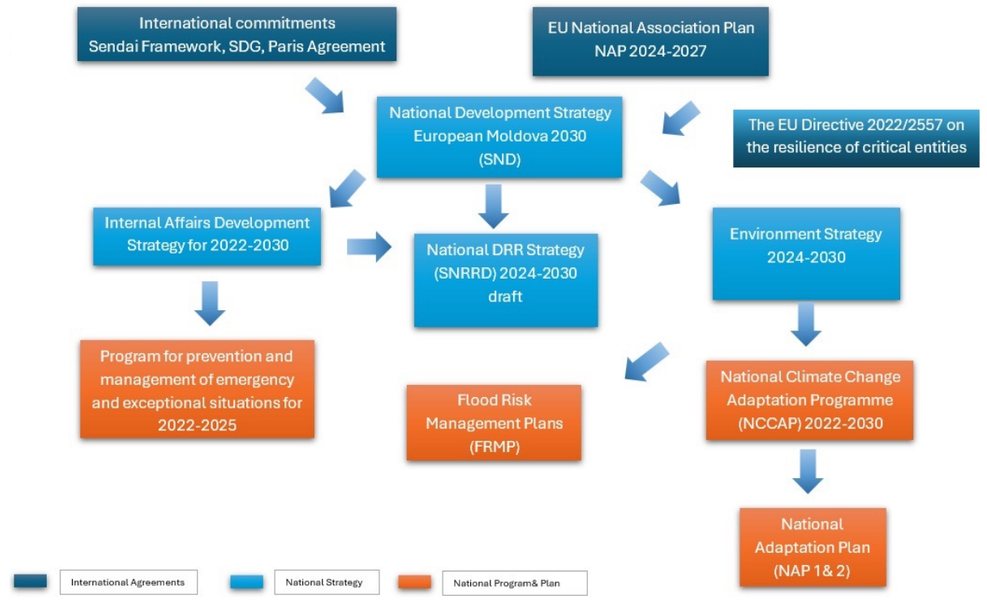
Resilience considerations in critical infrastructure sectoral policies

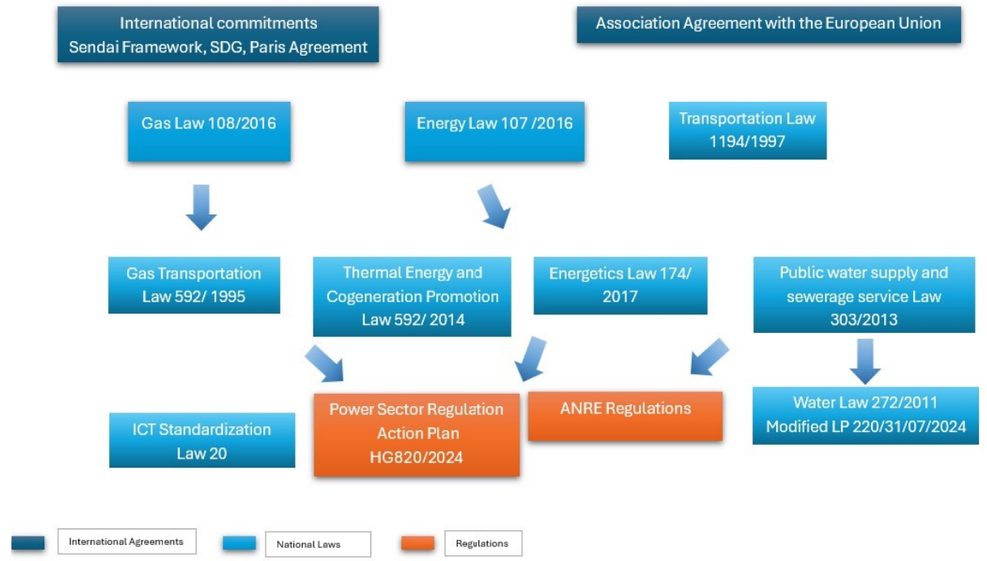
The new National Disaster Risk Reduction Strategy 2030 has a comprehensive set of provisions that covers all resilience principles both specifically applied to infrastructure in the section "Priority Direction 3.2 Development of Infrastructure Resilient to the Impact of Disasters" as well as reflected across other sections of the document.

In addition, key sectoral polices particularity relevant to the power sector have also incorporated provisions around learning from data assessments, minimizing the environmental impact of infrastructure upgrade or maintenance, fostering communication among private and public operators, and clarifying roles and responsibilities in each sector.

Resilience principle	Resilience policy provision (example)
Continuously learning (provisions on the call for multi-hazard assessment, including requirements for stress testing, and for using this information for formulating improvements).	Energy Law 107/2016 calls for multi-hazard assessments, including requirements for stress testing, and for using this information for formulating improvements in the sector.
Environmentally integrated (provisions aimed at minimizing environmental impacts, and encouraging the use of environmental solutions to deliver infrastructure services in the sector)	The Environment Strategy 2030, the Law of Energetics 174/2017, and ANRE regulations include clear provisions for promoting greener and renewable energy alternatives. These policies also encourage investments in sectors, such as solar and wind energy, both for on-grid and off-grid back-up systems (e.g., road safety signalling), particularly in the context of major gas and electricity infrastructure upgrades.
Socially engaged (provisions on fostering communication among operators in the sector and engagement with users, for example for demand management purposes)	The Ministry of Labor and Social Protection has the mandate to develop programs and regulations to ensure that policies use social engagement to reduce risks and e enhance disaster readiness e.g. social assistance programs for vulnerable people (children, elderly, disabled) affected by disasters, utility disruptions, or high spikes in costs due to regional security crises, as well as quick access to social assistance services and financial support.
Shared responsibility (provisions which clarify the roles and responsibilities of each actor in the sector, requiring intra-/intersectoral collaboration, and facilitation of information sharing)	The Government Decision 820/2024 (Government of the Republic of Moldova, 2024) approved the new Regulation and Action Plan for the Power sector in case of emergency situations and energy crisis, providing a detailed split of responsibility and allocation of roles between Ministry of Energy, Transmission Systems Operators, Distribution System Operators and General Inspectorate for Emergency Situations.
Adaptively transforming (requirements for the sector operators to have plans and strategies for adapting to changing needs)	The Energetics Law 174/2017 requires gas and electricity operators to have plans to adjust their operations on main gas pipelines, electricity networks, and related facilities in case of disruptions caused by disasters.

Figure II. Key legal policies relevant to resilience of water, power, transport and ICT infrastructure





3.

Exposure, vulnerability and economic relevance of critical infrastructure key functions

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Stress testing analysis and resilience scorecard assessment

Moldova's critical infrastructure plays a vital role in ensuring the country's economic stability and public welfare. However, it faces significant vulnerabilities due to exposure to natural hazards, infrastructure interdependencies, and gaps in data and coordination.

A comprehensive stress-testing approach – combining disaster risk, infrastructure performance, and economic data, along with qualitative research and expert insights from Technical Working Group members – identified key risks and areas for improvement. Addressing these vulnerabilities is essential to enhance resilience, reduce cascading failures, and safeguard essential services such as power, water, and telecommunications. This section summarizes the key findings on infrastructure vulnerabilities and outlines areas where targeted interventions are required.

Summary of key resilience vulnerability findings

The stress testing exercise identified ten critical infrastructure functions, economic sectors, and hazards, assessing their direct and cascading impacts on the country's overall economic and social stability. The critical infrastructure functions included electricity generation, power supply, water distribution, and telecommunications. Key economic sectors that play a vital role in the country's economy included retail, construction, and agriculture. Notably, economic data highlighted the significant role of the public sector in the labour market. Key hazards include droughts, floods, earthquakes, and extreme weather events.

Infrastructure risks and economic dependencies

The degree of **economic dependency on critical infrastructure** varies.

- Power distribution and road transport pose the highest risks, as disruptions could have widespread economic and social consequences.
- Water supply and wastewater treatment are less critical at the national level but remain important for specific sectors.
- Sectors such as health, industrial manufacturing and agriculture rely heavily on the continuous operation of critical infrastructure functions.

Hazard exposure and aystem interdependencies

Moldova faces significant vulnerability to various natural hazards—including droughts, floods, earthquakes, and extreme weather events—that severely **impact critical infrastructure systems such as road transportation, energy transmission and distribution, and water distribution**.

- Critical infrastructure functions, particularly power distribution and water supply, are **highly exposed to seasonal hazards like extreme cold and heatwaves** across the country. Additionally, they face threats from cyberattacks nationwide and more geographically concentrated risks from earthquakes in the southwestern regions.

The **complex interdependence** of infrastructure systems creates situations where **disruptions in one function**—such as power distribution—**can trigger cascading failures** throughout multiple sectors, including transportation, healthcare, and communications networks.

Addressing these interconnected risks demands **stronger coordination mechanisms** among regulators, public and private operators, and infrastructure owners, particularly in **the water, transport and power sectors**.

Gaps in sata and risk assessments

Effective risk management is hindered by **limited multi-hazard infrastructure maps**, incomplete GIS datasets for water, transport and power networks, and insufficient performance data collection for critical functions.

- Some interactive network maps are available online, showing the spatial coverage of private and state-owned energy operated networks (e.g., Premier Energy for renewable energy and Red Nord energy for electricity distribution). However, these **maps do not integrate hazard exposure or infrastructure performance data**, such as the length of power lines affected or out of service.
- While the Agency for Cadastre, Geodesy, and Cartography provides flood exposure maps and national-level earthquake exposure data exists, there are **no seismic micro zonation maps to help assess earthquake risks** in relation to power networks and other infrastructure layers.
- **Annual risk assessments should reflect the economic significance of critical infrastructure and integrate key statistical and demographic data.** These assessments should consider vulnerable and marginalized groups, gender aspects, and demographic trends, including aging rural populations and faster-growing populations in urban centres like Chisinau. Population growth and changes affect infrastructure needs and demands, placing additional stress on existing infrastructure and services.

Governance and institutional capacity challenges

The **prioritization of resilience measures** varies by sector, with some requiring greater attention and investment. While the system operates at an adequate level, it faces challenges related to consistency, effectiveness, and coverage.

- **Limited implementation capacity (due to staffing shortages)** hinders expertise development in infrastructure resilience.
- **Coordination gaps** exist due to **unclear roles and responsibilities** between **regulators, owners, and operators** across sectors. However, several legislative review processes, including new energy laws, are in the adoption stage and may address these challenges.
- **Supply chain resilience** needs improvement to ensure continuity during crises by establishing backup supplier networks, alternative transport routes, and renewable energy solutions for social infrastructure.

Public awareness and literacy around resilience are low, despite a supportive framework for social engagement and efforts done by GIES and media outlets.

Critical infrastructure risk profile

Impact, functional dependency, and exposure to natural and technological hazards

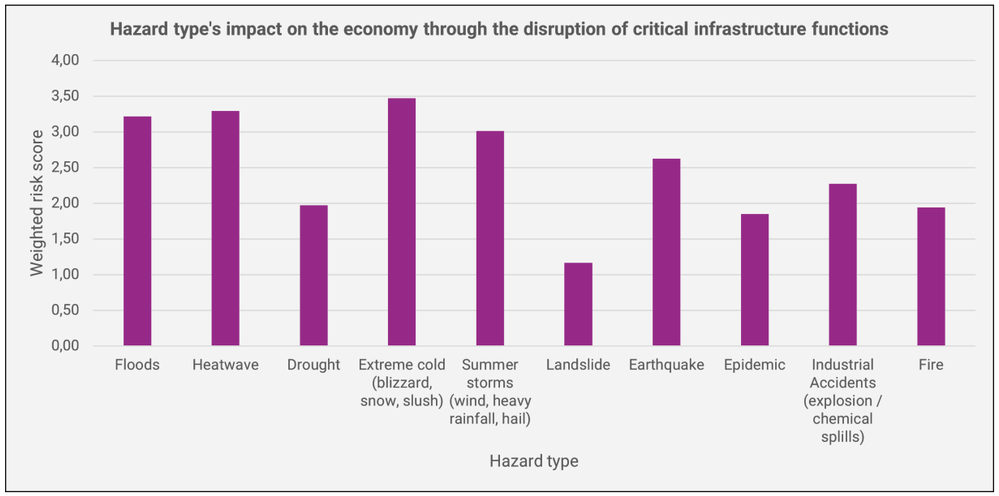
Moldova's disaster risk profile reveals that it is most vulnerable to the adverse impacts of natural hazards, such as droughts, floods, severe weather, earthquakes, and landslides rather than manmade hazards, such as technological and industrial risks, and the cascading impacts resulting from the war in Ukraine.

However, the top 3 hazards which impact infrastructure such especially the power sector, water and transport, are: (1) summer storms with heat waves, strong winds and heavy rain/floods, (2) winter storms with extreme temperature, heavy snowfall, and frost and (3) earthquakes, particularly in the southwest and central parts of the country (European Commission's Joint Research Centre, 2022).

It is estimated that the country will, on average, face a disaster preparedness and response funding gap of **US$146 million** each year (World Bank, 2024). Financial preparedness to meet post-disaster costs can reduce the fiscal impact of disasters; mitigate their impact on infrastructure development; and secure faster and more complete recovery of infrastructure assets and restoration of key functions.

Moldova's vulnerability to natural disasters is heightened by its reliance on agriculture, a large rural population, dependence on energy imports, and limited energy diversification. Natural hazards significantly impact agricultural production, with average annual losses from hydrometeorological hazards comprising about 3% of GDP. The rural

Figure III. Level of impact of different hazards on the economy through disruptions to critical infrastructure functions



population, which makes up 60% of the total population, is particularly affected (United Nations Development Programme [UNDP], 2024).

The April 2017 **heavy snowfall** severely affected 15 districts, blocking 810 km of roads and causing 183 million lei in damages. From 2000-2019, **blizzards** and heavy snowfalls caused 1.443 billion lei in damages.

Floods in 2010 and the subsequent water dam breach led to damages and losses of around US$41.92 million, and more recently the rains and floods of 2020 caused economic damages of more than US$2.1 million (Ionita & Nagavciuc, 2021).

The November 2000 ice deposits and frost severely affected northern and central districts, causing extensive damage to power and communication lines and disrupting transportation. From 2000-2019, ice-related damages to roads and energy transport amounted to around 339 million lei (approximately US$18 million) (Government of the Republic of Moldova, 2024).

Seismic risk is very high in the southwestern region and moderate in Chisinau. Earthquakes can also cause cascading impacts on national infrastructure, such as power station damage leading to failures in the main transboundary gas pipeline or high-voltage power lines, disrupting services nationwide. For example, Chisinau – the capital and Moldova's financial and business hub, which generates 50% of the national GDP – faces an estimated average annual loss of over US$8.4 million due to earthquake-related disruptions. These losses reflect potential damage to supply chains, infrastructure assets, public buildings, as well as private housing. A 100-year earthquake event is estimated to generate over US$700 million in losses country-wide, representing 4.35% of GDP (World Bank Group, 2024).

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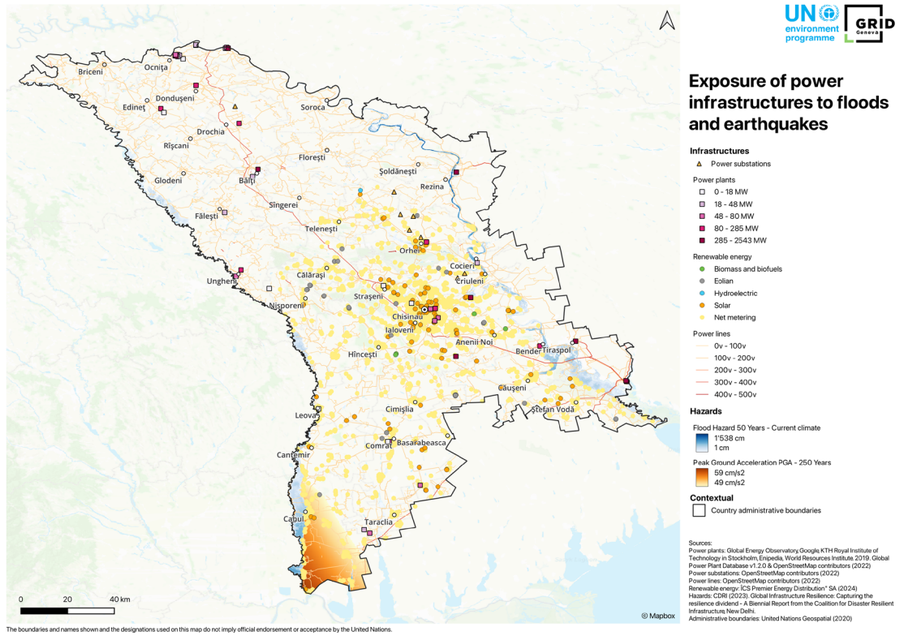
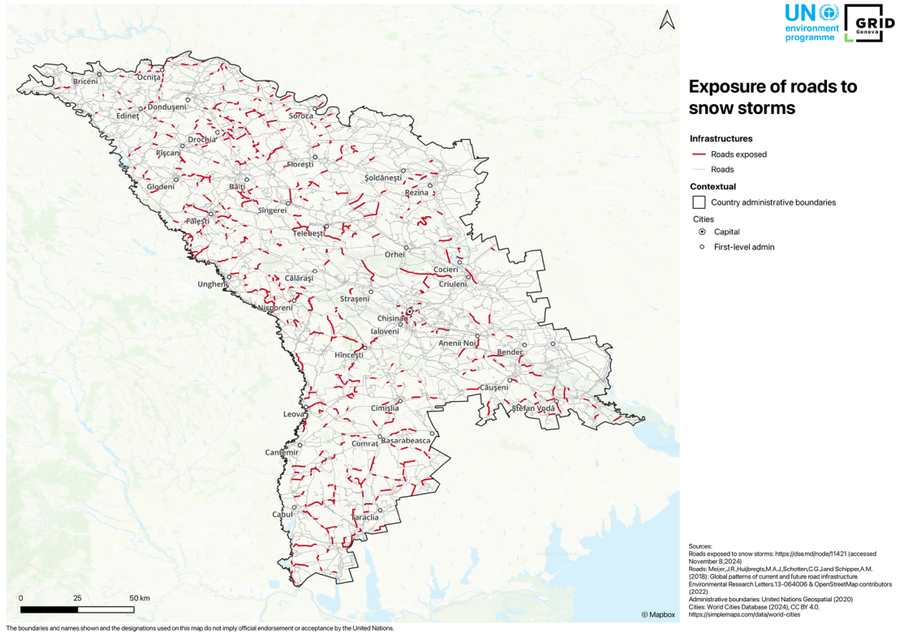
Figure IV. Exposure of power infrastructure to floods and earthquakes.



From "Exposure of power infrastructure to floods and earthquakes," by United Nations Environment Programme Global Resource Information Database [UNEP GRID], 2024.

Figure V. Exposure of road infrastructure to snowstorms.



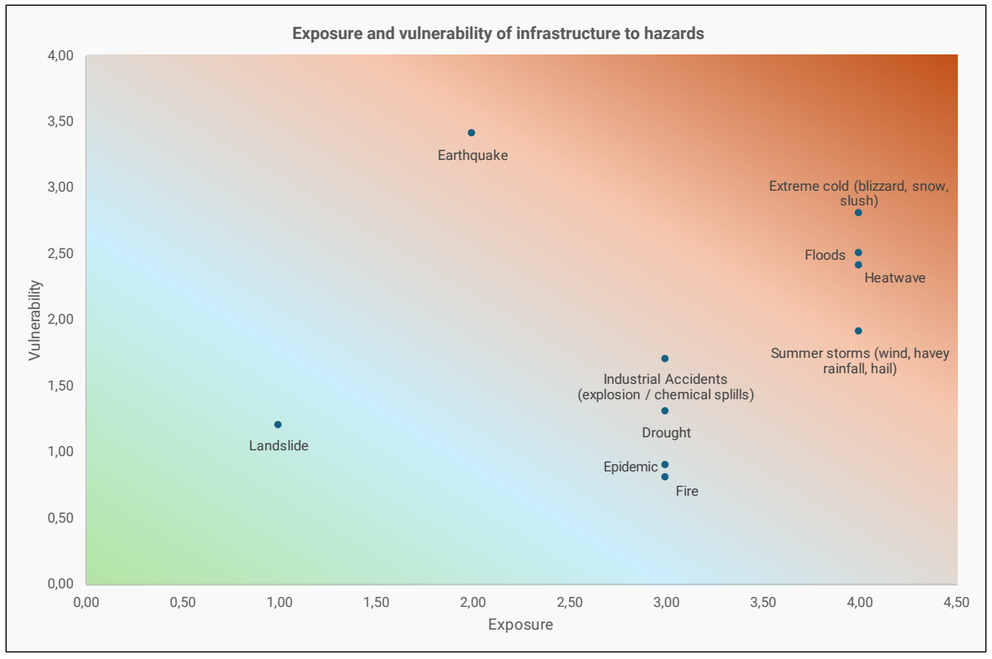
Adapted from "Exposure of road infrastructure to snowstorms" by United Nations Environment Programme Global Resource Information Database [UNEP GRID], 2024, and "Exposure layer" by General Inspectorate for Emergency Situations [GIES], (https://dse.md/node/11421).

In 2022, S.A. "RED Nord" reported a System Average Interruption Duration Index (SAIDI) of 26.07 minutes per year for outages caused by meteorological, hydrological, and climate hazards (RED Nord, 2022). SAIDI measures the total duration of power outages experienced by an average customer over a specified period, typically annually. By 2023, this figure had increased dramatically by 11-fold, reaching 294.1 minutes (RED Nord, 2023). Similarly, OSD Î.C.S. "Premier Energy Distribution" S.A. documented a parallel trend, with service interruptions due to natural hazards increasing 6-fold from 34.09 minutes in 2022 to 207.7 minutes in 2023 (Premier Energy Distribution, 2023).

Extreme cold poses a significant threat to transmission infrastructure, especially power lines. While high-voltage transmission lines generally demonstrate greater resilience, frost accumulation can both damage infrastructure and simultaneously increase energy demand for heating. Historical data shows that in certain regions, frost layers reaching 60-70 mm combined with wind speeds of 20 m/s have caused severe localized power outages persisting for weeks and affecting approximately 1,200 communities (General Inspectorate for Emergency Situations [GIES], 2023).

In Moldova, the main infrastructure functions with the highest risks (High Exposure, High Vulnerability) are **water supply, power distribution and transmission**.

Figure VI. Exposure and vulnerability of infrastructure functions to hazards



Function	Dependency
Water supply	Water supply systems exhibit high vulnerability to drought and floods, which degrade water quality and contaminate groundwater sources. Additional significant threats include heatwaves, earthquakes, epidemics, and industrial accidents—any of which could trigger complete disruption of water services.
Power distribution and transmission	Critically susceptible to extreme cold, summer storms, and earthquakes, all presenting severe risks to operational continuity. Epidemics and drought generally have minimal impact. Vulnerability varies by infrastructure type: disruptions to high-voltage lines (400v-500v) affect extensive geographic areas, while incidents involving lower-capacity substations typically impact more limited regions.
Air transport	Earthquakes can significantly affect air transport, although the impact varies depending on the frequency and intensity of seismic events. Droughts and landslides pose minimal risk due to their localized and seasonal nature. Epidemics may significantly disrupt passenger services while leaving technical airport operations largely functional.
Road and rail transport	Share similar vulnerabilities, with heatwaves and extreme cold causing substantial disruption, while droughts and epidemics present lower risks. Bridge infrastructure represents a critical vulnerability in road networks due to high reconstruction costs and extended recovery timeframes.
Oil and gas pipelines	Susceptible to both natural and technological hazards, particularly fires, requiring specialized technical response capabilities for containment and remediation.
Water distribution and wastewater treatment	Vulnerable primarily to droughts (seasonal, predictable) and earthquakes (unpredictable, sudden onset). Heatwaves typically cause minimal disruption to system functionality.
Voice and data communication	Especially vulnerable to infrastructure damage from summer storms and earthquakes, both of which can cause widespread service interruptions across communication networks.

4.

Disaster Risk Reduction considerations cutting across all sectors

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Cross-cutting Disaster Risk Reduction (DRR) considerations across all sectors

Summary of key findings

The cross-cutting DRR/DRM governance framework reveals critical needs for improved coordination, updated regulations, and enhanced preparedness plans across all sectors and stakeholders. This is especially important when addressing the complex systemic interdependencies identified through stress-testing analysis.

Governance and policy framework

- **Regulatory alignment:** Moldova must modernize regulations and standards to align with international frameworks and EU directives.
- **Strategic direction:** The National Disaster Risk Reduction Strategy 2030 establishes clear pathways for enhancing infrastructure resilience, aligned with the international agreements and standards.
- **Implementation gap:** A significant disconnect exists between current legislation and practical implementation, with notable challenges in enforcement mechanisms and clarity of roles and responsibilities.
- **Reactive approach:** Moldova's disaster risk management framework currently emphasizes emergency response rather than proactive disaster risk reduction measures.

Coordination and institutional arrangements

- **Coordination deficit:** Despite well-defined institutional frameworks, Moldova lacks formal coordination mechanisms among infrastructure operators to prevent cascading failures.
- **Platform recommendation:** Establishing a permanen National DRR Platform would strengthen vertical and horizontal collaboration at both central and local levels, bringing together representatives from key stakeholder groups (1) Government agencies, (2) Regulatory bodies, (3) Designers, planners, engineers, and contractors, (4) Operators and Owners, (5) Academia, (6) Development actors and Civil society, (7) Financial partners.
- **Sectoral integration:** Current operations in sectoral silos limit the development of a comprehensive whole-of-government approach to enhancing resilience.
- **Coordination framework:** Clear regulations are needed to define coordination responsibilities during emergencies and to integrate emergency plans led by GIES across interdependent sectors.

Data and disaster risk assessment approach

- **Strategic shift:** Moldova is transitioning from a reactive approach to a proactive multi-hazard approach applied to all-hazards national risk assessments.
- **Investment needs:** Increased investment in multi-hazard risk assessments is required in each sector, utilizing GIS and modern disaster data collection tools.
- **Capacity enhancement:** Key agencies, such as the Agency for Cadastre and Geodesy, need strengthened capacity to create multi-hazard infrastructure maps and GIS datasets for critical infrastructure networks in collaboration with infrastructure operators.
- **Integrated data:** There is a pressing need for integrated hazard exposure data with infrastructure performance information and maintenance and investment plans.
- **Seismic mapping gap:** The lack of seismic micro-zonation map for assessing earthquake risks to infrastructure networks limits effective structural mitigation measures and related investment.

Figure VII. The renovated road in Chistelnita with modernized road safety infrastructure.

© Photo by Elena Dintiu/Moldova State Road Administration.

Summary of key recommendations

Common resilience priorities across all infrastructure sectors highlight the need for a coordinated, multi-sectoral approach to infrastructure resilience that addresses interconnected vulnerabilities and ensures continuous essential services during disruptions.

Emergency response and preparedness systems:

Role	Action
Owners and Operators	Establish crisis management cells with GIES (General Inspectorate for Emergency Situations)
	Develop and implement disaster alert dissemination protocols
	Identify system anomalies and formulate upgrade plans
Government	Implement public communication strategies for emergency situations
	Publish timely statistics and analysis of assumptions, highlighting improvement priorities.
	Ensure monitoring protocols respect privacy and prevent adverse social and environmental outcomes.
Regulators	Develop new regulations establishing frameworks for mandatory annual drills and stress tests for operators
	Establish requirements for operators to collect and analyze infrastructure failure data during disasters and correlate with preparedness plan assumptions

Backup and alternative systems:

Role	Action
Owners and Operators	Install backup systems strategically aligned with multi-hazard risk maps
	Ensure redundancy for all critical functions
Government	Create incentive programs for developing alternative renewable energy solutions for social infrastructure

Resilience regulatory updates:

Role	Action
Government	Update and harmonize building codes and standards to address critical infrastructure upgrades and retrofitting requirements
	Strengthen enforcement of environmental regulations to minimize ecosystem impacts during infrastructure expansion or maintenance
	Align with EU directives and standards while incorporating resilience elements in all sector-relevant transposition projects

Financing mechanisms of DRR measures

Role	Action
Government	Provide enough financial resources for the state-owned infrastructure operators to increase compliance with existing maintenance and rehabilitation regulations
	Engage banks and international financial institutions in reviewing budget allocations for real-time infrastructure performance monitoring to enable timely interventions.
Financial institutions	Evaluate infrastructure performance monitoring results throughout project lifecycles before approving new investment plans. Quantify benefits derived from enhanced safety investments
	Prioritize investments in infrastructure projects with explicit maintenance components
	Develop parametric insurance solutions based on pre-defined trigger events (e.g., covering flood losses when rainfall exceeds specified thresholds).
	Integrate multi-hazard risk considerations into financial modelling to assess cost-benefit of infrastructure resilience measures under various disaster scenarios
	Apply rigorous environmental impact assessments in investment decision-making.
	Assess liability frameworks for force majeure events and evaluate consequences of risk transfer mechanisms on investment capital

Decentralized ownership

Role	Action
Government	Adapt funding mechanisms for emergency repairs and recovery efforts to align with the current centralized infrastructure ownership structure, reducing response delays.
	Use the unbundling process started for some state-owned companies to include DRR/DRM considerations in the decentralisation process, upfront.

Inclusive considerations

Role	Action
Government	Develop implementation frameworks for the gender equality, disability inclusion, and social inclusion principles embedded in the National DRR strategy
	Establish regulations clarifying roles and responsibilities of civil society and communities within the national DRM system, including their participation in prevention and DRR activities.
	Enhance public awareness and develop modern early warning systems ensuring inclusion of marginalized groups.
	Collect and analyse data to better understand impacts on human mobility and social protection systems, including energy price compensation mechanisms.

Representative of GIES Moldova during an emergency intervention. Photo: https://dse.md/

5.

Action plans for enhancing resilience

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Priority actions for enhancing infrastructure resilience

The stress testing analysis and resilience scorecard assessment identified high, medium, and low priority areas that require improvement, based on the six Principles of Resilient Infrastructure.

The action plans for enhancing critical infrastructure resilience in Moldova focus exclusively on the high priority actions listed in the table below. The plans take a dual-perspective approach: shorter-term, response- and reaction-oriented actions and longer-term prevention, preparedness and resilience-building actions. Both types of actions will require updated regulations, new investments, and integration into the pipeline of ongoing or planned projects.

Figure VIII. Actions that require improvement, ranked according to their priority across all sectors

High priority	Medium priority	Low priority
P1.2 Monitor and intervene appropriately	P1.1 Expose and validate assumptions	P2.6 Design for multiple scales
P1.3 Analyse, learn, and formulate improvements	P2.1 Raise essential safety requirements	P4.3 Incentivize demand behaviour
P1.4 Conduct regular stress tests	P2.2 Exceed basic requirements for critical components	P6.5 Allow for human discretion
P2.3 Consider complex interdependencies of connected networks	P2.5 Design infrastructure to fail safely	
P2.4 Embed emergency management	P5.2 Cultivate collaborative management	
P2.7 Commit to maintenance	P5.4 Enhance connectivity for information sharing	
P2.8 Devise long-term investments	P5.5 Assure data safety to develop trust	
P3.1 Minimize environmental impact	P5.6 Share risk and return information	
P3.2 Use environmental solutions	P6.2 Create adaptive capacity	
P3.3 Integrate ecosystem information	P6.3 Develop flexible management	
P3.4 Maintain the natural environment	P6.4 Enable capacity for transformation	
P3.5 Use local sustainable resources		
P4.1 Inform people about disruptions		
P4.2 Raise resilience literacy		
P4.4 Encourage community participation		
P5.1 Harmonize open standards		
P5.3 Establish shared responsibilities		
P6.1 Choose manageable solutions		

Resilience action plans

The resilience action plans emphasizes coordination, redundancy, communication, and preparedness as key strategies for managing infrastructure disruptions along all key phases of disaster management: 1. Anticipate 2. Prepare 3. Alert 4. Respond and 5. Secure.

They present a comprehensive list of interventions which can be incorporated in national sectoral programs and actions plans, focusing on two main categories: **(1) Response actions (short-term)** and **(2) Prevention and preparedness actions (long-term)**, both fully aligned with the National DRR Strategy 2030:

1. **Response actions** include establishing crisis management cells for coordinated command, developing alternative service solutions like backup power supplies and transportation routes, and implementing public communication protocols during emergencies.

2. **Prevention and Preparedness Actions** focus on strengthening cross-sector coordination between agencies and with neighbouring countries, enhancing infrastructure resilience through backup systems and updated building codes, conducting regular training exercises and stress tests, activating emergency communication systems for reliable information flow, and monitoring critical infrastructure with rapid protection protocols.

Power sector action plan

This action plan highlights:

1. How power sector response actions address immediate operational needs, strategic coordination requirements, communication necessities, and resource prioritization during energy emergencies.
2. How power sector prevention and preparedness measures create a comprehensive approach to building resilience before disasters occur, addressing infrastructure, resources, information management, coordination, financial mechanisms, and training needs.

Responsible entity	**Hydromet SHS, Ministry of energy, TSO, DSO, ANRE, producers, GIES**	
Vulnerability and Risk Scenarios (High Probability with High Impact): service disruption, physical assets damaged, functions stopped	• Logistics and supply chain disrupted for both population and economic entities • Network damage, conductor breakage, damage to insulators or conductors – along with falling trees – can lead to interruptions in the power supply of some sectors of the power network and groups of end consumers. • Disruptions in road transport networks can delay fault repairs and the restoration of power supply to end consumers. • Severe limitations in maintaining compliance with the N-1 safety standard. • Partial or total damage to IT elements due to medium and long-term power supply interruptions. • Difficulties in ensuring the adequacy of the National Energy System (NES) due to low production levels in power plants. • A sharp increase in electricity consumption may put pressure on network elements. • Disturbances in the electricity market due to large fluctuations in the trading price or an insufficient level of supply. • Low production in some power plants can cause large power flows to deficient areas, leading to electrical network overload, voltage deviations and challenges in maintaining reactive power balance. • Reduced operability of switching equipment may hinder interventions required to maintain the safe operation of the electrical network or activation of override protocols. • Extended drought can reduce production capacity in affected hydroelectric power plants. • Congestion may occur on the interconnection lines, limiting the ability to ensure electricity exports and imports. • Equipment tripping may result from sealing defects (e.g. oil or SF6 gas leaks) or incorrect operation of digital remote signal transmission devices due to excessive heating of the control panels. • In electrical and transformer stations, vegetation fires may occur, which can lead to short circuits in the electrical network and the melting of materials due to imperfect contacts.	
Actions	**Response (short term)**	**Prevention and prepardness (long term)**
DRR Strategy 2030 Marker	Chapter 2.3 Regulatory framework Chapter 2.6 Safety and Resilience Priority Direction 4.2 (4.2.1, 4.2.2) Priority Direction 4.3 (4.3.2, 4.3.3)	Priority Direction 4.4 (4.4.1, 4.4.4) Priority Direction 5.1 (5.1.1), 5.2 (5.2.1) Priority Direction 4.4 Chapter 4 Impact Chapter 5 Monitoring (2.2, 3.2, 3.3, 4.4) Chapter 7 Responsible Institutions

Emergency operational responses	**Infrastructure resilience**
• **Develop alternative power supply schemes** to restore the supply and initiate activities to return affected equipment to operation by repairing or replacing the damaged/ destroyed equipment or using equipment from the emergency reserves/ contingency inventory. • **Activate electricity networks code** regarding the state of emergency and restoration of the power system.	• **Enhance back-up systems** and service continuity: invest and install backup systems aligned with multi-hazard risk maps to ensure service continuity and system redundancy, e.g., renewable energy backup solutions for social infrastructure (schools, hospitals, administration, public urban transport safety) • **Establish autonomous, isolated electrical system** ("energy islands") to provide independent energy supply to specific areas • **Update and harmonize building codes** and standards applicable to new constructions and retrofitting of power infrastructure (e.g. power plants, transmission lines, and substation foundations). • **Develop and retrofit power plants** to operate on alternative fuels, enhancing system flexibility and energy reserves.
Strategic coordination	**Coordination and governance**
• **Establish a crisis management cell** with GIES, including representatives from all relevant parties, to ensure coordination and centralized information sharing at the national level. • **Develop the SOPs and protocols** to ensure that systems are in place to mobilize the necessary response personnel. • **Develop bilateral agreements** for requesting international emergency assistance from neighbouring country Transmission System Operators (TSOs) to address major national system disruptions (i.e. operational agreements and mutual assistance agreements signed with the TSOs from Romania and Ukraine).	• **Strengthen coordination between regulators, owners, and operators** in the energy sector by defining clear roles and procedures, including emergency communication protocols within the energy sector and with GIES, to enable rapid response to power supply interruptions. • **Ensure power sector emergency plans are integrated** with other critical infrastructure sectors that are highly dependent on the power sector (including health, water and transport). • **Develop the SOPs and protocols** to ensure that systems are in place to mobilize the necessary response personnel.
Communications and alerting	**Financial and operational sustainability**
• **Develop and test systems** to disseminate disaster alerts to state authorities and power operators • **Launch public communication** with the Ministry of Energy, GIES, and national media, to encourage the population to reduce electricity consumption during peak hours, and to use equipment intended for heating homes with caution.	• **Ensure that all operational and maintenance costs** are included in energy distribution tariffs.
Resource management	**Resource diversification and storage**
• **Activate power plants** capable of using alternative fuels to increase energy reserves and stabilize the electrical grid. • **Develop systems to prioritize critical electricity supply** • **Identify non-critical end consumers** that can be disconnected to reduce electric load, and simultaneously activate back-up power units to maintain supply for essential services.	• **Diversify energy resources:** continue efforts to diversify energy sources to reduce reliance on cross border energy supplies and enhance energy security. • **Improve energy storage capacities** to enhance supply resilience.
	Data and risk assessment
	• **Develop and maintain dedicated GIS dataset** for climate change probabilistic modelling to assess power infrastructure vulnerability to extreme temperatures. • **Regularly update risk assessments** and preventive action plans in accordance with Energy Community requirements.
	Training and readiness
	• **Conduct annual drills and stress tests** at both national energy system and operator levels to assess and improve emergency preparedness and response capabilities.

Transport sector action plan

This action plan highlights:

1. How transport sector response measures address operational needs, coordination requirements, communication systems, data management, and improvement practices during transportation emergencies.
2. How transport sector prevention and preparedness actions address infrastructure improvements, regulatory frameworks, coordination mechanisms, risk assessment processes, and training needs to strengthen resilience before transportation emergencies occur.

Responsible entity	**Hydromet SHS, Ministry of infrastructure and regional development, GIES, SRA, CFM, national inspectorate for technical surveillance; authority civil aeronautics; naval agency of the Republic of Moldova; private operators**	
Vulnerability and Risk Scenarios (High Probability with High Impact): service disruption, physical assets damaged, functions stopped	• The failure of water reservoirs and dams could result in damages to roadways and rails. • Large earthquakes, particularly in the southwest and Chisinau area, may severely affect roadway, bridges, and overpasses due to ground shaking, surface ground ruptures and soil liquefaction. • Landslides triggered by an earthquake may impact or cover vital transportation corridors, requiring bus routes and other services to be rerouted. • Flooding may damage roads and bridges, leading to road closures, rerouting around the flooded/damaged areas. • Extreme heat puts extra strain on mechanical equipment, warps train tracks, and softens road surfaces. • Extreme cold can negatively impact the performance of mechanical equipment and create icy roads, leading to delays and hazardous conditions. • Electric buses and road safety equipment relying on solar energy may be adversely affected by cold weather. • Disruptions may occur in traffic management systems, including traffic lights, toll booths and electronic traffic signs. • Disruption of dispatching and vehicle location systems may affect coordination and service delivery. • Disruption of the Trains Control system may pose risks to train safety and operational reliability.	
Actions	**Response (short term)**	**Prevention and prepardness (long term)**
DRR Strategy 2030 Marker	Chapter 2.3 Regulatory framework Chapter 2.4 Emergency Response Chapter 2.6 Safety and Resilience Priority Direction 4.4 (4.4.1.6, 4.4.3.4, 4.5.1.5)	Chapter 5 Monitoring (2.2, 3.2, 3.3, 4.4) Chapter 7 Responsible Institutions Chapter 2.2 Risk profile (2.2.3. Technogenic exceptional situations)

Emergency operational responses	**Infrastructure enhancement and safety standards**
• **Activate alternative road routes schemes** (road to rail and rail to road), including detouring routes • Implement contingency actions to restore road and rail safety equipment by repairing/replacing damaged equipment or using security stock. • Transition to alternative fuels in the event of energy failure, as established in emergency protocols. • Develop SOPs for activating override and manual disconnection protocols of electrical installations for transport.	• **Enhance safety and security standards** for rail and road transport on all identified emergency alternative routes. • **Accelerate implementation** of infrastructure projects on Solidarity Lanes. • **Focus on completing projects** approved under the Connecting Europe Facility Calls. • **Prepare and adapt** intelligent transport systems (ITS) strategy for all transport modes by integrating advanced technologies (sensors, communication networks, data analytics, real-time monitoring).
Strategic coordination	**Coordination and emergency planning**
• **Establish a crisis management cell** with representatives from GIES, key transport sector operators and stakeholders, to ensure coordination and centralized information at the national level. • Ensure emergency staffing protocols are in place to direct transport system operators to mobilize necessary personnel for rapid restoration of operations	• **Enhance interoperability**, cooperation and expertise exchange between neighbouring countries • **Improve coordination** between transport operators and emergency services. • **Establish a Transportation Emergency Hub** in MoIRD to ensure central coordination of transportation operations during disasters • **Preposition operational agreements** to utilize airports and commercial flights as alternate modes for emergency transportation • **Preposition contracts with bus and truck transport** companies for rapid evacuation and recovery support
Communications and alerting	**Regulatory framework and governance**
• **Ensure protocols for disaster alerts** dissemination to authorities and operators in the transport sector • **Establish risk communication protocols** for real-time public safety alerts about affected routes and available alternatives. • Install multiple modes of communication between transportation agencies (CFM State Rail Agency), S. E. “State Road Administration” SRA) and transit providers using multiple channels (e.g. radio, SMS, social media, emergency broadcasts etc.) • Encourage alternative transportation use during disruptions	• **Transpose EU provisions** related to road safety audits and inspections into national laws, procedures, and regulatory frameworks • **Establish disaster mitigation policies** which contribute to enhancing road safety crash data systems. • **Develop protocols** for activating supervision of safety management systems during disasters. • **Connect data from disaster risk assessments** at national level with the Law on Road Infrastructure (Law No. 509-XIII, 1995) and the Law on Road Safety (Law No. 131-XVI, 2007), to be used by a road safety audit at all the stages, even at the road infrastructure designing stage. • **Create national safety authority** and investigation body for rail
Resource management	**Risk assessment and data management**
• **Develop standardized protocols** and templates for monitoring and reporting damage to transportation systems during and after an incident. • **Share rapid** assessments with MoIRD covering critical information (damage, casualties, stranded vehicles/ passengers, status of roadways and rail tracks, geographic areas of damage, status of service. • **Regularly update templates** to reflect emerging needs and technological advancements. • **Conduct comprehensive reviews** of response protocols following incidents.	• **Include disaster risk mapping** for all hazards in cross-border transport connection projects • **Assess the capacity of transportation systems** using information from multiple providers • **Compile data** on populations requiring evacuation, including those with special needs such as women, children, the elderly, persons with disabilities and hospital patients.
Continuous improvement	**Training and readiness**
• **Integrate feedback** from stakeholders and post-incident evaluations. • **Implement improvements and update protocols** to enhance future response efficiency and effectiveness	• **Conduct annual emergency drills and stress testing** exercises for both the national transport system and transport operators • **Train emergency service providers** (ambulances, fire-fighter brigades, power operators) as well **regular service providers** (city transport management agency, CFM, SRA, private bus companies, taxi companies, trucking companies, paratransit providers) on emergency coordination.

Water sector action plan

The action plan highlights:

1. How water system should integrate disaster monitoring, emergency communication, infrastructure protection, crisis management, and resource deployment for effective water emergency response.
2. How to integrate infrastructure enhancement, regulatory reform, risk assessment, emergency preparedness, and coordinated governance to build long-term water system resilience against disasters.

Responsible entity	**Hydromet SHS, Ministry of environment, MoIRD, ANRE, GIES, water agency "Apele Moldovei" (AAM), the hydrological center (HC), the environment agency (MA)**	
Vulnerability and Risk Scenarios (High Probability with High Impact): service disruption, physical assets damaged, functions stopped	• Drought can lead to a deficit of water in the soil and groundwater reservoirs, severely affecting agriculture, consumption, water resources and ecosystems. • Prolonged drought could lead to loss or reduction of surface- and groundwater sources and deterioration of water quality. This may require the distribution of water via water trucks, increasing costs and causing the accumulation of solid matter in sewage systems due to the lack of running water flows. • Damage to the Novodnestrovsk hydro-technical nodes (Novodnestrovsk HPP with its buffer zone and Dubasari Hydroelectric Power Plant with its water reservoir) could cause flooding of 700 km2 area and 74 settlements, impacting a population of some 65,000 people (Government of the Republic of Moldova, 2024, p. 40). • Damage to the Costeşti - Stânca hydro-technical node could cause flooding of 170 km2 area, affecting 28 settlements with a population of some 25,000 people. • Damage to the dam of the Ghidighici water reservoir could lead to partial flooding of Chişinău along the Bîc river, with the potential total flooded area exceeding 60 km2 with 75 industrial assets potentially impacted (Government of the Republic of Moldova, 2024, p. 41). • Earthquakes could impact the water supply and sewage systems, causing total or partial destruction of intake, transmission, treatment, storage, and distribution systems. This could result in the rupture of transmission and distribution pipes and damage to joints between pipes or tanks leading to water loss, interruption of electric power, communications, and access routes, as well as deterioration of the water quality at the source due to landslides. • Flash floods can trigger changes in the physical or chemical characteristics of intake water, which will affect treatment and contamination • Flash floods damaging pumping stations cause buildup of mud and stones leading to blockages in sewage systems • Flooding of urban areas with outdated or undersized sewage and retention systems could impact the local economy and disrupt essential services (e.g. public transport, emergency services).	
Actions	**Response (short term)**	**Prevention and preparedness (long term)**
DRR Strategy 2030 Marker	2.3.2.2. The specialized central bodies of the central public administration (Ministry of Environment) Chapter 2.3 Regulatory framework Chapter 2.4 Emergency Response Chapter 2.6 Safety and Resilience Priority direction 1.1 (1.1.3.2, 1.3.4) Priority direction 3.2 (3.2.1, 3.2.1.1, 3.2.1.4) Priority direction 4.4 (4.4.3.1, 4.4.3.2, 4.4.3.3, 4.4.3.5)	Chapter 2.2 Risk profile (2.2.2. Exceptional natural situations, 2.2.3. Technogenic exceptional situations, 2.2.5. Risk assessment of emergency situations) Priority direction 1.1(1.5.4,1.5.4.2) Priority Direction 4.2 (4.2.1.4, 4.3.1.3) Priority Direction 4.4 (4.4.2.5, 4.4.3.4)

Monitoring and assessment	**Regulatory framework and standards**
• **Activate of hydrological monitoring systems**, including the installation of sensors on rivers, lakes and dams to monitor water levels, detect flood risks, and use rain gauges to forecast floods and droughts, sending alerts when critical water levels are reached. • **Implement real-time monitoring systems** to track water reservoir levels, pumping and piping performance. • **Conduct regular inspections** to assess the physical condition of water infrastructure (pipelines, water collection and treatment plants, pumps, tanks, trucks) and implement real-time monitoring systems to track their performance and condition. • **Identify the water and sewage affected** system's operational aspects (capacity, demand, deficit or surplus volume).	• **Update and harmonize building codes** and standards applicable to water infrastructure (dams, levees, water storage, pipes) • **Increase alignment of water management regulations** with EU standards (e.g., DIRECTIVE 2000/60/EC) • **Complement environmental impact assessment laws** with implementing regulations and action plans • **Update water and sanitation regulations** to incorporate disaster risk management and climate change projections • **Strengthen enforcement of environmental regulations** related to water resources • **Expand the licensing of water and sanitation** operators through streamlined processes.
Alert and communication systems	**Risk assessment and planning**
• **Ensure protocols** to ensure disaster alerts are disseminated and reach state authorities and operators in the water sector, as well as GIES. • **Establish risk communication protocols** for disseminating real-time public safety alerts through different channels (radio, SMS, social media, emergency broadcasts). • **Encourage population to reduce** water consumption during drought seasons • **Advise on cautious use** of water equipment intended for agricultural production	• **Develop a dedicated GIS dataset** for climate change probabilistic modelling to assess water infrastructure vulnerability • **Update disaster risk assessments** for drinking water distribution networks, water treatment systems, and sewage systems • **Develop water and sanitation safety plans** for public services and critical emergency service providers • **Identify minimum functional system requirements** necessary to ensure basic water service in case of emergency
Emergency infrastructure protection	**Infrastructure enhancement and resilience**
• **Develop protocols** for quick safeguarding of key hydrotechnical infrastructure (e.g., Stânca-Costesti) • **Activate water discharge protocols** when necessary. • **Trigger manual disconnections** of non-essential water consumers (e.g., public swimming pools, public green spaces watering). • **Activate backup and reserve energy sources** for water pumping stations.	• **Invest in and install backup systems** aligned with multi-hazard risk maps to ensure minimum redundancy and services • **Improve water storage capacities**, including for cooling energy production. • **Upgrade treatment and discharge systems** for both urban and rural areas to handle higher water volumes from flash floods. • **Invest in renewable energy backup solutions** for water and sewage services supporting social infrastructure
Emergency response coordination	**Coordination and governance**
• **Establish a crisis management cell** with GIES, including representatives from all involved parties • **Ensure centralized water information** management at the national level • **Ensure emergency staffing protocols** for mobilizing personnel for rapid recovery of water pumps and pipelines • **Activate backup communication** channels where needed	• **Establish regular coordination protocols** between regulators, owners, and operators in the water sector • **Establish clear procedures and roles**, including emergency communication protocols • **Ensure integration of water sector emergency planning** with other critical infrastructure sectors • **Develop regulatory framework requiring safety audits** and maintenance of water supply networks based on disaster scenarios
Resource mobilization	**Emergency preparedness capacity**
• **Ensure protocols to enable alternative power** schemes to restore disrupted water supply • **Initiate necessary repairs and replacement** of damaged equipment • **Access prepositioned stockpiles** or state reserves of supplies for water treatment and distribution (e.g. for hospitals, schools, collective shelters, etc.) • **Provide emergency drinking water** (in bags, plastic containers, etc.) especially to vulnerable categories	• **Establish clear procedures for rapid response** during water supply interruptions • **Preposition contracts** for increasing the fleet of trucks for water transportation and supply during disruptions • **Develop mandatory contingency budget** reserves for water owners and operators • **Conduct annual drills and stress testing** at both the national water and sewage system level and among operators

Information & Communication Technology (ICT) sector action plan

This action plan highlights:

1. How to approach integrating emergency communication systems activation, protocol implementation for interoperability between systems, and centralized crisis coordination to ensure effective information management during disasters.
2. How to approach the integration of robust infrastructure with redundancy, clear regulatory standards, continuous network monitoring, cutting-edge technology innovation, and international cooperation to ensure reliable communications during emergencies.

Responsible entity	**Hydromet SHS, Ministry of digital economy and development (MDED), GIES and MAI, ANRCETI, STISC, private telekom operators**	
Vulnerability and Risk Scenarios (High Probability with High Impact): service disruption, physical assets damaged, functions stopped	• ICT infrastructure, depending on the technological platform, is vulnerable in high earthquake risk areas and regions exposed to prolonged winter storms with frost. This can lead to cable breakage or the toppling and flooding of GSM/ Radio towers. • Power sources including the backup systems can fail, and personnel operating these systems could be injured or unable to reach their workstations. • Physical elements such as towers and wires survive a disaster, networks may still fail because of data congestion. • Sudden spikes of traffic in circuit-switched networks can cause network crashes, although these can generally be restored relatively quickly. In packet-switched networks, such spikes may result in degraded performance (Samarajiva & Waidyanatha, 2009). • Conventional media, such as newspapers, are likely to be affected by transport system disruptions. Conventional television may also be partially or completely inaccessible due to damage to transmitting or retransmitting facilities, the unavailability of television sets, or disruptions to household power supplies.	
Actions	**Response (short term)**	**Prevention and prepardness (long term)**
DRR Strategy 2030 Marker	Chapter 2.6 Safety and Resilience Priority Direction 1.3 (1.3.4.2, 1.3.4.6) Priority Direction 2.5 (2.5.1.1, 2.5.1.4) Priority Direction 3.2 (3.2.1.1) Priority Direction 4.2 (4.2.1.2, 4.2.1.3) Priority Direction 5.2 (5.2.1.6)	Priority direction 1.1(1.1.3.2, 1.3.4.6) Priority Direction 3.3 (3.3.3.3, 3.3.2.4) Chapter 7 (National Regulatory Agency for Electronic Communications and Information Technology) Priority Direction 4.3 (4.3.3.1, 4.3.3.2) Chapter 5 Monitoring, Ministry of Economic Development and Digitalization

Emergency communication system activation	**Infrastructure resilience and redundancy**
• **Connect all prepositioned communication** technologies, including mobile electronic communication services (Cell Broadcast and/or LB-SMS) • **Integrate with centralized electronic** governmental owned Information and Communication Technology (ICT) infrastructure • **Connect services of national** broadcasters (radio/TV Broadcast) to leverage communication capacity in case of emergencies	• **Implement alternative and backup communication** systems for DRM including satellite-based communication systems • **Build robust locations** and ensure adequate redundancy in the network to maintain communication even if some towers fail. • **Diversify communication infrastructure** by incorporating dedicated fixed and mobile phone channels, SMS and email systems, and applications (e.g., Viber, WhatsApp) • **Mandate telecommunication service providers** to maintain 100% redundancy and backups for critical databases and systems
Early warning system support	**Regulatory framework and compliance**
• **Provide emergency ICT support** for the activation of the national multi-risk and impact-based Early Warning Systems (EWS) • **Deploy ICT resources** to support information dissemination during large-scale disasters	• **Clarify and update the legislation** with the roles and responsibilities of the ICT institutions involved in the EWSs and public alerting systems • **Implement the NIS2 Directive** with Ministry of Digital Economy and Development (MDED) leading policy and National Cybersecurity Agency (ASC) handling regulation and technical standards • **Create incentives for resilient telecommunication** infrastructure through building standards, redundancy requirements, and insurance • **Prescribe sectoral standard operating procedures** for effective responses during disasters and emergencies
Interagency coordination	**Monitoring and assessment**
• **Implement communication** protocols between emergencies communications (TETRA) under the competence of IGSU and private electronic communication companies regulated by ANRCETI • **Establish a crisis management cell with GIES**, including representatives of all parties involved • **Ensure coordinated communication** and centralized information management at the national level	• **Monitor whether private operators** are allocating sufficient investment to maintain the integrity and security of their networks • **Ensure network functionality** before, during and after disasters, when public demand and consumption of services can increase sharply • **Conduct periodic consultations** with telecom operators to assess the resilience of networks to the highest-probability disasters • **Require approved contingency plans** for post-disaster recovery with periodic updates
	Technology innovation and development
	Mobilize and engage private companies, academia, universities and the IT community to develop new technologies for resilient infrastructure including: • Digital Technologies: Remote Sensing, Machine Learning, GIS, drones, Augmented Reality, AI, social media, IoT, Cloud computing • Data Quality for Predictive Modelling technologies to improve early warning systems • Simulation Software Development to understand infrastructure impacts • Sensor Technologies for infrastructure operation and maintenance • AI in Communication for improving agency-public communication during disasters • Technologies for Damage Assessment using drones, GIS, and remote sensing
	International integration and cooperation
	Integration into the European emergency communication system through: • Implementing secure telematics services between administrations (TESTA) • Connecting to the Emergency Communication and Information System (CECIS) • Supporting coordination with the European Commission's Emergency Response Coordination Centre (ERCC)

Conclusion and way forward

The National Roadmap for Resilient Infrastructure, developed through extensive stakeholder consultations, follows the globally recognised methodology by UNDRR and CDRI for assessing the resilience of critical infrastructure systems. It identities gaps and challenges in institutional and regulatory processes, and outlines priorities to strengthen structural and operational frameworks and investments at cross-sectoral and sectoral levels. These efforts aim to help Moldova better prepare for, withstand, respond, and recover from disaster events amid increasingly intense, frequent and interconnected risks, often driven by climate change.

This Roadmap, along with its Resilience Action Plans and supporting tools (such as exposure maps, stress testing, templates, etc.), provides a baseline for the next steps to be taken across and within sectors by relevant ministries, their subordinate agencies, and infrastructure operators and owners to strengthen critical infrastructure resilience.

At a systemic level, the Roadmap proposes that the government takes the following steps to enhance policies and regulations, conduct multi-hazard risk assessments, and develop both cross-sectoral and sectoral resilience programmes and activities to ensure critical infrastructure resilience:

1. **Policy and regulatory updates:** Develop and put in place legislative provisions (government decisions) that require the further development of national resilience programs and actions plans, with clear roles and responsibilities for each sector. For example, the regulation for the energy sector can be used as good practice and example (Government of the Republic of Moldova, 2024).

2. **Multi-hazard risk assessments:** Conduct multi-hazard risk assessments in each sector using GIS and other modern disaster data collection tools. These assessments should identify specific vulnerabilities and areas of high exposure for physical infrastructure assets (e.g. bridges, telecom towers, high voltage power lines) and cross-border power and road projects. They should evaluate the potential impact and level of damage in the event of disasters and scenario-based estimates of damage costs of disasters.

3. **National cross-sectoral resilience programs:** Building on the improved regulatory and policy frameworks, the key findings – outlined in the action plan – can serve as a baseline for developing detailed national sectoral resilience programs and corresponding action plans, which address the most critical infrastructure functions at risk:

   - **Top 3 highest individual and cascading risk:** water supply, power distribution and transmission.
   - **Top 3 medium individual and cascading risk:** air transport, road and rail transport (including transport by road of oil and gas) and oil and gas piping (transport by pipelines).
   - **Top 3 low individual and cascading risk:** water distribution and wastewater treatment, voice and data transmission.

The sectorial resilience national programs should also be linked and focus on with the economic vulnerability assessment, risks and impact on:

a. **Top 3 industries and economic sectors** highly dependent on critical infrastructure service provision continuity: wholesale and retail, trade; maintenance and repair of motor vehicles and motorcycles constituting 16.5% of GDP (National Bureau of Statistics of the Republic of Moldova, 2024, p. 22).

b. **Top 3 employers** in the country: public sector, health and education.

Additionally, these programmes should incorporate measures to support medium-term economic growth, particularly in sectors targeted for diversification and competitiveness under the EU accession agenda, such as the IT sector.

4. **Response and prevention.** The national resilience sectorial infrastructure programs should entail specific measures and protocols for both:

a. **Rapid response:** Ensuring quick action in case of infrastructure or service failure

b. **Longer-term preparedness and prevention:** Guiding investments in structural and non-structural mitigation and disaster risk reduction.

5. **Action plans.** An integrated coordination mechanism with GIES should be established, outlining:

a. Predefined Terms of Reference for a National Sectorial Resilience Action Plan

b. Clear roles and responsibilities for each sector.

c. Timelines, SMART indicators, deliverables, and monitoring frameworks, with identified agency focal points.

d. Identification of responsible agencies for implementation.

e. Predefined Terms of Reference for Infrastructure Cross Sectorial Coordination which can be in a form of a permanent Technical Working Group with representatives from all sectors, GIES, civil society and UN agencies present in Moldova.

This framework should be developed through collaborative workshops, consultation and agreed by all stakeholders – including policymakers, regulators, operators, TSOs/DSO, local authorities, civil society and communities – and ensure the incorporation of perspectives or adequate representation of marginalized and vulnerable groups.

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Abbreviations and acronyms

ANRE	National Agency for Energy Regulation
CER	Contingent Emergency Response
CSO	Civil Society Organisations
CCAP	Climate Change Action Plan
CCDR	Country Climate and Development Report
CPF	Country Partnership Framework
CHP	Combined Heat and Power Station
DG ECHO	Directorate General of European Civil Protection and Humanitarian Aid Operations
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EC	European Commission
ERCC	European Emergency Response Coordination Centre
ESCP	Environmental and Social Commitment Plan
ESMF	Environmental and Social Management Framework
EU	European Union
EWS	Early Warning System
FAO	Food and Agriculture Organization
FM	Financial Management
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse Gas
GIS	Geographic Information System
GIES	General Inspectorate for Emergency Situations
GoM	Government of Moldova
OST	Transport System Operator
DST	Distribution System Operator
GRID	Green, Resilient, and Inclusive Development
ICT	Information and Communication Technology
IOM	International Organisation for Migration
IMF	International Monetary Fund
M&E	Monitoring and Evaluation
MoE	Ministry of Environment
MoF	Ministry of Finance
MoIA	Ministry of Internal Affairs
MoIRD	Ministry of Infrastructure and Regional Development
MTR	Midterm Review
MGRES	Combined Heat and Power Station Moldavskaya
NDC	Nationally Determined Contribution
NDRA	National Disaster Risk Assessment
NPP	National Procurement Procedures
O&M	Operating and Maintenance
PIU	Project Implementation Unit
PPL	Public Procurement Law
PPSD	Project Procurement Strategy for Development
PWS	Public Warning System
SEP	Stakeholder Engagement Plan
SAIDI	Average Service Interruption Duration
SHS	State Hydrometeorological Service
SMORE	Strengthening Moldova's Disaster Risk Management and Resilience
TA	Technical Assistance
ToR	Terms of Reference
UCPM	Union Civil Protection Mechanism
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UNWOMEN	United Nations Agency for Women
UNOPS	United Nations Office for Project Services
WBG	World Bank Group

UNDRR
UN Office for Disaster Risk Reduction

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