CLIMATE CHANGE ADAPTATION TECHNOLOGY NEEDS ASSESSMENT

in

ENERGY, AGRICULTURE, WATER, FORESTRY, TRANSPORT, HEALTH

sectors of the

REPUBLIC of MOLDOVA

This publication is an output of the National Adaptation Plan and Agricultural Sectoral Plan Projects funded by the Green Climate Fund and implemented in collaboration with United Nation Development Programme (UNDP) and Food and Agriculture Programme (FAO).

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FOREWORD

The Republic of Moldova stands at a critical juncture in its development, where climate change adaptation is essential for safeguarding its economic, social, and environmental future. The country has aligned with the UNFCCC Parties in recognizing the significance of technology, following Article 10 of the Paris Agreement's Technology Framework, which emphasizes innovation, implementation, capacity building, enabling environments, collaboration, and stakeholder support.

As global weather patterns grow more erratic, Moldova adopted a strategic approach to climate adaptation, backed by technological innovation and coordinated policy efforts. Recognizing the technological needs for climate adaptation as a cornerstone of effective action, Moldova conducted a Technology Needs Assessment (TNA) in six priority sectors—Agriculture, Energy, Water, Forestry, Health, and Transport—during 2021-2023 In-depth sectoral assessments took an inclusive approach, guided by Sectoral Work Groups focused on enhancing resilience and promoting sustainable development in each area. The TNA was carried out as part of the second iteration of the National Adaptation Plan, funded by the Green Climate Fund and supported by UNDP and FAO UN Agencies.

The TNA process laid a robust foundation for integrating climate adaptation into sectoral planning, addressing existing adaptation gaps, and fostering systemic resilience in response to climate impacts. The identified and prioritised technological solutions aligned with Moldova's broader national and sectoral adaptation strategies, such as the *National Programme for Adaptation* (2023-2030), *Moldova 2030 Sustainable Development Strategy, Low Emission Development Programme up to* 2030 and the *Nationally Determined Contribution 2.0 and 3.0* (under consultation*).* The outcomes of the TNA emphasised transformative adaptation, aiming to meet Moldova's adaptation needs by establishing resilient systems capable of responding to identified climate impacts, vulnerabilities, and risks in a timely manner, matching the anticipated pace of climate change.

The TNA process in Moldova followed a structured, three-stage approach to ensure a comprehensive understanding and prioritisation of adaptation technologies: Identification and *Prioritization of Adaptation Technologies; Barrier Analysis and Enabling Environment; Development of Technology Action Plans (TAPs)* followed by the identification of *Project Ideas* (Energy, Water, Forestry, Transport, Health and investment Concept Note (Agriculture). Sectoral TNA Reports offer a thorough exploration of the technological pathways that can facilitate effective climate adaptation across the prioritized sectors.

Climate adaptation TNA assessments form a vital component of Moldova's contributions to global adaptation efforts under the Paris Agreement, underscoring the country's commitment to strengthening resilience against climate-induced impacts.

Aliona Rusnac

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CLIMATE CHANGE ADAPTATION
TECHNOLOGY NEEDS ASSESSMENT

ENERGY SECTOR

Integrated Report (TNA, BAEF, TAPs)

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TECHNOLOGY PRIORITISATION REPORT (TNA 1)

ABBREVIATIONS

AADM	Agency for Agricultural Development and Monitoring
BNS	National Bureau of Statistics
ACPMS	Agency for Consumer Protection and Market Surveillance
AIPA	Agency for Interventions and Payments in Agriculture
CAMA	The Center for Applied Metrology and Accreditation
CCA	Climate Change Adaptation
CCL	Center for Continuous Learning
CEEE	Center of Excellence in Energy and Electronics
DSO	Distribution System Operator
ECDH	Electricity Center with District Heating
EDO	The Entrepreneurial Development Organization
EFC	Enterprise with Foreign Capital
ES	Environmental Strategy
GCF	Green Climate Fund
GHGs	Greenhouse gases
LEDS	Low Emission Development Strategy
M&E	Monitoring and Evaluation
M&O	Maintenance and Operation
NAP	National Adaptation Plan
NIM	National Institute of Metrology
NIS	National Institute of Standardization
NMC	Normative in Moldavian Construction
UNFCCC	United Nations Framework Convention on Climate Change (UNFCCC)
RES	Renewable Energy Sources
SWG	Sector Working Group
TNA	Technology Needs Assessment
TSO	Transmission System Operator
TUM	Technical University of Moldova

Executive summary

In the absence of its own energy sources, Moldova imports (including from other sources) about 76.3% of gross energy consumption to meet domestic demand from a limited number of sources. The country's total dependence on energy resources makes the country vulnerable to energy security.

Statistics show that total energy consumption in the Republic of Moldova is on an upward trend. This is set to increase in the future, especially through increasing electricity consumption during the summer. At the same time, the energy sector is responsible for the majority of greenhouse gas emissions recorded in the Republic of Moldova.

Climate change is already having a significant impact on all sectors of the Republic of Moldova. In particular, the energy sector becomes vulnerable to rising outdoor temperatures during the summer, changing water regimes and extreme phenomena such as storms and droughts. The latter have a considerable impact on the reliability of the supply of energy and energy resources to final consumers.

Energy poverty is another basic element that makes the Republic of Moldova vulnerable to import dependence of energy resources, both natural gas and electricity.

The Energy Strategy 2030 and the action plan represent the main policy document regarding the long-term planning of this sector. The main actions are aimed at reducing GHG emissions and introducing new technologies in the infrastructure and operationalization of the sector. Phase II mentioned in the strategy foresees that, in the next decade, 2021-2030, carbon capture and storage technology will have to prove economically viable to allow it to actively enter the market, thus substantially changing the structure, values, prices and fuel costs of state-of-the-art technologies, otherwise, this will not have the expected positive impact on power generation technologies. This failure would, in turn, have a negative impact on coal's contribution to the future electricity generation mix. At the same time, smart grid technologies and equipment will clearly prove to be economically viable and will become a de facto standard for the electricity industry. This type of structuring of the energy system will greatly change existing approaches to system topologies, balancing, measuring, monitoring and energy mix. All these changes will work in favor of the uptake of increasing shares of electricity from renewable sources. Other policy documents are the National Energy Efficiency Action Plan 2018-2021 and the local energy and environmental action plans developed by local public authorities of level I and II. Although an impressive number of legislative and regulatory acts have been developed within this sector, there is no unified approach at national level to include adaptation aspects in the legislative part.

Analysis of current technologies used in the energy sector confirms that it is obsolete both morally and physically. Thus, it is necessary to urgently modernize the equipment, especially those in the field of electricity distribution and energy production. As Moldova's energy sector is in precarious conditions, outdated equipment, the sector is extremely vulnerable to the main

climatic events that damage infrastructure, thus increasing the number of power supply interruptions to end consumers.

Within the TNA component of the NAP Project, stakeholder consultation was an ongoing process throughout all phases. Their consultations and opinions in providing technological details about the current situation in the energy sector was of particular importance, with involvement in meetings, individual discussions, but especially through the use of new innovative technologies provided by virtual platforms. Stakeholders have an important contribution in identifying technologies, as well as in prioritizing them, in developing the final set of criteria used in the technology options prioritization exercise. In order to give an active role to stakeholders in the TNA process, sectoral working groups (SWGs) have been set up, including on the energy sector (14 members). Within the TNA process in the energy sector, SWG was involved as a priority in the following actions/activities:

1. Participation in identifying the long list of technologies/measures to adapt the energy sector to climate change (23 technologies/measures).

2. Primary selection/prioritization of efficient technologies/measures to adapt the energy sector to climate change (10 technologies/measures. organization of a workshop).

3. Participation in the multi-criteria analysis of final prioritization of technologies/measures for adaptation of the energy sector to climate change (evaluation of 10 technologies/measures. selection of evaluation criteria. scoring. organization of a workshop. validation of results regarding the selection for the energy sector of 2 climate change adaptation technologies/measures to be used in the subsequent phases of the TNA process, etc.).

Most of the identified sectoral technologies/measures have a medium or high degree of replicability. The actions include exchange of experience between the parties involved in the process, such as the private sector, specialized central public authorities, members of civil associations and government agencies.

The adaptation options identified include a wide range of technologies with innovative elements. Among the main innovative technologies of note are as follows:

a) Electricity generation installations based on renewable energy sources (mono-crystalline photovoltaic and vertical axis wind installations, high-efficiency cogeneration plants based on the combustion of gaseous and traditional biofuels).

b) Storage facilities for electricity produced from renewable energy sources.

c) Installations and measures to prevent frost deposits for electricity transmission and distribution networks, as well as development of coordinated programs for the development of electricity networks and construction of irrigation stations for agricultural land.

d) Development of backup options for supplying water to CHPs from alternative sources.

e) Technologies predestined for indoor and outdoor lighting with high technical characteristics.

f) Dry voltage and power transformer installations.

g) Thermal energy generation installations and heat distribution (solid biomass combustion plants, high-performance natural gas combustion plants through condensing process, vacuum solar installations for hot water consumption, installations based on low temperature potential (heat pumps, heat equipment and accumulators).

h) Thermal insulation technologies and materials with high global heat transfer coefficients.

i) Cooling and air conditioning technologies of high energy classes.

j) Electric motors and creation of favorable conditions for the implementation of the Energy Management Standard.

The main climate change adaptation benefits of identified technologies/measures in the energy sector applied on a large scale are the following:

a) Paradigm shift in the energy sector and among the population, including groups vulnerable to the impact of climate change.

b) Reducing the amount of traditional fuels used by district heating power plants and individual ones that use natural gas for heating.

c) Water savings for CHPs as a result of the use of renewable electricity generation technologies.

d) Development of new jobs both at the level of equipment suppliers and at the level of services provided by companies that will serve and exploit technologies.

e) Treating equidistantly and obtaining equal benefits from the realization of these technologies/measures from both men and women.

f) Reducing the number of interventions of task forces to remove damages and reducing the period of interruption of electricity to final consumers.

g) Reducing expenses for cooling and irrigation.

h) Reducing environmental pollution.

i) Ensuring the country's energy security and autonomy with benefits for the entire population.

The process of prioritizing adaptation technologies/measures at the level of the energy sector was carried out in two stages through a participatory process. At the first stage, SWG members prioritized through a sectoral web questionnaire (Google Forms) 10 technologies from the long list proposed for implementation for the energy sector. Thus, according to the results of the sectoral web questionnaire, the maximum vote (14 points) was accumulated by the technologies "Thermal energy generation for the production of hot drinking water based on vacuum solar collectors" and "Thermal insulation materials for the outer lining of buildings (mineral wool) (13 points) and the technology "Thermal energy generation based on solid biomass combustion plants, pellet boilers", which also scored 13 points.

In this regard, SWG proposed that 2 technologies be merged into one under the name "Thermal insulation material applied to the outer lining of buildings", and a technology was additionally proposed by the TNA team *Elaboration of a system for the prevention and protection of electrical networks against frost deposits.* Both proposals were submitted by the sectoral working group.

In order to prioritize the second stage of assessment, 10 assessment criteria were selected for all climate impacts. For each evaluation criterion, the score scale (0-10) was awarded, and SWG members individually determined the weight of each evaluation criterion (score matrix). Taking into account the specificity of the energy sector and its increased dependence on external energy resources, the maximum score was obtained by *mono-crystalline photovoltaic technologies* – 80 points, followed by *wind installations with horizontal axis* – 67 points and *ground-to-water heat pump technologies* with a total score of 62 points.

The results obtained were tested at robusticity (awareness-raising), i.e. how they are stable to changing factors determining the position of the technology/measure in the list of priority levels. In this regard, robustness was studied by changing the share of climate impacts and establishing 3 sensitization scenarios. The impacts were divided into short and long-term events, for which they were given values ranging from 0-100%.

This has led to a change in the hierarchy of climate change adaptation technologies/measures for the energy sector, as follows:

1) Awareness-raising scenario 1 (mono-crystalline photovoltaic installations – 64 points, Wind technologies with horizontal axis – 54 points, Ground-to-water heat pump technologies – 50 points).

2) Awareness-raising scenario 2 (Development of a system for prevention and protection of electricity networks against frost deposits – 56 points, Mono-crystalline photovoltaic installations – 8 points, Wind technologies with horizontal axis – 7 points).

3) Awareness-raising scenario 3 (Thermal insulation materials for the outer lining of buildings – 52 points, High efficiency cooling and air conditioning technologies – 28 points, Single crystalline photovoltaic installations – 8 points)

Following the prioritization exercise, the technology that responds to all climate impacts is mono crystalline photovoltaic installations. This technology is found in the first three positions in the analysis performed.

Climate impacts 1 and 3 are expected to be the most persistent in the near future in the Republic of Moldova, which is why it will significantly affect the energy sector, compared to climate impact no. 2.

In this sense, the technologies that would respond to these phenomena are heat pumps, including cooling installations that can operate based on low thermal potential from outside.

Thus, based on the above, it was proposed to prioritize 3 technologies:

1. Mono crystalline photovoltaic installations.

2. Wind technologies with horizontal axis.

3. Thermal heat pumps ground water.

These technologies address the most pressing climate impacts and lay the groundwork for a more resilient, autonomous energy sector in Moldova.

Important note: ***It is worth mentioning that during the execution of this exercise, the Agency for Energy Efficiency was reorganized into the National Center for Sustainable Energy and the Ministry of Energy of the Republic of Moldova was established.***

Chapter I. Introduction

1.1 About the TNA project

In the updated National Determined Contribution (NDC 2020), Moldova intends to attract more ambitious targets than in the Intentional NDC (2015). The new, unconditional objective, which covers the entire economy of the country, provides for reducing greenhouse gas emissions by 70% in 2030 compared to 1990, instead of 64-67% assumed in NDC1. Under the adaptation component, updated NDA (2020), the overall medium- and long-term adaptation objective of the Republic of Moldova is to achieve sustainable social and economic development, resilient to climate change impacts, by creating an enabling environment for coherent and effective adaptation actions with mitigation benefits, as well as by integrating climate risks into investment decision-making and business planning, while maintaining social inclusion in decision-making and remaining sensitive to the gender impact of climate change. For the energy sector, this document sets as major priorities ensuring reliable, clean and affordable energy for the population, as well as promoting increased resilience of smart climate infrastructure in the energy sector. These priorities are underpinned by a range of sectoral and cross-cutting activities and actions.

At the same time, climate change already profoundly affects the conditions of resource availability and activities within different sectors of the national economy, in particular, forestry, agriculture, transport, energy, water resources, health, etc. Over the past decade, Moldova has experienced a number of extreme events, such as droughts and major floods, along with incremental effects caused by the increase in average temperature and uneven distribution of precipitation throughout the year, which have had negative consequences on the country's economy, well-being and health of the population, etc. Severe droughts recur more frequently, causing significant economic losses. The increasing incidence and intensity of extreme events has also led to an increase in the frequency of high-risk situations.

The Government of the Republic of Moldova considers that the National Adaptation Planning (NAP) process is one of the basic keys to achieving the adaptation objectives outlined in Moldova's 2014 Climate Change Adaptation Strategy, National Determined Contribution, as well as for the continued integration of climate change considerations into its policies and budgetary processes. The government launched the NAP process in 2014 through consultations with national stakeholders and with the support of the Austrian Development Agency and UNDP.

The NDA contains a strong adaptation component that relies on the NAP process to inform the development and implementation of adaptation objectives. The interconnection of the NAP process with the setting of NDA targets provides a constructive response between national and international decision-making processes on climate change for better convergence between the implementation of the Paris Agreement, the Sendai Framework and the 2030 Agenda. At the same time, the Republic of Moldova is a signatory to a series of agreements with the EU that provide much-needed support to improve its national policies, as well as a monitoring and reporting component, which leads many of the recent changes in the legal and regulatory

framework. The Association Agreement is accompanied by an Action Programme for European integration: freedom, democracy, welfare 2011-2014 (Government Decision 289/2012), which establishes the framework for convergence of Moldovan and European policies.

As regards the conditional target of NDC2, financial support is planned from relevant donors, largely from the Green Climate Fund (GCF). Currently, the Country Program of the Republic of Moldova for employment with GCF for 2019-2024 is pending approval. Currently, a comprehensive assessment of the country's capacities, financial and technological needs to implement a number of measures to mitigate GHG emissions and adapt to climate change is taking place.

The actions undertaken under the Technology Needs Assessment (TNA) component of the NAP 2 Project support the Government of the Republic of Moldova in advancing the second cycle of its national planning process on adaptation of sectors to climate change (known as NAP-2). The results of national NAP-2 adaptation planning processes are:

- Outcome 1: strengthening and operationalizing the national coordination mechanism on adaptation to climate change.

- Outcome 2: improving the long-term capacity to plan and implement adaptation actions through advanced technologies.

- Outcome 3: Improve the integration of climate change adaptation by aligning it with national development priorities in priority sectors (forestry, health, energy and transport).

The assessment of technology needs for the energy sector provides for the elaboration of several important steps in achieving the results developed above. Thus, according to the same NDC document, based on the identified technology needs, a roadmap on priority technologies for the energy sector, a Technology Action Plan (PAT) for priority technologies of each of the five sectors of the national economy will be developed, as well as the identification of technology roadmaps within a coherent framework of technologies with clear long-term objectives and targets.

The TNA process w implemented within the PNA2 Project phased by:

1. Identifying and prioritizing adaptation technologies for the following sectors: energy, transport, forestry, water resources, health.

2. Identifying, analyzing and addressing barriers, including the enabling framework, hampering the diffusion and deployment of priority technologies for climate resilience and adaptation.

3. Development of the Technology Action Plan for the implementation of priority technologies.

1.2 Existing national policies related to technological innovation, climate change adaptation and development priorities

In 2010, the Republic of Moldova became a full member of the Energy Community, which implies a commitment to transpose the basic energy legislation to the acquis Communautaire. Since 2010, government efforts have focused on aligning the national legal framework with that of the EU. These reforms have had a positive impact on the quality of services provided to final energy consumers. In entrepreneurial activity, the investment environment and the attractiveness of the country as a whole are expected to improve on projects to capitalize on renewable potential.

According to the Republic of Moldova – European Union Association Agreement, Chapter 17[1] of this Agreement is assigned to Climate Action. Thus, the cooperation process encourages measures at national, regional and international level in the following areas:

- Climate change mitigation.
- Adaptation to climate change.
- Carbon trading.
- Research, development, demonstration, deployment and dissemination of safe and environmentally sustainable low-carbon technologies and climate change adaptation technologies.
- Mainstreaming climate law into sectoral policies as well as awareness-raising, education and training activities.

That cooperation shall include the development and implementation of:

- An overall climate strategy and action plan for long-term climate change mitigation and adaptation.
- Climate change vulnerability and adaptation assessments.
- A national climate change adaptation strategy.
- A low-carbon development strategy.
- Long-term measures to reduce greenhouse gas emissions.
- Measures to prepare for carbon trading.

[1] https://mfa.gov.md/img/docs/Acordul-de-Asociere-RM-UE.pdf

- Measures to promote technology transfer based on an assessment of technology needs.

At the same time, it is important to ensure the implementation of the most advanced policies and technologies in the process of economic growth, which lead to the lowest possible greenhouse gas emissions. Lately, the government has managed to respect this principle, adopting and implementing a whole set of normative acts oriented towards energy efficiency, use of renewable energy sources, conservation of soil quality, sustainable waste management, etc. This allowed it, in September 2015, to advance to the 21st Conference of the Parties to the UNFCCC, held in Paris, the country's ambitious targets for reducing greenhouse gas (GHG) emissions by 2030, expressed in the Intentional National Determined Contribution (NDC).

In order to achieve CNDI, on March 24, 2017, the Low Emission Development Strategy of the Republic of Moldova until 2030 (LEDS) and the Action Plan for its implementation were published and entered into force[2]. This document presented an integrated vision on changing the paradigm of development of the Moldovan economy on medium- and long-term towards a green economic development path, based on a study of the constraints to low-carbon economic development. In this respect, it will strengthen and guide the sectoral development approach that outlines the country's medium-term climate change objectives and strategy. The approach set out in the LEDS is to amplify financial coverage to promote appropriate policies to mitigate greenhouse gas emissions in sectors of the national economy, without compromising economic growth.

The overall objective of LEDS corresponds to that set out in the NDIC document. According to him, Moldova undertakes to reach by 2030 the unconditional target of 64-67% reduction of GHG emissions compared to the level of the base year (1990). The 64 percent reduction corresponds to an energy system development scenario that allows covering the domestic electricity consumption entirely through its own generation sources, and the 67 percent reduction allows up to 30 percent electricity imports. The commitment to reduce greenhouse gas emissions could conditionally increase to 78% if low-cost financial resources, technology transfer and multilateral technical cooperation are provided, access to all of which is commensurate with the challenges of global climate change.

LEDS will enable Moldova to adjust its development path towards a low-carbon economy and achieve green sustainable development based on the country's socio-economic and development priorities.

In order to achieve the objectives of reducing greenhouse gas emissions in the short term, the Government approved in February 2018 the "Program for promoting the "green" economy in the Republic of Moldova for 2018-2020 and the Action Plan for its implementation[3].

[2] The Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation. GD nr. 1470 of 30 December 2016. Official Gazette 2017, nr. 85-91.
[3] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=374523>

According to the same updated NDA document (2020), priorities with measures and actions to adapt the energy sector are reflected in Table 1.1

Table 1.1 *Sectoral adaptation priorities*

Sectoral adaptation priorities	**Main activities and actions in support of adaptation priorities**
Ensuring reliable, clean, affordable energy for the population	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy costs and making energy consumption more efficient. Promoting the development of "green" energy. Stimulating interest in the production and consumption of green energy by harnessing renewable energy sources (wind turbines and hydraulics, solar photovoltaic systems, solar panels for heating and hot water production), including the use of efficient and clean biomass production technologies, and facilitating the connection of production facilities to existing distribution capacities. Promoting public street lighting projects. Promoting climate technologies, boosting job creation in the energy sector
Promoting greater resilience of smart climate infrastructure in the energy sector	Developing quality, reliable, sustainable and resilient infrastructure across the country to support economic development and well-being of the population, with a focus on broad and equitable access for all. Construction of storage facilities for energy produced by wind and photovoltaic units. Promoting decentralized electricity generation (solar photovoltaic systems, hydraulic installations, micro-hydroelectric stations, etc.). Promoting energy efficiency (e.g., use of modern energy generation and transport technologies, thermal insulation of buildings, construction of refrigerators near CHPs and production of cold steam to preserve fruit and vegetables, etc.). Restoration of equipment of power stations of energy distribution networks intended for defrosting / melting ice or introduction of new defrosting technologies. Improving the robustness of electricity transmission and distribution infrastructure. Creation of free economic zones (FEZs) near CHPs for the economic production of sectors that use steam or hot water in technological processes (greenhouses, absorption cooling systems, processing of agricultural raw materials, etc.). Promoting climate assessment of buildings and infrastructure to enhance their energy efficiency performance. Review existing building standards to ensure that new buildings are resilient, energy efficient and have additional mitigating effects. Contribute to the development of a stream of climate-smart infrastructure projects

The Republic of Moldova has developed and adopted a series of policy documents comprising integrated measures to address the new conditions created by climate change for the energy sector. Thus, the national policy framework in force with reference to technological innovations, climate change and energy sector development includes a comprehensive set of documents (Parliament and Government decisions) that refer, in whole or in part, to the energy

field, establish objectives and measures in terms of addressing climate change, in the light of international documents ratified or adopted by the Republic of Moldova.

The documents adopted by the Republic of Moldova in the field of climate change include, on the one hand, the energy sector among vulnerable sectors, and on the other hand, among the sectors that can make a significant contribution to mitigating the effects of climate change, including for other sectors (transport, health, agriculture, etc.). The list of these documents is presented below, including brief information about the provisions and their potential impact. Thus, the main national strategic documents in the field of energy and related to climate change are the following:

- The Environmental Strategy for 2014-2023 and the Action Plan for its implementation, approved by GD nr. 301/2014.

- The Strategy of the Republic of Moldova for adaptation to climate change until 2020 and the Action Plan for its implementation, GD nr. 1009/2014.

- Energy Strategy of the Republic of Moldova for 2013-2030 and Action Plan for its implementation, approved by GD no. 102/2013.

- The Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation, approved by GD nr. 1470/2016.

The environmental strategy for 2014-2023 specifies that the promotion of green economic development at national scale will be achieved by integrating the principles of green economy, environmental protection and adaptation to climate change into sectoral policy documents, so that they are integrated into priority sectors, including energy.

The integration of environmental principles into the country's energy policy will be achieved in order to strengthen the sustainable efforts of national and local authorities, involve the private sector and ensure the active participation of civil society in the regulation, creation of the institutional framework and financial mechanism for energy saving. Ensuring energy efficiency will occur by reducing energy intensity in residential, industrial, transport and agricultural sectors. modernization of the energy system. implementation of efficient energy technologies. introduction into the consumption balance of own energy resources, including renewable ones.

As regards improving energy efficiency, a regulatory framework necessary to promote and stimulate energy efficiency in enterprises, buildings and public institutions will be developed. It is also expected to use renewable energy from total energy consumption in the country. To this end, particular attention will be paid to the promotion and production of green energy, achieved through:

1) Exploitation of wind, hydraulic energy (wind power plants, wind power systems for pumping, small hydropower plants without dams and small hydroelectric plants.

2) Exploitation of solar energy by conversion into electricity and heat (photovoltaics, biomass heat, etc.).

3) Development of energy potential of biomass (production of biofuel from cereals, sorghum, technical oily crops – rapeseed, sunflower, grape seeds from wine industry, etc.) and other sources.

Moldova's strategy for adaptation to climate change until 2020 stipulates that most of the energy capacities installed in Moldova are obsolete and their energy efficiency is low. Energy losses (electricity and heat) through transmission and distribution networks were excessive in the past and are still considerable today, which affects the energy efficiency of the sector.

There could also be changes in energy supplies. Extreme events, extreme temperatures could damage energy supply infrastructure, and the development of renewable energy sources depends heavily on the potential of water, wind and biomass, all of which will change with climate change. The main direct impacts of climate change and their potential socio-economic consequences in the Republic of Moldova are relevant for the energy sector.

According to the vulnerability assessment in terms of risks likely impacts caused by possible climate change on the energy sector, the most vulnerable areas in the Republic of Moldova will become: the Chisinau municipality, the north and, partly, the south of the country, for which there will be the highest risk with high probability of climate change.

The Climate Change Adaptation Strategy comes to present an integrated vision on the development opportunities of the Republic of Moldova on a resilient path to the impact of these changes, based on an in-depth study of future climate risks and climate change impacts on different development sectors. In this respect, it will strengthen and guide the sectoral approach characteristic of climate risks, climate change impacts on vulnerable sectors such as agriculture, water resources, forestry, health, energy, transport and road infrastructure, as well as adaptation of these sectors to potential climate change.

External assistance and investment will play an important role in promoting climate action in all economic sectors and catalyzing the targeted investments that will be needed to ensure adaptation to the impacts of climate change. These investments are linked to a wide range of technologies aimed at improving energy efficiency, using renewable energy sources and developing related infrastructures and adapting to the effects of climate change.

Energy Strategy of the Republic of Moldova for 2013-2030. The strategy approaches the period 2021-2030 in a different way compared to the period 2013-2020. In the European Union, a global plan with concrete indicators is adopted, to be achieved by 2020, and for the period 2021-2030 there are only forecasts in the form of roadmaps, to ensure a smooth continuation after the rigid threshold represented by 2020. The overall strategic objectives for the period

2020-2030 foresee that carbon capture and storage technologies will have to prove economically viable to allow them to actively enter the market, thus substantially changing the structure, values, prices and fuel costs of state-of-the-art technologies, otherwise it will not have the expected positive impact on electricity generation technologies. This failure would, in turn, have a negative impact on coal's contribution to the future electricity generation mix.

In the period 2021-2030, smart grid technologies and equipment will clearly prove to be economically viable and will become a de facto standard for the electricity industry. This type of structuring of the energy system will greatly change existing approaches to system topologies, balancing, measuring, monitoring and energy mix. All these changes will work in favor of the uptake of increasing shares of electricity from renewable sources.

Likewise, Specific Objective no. 1 for the period 2021-2030 of this Strategy is "Ensuring the increase in the use of renewable energy sources. Scenarios for the long-term availability of carbon capture and storage technology". In order to cope with the increase in electricity consumption by 2030, the contribution of renewable sources will increase to 600 MW.

The Low Emission Development Strategy until 2030 presents a vision of changing the paradigm of long-term development of the Republic of Moldova towards green economic development, based on an assessment of the constraints of low-carbon development. In this respect, it will strengthen and guide the sectoral development approach. The vision of this Strategy is premised on developing a development mechanism aimed at reducing greenhouse gas emissions and amplifying financial coverage to promote adequate investment policies and projects to mitigate them in all sectors of the national economy.

The specific objective of the energy sector provides for the unconditional reduction, by 2030, of greenhouse gas emissions from the energy sector by 74% and the reduction of greenhouse gases conditionally up to 82% compared to 1990.

At the same time, a number of other indicators were and are the basis of primary and secondary normative acts in the Republic of Moldova in the energy sector The targets targeted in the reference documents also concern the contribution of the energy sector to achieving the global objectives of reducing greenhouse gas emissions.

Table 1.2 *Inventory of objectives set by various strategic documents of the Republic of Moldova*[4]

National targets	**National policy documents**								
	NDS 2020	**Law RES 10/2016**	**Law EE 2018**	**SE 2030**	**PNEE 2011-2020**	**PNAER 2013-2020**	**PNAEE 2016-2018**	**ES 2014-2023**	**SASC 2020**
Global objectives									
GHG emissions reduction by 2020 compared to 1990	25%	-	-	25%	25%	-	1 950 kt	20%	-

[4] https://www.legis.md/cautare/getResults?doc_id=119890&lang=ro

Energy efficiency by 2020 compared to base year 2009	-	-	2 837 kt	20%	20%	20%	9%	-	-
Share of RES in total energy consumption in 2020	20%	17%	-	20%	20%	20%	-	20%	-
Specific objectives									
Energy intensity reduction towards 2020	10%	-	-	10%	-	-	-	-	10%
Reducing energy consumption in buildings in 2020	10%	-	-	20%	-	-	-	-	-
Share of public buildings renovated by 2020	10%	-	1%/an	10%	-	-	1%/an	-	-
Share of electricity in RES by 2020	10%	-	-	10%	-	10%	-	-	
Share of RES (biofuels) in transport in 2020	10%	10%	-	10%	10%	10%	-	10%	15%
Share of RES for heating and cooling in 2020	-	-	-	-	-	27%	-	-	-

A significant impact on the modernization and promotion of sustainable development of the national economy by encouraging the exploitation of energy efficiency potential in the industrial sector at national level will have the priority measures provided for in the Energy Efficiency Law no. 139/2018.

The Law on the Promotion of the Use of Energy from Renewable Sources (no. 10 of 26.02.2016) and the National Energy Efficiency Action Plan for 2019-2021, in draft version, represent the legal basis for promoting the use of energy from renewable sources, diversifying primary energy resources and ensuring safety, health and labor protection in the process of producing energy from renewable sources.

Improving the energy performance of buildings is a priority of public policies in the Republic of Moldova, and the draft Government Decision (no. 1103 of 14.11.2018) approving the Regulation on periodic inspection of air conditioning systems in buildings24 was developed in support of the implementation of Law no. 128 of 11 July 2014 on the energy performance of buildings.

Starting from this premise, the analyzed framework does not provide clear measures to mitigate this effect by applying technological needs to adapt to climate change, and this does not represent a favorable permissive environment for technology transfer to this sector. Also, there is an urgent need to update the strategic directions for adapting this sector to climate change. In this respect, it is necessary to develop, or, as the case may be, update normative acts in the field of climate change, especially on the adaptation component.

1.3 Assessing the country's vulnerability to climate change

According to National Communications 2-4 of the Republic of Moldova to the UNFCCC, the country is particularly affected by three types of climate impacts: temperature increase, changes in precipitation regimes and increased climate aridity, which are associated with the frequency and intensity of amplification of extreme weather events, such as heat waves and frost, floods, storms with heavy rainfall and hail, severe droughts. These conclusions are drawn on the basis of projected climate change scenarios, assessments undertaken in national communications 2 to 4 to UNFCCC, together with various other assessments carried out at project level, covering national, sub-national and geographical scale. Those documents shall define the basis for setting medium and long-term priorities for planning, actions and investments in adaptation, together with monitoring the effectiveness of planned and implemented adaptation.

The analysis of national climate data reveals that the frequency of droughts in the Republic of Moldova over a period of 10 years is about 1-2 droughts in the northern part of the country. 2-3 droughts in the central part and 5-6 droughts in the south. It is also mentioned that 7 out of 10 warmest years in Moldova's history were in the last two decades. Historically, Moldova has experienced episodes of drought once every 3-10 years, depending on the geographical location in the country.

Floods affect Moldova repeatedly. In the last 70 years, 10 major floods of the Dniester and Prut rivers have been reported, three of which occurred in the XXI century (in 2006, 2008 and 2010). Flooding caused by smaller rivers in the country is also quite common. The socio-economic costs of climate change associated with natural disasters such as droughts and floods are significant. Between 1984 and 2006, they amounted to about 61 million US dollars. Droughts in 2007 and 2012 caused an estimated economic loss of about $1.0 billion and $0.4 billion, respectively.

Projected temperature increases, volatility of precipitation and incidence and severity of drought episodes due to climate change could worsen the impact of hydrometeorological disasters in the medium term. Natural hazard events could have a significant impact on Moldova's development trajectory and disproportionately affect poor and vulnerable income groups. Thus, climate change is expected to further intensify the severity and impact of hydrometeorological hazards in Moldova. In line with global climate trends, the likelihood of multi-year droughts is expected to increase and, without proper management, the repercussions could be disastrous for the economy.

The negative impacts of climate change pose challenges to the country's economic growth, directly and indirectly affecting sectors that rely on natural resources (agriculture, water and forestry), but also industrial sectors such as energy, transport, along with the impact on population health. The exacerbating impact of climate change can have repercussions on social and gender equality.

The national policy framework on climate resilience should comprise a range of short- and medium-term reform and investment programmes, including to improve risk identification in Moldova, invest in better risk reduction – both structural and non-structural interventions, improve disaster preparedness and ensure stronger financial protection mechanisms. and updating recovery and resilient reconstruction policies. This framework should gradually shift

the focus from 'reactive', ex-post responses to 'proactive', ex-ante risk management. Given the limited financial resources, the Republic of Moldova should ensure that risk mitigation priorities are properly systematized in existing national programmes (agriculture, forestry, infrastructure, urban planning, flood risk management, etc.), also include financial protection measures for climate risks that cannot be fully mitigated.

According to the *updated National Determined Contribution (2020),* the overall medium- and long-term adaptation objective of the Republic of Moldova is to achieve sustainable social and economic development, resilient to the impacts of climate change, by creating an enabling environment for coherent and effective adaptation actions with mitigation benefits, as well as by integrating climate risks into investment decision-making. and business planning, maintaining social inclusion in decision-making and remaining sensitive to the gender impact of climate change.

The main impacts and vulnerabilities to climate change identified in the[5] energy sector according to the updated NDA are as follows from the description in Table 1.3 below.

Table 1.3 *Main climate change impacts and vulnerabilities identified in the energy sector*

Climatic events	Climate impact on the energy sector, ecosystems and their vulnerabilities
High temperatures	- Increased demand for electricity due to higher summer temperatures and the need for room air conditioning and cooling of industrial processes. - Increased consumption of natural gas due to increased demand for electricity. - Large losses of electricity due to intensive use of electrical cooling equipment, caused by increased air temperature. - Reduced electricity and heat generation capacities of power plants (CHPs) due to insufficient thermal load.
Changes in water regime	- Increased demand for electricity for irrigation caused by low soil moisture. - Reduced electricity production capacities of CHPs caused by decreased water flow in the Prut and Dniester rivers, as a result of reduced rainfall.
Extreme Weather events: - heat waves. - frosts. - droughts. - flood. - winds, storms with hail, heavy rains more frequent and intense.	- Reducing the resilience of energy sector infrastructure, including asset lifetimes, capital expenditure and higher operating costs. - Increased energy intensity, caused by higher electricity consumption for air conditioning and irrigation. Increasing intermittency in electricity supply. - Wood production compromised by climate change (drought), including reduced biomass production for power generation and production of liquid biofuels. - Longer duration of unplanned distortions in electricity supply due to increased frequency of spontaneous fires and the need to protect overhead lines. - Decrease in the share of electricity production from renewable energy, due to the reduction of balancing energy.

The identification of technological needs and requirements for adaptation to climate change in the energy sector are presented in the basic document on *the updated National Determined Contribution* to the compartment priorities in climate change adaptation. To address the severe

[5] http://clima.md/doc.php?l=ro&idc=93&id=4392

economic and social impacts of current and future climate change, Moldova needs to promote effective sector-wide adaptation measures in key sectors of the economy: agriculture, forestry, water, health, energy, transport. While needs to address climate change are still being assessed in the various activities, it is clear that implementation efforts will certainly be of significant proportions and will require mobilizing innovative solutions, financial resources, institutional capacities and political will for effective action. In identifying adaptation priorities at national and sectoral level, policies were taken into account relevant sectors on climate change and development, as adaptation is closely linked to the country's development policy and regulatory framework.

Even if it operates with the notion of "vulnerable consumer", the legislation does not contain plausible solutions that would target and solve the problem of "energy poverty" affecting large categories of the population. Understood as a situation where 'a household or individual cannot afford, affordable adequate heating or other basic energy services in their homes', 'energy poverty' has tangents with several interdependent elements. First, low incomes of individuals or households undermine their financial capacity to obtain energy consumption facilities. Secondly, this type of poverty results from frequent episodes of politicization of tariff policy by the market regulator, which diminishes the predictability and sustainability of energy prices. Thirdly, the condition of energy poverty includes inadequate energy efficiency in maintaining livelihoods, and this problem has only recently begun to be addressed. Most of these aspects are largely overlooked in national legislation and public policies in the energy sector[6].

Being a poor country, the population of the Republic of Moldova hardly adapts to the new conditions and requirements regarding the generation of electricity from renewable energy sources. This is determined by the high costs of new electricity generation technologies and limited access of the population to primary energy resources in the country. Adapting to new requirements becomes a necessity when it comes to the inability of communities to pay their bills for high energy costs. At the same time, studies presented by the World Bank show that 80% of Moldova's population can be considered "energy poor", meaning they spend more than 10% of their budget on energy bills. On average, energy spending accounts for 17% of the total, which is a lot compared to other countries in the region, where this value reaches up to 8%. The impact of poverty is highest among groups that already have a high poverty rate: single women and the rural population, due to their vulnerability to electricity tariffs, which are always increasing.

According to *the An integral part of the Project "Supporting Moldova´s National Climate Change Planning Process"* developed by the Austrian Agency for Development and Cooperation, the energy sector is treated under two aspects: i) opportunities to adapt the sector as positive effects that may occur in the future and ii) preparing (modifying) existing systems to prepare for new and resilient climatic conditions to any risks that may arise. For both cases, measures should be designed with a focus on aligning adaptation with the objectives set for Moldova's energy sector. This includes trying to avoid conflict with other existing sectoral strategies and, as far as possible, complementing them and exploring co-benefits.

[6] https://www.expert-grup.org/ro/biblioteca/item/1900-s%C4%83r%C4%83cia-energetic%C4%83-%C3%AEn-moldova-asisten%C8%9B%C4%83-social%C4%83-versus-capacitare-tehnic%C4%83

1.4 Choice of Sector

In the last 127 years (1887-2014), changes in average temperatures and precipitation have occurred in the Republic of Moldova. RM became warmer, with an average increase in temperatures greater than 1.0°C, while the increase in precipitation was only about 54.7 mm. The early 1980s is generally considered a "turning point" in the long-term air temperature curve, where human influence on the atmosphere is most distinctly expressed (IPCC, 2007). this has been statistically confirmed by both international studies (Gil-Alana, 2008) and national studies (Corobov et al., 2013. Taranu, 2014). The temperature increase is evident (from an average annual value of 8.5°C in the north to 10.3°C in the south), followed by a decrease in the amount of annual precipitation, respectively, from 622 mm to 508 mm. The increase in temperatures on the territory of the Republic of Moldova during 1981-2010 no longer offers any room for doubt and is very evident in the warm period, especially in summer, when T average increases by 0.9-1.0°C and T max - by 0.9-1.3°C / decade with a very high degree of certainty.

According to available studies and information, Moldova is very vulnerable to climate variability and change. For the period ahead, the impact of climate change is expected to intensify as changes in temperature and precipitation affect economic activity, and socio-economic vulnerability to these changes is extremely high. The socio-economic costs of climate-related natural disasters such as droughts, floods and hail are significant and both their intensity and frequency are expected to increase further as climate change has resulted. Adaptation is relevant for many sectors of Moldova's economy, but when it comes to operationalizing it, at district or country level, institutions may be overburdened by coordination, integration and monitoring requirements.

The existing policy framework is usually not designed to promote the integration of future climate projections and their uncertainties with sectoral priorities and measures at different levels and within different organizational structures and stakeholders. Communities operate at different spatial and time scales, have different priorities, and may need different incentives to increase their capacities to respond to climate change. Climate change is increasingly recognized as a fact of national importance but, so far, the national strategic framework lacks integrated climate change adaptation measures. Therefore, a strategic framework is needed at national level to ensure that a qualitative, efficient and coherent process of adaptation to climate change takes place.

As regards the energy sector, it is vulnerable to the climate bill described above. In this regard, demand for electricity during the summer cooling period is expected to increase, as well as diminished electricity generation at CHPs due to water shortages caused by droughts.

In this regard, a series of investment priorities are expected for the energy sector to adapt to climate change and ensure the country's energy security by:

1. Promoting water-energy nexus with a focus on renewable energy sources.

2. Increased climate resilience of energy sector infrastructure.

3. Secure operation of energy infrastructure under all climatic conditions.

During the last 27 years, in the Republic of Moldova there is a reduction in GHG emissions, in full compliance with the reduction of the value of important socio-economic indicators: the number of population decreased by 11.9%, the value of Gross Inter Product (GDP) by 27.1%, GHG intensity (CO2eq/GDP) - by 55.1%, electricity consumption by 54.3%, heat consumption by 82.7%, while consumption of primary energy resources decreased by 73.1%.

Despite these decreases in indicators, this sector remains one of strategic and economic importance at national level. This is also determined by the prioritization of this within sectoral policies. The high energy intensity, the import dependence on primary energy resources, makes this sector extremely vulnerable to climate change. Adapting new technologies to the challenges of extreme phenomena is a key element in ensuring the country's energy security.

1.4.1 Energy sector overview on the impact of climate change on Moldova's energy sector

The energy sector plays an important role in the country's national economy. The impact of climate change on sub-sectors can have serious consequences in securing the country's supply of primary and secondary energy resources.

According to different climate modelling, depending on three analyzed emission scenarios, an imminent danger is forecast to affect the energy sector by 2080, namely, the increase of the average annual air temperature by up to 4.3 ^{0}C (National Communication Four of the Republic of Moldova). Due to the occurrence of this extreme phenomenon, the demand for electricity consumption during the summer period of the year for air conditioning and cooling needs of industrial, public and residential premises will be increased. Due to this phenomenon, the electricity charge will also increase over a one-year period for photovoltaic and thermal technologies for the production of hot drinking water. In order to reduce electricity consumption caused by this phenomenon, it is necessary to apply energy efficiency measures for the buildings sector by insulating their outer envelope.

In the absence of its own energy sources, Moldova imports (including from other sources) about 76.3% of gross energy consumption to meet domestic demand from a limited number of sources. In 2018, energy imports, including inputs from other sources in Moldova, constituted 85,955 TJ. The lack of interconnections with the European energy system and the current electricity supply structure pose significant supply risks and hamper competition in electricity supply, leading to high-cost electricity procurement and vulnerability to external shocks.

Statistics show that final energy consumption in the Republic of Moldova has an upward trend. If in 2015 the final energy consumption was 101,231 TJ, and the three largest energy consuming sectors consumed as follows: residential sector with 50,114 TJ, transport sector with 28,133 TJ and trade and public services sector with 10,952 TJ, then in 2018, according to the NBS, gross energy consumption was already 116,663 TJ and the structure of consumption by sectors remained unchanged.

Thus, the country's energy security is unsatisfactory, and besides this, the energy efficiency is very low, the energy intensity exceeding the Western European one about three times.

In such circumstances, overcoming the accumulated problems can only be seen through massive investments in the sector, transfer of modern technologies and knowledge. The most plausible way in this regard is to promote Western European ideals, with subsequent accession to the EU, an essential condition for opening opportunities for economic growth and, at the same time, energy security.

1.4.2 Energy sector selection process and results

According to NAER's activity report for 2019[7] on the dynamics of energy flows in electricity networks, during 2019, the transmission system operator, distribution system operators and suppliers purchased electricity in the amount of 4,301.9 million kWh, by 0.05% less than in the previous year (4 303.9 million kWh), and 3 875.1 million kWh was delivered to final consumers, by 0.3 percent more than in 2018 (3,862.7 million kWh). The level of technological consumption and electricity losses in electricity distribution networks in 2019 decreased compared to the previous year by 0.2 percentage points and constituted 8.1%.

Table 1.4 *Quantities of electricity purchased and delivered to final consumers* (2001 – 2019)*

Indices	**Unit of measurement**	**2001**	**2005**	**2010**	**2017**	**2018**	**2019**
1. Quantity of electricity purchased – total	**mil. kWh**	3 194,8	3 359,5	3 835,7	4 066,4	4 178,8	4 301,9
	mil. Lei	1 161,6	1 180,1	2 905,5	4 027,3	4 152,1	4 542,9
2. The average price of purchasing electricity	**money/kWh**	36,36	35,13	75,75	99,04	99,36	105,60
3. Total quantity of electricity delivered to final customers	**mil. kWh**	2 166,0	2 585,0	3 229,2	3 637,4	3 737,6	3 875,1
	mil. Lei	1 376,4	1 943,1	4 320,4	7 048,2	6 926,8	6 806,5
4. Average electricity supply price (*excluding VAT*)	**money/kWh**	63,55	75,17	133,80	193,77	185,33	175,65

**The data in the table, up to 2019, do not include final customers who have made use of the status of eligible customer'.*

It should be noted that, in 2019, the evolution of electricity production was influenced by the decrease in electricity production at district heating power plants and by the increase in the amount of electricity generated by electricity production installations from renewable sources. Thus, the quantity of electricity produced by JSC "Termoelectrica" amounted to 601,3 mil. kWh, lower by 49,8 mil. kWh (7.6%) compared to the previous year's electricity production (651,1 million kWh). Regarding JSC "CET-Nord", the enterprise generated 58,3 mil. kWh, increasing electricity production by 4,5 mil. kWh or 11.2% compared to the previous year's electricity production (53,8 million kWh). We mention that, compared to the previous year, the electricity produced from renewable energy sources increased by 42,0 mil. kWh (43,3%).

Of these, the S.E."NHE Costesti" increased its electricity production (by 46.5% or 20,3 million kWh), and the other producers of electricity from renewable sources delivered to the grid by 21.6 million euros. kWh (40.6%) more than the previous year.

At the same time, the quantity of electricity produced and delivered to the network by sugar plants within their own generation sources increased by 0.5 mil. kWh, or by 25.2 % (2,5 million kWh).

[7] http://www.anre.md/raport-de-activitate-3-10

Table 1.5 *Production and procurement of electricity during 2001-2019*

Indices	2001	2005	2010	2017	2018	2019
Electricity production (delivered from departure power lines) – total, mil. kWh	1 042,9	999,8	888,1	747,4	804,2	801,1
incl.: ECDH-1	115,4	128,9	82,0	×	×	×
ECDH-2 (din 2015 – Termoelectrica)	812,6	724,7	665,4	619,3	651,0	601,3
CET-Nord	31,5	55,5	57,1	48,4	53,9	58,3
NHE Costesti	72,2	83,8	78,3	46,9	43,7	64,0
Other domestic producers	11,2	6,9	5,3	32,8	55,5	77,4
Electricity procurement – total, mil. kWh	3 194,8	3 465,1	3 915,6	4 159,0	4 303,9	4 301,9
incl.: RED Nord	569,7	588,1	651,0	53,2	85,0	76,4
RED Nord-Vest	314,9	287,1	342,4	29,5	×	×
Premier Energy Distribution (RED Union Fenosa)	2 310,2	2 484,3	2 842	234,9	243,2	243,9
Premier Energy (GNF Energy Supply)	×	×	×	2 704,4	2 767,6	2 621,5
FEE Nord	×	×	×	933,1	970,0	972,7
Moldelectrica	×	×	×	111,3	112,9	106,5
Consumers who have made use of eligibility	×	105,6	80,0	92,6	125,1	280,9

In this context, it is necessary to take into account that the quantity generated and delivered to the grid of electricity remains well below the consumption level, domestic production (the right side of the Nistru River, except for the Moldovan TPP) covering only 18.6% of the need, while deliveries to final consumers increased by 0.3% compared to the previous year, and production is 6.3% below the average annual level recorded in the years 2001-2018. The described situation eloquently shows a state of increased vulnerability of the national electricity sector, which persists over a long period of time.

According to information on the activity of enterprises in the electricity sector, in 2019, electricity consumption by final consumers amounted to MDL 3,875.1 million. kWh, with 12.4 mil. kWh more than in the previous year. Thus, the increase in electricity consumption by 0.3% in 2019 continues the upward trend of consumption recorded since 2001 until now.

Table 1.6 *Electricity supplies in the period 2001-2019*

Indices	2001	2005	2010	2017	2018	2019
Delivered useful to end consumers (electricity consumption) – **total, mil. kWh**	**2 166,0**	**2 695,1**	**3 311,6**	**3 730,0**	**3 862,7**	**3 875,1**
incl.: RED Nord	391,0	483,2	564,7	×	×	×
RED Nord-Vest	181,0	220,3	288,6	×	×	×
RED Union Fenosa	1 594,0	1 881,6	2 375,9	×	×	×
Premier Energy				2 704,3	2 767,6	2 621,5
(GNF Energy Supply)						
FEE Nord				933,1	970,0	972,7
Consumers who have made use of eligibility	×	101,6	77,4	92,6	125,1	280,9
Other consumers	×	8,4	5,0	×	×	×

Household consumers

The change in electricity consumption in 2019 compared to the previous year differs depending on the main categories of final consumers monitored (Figure 1.1).

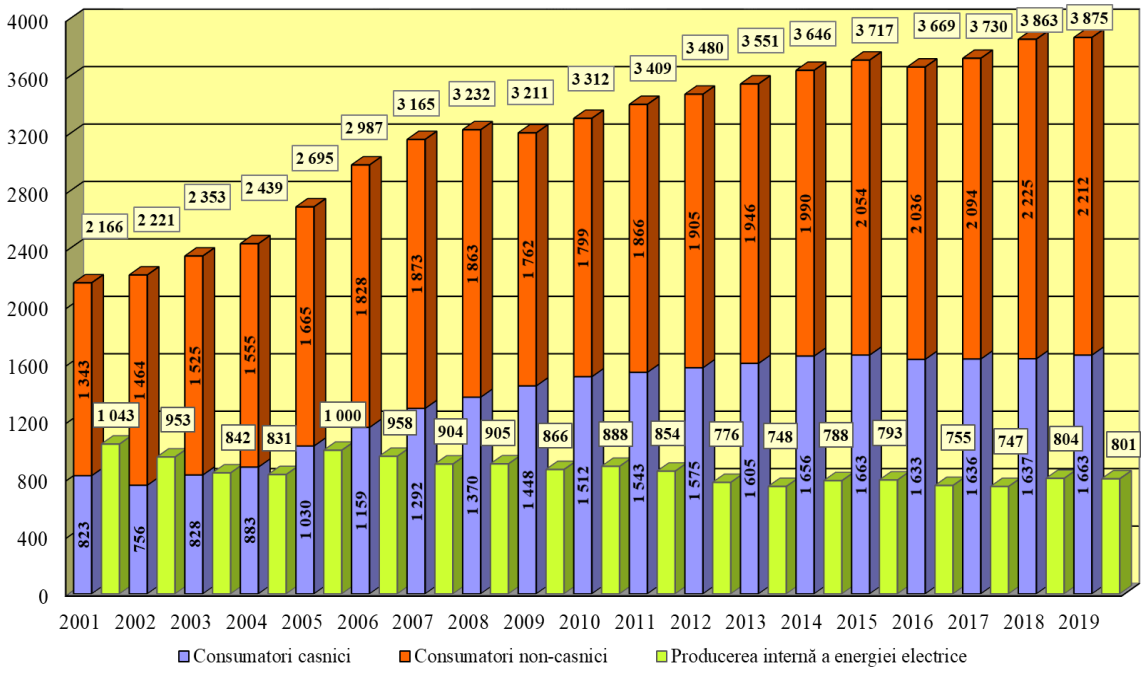


Figure 1.1 *Production and consumption of electricity in the period 2001-2019, mil. kWh*

Thus, if electricity consumption increased on average by 0.3%, for household consumers the increase was 1.6%. With reference to household consumers, we mention that those in rural areas increased their consumption by 3.1%, while consumption of household consumers in urban areas increased by 0.2%. At the same time, electricity consumption for non-household consumers decreased by 0.6%. As a result, the structure of electricity consumption has changed.

For 2019, NAER approved investment plans for the transmission system operator Moldelectrica, totaling MDL 275.8 million. lei, for distribution system operators totaling MDL 577.1 million. lei, as well as for electricity suppliers totaling 1.4 mil. Lei.

According to NAER's activity report for 2019[8], the producers for whom the support scheme applies (except for the State Enterprise "Costesti Hydropower Node" and producers who do not benefit from the support scheme, whose installations are connected to the electricity distribution networks), amounted to 67.43 million kWh (Table 1.7). Of its total, for 56.35 mil. kWh electricity guarantees of origin have been issued by the central supplier.

Table 1.7 *Production of electricity from renewable sources in the period 2016 – 2019*

Type SER	**Amount of electricity generated, thousands kWh**			
	2016	**2017**	**2018**	**2019**
Solar energy (photovoltaic)	1 311	1 509	1 457	1 437
Biogas (produced from biomass)	14 030	21 576	27 961	28 748
Wind energy	2 477	7 066	21 968	36 915
Hydroelectric power		38	279	330
TOTAL	17 818	30 189	51 665	67 430

The monthly quantity produced cumulatively by RES generating installations varied, these being largely dependent on climatic conditions. Thus, the month in which the minimum amount of energy generated was recorded was June 2019 - about 4.0 million euros. kWh, and the maximum quantity in February 2019 – about 7.3 mil. kWh. The average monthly quantity generated during 2019 was about 5.6 million lei. kWh (Figure 1.2).

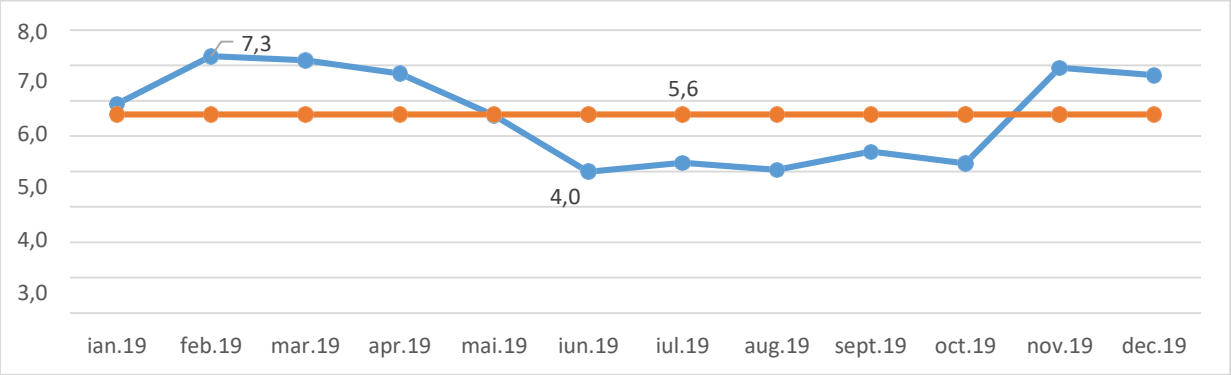


Figure 1.2 *Change of monthly electricity generated in 2019, mil. kWh*

Of the total mix of electricity generated from RES, energy generated using wind potential accounts for the largest share (54.7 % of total electricity produced from renewable sources), followed by electricity produced from biogas (42.6 %), electricity produced from solar energy (2.1 %), with hydropower installations having the lowest share1, less than 1 percent.

[8] http://www.anre.md/raport-de-activitate-3-10

At the same time, the largest amount of energy delivered by a single installation producing electricity from RES comes, as in the case of 2018, from the power plant belonging to "Sudzucker Moldova" J.S.C. with a capacity of 3.6 MW, generating in 2019 – 20.5 mil. kWh electricity.

It should be mentioned that the total installed power of power plants producing electricity from RES in 2019 was **41.8 MW.**

In 2019, the number of final consumers who benefited from the net metering mechanism, provided by art. 39 of Law nr. 10 of 26.02.2016 on the promotion of the use of energy from renewable sources. Thus, during 2019, 127 final consumers were registered who owned renewable energy sources for domestic consumption and who delivered about 470.1 thousand kWh of electricity to the electricity grid.

Table 1.8 *Data on the application of the net metering mechanism in 2019*

Provider	**Number of consumers Final**	**Type SER**	**Total installed power, kW**	**Amount of energy delivered, kWh**
E.F.C. „Premier Energy" SRL	118	Photovoltaics	1 253,8	422 254
J.S.C. „Furnizarea Energiei Electrice Nord"	9	Photovoltaics	236,7	47 874
TOTAL	127	Photovoltaics	1 490,5	470 128

The thermal energy balance during 2017-2019 reveals for 2019 a decrease in the total amount of heat produced by district heating power plants and thermal power plants of regulated enterprises in the thermal energy sector (without technological consumption and own consumption) (Table 1.9).

Table 1.9 *Evolution of heat balance in 2017-2019*[9]

Name of companies	**Heat delivered to the grid, thousands Gcal**			**Thermal energy losses, thousands Gcal**			**Delivered useful to end consumers, thousands Gcal**			**Percentage in total deliveries, %**		
	2017	**2018**	**2019**	**2017**	**2018**	**2019**	**2017**	**2018**	**2019**	**2017**	**2018**	**2019**
S.A. "Termoelectrica"	1635,8	1710,1	1532,3	349,6	335,8	304,1	1286,3	1374,2	1228,1	86,5	86,3	87,13
S.A. „CET-Nord"	192,9	211,8	175,7	42,5	45,0	38,1	150,4	166,8	137,6	10,1	10,5	9,76
S.A. „Apa-Canal Chisinau"	25,1	28,2	24,3	2,7	3,2	3,5	22,4	25,0	20,8	1,5	1,6	1,48
S.E. „Termogaz-Balti"	11,2	12,4	10,7	1,2	1,3	1,2	10,1	11,0	9,5	0,7	0,7	0,67
S.A. „Comgaz Plus"	7,4	7,1	6,2	1,0	0,9	1,1	6,4	6,2	5,2	0,4	0,4	0,37
E. M. R. C.T. Comrat	7,0	7,9	6,8	0,3	0,3	0,2	6,7	7,6	6,6	0,5	0,5	0,47
S.R.L. „Thermohouse"	3,5	0,0	0,0	0,5	0,0	0,0	3,0	0,0	0,0	0,2	0,0	0,00
S.E. „Servicii Comunale Glodeni"	2,1	2,0	2,0	0,2	0,1	0,2	1,9	1,9	1,8	0,1	0,1	0,13
Total per regulated undertaking	**1885,1**	**1979,5**	**1757,9**	**397,9**	**386,7**	**348,4**	**1487,1**	**1592,8**	**1409,5**	**100**	**100**	**100**

[9] http://www.anre.md/raport-de-activitate-3-10

In 2019, the total amount of heat delivered to the network was 1757.9 thousand Gcal, by 221.6 thousand Gcal (-11.2%) less compared to the amount of heat delivered in 2018. Compared to 2017, in 2019 the amount of heat delivered to the network decreased by 127.1 thousand Gcal (-6.7%).

Although the operating period of the machine during the heating season in 2019 was comparatively equal to the period of 2018, the decrease in the amount of thermal energy produced was determined by higher average temperatures compared to the same period of the previous year.

Technological consumption and actual losses of thermal energy in 2019 amounted to 348.4 thousand Gcal, by 38.3 thousand Gcal less compared to 2018. For 2019, the share of technological consumption and actual losses in the total amount of heat delivered to the network was 19.8%.

In absolute value, in 2019 thermal energy was delivered to final consumers in the amount of 1409.5 thousand Gcal, by 183.3 thousand Gcal less compared to 2018. In relative value, in 2019 compared to 2018, the quantity of heat delivered to final consumers decreased by 11.5%.

In 2019 compared to 2018, the most important supplier of thermal energy JSC "Termoelectrica" recorded a decrease in the quantity of thermal energy delivered by 146.1 thousand Gcal (-10.6%). The quantity of delivered thermal energy decreased for other license holders as follows: at JSC "CET - Nord" by 29.2 thousand Gcal (-17.5%), at JSC "Apa-Canal Chisinau" - by 4.1 thousand Gcal (-16.6%), at JSC." Termogaz - Balti" - by 1.6 thousand Gcal (-14.3%), at JSC "Comgaz Plus" - by 1.1 thousand Gcal (-17.3%), at Î.M.R.C.T. Comrat - by 1 thousand Gcal (-13.4%), at the Enterprise "Communal Services Glodeni" - by 0.1 thousand Gcal (-6.2%).

In absolute values, the most significant decrease was registered in the category of household consumers, where consumption decreased by 140.9 thousand Gcal (-11.5%). Thermal energy delivered to budgetary institutions decreased by 26.5 thousand Gcal (-11.7%), and in the case of economic agents decreased by 15.9 thousand Gcal (-11.2%).

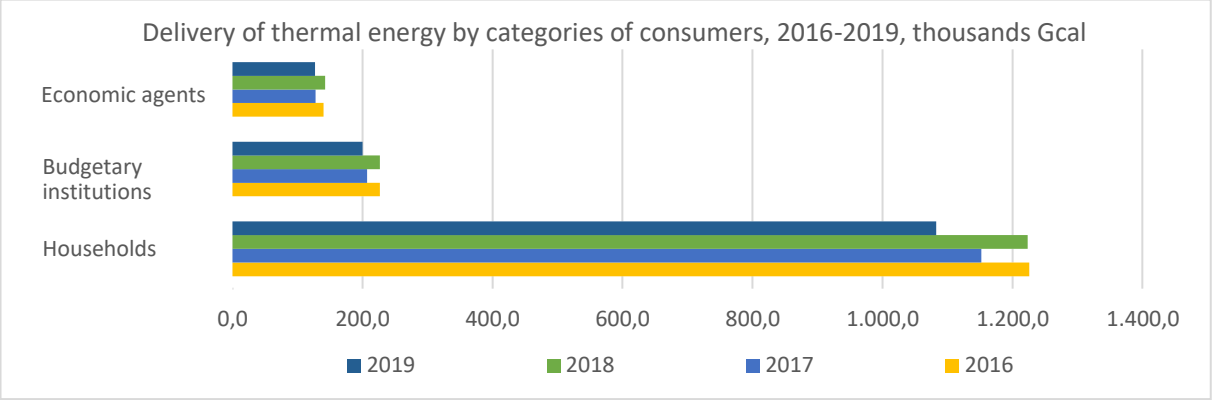


Figure 1.3 *Heat supply by categories of consumers, thousand Gcal, 2016-2019*

In 2019, heat deliveries by categories of consumers in absolute values recorded the sharpest decrease. If in 2017 compared to 2016 there was a decrease by 105.2 thousand Gcal, then in 2019 compared to 2018 the deliveries of thermal energy by categories of consumers decreased by 183.3 thousand Gcal.

In relative values, for 2018 and 2019, there were no significant changes in the structure of heat supplies by categories of consumers. The share of consumer categories in the total amount of heat supplied remained practically the same. In 2019, household consumers recorded a share of 76.8%, budgetary institutions had a share of 14.2%, and economic agents - 9.0%.

In accordance with the provisions of art. 36 of Law nr. According to Law no. 92 of 29 May 2014 on thermal energy and promotion of cogeneration, license holders for the production, distribution and supply of thermal energy have the obligation to ensure the delivery of thermal energy to consumers in accordance with the technical regulations and standards in force and with the conditions stipulated in licenses and / or heat supply contracts.

In this context, during 2015-2018, NAER approved the investment plans of license holders in the thermal energy sector totaling MDL 2115.57 million. Lei.

Part of the investments made by JSC "Termoelectrica" are financed in accordance with the Loan Agreement, ratified by Law nr. 148 of 30.07.2015, in order to implement the Project for improving the efficiency of the district heat supply sector. Investments are directed towards the following works and technologies:

- Increasing the load of the SACET managed by JSC "Termoelectrica" by reconnecting some buildings managed by the authorities to the centralized heat supply system with the reconstruction of thermal networks and connection through individual thermal points).
- Construction of a new main thermal network and pumping station.
- Capital reconstruction of sections of main thermal networks.
- Re-equipment of 3 pumping stations, by changing pumping installations, etc.
- Modification of connections by mounting individual thermal points to a number of consumers and others.

In the case of JSC "CET-Nord", under the Agreement, investment projects were selected under a loan from the EBRD, including:

- Increasing the installed power at CET-Nord by installing three gas engines, which will increase electricity production by about 60%.

- Replacing existing morally and technically obsolete pumps and fans by using high-performance installations equipped with frequency converters, which will reduce the need for auxiliary electricity by about 30%.

- Replacement of coal boilers in the thermal power plant with pellet boilers.

- Installation of 169 individual thermal points in 130 buildings, including domestic hot water preparation and organization of the automatic SCADA data collection system.

According to NAER's activity report for 2019[10], natural gas supplied to the Moldovan market was purchased from S.A.P. "Gazprom" from the Russian Federation, the total volume of natural gas purchased amounting to 1,057.7 million m^3. The total volume of natural gas purchased in 2019, compared to the previous year, decreased by MDL 72.0 million m^3 (-6.4 %). Analyzing the total purchases of natural gas for a longer period of time, we find that the continuous downward trend characteristic of the period 2005-2013 was reversed in 2014, 2016 and 2018, when there were increases of 2.1%, 3.0% and 9.3%, respectively, followed by the decrease in the last year.

The data presented in Table 1.10 show that the consumption of natural gas in the Republic of Moldova (both distributed to final consumers and delivered directly from natural gas transmission networks) in 2019 decreased significantly compared to the previous year, by 53.9 million m^3 (-5.0%).

Table 1.10 *Volumes of natural gas purchased and supplied to final consumers (2001-2019)*

Indices	**Unit of measure**	**2001**	**2005**	**2010**	**2016**	**2017**	**2018**	**2019**	**Changes**			
									2018/2017		**2019/2018**	
									Sum	**%**	**Sum**	**%**
1. Volume of natural gas purchased – total	**mil. m^3**	1127.0	1418.6	1187.8	1038.4	1033.9	1129.7	1057.7	*+95.8*	*+9.3*	*-72.0*	*-6.4*
	mil. Lei	1131.8	1364.9	3674.0	4036.8	3107.3	4146.0	4298.7	*+1038.6*	*+33.4*	*+152.8*	*+3.7*
2. Average purchase price of natural gas	**$/1000 m^3**	78.0	76.1	250.1	193.5	162.05	217.5	233.7	*+55.4*	*+34.2*	*+16.2*	*+7.4*
	lei/1000m^3	1004	962	3093	3887	3005.4	3670.0	4064.3	*+664.5*	*+22.1*	*+394.3*	*+10.7*
3. Volume of natural gas delivered (*including from transmission networks*) **— total**	**mil. m^3**	1108.5	1315	1089.8	965.3	965.1	1069.5	1015.6	*+104.4*	*+10.8*	*-53.9*	*-5.0*
	mil. Lei	1004	1551	4362.2	5873.5	5762.4	5384.6	4834,4	*-377.7*	*-6.6*	*-550,2*	*-10,2*
4. Average price for the supply of natural gas (*including VAT*)	**lei/1000 m^3**	906	1180	4003	6085	5970.7	5034.8	4760,1	*-935.9*	*-15.7*	*-274,7*	*-5,5*

Under the circumstances of decrease in 2019 of natural gas consumption in total by 53.9 mil. m^3 (5.0 %), we show similar downward trends in the quantities of natural gas consumed by each of the monitored categories of final consumers, except for household consumers, which increased insignificantly, although their intensity varied (Table 1.11).

[10] http://www.anre.md/raport-de-activitate-3-10

Table 1.11 *Structure of natural gas supply by categories of final customers (2017-2019)*

Categories of final customers	2017		2018		2019		2018 / 2017		2019 / 2018	
	mil. m^3	%	mil. m^3	%	mil. m^3	%	mil. m^3	%	mil. m^3	%
Natural gas consumption (delivered to final consumers), **total**	**965.1**	**100.0**	**1069.5**	**100.0**	**1015.6**	**100.00**	**104.4**	**10.8**	**-53.9**	**-5.0**
incl.: households	302.8	31.4	346.4	32.4	347.9	34.3	+43.6	+14.4	+1.5	+0.4
Public institutions	45.4	4.7	51.2	4.8	45.7	4.5	+5.8	+12.7	-5.5	-10.6
Energy sector	384.0	39.8	404.9	37.9	364.7	35.9	+20.9	+5.4	-40.2	-9.9
Other economic agents	232.9	24.1	267.1	25.0	257.4	25.3	+34.1	+14.7	-9.7	-3.6

The most relevant decrease, both relative and absolute, of natural gas consumption in 2019, by EUR 40.2 million. M3 (or 9.9%) was recorded by the energy sector. At the same time, in the context of the general decrease of natural gas consumption, in the case of other economic agents there was a decrease in natural gas consumption by MDL 9.7 million. m3, or by 3.6%, after an increase for this category of consumers in the previous annual period (2018) of 14.7%.

In the case of household consumers, there was an increase in natural gas consumption by mil. m3, or 0.4%, which is insignificant compared to the increase for this category in 2018 of 14.4%.

The largest share (of 35.9%) in the structure of natural gas consumption in 2019 was held by enterprises in the energy sector. However, this share is decreasing by 2.0 p.p. compared to 2018, and by 3.9 p.p. compared to 2017. At the same time, the share of natural gas consumption returned to household consumers, given the increase compared to previous years of natural gas consumption by this category, increased by 1.9 p.p. and constituted 34.3%. The share of natural gas consumption held by public institutions and economic agents (except those in the energy sector) during the reporting period constituted 4.5% and 25.3% correspondingly, with a decrease of 0.3 p.p. and an increase of 0.3 p.p., respectively.

For 2019, NAER approved the modified investment plans of license holders with a total value of MDL 835.95 million. Lei. Of the total approved investments, 91.2% return to the natural gas transmission activity, 8.7% - to the distribution activity, and 0.1% - to the natural gas supply activity. Also, for 2020, NAER approved the investment plans of license holders totaling MDL 240.42 million. Lei. Of the total approved investments, 53.6% belong to the natural gas transmission activity, 45.3% - to the natural gas distribution activity, and 1.1% - to the natural gas supply activity.

According to the Energy Efficiency Agency[11] 's report for 2018, the results and developments of final energy savings estimated based on the bottom-up approach of projects implemented mainly with the support of Development Partners during 2012-2018, according to available information, is presented in Table 14. Methodologically, projects or financing programs that did not report energy savings based on ex-ante estimates, the amount of savings was assessed based on available technical information.

[11] https://mei.gov.md/ro/documents-terms/energetic%C4%83-rapoarte

Table 1.12 *Estimated value of final energy investments and savings financially supported by local commercial banks*

Division of the objective into sectors	Resources provided by local commercial banks (mil. MDL)			Estimated final energy savings (ktep)		
	2016	2017	2018	2016	2017	2018
Residential	388	460	647	3,59	4,46	5,99
Public (services)	2,3	1	1	0,02	0,01	0,01
Industry	519	496	490	8,02	7,57	7,14
Transport	20	19	22	0,09	0,09	0,11
TOTAL	**909,3**	**976**	**1.160**	**11,91**	**12,13**	**13,25**

Respectively, the summary value of final energy savings in all sectors of the national economy is presented in the generalizing table no. 1.13.

Table 1.13 *Summary amount of final energy savings estimated under the ex-ante approach*

Division of the objective into sectors	Planned energy savings (ktoe)			Estimated final energy savings (ktoe)		
	2016	2017	2018	2016	2017	2018
Residential	40,1	48,12	56,14	15,87	20,33	26,33
Public (services)	27,8	33,36	38,92	15,32	22,56	27,94
Industry	8,3	9,96	11,62	51,97	59,54	67,93
Transport	16,7	20,04	23,38	0,36	0,49	0,59
TOTAL	**92,9**	**111,5**	**130,1**	**83,52**	**102,93**	**122,79**

The target set for 2018 is 130,1 ktoe. Based on the available information, about 122,8 ktoe of cumulative final energy savings were estimated in that year, which practically corresponds to the targets set, with a deviation of 5.6%.

The value of actual savings would be higher, given that not all projects reported the results obtained to the Energy Efficiency Agency in due time, some of the estimates made aimed to describe the worst possible scenario, and energy efficiency measures financed from household savings, remittances and other sources cannot be quantified.

Table 1.14 presents the estimation of primary energy savings by converting final energy savings, obtained by applying the conversion factors established by the construction normative NCM M.01.02:2016 - Energy performance of buildings, Methodology for calculating the energy performance of buildings, valid for the construction sector / buildings, both residential and public.

Table 1.14 *Primary energy savings in the buildings sector*

Indicator/ year	2016	2017	2018
Primary energy savings	43,20	59,31	75,09
TOTAL	**43,20**	**59,31**	**75,09**

The summary amount of primary energy savings for the period under review is presented in Table 1.15.

Table 1.15 *Summary amount of primary energy savings*

Consumer sectors	Primary energy savings (ktoe)		
	2016	**2017**	**2018**
S. transformations	8,13	5,0	6,74
S. residential	22,48	28,80	37,30
S. public (Services)	20,72	30,52	37,80
Industry	55,40	63,48	72,35
Transports	0,36	0,49	0,59
TOTAL	**107,09**	**128,29**	**154,78**

The economic structure of the country, the real estate fund and outdated car parks make the Republic of Moldova one of the most energy-intensive countries compared to the countries in the European space. However, in recent years there has been a slight decrease in energy intensity influenced by investments in energy efficiency measures in all sectors of the national economy, including industry, as well as an increase in gross value added resulting from the services sector (IT sector, etc.).

Chapter II Institutional arrangement for TNA and stakeholder involvement

Moldova's institutional arrangements on climate change and adaptation need significant improvement. Given the complexity and multidisciplinary nature of climate change, a number of institutions each focus on different aspects of this issue and the challenges associated with it. However, in order to address climate change effectively and systematically, formal coordination structures between relevant ministries are needed to ensure a better overview of climate policy. The Ministry of Finance would also be an important actor in setting up and supervising such a structure, given its critical stance on resource allocation.

The existing institutional framework, as well as the institutions and organizations directly involved in the activity of the energy sector in the Republic of Moldova are: the central public authority responsible for the energy sector (Ministry of Infrastructure and Regional Development), the national authority on energy sector regulation (National Agency for Energy Regulation), the specialized central authority that implements state policies in the field of efficiency energy and promotion of renewable energy sources (Energy Efficiency Agency), energy enterprises subordinated to the Public Property Agency, local public authorities of all levels, which have the responsibility to attract, implement and monitor projects in the energy field, private sector, etc. The main tasks of authorities responsible for managing energy issues and climate change are set out in Table 2.1.

Table 2.1 *Analysis of the main tasks of authorities responsible for the energy sector and climate change*

Nr.	Institution/authority	Duties and responsibilities of stakeholders, including climate change adaptation/mitigation
1.	Ministry of Environment	The central public authority responsible for developing, promoting and implementing state policy in the fields of environmental protection and climate change, biodiversity conservation, rational use of natural resources, etc. Operates according to the Operating Regulation approved by GD nr. 145/2021. Within the framework there are two directorates with responsibilities for the forestry sector and climate change – the Biodiversity Policy Directorate (5 units). Air Policy and Climate Change Directorate (5 units). Through the Secretary of State, the Ministry is also the National Authority designated in the institutional commitments of the Republic of Moldova in accessing the financial means of the Green Climate Fund, including projects for adaptation of the energy sector to climate change.
2.	Ministry of Infrastructure and Regional Development	The Ministry has the mission to analyze the situation and develop efficient public policies in the administered areas and to propose justified interventions of the state that are to provide efficient solutions in the fields of activity. The policy visions regarding the evolution of the energy sector are reflected by the Government Decision No. 102 of 05.02.2013 on the Energy Strategy of the Republic of Moldova until 2030. The Ministry was created by GD 142/2021 on the amendment and abrogation of some Government decisions.

3.	National Agency for Energy Regulation	The Agency was established in 1997 based on Government Decision nr. 767 of 11.08.97. It implements the state policy on regulation in energy sectors, ensures regulation and monitoring of the efficient functioning of the energy market and activities in energy sectors in conditions of accessibility, availability, reliability, continuity, competitiveness and transparency, in accordance with quality, safety and environmental protection standards.
4.	Energy Efficiency Agency	The Agency operates on the basis of Government Decision nr. 45 of 30.01.2019 on the organization and functioning of the Energy Efficiency Agency. It is a specialized administrative authority subordinated to the Ministry of Economy and Infrastructure and its mission is to implement state energy policy, efficiency, energy performance of buildings and renewable energy sources, as well as financing projects in these areas
5.	Local public authorities of level I and II	Operates according to the Law on Local Public Administration, nr. 436 of 28.12.2006 (as amended). In the field of energy and climate change, authorities are responsible for developing local action plans in the field of energy efficiency, or environment. Over 10 level I local public authorities are party to the Covenant of Mayors, which is why they have the obligation to develop local sustainable energy and environment plans.
6.	Institute of Power Engineering	The mission of the Institute of Power Engineering is scientific support on increasing energy security, development and efficient functioning of the energy complex of the Republic of Moldova under the conditions of liberalization of the energy market and increase of the share of use of renewable energy resources, contribution to the process of regional and European integration of the national energy system.
7.	National Agency for Research and Development	The National Agency for Research and Development (ANCD) is a central administrative authority subordinated to the Government of the Republic of Moldova, established by Government Decision no.196 of 28.02.2018. ANCD is the legal successor of rights and obligations of the Center for International Projects, the Agency for Innovation and Technology Transfer and the Agency for Research and Development, all of which are public institutions within the Academy of Sciences of Moldova. ANCD is responsible for implementing the national research, innovation and development policy, the EU Framework Programme for Research and Innovation Horizon 2020 and other European programmes and coordinates the Science and Technology Office of the Republic of Moldova in Brussels (MOST).
8.	Non-governmental organizations with energy/environment profile	NGOs make an essential contribution to solving environmental protection and engineering problems (about 200 environmental NGOs), which actively participate in the implementation of projects in the targeted areas. promoting public awareness actions. conducting applied research with reference to the state of the energy sector, promoting energy efficiency and renewable energy sources, etc.

2.1 TNA national team of the Energy sector

The TNA National Team includes a TNA Coordinator as well as a wide range of stakeholders to constitute the NAP2/TNA Coordination Board and national consultants/experts organized in working groups. The NAP2/TNA Coordination Council is envisaged as the highest decision-making body of the TNA Project, comprising decision-makers from relevant key ministries. As shown in the figure below, as well as in the detailed description provided below, each element of the institutional set-up in the country is designed to play an important role in the process of implementing and promoting the NAP2/TNA project.

The TNA National Team is the main decision-making body for the project, with the TNA Coordinator acting as a national focal point. The TNA national team is composed of a small core group (project manager, assistant, etc.) as well as a broader group of stakeholders and experts, who help the core group. This broader group includes national consultants and sectoral/technology working groups. The TNA coordinator will play a key role and coordinate between the different groups to ensure they work together as a team. At the same time, this is the focal point for the effort and management of the entire TNA process. This involves providing vision and leadership for the overall effort, facilitating communication tasks with NAP2/TNA Coordination Board members, national consultants and stakeholder groups, networking, information acquisition, and coordination and communication of all work products.

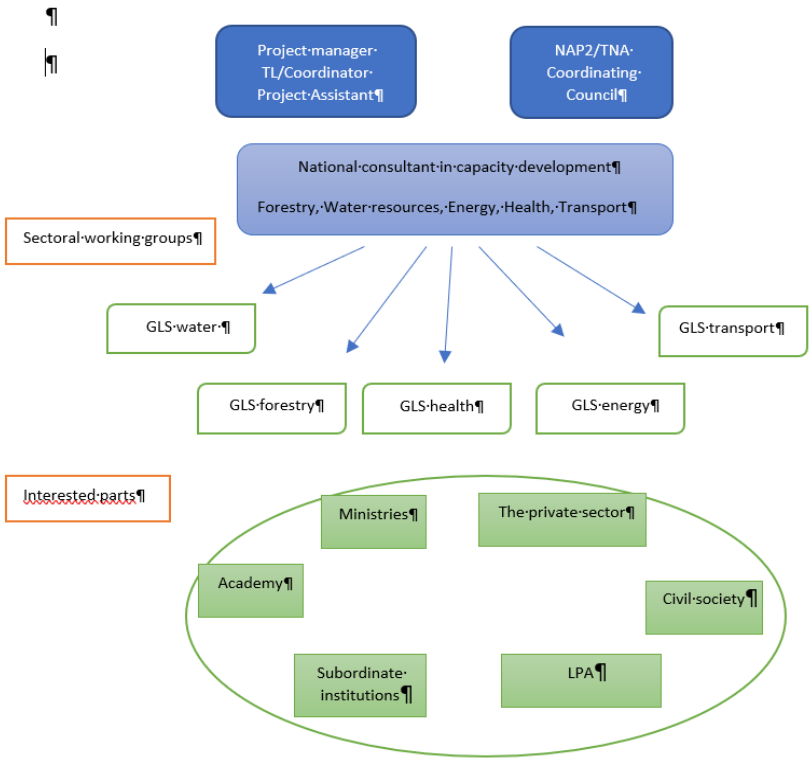


Figure 2.1 *Institutional structure of the ENT/TNA component within Project NAP2*

The NAP2/TNA Coordination Council is the core group of decision-makers and includes policy implementation representatives from the ministries involved, members familiar with national development goals, sectoral policies, climate change science, potential impacts of climate change for the country and adaptation needs. The NAP2/TNA Coordination Board is to provide project leadership in association with the TNA Coordinator. The specific responsibilities of the NAP2/TNA Coordination Board shall include, in particular, the following:

- Identification of national development priorities and priority sectors.
- Decision on setting up sectoral/technological working groups.
- Approval of adaptation technologies and strategies that are recommended by sectoral working groups.
- Endorse the Technology Sector Action Plan (a roadmap of policies that will be needed to remove barriers and create an enabling environment) and develop the Technology Action Plan for Adaptation.

The Technology Needs Assessment (TNA) is central to the work of the Parties to the UNFCCC and represents an opportunity to track the evolving need for new equipment, techniques, practical knowledge and skills that are needed to reduce the vulnerability of sectors and livelihoods to the adverse impacts of climate change. In this context, UNDP Moldova has recruited a team of five national experts to support the participatory adaptation process at national level in the water, health, transport, energy and forestry sectors. The results of their mission will contribute to achieving Moldova's adaptation goals declared in the updated NDC (2020), while meeting national targets for a number of SDGs: 13, 7, 9, 3, 15, 6. The experts employed under the TNA project have in-depth knowledge and extensive experience in the field of climate change. Most experts have participated in other climate change projects, especially in national communications, which is of great benefit for the TNA assessment. The involvement in TNA evaluation of high-level professionals from different sectors ensures a multidisciplinary team, led by the TNA National Coordinator.

The role of national consultants is to lead and undertake activities such as research, analysis and synthesis in support of the TNA exercise. The leadership of the national working group of consultants/experts on the TNA component was ensured by Dr. Druta Ala. The national consultants worked closely with the NAP2/TNA Coordination Council and other working groups involved in the NAP2 project.

National consultants applied a participatory approach in TNA to climate adaptation of assigned sectors, involving a wide range of stakeholders and ensuring a multisectoral and multidisciplinary scope. In close cooperation with the TNA working group leader, national

consultants supported and facilitated the activities of sectoral working groups (SWGs), ensuring communication with stakeholders on working products, etc. The core tasks assigned to the TNA Expert/Consultant Group shall include the following:

- Identify priority technologies for climate adaptation of assigned sectors (water, health, transport, energy, forestry) by providing an overview of possible adaptation technological options, highlighting their adaptation potential based on identification of sectoral vulnerabilities and currently applied technologies.

- Preparation of the TNA Report according to the established technological prioritization steps.

- Elaboration of the Report on conducting the analysis of barriers and proposing the framework of activity for the implementation and dissemination of the first three priority technologies in the sector (including market and barrier analysis for the development, implementation and dissemination of priority technologies. production of market maps and problem trees for each prioritized technology. identification of measures to overcome barriers, etc.).

- Perfecting action plans for each prioritized technology (TAP).

- Elaboration of sectoral reports on TAPs and compilation of sectoral technology roadmaps on SACs.

- Formulating, based on TAPs, project ideas (IP) for prioritized technologies.

The tasks and areas of activity of the national consultants employed in the TNA Working Group are generalized in the table below.

Table 2.2 *Context of national consultants contracted under the adaptation component of the TNA project*

National consultants	Title, function, institution	Area of competence
Druta Ala	PhD in biology, associate professor, Team leader	National adaptation team leader in TNA project
Comendant Ion	PhD technical sciences, coordinating scientific researcher, Energy Efficiency and Renewable Energy Sources Laboratory, Institute of Power Engineering	National capacity development consultant within the TNA component
Șalaru Ion	Deputy Director, National Agency for Public Health	National consultant on the health sector
Lupu Mihai	Head of Energy Efficiency and Renewable Energy Sources Laboratory, Institute of Power Engineering	National consultant on the energy sector

National consultants	Title, function, institution	Area of competence
Bejenaru Gherman	PhD in Geography, associate professor, Tiraspol State University	National consultant on water resources sector
Soloviov Nicolae	Coordinating scientific researcher, Energy Efficiency and Renewable Energy Sources Laboratory, Institute of Power Engineering	National consultant on the transport sector
Talmaci Ion	Technical Deputy Director, Institute for Forest Research and Management	National consultant on forestry sector

2.2 TNA stakeholder involvement - Overall assessment

In order to carry out the mapping of the parties involved in the development of technological needs for adaptation to climate change of the energy sector, the national consultant developed and proposed for approval to the project manager the list of institutions and potential parties to be involved in the working group on the adaptation component. The mapping of the institutions with the description of their basic duties, as well as the name, surname, potential delegated persons on their behalf in the working group, are presented in Annex 1.

As a result of the analysis of the existing institutional framework, as well as of the beneficiaries of energy services/products, the institutions and organizations directly involved in the activity of the energy sector in the Republic of Moldova are: The central authority responsible for the development of energy policies; specialized central authorities that implement policies in the field of energy efficiency and renewable energy sources, as well as having the role of local regulator on the market energy; energy enterprises with majority state capital and private companies, etc. Finally, 9 public governmental and research institutions, 3 public associations and 10 state and private enterprises in the energy field were selected as interested parties

Stakeholder consultation was an ongoing process throughout all phases of the project. Their consultations and views in providing technological details about the current situation in sectors was of particular importance, including the use of new technologies. Stakeholders have an important contribution in developing the final set of criteria and indicators used to prioritize technology options. Extensive discussions have been developed to consider different technology options in adapting the energy sector to climate change. Also, important arguments were raised during the exercise of awarding the weighting of criteria, as the members of the working group judged according to their knowledge, interests, other considerations. During these discussions, stakeholders' views and arguments were considered decisive in establishing the short list of adaptation technologies.

Stakeholders are essential in the TNA process. Therefore, in order to give an active role to stakeholders in the TNA process, sectoral energy working groups have been established.

Out of a total of 21 stakeholders for the energy sector, SWG consisted of 15 members, including the NAP2 national consultant on the energy sector, who followed up on this participation initiative. In the TNA process for the energy sector, SWG was involved as a priority in the following actions/activities:

- Participation in identifying the long list of technologies/measures to adapt the forestry sector to climate change (23 technologies/measures).

- Primary selection/prioritization of effective technologies/measures for adaptation of the forestry sector to climate change (10 technologies/measures. organization of a workshop).

- Participation in the FCM analysis for the final prioritization of technologies/measures for adaptation of the forestry sector to climate change (evaluation of 10 technologies/measures. selection of evaluation criteria. scoring. organization of a workshop. validation of results regarding the selection for the energy sector of 2 technologies/measures for adaptation to climate change, etc.).

2.3 Gender aspects in the TNA project

Women and men have different experiences, perceive and identify differently health, activity and life risks in the context of climate change, and for this, gender is a significant aspect in the implementation of energy sector projects in the Republic of Moldova.

Statistical data confirm the existence of gender gap in the energy sector, which affects final decisions related to this sector, including climate change.

The energy sector is also characterized by aspects of increased risk to the health and lives of people involved in activities in this sector. In fact, this is also a basic reason why the ratio of men to women has such a large gap for the energy field.

In the TNA project implemented in Moldova, 2 out of 5 members of the National Steering Committee are women. The TNA team consists of one man and two women. In the sectoral working group in the energy sector, 6 out of 14 members are women.

If we make a reference to gender statistics provided by the National Bureau of Statistics[12], then the economic empowerment of women, in the compartment of employed population aged 15 and over, in the sectors of the national economy during 2018 is distributed as follows in the figure below. Thus, we can conclude that women are part of the occupational process in the field of services.

12 https://statbank.statistica.md/PxWeb/pxweb/ro/50%20Statistica%20gender/50%20Statistica%20gender__GEN01/GEN010290mun_rcl.px/chart/chartViewColumn/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774

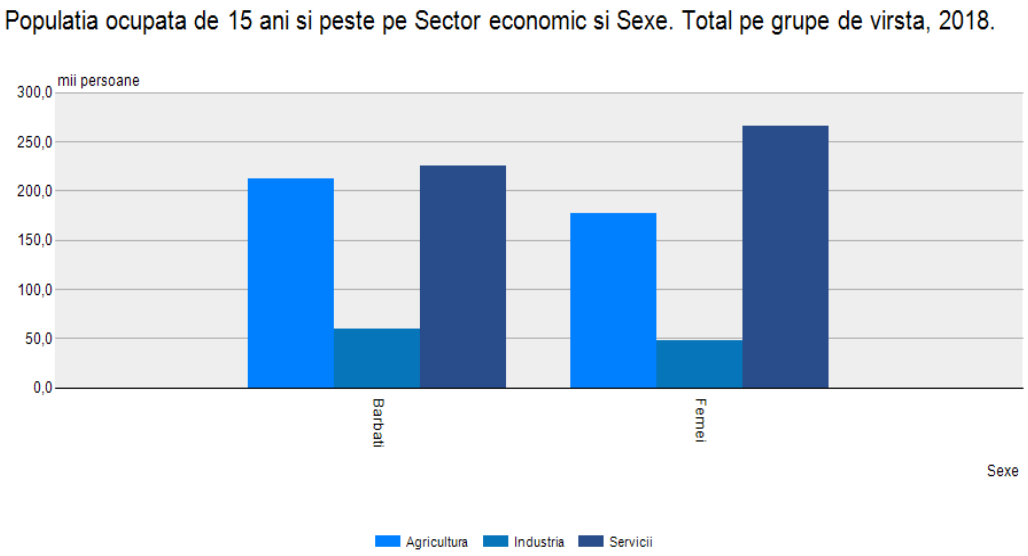


Figure 2.2 Employed population in sectors of the national economy

In the process of prioritizing technologies/measures to adapt the energy sector to climate change, the gender aspect was also pursued. Thus, in the structure of the criteria for assessing technologies/measures for adaptation of the forestry sector to climate change, a criterion dedicated to this field is also included.

Chapter III Prioritization of technologies in the Energy sector

3.1 Key vulnerabilities of the energy sector to climate change

Climate change is already recognized as a national problem but, so far, there are no integrated adaptation measures in the national strategic framework. The Climate Change Adaptation Strategy of the Republic of Moldova until 2020 (GD 1009 of 10.12.2014) guides the sectoral approach characteristic of climate risks, climate change impacts on vulnerable sectors, as well as adaptation of these sectors to potential climate change. However, increasing the economy's resilience to climate change requires integrating climate adaptation measures into sectoral policies and needs to update this strategy. The climate of the Republic of Moldova is temperate continental, characterized by relatively mild winters with little snow, long, hot summers and low humidity.

Table 3.1 *Infrastructure vulnerability and adaptation opportunities*[13]

Climate impact	Identified vulnerabilities	Adaptation measures
Increase in average annual air temperature Substantial extension of the warm period of the year	Increased energy demand during the summer cooling period Increased demand for summer electricity for irrigation of agricultural land Decrease of electricity and heat generation capacity at district heating power plants due to insufficient thermal load Increased losses in the core of transformers with their oil-based cooling Increasing the need to preserve air conditioning during the summer period of the year Increasing the need to preserve air conditioning during the summer period of the year	Covering the energy demand necessary for the cooling process of the premises. The contribution of technology to the development of distributed generation in order to reduce energy and power losses Covering the energy demand needed to irrigate land. The contribution of technology to the development of distributed generation in order to reduce energy and power losses Coverage of thermal energy requirements from solid biomass combustion plants Increasing the reliability of electricity supply to final customers under extreme conditions based on rising outdoor temperatures Reducing energy consumption predestined for conditioning, which in turn leads to a decrease in the amount of water consumed by traditional power plants, the latter becoming in shortage as a result of climate change Reducing heat intake in the building during the summer period of the year
Slight reduction in annual rainfall volume Water scarcity in reservoirs	Reduction of water flow for cooling CHPs Reduction of electricity generation from HPP account Lack of energy infrastructure and crop needs	Covering the energy demand needed to irrigate land. The contribution of technology to the development of distributed generation in order to reduce energy and power losses Coverage of energy requirements from regeneration

[13] http://clima.md/doc.php?l=ro&idc=81&id=4256

	Lack of water supply sources for district heating power plants Overheating of engines due to average annual air temperatures Increasing energy consumption and energy intensity	Compensation for lost electricity due to low water flow at HPP dams Development of overhead power lines infrastructure and coverage of water needs by irrigation of agricultural land Addressing the problem of supplying alternative sources to CHPs Avoiding overheating of engines due to high temperatures Optimizing energy consumption during extreme periods of climate change phenomena and reducing the energy intensity of products

Out of all the sectors analyzed, the natural gas transmission and distribution infrastructure is less sensitive to climate change. This infrastructure is sensitive only to natural disasters, especially landslides, strong storms, torrential rains or earthquakes.

The increase in natural gas consumption may occur due to increased local electricity demand. Thus, for the use and storage of liquefied natural gas under climate change conditions, they will require a greater amount of energy to keep it liquid or will require a higher level of thermal insulation of liquefied gas storage and transportation facilities.

Risks identified in the natural gas sub sector: The increase in natural gas consumption on the domestic market of the Republic of Moldova will diminish the transit capacity of natural gas networks, thus prejudicing the basic objective of the Energy Strategy 2030 to transform the Republic of Moldova into a transit corridor of natural gas. The increase in natural gas consumption on the domestic market will be determined by the new electricity and heat generation capacities, another reason being the deterioration of ecological climatic conditions for the expansion of forest territories, this representing a serious competition field for biomass thermal energy production, which is a traditional one for the rural population of the republic.

Compared to the gas sector, **the electricity sector** has a higher degree of sensitivity to climate change. The electricity infrastructure is largely composed of open and closed overhead power lines and transforming substations. The latter are sensitive to variations in outdoor air temperature increases, which may result in energy and power losses greater than the norms laid down in the technical documentation of such equipment.

Moreover, the increase in the average annual temperature, in addition to the heat waves during summer, will cause a substantial increase in electricity consumption in air conditioning installations. Violent storms can affect the functionality of overhead power lines, and frosts form ice on these lines.

The modernization and rehabilitation of electricity networks is often conditioned by the choice of cheap technologies, but this does not ensure the reduction of *losses* in electricity networks; its own consumption being almost unchanged. The imposition of performance conditions for

the electrical equipment of the power grids will impose a high degree of energy performance at own consumption, reducing losses in networks, as well as will serve as a basis for choosing innovative technologies of high efficiency. The new challenges in the Republic of Moldova regarding distributed generation and the development of micro grids will directly contribute to reducing these phenomena such as reducing energy losses in the electricity grid. The concept, generate (produce) locally – consume locally is directed towards reducing electricity losses throughout its transmission and distribution chain.

The decrease in total rainfall will have a significant direct impact on the electricity sector, through the increasing demand for electricity for irrigation.

At the same time, irrigation systems are the key element in the agricultural sector of the Republic of Moldova, which is responsible for ensuring the country's food security. According to National Communication Four and NDC, the development of this sector will be conditioned by:

- Increase in average annual air temperature by up to 4.3°C.
- Reducing the annual rainfall volume by up to 13.5%.
- Reducing the level of soil moisture supply and increasing the frequency and severity of droughts.
- Substantial extension of the warm period of the year.
- Water scarcity that will cause an obstacle to increasing energy production in hydroelectric power plants.
- More frequent occurrence of extreme climatic events, as an example violent storms.

The demand for electricity for irrigation will be constantly increasing, if the extreme phenomena described above are maintained for a long time. The promotion and widespread use of renewable energy sources would ensure the elimination of extremely high costs when constructing an overhead power line supplying a pumping installation predestined for irrigation.

Excess water in the form of floods, flash floods and mud siltation will affect energy infrastructure at all levels (additional pressure from water on dams of hydroelectric power plants, flooding of transformer stations and power transmission and distribution lines, overhead power lines falling due to frost, landslides, etc.).

Risks identified under the electricity sub sector:

- Increasing the demand for electricity during summer, necessary for air conditioning in rooms.

- Increased demand for electricity during summer for irrigation of agricultural land, caused by the decrease in soil moisture supply.

- Increasing the level of electricity losses due to the increase in air temperature that will cause the extension of the operating times of the cooling installations of the electrotechnical equipment (especially TRAFO). increased energy losses in OHL caused by heating conductors.

- Increasing the duration of unplanned interruptions of electricity supplies caused by the increase in the frequency of wildfires in the protection areas of overhead power lines, as well as due to damage to overhead power lines and substation equipment as a result of floods, landslides, frost, strong winds, etc.

The thermal energy sub sector is one of the most sensitive sectors to climate change. This is mainly due to the infrastructure of the thermal energy sub sector, which includes cogeneration and heat plants, which are mutually dependent – the lack of heat load causes the cost price of electricity to rise, which in turn becomes too expensive and not economically justified. The increase in average annual temperatures in the coming decades will reduce the total demand for thermal energy. It is anticipated that, due to earlier springs and later autumns, the climate of Moldova will be characterized by a substantial extension of the warm period of the year. Gas boilers require cooling water. The drop in water levels in rivers due to the long drought in this regard will cause problems: Plants will have to reduce production, either because there is not enough water available, or because heated water cannot be returned to rivers because it would create additional burdens on river ecosystems already severely affected by heat and drought. This is aggravated by the fact that the demand for electricity produced by power plants will be higher during the warm period, as fans or air conditioning systems operate at full power. With the increasing share of renewables, heat produced through CHPs is expected to be reduced due to applications of other heating technologies such as the use of heat pumps. They will prevail if sectoral strategies are based on reducing greenhouse gas emissions from plants burning traditional fuels. According to some estimates, for each temperature increase of 1°C at natural gas and fuel oil power plants, a decrease in plant efficiency by 0.1% will result. "This causes marginal electricity generation costs to increase due to high fuel consumption of the order of 2%/°C.

Gas boilers require cooling water. The drop in water levels in rivers due to the long drought in this regard will cause problems: plants will have to reduce production, either because there is not enough water available, or because heated water cannot be returned to rivers because it would create additional burdens on river ecosystems already severely affected by heat and drought. This is aggravated by the fact that the demand for electricity produced by plants will be higher during the warm period, as air conditioning systems are stressed at full capacity.

Risks identified in the thermal energy sub sector:

- Diminishing the electricity generation capacity of district heating power plants caused by insufficient thermal load.

- Increasing energy and water losses at CHP caused by the increase in air temperature and decreasing the efficiency of power plants.

- Decrease in heat demand due to the increase in average annual temperature and shortening the cold period of the year.

Energy efficiency as a sub sector is not directly sensitive to climate risks. The impact of climate change risks on the sector is indirect and is driven by increased energy consumption in other sectors.

The buildings sector is the largest consumer of energy resources in the country, accounting for 48% of total gross energy consumption and is responsible for 36% of greenhouse gas emissions. The early state of this sector, both residential and public, requires urgent measures to be taken for thermal rehabilitation of buildings. The variation in energy consumption in this sector is directly related to the average variation in temperatures over a year, which are increasing alarmingly. Affecting the condition of constructions as well as materials used for thermal insulation is directly related to acid rain and increasing the number of sunny hours during a year. Both this sector and the industrial sector need to develop a more efficient energy management in the prudent management of energy resources.

Risks identified in the energy efficiency sub sector:

- Increase of energy intensity caused by increased consumption of electricity for air conditioning and irrigation.

- Decrease of production volume in agriculture, caused by difficult weather conditions, which will lead to operation below the nominal load level of existing equipment.

- Decrease in efficiency of district heating power plants caused by increased air temperature.

Renewable energy sources are most sensitive to extreme phenomena such as floods, hail, strong storms, which will negatively influence the production of energy from renewable energy sources. The decrease in the annual volume of rainfall will lower the water level in the main rivers where there are hydroelectric plants, their energy generation capacity diminishing. Wind and photovoltaic power plants will be damaged due to extreme phenomena (floods, landslides, hail, etc.). Biomass production will be affected by forecast droughts and biomass availability will increase with it.

Risks identified under the renewable energy sub sector

- Decrease of electricity generation capacity at hydroelectric power plants caused by reduced water flow in Prut and Dniester rivers due to their distribution during the year.

- Decrease of the available amount of biomass due to the increase in the frequency of droughts.

- The decrease in agricultural production caused by increasingly frequent droughts, as well as extreme climatic phenomena (floods, hail) will result in a reduction in the amount of liquid biofuels produced (biodiesel and bioethanol).

3.2 Decision-making context

The identification of technological needs for climate change adaptation of the energy sector will be based on three aspects:

1. Increasing temperature trends, which would mean higher daily, seasonal and annual temperature maximums, but also annual average temperatures with cumulative effect.

2. Humidity change trends, which would mean uneven distribution of precipitation, but also of its volumes on intervention areas.

3. Extreme events, which would mean large floods along river basins and lakes, but also in the form of torrential rain showers and flash floods.

New technologies must cover these aspects, but also contribute to increasing the resilience of infrastructure. About 70-75% of equipment in the energy sector is worn out. In the period 2001-2008, gas losses from pipelines were assessed at an average of 7%. Today, losses are estimated at 5.5% in the distribution system and 2.3% in the transmission system. During 2005-2010, the level of losses in electricity distribution networks decreased from a level of over 20% (JSC "RED Nord" registering only 14.39%) to a level of approximately 13%, distribution network operators being obliged to improve their services under the pressure of obligations imposed by regulations approved by the National Agency for Energy Regulation. In 2011, losses recorded by distribution network operators accounted for 13.11%.[14]

During this period, the centralized heat supply sector in the Republic of Moldova faced a high level of thermal energy losses, accounting for 21% in 2009 and having an increasing trend of about 6 percentage points in the last 10 years. In 2011, technological consumption and thermal energy losses accounted for a total of 19.8% The electricity generation capacity includes:

- MGRES (2520 MW, natural gas, fuel oil, built in 1964-1982).

- Chisinau CET-2 (240 MW electrical capacity, 1200 Gcal/h thermal capacity, built in 1976-1980).

- Chisinau CET-1 (66 MW electrical capacity, 254 Gcal/h thermal capacity, built in 1951-1961).

- CET Nord, Balti (20.4 MW electrical capacity, 200 Gcal/h thermal capacity, built in 1956-1970, during 2019, the construction of a 13.5 MWe cogeneration power plant was completed).

[14] https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro

- Dubasari HPP (48 MW, built in 1954-1966).

- HPP Costesti (16 MW, built in 1978).

- Other power plants, including 9 sugar factory CHPs (97.5 MW, gas, fuel oil, built in 1956-1981).

According to the level of specific fuel consumption, the technologies used for electricity generation in the Republic of Moldova are not as efficient compared to modern technologies. Due to the reduction of thermal energy consumption in recent years, the current operating regimes of CHPs are far from nominal, determining an efficiency well below the nominal value. The efficiency of heat generation in cogeneration mode cannot compensate for the high price for electricity produced in the same way. As a result, the tariff of CETs is high, reflecting the precarious state of assets today and the lack of viability in the future. The decrease of the thermal load at cogeneration installations is also caused by the trend of high outdoor air temperatures, as well as by persistent extreme phenomena more and more often on the territory of the Republic of Moldova.

Among the main major challenges facing the energy sector of the Republic of Moldova at present, we can mention:

- Dependence on imports of energy resources (especially natural gas, petroleum products and electricity).

- Reduced interconnection capacities of the electricity system to meet safety criteria and increase the capacity of the interface with the Romanian electricity system.

- Reduced interconnection capacities in the natural gas sector to diversify alternative sources and ways of supplying the country with natural gas, which would lead to the improvement of transmission interconnections in the field.

- Low efficiency in the production and distribution of electricity and heat due to outdated installations and networks.

- Insufficient capacities of institutions responsible for developing, promoting and implementing energy policies in general, and, in particular, energy efficiency and renewable energy, including at the level of local public administrations.

- Low level of implementation of legislation affecting energy performance of buildings and energy efficiency.

- Limited access to finance in the field of energy efficiency and renewable energy in the residential and public sectors.

- Low level of implementation of projects to streamline production, transmission, distribution and consumption of energy resources and capitalize on renewable potential,

by insufficient use of market financial instruments, by promoting competition on these market segments.

- Reduced promotion of the concept of local energy autonomy and community projects to capitalize on renewable energy potential.

- Lack of promotion and implementation of the concept of energy recovery of waste.

- Insufficient promotion of energy efficiency and renewable energy among final consumers, including through energy labelling instruments, certification of the energy performance of buildings, etc.

According to the same strategic planning document *Energy Strategy 2030*, the causes of missing the achievement of some objectives of the *Energy Strategy 2020* are related to the fact that efficient energy generation technologies with low environmental impact have not been implemented and, in general, investments in new electricity generation and cogeneration capacities have not been attracted, as well as in the centralized heat supply system.

In the next decade, 2021-2030, carbon capture and storage technology will have to prove economically viable to allow it to actively enter the market, thus substantially changing the structure, values, prices and fuel costs of state-of-the-art technologies. Otherwise, it will not have the expected positive impact on electricity generation technologies. As a result, it will be difficult to adapt to climate change.

Smart grid technologies and equipment will clearly prove to be economically viable and will become a de facto standard for the electricity industry. This type of structuring of the energy system will greatly change existing approaches to system topologies, balancing, measurement, monitoring and energy mixing. All these changes will work in favor of the uptake of increasing shares of electricity from renewable sources[15.]

Over the past 10 years, the production of electricity and heat from renewable sources have taken a considerable toll. The primary legal framework allows investors to use advanced generation technologies, as well as to apply support schemes when obtaining regulated tariffs. By types of technologies and installed powers, wind equipment predominates in this chapter, followed by photovoltaics.

Current generation technologies based on renewable energy sources, which are less mature, will have time to become more competitive, and new technologies for energy production and storage, as well as, possibly, carbon capture technologies, currently only in an experimental phase, will acquire the dimension of an economy of scale and flexible to climate change.

At the same time, during the last decade, the Republic of Moldova implements a series of actions and activities aimed at reducing the vulnerability of the energy sector to climate change. The generalized analysis of the degree of implementation of the main policy

[15] https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro

documents/programs containing measures in the energy field shows that substantial financial means have been attracted during the last 10 years. Most of these programmes/plans and pilot projects had a relatively high degree of finality/implementation. Financial sources were allocated mainly by foreign donors active on the territory of the Republic of Moldova. Main programmes/projects are listed in Table 3.2

Table 3.2 *Programmes, plans and projects related to the energy sector and climate change*

Name of program, plan, project	Implementing institutions	Budget	Main activities
Direct budgetary support for EU energy sector reform	Initiated by the Energy Efficiency Fund and subsequently taken over by the Energy Efficiency Agency, following the merger process of the mentioned institutions	40 million Euros	Financing energy efficiency measures in the public domain. Energy efficiency works for public street lighting
EU-funded Energy and Biomass Project	UNDP Moldova	Phase I 9,6 mil Euro Phase II 6,7 mil Euro	Financing of solid biomass combustion plants in Moldova predestined to the public sector. Financing of solid biomass briquetting equipment. Financing of solar water production installations falls for consumption
Improving energy efficiency SACET Chisinau. World Bank financier	Energy Project Implementation Unit	40,5 mil $	Refurbishment of energy installations within JSC Termoelectrica Energy efficiency works of heat pumping stations. Installation of individual thermal points in Chisinau
Energy efficiency improvement / SACET Balti / EBRD financier, E5P Fund and Green Climate Fund	SA CET Nord	10,7 mil Euro	Construction of a 13.5 MW cogeneration plant. Installation of individual thermal points in the city. Balti
Energy efficiency and thermal rehabilitation of public buildings in Chisinau. Chisinau EBRD, EIB financier and E5P Fund contribution	City Hall mun. Chisinau	25 mil Euro	Thermal rehabilitation of public institutions in Chisinau. Chisinau. Implementation of energy efficiency measures
Energy Efficiency Project of 8 high schools in Moldova. Funder EU League	German Cooperation Agency GIZ	20 mil Euro	Implementation of energy efficiency measures such as: 1. Thermal insulation of buildings. 2. Change of windows.

			3. Roof insulation. 4. Change of interior lighting. 5. Installation of heat recuperators. 6. Change of the internal ventilation system. - Etc.
Energy Efficiency Project in the Republic of Moldova. EBRD financier	Energy Efficiency Agency	75 mil Euro	Implementation of energy efficiency measures to the public sector.
MOSEFF project in the Republic of Moldova. EBRD financier	Local commercial banks	20 mil euro	The final beneficiaries – the business environment. Financing energy efficiency projects and purchasing environmentally friendly equipment and machinery. The project also financed electricity production activities from renewable energy sources. The grant component allocated to final beneficiaries is 5%-20%
GEFF Moldova project. EBRD financier and Green Climate Fund contribution	Moldova Agroindbank SA	20 mil Euro	Financing energy efficiency measures for the private and residential sectors (including procurement of thermal insulation materials, electrical appliances, individual thermal power plants, heat pumps, photovoltaic installations). The project is based on the green technology selector
E4Business Project in the Republic of Moldova EBRD financier	Local commercial banks	25 mil Euro	The final beneficiaries – the business environment. Financing energy efficiency projects and purchasing environmentally friendly equipment and machinery. The project also finances activities to produce electricity from renewable energy sources The grant component allocated to final beneficiaries is 5%-15%

Since 2012, the energy sector has a separate sectoral spending strategy within the MTBF (Medium-Term Budgetary Framework), which in the state budget is reflected in the budget program "Development of the energy sector". In the current period, thanks to the financial support attracted from the Development Partners, it was possible to mobilize important financial resources for the implementation of energy infrastructure projects, both in the electricity system, in the natural gas supply system, as well as in the rehabilitation and modernization of centralized heat supply systems.

3.3 Overview of existing technologies in the energy sector of the Republic of Moldova

The energy sector is a basic branch of the national economy and fulfils an important role in the successful implementation of economic development programs, as well as in maintaining social stability. The main objective of the Government is to provide all consumers in the country with qualitative energy at reasonable prices, as well as to implement the concept of sustainable development of the national economy.

The electricity and heat generation sector, through cogeneration, is poorly developed in the Republic of Moldova. The basic reason is the lack of thermal load on final consumers, which makes these installations technically and economically inefficient. This was mainly caused by the destruction of district heating in district centers of the country, except for mun. Chisinau and Balti. Even so, the available installations within SA Termoelectrica and SA CET Nord are obsolete both morally and technologically. In this respect, more than 22,000 consumers were disconnected from district heating sources in mun. Chisinau and just over 9,000 consumers from SA CET Nord, which generated a frequent balancing of the hydraulic system and a decrease in efficiency at the generation source.

With the development of renewable energy sources, some processing enterprises have installed biogas-based cogeneration equipment. This equipment has become efficient for some processing enterprises that use thermal energy for their own needs. This equipment can be found in the sugar beet, alcohol processing industry, etc.

In terms of obtaining electricity based on biogas, according to NAER reports, the total installed capacity in the country of plants using biogas as fuel is 5.7 MW. Despite the fact that the Republic of Moldova has set capacity quotas for producers from renewable energy sources, biogas production and combustion technologies are still poorly developed in the country.

The Republic of Moldova has a significant potential for solar and wind energy, which is not yet fully exploited. Thus, the possible (theoretical) duration of sunlight is 4,445 – 4,452 h/year. The actual duration is 47 – 52 % or 2100 – 2300 h of the possible. Global radiation on a horizontal surface under medium cloudiness conditions is 1,280 kWh/m^2.year in the north and 1,370 kWh/m^2.year – in the south.

Solar energy resources in Moldova are higher in the southern part of the country and are steadily decreasing towards the north of the country. For example, in the northern locality of the country, a system with an installed capacity of 1 kW (peak direct current capacity) with fixed and unshaded mounting, which requires approximately 6.5 m^2 of modules, will produce between 1,100 and 1,200 kWh per year, and a plant with the same characteristics mounted in the south will produce between 1,200 and 1,300 kWh per year.

Wind energy is the most abundant source of renewable energy in Moldova, with almost the entire country having technically suitable locations for investments in wind energy. In addition,

according to IRENA's 2017 report[16], cost-competitive renewable electricity generation: Potentially in Southeast Europe, wind energy can supply up to 21 GW.

With a capacity of only 29.4 MW currently installed[17], wind energy is poorly used in the Republic of Moldova. Wind technologies are largely based on second-hand turbines imported from European countries. The newly developed legal framework in this field provides for the purchase of only new equipment, with high performance in terms of generation.

The potential of Moldova's geothermal energy resources has been inadequately researched without any quantified and exhaustive estimates. However, the country has significant availability of low-enthalpy geothermal energy potential, especially in the southern part of the country, which can be widely used for heat pumps. The government's interest in this technology is limited, and there are no actions envisaged in the National Renewable Energy Action Plan.

The Republic of Moldova is known as an agricultural country with significant biomass potential. Thus, bioenergy is the most popular renewable energy source in the country and remains a priority for the government. However, almost all biomass is traditionally used as firewood and agricultural waste and is usually consumed for heating purposes, especially in rural communities. In 2010, the annual potential of solid biomass was estimated at 21,042 TJ or 503 ktoe (according to UNDP Moldova report, 2010).

This figure is sufficient to cover 18% of national energy needs. In 2017, total biomass consumption was 733 ktoe. (NBS, 2018). Pellets and briquettes, burned in high-efficiency boilers or stoves, account for 3 to 5 percent of biomass use, according to estimates by the Energy Efficiency Agency. The same report of the Agency for 2019 shows that the installed capacity for these types of installations is 67.54 MW for the residential sector and 85.7 MW for the public one. However, the capitalization of advanced technologies that would burn solid biomass based on high yields is still to be developed.

3.4 Adaptation options and technologies for the energy sector and main adaptation benefits

A technology is a synthesis of equipment, techniques, practical knowledge or skills for performing certain actions. For the energy sector, technology is associated with equipment, measures or actions from the generation chain of different forms of energy to its final consumption.

In order to ensure the development of relevant measures/technologies based on concrete goals and targets, the potential climate impacts (CIs) on the energy sector described in the previous chapters of this Report have been aggregated into the following 3 categories:

[16] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_RRA_Moldova_2019_RO.pdf
[17] http://www.anre.md/registrul-producatorilor-eligibili-3-213

Climate impact no. 1 *The danger of diminishing electricity and heat production due to lack of water at CHP and HPP as a result of droughts*.

Climate impact no. 2 *Damage to power grids due to extreme events.*

Climate impact no. 3 *The significant increase in power and energy consumed during the summer due to the increase in energy demand for air conditioning and irrigation of land, as a result of heat waves*

In order to respond to these climate impacts, a number of sectoral technologies/measures (23 technologies/measures) were identified at the initial stage, classified under 3 sub-sectors.

Most of the identified sectoral technologies/measures have a medium and high degree of replicability and applicability. Activities include exchange of experience between national institutions involved in the process (Ministries, Government Agencies, Civil Society, private sector, etc.).

The implementation of these technologies/measures will require at the initial stage a comprehensive analysis of regulatory and policy barriers, but also a list of activities aimed at solving (development and/or strengthening of the institutional framework for activities promoting renewable energy sources and energy efficiency. updating technical norms and regulations, etc.), which will partially change approaches and the situation in the energy sector.

The detailed description of the sectoral technologies/measures was made on the basis of a technical sheet form (Annex no. 2) containing the basic information about the technological options, including the brief description of the technology, the potential for application in the country, investment costs, technical aspects (range of geographical applicability, maturity, etc.), impacts/benefits from their application (environmental, social, economic, etc.). The long list of technology options for the energy sector includes the following technologies grouped under sectors:

Under the electricity generation and distribution technologies sector

a) Electricity generation by applying photovoltaic, mono-crystalline technologies.

b) Electricity generation by applying wind technologies with horizontal axes.

c) Generation of electricity and heat by applying biogas technologies (tri generation).

d) Electricity and heat generation by applying high-efficiency cogeneration technologies based on natural gas.

e) Storage facilities for electricity produced from renewable energy sources.

f) Elaboration of a system for prevention and protection of electrical networks against frost deposits.

g) Elaboration of coordinated programs for the development of electrical networks and construction of irrigation stations for agricultural land.

h) Construction of backup options for water supply to CHPs from alternative sources.

i) Technologies predestined for outdoor artificial lighting based on LED fixtures with high protection IP.

j) Technologies predestined for interior artificial lighting based on LED fixtures.

k) Dry voltage and power transformers.

Under the electricity generation and distribution technologies sector

a) Thermal energy generation based on solid biomass combustion plants.

b) Generation of thermal energy based on natural gas combustion plants by condensation.

c) Generating thermal energy for the production of hot water for consumption based on solar collectors.

d) Thermal energy generation based on ground-water heat pumps.

e) Thermal energy generation based on water-water heat pumps.

f) Heat accumulators.

Under the energy efficiency technologies and materials sector

a) Thermal insulation materials for the outer lining of buildings (mineral wool).

b) Double-glazed exterior windows.

c) High-efficiency cooling and air conditioning technologies.

d) Chiller cooling technologies.

e) Class IE 3 electric motors.

f) Creating favorable conditions for the implementation of the Energy Management Standard (ESISO 50001:2012 "Energy management systems. Requirements and User Guide") at enterprises in the energy, industrial and public sectors in order to increase energy efficiency and reduce energy intensity.

The identified adaptation options allow achieving a wide spectrum of technology transfer based on both existing and new equipment in the energy sector of the Republic of Moldova.

The main innovative aspects, foreseen by the selected technologies we can mention the following:

- Use of high-performance power generation equipment, established on the basis of high efficiency.
- Use of cogeneration and trigeneration concepts in a heat and power production process.
- High energy performance established based on the COP indicator for heat pumps of various types.
- Qualitative thermal insulation materials established on the basis of global heat transfer coefficients.
- Use of storage equipment using renewable energy sources.
- High-performance technologies for burning solid biomass.
- Others.

Among the main climate change adaptation benefits of the identified technologies/measures, the following are mentioned:

- Paradigm shift in energy producers and final consumers, by applying environmentally friendly technologies.
- Increasing the resilience of the energy sector to extreme weather events (storms, heat waves, drought, etc.).
- Reducing the amount of fossil fuels used in the process of generating electricity and heat, by promoting renewable energy sources on a national scale.
- Saving water by reducing its consumption at CHPs.

- Reducing the number of interventions of task forces and reducing the period of interruption of electricity due to extreme phenomena (frost).

- Reducing expenses for cooling and heating spaces.

- Development of new jobs.

3.5 Criteria and processes for prioritizing adaptation technologies in the energy sector

In accordance with the provisions of the TNA process, the technology prioritization exercise at the level of the energy sector was carried out through a participatory process of the sectoral working group in the field of energy.

In this context, the project manager sent in advance (on 23.07.2021) an e-mail message to SWG members in the energy sector requesting participation in the preliminary selection exercise of technologies presented in the long list of technologies. The following documents have been attached to the sent message:

- List of technologies proposed to the energy sector in the context of its adaptation to climate change.

- Official invitation letter, signed by NAP 2 project manager.

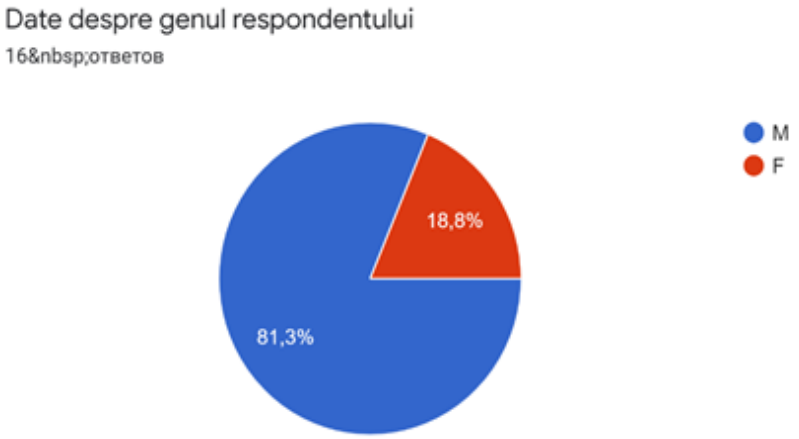
- Specifications for SWG members on the assessment of TNA for the energy sector.

The direct event was organized during an online session on August 3, 2021, starting at 15:00. The workshop was attended by 16 SWG members, out of 14 for whom they were delegated to SWG. The preliminary selection of technologies for the forestry sector by SWG members was carried out on the basis of a virtual platform through the questionnaire "Energy TNA_2021_sectorul prioritization" (reference – https://docs.google.com/forms/d/1mIoygKokdbwESytBZYb-eU38zFXrwCXCzPiN7QKYTBw/edit) developed with the support of the application "Google forms". The topic being of increased interest from 2 invited entities, two representatives each participated.

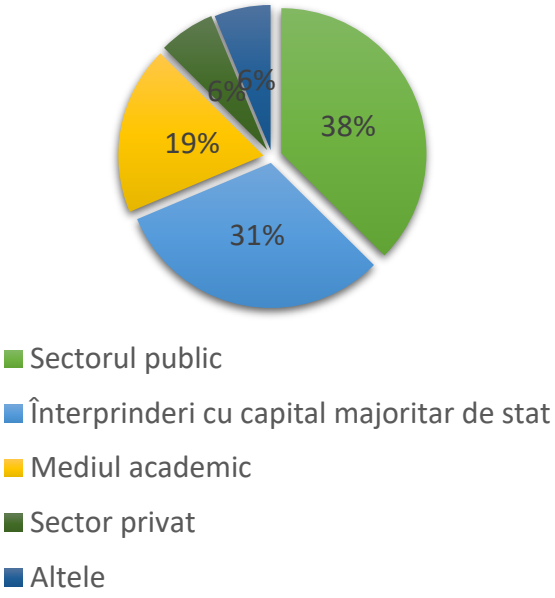
The technological sheets developed allowed the members of the working group to make an analysis and expose themselves on the prioritization of sectoral technologies. The results of the exercise are presented as follows:

1. **Number of respondents participating in the technology assessment based on the proposed Google Forms format – 16 people.**

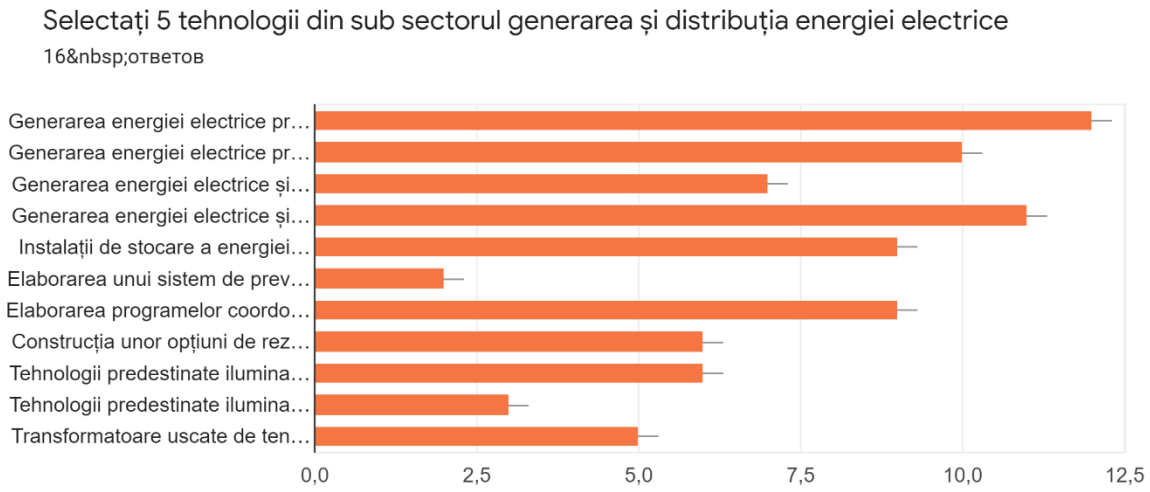
2. **The share of participants by gender - 81.3% men, 18.8% women.**



3. **Distribution of respondents by field of activity**



4. **Selection of 5 technologies from the electricity generation and distribution sector**



Naming of selected technologies**:**

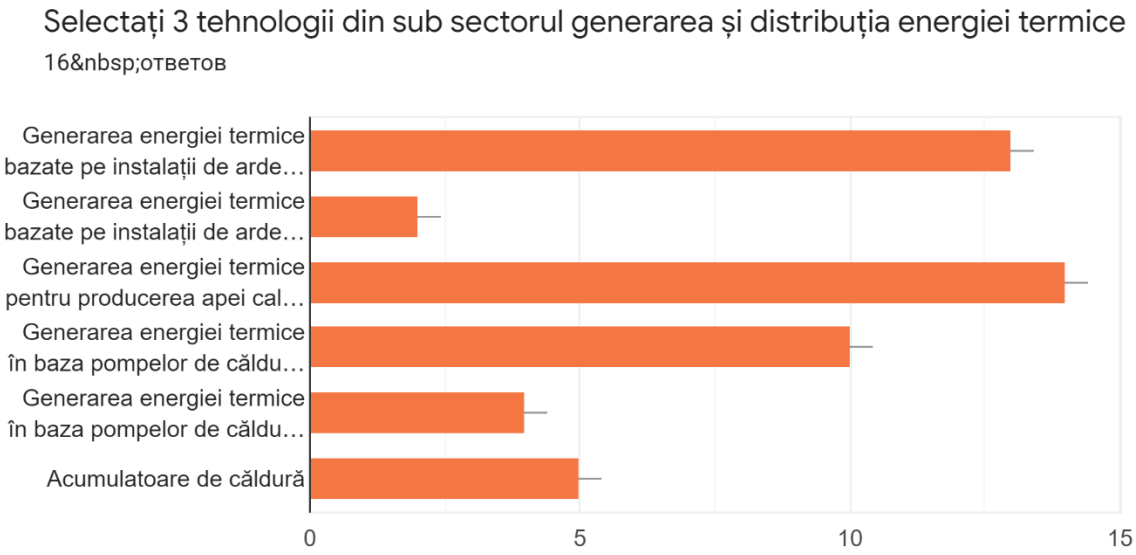
1. Electricity generation by applying mono-crystalline photovoltaic technologies **– 12 points.**

2. Electricity and heat generation by applying high-efficiency cogeneration technologies based on natural gas **– 11 points.**

3. Electricity generation by applying wind technologies with horizontal axis **– 10 points.**

4. Storage facilities for electricity produced from renewable energy sources **– 9 points.**

Selection of 3 technologies from the thermal energy generation and distribution sector



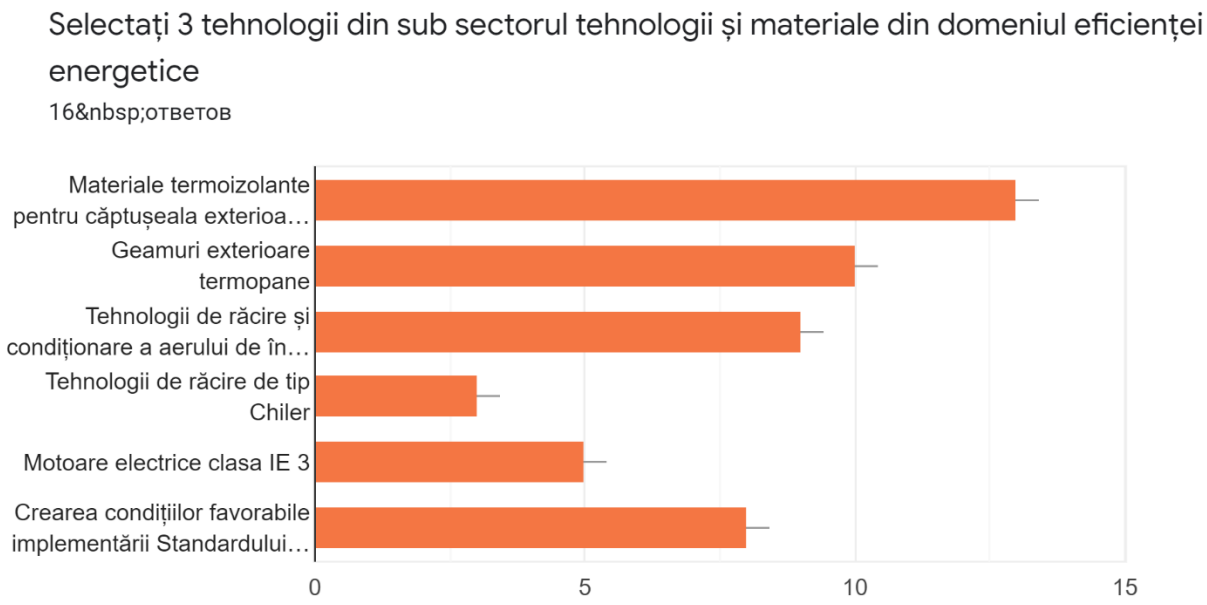
Naming of selected technologies**:**

1. Thermal energy generation for the production of hot water consumption based on vacuum solar collectors **– 14 points.**

2. Thermal energy generation based on solid biomass combustion plants, pellet boilers **– 13 points.**

3. Thermal energy generation based on ground-to-water heat pumps **– 10 points.**

Selection of 3 technologies from under the energy efficiency technologies and materials sector



Naming of selected technologies**:**

1. Thermal insulation materials for the outer lining of buildings (mineral wool) **– 13 points.**

2. Double-glazed exterior windows **– 10 points.**

3. High-efficiency cooling and air conditioning technologies **– 9 points.**

As a result of the analysis of available materials, especially Technology Sheets (TFS), discussions and debates during the workshop, SWG members prioritized through the sectoral web questionnaire 10 technologies from the long list, proposed for implementation for the energy sector.

Thus, according to the results of the sectoral web questionnaire, the maximum score (14 points) was accumulated by the technology *Thermal energy generation for the production of hot water consumption based on solar collectors*, The name of the technologies prioritized by the energy sector, as well as the value of the score given by the sectoral working group are exposed in Table 3.3.

Table 3.3 *Value of the score obtained by the proposed technologies/measures to adapt the energy sector to climate change*

Nr.	Name of measure technologies	Value of the score obtained
1.	Thermal energy generation for the production of hot water consumption based on vacuum solar collectors	14
2.	Thermal energy generation based on solid biomass combustion plants, pellet boilers	13

3.	Thermal insulation materials for the outer lining of buildings (mineral wool)	13
4.	Electricity generation by applying photovoltaic technologies, mono crystalline type	12
5.	Electricity and heat generation by applying high-efficiency cogeneration technologies from natural gas	11
6.	Electricity generation by applying horizontal axis wind technologies	10
7.	Thermal energy generation based on ground-to-water heat pumps	10
8.	Double-glazed exterior windows	10
9.	Storage facilities for electricity produced from renewable energy sources	9
10.	High-efficiency cooling and air conditioning technologies	9

Following the analysis carried out, the TNA team within the project proposed that SWG accept another technology in the short list, namely the one related to *the elaboration of a system for the prevention and protection of electrical networks against frost deposits*, as well as the merging of two technologies under one*: Double-glazed exterior windows* and *Thermal insulation materials for the outer lining of buildings (mineral wool).* The proposal was put forward in light of the fact that both technologies refer to energy efficiency measures applied to the outer lining of the building. In this regard, the proposed new technology was called *Thermal insulation materials for the outer lining of the building.* Both proposals were approved by SWG.

For the second stage of prioritizing climate change adaptation technologies/measures in the energy sector, the evaluation criteria dedicated to this sector were identified. This contributed to achieving a clear and transparent process of prioritizing climate change adaptation technologies/measures selected at the primary stage. The evaluation criteria were derived by the national sectoral consultant in consultation with SWG members, based on the specified objectives of this Report.

The process sought to include all aspects relevant to the energy sector. Criteria that cannot be measured or are subjective, specifically related to benefits, have been converted into a numerical form on a scale from 0 to 100 (SWG scoring).

Thus, in order to prioritize technologies in the energy sector, these technologies were distributed by climate impacts as follows from Table 3.4.

Table 3.4 *Grouping technologies by climate impacts*

Name of climate impact	Proposed technologies to overcome climate impacts
The danger of diminishing the production of electricity and heat due to lack of water at CHP and HPP	1. Electricity generation by applying mono-crystalline photovoltaic technologies. 2. Electricity and heat generation by applying high-efficiency cogeneration technologies based on natural gas. 3. Electricity generation by applying horizontal axis wind technologies. 4. Storage facilities for electricity produced from renewable energy sources. 5. Generating thermal energy for the production of hot water consumption based on vacuum solar collectors.

	6. Thermal energy generation based on solid biomass combustion plants, pleat-based thermal power plants. 7. Thermal energy generation based on ground-water heat pumps. 8. Elaboration of coordinated programs for the development of electrical networks and construction of irrigation stations for agricultural lands
Damage to power grids due to extreme events	1. Development of a system for prevention and protection of electrical networks against frost deposits
The significant increase in power and energy consumed during the summer due to the increase in energy demand for air conditioning and irrigation of land, as a result of heat waves	1. Thermal insulation materials for the external lining of buildings (mineral wool and double-glazed windows). 2. High-efficiency cooling and air conditioning technologies

In order to achieve the direct priorities of technologies/measures, the multi-criteria evaluation procedure (FCM) was used. In accordance with Table 3.5, the following selection criteria were used for the assessment procedure

Table 3.5 *Selection criteria for assessing technologies/measures to adapt the energy sector to climate change*

Impact climatic	Criterion	Name of criterion
The danger of diminishing the production of electricity and heat due to lack of water at CHP and HPP	Costs	1. Specific investment per generated energy unit, USD/kWh 2. O&M, USD/kWh expenses
	Benefits	1. Determination of the amount of fuel used 2. The amount of water saved 3. Developing new jobs 4. Gender impact 5. Environmental pollution 6. Multiplier potential 7. Degree of innovation 8. Paradigm shift
Damage to power grids due to extreme events	Costs	1. Specific investment, USD 2. Expenditure M&O, USD/year
	Benefits	1. Reducing the number of interventions of task forces to remove damages

		2. Reduction of electricity interruption period to final consumers 3. Job development 4. Gender impact 5. Environmental pollution 6. Multiplier potential 7. Degree of innovation 8. The area of consumers who will benefit from the implementation of technology
The significant increase in power and energy consumed during the summer due to the increase in energy demand for air conditioning and irrigation of land, as a result of heat waves	Costs	1. Specific investment, USD/unit 2. Expenditure O&M, USD/year
	Benefits	1. Reducing the amount of fuel used 2. Reducing cooling and irrigation costs 3. Developing new jobs 4. Gender impact 5. Environmental pollution 6. Multiplier potential 7. Degree of innovation 8. Paradigm shift

The multicriteria evaluation model is based on Excel format and the working group members were asked to assess the mentioned criteria. In context, with the support of spreadsheets, 3 interconnected matrices were built: the performance matrix, the score matrix and the decision matrix. Those matrices have been constructed for each climate impact described in the chapters of this Report.

For a clearer understanding of the tasks imposed on the working group, a short guide for filling in Excel tables has been developed by the consultant.

The Performance Matrix table contains information on the technological options proposed for prioritization, as well as the criteria based on which prioritization was made. For some criteria the numerical values are known (investment costs or M&O expenses), for others not. For criteria where values are not known, it was necessary to allocate points from 0 to 100, based

on the expertise that each member of the working group has, as well as on the information provided in the technological sheets.

Point values include the following explanation:

0	Used when information about a technology does not apply to specific criteria
1-20	Extremely poor, strongly unfavorable performance
21-40	Poor performance, major improvements needed
41-60	At an acceptable level or above
61-80	Very favorable performance, but still requiring improvement
81-100	Clearly outstanding performance that is well above the norm

In addition to establishing the above-mentioned score, it was also established for the weight of the criteria (i.e. their importance, weight in selecting technologies/measures), also applying the score from 0 to 100. The value 0 corresponds to the criterion which has no value in the selection of technologies, and 100 corresponds to the criterion distinguished by its major importance in the technology selection exercise.

Based on the mentioned and the materials developed, the national consultant made available to the members of the working group the extended format of technologies, 10 in number, as well as the primary forms for the performance matrix and for the score matrix, also weighting the evaluation criteria. Thus, within the performance matrix, for 2 evaluation criteria (investment costs. maintenance costs) the score was calculated in advance by the national consultant based on detailed TFS.

At the same time, SWG members individually set the weight of each evaluation criterion (score matrix). For the Innovation Degree evaluation criterion, it was jointly established in the group during the working meeting. As a working condition, it was established that the cumulative value of the weight of all criteria should not exceed 1.

The forms filled in by SWG members were submitted by the national sector consultant. Thus, 9 forms were filled in, sent to 14 SWG members. At the final prioritization stage on 9.11.2021, at 16:00, a webinar was organized with the participation of SWG members (9 people out of 14) and PNA2 project staff. During that event, the national sectoral consultant presented the results of the preparation of the performance matrix and score matrix forms.

An important element discussed during the event was the weighting of criteria and their average. Thus, as a result of SWG members awarding the corresponding score, the ranking of evaluation criteria by energy sector was obtained (Table 3.6).

Table 3.6 *Hierarchy of criteria for assessing technologies/measures for adaptation of the energy sector to climate change*

Climate impact	Name of criterion	Weighted average	Place occupied
Climate impact I	Specific investment	90	1
	The amount of water saved	75,6	2
	Replicability	70	3
	Environmental pollution	63,3	4
	Operating and maintenance costs	55	5
	Developing new jobs	51	6
	Degree of innovation	50	7
	Ensuring gender equality	48	8
	Reducing the amount of fuel used	42,8	9
	Paradigm shift	20	10
Climate impact II	Reduction of electricity interruption period to final consumers	72,8	1
	Specific investment	70	2
	Reducing the number of interventions of task forces to remove damages	63,9	3
	Developing new jobs	51	4
	Degree of innovation	50	5
	Ensuring gender equality	48	6
	Environmental pollution	42,2	7
	Replicability	40	8
	The area of consumers who will benefit from the implementation of technology	40	9
	Operating and maintenance costs	30	10
Climate impact III	Specific investment	80	1
	Replicability	80	2
	Reducing cooling and irrigation costs	63,3	3
	Environmental pollution	61,1	4
	Reducing the amount of fuel used	60,6	5
	Developing new jobs	52	6
	Degree of innovation	50	7
	Ensuring gender equality	45	8
	Paradigm shift	31,1	9
	Operating and maintenance costs	25	10

Taking into account the specificities of the energy sector, the maximum score is obtained for all 3 climate impacts by the criterion Specific investment. This shows that investment costs are still high for the given sector, and investments are the most important aspects of promoting new technologies. It is important to note that at the meeting the score given to each criterion was agreed by consensus of all SWG members.

The next operation in the prioritization process was to normalize the values/indicators within the performance matrix and build the score matrix. For this, all values in the performance matrix, including costs, are converted to points on the scale 0-100, and the achievement of that operation is ensured by using two equations:

- In cases where the minimum value is preferable (under cost criteria):

$$Yi = 100^{**}(Sinx - Xi) / (Sinx - Xmin)$$

- In cases where the maximum value is preferable:

$$Yi = 100^{**}(Xi - Xmin) / (Sinx - Xmin)$$

Upon completion of the mentioned exercise, results were obtained automatically, as a result of logical links and formulas used in the Excel calculation model.

3.6 Results of prioritizing climate change adaptation technologies of the energy sector

The final stage of the prioritization exercise with MCA support is the construction of the decision matrix. The decision matrix is based on performance and score matrix data. The results of the MCA exercise were carefully examined to see if the calculations and rows were logical. First, it has ensured that the scores given to different criteria are consistent and reflect technological merits. The results of prioritizing adaptation technologies/measures are presented in Table 3.7. The intermediate score (The score obtained according to the steps taken) is the sum of the values calculated in the score matrix multiplied by the weight of the evaluation criteria. The final score is the product of the intermediate score and the value given to climate impact of 40% for Climate Impact I, 30% for Climate Impact II and 30% for Climate Impact III, respectively.

Table 3.7 *Hierarchy of technologies/measures to adapt the energy sector according to FCM assessment*

Name of the technologies assessed	Intermediate score	Final score	Priority level of T/M
Single-crystal photovoltaic systems	80	56	1
Horizontal axis wind technologies	67	47	2
Ground-to-water heat pump technologies	62	43	3
High-efficiency natural gas-fired cogeneration plants	62	43	4
Technologies for the production of hot water for consumption based on vacuum solar collectors	60	42	5
Solid biomass combustion technologies based on pellet boilers	48	33	6
Li-Ion electricity storage plants	39	27	7
Thermal insulation materials for the exterior lining of buildings	65	13	8
Development of a system for the prevention and protection of electricity networks against frost deposits	70	7	9
High-efficiency cooling and air conditioning technologies	35	7	10

The analysis of the results presented in the table above shows that SWG gave priority to electricity generation technologies in the Republic of Moldova. In this regard, the *technology Monocrystalline photovoltaic installations* obtained the highest final score of 80 and ranks first, followed by *Horizontal axis wind technologies*, which obtained 67 points and ranks second.

During the discussions with SWG members, there were other opinions regarding the allocation of weight to criteria from an application perspective, but also from the perspective of future climate scenarios. This led to the application of the awareness-raising exercise, which also pointed to other aspects of prioritization of technologies.

In this sense, the climate impacts were divided into short and long-term events, for which they were given values between 0-100%. Thus, 3 scenarios were analyzed based on the above-mentioned ones (Table 3.8).

Table 3.8 *Climate impact awareness scenarios on selected technologies*

Scenarios	Name of climate impact	Climate impact weight, %
Scenario I	The danger of diminishing the production of electricity and heat due to lack of water at the CET and HPP, as a result of the drying up	80%
	Damage to power grids as a result of extreme events	10%
	Significant increase in power and energy consumed during the summer as a result of the increase in energy demand for air conditioning and land irrigation, as a result of heat waves	10%
Scenario II	The danger of diminishing the production of electricity and heat due to lack of water at the CET and HPP, as a result of the drying up	10%
	Damage to power grids as a result of extreme events	80%
	Significant increase in power and energy consumed during the summer as a result of the increase in energy demand for air conditioning and land irrigation, as a result of heat waves	10%
Scenario III	The danger of diminishing the production of electricity and heat due to lack of water at the CET and HPP, as a result of the drying up	10%
	Damage to power grids as a result of extreme events	10%
	Significant increase in power and energy consumed during the summer as a result of the increase in energy demand for air conditioning and land irrigation, as a result of heat waves	80%

That approach made it possible to carry out a comparative analysis of the data obtained by SWG and those subject to the awareness-raising procedure. The results obtained are reflected in Table 3.9.

Table 3.9 *Ranking of technologies/measures in the energy sector according to the awareness-raising analysis*

Name of the evaluated technology	According to SWG		According to Scenario I		According to Scenario II		According to Scenario III	
	Final score	Priority level	Final score	Priority level	Final score	Priority level	Final score	Priority level
Single-crystal photovoltaic systems	56	1	64	1	8	2	8	3

Horizontal axis wind technologies	47	2	50	2	6	3	7	5
Ground-to-water heat pump technologies	43	3	54	3	7	5	6	6
High-efficiency natural gas-fired cogeneration plants	43	4	49	4	6	6	6	7
Technologies for the production of hot water for consumption based on vacuum solar collectors	42	5	48	5	6	7	6	8
Solid biomass combustion technologies based on pellet boilers	33	6	38	6	5	8	5	9
Li-Ion electricity storage plants	27	7	31	7	4	9	4	10
Thermal insulation materials for the exterior lining of buildings	13	8	7	8	7	4	52	1
Development of a system for the prevention and protection of electricity networks against frost deposits	7	9	7	9	56	1	7	4
High-efficiency cooling and air conditioning technologies	7	10	3	10	3	10	28	2

Table 3.10 below represents the final ranking of sectoral technologies and is a cumulative statement of the outcome of the prioritization exercise at the SWG meeting as well as the awareness-raising exercise, taking into account possible changes in climate impacts based on developments in future climate scenarios. This final ranking was communicated and validated by SWG.

Table 3.10 *Ranking of technologies/measures in the energy sector according to the awareness analysis*

Name of the technologies assessed	Priority level of T/M
Single-crystal photovoltaic systems	1
Horizontal axis wind technologies	2
Ground-to-water heat pump technologies	3
High-efficiency natural gas-fired cogeneration plants	4
Technologies for the production of hot water for consumption based on vacuum solar collectors	5
Solid biomass combustion technologies based on pellet boilers	6
Li-Ion electricity storage plants	7
Thermal insulation materials for the exterior lining of buildings	8
Development of a system for the prevention and protection of electricity networks against frost deposits	9
High-efficiency cooling and air conditioning technologies	10

Annex 1 List of parties involved in the prioritization of climate change adaptation technologies for the energy sector

Nr.	Under Sector	Name	Description	Contacts (email)
	Government institutions			
1	All	Ministry of Economy and Infrastructure	The Ministry was created by GD 142/2021 on the modification and repeal of some Government decisions.	secretariat@mei.gov.md denis.tumuruc@mei.gov.md gheorghe.croitoru@mei.gov.md
2	All	Energy Efficiency Agency	The agency implements the state's policy in the field of energy efficiency and promotion of renewable energy sources.	office@aee.md manole.balan@aee.md
3	All	National Agency for Energy Regulation	It implements the state's policy on regulation in the energy sectors, ensures the regulation and monitoring of the efficient functioning of the energy market and activities in the energy sectors.	anre@anre.md
4	All	National Institute for Standardization	The Institute is a public institution subordinated to the central specialized body of the public administration responsible for quality infrastructure. Their basic activity is guided by Law no. 20 of 04.03.2016 on national standardization.	info@standard.md
	Research and innovation institutions			
5	All	Institute of Energetics	The mission of the Institute of Energetics is the scientific support regarding the increase of energy security and the execution of research in the targeted field.	tirsu.mihai@gmail.com
6	All	Technical University of Moldova	TUM is a public institution in the field of technical higher education. TUM assumes the general mission of advanced scientific research and education, generating and transferring knowledge to society through: a) scientific research, development, innovation and technology transfer, through individual and collective creation in the field of engineering sciences, as well as capitalizing on and disseminating their results. b) initial and continuous training, at university level, for the purpose	secretariat@adm.utm.md victor.gropa@ee.utm.md sergiu.bejan@fua.utm.md

			of personal development, professional insertion of the individual and satisfaction of the skills needs of the socio-economic environment.	
7	Thermo	Center of Excellence in Construction	In accordance with the Government Decision no. 444 of 20.07.2015 regarding the reorganization of some vocational technical education institutions, the College of Constructions was reorganized into the Center of Excellence in Construction, which is a public institution. The center has the following specialties: - Specialty N73220 "Civil Constructions and Operation of Buildings and Edifices" (CECE) -Specialty N73230 "Road construction and operation" - Specialty N73230 "Heat and gas supply systems, ventilation" (SACGV) and others.	valeriu.pelivan@gmail.com catedra.acgv@gmail.com
8	Electro	Center of Excellence in Energy and Electronics	The center is a public institution in the field of technical vocational education, which trains staff in the field of electricity in the country's economy.	secretariat@ceee.md
9		National Agency for Research and Development	The National Agency for Research and Development (ANCD) is a central administrative authority subordinated to the Government of the Republic of Moldova, established by Government Decision no. 196 of 28.02.2018. ANCD is the legal successor of rights and obligations of the Center for International Projects, the Agency for Innovation and Technology Transfer and the Agency for Research and Development, all of which are public institutions within the Academy of Sciences of Moldova. ANCD is responsible for the implementation of the national research, innovation and development policy, the EU Framework Programme for Research and Innovation	agentia@ancd.gov.md

			Horizon 2020 and other European programmes and coordinates the Office for Science and Technology of the Republic of Moldova in Brussels (MOST).	
	Public Associations			
9	All	Chamber of Commerce and Industry	The Chamber of Commerce and Industry, hereinafter referred to as the Chamber, is a non-governmental, autonomous and independent organization, established in accordance with this law, on the basis of membership, which represents the overall interests of entrepreneurs in the Republic of Moldova.	camera@chamber.md
10	All	Association of Installation Engineers of Moldova	The purpose of the Association is to defend the professional and social interests of installation engineers in the Republic of Moldova and to strengthen their role and importance in the entire economic and social activity.	aiirmoffice2002@gmail.com lvirlan@mail.ru
11	All	Public Association of the National Energy Council of Moldova	The National Energy Council is a public association that promotes policies to combat climate change and protect the environment through energy efficiency and the use of renewable energy sources for sustainable development.	valentin.arion@tme.utm.md constantin.borosan@tme.utm.md
	Energy companies			
12	Thermo and Electro	SA CET Nord	The economic company is an institution that provides public services for the supply of heat and electricity to the residents of mun. Balti.	office@cet-nord.md
13	Thermo and Electro	SA Termoelectrica	The economic company is an institution that provides public services for the supply of heat, hot water for consumption and electricity to the residents of mun. Chisinau.	anticamera@termoelectrica.md
14	Electro	Premier Energy Distribution	The economic company is an enterprise with majority foreign capital. The company provides electricity distribution services in the Republic of Moldova	servicii_client@premierenergy.md
15	Electro	SA RED Nord	The economic company is an enterprise with majority state capital. The company provides electricity distribution services in the Republic of Moldova.	anticamera@rednord.md

Annex 2. Technology Fact Sheets, short format for energy sector adaptation to climate change

TECHNOLOGY FACT SHEETS, SHORT FORMAT for ENERGY SECTOR ADAPTATION TO CLIMATE CHANGE

Under the sector Electricity generation and distribution technologies		
1.	**TNA Technology**	**Electricity generation by applying photovoltaic technologies**
	The national policy framework that supports technology	Law 10/2016 on promoting the use of energy from renewable sources; Government Decision 690/2018 for the approval of the Regulation on the conduct of tenders for the granting of the status of eligible producer; Government Decision 689/2018 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources until 2020; ANRE decision no. 54/2020 on fixed tariffs and ceiling prices for electricity produced from renewable energy sources by producers who will obtain the status of eligible producer.
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Technologies for producing electricity based on photovoltaic systems is one of the most widespread in the Republic of Moldova. Two basic technologies used locally are known, namely mono and poly crystalline photovoltaic panels. Their yield is higher than the amorphous ones, being between 16-18%. Due to the flat technological construction, they are widely used in the residential and public sectors.
	Investment cost and profitability	The investment cost of such a technology is determined based on GD 54/2020 and is $ 960 / kW installed power. At the level of profitability are the benefits obtained by investors from the sale of electricity to local energy suppliers and the coverage of their own energy consumption.
	Market potential (replication)	The replication potential of the project would be 40 MW through the fixed tariff, tender support schemes and 37 MW through the application of the net metering support scheme.
	Impact and benefits of adaptation	Covering the energy demand required for the space cooling process. The contribution of technology to the development of distributed generation in order to reduce energy and power losses. Covering the energy demand needed to irrigate the land.
2.	**TNA Technology**	**Electricity generation through the application of wind technologies**
	The national policy framework that supports technology	Law 10/2016 on promoting the use of energy from renewable sources; Government Decision 690/2018 for the approval of the Regulation on the conduct of tenders for the granting of the status of eligible producer; Government Decision 689/2018 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources until 2020; ANRE decision no. 54/2020 on fixed tariffs and ceiling prices for electricity produced from renewable energy sources by producers who will obtain the status of eligible producer.

	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Technologies for the production of electricity based on wind systems are on the rise in the Republic of Moldova. According to the data presented by ANRE, the total installed capacity with such technologies in the Republic of Moldova is approximately 30 MW. Installed power per technology varies from manufacturer to manufacturer and ranges from 30 kW to 3 MW. The capacity factor of these technologies ranging from 15-50% According to GD 54/2020 the capacity factor must not be less than 30%.
	Investment cost and profitability	The investment cost of such a technology is determined based on GD 54/2020 and is $ 1500 / kW installed power. At the level of profitability are the benefits obtained by investors from the sale of electricity to local energy suppliers and the coverage of their own energy consumption..
	Market potential (replication)	The replication potential of the project would be 70 MW through the fixed tariff, tender support schemes and 37 MW through the application of the net metering support scheme.
	Impact and benefits of adaptation	Covering the energy demand required for the space cooling process. The contribution of technology to the development of distributed generation in order to reduce energy and power losses. Covering the energy demand needed to irrigate the land.
3.	**TNA Technology**	**Generarea energiei electrice și termice prin aplicarea tehnologiilor pe baza de Biogaz (inclusiv trigenerare)**
	The national policy framework that supports technology	Law 10/2016 on promoting the use of energy from renewable sources; Government Decision 690/2018 for the approval of the Regulation on the conduct of tenders for the granting of the status of eligible producer; Government Decision 689/2018 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources until 2020; ANRE decision no. 54/2020 on fixed tariffs and ceiling prices for electricity produced from renewable energy sources by producers who will obtain the status of eligible producer.
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Biogas-based electricity generation technologies are in their infancy in the Republic of Moldova. According to the data presented by ANRE in Moldova, there are only 6 producers using the respective technology, and the total installed capacity is approximately 6 MW. As a technological process, these facilities use biogas obtained from the processing of various agricultural products such as sugar beet, waste from alcohol factories and less from animal waste in the country's livestock sector. The capacity factor will not be allowed below 70%.
	Investment cost and profitability	The investment cost of such a technology is determined based on GD 54/2020 and is $ 3500 / kW installed capacity. At the level of profitability are the benefits obtained by investors from the sale of

		electricity to local energy suppliers and the use of thermal energy for personal technological needs.
	Market potential (replication)	The replication potential of the project would be 20 MW through fixed tariff and tender support schemes.
	Impact and benefits of adaptation	Covering the energy demand required for the space cooling process. The contribution of technology to the development of distributed generation in order to reduce energy and power losses Covering the energy demand needed to irrigate the land. The contribution of technology to the development of distributed generation in order to reduce energy and power losses Covering the necessary thermal and cooling energy at the expense of triginerization. Compensation for lost electricity from low water flow at CHE dams and their use as balancing sources for energy produced from other SER sources.
4.	**TNA Technology**	**Generation of electricity and heat through the application of high efficiency cogeneration technologies based on natural gas**
	The national policy framework that supports technology	Law 92/2014 on thermal energy and promotion of cogeneration
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	The technologies used to produce thermal and electrical energy through the cogeneration process are widely used by companies that produce centralized thermal energy. However, obsolete equipment lowers its operating efficiency below the technical normative values recommended by the manufacturer. The application of new technologies of high efficiency in the cogeneration process involves the use of an overall energy production efficiency between 85 -92%.
	Investment cost and profitability	The investment cost of such a technology is deducted from the analysis of the local market and is around $ 700 / kW (example SA CET Nord). At the level of profitability are the benefits obtained by investors from the sale of electricity to local energy suppliers and the coverage of the need for thermal consumption and hot water consumption to the final beneficiaries that are supplied from SACET ul.
	Market potential (replication)	The replication potential of the project would be 70 MW, distributed as follows: 55 MW for Chisinau municipality; 15 MW for district centers.
	Impact and benefits of adaptation	Covering the energy demand required for the space cooling process. Technology's contribution to the development of distributed generation in order to reduce energy and power losses Covering the demand for thermal energy for the production of hot water for consumption

		Compensating for lost electricity due to low water flow at CHP dams and using them as balancing sources for energy produced from RES sources.
5.	**TNA Technology**	**Installations for the storage of electricity produced from renewable energy sources**
	The national policy framework that supports technology	Law 139/2018 on energy efficiency, art. 27, para. (9), lit. f) Regulatory acts approved by the National Energy Regulatory Agency and tariffs for electricity transmission and distribution services will not prevent system operators from making system services available on organized electricity markets in connection with energy management measures. demand and response to demand and in connection with distributed production, in particular measures such as: f) energy storage. " ANRE decision no. 283/2020 on the approval of the Rules of the electricity market, point 459) Each operator of the distribution system assumes the responsibility of balancing for its own technological consumption and electricity losses in its own electricity distribution network.
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	The energy storage technologies produced in RES will reduce the impact on the energy system and consumers in the implementation of different diversification scenarios of energy sources. Modern technologies are based on Li-Ion storage equipment.
	Investment cost and profitability	The investment cost is calculated for 100 kVA, integrated with charge controller and inverter connected to the voltage of 380 V and is $ 75,000
	Market potential (replication)	The replication potential of the project will include the intermittent capacity set for 2020 and is 168 MW.
	Impact and benefits of adaptation	Reducing the number of hours and disconnections due to damage
6.	**TNA Technology**	**Development of a system for the prevention and protection of electrical networks against frost deposits**
	The national policy framework that supports technology	ANRE decision no. 939/2019 on the approval of normative-technical documents in the field of energy NE1-01: 2019 Norms for the operation of electrical installations of non-household consumers
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	In the context of the warming of winters in Moldova and the increase in temperature, in terms of evolution, the frost shows a growing trend, especially in the north and in the center, where temperature changes are more significant. Measures will include: 1. Inventory of the equipment intended for melting the existing frost in the power stations; 2. Elaboration of the feasibility study for the protection of electrical networks against frost deposits (considering the mechanical and electrical methods of frost removal, zonal fortification of RE and implementation of early prevention systems);

		3. Selection of suppliers and conclusion of contracts for the delivery of the necessary equipment; 4. Selection and contracting of the executors of the works necessary for the construction, assembly and adjustment of the prevention system; 5. Analysis of climate developments and new technologies for removing frost from the elements of electricity networks
	Investment cost and profitability	The cost of investment cannot be identified at this stage. Profitability will be achieved by preventing frost deposits on overhead line conductors and preventing conductor breakage and pylon falls.
	Market potential (replication)	Areas of intervention of the energy distribution and transmission companies Premier Energy Distribution, SA RED Nord and IS Moldelectrica
	Impact and benefits of adaptation	Reducing the number of hours and disconnections due to breakdowns of overhead power lines caused by frost
7.	**TNA Technology**	**Elaboration of coordinated programs for the development of electrical networks and the construction of agricultural land irrigation stations**
	The national policy framework that supports technology	ANRE decision no. 94/2019 on the approval of the Regulation on the development of electricity distribution networks; GD no. 1015/2018 regarding the amendment of the Government Decision no. 707/1993 on the approval of regulations on land intended for industry, transport, telecommunications, defense and other special purposes and on the method of transfer to loss of systems for the improvement and classification of irrigated and desiccated land in the category of non-irrigated
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Irrigation of agricultural land, due to the decrease in annual rainfall, will become a precondition for maintaining state food security. The location of the irrigation stations, as well as the installed power of their pumps, must be based on the development projects of the electrical distribution networks or even the transmission ones. The previously existing mechanism for coordinating territorial development plans has lost its relevance. The urban plans of urban and local localities are often not followed, or even not it does not exists. The elaboration of medium and long term programs regarding the irrigation of agricultural lands will allow the development in timely terms of the necessary infrastructure for the supply of electricity to the communication routes.
	Investment cost and profitability	The investment cost cannot be determined at that stage. Profitability is the development of the construction infrastructure of power lines and irrigation stations for agricultural land.
	Market potential (replication)	Agricultural land near stationary aquatic resources and rivers.
	Impact and benefits of adaptation	Development of overhead power line infrastructure and coverage of water needs by irrigating agricultural land
8.	**TNA Technology**	**Construction of CET water supply reserve options, from alternative sources**

	The national policy framework that supports technology	Law no. 92/2014 on thermal energy and the promotion of cogeneration; GD 977/2016 on the approval of the Standard Regulation for the operation of reservoirs / ponds
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Central heating power plants require cooling water. Decreasing water levels in rivers due to long periods of drought from this point of view will create problems: plants will have to reduce production, either because there is not enough water available or because heated water will not be able to be returned to rivers because it would create additional burdens on already severely affected river ecosystems and drought. Water probes are currently used at CETs as an alternative power source. However, there are no studies that would evaluate the water extraction capacity of these wells and their operation time in case of faults in the basic water supply network.
	Investment cost and profitability	The value of the cost is determined by the drilling depth and varies from case to case. The profitability of the project consists in maintaining the water-repellent regime of the rivers.
	Market potential (replication)	Central heating power plants (CHPs) Cogeneration plants.
	Impact and benefits of adaptation	Solving the problem of supplying CHPs with water from alternative sources
9.	**TNA Technology**	**Technologies predestined for outdoor artificial lighting based on LEDs with high protection IP**
	The national policy framework that supports technology	GD no. 698/2019 on the approval of the National Action Plan in the field of energy efficiency for the year 2019-2021 GD no. 1003/2014 for the approval of the regulations regarding the energy labeling requirements of some products with energy impact
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	LED lighting technologies are currently widely used in the Republic of Moldova. These technologies have a considerable advantage over others, due to several reasons, namely: longer life 50 000 - 100 000 h / functional, high light efficiency of min 90 lm / W. They can also be found in the field of climate change adaptation. A high IP also protects the given technology from increased amounts of dust and moisture penetration due to extreme phenomena.
	Investment cost and profitability	According to the technical estimates made, the cost of a high-performance luminaire can be between 1500 - 3000 lei. Having a high IP increases the likelihood that dust and moisture will destroy the body. Respectively, the maintenance and operating costs related to the maintenance of the public lighting system will be lower.
	Market potential (replication)	According to the National Action Plan, this technology can be replicated as follows: - Public lighting of the main and auxiliary arteries of cities and villages; - Public lighting over the Dniester River (Rezina-Râbnița section)
	Impact and benefits of adaptation	Increasing the reliability of moisture and dust due to the identified extreme phenomena.

10.	TNA Technology	Technologies predestined for indoor artificial lighting based on LED bodies
	The national policy framework that supports technology	GD no. 1003/2014 approving the regulations on energy labeling requirements for energy-related products, Annex 4
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	The fact that incandescent lamps consume a lot of energy also contributes to the heating of homes. Only 10% of the energy consumed is transformed into light, the remaining 90% being released in the form of heat. LED lighting technology works the opposite of the parameters described above. The fact that they are energy-saving they contribute minimally to the heating of office and home spaces.
	Investment cost and profitability	The cost of investing in such technologies varies from case to case. The market analysis shows that this value is between 350 - 2000 lei per body, and the NAMA project developed by ME and included in the electronic register of CCONUSC, the total cost of the investment is equal to 190 million Euros, all over the country. The profitability of this project is determined by the reduction of the maintenance and upkeep costs of the lighting system, and the related benefits in the field of climate change would be the reduction of GHG emissions and electricity consumption.
	Market potential (replication)	Project replication can be extended to public institutions, offices and the residential sector.
	Impact and benefits of adaptation	Decreasing heat supply in buildings during the warm period of the year
11.	**TNA Technology**	**Dry voltage and power transformers**
	The national policy framework that supports technology	ANRE decision no. 94/2019 on the approval of the Regulation on the development of electricity distribution networks;
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Dry transformers require virtually no maintenance. The insulation, composed of a heavy mixture of epoxy resin and quartz dust, makes the transformer maintenance-free, operates safely at 100% humidity and condensation, takes very heavy fire and extinguishes itself without the use of aluminum hydroxide. Transformers manufactured according to the international standard IEC 60726. They are not flammable, they have self-extinguishing properties and in case of a defect they do not present the risk of leakage of flammable or contaminated substances. Dry transformers are the most suitable for installations that require a high degree of safety, such as those for: hospitals, shopping centers, industry, etc.
	Investment cost and profitability	The investment cost of dry transformers compared to oil-based transformers is more expensive. Its value is between 20-25 Euro / kVA unit of installed power
	Market potential (replication)	Electricity distribution and transmission companies

	Impact and benefits of adaptation	Increasing the reliability of final consumers' power supply in extreme conditions, based on rising outdoor temperatures. Avoidance of danger of explosion of transformer oil
Under the sector Thermal energy generation and distribution technologies		
12.	**TNA Technology**	**Thermal energy generation based on solid biomass combustion plants**
	The national policy framework that supports technology	GD 1073/2013 on the National Action Plan in the field of renewable energy for the year 2013-2020
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Biomass is the most widely used renewable energy source for decentralized heat supply. Biomass remains a decentralized source of heat supply throughout this decade; however, a niche will be formed in the future for the use of biomass in the process of small-scale cogeneration. Thus, the technologies aimed in this direction are focused on improving the combustion process and increasing the efficiency of power plants used by residents and private companies. There are two technologies in this regard, namely thermal power plants that burn solid biomass based on briquettes and pellets. Compared to the simple stove, the yield of the premiums can reach values of 86%.
	Investment cost and profitability	The cost of investing in such technology varies depending on the thermal power required for heating needs and is between 900 - 2500 Euro per installation based on briquettes or pellets with a capacity of up to 24 kW. Profitability will be directed towards reducing GHG emissions and local heat production.
	Market potential (replication)	The technology will cover in particular the country's sectors such as: residential and public
	Impact and benefits of adaptation	Covering the heat demand from solid biomass combustion plants
13.	**TNA Technology**	**Thermal energy generation based on natural gas combustion plants by condensation**
	The national policy framework that supports technology	GD no. 1003/2014 approving the regulations on energy labeling requirements for energy-related products, Annex 11
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	A condensing boiler is a double-boiler heating system or a dual-function boiler heating system in which, under normal operating conditions and at certain operating water temperatures, the water vapor in the combustion products is partially condensed so that the latent heat of these water vapor can be used for heating. The main feature of these types of boilers are the high efficiency at which they operate, and they start from 98%.
	Investment cost and profitability	Depending on the manufacturer, the cost of investing in such technology varies from 600 to 2000 Euro per boiler with an installed power of up to 24 kW. Profitability is determined by the reduction of natural gas consumption in the combustion process and the reduction of GHG emissions into the atmosphere.

	Market potential (replication)	The potential for replication is in the residential and public sectors.
	Impact and benefits of adaptation	Covering the necessary thermal energy at the expense of natural gas combustion plants
14.	**TNA Technology**	**Generation of thermal energy for the production of hot water for consumption based on solar collectors**
	The national policy framework that supports technology	GD no. 1003/2014 approving the regulations on energy labeling requirements for energy-related products, Annex 11
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	The solar collector is a device designed to absorb the global solar radiation that transfers the heat energy thus produced to a fluid passing through the device. Collector efficiency (ηcol) - represents its efficiency at a temperature difference between the solar collector and the surrounding air of 40 K and at a global solar radiation of 1 000 W / m2, expressed as a percentage. Depending on the manufacturer and its type, the yield varies from 78% -98%.
	Investment cost and profitability	Depending on the manufacturer and the hot water storage vessel, the cost of a collector varies from 2000 to 5000 euros
	Market potential (replication)	Residential and public sector
	Impact and benefits of adaptation	Covering the demand for thermal energy predestined for the production of hot water for consumption. Covering the heat load curve used to prepare hot water for consumption.
15.	**TNA Technology**	**Thermal energy generation based on ground-to-water heat pumps**
	The national policy framework that supports technology	GD no. 1003/2014 approving the regulations on energy labeling requirements for energy-related products, Annex 11
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	These are technologies that are mainly suitable for constructions with a high heat demand and the lack of land surfaces or the lack of water in the groundwater. The heat is extracted by circulating an intermediate agent (ethanol-water, antifreeze-water mixture) in wells inserted in vertical boreholes. Drilling is carried out at depths between 60-150m. The efficiency of these systems is superior to air-to-water heat pump systems. Ground-to-water heat pumps with drilling cover a power range between 5 and 1500 kW. The main technical characteristic is determined by the COP performance coefficient and can be between 3.5-5.0
	Investment cost and profitability	The cost of the investment varies from case to case depending on the installed power of the pump and is equal to 4000 - 7000 euros, installation with power up to 24 kW Reduction of energy consumption and GHG emissions. The estimated cost of the total investment per country calculated on the basis of the NAMA project is approximately USD 180 million.

	Market potential (replication)	The residential and public sectors
	Impact and benefits of adaptation	Covering the thermal energy demand predestined for heating
16.	**TNA Technology**	**Thermal energy generation based on water-to-water heat pumps**
	The national policy framework that supports technology	GD no. 1003/2014 for the approval of the regulations regarding the energy labeling requirements of some products with energy impact
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Heat pumps, in general, are heating systems capable of transferring energy (heat) from one environment to another. They fall into several categories, but in terms of the technology of operating a water-to-water heat pump, it involves the absorption of heat from a liquid source environment. COP of these types of technologies can reach up to 5 and above.
	Investment cost and profitability	The cost of the investment varies from case to case depending on the installed power of the pump and is equal to 5500 - 8500 euros, installation with power up to 24 kW Reduction of energy consumption and GHG emissions
	Market potential (replication)	The residential and public sectors
	Impact and benefits of adaptation	Covering the thermal energy demand predestined for heating
17.	**TNA Technology**	**Heat accumulators**
	The national policy framework that supports technology	GD 189/2003 on the approval of the Concept regarding the renovation of the republican heat supply system
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	A heat accumulator consists of a storage tank (usually thermally insulated), storage medium (working agent), charging and discharging devices and auxiliary equipment. The storage system is characterized by the ways in which the energy for charging the battery is taken from the source, transformed (if necessary) into the desired type of energy and delivered to the consumer. The most common heat accumulators are with liquid (usually water) and solid (usually gravel or soil) heat storage material, underground energy storage systems using the storage medium geological formations between soil or sand and solid bottom, or aquifers and seasonal accumulation of thermal energy in boreholes.
	Investment cost and profitability	The specific cost for a kW capacity of the heat accumulator varies quite a lot from case to case, between 200-1600 euro / kW The profitability of the project would be, the coverage of the necessary heat and hot water consumption during the cold period of the year.
	Market potential (replication)	Cities that use central heating, as appropriate, and consumers that use hot water produced by solar collectors
	Impact and benefits of adaptation	Covering the demand for thermal energy and preparing hot water for consumption
Under the sector		

Technologies and materials in the field of energy efficiency		
18.	**TNA Technology**	**Thermal insulation materials for the outer lining of buildings (mineral wool)**
	The national policy framework that supports technology	Law 139/2018 on energy efficiency NCM M.01.01-2016 Minimum energy performance requirements for buildings
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Mineral wool is currently the most widely used thermal insulation material for building facades. The technical coefficients applied on the basis of construction regulations and good practices constitute the value of the density which must not be less than 135 kg / m3, at a thickness of 150 mm and the overall heat transfer coefficient 0.039 W / (m2xK)
	Investment cost and profitability	Depending on the manufacturer it varies from 10-12 euros / plate
	Market potential (replication)	Public sector: In order to promote the role of public buildings as an example, this law sets as its objective the annual renovation of a certain area of state public buildings, heated and / or cooled, in which the central public administration authorities operate. This value constitutes 1% of the renovation cancellation of the total raised or cooled area within the public institutions; The residential sector.
	Impact and benefits of adaptation	Decreased energy consumption predestined for conditioning, which in turn leads to a decrease in the amount of water consumed by traditional power plants, the latter becoming a shortage due to climate change
19.	**TNA Technology**	**Double glazed exterior windows**
	The national policy framework that supports technology	Law 139/2018 on energy efficiency NCM M.01.01-2016 Minimum energy performance requirements for buildings
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	The installation of windows with high thermotechnical characteristics will favor their adaptation to the extreme conditions of nature, such as high temperatures, violent storms. The proposed technology is PVC profile windows with at least 5 chambers, Uprof <= 1.30 W / (m2xK), double glazing consisting of 3 4 mm thick glass (2 chambers), 16 mm glass spacing, with a Low-E glass, rooms filled with argon Us <= 0.60 W / (m2xK), total value of Ufer = 0.97 W / (m2xK)
	Investment cost and profitability	The investment account is 80-120 euro / m2. The profitability of the project will be directed towards the reduction of heat loss and cooled air through the building envelope.
	Market potential (replication)	Public sector: In order to promote the role of public buildings as an example, this law sets as its objective the annual renovation of a certain area of state public buildings, heated and / or cooled, in which the central public administration authorities operate. This value constitutes 1% of the renovation cancellation of the total raised or cooled area within the public institutions; The residential sector.

	Impact and benefits of adaptation	Decreased energy consumption predestined for conditioning, which in turn leads to a decrease in the amount of water consumed by traditional power plants, the latter becoming a shortage due to climate change.
20.	**TNA Technology**	**High efficiency cooling and air conditioning technologies**
	The national policy framework that supports technology	GD no. 1003/2014 approving the regulations on energy labeling requirements for energy-related products, Annex 2
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Air conditioners - a device that can cool, heat or even cool and heat the air inside buildings using a cycle of vapor compression driven by an electric compressor, including air conditioners that also perform other dehumidifying, purifying functions , for ventilation or additional heating of the air by means of an electric heater, as well as devices which may use condensed water forming in the evaporator compartment or added water from the outside for evaporation on the condenser, provided that the device can operate without using a external source of water, air only. The COPs of these technologies can range from 1.9, energy class G to 5.1, energy class A +++
	Investment cost and profitability	Depending on the type and the cooled area, the investment cost can vary from 300 to 2500 euros per equipment. Profitability is achieved by reducing energy consumption and GHG emissions.
	Market potential (replication)	Residential, public and industrial sector.
	Impact and benefits of adaptation	Covering the growing demand for air conditioning during the warm period of the year
21.	**TNA Technology**	**Chiller cooling technologies**
	The national policy framework that supports technology	GD no. 1003/2014 for the approval of the regulations regarding the energy labeling requirements of some products with energy impact
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	Chillers are machines that remove heat from a space by means of one or more compressors. The refrigerant used is type R-410a. Cooling systems as well as air-to-air heat pumps are characterized by the COP performance coefficient and vary from manufacturer to manufacturer for energy class A +, which is on average 2.5.
	Investment cost and profitability	The price of the investment is determined by the capacity and power consumption of the given equipment. Profitability is related to the centralized obtaining of the cold for cooling different spaces
	Market potential (replication)	Represents the building and industrial sectors
	Impact and benefits of adaptation	Covering the growing demand for air conditioning during the warm period of the year
22.	**TNA Technology**	**Electric motors class IE 3**
	The national policy framework that supports technology	GD no. 1003/2014 for the approval of the regulations regarding the energy labeling requirements of some products with energy impact

	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	From January 2015, all electric motors with powers between 7.5 kW and 350 kW must comply with the IE3 energy efficiency standard, thus implementing in the European Union Directive 2005/32 / EC (promoted by EC rules 640/2009). The theoretical premises of this taxation are very positive: as the statistics show that electric motors consume about 70% of the electricity produced in Europe, the forecasts of specialists speak of significant savings by switching to IE3 (savings of hundreds of TWh).
	Investment cost and profitability	Depending on the electric power of the motors, the investment cost varies from 1500 - 3000 Euro / per unit. The profitability of this technology in terms of significantly reducing electricity costs and reducing GHGs
	Market potential (replication)	The industrial and agricultural sector of the Republic of Moldova
	Impact and benefits of adaptation	Avoid overheating the engines due to high temperatures
23.	**TNA Technology**	**Creating favorable conditions for the implementation of the Energy Management Standard (SM ISO 50001: 2012 "Energy Management Systems. Requirements and User Guide") for enterprises in the energy, industrial and public sectors in order to increase energy efficiency and decrease energy intensity**
	The national policy framework that supports technology	Law 139/2018 on energy efficiency
	Brief description of the technology (including technical indicators such as yields, coefficients, etc.)	An energy management system is the set of interrelated or interacting elements that belong to a plan that sets the goal of energy efficiency and the strategy to achieve that goal. In accordance with this legal framework, large enterprises that implement an energy or environmental management system are exempted from the application of the requirements for the preparation of an energy audit report that meets the minimum criteria established by law.
	Investment cost and profitability	The cost of the investment is determined by the size of the company and can range from 2,000 to 10,000 euros per company. The profitability of the action is related to the organization of energy management processes in the enterprise in order to save primary and secondary energy resources.
	Market potential (replication)	Large enterprises that do not fall under the scope of Law no. 179/2016 on small and medium enterprises
	Impact and benefits of adaptation	Optimizing energy consumption during extreme periods of climate change and reducing the energy intensity of products

Annex 3. Technology fact sheets, extended format for energy sector adaptation to climate change

General aspects of overcoming climate impacts

In the energy sector three climate impacts are expected to be overcome by applying appropriate technologies/measures:

1. The risk of reduced electricity and heat production due to a lack of water at the CET and CHE as a result of droughts;
2. Damage to electricity grids following extreme events;
3. Significant increase in power and energy consumed in summer due to increased energy demand for air conditioning and land irrigation as a result of heat waves;

The following technologies contribute to **overcoming climate impact No. 1** *The risk of reduced electricity and heat production due to lack of water at the CET and CHE due to droughts:*

1. Generating electricity by applying photovoltaic technologies;
2. Electricity and heat generation by applying high-efficiency cogeneration technologies based on natural gas;
3. Generating electricity by applying wind technologies;
4. Storage installations for electricity produced from renewable energy sources;
5. Thermal energy generation for domestic hot water production based on solar collectors;
6. Thermal energy generation based on solid biomass combustion plants;
7. Thermal energy generation based on ground-to-water heat pumps.

The following technologies contribute to **overcoming climate impact No. 2** *Damage to electricity grids from extreme events:*

1. Development of a system for the prevention and protection of electrical networks against scale deposits;

The following technologies contribute to **overcoming climate impact 3 The** *significant increase in power and energy consumed in summer due to increased energy demand for air conditioning and land irrigation as a result of heat waves:*

1. Thermal insulating materials for the external cladding of buildings (mineral wool and thermopane glazing);
2. High efficiency cooling and air conditioning technologies.

The TFSs for each of these climate impacts are presented below.

1. **Climate impact no. 1 Risk of reduced electricity and heat production due to lack of water at the CET and CHE**

Mono crystalline photovoltaic systems

● **General Information**	
Sector	Energetic
Category	Electricity and heat generation and distribution
Technology name	**Monocrystalline photovoltaic installations**
Short description of the technology	Photovoltaic power generation technology is one of the most widespread in the Republic of Moldova. Two basic technologies used locally are known: mono and poly crystalline photovoltaic panels. Monocrystalline photovoltaic panels are manufactured using monocrystalline cells, and a monocrystalline cell is, after all, a pure silicon crystal. Monocrystalline solar panels are very easy to recognize because there is no free space between the cells that make up the module, unlike other types of photovoltaic panels. It is characterized by flexibility, reduced weight, compactness, reliability and durability.[18] Advantages of monocrystalline solar panels: ● The efficiency with which it converts sunlight into electricity exceeds that of other panel types available. Why is this? Its efficiency is due to the purity of the silicon and the fact that electrons are not lost in the crystal pieces, as happens with polycrystalline panels. The average efficiency for this type of photovoltaic panel is typically between 15% and 20%; ● It produces four times more electricity than previous solar panels in use; ● It does not take up a large area on the roof; ● The average lifetime of monocrystalline photovoltaic panels is about 25-30 years; ● Compared to polycrystalline modules, monocrystalline photovoltaic panels perform better under the same lighting conditions. Disadvantages of monocrystalline solar panels ● They are made using more expensive materials (pure crystals) and are therefore more expensive than polycrystalline solar panels. However, because of their quality, solar panels of this type are in most cases a better investment; ● They are more fragile when temperatures are very high; all types of panels have lower resistance when exposed to high temperatures, but monocrystalline solar panels seem to be more sensitive. Even their yield is significantly higher than that of amorphous types. Due to their flat technological construction they are also widely used in the residential and public sectors.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient.

[18] http://www.esolar.ro/sfaturi-utile/toate-tipurile-de-panouri-solare-avantajele-si-dezavantajele-lor.html

	Green energy development. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient and clean biomass combustion technologies, and facilitating the connection of production facilities to existing distribution capacity. Active and effective communication on the benefits of green energy for improved living conditions and environmental protection Facilitating the creation of regional Eco-energy centers in order to increase the degree of energy autonomy at local level through the use of renewable technologies. The priorities mentioned above are part of the Government Decision no. 377/2020 on the approval of the draft law for the approval of the National Development Strategy *Moldova 2030* . [19]
The country's economic development priorities	Promoting energy efficiency and renewable energy projects in the public and residential sectors, with the development of financing instruments accessible to the subjects of these sectors, where appropriate, with a focus on vulnerable consumers. According to the Energy Strategy 2030, the Republic of Moldova already has a substantial domestic generation capacity, in relation to current and projected consumption, which is superior in this ratio to the Contracting Parties of the Energy Community, and one of the three directions to strengthen this capacity is the integration of new capacity, including renewable electricity capacity, into the transmission and distribution networks[20]
The country's environmental development priorities	Developing green energy to reduce environmental pollution. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient and clean photovoltaic technologies. At the same time, in accordance with the Environmental Strategy for 2014-2023, special attention will be paid to the promotion and production of green energy, obtained through: 1) exploitation of wind, hydro (wind power plants, pumped storage wind power systems, micro-hydropower plants without dams and small hydropower plants; 2) exploitation of solar energy through conversion into electricity and heat (photovoltaic energy, biomass heat, etc.); 3) development of the energy potential of biomass (biofuel production from cereals, sorghum, technical oil crops - rapeseed, sunflower, grape seeds from the wine industry, etc.) and other sources [21]
Marketing potential	The marketing potential of the technology would be 40 MW through the support schemes fixed tariffs, auction and 37 MW through the application of the net metering support scheme. The new draft decision on the amendment of GD No 689/2018 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable energy sources until 2020, provides that the cumulative capacity by given type of technologies will increase by 2025 to 135 MW.
• **Country specific applicability**	
Institutional capacities	The institutional capacities that support photovoltaic panel technology are primarily state institutions that promote these technologies. Thus, the Agency for Energy Efficiency has developed and made public the informative Guidebook on the Net Metering support mechanism, specifically targeting PV

[19] https://www.legis.md/cautare/getResults?doc_id=121920&lang=ro

[20] https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro

[21] https://mecc.gov.md/sites/default/files/document/attachments/strategia_de_mediu_pentru_anii_2014-2023.pdf

	technologies[22] that can be used in the residential sector. A number of private companies also supply and install PV equipment for the private and public sector. Detailed information on the main companies practicing and promoting such technologies can be accessed at the links below[23][24]
Technology status in the country	At the moment there are several PV projects in the country, which have been implemented (Ungheni carpets, FLY REN PV park, the public building of the Ministry of Environment, etc.), both by the private and public sector. The total installed capacity currently installed in the country is just over 4 MW, with a theoretical potential to expand up to 1 GW (considered cost competitive according to IRENA estimates)
Local acceptability	At the local level, PV-based electricity generation technology is accepted by both the private and the public sector in order to cover their own energy needs and generate revenues from the sale of energy to the public grid. As a rule, projects are implemented independently without causing conflicts of interest.
The potential for a paradigm shift	The paradigm shift is to replace fossil fuel energy with renewable energy. On a national scale, the technology is expected to have a paradigm shifting impact on society through the support schemes proposed and offered by the Government, as well as the promotion of the concept of local energy autonomy. The contribution of the technology will significantly contribute to the economic development of the country, improvement of living conditions, as well as the population's access to clean energy by substituting fossil energy resources.
Efficiency and effectiveness	Compared to other types of technologies that generate green energy from renewable energy sources, photovoltaic installations still have a low efficiency on the local and global market. However, their efficiency is primarily determined by the simplicity of installation and operation, as well as their use in areas where power transmission or distribution lines cannot be built. The effectiveness of this technology increases significantly when we talk about the use of photovoltaic panels to generate electricity used for pumping water for irrigation purposes. In this sense, the energy supply during the summer period corresponds to the energy demand required for irrigation. According to the IRENA report on the assessment of readiness for renewable energy utilization in the Republic of Moldova[25] , trends have been observed in new technologies with increased efficiencies. Thus, amorphous panels with a maximum efficiency of 15% have given way to mono and polycrystalline photovoltaic panels that exceed 18% in terms of efficiency.
Potential for sustainable development	Sustainability of the project will be ensured through economic co-benefits in particular reduced electricity bills for prosumers as well as local business development. The technology contributes to achieving the objective of energy autonomy at local level in the context of climate change. At the same time, the potential for sustainable development will also be ensured by the advantage of local power generation, which will contribute to the reduction of energy and power losses in the service areas of the power line

22 https://aee.gov.md/storage/publicatii/Ghid%20informativ%20privind%20mecanizmul%20de%20sprijin%20contorizare%20neta.pdf

23 https://zawenergy.md/ru/%d0%b3%d0%bb%d0%b0%d0%b2%d0%bd%d0%b0%d1%8f/

24 https://amper.md/

25 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_RRA_Moldova_2019_RO.pdf

	operators. Thus, the aim is to increase the reliability of low and medium voltage networks in the service area of distribution system operators.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of photovoltaic power generation technologies. The impact of the technology will particularly extend to the agricultural sphere, where women are employed in the technological process of crop sorting.
• **Costs**	
Investment, US$/kW	The specific investment of the technology in question is determined on the basis of ANRE decision no. 54/2020[26] and constitutes 960 $/kW installed power.
O&M costs, US$/year	O&M costs are determined based on the same ANRE Decision and will not exceed 1.9%/year of the total investment cost. The estimated O&M costs are 18.5 $/kW/year.
• **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which is required to be performed as an operation at least once a year.
Boosting investment	The driver of the investment stimulus is the benefits of the technology, which pay for themselves within 7-9 [27][28] years. At local level investment incentives are promoted through different donors and projects. An example is Livada Moldovei, which is a line of credit offered by the European Investment Bank (EIB) to the Government of the Republic of Moldova, which in turn provides this loan to participating commercial banks. The loans are intended for investments in the horticultural sector, including photovoltaic financing[29] . Similarly, the European Bank for Reconstruction and Development (EBRD), through the GEFF project and local commercial banks, finances photovoltaic technology projects targeting the small and medium-sized enterprise sector. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy efficient technologies[30]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. Photovoltaic technologies will be directed towards reducing public and private expenditure on the energy resources used. For those users who will abuse the net metering support scheme, they will benefit from the reduction of their own energy consumption, and their expenditure will decrease in proportion to the electricity produced by the PV installations. The reduction in

[26] https://www.legis.md/cautare/getResults?doc_id=125777&lang=ro#

[27] Economic aspects of electricity suppliers using photovoltaic installations and applying the net method support scheme

[28] Pre-feasibility study on facilitating the financing of renewable energy electricity generation projects (RES-E) for accessing FVC funds

[29] https://livada-moldovei.md/

[30] https://techselector.com/moldova-ro/

	electricity costs will be recorded from the first year of the investment and the savings in financial resources can be re-invested according to the needs of the beneficiaries.
● **Social benefits**	
Direct hiring	Due to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	Promoting the technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment, the labor market in the Republic of Moldova has an acute shortage of qualified professionals in the field of photovoltaic system installers. Thus, it will be necessary that the capabilities of the newly trained cadres will be developed with skills and work skills adjusted to the new technology requirements.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing electricity generation as a result of possible reductions in electricity production at existing power plants caused by water shortages at existing power plants due to climate change. The generation process will contribute to meeting the energy demand for space cooling and energy needs for land irrigation.
Others, if they are	

High efficiency natural gas cogeneration plants

● **General Information**	
Sector	Energetic
Category	Electricity and heat generation and distribution
Technology name	**High efficiency natural gas cogeneration plants**
Short description of the technology	Cogeneration technologies are an efficient way of utilizing primary energy resources and reducing negative environmental impacts. In the case of the Republic of Moldova, the use of high-efficiency cogeneration for energy production helps to reduce energy dependence on external suppliers and increases the country's energy security .[31] Under the existing legal framework, high-efficiency cogeneration meets the following criteria: 1. cogeneration production from cogeneration units shall provide primary energy savings of at least 10% compared to the reference values for separate production of electricity and heat; 2. The production of low power units and micro-cogeneration units providing primary energy savings can be considered as high efficiency cogeneration.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient. Strengthening the centralized heat supply systems in cities in order to increase the overall efficiency of generation and supply of heat and domestic hot water, as well as to reduce the related risks of "transferring" the burden of the centralized heat supply systems on the shoulders of the population remaining connected to the centralized system, and to reduce the risk of massive pollution of cities with combustion products of individual heating installations The above priorities are part of the Government Decision No 377/2020 on the approval of the draft law on the approval of the National Development Strategy *Moldova 2030* . [32]
The country's economic development priorities	Increased allocation of private and public resources to infrastructure projects will enable its modernization and increase access of the population, especially vulnerable groups, to the infrastructure elements that define quality of life, including access to electricity and heat. In order to promote high efficiencies in cogeneration plants, Government Decision No. 297/2016 on the approval of harmonized efficiency reference values for separate production of electricity and heat was approved. In this regard, it shall be taken into account that at the choice of technology the existing cogeneration unit is retrofitted, and the investment cost for retrofitting exceeds 50 % of the investment cost for a new, equivalent high-efficiency cogeneration unit, when applying the provisions of points 3 and 4 of the Annex to the mentioned Government Decision[33] the year of commissioning shall be considered as the year of commissioning the year when the tests on commissioning the cogeneration unit after retrofitting are completed
The country's environmental	According to the law no. 92/2014 on thermal energy and promotion of cogeneration, the technology will contribute to ensuring energy security, environmental protection, and consumer interests.

[31] http://cris.utm.md/bitstream/5014/239/1/87-90_21.pdf

[32] https://www.legis.md/cautare/getResults?doc_id=121920&lang=ro

[33] https://www.legis.md/cautare/getResults?doc_id=91468&lang=ro

development priorities	The law also provides for environmental protection through appropriate measures to prevent pollution, including the prevention of accidents or limiting their consequences.
Marketing potential	The marketing potential of the technology has been established based on the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, HG no. 1470 of 30.12.2016[34] . Thus, the promotion of the implementation of distributed power generation with the application of high-efficiency natural gas-fired district heating power plants envisages the construction of 40 small power plants with a total installed capacity of 20 MW. As a related effect of the adaptation measure, this technology reduced CO2 emissions by 41 456 tons/year.
• **Country specific applicability**	
Institutional capacities	The institutional capacities that support CHP technology are primarily state institutions that promote these technologies. Thus, the basic promoter of this technology are the policies developed at the country level and supported by specialized central public authorities such as the Ministry of Infrastructure and Regional Development, the Energy Efficiency Agency. The market of suppliers of equipment based on these technologies is poorly developed in Moldova. In most cases this equipment is imported by foreign companies.
Technology status in the country	There are currently several cogeneration projects in the country with capacities ranging from 1 MW to 13 MW. The most important cogeneration project that uses natural gas as fuel is the 13.5 MWe plant in Balti, which is located in the city of Balti, serving the SA CET Nord. The project was implemented with the support of development partners and loans contracted from the EBRD. Also a cogeneration plant with a capacity of 5 MWe using biogas is built and operating in the city of Bălți. Drochia, in the company Sudzuker Moldova.
Local acceptability	At the local level, the technology of producing electricity and heat through the application of cogeneration processes is particularly predestined for the public and residential sectors
The potential for a paradigm shift	The paradigm shift is to promote the concept of district heating through high-efficiency cogeneration plants at both local and central level. At national scale the technology is expected to have a paradigm shifting impact on society by promoting the concept of local energy autonomy. The contribution of the technology will significantly contribute to the economic development of the country, to the improvement of living conditions of the population, especially those in district centers.
Efficiency and effectiveness	Compared to other types of technologies generating electricity and heat, high efficiency cogeneration plants have a higher efficiency compared to other types of technologies currently available on the local market. Their efficiency is primarily determined by the overall annual efficiency set at a level of at least 80%[35] . In order to adapt the harmonized efficiency reference values for separate production of electricity to the average climatic situation in the Republic of Moldova with the deviation of the annual average outdoor temperature from the standard conditions (+15 ºC), corrections related to the efficiency will be applied as follows: (a) 0,1 percentage point yield loss for each degree above +15 °C;

[34] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

[35] https://www.legis.md/cautare/getResults?doc_id=121989&lang=ro

	b) 0.1 percentage point increase in efficiency for each degree below +15 °C .[36]
Potential for sustainable development	The sustainability of the project will be ensured primarily through economic co-benefits, in particular the reduction of bills for thermal energy delivered to the localities of the district centers. The technology contributes to achieving the objective of local energy autonomy. At the same time, the potential for sustainable development will also be ensured by the advantage of generating thermal energy locally, which will contribute to the reduction of energy losses in its transportation and distribution. On the basis of the implementation of Law 139/2018 in order to promote energy efficiency in heating and cooling, including high-efficiency cogeneration, the central specialized body of public administration in the field of energy is conducting a comprehensive assessment of the national potential for the implementation of high-efficiency cogeneration and efficient system of centralized supply of heat and cooling, thus ensuring the sustainable development of technologies at the country level.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of combined heat and power technologies. The impact of the technology will extend especially in the sphere of localities and district centers, where the centralized heat supply system has been destroyed. Living conditions will be improved for families living especially in multi-storey blocks of flats and working in the public sphere.
● **Costs**	
Investment, Euro/kW	The specific investment of the technology in question is determined on the basis of ANRE decision no. 54/2020[37] and constitutes 3000 Euro/kW installed power.
O&M costs, Euro/year	O&M costs are determined based on the same ANRE Decision and will not exceed 3%/year of the total investment cost. Specific variable maintenance and operation expenses will be 13 Euro/MWh, energy produced
● **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which is required to be performed as an operation at least once a year.
Boosting investment	The generator of the investment incentive is the advantage that the country's normative legal framework provides to electricity producers, namely that they are entitled to participate in the wholesale and retail markets, balancing electricity markets and to provide other operational services to system operators, in compliance with the provisions of Law No. 107/2016 on Electricity and under the conditions set out in the Electricity Market Regulations approved by the National Energy Regulatory Agency. This aspect

[36] https://www.legis.md/cautare/getResults?doc_id=91468&lang=ro

[37] https://www.legis.md/cautare/getResults?doc_id=125777&lang=ro#

	represents a significant advantage for potential investors, where the Republic of Moldova has a low potential for balancing energy coverage. Similarly, the European Bank for Reconstruction and Development (EBRD), through the GEFF project and local commercial banks, finances projects in the field of cogeneration technologies for small and medium-sized enterprises and the residential sector. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy efficient technologies[38]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. Cogeneration technologies will be aimed at reducing public and private expenditure on the energy resources used.
● **Social benefits**	
Direct employment	Due to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	Promoting the technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment, the labor market in the Republic of Moldova has an acute shortage of qualified personnel in the field of high efficiency cogeneration installers. Thus, it will be necessary that the capabilities of the newly trained cadres will be developed with skills and work skills adjusted to the new technology requirements.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at the CET.
Benefits of adapting to climate change	The proposed technology will make a significant contribution to the provision of electricity and heat generation as a result of possible reductions in electricity generation at existing power plants due to water shortages at existing power plants as a result of climate change. The generation process will contribute to meeting the energy demand for space cooling and energy needs for land irrigation.
Others, if they are	

[38] https://techselector.com/moldova-ro/

Horizontal axis wind technologies

● **General Information**	
Sector	Energetic
Category	Electricity generation and distribution
Technology name	**Horizontal axis wind technologies**
Short description of the technology	Wind power is a clean and renewable energy but it is intermittent, varying throughout the day and season, and even from year to year. Wind turbines operate about 60% of the year in windy regions. Most wind turbines produce power more than 25% of the time, with this percentage increasing in winter when winds are stronger. The first wind turbine in Moldova was installed in the north of the country by Elteprod SRL. The priority applied technologies for the Republic of Moldova are horizontal axis wind turbines. Basically it is a rotating machine in which the motion is produced by the kinetic energy of the wind when acting on an impeller which normally has three blades. The rotational motion produced is transmitted and multiplied by a speed multiplier to a generator which is responsible for producing electricity. All of these components sit on a gondola that sits atop a supporting tower. These are the conventional ones that can be found in some parts of our country, charting a different skyline and landscape, but offering clean and cheap energy. The energy obtained from a wind turbine depends on the power of the wind passing through the rotor and is directly proportional to the air density, the area swept by its blades and the wind speed. The absolute majority of turbines on the market are horizontal axis. This has a considerable advantage over vertical axis turbines, where the axis of rotation of the former coincides with the direction of the wind and is parallel to the ground surface. In vertical axis wind turbines, the wind direction is perpendicular to the axis of rotation and perpendicular to the ground surface, respectively: - Lower operating and maintenance costs; - Increase wind energy conversion, including in areas with moderate winds; - Decreasing the starting speed of the turbine, thus increasing the range of working wind speeds; - Reducing the length and weight of the gondola; - Reduced vibration and noise; - Increased turbine reliability. The operation of a wind turbine is characterized by its power curve, which indicates the range of wind speeds in which it can be driven and the power required in each case.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient. Developing green energy. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of wind technologies. Active and effective communication on the benefits of green energy for improving living conditions and protecting the environment Facilitating the creation of regional Eco-energy centers in order to increase the degree of energy autonomy at local level through the use of renewable technologies. The priorities mentioned above are part of the Government

	Decision No 377/2020 on the approval of the draft law for the approval of the National Development Strategy *Moldova 2030* .[39]
The country's economic development priorities	Promoting energy efficiency and renewable energy projects in the public and residential sectors, with the development of financing instruments accessible to the subjects of these sectors, where appropriate, with a focus on vulnerable consumers. According to the Energy Strategy 2030, the Republic of Moldova already has a substantial domestic generation capacity, in relation to current and projected consumption, which is superior in this ratio to the Contracting Parties of the Energy Community, and one of the three directions to strengthen this capacity is the integration of new capacity, including renewable electricity capacity, into the transmission and distribution networks[40]
The country's environmental development priorities	Developing green energy to reduce environmental pollution. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient and clean wind technologies. At the same time, in accordance with the Environmental Strategy for 2014-2023, special attention will be paid to the promotion and production of green energy, obtained by: 1) harnessing wind energy (wind power plants, wind pumped storage systems); [41]
Marketing potential	The marketing potential of the technology would be 100 MW through the support schemes fixed tariffs and auction. The new draft decision on amending GD No. 689/2018 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable energy sources until 2020, provides that the cumulative capacity by given type of technologies will increase by 2025 to 105 MW. [42]
• **Country specific applicability**	
Institutional capacities	The institutional capacities that support wind power technology are primarily the state institutions that promote these technologies. The Energy Efficiency Agency is one of them. Also, a number of private companies have already installed and are generating electricity in the national public grid. Detailed information on the main companies that are eligible for this type of activity, based on wind technology, can be found on the ANRE website[43]
Technology status in the country	At the moment there are several wind projects in the country, which have been implemented by private companies such as SRL Elteprod, SRL INTS:NET, G&G Wind, etc. The total installed capacity in the country is 29.4 MW (according to data presented by ANRE[44] , with an estimated technical potential of up to 9151 MW [45]
Local acceptability	At the local level, wind-based electricity generation technology is accepted by the private sector for the purpose of power generation and sale into the national grid.
The potential for a paradigm shift	The paradigm shift is to replace fossil fuel energy with renewable energy. On a national scale, the technology is expected to have a paradigm shifting impact on society through the support schemes proposed and offered by the

[39] https://www.legis.md/cautare/getResults?doc_id=121920&lang=ro

[40] https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro

[41] https://mecc.gov.md/sites/default/files/document/attachments/strategia_de_mediu_pentru_anii_2014-2023.pdf

[42] https://cancelaria.gov.md/sites/default/files/document/attachments/proiect-33.pdf

[43] https://www.anre.md/registrul-producatorilor-eligibili-3-213

[44] https://www.anre.md/registrul-producatorilor-eligibili-3-213

[45] http://www.cnaa.md/files/theses/2016/24496/vasile_rachier_thesis.pdf

	Government, as well as the promotion of the concept of local energy autonomy. The contribution of the technology will significantly contribute to the economic development of the country, improvement of living conditions, as well as the population's access to clean energy by substituting fossil energy resources.
Efficiency and effectiveness	These types of turbines are installed on poles, at great heights, where they benefit from a wind at least 2-3 times stronger, uniform and constant, compared to installation in the same place but on the ground. They have a much higher efficiency, generating electricity using up to 50-55% of the available wind energy (wind power), compared to 15-20% for vertical wind turbines.
Potential for sustainable development	Sustainability of the project will be ensured through economic co-benefits in particular local business development. The technology contributes to achieving the objective of energy autonomy at local level in the context of climate change. At the same time, the potential for sustainable development will also be ensured by the advantage of local power generation, which will contribute to the reduction of energy and power losses in the service areas of power line operators. Thus, the aim is to increase the reliability of medium and high voltage networks in the service area of distribution and transmission system operators.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the deployment of wind power technologies. The impact of the technology will particularly extend to electricity transmission and distribution companies as well as local electricity supply companies.
• **Costs**	
Investment, US$/kW	The specific investment of the technology in question is determined on the basis of ANRE decision no. 54/2020[46] and constitutes 1500 $/kW installed power.
O&M costs, US$/year	O&M costs are determined based on the same ANRE Decision and will not exceed 3%/year of the total investment cost. The estimated O&M costs are 45 $/kW/year.
• **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which needs to be performed as an operation at least once a year.
Boosting investment	At the local level investment incentives are promoted through local commercial banks. At the moment there is no project or program from foreign donors that would stimulate the given business in the aspect of preferential credits. Investments take place at the investor's own risk.
Public and private expenditure	The costs of the technology described are borne solely by the private sector. The decrease in public sector expenditures for primary energy resources is expected to be achieved once the local market is sufficiently penetrated by intermittent energy produced based on wind technologies. This is expected after 2030.

[46] https://www.legis.md/cautare/getResults?doc_id=125777&lang=ro#

● **Social benefits**	
Direct hiring	Thanks to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, designers, etc.).
Skills and capacity development	Promoting the technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment, the labor market in the Republic of Moldova has an acute shortage of qualified personnel in the field of wind power plant installers. Thus, it will be necessary to develop the capacities of the newly trained cadres with skills and work skills adjusted to the new technology requirements.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing electricity generation as a result of possible reductions in electricity production at existing power plants caused by water shortages at existing power plants due to climate change. The generation process will contribute to meeting the energy demand for space cooling and energy needs for land irrigation.
Others, if they are	

Li-Ion electricity storage installations

● **General Information**	
Sector	Energetic
Category	Electricity generation and distribution
Technology name	**Li-Ion electricity storage installations**
Short description of the technology	Energy storage technologies offer a flexible response to imbalances caused by an increasing share of variable renewable energy sources such as solar and wind power in the electricity grid. Batteries store electrical energy in chemical form and convert that energy into electricity. A battery usually has three parts: two electrodes and an electrolyte between them. When a charged battery is connected to a circuit, charged ions flow between the electrodes through the electrolyte. This charge transfer generates electricity in the circuit. Batteries can be used for short term energy storage for several hours or days, for example for shifting peak daily demand. When charged, however, batteries cannot hold their charge for several weeks or months without significant losses. Many types of batteries, such as lead-acid and lithium-ion, are commercially available. New versions of these technologies are under development. Researchers are working on alternatives, such as solid-electrolyte lithium batteries.[47] The unstable / intermittent nature of renewable energy sources, such as wind and solar energy, are strongly dependent on climatic conditions. The problem is particularly accentuated on grid sections where the momentary generation capacity of renewable energy sources exceeds the momentary consumption load. The large-scale deployment of innovative electricity storage technology in distribution grids will reduce the tariff for electricity distribution, as it will reduce the amount of electricity needed to be purchased to cover technological consumption and network losses. Energy storage can be designed based on Li-Ion batteries and integrated in individual containers. This allows the storage of more energy resulting from the generation of intermittent sources. Equipping the storage equipment with a control system also provides greater flexibility to provide more energy storage services.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy costs and making energy consumption more efficient. Developing green energy. Stimulate interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient technologies. Facilitating the creation of regional Eco-energy centers in order to increase local energy autonomy through the use of renewable technologies, or electricity storage equipment is part of this process.
The country's economic development priorities	According to Law 139/2018 on Energy Efficiency, Art. 27, paragraph (9), letter f) The regulatory normative acts approved by the National Agency for Energy Regulation and the tariffs for electricity transmission and distribution services shall not prevent system operators from making available on the organized electricity markets system services in connection with demand-side management and demand response measures and in connection with distributed generation, in particular measures such as: f) energy storage."

[47] https://www.eca.europa.eu/Lists/ECADocuments/BRP_ENERGY/BRP_ENERGY_RO.pdf

	At the same time it is expected that ANRE Decision no. 283/2020 on the approval of the Electricity Market Rules will be realized, namely by the application of item 459) by the system operators which states that: each distribution system operator assumes the responsibility for balancing its own technological consumption and losses of electricity in its own distribution network .[48]
The country's environmental development priorities	In turn, the technology of storing electricity produced from renewable energy sources will directly contribute to the process of environmental development in the country by reducing CO2 emissions and improving the environment, improving the health of the population.
Marketing potential	The marketing potential of the technology would be included in the service areas of the operators of the electricity distribution and transmission networks. According to the concept note developed by the Institute of Energetics in the framework of the technology transfer competition[49] , in the Republic of Moldova a total storage capacity of 4700 MVA is estimated.
● **Country specific applicability**	
Institutional capacities	The institutional capacities that support PV panel-based power generation technology are local companies importing different types of batteries. Most of the companies importing such equipment are focused on storage batteries of small capacities, mainly used for off grid connection of renewable energy sources. From the main importing companies of storage equipment we can list the following: ZawEnergy[50] , Compass Moldova [51]
Technology status in the country	At the moment in the country there is no energy storage equipment predestined for the operators of energy distribution and transmission systems, except for small power generation facilities based on photovoltaic installations connected off grid.
Local acceptability	Locally, the technology for storing electricity produced from renewable energy sources is accepted by the private sector and distribution companies. The latter are aligning their policies on the local market based on the new provisions imposed by the legal framework for the liberalization of the electricity market by the end of 2021.
The potential for a paradigm shift	The paradigm shift is the use of technologies proposed by distribution and transmission companies to balance their own technological consumption and losses of electricity in the grid. On a national scale, the technology is expected to have a paradigm-shifting impact and in promoting the concept of local energy autonomy. The contribution of the technology will significantly contribute to the economic development of the country, improve the technological processes of companies and encourage the private sector to widely utilize off grid connections.
Efficiency and effectiveness	The technology on the international market is intended strictly for use in the immediate vicinity of intermittent sources with delivery into the transmission grid. The efficiency of the technology is its use in certain points of the distribution network, where energy losses are usually 2-3 times higher than in the transmission networks. These aspects make it possible to flatten the load curve and reduce energy losses in distribution networks, which means significant savings of electricity predestined for technological processes. The

[48] https://www.legis.md/cautare/getResults?doc_id=123381&lang=ro

[49] https://ancd.gov.md/sites/default/files/document/attachments/Expertiza%20ITT%202021.pdf

[50] https://zawenergy.md/ru/%d0%b3%d0%bb%d0%b0%d0%b2%d0%bd%d0%b0%d1%8f/

[51] https://amper.md/

	revenues generated annually will increase with the increase in the price of balancing energy. Under these minimum conditions, the payback period of such a plant will constitute 8-9 years.
Potential for sustainable development	The sustainability of the project will be ensured through economic co-benefits obtained by the distribution and transmission companies. The technology contributes to the objective of energy autonomy at local level in the context of climate change. At the same time, the potential for sustainable development will also be ensured by the advantage of local power generation, which will contribute to the reduction of energy and power losses in the service areas of power line operators. Thus, the aim is to increase the level of reliability of low, medium and high voltage grids in the service area of distribution and transmission system operators.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the deployment of technology based on electricity storage facilities. The impact of the technology will be particularly widespread in distribution and transmission companies, where currently 20% of the total number of staff employed are women . [5253]
• **Costs**	
Investment, US$/kVA	The investment cost of such a plant depends on several parameters and is exactly determined at the stage of project documentation. On the basis of the analysis of several storage projects it was determined, that the specific cost for such installations is about 270 USD/kVA. Reference to this investment cost is the project proposal prepared by the Institute of Energetics for the technology transfer project announced in 2020 by the National Agency for Research and Development.
O&M costs, US$/year	An exact cost of O&M costs is not established, but estimates show that they will not exceed 1%/year of the total investment cost, i.e. 2.7 USD/kVA
• **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which is required to be performed as an operation at least once a year. Also according to the above mentioned project proposal it is expected to open around 4000 new jobs.
Boosting investment	At the moment in the Republic of Moldova there are no incentives or preferential credits for the promotion of these technologies at local level. However, competitions announced by research organizations at national level stimulate innovation and the promotion of these technologies, offering from the

52 https://www.rednord.md/doc/dezvinfo/Rapoarte%20privind%20activitatea/2020/Raportul%20conducerii%20a.2020.pdf

53 https://www.premierenergydistribution.md/sites/default/files/2020-07/Raport_de_responsabilitate_corporativa_Distribution_2019.pdf

	state account 50% subsidies in the form of grants[54] . Investment incentives are also expected to come as a response to the additional source of revenue from companies obtained as a result of the entry into force of the new Electricity Market Rules, namely: ● primary and secondary frequency regulation reserve; ● power reserve for tertiary regulation; ● voltage regulation; ● Turning on generation to restore the power system; ● active energy to cover losses in distribution and transmission networks.
Public and private expenditure	The costs of the technology described will be borne by the operators of the electricity distribution and transmission systems. In some cases by the private sector, which will be co-interested in the promotion of off-grid off-grid system of grid connection of intermittent installations. Energy storage technologies will be directed to reduce the expenses related to covering own technological energy consumption, as well as to reduce power and energy losses on power line sections. The reduction of expenses for covering own technological consumption will be recorded from the second year after the energy storage facilities are put into operation.
● **Social benefits**	
Direct hiring	Thanks to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, designers, sales managers, etc.).
Developing skills and capacities	The promotion of technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment, the labor market in the Republic of Moldova has an acute shortage of qualified personnel in the field of electrical energy storage equipment. Thus, it will be necessary that the capabilities of the newly trained cadres will be developed with skills and work skills adjusted to the new technology requirements.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing electricity generation as a result of possible reductions in electricity production at existing power plants caused by water shortages at existing power plants due to climate change. The generation process will contribute to meeting the energy demand for space cooling and energy needs for land irrigation.
Others, if they are	

[54] https://ancd.gov.md/ro/content/concursului-proiectelor-de-inovare-%C8%99i-transfer-tehnologic-finan%C8%9Bate-de-la-bugetul-de-stat-0

Evacuated solar collectors

● **General Information**	
Sector	Energetic
Category	Electricity and heat generation and distribution
Technology name	**Evacuated solar collectors**
Short description of the technology	Solar collectors feature a special heat exchanger that converts solar radiation energy into thermal energy. They differ from most conventional heat exchangers in which the transfer of heat by radiation plays an insignificant role (e.g. liquid-liquid heat exchanger). From a functional point of view, the main component of the solar collector is the radiation absorber which converts the energy of the sun's rays into thermal energy and transfers it to a thermal agent (water, antifreeze). With this thermal agent, the energy is taken from the collector and is either stored or used directly (e.g. domestic hot water). In order to reduce unavoidable heat losses, thermal insulation of the absorbing element from the surrounding environment is necessary. Depending on the technique used for this purpose, a distinction is made: ● collectors using ordinary insulating materials; ● collectors where thermal insulation is achieved by vacuum but are expensive to manufacture; ● collectors based on simple techniques for heating swimming pools. A special design is the evacuated tube solar collector. They consist of parallel tubes behind which are reflectors for concentrating the solar radiation. The evacuated tubes consist of two concentric glass tubes with a vacuum between them. The inner tube is surrounded by an absorbent surface to which is attached a copper tube through which a heat transfer medium circulates. The vacuum between the tubes minimizes heat loss through convection and conduction, allowing for higher performance (higher efficiency and higher temperatures). Due to higher temperatures the heating installation may require special elements to eliminate the danger of overheating. Such collectors are more efficient in moderate temperature zones, their use in hot zones is only justified in technical installations where higher temperatures are needed. A further advantage is that the absorbing surface is always perpendicular to the direction of the sun's rays, so that the absorbed energy is almost constant throughout the day.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient. Developing green energy. Stimulating interest in the production and consumption of green energy by harnessing renewable energy sources, including the use of efficient solar-to-heat technologies Active and effective communication on the benefits of green energy for improving living conditions and protecting the environment
The country's economic development priorities	Promoting energy efficiency and renewable energy projects in the public and residential sectors, with the development of financing instruments accessible to the subjects of these sectors, where appropriate, with a focus on vulnerable consumers.

The country's environmental development priorities	Developing green energy to reduce environmental pollution. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient and clean photovoltaic technologies. At the same time, according to the Environmental Strategy for 2014-2023 special attention is paid to the promotion and production of green energy, obtained by: 2) harnessing solar energy by converting it into electricity and heat (photovoltaics, biomass heat, etc.); Also through the strategy is aimed at attracting investment in infrastructure, equipment and technologies for the use of renewable energy sources such as solar energy (location of systems based on expected changes in solar duration).
Marketing potential	According to the Energy Solution Guide for Better Living[55] , about 66-70% of the annual demand for domestic hot water can be covered by using solar collector technologies. According to the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, HG no. 1470 of 30.12.2016[56] harnessing solar energy for domestic hot water production in urban and rural settlements and enterprises would include 64 thousand m2 solar collectors, and as a related effect to the adaptation measure would be the mitigation effect that would reduce about 203 130 tons CO2/year, in the case of the unconditional GHG emission reduction scenario.
● **Country specific applicability**	
Institutional capacities	In 2016, between the Agency for Energy Efficiency and the United Nations Industrial Development Organization was signed the contract for the implementation of the project "Strengthening the local production capacity of solar thermal energy systems in the Republic of Moldova". The total budget of the given project was 246 743 EURO, as funders of the given project the Government of Poland and the United Nations Development In 2017 the specialized technical staff at the local company, partner of the project that assembles data collectors were trained in Poland, at a one-week training course where they participated in both theoretical and practical classes assisting the assembly process at the production lines at the Polish factories. Similarly, the strengthening of institutional capacities related to this technology is also linked to HG no. 1051/2018 for the approval of the Regulation on the qualification and registration of installers of biomass boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. This decision provides for a training and qualification mechanism for solar thermal installers.
Technology status in the country	At the moment in the country there are several projects related to this technology. From the main projects implemented we can mention the following: installations of evacuated solar collectors realized at the swimming pool of the Public Institution Institute of Physical Education and Sport, a number of other projects in the residential sector. We can also mention the achievements of the UNDP-funded energy and biomass project, where 27 kindergartens benefiting from the first phase of the project were equipped with solar hot water installations, which work together with the solid biomass heating system.
Local acceptability	At the local level, the technology of producing thermal energy for the preparation of drinking water is accepted by both the private and the public

[55] https://www.odimm.md/images/2._Ghid_-_Solutii_energetice_pentru_o_viata_mai_buna.pdf

[56] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

	sector in order to cover their own thermal energy needs and to generate energy savings based on the reduction of their own consumption of natural gas.
Potential paradigm shift	The paradigm shift is to replace fossil fuel energy with renewable energy. On a national scale, the technology is expected to have a paradigm shifting impact on society by replacing traditional technologies for the production of domestic hot water. The technology will significantly contribute to the economic development of the country, improvement of living conditions, as well as the population's access to clean thermal energy without the participation of fossil fuel combustion process.
Efficiency and effectiveness	Compared to flat-plate solar collector technology, evacuated collectors have a higher efficiency ranging from 90-92% compared to flat-plate collectors ranging from 74-82%.
Potential for sustainable development	Sustainability of the project will be ensured through economic co-benefits in particular in reduced thermal energy bills and local business development. The technology contributes to the national target of increasing renewable energy production. At the same time, the potential for sustainable development will also be ensured by replicating projects in the residential sector.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of technologies for the production of thermal energy (domestic hot water) based on solar collectors. The impact of the technology will particularly extend to the social sphere, such as kindergartens and public institutions, where women are mostly employed.
• **Costs**	
Investment, US$/m2	The specific technology investment varies depending on the manufacturer and country of origin. The investment cost of the evacuated solar collector technology[57][58] , are related to the collector surface area and it constitutes the value between 180 - 220 US$/m2.
O&M costs, US$/year	The major maintenance and operation of a solar collector system is in most cases directed towards its preparation and conservation during the summer-winter period. Estimated this will not exceed 0.5% of the total investment cost.
• **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which is required to be performed as an operation at least once a year.
Boosting investment	At local level, investment incentives are promoted through different donors and projects. As an example, the European Bank for Reconstruction and Development (EBRD), through the GEFF project and local commercial banks, is financing such technologies for the small and medium-sized enterprise and residential sectors. Financing takes place through the Green Technology

[57] https://cap-cap.md/ro/panou-solar-tuburi-vidate-helis-jdl-pm30-58-18/6966

[58] http://www.termostal.md/baterie-solara-heat-pipe-18-tub-58-1800

	Selector, which provides a broad platform for selecting the most effective renewable and energy efficient technologies[59]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. The solar collectors will be aimed at reducing public and private expenditure for the energy resources used. The reduction of electricity expenses will be registered during the period of utilization of the maximum thermal energy consumption load for the production of domestic hot water.
● **Social benefits**	
Direct hiring	Thanks to the implementation of the technology, jobs will be opened up through direct employment, in particular through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	The promotion of technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment on the labor market in the Republic of Moldova, there are specialists who execute and exploit these types of technologies. However, there is a lack of capacity building in this direction. It is expected that HG 1051/2018 will become operational, and the training of professionals in this field will gain momentum.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing thermal energy production as a result of possible reductions in thermal energy production at existing power plants caused by water shortages at existing power plants due to climate change. The generation process will contribute to covering the thermal energy demand needed for the heating process and the energy needs for land irrigation.
Others, if they are	

[59] https://techselector.com/moldova-ro/

Pellet-based solid biomass combustion technologies

● **General Information**	
Sector	Energetic
Category	Electricity and heat generation and distribution
Technology name	**Pellet-based solid biomass combustion technologies**
Short description of the technology	As the most accessible renewable energy source in the country, biomass is the first option when it comes to promoting renewables. It already provides more than half of the primary energy produced in the Republic of Moldova and the main concern of the Government will be to ensure the smooth functioning of all elements of this market. At the same time, the development of the biomass energy consumption sector and the solid biofuel market in Moldova has brought with it the transfer and implementation of modern, environmentally friendly technologies and has increased the quality of life in rural communities, thus meeting the priorities of the Sustainable Development Goals. Depending on the feedstock used, there are two types of technologies that burn solid biomass, namely: 1. Thermal power plants for solid biomass combustion based on briquettes; 2. Pellet-based solid biomass combustion power plants. Both technologies are widespread in the Republic of Moldova and most of the projects linking these technologies have been realized in the residential and rural sectors. If we make a comparison between the applied technologies, the most efficient and resistant are the pellet-fired central heating systems that have a self-cleaning burner function. In this sense these plants are equipped with an automated cleaning process and heat exchangers. This technical aspect of modernization and innovation of the combustion process, allow to increase the efficiencies of these power plants, as well as the complete transition to an automated process of biomass combustion using burners.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient. Green energy development. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient and clean biomass combustion technologies, and facilitating the connection of production facilities to existing distribution capacity. Active and effective communication on the benefits of green energy for improving living conditions and protecting the environment. [60] Facilitating the creation of regional Eco-energy centers in order to increase the degree of energy autonomy at local level through the use of renewable technologies. The priorities mentioned above are part of the Government Decision no. 377/2020 on the approval of the draft law on the approval of the National Development Strategy *Moldova 2030.*
The country's economic development priorities	Promoting energy efficiency and renewable energy projects in the public and residential sectors, with the development of financing instruments accessible to the subjects of these sectors, where appropriate, with a focus on vulnerable consumers.
The country's environmental	In line with the Environmental Strategy for 2014-2023, particular attention will be paid to the promotion and production of green energy, obtained by: 2)

[60] https://gov.md/sites/default/files/document/attachments/intr40_12_0.pdf

development priorities	harnessing solar energy by converting it into electricity and heat (photovoltaics, biomass heat, etc.); 3) developing the energy potential of biomass (biofuel production from cereals, sorghum, technical oil crops - rape, sunflower, grape seeds from the wine industry, etc.) and other sources [61]
Marketing potential	The residential sector represents a large potential for reducing the consumption of fossil energy resources in Moldova and, at the same time, it is also a potential market for local producers of solid biofuels and suppliers of new solid biomass combustion technologies. The transition of households to biomass heating is of paramount importance, considering that more than 56% of households in Moldova are heated with individual wood or coal stoves, according to a survey by the National Bureau of Statistics. According to the same research, households spend about 2.4 million lei annually on heating with wood and wood waste and consume 2.7 million m3 of firewood and 338 thousand m3 of wood waste used for making fire. And this at a time when the forest area in Moldova is relatively small, about 11% of the territory. According to data from the Agency for Energy Efficiency, this market produces 155 MW through biomass-fired boilers exclusively for heating, with an installed capacity of 67 MW in the public sector and about 88 MW in the residential sector. The marketing potential could double the above mentioned potential if there were subsidies from the state, such as those during 2012-2016.
● **Country specific applicability**	
Institutional capacities	Operators of biomass-fired thermal power plants were trained in topics related to the management, maintenance and conservation of the plants. The trainings were organized at the Operators Training Centre, opened within the Centre of Excellence in Construction. 9 trainings were conducted for about 138 operators from 57 communities. The Operator Training Centre within the Centre of Excellence in Construction aims to ensure the sustainability of the training activity also after the end of the Energy and Biomass Project by organizing 40 academic (theoretical and practical), 90 academic and 150 academic hours courses in which future operators will be trained. For the proper functioning of the Training Center training modules have been developed, approved and endorsed by the Ministry of Education, Culture and Research. A Technical Guide on the Use and Maintenance of Combined Heat and Power Plants has been developed for the operators of combined heat and power plants. The Guide is distributed in the training activities for operators and beneficiaries, as well as in Vocational Schools that train operators in biomass CHP, such as Vocational School No. 3 in Chisinau. All trainings related to institutional capacity building have been realized with the support of the Energy and Biomass project in 2012-2016[62]
Technology status in the country	At the moment there are several projects in the country, which were directly financed by the Energy and Biomass in the Republic of Moldova project in the period 2012-2016. Thus, in addition to 233 public institutions, which annually consume 33 thousand tons of biofuel, 1134 households and 50 micro-enterprises received subsidies from European funds for the purchase of biomass boilers between 2012-2016. In total, from the European funds of the Energy and Biomass Project, subsidies in the amount of 24.2 million lei were granted, which covered about 30% of the cost of purchase and installation of boilers.

[61] https://mecc.gov.md/sites/default/files/document/attachments/strategia_de_mediu_pentru_anii_2014-2023.pdf

[62] Report of the project Energy and Biomass in the Republic of Moldova, 7 years at home.

	The total installed capacity of the boilers is 25 MW and they are supplied by 24 local companies, accredited by the Energy Efficiency Agency.
Local acceptability	At local level, the technology of thermal energy production based on solid biomass combustion technologies is accepted by both private and public sectors in order to cover their own energy needs and generate energy savings by renouncing traditional energy resources.
The potential for paradigm shift	On a national scale the technology is expected to have a paradigm-shifting impact on society by replacing traditional solid biomass combustion sources (stoves) with modern and innovative combustion technology. The technology will contribute significantly to the economic development of the country, improvement of living conditions, as well as people's access to clean and green energy.
Efficiency and effectiveness	Depending on the fuel used, the efficiency of thermal power plants also varies. For briquettes, it is as high as 75%, while pellet boilers have efficiencies of over 85%. In general, the more efficient boilers offer a more significant reduction in future plant operating costs, and many also offer additional convenience options, such as remote temperature setting in the home via a computer or even a mobile phone.
Potential for sustainable development	Sustainability of the project will be ensured through environmental co-benefits, in particular the reduction of greenhouse gas emissions and local business development.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of thermal energy technologies based on pellet combustion technologies. The impact of the technology will extend particularly in the social and domestic spheres, as well as in kindergartens and public institutions, where women are employed to a large extent.
● **Costs**	
Investment, US$/kW	The specific investment of the technology is related to one kW of installed thermal capacity and is between 180-280 US$/kW. The investment cost has been calculated on the basis of prices currently analyzed on the local market[63][64]
O&M costs, US$/year	The O&M costs are determined on the basis of the salaries of the operational staff during the heating season (5 months), which amount to 1000$/year, as well as the expenses directly related to the maintenance of the technology, which amount to 150-200$/year (spare parts). Total O&M costs are 1150-1200$.
● **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the

[63] https://climatec.md/categorie-produs/incalzire-si-acm/centrale-termice/cazane-pe-combustibil-solid/

[64] https://termoformat.md/ro/cazane/combustibil_solid?utm_source=google&utm_medium=cpc&utm_campaign=poisc_kotli_ro&utm_content=456133955034&utm_term=%%2Bcentrala%20%2Bpe%20%2Bbiomasa&gclid=Cj0KCQjwwNWKBhDAARIsAJ8HkhdVqT0F_N4o4LaKcp1nkBWTMIlh7R7R4pvD7nbm8d_nNt0V3mmE9bEaAibdEALw_wcB

	technology, which needs to be carried out as an operation at least once a year. The use of biomass also continues to offer employment opportunities. Current efforts are geared towards strengthening the newly created solid biofuel (briquettes and pellets) production industry, which has already created around 400 new jobs in rural areas and had a turnover valued at between USD 6 million and USD 8 million in 2017[65]
Boosting investment	During the period 2012-2016 through the Energy and Biomass project several incentives were offered to final beneficiaries of projects using biomass for heating. According to the project's final activity report 265 kindergartens, schools, hospitals and community centers received non-reimbursable grants amounting to 75% of the total investment cost. For the residential sector, 1300 Euro/per piece of equipment has been allocated for the purchase of plants with an efficiency of more than 85% and a 36-hour working autonomy. 1134 households have already installed biomass boilers. Similarly, the European Bank for Reconstruction and Development (EBRD) through the GEFF project and local commercial banks is financing projects in the field of solid biomass-based thermal energy technologies for the residential and commercial sectors. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy efficient technologies[66]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. The technology will be directed toward reducing public and private expenditures for the energy resources used. The reduction of thermal energy expenditures will be registered during the period of utilization of the maximum thermal energy consumption load for space heating.
● **Social benefits**	
Direct hiring	Thanks to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, heating engineers, etc.). Estimated number of new jobs 400.
Skills and capacity development	The promotion of technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment on the labor market in the Republic of Moldova, there are specialists who execute and exploit these types of technologies. However, there is a lack of capacity building in this direction. It is expected that HG 1051/2018 will become operational and the training of professionals in this field will gain momentum.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water supplies for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing thermal energy production as a result of possible reductions in thermal energy production at existing power plants caused by water shortages at existing power plants due to climate change.
Others, if they are	

[65] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_RRA_Moldova_2019_RO.pdf

[66] https://techselector.com/moldova-ro/

Ground-to-water heat pump technologies

● General Information	
Sector	Energetic
Category	Electricity and heat generation and distribution
Technology name	**Ground-to-water heat pump technologies**
Short description of the technology	These are technologies that are mainly suitable for buildings with high heat requirements and a lack of land or water in the water table. Heat is extracted by pumping an intermediate medium (ethanol-water, antifreeze-water mixture) into boreholes inserted in vertical boreholes. The boreholes are drilled at depths of 60-150m. The efficiency of these systems is superior to air-to-water heat pump systems. Ground-to-water borehole heat pumps cover a power range from 3 to 1500 kW. The ground-to-water heat pump is the perfect solution for residential and commercial heating, domestic hot water and even cooling. The technology applied is nothing but a geothermal pump, which takes its heat directly from the ground. The earth is a free source of heat, available in unlimited quantities, because the ground has a constant temperature at depth. In ground-to-water heat pumps, the constant extracted temperature (10-12 degrees Celsius) is used to obtain the heat needed for heating or domestic hot water. Heating can be done by radiators, fan convectors or underfloor heating. The advantage of this type of pump is that it can also be used for cooling, via a fan coil unit. This successfully replaces the need to purchase one or more air conditioners.
The country's social development priorities	Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy expenditure and making energy consumption more efficient. At the same time, the Law on Energy Performance in Buildings, No. 128[67] of 11.07.2014, stipulates that the technical, economic and environmental feasibility of using alternative energy sources, including heat pumps, which are available, should be taken into account during the design phase of new buildings.
The country's economic development priorities	The economic priority covers the promotion of energy resource efficiency and renewable energy projects in the public and residential sectors, with the development of financing instruments accessible to the subjects of those sectors, where appropriate, with a focus on vulnerable consumers. In accordance with the energy strategy of the Republic of Moldova until 2030 approved by GD no. 102 of 05.02.2013 provides for improving energy security and energy efficiency. The proposed technology will enhance the national efforts to improve energy efficiency and increase the energy security of the country due to the decrease in the amount of fossil fuel used to meet the heat demand.
The country's environmental development priorities	Developing green energy to reduce environmental pollution. Stimulating interest in green energy production and consumption by harnessing renewable energy sources, including the use of efficient low-energy technologies. The technology is expected to deliver an estimated 37% reduction in annual fuel consumption compared to the baseline scenario and a reduction in greenhouse gas (GHG) emissions of at least 66741 tons of CO2 equivalent per year. The Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, HG no. 1470 of

[67] https://www.legis.md/cautare/getResults?doc_id=95262&lang=ro#

	30.12.2016[68] , as well as data from the conditional NDC, 82% of GHG emission reduction should be achieved in the energy sector by 2030 compared to 1990. The deployment of this technology is listed in the LEDS, among other measures related to achieving this target.
Marketing potential	About 13160 heat pumps of different capacities are expected to be installed in isolated residential buildings, industrial and commercial enterprises, schools, hotels, restaurants and other premises. The majority of the heat pumps (12654) will have a small capacity ranging from 12 kW to 19 kW and will be installed by the owners of existing or newly constructed detached buildings. Around 500 heat pumps with an average capacity of 50 kW will be installed at various businesses, schools, hotels, restaurants and other premises to meet heating and hot water requirements. A limited number (about 6) of large heat pumps with a capacity of 1 MW will be installed at waste water treatment plants and other enterprises where lower quality energy sources are available. Implementation of the heat pumps will result in an annual production of about 1,743 PJ of heat. Data are provided on the basis of project proposals of NAMA type projects submitted by the Government of the Republic of Moldova and registered in the UNFCCC electronic register[69]
• **Country specific applicability**	
Institutional capacities	The institutional capacities that support the technology of thermal agent production based on low energy potential are private companies. Thus, the Republic of Moldova does not have its own individual production of ground-water type heat pumps, and for this reason this equipment is imported. The main companies importing heat pumps are: Romstal SRL[70] , Laiola SRL[71] , Cvadro Therm SRL [72] Capacity building will also be provided in the form of trainings, workshops and demonstration tools and by informing potential beneficiaries and stakeholders about the financial and environmental benefits of heat pump implementation, as well as by improving the skills of local staff needed to scale up the technology.
Technology status in the country	The given technology was fully utilized by private and public institutions. Among the main executed works we can mention the following: the Cvadro Therm Ltd. Basarabeasca, Casă particulară comuna Băcioi[73] , precum și sediul instituțiilor publice precum: Sala sportivă din or. Drochia, Block 6 of the Technical University of Moldova, etc..
Local acceptability	At the local level, low potential energy technology is accepted by both the private and the public sector in order to cover their own thermal energy needs. As a rule, projects are implemented in areas where there is no access to district heating or the natural gas infrastructure is poorly developed.
Potential paradigm shift	The paradigm shift is the substitution of energy produced from fossil fuel sources with renewable energy, utilizing reduced energy potentials such as ground heat. On a national scale it is expected that the technology will have a paradigm shifting impact on society by switching to a different form of heating. The technology will contribute significantly to the country's economic

[68] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

[69] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

[70] https://romstal.md/echipamente-incaelzire/

[71] https://www.laiola.md/ro

[72] https://cvadro.md/ru/

[73] https://cvadro.md/ru/project/incalzire-cu-o-pompa-de-caldura-geotermala/

	development, improved living conditions, as well as people's access to clean energy.
Efficiency and effectiveness	The main technical characteristic of the technology related to efficiency is determined by the coefficient of performance COP, which is between -5,0[74] . COP represents how many kWh heat energy the heat pump produces per kWh electricity consumption. In this respect the technology stands out with a relatively high coefficient of performance, compared to other types of technologies where the COP reaches a maximum of up to 4. At the same time, the requirements related to the efficiency of the technology are also set by the legal framework imposed on the basis of HG no. 1003/2014 for the approval of the regulations on energy labeling requirements for some energy-impacting products[75] , Annex 11
Potential for sustainable development	Sustainability of the project will be ensured through economic co-benefits, in particular reduced heating bills and local business development. The technology contributes to the objective of energy autonomy at local level in the context of climate change. It will also change the living and working conditions of people living in the homes and staff working in the businesses where heat pumps will be installed. Safety in operation will increase as this technology does not use open fire. There will also be no need to dispose of ashes and other products from burning fossil and biomass fuels.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of heat pump technologies for heating/cooling (including domestic hot water preparation). The impact of the technology will particularly extend to the social sphere, such as kindergartens and public institutions, where women are largely employed.
• **Costs**	
Investment, US$/bu	The investment cost varies from case to case depending on the installed power of the pump and is equal to 4600 - 7600 US$[7677] , installation up to 24 kW The estimated total investment cost per country calculated on the basis of the NAMA project is about 180 million USD.[78]
O&M costs, US$/year	Annual inspections are often even cheaper than for other types of heaters - they usually amount to 60 to 170 US$ per year. Repairs are rarely needed, and adjustments are usually not necessary. Electrical parts and schematics are the major operating costs for heat pumps .[79]

[74] https://www.romstal.ro/pompa-de-caldura-sol-apa-wpf10-p48159.html

[75] https://www.legis.md/cautare/getResults?doc_id=110628&lang=ro#

[76] https://geosolar.md/ro/product-category/teplovye_nasosy/geotermalinye_teplovye_nasosy/

[77] https://www.emag.ro/pompa-de-caldura-apa-apa-sol-apa-18-kw-termocasa-150-180mp-tmc48-hyper-jet/pd/DQ5XSVBBM/?ref=graph_profiled_similar_c_1_19&provider=rec&recid=rec_49_091e7aa7c0cfca78c90c3317911fc8949c1f09cade759774bbffe59c6df04b17_1623934962&scenario_ID=49

[78] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

[79] https://ro.your-best-home.net/7366778-heat-pumps-you-can-expect-these-costs#menu-4

● **Economic benefits**	
Employment	New jobs will be created when the project is implemented, both for installers and equipment suppliers. The job market will be expanded as well by the development of services for operation, maintenance and servicing of the technology, which is required to be performed as an operation at least once a year.
Boosting investment	The European Bank for Reconstruction and Development (EBRD) through the GEFF project and local commercial banks is financing projects in the field of heat pump technologies for the residential sector and small and medium-sized enterprises. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy-efficient technologies[80]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. The technology will be aimed at reducing public and private expenditures on primary energy resources predestined for heating, such as natural gas and solid fuels.
● **Social benefits**	
Direct hiring	Due to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	Promoting technology requires the availability of specialists for the whole chain of its implementation and maintenance. At the moment, the labor market in the Republic of Moldova has an acute shortage of qualified professionals in the field of installers. Thus, it will be necessary that the capacities of the newly trained cadres are developed with skills and work skills adjusted to the new requirements of the technologies.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact; Saving water for cooling processes at CET
Benefits of adapting to climate change	The proposed technology will make a significant contribution to securing thermal energy production as a result of possible reductions in thermal energy production at existing district heating power plants due to water shortages in these plants as a result of climate change. The generation process will contribute to meeting the energy demand for space heating/cooling in the residential and public sectors.
Others, if they are	

[80] https://techselector.com/moldova-ro/

2. Climate impact No. 2 Damage to electricity grids from extreme events Development of a system to prevent and protect electrical grids against scale deposits

● **General Information**	
Sector	Energetic
Category	Protection of electricity grids
Technology name	**Development of a system to prevent and protect electrical grids against scale deposits**
Short description of the technology	In the context of warming winters on the territory of the Republic of Moldova and increasing temperature alternations, in evolutionary aspect, the blight shows an increasing trend, especially in the northern and central part where temperature alternations are more significant. The analysis of the vulnerability of the territory to the occurrence of blight on the territory of the Republic of Moldova shows that the most vulnerable territories to this phenomenon are the Central Moldavian Plateau and the extreme north-western part. The intensive deposition of ice on November 26-28, 2000 reported in the northern and central districts of the republic, on conductors with a diameter of 10 mm at a height of 10 m, formed a layer of ice with a diameter of 60 - 70 mm and a weight of about 4000 grams per linear meter. Thus, in the northern and partly central part of the Republic of Moldova, the infrastructure of electricity transmission to consumers was destroyed. Thus, in 2009, several chapters of the 7th edition of the Electrical Installations Planning Rules (ПУЭ) were implemented, including the one regulating the input values for the design of overhead power lines in connection with the change of climatic conditions (the load according to the maximum wind speed for zone II was increased from 25 m/s to 29 m/s and the load according to the thickness of the layer of frost for zone III and IV was increased from 15 mm and 20 mm to 20 mm and 25 mm, respectively). Thus, if we take into account the new conditions for the arrangement of electrical installations, we can conclude that the totality of power lines in operation and designed according to the requirements of NAIE (ПУЭ) 6th (previous) edition will not cope with the frequency of occurrence and increased thickness of the scale layer. It is precisely for these reasons that it is necessary to rehabilitate or implement new technologies for melting of the limestone in the areas of increased risk. In the composition of ice-melting technology is distinguished: ● the possibility to adjust the melting current including signals from ice sensors; ● smooth switching on and off of the rectifier, which avoids power surges and facilitates the operation of switching equipment; ● Advanced microprocessor control, regulation, protection and automation system allows to coordinate start, stop and change of current according to signals from the ice formation control system; ● presence of top-level user-friendly interfaces; ● The containerized version of the power unit with a closed forced cooling system facilitates mounting the rectifier on the open side of the station;

	● the presence of a set of metering transformers inside the container reduces the requirements for the switchgear and switchgear of the station; ● possibility of transportation by any type of transport[81] .
The country's social development priorities	The Government of the Republic of Moldova has set three general objectives in the Energy Strategy 2030: - ensuring security of energy supply; - developing competitive markets and their regional and European integration; - ensuring the sustainability of the energy sector and combating climate change. Compared to the other contracting parties of the Energy Community, the Republic of Moldova cannot realize the implementation of competitive energy markets before building the necessary infrastructure, which is a part of security of supply. The very specific situation of the Republic of Moldova, which lacks physical connections to larger electricity markets, is the rationale for giving top priority in the country's energy agenda to the extension of the interconnection with the EU and the connection to the ENTSO-E system. Although the unavoidable time limits for complying with the requirements for connecting the power system to ENTSO-E can be considered quite daunting, this should only stimulate the discovery of technically and financially efficient solutions to manage this situation. In the event of a climatic impact on overhead power lines, the burden of ensuring a lasting power supply to end consumers is further increased.
The country's economic development priorities	In order to prevent economic losses related to interruptions in the supply of electricity to the consumer, by ANRE Decision No. 939/2019 on the approval of normative-technical documents in the field of energy NE1-01:2019 NE1-01:2019 Rules for the operation of electrical installations of non-domestic consumers[82] , the latter are assigned a number of prevelegii in order to avoid situations of deposits of scale due to extreme phenomena. Thus, the melting of scale by means of electric current on overhead power lines with a voltage of more than 1000 V, where the scale layer is intensively created, is required to be carried out at the decision of the non-household consumer's administrator. The non-household consumer, who operates the line, shall control the process of the formation of the scale layer on the power lines and ensure timely connection of the scale melting scheme. The overhead power lines on which the melting of the scale is carried out shall, as a rule, be equipped with automatic devices for controlling and signaling the creation of the scale layer and the process of its melting, as well as with short-circuit switching devices. The choice of the method of melting the soot is determined depending on the working conditions of the lines (scheme of the utilization installation; load of the non-household consumer; area of soot formation; possibility of disconnecting the line, etc.).
The country's environmental development priorities	In accordance with the Strategy for Low Emission Development of the Republic of Moldova until 2030[83] the approval and application of tariffs for the distribution service and, separately, the transportation of electricity establishes an adequate return on capital, which will allow the consolidation of the

[81] https://www.ruscable.ru/article/Metody_predotvrashheniya_gololyodnyx_avarij_v/

[82] https://www.legis.md/cautare/getResults?doc_id=120132&lang=ro

[83] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

	respective networks and new investments in it. It has been designed in such a way that network operators will be motivated to reduce electricity losses in the distribution and transmission networks and maintain the infrastructure in a reliable condition, thus contributing to the reduction of greenhouse gas emissions.
Marketing potential	The marketing potential of the technology encompasses the electrical household of ÎS Moldelectrica, which is directly affected by climatic phenomena such as scale deposits on non-insulated high-voltage conductors. The household includes 4704 km of 35-400 kV overhead power lines [84]
● **Country specific applicability**	
Institutional capacities	The institutional capacities that support the technology to prevent scaling are the country's electricity transmission and distribution companies, such as IS Moldelectrica ICS Premier Energy Distribution and SA RED Nord. Che
Technology status in the country	At the moment there are no similar projects in the country on the widespread use of this type of technology, applied in particular to high-voltage networks.
Local acceptability	At local level, the technology for melting the scale on the wires of overhead power lines is accepted by the companies operating and servicing these lines.
Potential paradigm shift	The paradigm shift is to promote the technology in extreme climatic situations, such as scale deposits on non-insulated conductors of overhead power lines.
Efficiency and effectiveness	Technological efficiencies are driven by reduced hours and disconnections due to overhead power line breaks caused by limescale.
Potential for sustainable development	The sustainability of the project will be ensured by the technology's advantage in responding to extreme climatic events such as frost deposition. The aim is to increase the reliability of high and medium voltage networks in the service area of transmission and distribution system operators.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of technologies to protect overhead power lines against the build-up of soot.
● **Costs**	
Investment, US$	Investment measures will include a series of interventions such as: 1. Inventory of the existing equipment for melting down the existing soot in electrical substations; 2. Elaboration of the feasibility study for the protection of electricity grids against scale deposits (considering mechanical and electrical methods of scale removal, zonal fortification of electricity grids and implementation of early prevention systems); 3. Selecting suppliers and concluding contracts to supply the necessary equipment; 4. Selection and contracting of contractors for the necessary construction, installation and adjustment of the prevention system; 5. Analysis of climatic developments and new technologies for the removal of soot from electricity network elements.

[84] https://www.moldelectrica.md/files/docs/TYNDP.pdf

	The actions described as investment costs can reach up to 138 068 US$, Estimates were made on the basis of the analysis carried out in the Report for the set of proposed actions to incorporate climate change adaptation measures towards 2030.
O&M costs, US$/year	The O&M costs are determined at 5% of the total investment cost and amount to approximately 7 000 US$/year.
● **Economic benefits**	
Employment	The implementation of the technology will involve staff already employed by local companies. The duties of the staff employed will be expanded by developing services for the operation, maintenance and servicing of the technology, required to be executed as an operation at least once a year.
Boosting investment	The investment incentive for the technology to melt the scale layer is not applied in any form of subsidies or preferential credits. The transmission and distribution company assumes the investment risks of supporting the technology in its intervention areas and subsequently requests its inclusion in the cost of the electricity tariff.
Public and private expenditure	The costs of the described technology will be borne by the electricity transmission and distribution companies.
● **Social benefits**	
Direct hiring	No new job openings will be certified due to the implementation of the project. It is expected that the technology will be implemented directly by the employees of electricity distribution and transmission companies.
Skills and capacity development	Promoting technology requires the availability of specialists and training them to develop the skills to operate and maintain the technology.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing air pollution; Reduced environmental impact;
Benefits of adapting to climate change	The proposed technology will make a significant contribution to maintaining the reliability of electricity supply following extreme events that lead to damage to electricity grids
Others, if they are	

3. **Climate Impact No. 3 The significant increase in power and energy consumed in summer due to increased energy demand for air conditioning and land irrigation as a result of heat waves is contributed by the following technologies**

Thermal insulation materials for the external cladding of buildings

● **General Information**	
Sector	Energetic
Category	**Energy efficiency technologies and materials**
Technology name	Thermal insulating materials for the external cladding of buildings (mineral wool and thermopane glazing)
Short description of the technology	The energy efficiency of buildings is achieved by means of thermal insulating materials, mainly mineral wool and PVC thermopane windows are used.In this regard, mineral wool is obtained by fibrillation of basalt melt.It is very important to mention that:- - does not act corrosively on metals with which it comes into contact - are non-combustible, with maximum fire resistance - Class A1; - stability is dimensional, - not rot; - they do not allow vapor diffusion and have excellent sound absorption. - allow walls to breathe and prevent condensation; - have a lightweight fastening system that protects the internal masonry structure; - the boards are simple to process and material losses are minimal; - are easy to install, reducing labor costs; - maintain the aesthetic appearance of the facade for a long time. In the benefits held by mineral wool boards, insulation systems mounted on facades must allow vapor transfer and prevent condensation from forming between them and the masonry. They should also have a similar durability to that of the construction to reduce the number of subsequent interventions on the façade. Mineral wool tiles fall entirely into this category, as they are able to meet all the necessary characteristics to provide effective thermal insulation and thus protect health. And thanks to the fact that they are available in several thickness variants, they can be selected according to the insulation needs and the state of the building to be insulated. This ensures maximum comfort inside and a beautiful appearance outside. What about the double-glazed windows, fitted with Low-E glass allow: - Significantly reduce the thermal conductivity of the construction; - Much of the heat energy is reflected back into the room; - They are recommended for installation in residential and public buildings with autonomous and centralized heating. - When filled with inert gas (argon), the thermo-technical characteristics improve.
The country's social development priorities	In line with the Energy Strategy 2030, with regard to energy efficiency and promotion of market competition, several aspects are emphasized, among which the launching and investments in energy efficiency projects in the industrial and public sectors, including with the support of international financial institutions. In this regard energy efficiency measures are directed to improve the social living conditions of people employed in both the public and residential sectors. For the purposes of the application of Law 139/2018 when determining the energy efficiency measures to be undertaken to achieve energy

	savings, priority will be given to energy efficiency measures with social impact, measures aimed at reducing energy poverty or improving the living conditions of vulnerable consumers .[85]
The country's economic development priorities	For the purpose of determining the country's economic development priorities, according to Law 139/2018 the national energy efficiency targets are expressed in absolute values and represent a ceiling of primary and final energy consumption for the entire national economy and are set for a certain time horizon. The proposed solutions to modernize the built environment will include measures to: 1. identified for the renovation of the national building stock, which are economically efficient and relevant to the climate zone and building types concerned; 2. policies and incentives for cost-effective major renovation works, including phased major renovation works.
The country's environmental development priorities	Besides the low level of energy resources and the very high dependence on imports, low energy efficiency and high energy intensity are the reasons why energy efficiency is considered as one of the main objectives of the Energy Strategy 2030. As in the case of developing the use of renewable energy sources, improving energy efficiency has an exceptional status compared to other specific objectives, contributing to both the security of energy supply and environmental sustainability and combating climate change.
Marketing potential	According to the Energy Strategy of Moldova 2030, the buildings sector consumes the most energy resources. In this regard, it is envisaged that the share of renovated public buildings by 2030 should constitute 10% of their total number[86] . Similarly according to Law No. 139/2018 on energy efficiency The annual renovation rate constitutes 1% of the total area of buildings in the public domain of the state, with a total usable floor area of more than 250 m2, in which the specialized central public administration authorities operate and which do not meet, on January 1 of each year, the minimum energy performance requirements[87] . These provisions intensify the search for the most optimal thermal insulation technologies and materials applied in the building sector. The list of buildings to be renovated shall include information on the total surface area in square meters of each building and its energy performance or other relevant energy data. In drawing up the list, priority shall be given to the buildings with the lowest energy performance, within economic possibilities, taking into account the cost-benefit ratio and the possibility of implementing energy performance contracting in this respect. At the same time, in accordance with the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, GD no. 1470 of 30.12.2016[88] Specific objective no. 3 provides for measures to increase the thermal resilience of the building envelope by retrofitting 30% of buildings by 2030, and as a related effect of the unconditional mitigation process would bring CO2 emission reductions by 2030 of up to 284809 tons/year
● **Country specific applicability**	

[85] https://www.legis.md/cautare/getResults?doc_id=105498&lang=ro
[86] https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro
[87] https://www.legis.md/cautare/getResults?doc_id=105498&lang=ro
[88] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

Institutional capacities	Particular attention in the field of promoting energy efficiency will be paid to the education and training of staff, university and school students and the population at large in the efficient use of energy, energy saving and related actions. To this end, a series of educational programs will be developed to raise public awareness, competitions will be organized and achievements in this field will be demonstrated, pct. 104 of the Energy Strategy of Moldova 2030. Institutional capacity building will take place not only at the level of specialized central authorities but also at the level of companies that apply energy efficiency measures through the correct use of thermal insulation technologies of the building envelope. At the moment there is sufficient institutional capacity for the proposed technology to be accepted on the local market.
Technology status in the country	At the moment in the country there are several projects in the field of energy efficiency with the application of thermal insulation and glazing technologies. Both the state structures specialized in this field and external donors are devoting a lot of attention to these technologies. So far, only through the Agency for Energy Efficiency, energy efficiency measures have been implemented in more than 300 public facilities such as schools, kindergartens, etc. Most of the measures are directed towards energy insulation of the building envelope.
Local acceptability	Locally, the technology is accepted by both the private and public sectors to reduce their own energy needs and generate revenue from energy savings.
The potential for paradigm shift	The paradigm shift is to raise awareness of the widespread application of these technologies in both the private and public sectors. The technology will significantly contribute to the economic development of the country and to the improvement of the living conditions of the population, as well as to the reduction of the primary energy consumption for cooling and heating of the premises.
Efficiency and effectiveness	The efficiency of the technology is characterized by the technical coefficients applied on the basis of building regulations and good practice, constituting the value of density which must not be less than 135 kg/m3 at a thickness of 150 mm and the overall thermal coefficient of heat transfer 0.039 W/(m2xK) in the case of the thermal insulation material mineral wool. The proposed glazing technology these are PVC profiles with at least 5 chambers, where: Uprof<=1.30 W/(m2xK), with 3 panes 4 mm thick (2 chambers), distance between panes 16 mm, with one Low-E glass, chambers filled with argon Us<=0.60 W/(m2xK), total value of Ufer=0.97 W/(m2xK).
Potential for sustainable development	The sustainability of the project will be ensured through economic co-benefits, in particular the reduction of heating bills in winter and the reduction of electricity in summer for air conditioning and cooling of the rooms. The sustainability of projects that will utilize energy efficiency technologies will be ensured by the continuous training and education of the people who are responsible for the maintenance of the built environment. In application of Law 721/1996 on quality assurance of construction works, only specialists certified as individuals on their own behalf or as employees of the economic agents carrying out this activity are entitled to perform activities of quality control and management of the built fund.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender	Both women and men will benefit from the implementation of the technology (mineral wool and double glazing). The impact of the technology will particularly extend into the social sphere, such as kindergartens, schools and public institutions, where women are largely employed.

equality? What is the expected scale of impact?	
● **Costs**	
Investment, US$/m2	Depending on the manufacturer the average price per square meter of mineral wool varies from it ranges from 15-18 US$/m2[89] . The same is attributed to thermopane glazing, which where the cost per meter 2 of thermopane glazing ranges from 110 - 150 US$/m2. The total cost of the technology used for thermal insulation would be at least 125 US$/m2
O&M costs, US$/year	O&M costs are virtually excluded from the analysis. Maintenance and operation works occur in year 10 after the realization of the measure, in the case of thermopane glazing, mainly directed to adjusting the seals and closing mechanisms. O&M costs per m2 of surface area are 15-18 US$/year
● **Economic benefits**	
Employment	The implementation of the project will create new jobs for both installers and suppliers of thermal insulation materials. The job market will also be enlarged by the development of installation, maintenance and servicing of the technology, which is required to be carried out as an operation after the period recommended by the manufacturer.
Boosting investment	The European Bank for Reconstruction and Development (EBRD), through the GEFF project and local commercial banks, finances projects in the field of thermal insulation technologies for buildings (mineral wool insulation and double glazing) for the residential sector. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy-efficient technologies[90] . Also other active donors in the Republic of Moldova such as GIZ, Romanian Government, Swedish Embassy have financed or co-funded energy efficiency projects in the public sector of the country.
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. The technologies applied to energy efficiency measures will be aimed at reducing public and private expenditure on primary energy resources. The reduction in thermal and electrical energy costs will be recorded from the first year of the investment, and the savings in financial resources can be re-invested according to the needs of the beneficiaries.
● **Social benefits**	
Direct hiring	Due to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	The promotion of technology requires the availability of specialists for the whole chain of production, realization of works and maintenance of the technology. At the moment, the labor market in the Republic of Moldova has sufficient skills and capabilities in this field, and several businesses have been developed locally in this field.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact;
Benefits of adapting to climate change	The proposed technology will make a significant contribution to reducing the energy demand for air conditioning and cooling due to heat waves**.**

[89] https://construct.md/index.php?/ro/pages/search/vata%20minerala/products/1//

[90] https://techselector.com/moldova-ro/

Others, if they are	

High efficiency cooling and air conditioning technologies

● **General Information**	
Sector	Energetic
Category	Energy efficiency technologies and materials
Technology name	**High efficiency cooling and air conditioning technologies**
Short description of the technology	Cooling or conditioning technologies are devices that can cool, heat, or both cool and heat indoor air using a vapor compression cycle driven by an electric compressor. An air conditioner is a specialized installation capable of altering and controlling the climatic conditions in an enclosed room, from apartments and dwelling houses to offices and large commercial premises. In general, air conditioners can be categorized according to the following criteria: purpose and place of use or type of construction and mode of installation. According to the purpose and place of use, we distinguish three categories of air conditioners: industrial (complex systems installed in shopping centers, offices, gyms - 1000 kW); semi-industrial (used in large houses, shops or offices, up to 300m2 - 30kW) and domestic (used in apartments or dwelling houses - 1.5kW-8kW). The correct choice of power level directly influences the cooling quality of the room, the cooling surface and the proper operation of the air conditioner. When selecting an air conditioner take into account: ● Type of room and purpose of use. ● Construction specifics. ● Number of persons and technical devices. These technologies can also perform other functions such as humidification, purification, ventilation or additional heating of the air by means of an electric resistance, as well as devices that can use condensed water that forms in the evaporator compartment or water added from outside for evaporation on the condenser, provided that the device can operate without using an external water source. COPs of these technologies can range from 1.9, energy class G to 5.1, energy class A+++
The country's social development priorities	In line with the Energy Strategy 2030, with regard to energy efficiency and promotion of market competition, several aspects are emphasized, among which the launching and investments in energy efficiency projects in the industrial and public sectors, including with the support of international financial institutions. In this regard energy efficiency measures are directed to improve the social living conditions of people employed in both the public and residential sectors. For the purposes of the application of Law 139/2018 when determining the energy efficiency measures to be undertaken to achieve energy savings, priority will be given to energy efficiency measures with social impact, measures aimed at reducing energy poverty or improving the living conditions of vulnerable consumers .[91]
The country's economic	For the purpose of determining the country's economic development priorities, according to Law 139/2018 the national energy efficiency targets are expressed in absolute values and represent a ceiling of primary and final energy

[91] https://www.legis.md/cautare/getResults?doc_id=105498&lang=ro

development priorities	consumption for the entire national economy and are set for a certain time horizon. The proposed solutions to modernize the built environment will include measures to: 3. identified for the renovation of the national building stock, which are economically efficient and relevant to the climate zone and building types concerned; 4. policies and incentives for cost-effective major renovation works, including phased major renovation works.
The country's environmental development priorities	Besides the low level of energy resources and the very high dependence on imports, low energy efficiency and high energy intensity are the reasons why energy efficiency is considered as one of the main objectives of the Energy Strategy 2030. As in the case of the development of the use of renewable energy sources, improving energy efficiency has an exceptional status compared to other specific objectives, contributing to both the security of energy supply and environmental sustainability and combating climate change. The application of energy efficiency measures in the air conditioning and air-conditioning process contributes directly to reducing the country's energy intensity and specific energy consumption per m2 of heated or cooled surface area.
Marketing potential	According to the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, GD no. 1470 of 30.12.2016[92] only in the case of a phased reduction of hydrofluorocarbon consumption would be needed 36 500 units of refrigeration and air conditioning equipment with new generation alternative freons and 4 770 units of refrigeration and air conditioning equipment operating with hydrofluorocarbons subject to retrofit and reuse. The realized marketing potential is even greater when taking into account the increase in living space in the city's newly built blocks.
• **Country specific applicability**	
Institutional capacities	Special attention in the field of promotion of the respective technologies in terms of energy efficiency will be paid to the education and training of staff, university and school students and the population at large in the field of energy efficiency, energy saving and related actions. For this purpose, 250 persons will be trained for servicing refrigeration and air conditioning equipment, a provision stipulated in the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, GD no. 1470 of 30.12.2016[93] At the same time, a series of educational programs will be developed to raise public awareness, competitions will be organized and achievements in this field will be demonstrated, point 104 of the Energy Strategy of Moldova 2030. The increase of institutional capacities will take place not only at the level of central specialized authorities but also at the level of companies that apply energy efficiency measures through the use and correct sizing of the energy label of electrotechnical products. Sufficient institutional capacities are currently in place for the proposed technology to be accepted on the local market.
Technology status in the country	At the moment there are several projects in the country where this technology is fully applied. Both the state structures specialized in this field and external

[92] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

[93] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

	donors are devoting considerable attention to these technologies. Both the private (residential) and business (industrial and agricultural) sectors use this technology to maintain the indoor microclimate at standardized conditions, as well as for technological processes that require strict control of temperature regimes.
Local acceptability	Locally, the technology is accepted by both the private and public sectors to reduce their own energy needs and generate revenue from energy savings.
The potential for paradigm shift	The paradigm shift is to raise awareness of the application of the mentioned technologies on a large scale and to make the public aware of the economic and environmental effects of using the application of the product energy class A and above. The technology will significantly contribute to the economic development of the country and to the improvement of living conditions of the population and to the decrease of the primary energy consumption predestined for the process of cooling and heating of premises.
Efficiency and effectiveness	The efficiency of the technology is determined on the basis of the requirements assigned on the basis of Government Decision No. 1003/2014, Annex 2 Regulation on energy labeling requirements for air conditioners[94] . The product label shall provide the consumer with the necessary and adequate information on the actual consumption of the equipment, thus with regard to air conditioners placed on the market from January 1, 2019, with the exception of single-duct and dual-duct air conditioners, labels with energy efficiency classes A+++, A+++, A+, A, B, C and D shall comply with subpct. 1.4. for reversible air conditioners, with sub-paragraph 2.4. for air conditioners with cooling function only, and with sub-paragraph 3.4. of Annex 3 to this Regulation, for air-conditioning appliances with heating function only. Thus, an energy efficiency class of A+++++ at a COP greater than or equal to 5.10 will be set for the technology under consideration.
Potential for sustainable development	The sustainability of the project will be ensured through economic co-benefits, in particular the reduction of electricity bills in summer and the reduction of thermal energy in winter, which is used for air conditioning and cooling of the rooms.
Gender impact. Does this technology have the potential to address gender inequalities? How can it contribute to achieving gender equality? What is the expected scale of impact?	Both women and men will benefit from the implementation of the technology. The impact of the technology will particularly extend into the social sphere, such as kindergartens, schools and public institutions, where women are largely employed.
• **Costs**	
Investment, US$/bu	Depending on the manufacturer the average price of a piece of equipment can range from 300 - 2500 euro per unit.
O&M costs, US$/year	For long-term operation, several operation and maintenance operations are recommended, the most frequent of which is regular cleaning and changing of air filters at least once a year. However, there are some filters that need to be changed even more often. For example, the catechin filter, which cleans the air of bacteria, will be effective for a maximum of 30 days, after which it is useless and can even eliminate

[94] https://www.legis.md/cautare/getResults?doc_id=110628&lang=ro#

	unpleasant odors if the maintenance procedure is not done on time. Thus, proper operation and care of the equipment can ensure a long life of the equipment and a higher level of efficiency. O&M costs will be in the range of 5-7%/year of the value of the investment dedicated to this technology.
● **Economic benefits**	
Employment	The implementation of the project will create new jobs for both installers and suppliers of household and industrial equipment. The job market will be expanded as well by the development of installation, maintenance and servicing of the technology, necessary to be carried out as an operation during the summer season.
Boosting investment	The European Bank for Reconstruction and Development (EBRD) through the GEFF project and local commercial banks finances projects in the field of air conditioning and air-conditioning technologies for the residential and industrial sectors. Financing takes place through the Green Technology Selector, which provides a broad platform for selecting the most effective renewable and energy-efficient technologies . [95]
Public and private expenditure	The costs of the technology described are borne by both the public and private sectors. The technologies applied to energy efficiency measures will be directed towards reducing public and private expenditure by reducing electricity consumption. The reduction in electricity costs will be recorded from the first year of the investment and the savings in financial resources can be re-invested according to the needs of the beneficiaries.
● **Social benefits**	
Direct hiring	Due to the implementation of the project, jobs will be opened through direct employment, especially through the promotion of technical specialists (technicians, sales managers, etc.).
Skills and capacity development	Technology promotion requires the availability of engineering and sales specialists. At the moment the labor market in the Republic of Moldova has sufficient skills and capabilities in this field, with several businesses being developed locally in this field.
● **Development impact, indirect benefits**	
Positive local environmental impact	Reducing water and air pollution; Reduced environmental impact;
Benefits of adapting to climate change	The proposed technology will make a significant contribution to reducing the energy demand for air conditioning and cooling due to heat waves**.**
Others, if they are	

[95] https://techselector.com/moldova-ro/

BARRIER ANALYSIS and ENABLING ENVIRONMENT REPORT/BAEF (2)

REPORT II Barrier Analysis and Enabling Framework of technologies

Executive summary

This report is the second in the Technology Needs Assessment Project and is dedicated to the analysis of barriers and the facilitation framework for the transfer and diffusion of technologies in the energy sector of the Republic of Moldova, for its adaptation to climate change. Three technologies for the energy sector were analyzed, namely (i) monocrystalline photovoltaic installations, (ii) ground-water heat pump technologies, (iii) wind technologies with vertical axes. It is worth mentioning that all the technologies that have been selected respond to the challenges related to the climate impact on the level of electricity and heat production, an impact resulting in the limitation of the technological water needed at the CET and the HPP.

Thus, on April 13, 2022, the sectoral working group, composed of specialists in the field and in accordance with Annex II, was sent the list of barriers identified for the technologies mentioned above. For a better perception of their prioritization, the problem tree on the types of technologies was attached to the document, which indicates the logical path of identifying the barriers that block the diffusion of technologies on the local market. The working group was given the task of assigning a degree of assessment of barriers from 1 to 4 points, as follows:

1. Less important (lowest barrier)
2. Important (important barrier)
3. Very important (very important barrier)
4. Stopping the promotion of technologies (the biggest barrier)

As a result of the fact that the technologies selected following the evaluation procedures respond to the overcoming of one and the same climate impact *(Danger of diminishing the production of electricity and heat due to lack of water at the CET and at the CHP, as a result of droughts)*, in the table below are reflected in the form of a totalizer only the common barriers and measures (see table 1) identified for the analyzed technologies.

Table 1. *List of common barriers and measures to overcome them, found relevant to the transfer and deployment of technologies on the local market*

Nr.	Barriers	Measures applied to overcome barriers
1.	High initial investment costs	Diversification of suppliers and importers of new technologies
2.	Limited access to financial resources to promote technologies	Mobilization of financial resources from donors and Funding Partners (in particular access to cheap financial means from international funding organizations) as well as mobilization of the own financial resources of entrepreneurs and the residential sector.

		Launch in the Republic of Moldova various technology subsidy programs, including through the active involvement of banking institutions, which can intervene with financial instruments in the form of preferential loans.
3.	Lack of bidding procedures for large production capacities and transparent procurement processes	Attracting financial and technical assistance for the development of bidding procedures for generation capacities based on the technologies analyzed in a transparent and non-discriminatory manner.
4.	Reduced tax incentives	Promoting tax incentives through customs duties for selected technologies. Introduction of facilities in the national tax legislation by completing/amending the Fiscal Code of the Republic of Moldova.
5.	Legislative framework	Extension of technical assistance to branch ministries to intensify the elaboration of the secondary regulatory framework and development of new procedures regarding the rules of the electricity market produced from renewable energy sources.
6.	Limiting access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with high renewable potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas.	Synchronization of the plans for the expansion of the public electricity supply network with the research carried out by the Government on the subject of renewable potential. Active participation of electricity actors in dedicated working groups and platforms set up to coordinate sectoral policies.
7.	Limited local balancing capacities and mechanisms for the participation of renewables in the electricity market.	Contracting balancing capacities in adjacent markets and establishing a favorable climate for producer-supplier communication. Creating favorable conditions for the construction/reconstruction, by the private and public sector, of non-intermittent generation units and developing mechanisms for the participation of producers of intermittent sources in balancing.
8.	Lack of support tools on the real exploitation of the renewable potential in the region.	Elaboration of maps with high energy potential in the Republic of Moldova, by attracting external assistance or budgeting the local financial resources necessary for this exercise.
9.	Long and arduous procedures for obtaining building and assembly permits and permits.	Amending the legislative framework in the field of constructions by imposing new rules for the exclusion of permissive acts and developing the new urban planning and construction code.
10.	Insufficient training of assembly staff.	Establishment and accreditation of training and continuous training programs for specialists in the field of installations.

Chapter I. Energy sector

The objectives and commitments on technology transfer are set out in the framework of the United Nations Framework Convention on Climate Change. The aim of the Technology Needs Assessment project is to support participating developing countries to identify and analyze priority technological needs, which can form the basis of a portfolio of projects and programmes, with a view to facilitating their transfer and know-how aspects through the implementation of Article 4.5 of the UNFCCC. Therefore, TNAs are essential for the work of the Parties to the Convention on Technology Transfer and present an opportunity to track the evolution of new equipment, techniques, know-how and skills, needed to mitigate GHG emissions and/or reduce the social vulnerability, economic and natural systems to climate change.

The work on identifying barriers to the deployment of technologies in the energy sector is part of the report II proposed to be carried out in accordance with the pre-established standard template. In Report I, the technology sheets on adaptation of the energy sector to climate change were prepared and evaluated. The work in question was carried out with the assistance of the sectoral working group, in the end 3 sectoral technologies were prioritized. As a result of this process, the following technologies will be analyzed in terms of identifying barriers and measures to overcome them:

- Monocrystalline photovoltaic installations.
- Ground-to-water heat pumps.
- Wind turbines with horizontal axes.

1.1 Preliminary targets for technology transfer and promotion

The preliminary targets set in the report are aligned with the requirements and conditions imposed by the main normative acts in the energy field and the studies carried out on long-term forecasts for the integration of renewable energy sources into the country's energy mix.

In this respect, the targets set for technologies A1 (monocrystalline photovoltaic installations) and A3 (wind installations with horizontal axes) are divided into two reference scenarios, long-term and short-term. In order to set the long-term targets, the information reflected in GD 1470/2016 on the approval of the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation[96], as well as the study on the Competitiveness of renewable sources to cover the electricity demand of the Republic of Moldova was used[97].

[96] https://www.legis.md/cautare/getResults?doc_id=129232&lang=ro#

[97] https://ibn.idsi.md/ro/vizualizare_articol/137145

According to the above, the preliminary targets for the transfer and diffusion of the selected technologies are related to overcoming the climate impact on the reduction of electricity and heat production due to the limited level of water at the CET and at the HPP. These include ambitious medium- and long-term targets and specific quantitative targets. Thus, the ambitious objectives set for the promotion of photovoltaic and wind technologies are seen through the prism of the Energy Strategy of the Republic of Moldova 2030 and the Strategy of the Republic of Moldova for adaptation to climate change 2020.

The quantitative objectives are determined for each technology individually, resulting from the political commitments made available by the main normative acts in the Republic of Moldova. Thus, for photovoltaic (A1) and wind (A3) technologies, the following long-term targets are identified and are established based on the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation[98], as well as the study on the Competitiveness of renewable energy sources, for the 100% RES scenario, to cover the electricity demand of the Republic of Moldova[99]. The ambitious targets for adapting the energy sector to climate change for technology A1 and A3 are as follows:

1. **A1 technology. Promotion and construction of photovoltaic plants connected to the grid – 470 MW, in order to overcome the climate impact on the danger of diminishing electricity production due to the lack of technological water at CET and HPP, as a result of drought.**

2. **A3 technology. Promotion and construction of wind power plants connected to the grid – 1,300 MW, in order to overcome the climate impact on the danger of diminishing electricity production due to the lack of technological water at CET and HPP, as a result of drought.**

At the same time, the secondary legislative framework provides for the development of the short-term scenario, regulated by GD no. 401/2021 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources valid until December 31, 2025.[100]

Thus, for the promotion of the A1 and A3 technology, the following targets have been set:

1. Photovoltaic installations – 130 MW

2. Wind farms – 120 MW

At the same time, it is worth mentioning that the support schemes for the promotion of renewable energy sources are also provided through net metering. In this regard, and according to art. 39 of Law 10/2016, the final consumers owning power plants whose cumulative installed capacity does not exceed 5% of the value of the maximum load recorded during the previous

[98] https://www.legis.md/cautare/getResults?doc_id=129232&lang=ro
[99] https://ibn.idsi.md/vizualizare_articol/115080
[100] https://www.legis.md/cautare/getResults?doc_id=128987&lang=ro

year by the distribution system operator to whose networks the respective power plants are connected benefit from the net metering mechanism, based on the "first come, first served" principle[101]. According to estimates and studies, this value per country does not exceed 37 MW.[102]

In the case of technology A2 (ground-water heat pumps), the ambitious target for adapting the energy sector to climate change for that technology is determined as follows:

Promotion and installation of ground-to-water heat pumps with a total cumulative thermal power of 225 MW, in order to overcome the climate impact on the danger of decreasing the production of thermal energy due to the lack of technological water at the CET, as a result of the drought.

The ambitious target related to this technology corresponds to the Energy Strategy of the Republic of Moldova 2030 and the Strategy of the Republic of Moldova for adaptation to climate change 2020 which provide:

- Increasing the country's energy security in supplying final consumers with thermal energy.
- Diversification of thermal energy supply sources for end consumers.
- Developing climate resilience by reducing climate change risks and facilitating climate change adaptation of the thermal energy sector.
- Increasing the institutional framework in the field of climate change, which ensures the efficient implementation of adaptation measures at national level and specific to the thermal sector in the country.
- Development of institutional communication and cooperation in order to implement policies for adaptation of the energy sector to climate change.

At the same time, the quantitative targets were established on the basis of analyses and studies carried out on the local market and project proposals submitted to CONUSC by the Republic of Moldova. In this regard, approximately 13,160 heat pumps of different capacities are expected to be installed in residential insulated buildings, industrial and commercial enterprises, schools, hotels, restaurants and other spaces. Most of the heat pumps (12,654) will have a small capacity from 12 kW to 19 kW and will be installed by the owners of existing or newly constructed detached buildings. Around 500 heat pumps with an average capacity of 50 kW will be installed at various enterprises, schools, hotels, restaurants and other premises to meet the requirements of heating and hot water supply. A limited number (about 6) of large heat pumps with a capacity of 1 MW will be installed at wastewater treatment plants and other enterprises where low thermal potential energy sources are available. The implementation of

[101] https://www.legis.md/cautare/getResults?doc_id=130209&lang=ro

[102] https://energetica.md/sites/default/files/2021-02/Raport%20final%20detaliat%20IE%20program%20de%20stat%202020_0.pdf

the heat pumps will result in an annual production of approximately 1,743 PJ of heat. The data are provided based on NAMA project proposals submitted by the Republic of Moldova and registered in the electronic register of CONUSC.[103]

1.2 Barrier analysis and possible support measures for monocrystalline photovoltaic technologies

The promotion of renewable energy sources in the Republic of Moldova is still in its early stages, including photovoltaic technologies. This was mainly caused by numerous barriers that emerged locally, which led to reduced the replication of these technologies on a large scale. Only an insignificant share of these technologies goes to the private sector, while in the public and residential sectors these shares are even lower. In order to identify the barriers and the measures to overcome them, in the paper, the mapping of the local technology market was carried out (Annex I), and the problem tree was developed according to figure 1.

1.2.1 General description of monocrystalline photovoltaic technologies

In fact, electricity production technologies based on photovoltaic systems are one of the most widespread in the Republic of Moldova. Two basic technologies used locally are known, namely, mono and polycrystalline photovoltaic panels. Monocrystalline cells are used in the manufacture of monocrystalline photovoltaic panels, and a monocrystalline cell is, after all, a pure silicon crystal. Monocrystalline solar panels are very easy to recognize because there is no free space between the cells that make up the module, unlike other types of photovoltaic panels. It is characterized by flexibility, weight, compactness, reliability, and durability.

Advantages of monocrystalline solar panels:

- The efficiency with which it converts sunlight into electricity exceeds that of other types of panels available. Why does this happen? Its yield is due to the purity of silicon and the fact that electrons are not lost in crystal pieces, as is the case with polycrystalline panels. The average efficiency for this type of photovoltaic panel is usually between 15% and 20%.

- It produces four times more electricity than the previous solar panels used.

- It does not occupy a large area on the roof.

- The average lifespan of monocrystalline photovoltaic panels is about 25-30 years.

- Compared to polycrystalline modules, monocrystalline photovoltaic panels perform better under the same lighting conditions.

Disadvantages of monocrystalline solar panels

[103] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

- More expensive materials (pure crystals) are used in their manufacture and therefore have a higher price than polycrystalline solar panels. However, due to their quality, solar panels of this type turn out to be, in most cases, a better investment.

- They are more fragile when temperatures are very high. All types of panels have less resistance when exposed to high temperatures, but monocrystalline solar panels seem to be more sensitive.

Compared to other types of technologies that generate green energy based on renewable energy sources, photovoltaic installations still have a low yield on the local and global market. However, their efficiency is determined primarily by the simplicity of the installation and operation works, as well as their use in areas where power lines for the transmission or distribution of electricity cannot be built. The effectiveness of this technology increases significantly when we talk about the use of photovoltaic panels to generate electricity used to pump water for irrigation purposes. In this sense, the energy offering during the summer period corresponds to the energy demand necessary for the irrigation process.

According to IRENA's report on the assessment of readiness to harness renewable energy in the Republic of Moldova, trends towards new technologies with higher yields have been observed. Thus, amorphous panels with a maximum efficiency of 15% have given way to mono and polycrystalline photovoltaic panels that exceed 18% in terms of efficiency.

1.2.2 Identification of barriers for monocrystalline photovoltaic technologies

According to the data provided by the Energy Efficiency Agency, just over 8 MW[104] represent the photovoltaic systems installed at country level out of the total share of capacities allocated for this type of technologies. This figure can be compared with the available capacities set at 130 MW in the policy acts, which constitutes only 6% of the maximum capacity quotas identified by the types of photovoltaic generation installations.

In this respect, the said technology will be examined as a market good, for potential consumers who want to promote such technology (Annex I.I). Thus, we can identify the following barriers that make it difficult to replicate these technologies on a sufficiently large scale on the local market (see Table 3):

1.2.2.1 Economic and financial barriers

High initial investment costs

[104] https://aee.md/ro/page/surse-de-energie-regenerabila

The investment cost of the project is significant and requires mobilization of financial resources in both the private and public sectors. The banking sector will play a significant role in attracting and financing photovoltaic technologies. According to estimates and based on NAER decision no. 76/2022 on fixed tariffs and ceiling prices for electricity produced from renewable energy sources for 2022[105], the investment cost for one kW of installed power is distributed by power and type of location. Thus, for:

- Solar PV installations mounted on buildings with a power of up to 50 kW – 18 575 lei/kW (980 USD)
- Solar PV installations mounted on buildings with a power of up to 51-200 kW – 17 768 lei/kW (935 USD)
- Solar PV installations mounted on buildings with a power of up to 201 – 1,000 kW – 16 152 lei/kW (850 USD)
- Others larger than 1,000 kW – 16 703 lei/kW (880 USD)

The average investment for these types of technologies is USD 912/kW, and the average total short-term investment based on the descriptions in Chapter I would be $152,304,000, and for the long-term scenario it would be $428,640,000.

Limited access to financial resources for the promotion of photovoltaic technologies

This was caused by the formation of high or exaggerated costs of capital - the high bank interest rate, the imperative of guaranteeing loans at the level of 120-150% of its value, etc. Even if more efforts have been made in this direction through externally financed projects, the cost of bank interest rates still remains high. Thus, the impact on the final beneficiaries in terms of ensuring resilience on adaptation to climate change will be low and with a delayed effect over time.

Lack of bidding procedures for photovoltaic generation capacities

In accordance with the primary and secondary regulatory framework, the Government of the Republic of Moldova is responsible for auctioning renewable electricity production capacities, through the application of the fixed price support scheme. In the case of photovoltaic installations, capacities of 60 MW are to be auctioned[106]. The lack of procedures developed and approved by the government, later made available to investors, blocks the replication of this technology on a larger scale in the country.

Reduced tax incentives

[105] https://www.legis.md/cautare/getResults?doc_id=130191&lang=ro
[106] https://www.legis.md/cautare/getResults?doc_id=128987&lang=ro

Even if the state partially promotes tax incentives on such technologies, they are focused only on certain elements within a photovoltaic system. Starting from the premise that the Republic of Moldova is not a country producing photovoltaic systems, import tax incentives would reduce the costs of investments in such equipment.

1.2.2.2 Non-financial barriers

Legislative barriers

According to the regulatory framework, the new rules of the electricity market are started slowly due to sophisticated and complex procedures. This is related to the lack of a secondary regulatory framework resulting from Law 10/2016 on the promotion of renewable energy sources. Because of the above, until today it has not been able to start the new rules on the electricity market, or monocrystalline photovoltaic systems are part of this process.

Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased solar potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas

When viewing this barrier in terms of the net metering support scheme, this fact does not represent a major barrier for consumers. The principle of net metering operation actually represents the coverage of their own energy consumption, which is why it can be deduced that these categories of consumers already have an electrical infrastructure built around. The situation is completely different in the case of large electricity generation capacities based on fixed tariff and fixed price support schemes.

Limited local balancing capacities for the participation of PV system manufacturers in the electricity market

For small capacities, local balancing capacity can be neglected. This is not attributed to large capacities. The secondary regulatory framework resulting from Law 10/2016 also includes how this balancing will be carried out. This aspect becomes even more topical, as we talk about the liberalization of the electricity market, where producers from renewable energy sources have assumed obligations regarding the mandatory insurance of imbalances arising in the network, NAER Decision no. 283/2020 on the approval of the Electricity Market Rules[107].

Lack of high-precision support tools (solar potential map, forecasts)

According to the same IRENA report related to the *Assessment of the Degree of Readiness on the Valorisation of Renewable Energy in the Republic of Moldova,* the solar technical potential in the country is enormous. However, for potential investors there is a major barrier in correctly

[107] https://www.legis.md/cautare/getResults?doc_id=123381&lang=ro

and accurately identifying the solar potential for different geographical areas in the country. The first attempt to develop such a map of solar potential took place in 2016 with the support of external technical assistance. In the end, it did not become functional, which stops investments in this direction.

At the same time, producers from renewable energy sources are part of the electricity market. This makes it mandatory to use specialized high-precision software related to the forecasting of the amount of energy offered on the market, in order to avoid imbalances within the balancing group. The lack of such accurate forecasts requires the Transmission System Operator to apply penalties to market participants, who have not accurately forecasted the amount of energy offered during the day or during the next day.

Inadequate quality control of imported equipment

In the absence of state control on the import of photovoltaic equipment, it can discredit this technology, if certain technical parameters such as efficiency and efficiency do not correspond to the product label. At the same time, the imposition of a control would also protect the final consumer from having security in the purchased technology.

Long and arduous procedures for obtaining the building permits and permits necessary for the construction of a photovoltaic power plant

The installation and quality assurance of the execution of the construction and installation works of a photovoltaic system is ensured in the light of Law 721/96 on the quality assurance of construction works. In addition to the nominated, procedural legislative framework, a potential Beneficiary must go through several steps, which also include obtaining permissive acts, coordination and approvals at the level of authorities and parties involved in the implementation of such a project. These procedures complicate and delay the realization of such a project over time.

Insufficient training of assembly staff

According to the regulatory framework, GD 1051/2018 for the approval of the Regulation on the qualification and registration of installers of biomass-based boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps, specialists in the nominated field were to be established and trained in the Republic of Moldova. This has not happened until today, which is why the quality assurance of the execution of the installation and operation of photovoltaic installations is not ensured to the expected extent.

In accordance with the decision of the Working Group on Barriers to Technology Transfer and Diffusion, monocrystalline photovoltaic installations have been prioritized as follows, according to the data in Table 3 below. It is important to note that no barriers were identified within the working group that can completely stop the promotion of the technology on the local market.

Gender unequal treatment

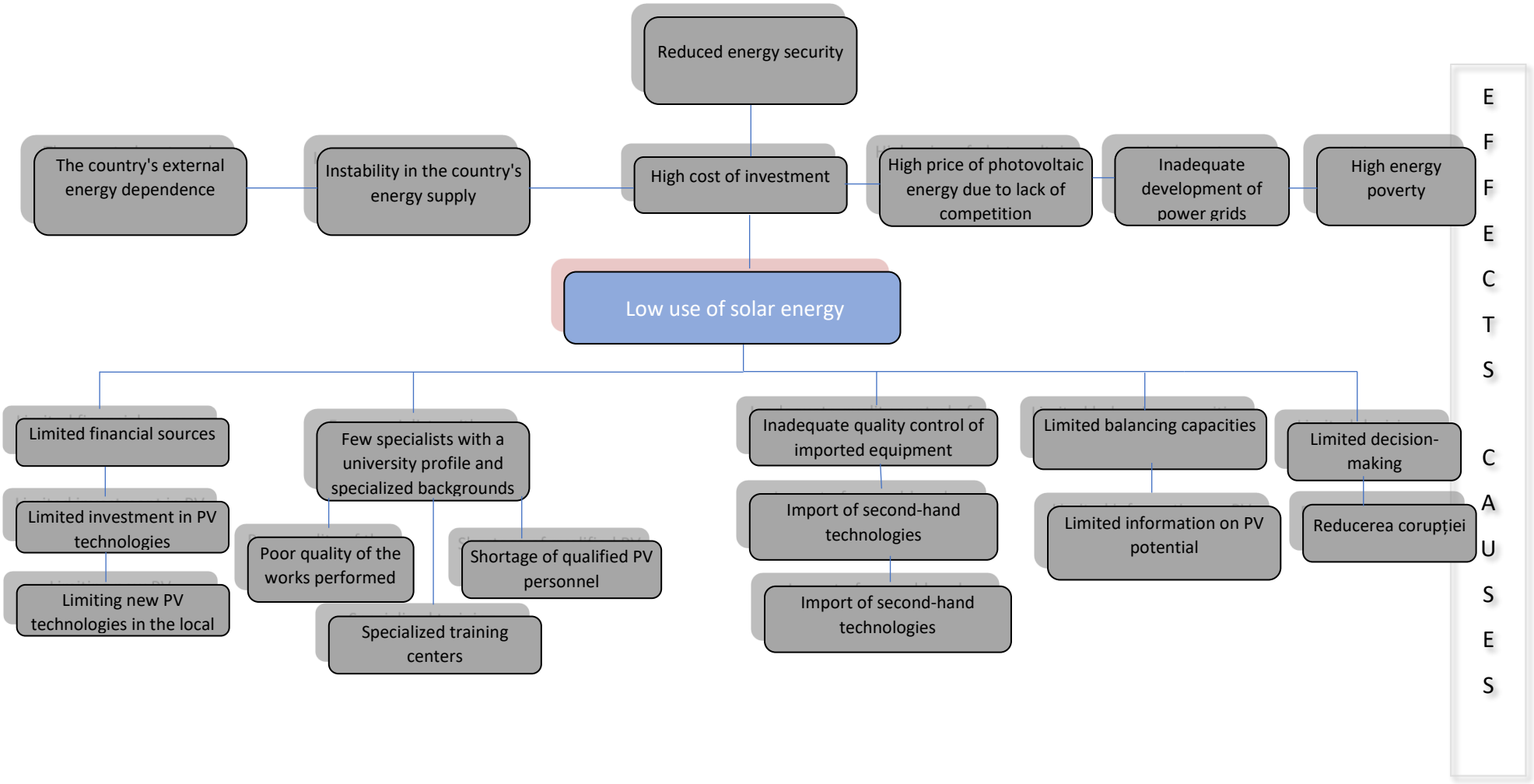
The mentioned technology is in the engineering field, and this fact in the Republic of Moldova involves few women who can develop, manage and benefit from the results of this technology. Gender inequality in technology appears, including in terms of the level of professional training in the field of installations, where there is a low presence of women.

Table 3. *Prioritizing the barriers of monocrystalline photovoltaic technology*

Nr.	Name of barrier	Category	Degree of appreciation
1.	Limited local balancing capacities for the participation of PV system manufacturers in the electricity market	Technical	Very important
2.	Inadequate quality control of imported equipment	Legislative framework	Important
3.	Limited access to financial resources	Economic and financial	Important
4.	Limited access to the distributor's network	Technical	Important
5.	High-precision support tools (including solar potential map) for PV-based power generation forecasting	Technical	Important
6.	Reduced tax incentives	Economic and financial	Important
7.	Level of corruption and conflict of interest in project implementation	Legislative framework	Important
8.	Limited knowledge of technology implementation procedures	Information and awareness	Important
9.	Insufficient training of assembly staff	Training and preparation of staff	Important
10.	High investment cost	Economic and financial	Important
11.	Lack of tendering procedures for large production capacities	Legislative framework	Less important
12.	Unequal treatment of gender	Information and awareness	Less important

The problem tree, see figure 1, was developed based on the decision of the working group, where it was found that the problem related to the lack of balancing capacities is very important, but does not contribute to stopping the promotion of the technology on the local market. This aspect is related to the lack of their own balancing capacities, which is why it blocks producers of energy from photovoltaic renewable sources from quickly adapting to the new rules of the electricity market.

Figure 1 *Problem tree. Monocrystalline photovoltaic technologies*



1.2.3 Identifying measures

1.2.3.1 Economic and financial measures

The following measures have been identified to overcome economic and financial barriers for the transfer and diffusion of monocrystalline photovoltaic system technology (see Table 4).

Table 4. *Measures to overcome the economic and financial barriers of monocrystalline photovoltaic systems technology.*

Nr.	Barriers	Measures applied to overcome barriers
1.	High initial investment costs	Diversification of suppliers and importers of mono crystalline photovoltaic systems
2.	Limited access to financial resources to promote technologies	Mobilization of financial resources from Donors and Funding Partners (especially access to cheap financial means from international funding organizations) as well as mobilization of own financial resources of entrepreneurs and the residential sector. Launch in the Republic of Moldova of various technology subsidy programs, including through the active involvement of banking institutions, which can come up with financial instruments in the form of preferential loans.
3.	Lack of bidding procedures for photovoltaic generation capacities	Attracting financial and technical assistance for the development of bidding procedures for generation capacities based on photovoltaic technologies in a transparent and non-discriminatory manner.
4.	Reduced tax incentives	Promoting tax incentives through customs duties for photovoltaic technologies, (invoking the economic and environmental benefits that such investments generate), especially for small units, in the order of hundreds of kW. Introducing the facilities into the national tax legislation by supplementing/amending the Fiscal Code of the Republic of Moldova, without indicating any terms of validity of the forecasts and obtaining the commitments of the Ministry of Finance regarding the amendments made.

1.2.3.2 Non-financial measures

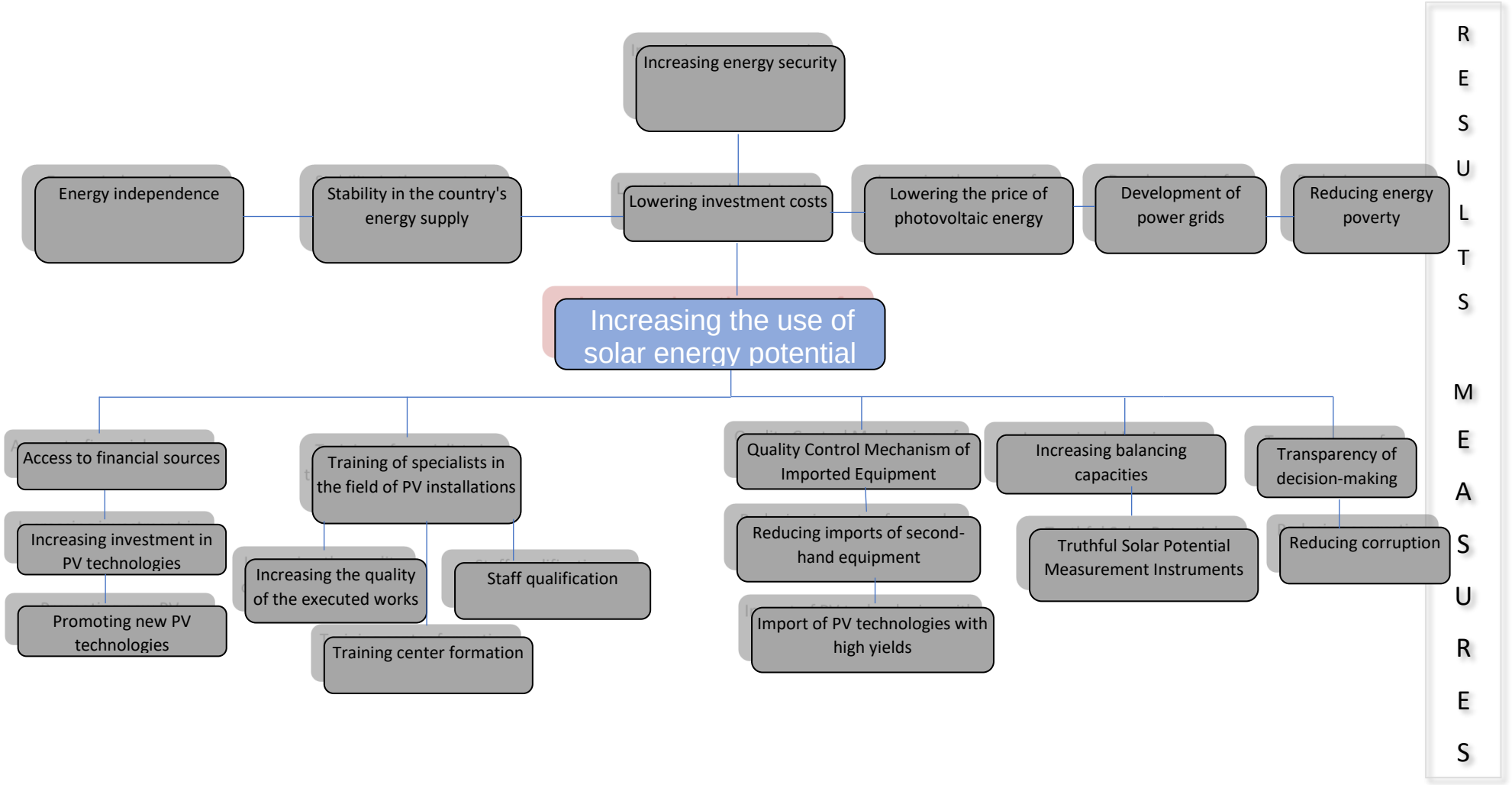
The following measures have been identified to overcome the non-financial barriers for the transfer and diffusion of monocrystalline photovoltaic system technology (see Table 5), and the preliminary results obtained have been developed based on the monocrystalline photovoltaic technology objective tree, reflected in Figure 2 below.

Table 5. *Measures to overcome the non-financial barriers of monocrystalline photovoltaic systems technology.*

Nr.	Barriers	Measures applied to overcome barriers
1.	Legislative framework	Extension of technical assistance to the branch ministry to intensify the elaboration of the secondary regulatory

		framework and the development of new procedures regarding the rules of the electricity market produced from renewable energy sources.
2.	Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased solar potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas	Synchronization of the plans for the expansion of the public electricity supply network with the research carried out by the Government on the subject of the renewable potential – solar for electricity production. Active participation of actors in the electricity field (Electricity transmission and distribution system operators. Ministry of Environment. Ministry of Infrastructure and Regional Development, Energy Efficiency Agency, etc.) within the dedicated working groups and platforms set up for the coordination of sectoral policies.
3.	Reduced local balancing capacities for the participation of PV system manufacturers in the electricity market	Contracting balancing capacities in adjacent markets and establishing a favorable climate for producer-supplier communication. Creation of favorable conditions for the construction/reconstruction, by the private and public sector, of non-intermittent generation units (practically possible only under the conditions of the existence of a developed electricity market).
4.	Lack of high-precision support tools (solar potential map, forecasts)	Elaboration of the solar atlas (such as those of increased interest) of high precision, with a high scale of detail, by attracting external assistance or budgeting the local financial resources necessary for this exercise. Attracting foreign donors to finance specialized software for forecasting the amount of energy produced during the day or during the next day.
5.	Long and arduous procedures for obtaining building permits and permits	Modification of the legislative framework with an impact on the field of constructions and the quality of construction works by imposing new approvals of the Urban Planning and Construction Code.
6	Inadequate quality control of imported equipment	Involvement of institutions in the Republic of Moldova to strengthen a mechanism for quality control of imported technologies. Inclusion in the regulatory framework of the mandatory application of quality standards and minimum technical requirements regarding monocrystalline photovoltaic installations
7.	Lack of qualified personnel in the field of assembly	Establishment and accreditation of continuous training programs for specialists in the field of photovoltaic systems for the conversion of photovoltaic energy.
8.	Gender unequal treatment	Gender issues are to be addressed at different levels in the promotion of technology at local level. Starting especially from the fact that women represent the majority of employees in institutions where technology is to be intensively promoted (schools, kindergartens, etc.), including in the residential sector, they will equally benefit from its advantages of matching men.

Figure 2 *Objective tree of monocrystalline photovoltaic technology*



1.3 Barrier analysis and possible support measures for ground-to-water heat pump technologies

The promotion of ground-to-water heat pump technologies in the Republic of Moldova is not fully exploited at present. This was caused by the prioritization by sectors of the national economy of other heat supply technologies. In the public sector, these technologies are practically not found, and in the private sector they are used on a rather small scale, due to their poor promotion.

At the same time, the potential of the geothermal energy resources of the Republic of Moldova has been inadequately researched, without any quantified and exhaustive estimate. However, the country has a significant availability of low-enthalpy geothermal energy potential, especially in the southern part of the country, which can be widely used for heat pumps. The government's interest in this technology is limited, as there are no actions envisaged in the Energy Strategy of Moldova 2030. However, the Energy Efficiency Agency has identified four operational geothermal installations with a total installed capacity of only 142 kW in the public sector[108].

1.3.1 General description of ground-water heat pump technologies

Heat pumps are technologies that lend themselves mainly to constructions with high heat requirements and lack of land areas or lack of water in the groundwater. The heat is extracted by conveying an intermediate agent (ethanol-water mixture, antifreeze-water) in wells inserted in vertical boreholes. The boreholes are carried out at depths between 60-150 m. The efficiency of these systems is superior to air-to-water heat pump systems. Ground-to-water heat pumps with borehole cover a power range from 3 to 1,500 kW. The main construction elements of the heat pump are:

- Vaporizer
- Compressor
- Capacitor
- Expansion valve

The 4 components are integrated into a closed circuit in which refrigerant circulates: The ground-to-water heat pump is a perfect solution to obtain heat, domestic hot water and even cooling for residential and commercial areas. The technology applied is nothing more than a geothermal pump, which takes its necessary heat directly from the ground. The earth is a source of free heat, available in unlimited quantities, because the soil has a constant temperature at

[108] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_RRA_Moldova_2019_RO.pdf?la=en&hash=70FE3A5333CC4772FA4BA3B223AB8223DF5E6CAB

depth. In ground-to-water heat pumps, the constant extracted temperature (10-12 degrees Celsius) is used to obtain the heat necessary for heating or preparing domestic hot water. Heating can be done through radiators, fan coils or underfloor heating system. The advantage of this type of pump is that it can also be used for cooling, by means of a fan coil unit. This successfully replaces the need to purchase one or more air conditioners.

The main technical characteristic of the technology related to efficiency is determined by the coefficient of performance COP and which is between 3.0-5.0. COP represents how many kWh of thermal energy the heat pump produces by consuming one kWh of electricity. In this sense, the technology imposes itself with a relatively high coefficient of performance, compared to other types of technologies where the COP reaches a maximum of 4. At the same time, the requirements related to the efficiency of the technology are also established by the legal framework imposed on the basis of GD no. 1003/2014 for the approval of the regulations on the energy labelling requirements of some products with energy impact, Annex 11.

1.3.2 Identification of barriers for ground-to-water heat pump technologies

According to the above, ground-water heat pumps are used at a low level in the Republic of Moldova. The main cause is also the high initial investment costs, as well as the monopolization of the local natural gas market as a primary heating energy resource. However, according to the estimates made by the Institute of Energetics[109] on the development of the decarbonization scenario of the energy sector for the Republic of Moldova, towards the 2050 time horizon, with a share of renewable energy sources of up to 68%, in the country's energy mix, heat pumps become competitive for heating and can replace centralized and individual heating based on natural gas.

In this regard, the ground-to-water heat pump technology will be examined as a market good, for potential beneficiaries who want to promote such technology (Annex I.II). In the sense of the above, we can identify the following barriers that make it difficult to replicate these technologies on a sufficiently large scale on the local market (see Table 6)

1.3.2.1 Economic and financial barriers

High initial investment costs

The investment cost of the project is significant and requires mobilization of financial resources in both the private and public sectors. The banking sector will play a significant role in attracting and financing these types of technologies. In accordance with the preliminary measurable targets set out in this report, the investment costs vary from case to case depending

[109] https://energetica.md/sites/default/files/2021-02/Raport%20final%20detaliat%20IE%20program%20de%20stat%202020_0.pdf

on the installed capacity of the pump and is equal to US$4,600 – US$7,600[110][111] for installation up to 24 kW for the residential sector and over US$20,000 for heat pumps for high-storey or industrial buildings. the estimated cost of the total investment per country calculated based on the NAMA project proposal is approximately USD 180 million.[112]

Lack of techno-economic studies and analyses

There is currently no clear analysis and vision regarding the economic and technical aspects that would justify the investment in such technologies. At the same time, the lack of such an analysis blocks the promotion of technology especially in the public sector.

Reduced tax incentives

Starting from the premise that the Republic of Moldova is not a country producing heat pump technologies, import tax incentives would reduce the costs of investments in such equipment.

1.3.2.2 Non-financial barriers

Legislative barriers

According to the primary and secondary regulatory framework, it does not oblige investors or potential end consumers to promote such technologies. Based on the significant dependence on natural gas imports from the East and the intense promotion of renewable energy sources, this type of technology would be a reliable source of heating for the long term in the country. At the same time, no strategic planning act at the country level directly supports the promotion of the mentioned technology, with the exception of the Law on Energy Performance in Buildings, no. 128[113] of 11.07.2014, where it is stipulated that the technical, economic and environmental feasibility of the use of alternative energy sources, including heat pumps, which are available, should be taken into account at the time of the design phase of new buildings.

Lack of support tools on geothermal potential

At the market level, the mentioned technologies are promoted without investors or beneficiaries taking into account the real geothermal potential available in each locality. This ultimately generates distrust in the mentioned technology, as well as an incorrect approach in terms of sizing and designing such a heating system.

[110] https://geosolar.md/ro/product-category/tepalvi_nasosi/geotermaliene_tepalvi_nasosi/

[111] https://www.emag.ro/pompa-de-caldura-apa-apa-sol-apa-18-kw-termocasa-150-180mp-tmc48-hyper-jet/pd/DQ5XSVBBM/?ref=graph_profiled_similar_c_1_19&provider=rec&recid=rec_49_091e7aa7c0cfca78c90c3317911fc8949c1f09cade759774bbffe59c6df04b17_1623934962&scenario_ID=49

[112] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

[113] https://www.legis.md/cautare/getResults?doc_id=95262&lang=ro#

Long and arduous procedures for obtaining the necessary building permits and permits for heat pump projects

The installation and quality assurance of the execution of the construction and installation works of a geothermal system is ensured in the light of Law 721/96 on the quality assurance of construction works. In addition to the nominated, procedural legislative framework, a potential Beneficiary must go through several steps, which also include obtaining permissive acts, coordination and approvals at the level of authorities and parties involved in the implementation of such a project. These procedures complicate and delay the realization of such a project over time.

Insufficient training of assembly staff

According to the regulatory framework, GD 1051/2018 for the approval of the Regulation on the qualification and registration of installers of biomass-based boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps, specialists in the nominated field were to be established and trained in the Republic of Moldova. This has not happened until today, which is why the quality assurance of the execution of the installation and operation works of the heat pump installations is not ensured to the expected extent.

Gender unequal treatment

The mentioned technology is in the engineering field, and this fact in the Republic of Moldova involves few women who can develop, manage and benefit from the results of this technology. Gender inequality in technology appears, including in terms of the level of professional training in the field of installations, where there is a low presence of women.

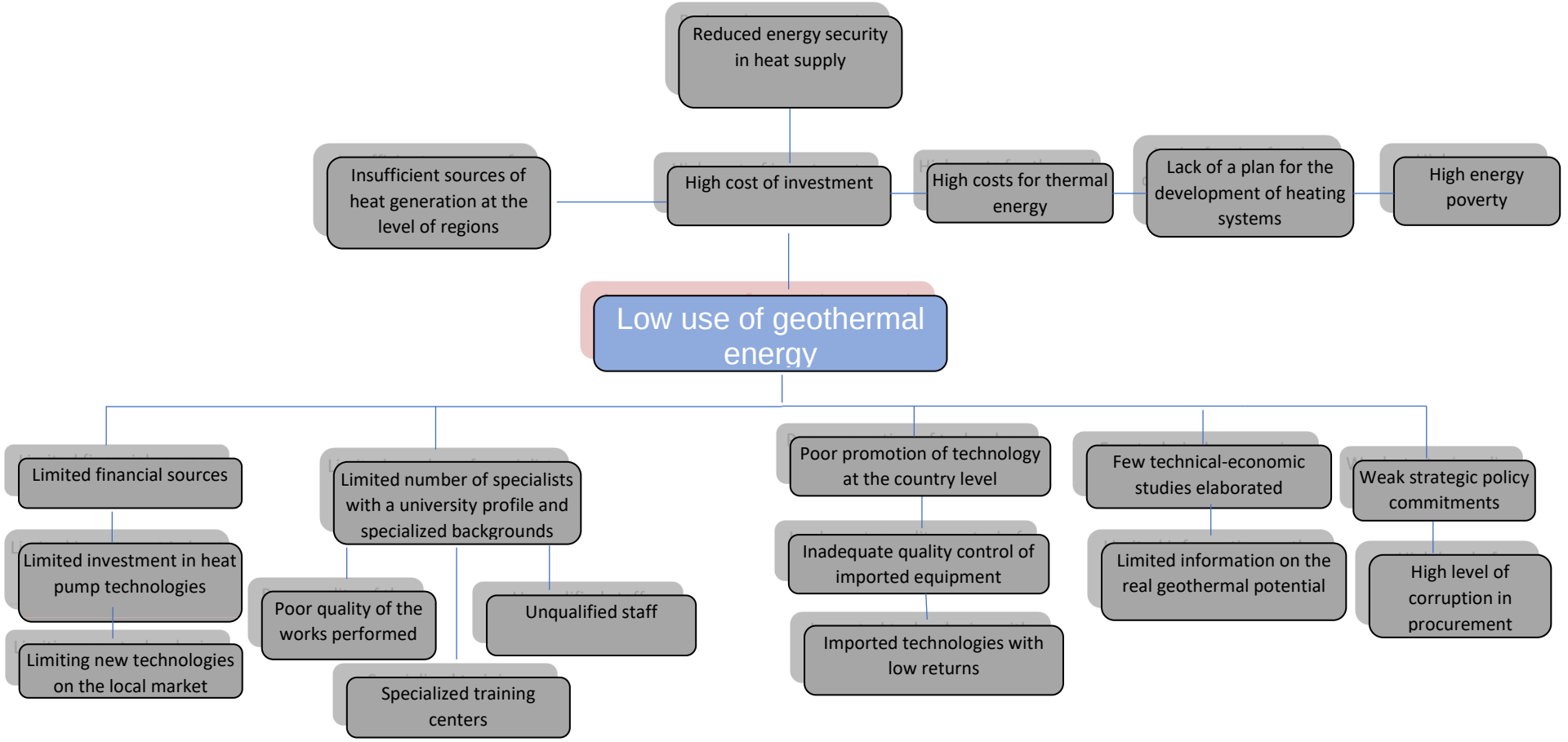
Table 6 below shows the barriers, prioritized. The working group did not identify barriers that would stop the promotion of the technology on the local market.

Table 6. *Prioritization of barriers to ground-to-water heat pump technology*

Nr.	Name of barrier	Category	Degree of appreciation
1.	High investment cost	Economic and financial	Very important
2.	Lack of a clear vision at central and local level on the promotion of technology	Legislative framework	Important
3.	Limited access to financial resources	Economic and financial	Important
4.	Studies and methodologies for capitalizing on geothermal potential	Technical	Important
5.	Lack of a control and quality system for imported technologies	Legislative framework	Important
6.	Non-qualified personnel in the field of assembly	Training and preparation of staff	Important
7.	Reduced tax incentives	Economic and financial	Important
8.	Limited knowledge of technology implementation procedures	Information and awareness	Important
9.	Level of corruption and conflict of interest	Legislative framework	Less important
10.	Gender unequal treatment	Information and awareness	Less important

The problem tree (see figure 3) was developed based on the decision of the working group, where it was found that there are no barriers in the country that would stop the promotion of the technology at the local level. At the same time, according to Figure 4, the tree of objectives of the ground-water heat pump technology was also developed, which aims to develop measures that contribute to overcoming the identified barriers.

Figure 3 *Problem tree. Ground-to-water heat pump technologies*



1.3.3 Identifying measures

1.3.3.1 Economic and financial measures

The following measures have been identified to overcome economic and financial barriers to the transfer and diffusion of ground-water heat pump technology (see Table 7).

Table 7. *Measures to overcome the economic and financial barriers of ground-to-water heat pump technology.*

Nr.	Barriers	Measures applied to overcome barriers
1.	High initial investment costs	Diversification of suppliers and import manufacturers of ground-to-water heat pump technologies
2.	Limited access to financial resources	Mobilization of financial resources from Donors and Funding Partners (especially access to cheap financial means from international funding organizations) as well as mobilization of own financial resources of entrepreneurs and the residential sector. Launch in the Republic of Moldova of various technology subsidy programs, including through the active involvement of banking institutions, which can come up with financial instruments in the form of preferential loans. Lowering the bank interest rate
3.	Lack of techno-economic studies and analyses	Attracting financial and technical assistance for the development of feasibility studies and technical-economic analyses of projects supporting ground-water heat pump technology.
4.	Reduced tax incentives	Promotion of tax incentives through customs duties for ground-water heat pumps, (invoking the economic and environmental benefits generated by such investments). Introducing the facilities into the national tax legislation by supplementing/amending the Fiscal Code of the Republic of Moldova, without indicating any terms of validity of the forecasts and obtaining the commitments of the Ministry of Finance regarding the amendments made.

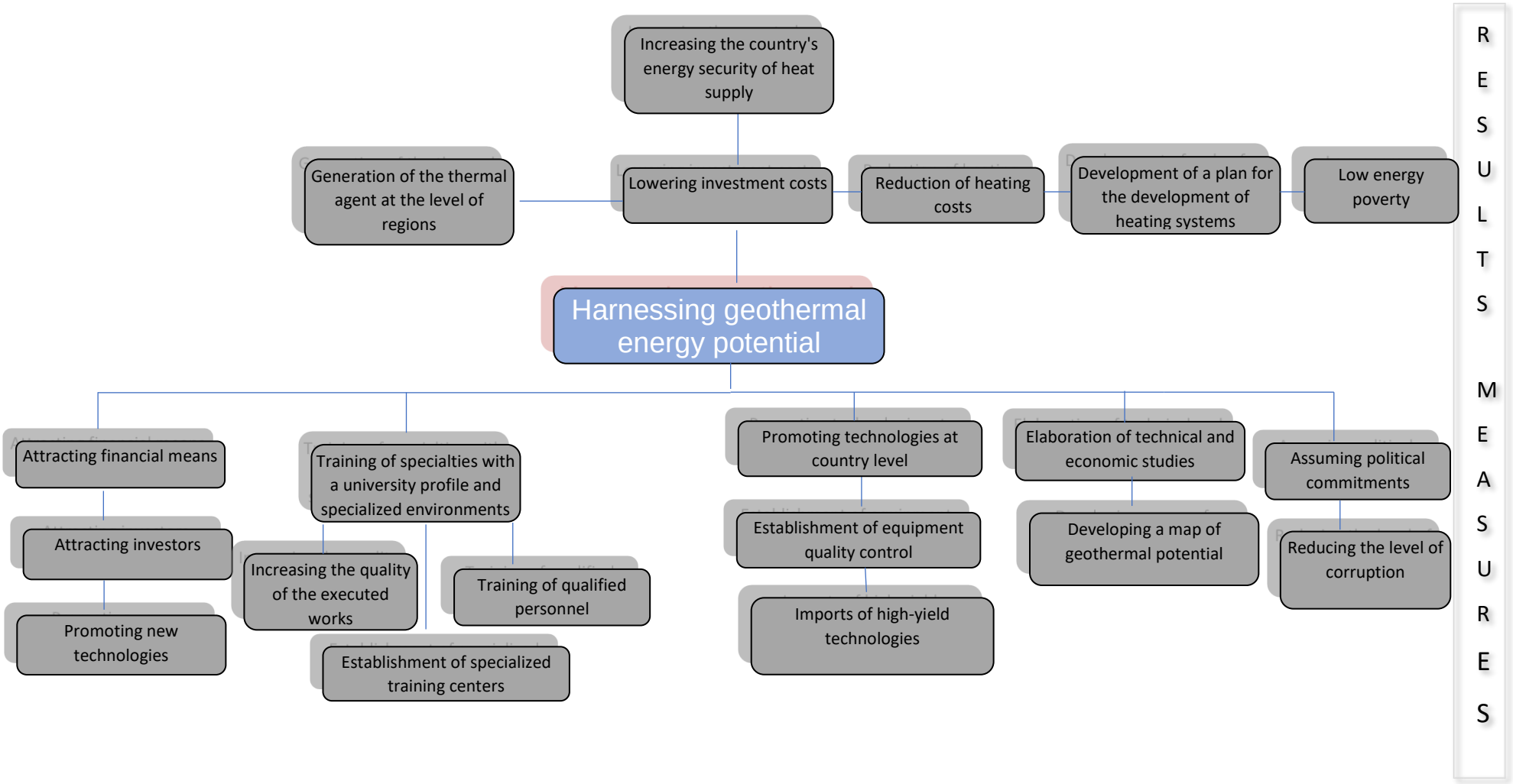
1.3.3.2 Non-financial barriers

The following measures have been identified to overcome non-financial barriers to the transfer and diffusion of ground-water heat pump technology (see Table 8).

Table 8. *Measures to overcome the non-financial barriers of ground-water heat pump technology.*

Nr.	Barriers	Measures applied to overcome barriers
1.	Legislative aspects regarding the lack of medium and long-term strategic planning on the promotion of technology	Developing or, as the case may be, updating sectoral strategies in order to support technology. Setting ambitious targets for national and local engagement to promote the technology.
2.	Lack of truthful information on geothermal potential in the Republic of Moldova.	Elaboration of studies and analyses on the identification of geothermal potential in different regions of the country.
3.	Long and arduous procedures for obtaining building permits and permits.	Modification of the legislative framework with an impact on the field of constructions and the quality of construction works by imposing new approvals of the Urban Planning and Construction Code.
4.	Minimum training of executives in the field of assembly.	Establishment and accreditation of continuous training programs for specialists in the field of heat pumps.
5.	Low country-level promotion of ground-to-water heat pump technologies.	Development of guides, brochures and instructions on the benefits of technology
6.	Gender unequal treatment	Gender issues are to be addressed at different levels in the promotion of technology at local level. Starting especially from the fact that women represent the majority of employees in institutions where technology is to be intensively promoted (schools, kindergartens, etc.), including in the residential sector, they will equally benefit from its advantages of matching men.

Figure 4 *Focus tree of ground-water heat pump technology*



1.4 Barrier analysis and possible support measures for vertical axis wind technologies

The promotion of renewable energy sources in the Republic of Moldova, especially the use of wind energy, has gained momentum in the last 5 years, when it was possible due to the approval by the Government of normative acts that facilitate the interest of potential investors in wind technologies. However, a number of barriers have not yet been removed, which means that only a non-significant part of installed capacities cover the local energy market. The private sector is a leader in this regard, and no project has been carried out in the public sector with the use of these technologies.

1.4.1 General description of vertical axis wind technologies

The energy obtained from a wind turbine depends on the power of the wind passing through the rotor and is directly proportional to the density of the air, the area swept by its blades and the speed of the wind. The absolute majority of the turbines sold are with a horizontal axis. This has a considerable advantage over vertical axis turbines, where the axis of rotation of the former coincides with the direction of the wind and is parallel to the ground surface. In vertical axis turbines, the wind direction is perpendicular to the axis of rotation and perpendicular to the ground surface respectively Even so, the focus on wind turbines with the horizontal axis will be placed on those with larger capacities with direct coupling and greater than 1 MW, which have a number of advantages, namely:

- Reduction of operation and maintenance costs.
- Increasing the conversion of wind energy, including in areas with moderate winds.
- Lowering the starting speed of the turbine, thus increasing the range of lucrative wind speeds.
- Decrease in the length and weight of the gondola.
- Reduction of vibration and noise.
- Increased turbine reliability.

1.4.2 Identifying barriers for vertical axis wind technologies

According to the same data made available by the Energy Efficiency Agency, 51 MW[114] represents the wind technologies installed at country level out of the total share of capacities allocated until 2025 of 120 MW and 130 MW for the long-term scenario.

[114] https://aee.md/ro/page/surse-de-energie-regenerabila

In this respect, the mentioned technology will be examined as a market good, for potential consumers who want to promote such technology (Annex I.III). In the sense of the above, we can identify the following barriers that make it difficult to replicate these technologies on a sufficiently large scale on the local market (see Table 9):

1.4.2.1 Economic and financial barriers

High initial investment costs

In accordance with the latest regulatory amendments, the investment costs and their capping is established based on NAER Decision no. 76/2022 on the establishment of fixed tariffs and ceiling prices for electricity produced from renewable energy sources for 2022[115]. The costs are established depending on the scale of powers and constitute

- For installations with installed power 10-500 kW – 31 909 lei/kW (1700 USD)
- For installations with installed power 501-4000 kW – 26 278 lei/kW (1400 USD)

At the same time, the primary regulatory framework, Law 10/2016 on the promotion of renewable energy sources, stipulates that all technological equipment must be new, in order to benefit from regulated tariffs and based on the status of eligible producer. As a result of the fact that the investment costs are high, most of the wind installations in the Republic of Moldova are imported second-hand, and the sale of electricity takes place at an unregulated tariff and at the wholesale market price. According to estimates and based on NAER decision no. 76/2022, the average investment cost for one kW of installed power is $1550, and the total investment established based on the short-term scenario described in Chapter I is $186,000,000, and long-term $2,015,000,000.

Limited access to financial resources to promote wind technologies

This was caused by the formation of high or exaggerated costs of capital - the high bank interest rate, the imperative of guaranteeing loans at the level of 120-150% of its value, etc. Even if more efforts have been made in this direction through externally financed projects, the cost of bank interest rates still remains high. The solution to overcome the barrier would be to mobilize financial resources from Donors and Funding Partners (especially access to cheap financial means from international funding organizations) as well as to mobilize the own financial resources of entrepreneurs and the residential sector.

Lack of tendering procedures for large wind generation capacities

In accordance with the primary and secondary regulatory framework, the Government of the Republic of Moldova is responsible for auctioning renewable electricity production capacities, through the application of the fixed price support scheme. In the case of wind installations,

[115] https://www.legis.md/cautare/getResults?doc_id=130191&lang=ro

capacities of 105 MW are to be auctioned. The lack of procedures developed and approved by the government, later made available to investors, blocks the replication of this technology on a larger scale in the country. In this regard, overcoming this barrier, the Ministry of Infrastructure and Regional Development is to benefit from immediate technical assistance to develop the bidding procedures for wind capacities.

Low tax breaks

Even if the state partially promotes tax incentives on such technologies, they are focused only on certain elements within a wind system. Starting from the premise that the Republic of Moldova is not a country producing wind installations, import tax incentives would reduce the costs of investments in such equipment.

1.4.2.2 Non-financial barriers

Legislative barriers

According to the regulatory framework, the new rules of the electricity market are introduced slowly due to sophisticated and complex procedures. This is related to the lack of a secondary regulatory framework resulting from Law 10/2016 on the promotion of renewable energy sources. Because of the above, to this day it has not been able to start the new rules on the electricity market, with the persistent involvement of wind technologies.

Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased wind potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas

Compared to photovoltaic technologies, where the net metering support scheme is widely applied to small production capacities to cover their own energy needs, in the case of wind technologies, they are primarily directed towards the business model by applying the tariffs and fixed prices support scheme. Thus, the lack of transmission and/or distribution networks in areas with high wind potential blocks the promotion of the technology or directly contributes to increasing the investment costs for their expansion.

Limited local balancing capacities for the participation of wind turbine producers in the electricity market

For small capacities, local balancing capacity can be neglected. This is not attributed to large capacities. The secondary regulatory framework resulting from Law 10/2016 also includes how this balancing will be carried out. This aspect becomes even more topical when we talk about the liberalization of the electricity market, where producers from renewable energy sources have assumed obligations regarding the mandatory insurance of the imbalances arising in the

network, NAER Decision no. 283/2020 on the approval of the Electricity Market Rules[116]. In this regard, producers participating in the wholesale electricity market, based on wind technologies, are obliged to sign balancing contracts with the transmission system operator. At the same time, the production companies that have been issued by NAER a license for the production of electricity are obliged to contact the transmission system operator, within ten working days, after the issuance of the respective license for the purpose of signing the balancing contract.

Long and arduous procedures for obtaining the necessary building permits and permits for the construction of a wind power plant

The installation and quality assurance of the execution of the construction and installation works of a wind system is ensured in the light of Law 721/96 on the quality assurance of construction works. In addition to the nominated, procedural legislative framework, a potential Beneficiary must go through several steps, which also include obtaining permissive acts, coordination and approvals at the level of authorities and parties involved in carrying out such a project, developing studies and analyses. These procedures complicate and delay the realization of such a project over time. At the same time, studies related to the impact of technologies on the environment are mandatory, and the lack of specialized companies in this direction delays the processes of obtaining permissive documents. The recent conditions for obtaining connection permits from potential investors with a power greater than or equal to 1 MW, within the voltage range greater or less than 110 kV, have the obligation to develop studies of solutions for the connection of power plants[117]. This also delays the realization of a project in the wind field, due to the lack of companies specialized in this direction.

Insufficient training of assembly staff

If we make a comparison between the first two technologies analyzed, the training of staff in the field of assembly, assembly and service are ensured through GD 1051/2018 on the approval of the Regulation on the qualification and registration of installers of biomass boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. In the case of wind technologies, both the construction and the servicing of the mounted equipment are not legally covered, and the training of staff in this direction is not fully ensured by the universities and training centers in the country. At national level, there is a total lack of specialists in the field, as well as accredited training programs and professional training from the mentioned institutions.

Gender unequal treatment

The mentioned technology is in the engineering field, and this fact in the Republic of Moldova involves few women who can develop, manage and benefit from the results of this technology. Gender inequality in technology appears, including in terms of the level of professional training in the field of installations, where there is a low presence of women.

[116] https://www.legis.md/cautare/getResults?doc_id=123381&lang=ro
[117] https://www.legis.md/cautare/getResults?doc_id=126419&lang=ro

These elements create significant barriers in the promotion of technology at the country level, as well as ensuring a lasting and sustainable process of investments made in this field.

In accordance with the decision of the working group, barriers to technology transfer and diffusion, horizontal axis wind turbines have been prioritized as follows:

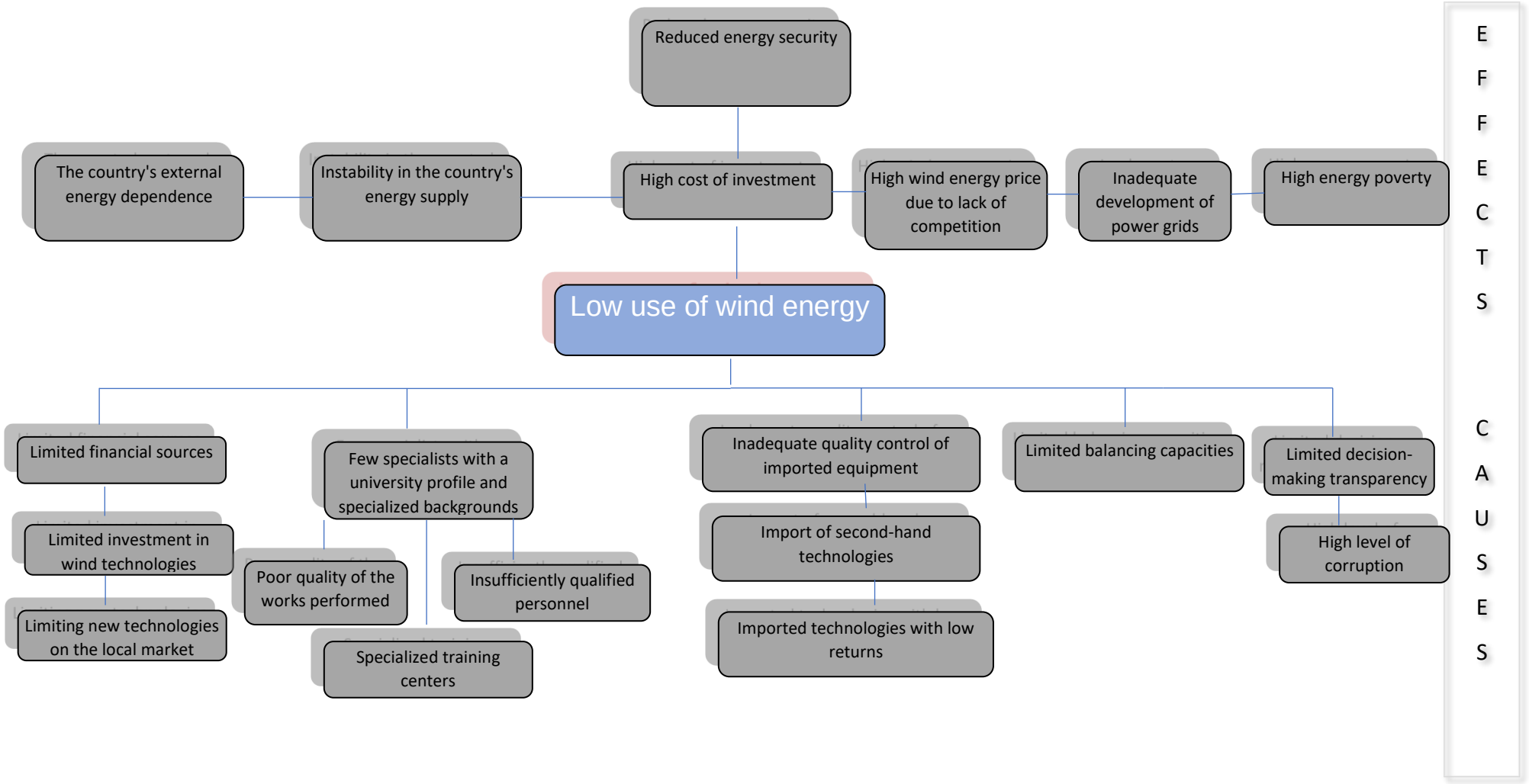
Table 9. *Prioritization of barriers to wind technology with horizontal axes*

Nr.	Name of barrier	Category	Degree of appreciation
1.	Reduced local balancing capacities for the participation of wind power plant producers in the electricity market	Technical	Very important
2.	High investment cost	Economic and financial	Important
3.	Access to the distributor's network	Technical	Important
4.	Insufficiency of specialized companies to carry out environmental impact studies and grid connection solutions	Technical	Important
5.	Inadequate quality control of imported technologies	Legislative framework	Important
6.	Reduced tax incentives	Economic and financial	Important
7.	Limited access to financial resources	Economic and financial	Important
8.	Limited knowledge of technology implementation procedures	Information and awareness	Important
9.	Lack of bidding procedures for generation capacities	Legislative framework	Important
10.	Lack of qualified personnel in the field of assembly	Training and preparation of staff	Important
11.	Level of corruption and conflict of interest	Legislative framework	Important
12.	Unequal treatment of gender	Information and awareness	Important

The problem tree was developed based on the decision of the working group (see figure 5), where it was found that barriers that would stop the promotion of the technology on the local market do not exist.

At the same time, according to Figure 6, the tree of objectives of the horizontal axis wind turbine technology was also developed, which aims to develop measures that contribute to overcoming the identified barriers.

Figure 5 *Problem tree. Wind technologies with horizontal axes*



1.4.3 Identifying measures

1.4.3.1 Economic and financial measures

The following measures have been identified to overcome economic and financial barriers to the transfer and diffusion of horizontal axis wind technologies (see Figure 10).

Table 10. *Measures to overcome the economic and financial barriers of wind technologies with horizontal axes.*

Nr.	Barriers	Measures applied to overcome barriers
1.	High initial investment costs	Diversification of suppliers and importers of wind technologies.
2.	Limited access to financial resources to promote technologies	Mobilization of financial resources from Donors and Funding Partners (especially access to cheap financial means from international funding organizations) as well as mobilization of own financial resources of entrepreneurs and the residential sector. Launch in the Republic of Moldova of various technology subsidy programs, including through the active involvement of banking institutions, which can come up with financial instruments in the form of preferential loans.
3.	Lack of bidding procedures for photovoltaic generation capacities	Attracting financial and technical assistance for the development of bidding procedures for generation capacities based on wind technologies in a transparent and non-discriminatory manner.
4.	Reduced tax incentives	Promoting tax incentives through customs duties for wind technologies, (invoking the economic and environmental benefits that such investments generate), especially for large units, in the order of hundreds of kW. Introducing the facilities into the national tax legislation by supplementing/amending the Fiscal Code of the Republic of Moldova, without indicating any terms of validity of the forecasts and obtaining the commitments of the Ministry of Finance regarding the amendments made.

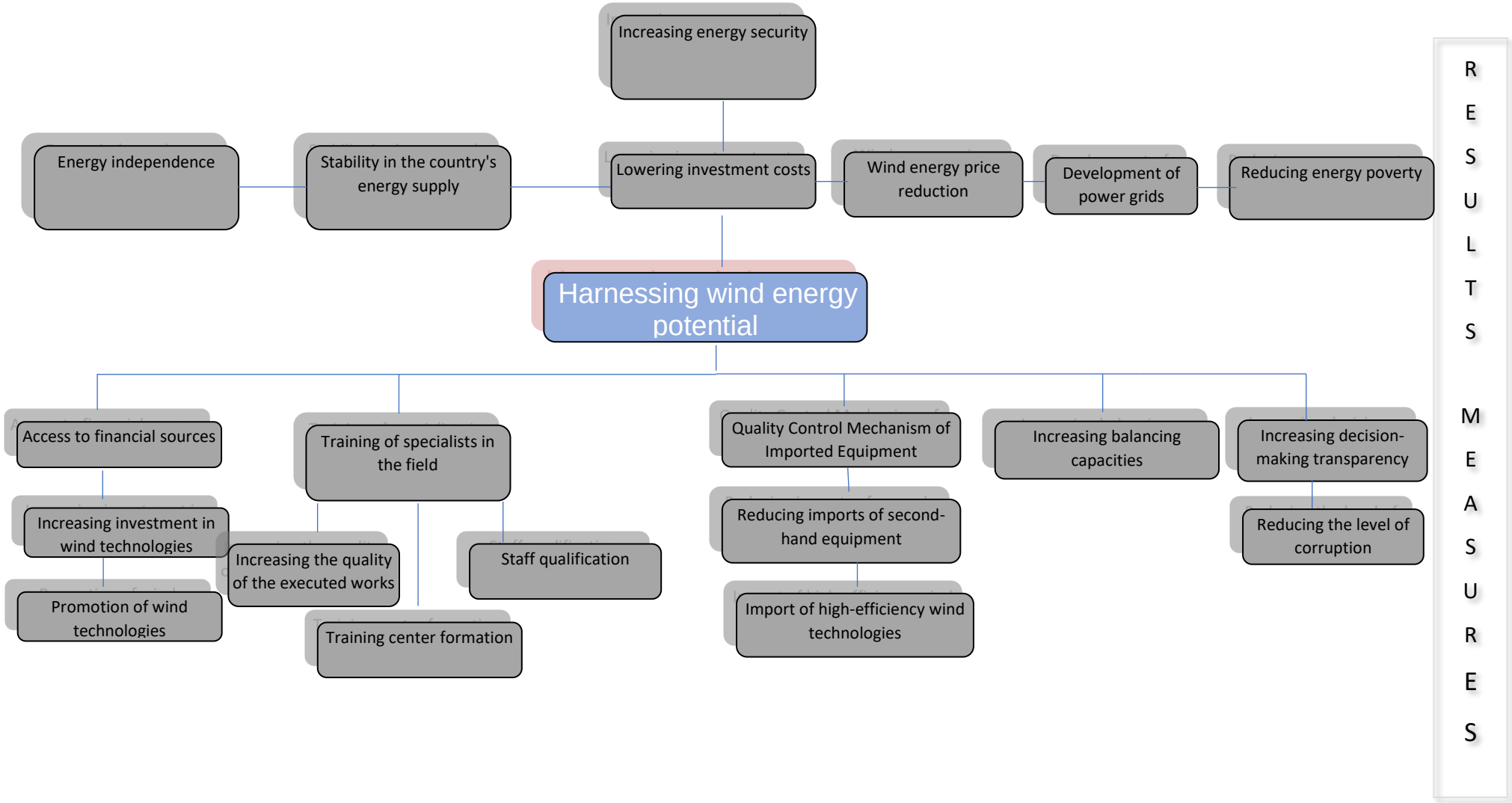
1.4.3.2 Non-financial measures

The following measures have been identified to overcome non-financial barriers to the transfer and diffusion of horizontal axis wind technologies (see Table 11).

Table 11. *Measures to overcome the non-financial barriers of wind technologies with horizontal axes.*

Nr.	Barriers	Measures applied to overcome barriers
1.	Legislative framework	Extension of technical assistance to the branch ministry for the intensification and elaboration of the secondary regulatory framework and development of new procedures regarding the rules of the electricity market produced from renewable energy sources.
2.	Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased solar potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas	Synchronization of the plans for the expansion of the public electricity supply network with the research carried out by the Government on the subject of the renewable potential – wind power for electricity production. Active participation of actors in the electricity field (Electricity transmission and distribution system operators. Ministry of Environment. Ministry of Infrastructure and Regional Development, Energy Efficiency Agency, etc.) within the dedicated working groups and platforms set up for the coordination of sectoral policies.
3.	Limited local balancing capacities for the participation of wind producers in the electricity market	Contracting balancing capacities in adjacent markets and establishing a favorable climate for producer-supplier communication. Creation of favorable conditions for the construction/reconstruction, by the private and public sector, of non-intermittent generation units (practically possible only under the conditions of the existence of a developed electricity market).
4.	Lack of legislation on training and capacity building of wind technology specialists	Elaboration of the regulatory framework for the training of installation specialists in the field of wind technologies. Preparation, elaboration and accreditation of training programs dedicated to specialists in the field of wind installations. Adjustment of the regulatory framework on safety technology in installations related to wind technologies.
5.	Long and arduous procedures for obtaining building permits and permits	Modification of the legislative framework with an impact on the field of constructions and the quality of construction works by imposing new approvals of the Urban Planning and Construction Code.
6.	Insufficient training of staff in the field of assembly	Establishment and accreditation of continuous training programs for specialists in the field of wind systems.
7.	Gender unequal treatment	Gender issues are to be addressed at different levels in the promotion of technology at local level. Starting especially from the fact that women represent the majority of employees in institutions where technology is to be intensively promoted (schools, kindergartens, etc.), including in the residential sector, they will equally benefit from its advantages of matching men.

Figure 6 *Objective tree of wind technology with horizontal axes*



1.5 Links between identified barriers

The common barriers identified within the three technologies analyzed are both financial and non-financial. The most important barriers that prevail for two technologies are related to the lack of balancing sources, as well as the lack of cheap financial means to make possible the diffusion of technologies on the local market. The last barrier is also common for ground-to-water heat pump technology. The detailed common barriers of the three technologies are presented in Table 12 below. At the same time, those in the less important category were not examined.

Table 12. *Common barriers to energy technologies*

No.	Category of barriers	Barriers
1	Financial and economic	● Limited access to cheap financial resources.
2	Legislative and regulators	● Limited balancing capacities for renewable electricity sources. ● Dedicated training programs and accreditation for installation specialists. ● Inadequate quality control of imported equipment.
3	Technical tools	● Lack of digital maps on identifying and capitalizing on geothermal and photovoltaic potential. ● Lack of guidelines or guidance for potential beneficiaries of technologies on facilitating diffusion and promoting them.
4	Others	● Limited access to the national electricity grid.

1.6 Facilities for overcoming barriers in the energy sector

One of the main elements regarding the facilitation of overcoming barriers in the energy sector is the development and approval of Government decisions that emerge from the primary regulatory framework. Among them we can mention: Dedicated programs for installers, approval of the regulation on the auctioning of large capacities, etc. Once approved, this will create a favorable framework for the more effective development and introduction of new technologies on the local market.

At the same time, the awareness of the private and public sectors about the risks of climate change and the importance of adaptation measures can also become an effective measure for the diffusion of technologies. This measure must also be supported legislatively, by developing or updating the climate change adaptation strategies and the action plan for the Republic of Moldova.

The development of new financing mechanisms are equally important for the promotion of technologies. This can be achieved by involving the state in supporting these investments and facilitating instruments to subsidize loans issued by commercial banks. In this respect, the awarding of grants is necessary to trigger the introduction of new technologies at local level. Maintaining partnership relations with external donors and development partners is a requirement for access to cheap financing instruments, so as to create favorable conditions for the development of the energy sector based on the legislative provisions in the energy field.

The proposals for the development of the enabling framework to facilitate the diffusion of technologies in the energy sector are reflected in Table 13 below. As a result of the fact that they are common for all three technologies, which respond to overcoming the climate impact by reducing the production of electricity and heat due to the lack of water at CET and HPP, they will be developed jointly.

Table 13. *Favorable framework for ensuring the diffusion of the analyzed technologies*

No.	Favorable framework	Comments
1.	Legislative	These technologies need to be part not only of the energy legislative framework, but also adjacent to it, as well as those in the field of adaptation to climate change.
2.	Technical standards and regulations	The transposition of standards at national level through the primary regulatory framework, as well as the development of norms and practical codes will facilitate the placing of qualitative technologies on the market, from a technical point of view.
3.	Financial and fiscal policies	It is necessary to develop financial and fiscal policies to facilitate bank lending by potential investors and to reduce import taxes on technologies.
4.	Corruption and decision-making transparency	There is a need for mechanisms to control corruption and ensure transparent and non-discriminatory decision-making processes for all potential investors by the parties involved.
5.	Sectoral strategies and national action plans	Strategic planning policy documents need to be developed, tangentially to those in the energy field. The development of a national action plan on renewable energy sources with the integration of photovoltaics, heat pumps and wind pumps with vertical axes would facilitate their promotion at national and local level. At the same time, they are expected to be an integrated part of environmental and energy actions at local level.
6.	Training of installation specialists	It is necessary to develop new programs and conduct studies to prepare potential specialists in the field. The preparation and accreditation of training and continuous training programs for installation specialists will be crucial in ensuring a sustainable maintenance and operation process of the promoted technologies.

Annex I.

Market mapping

The market mapping was developed by the team of experts of the adaptation component of TNA to present the main market actors of the analyzed technologies, as well as the elements necessary for their successful transfer and dissemination in the Republic of Moldova. The mapping consists of three levels, comprising market actors, service providers and the supporting framework (enabling environment).

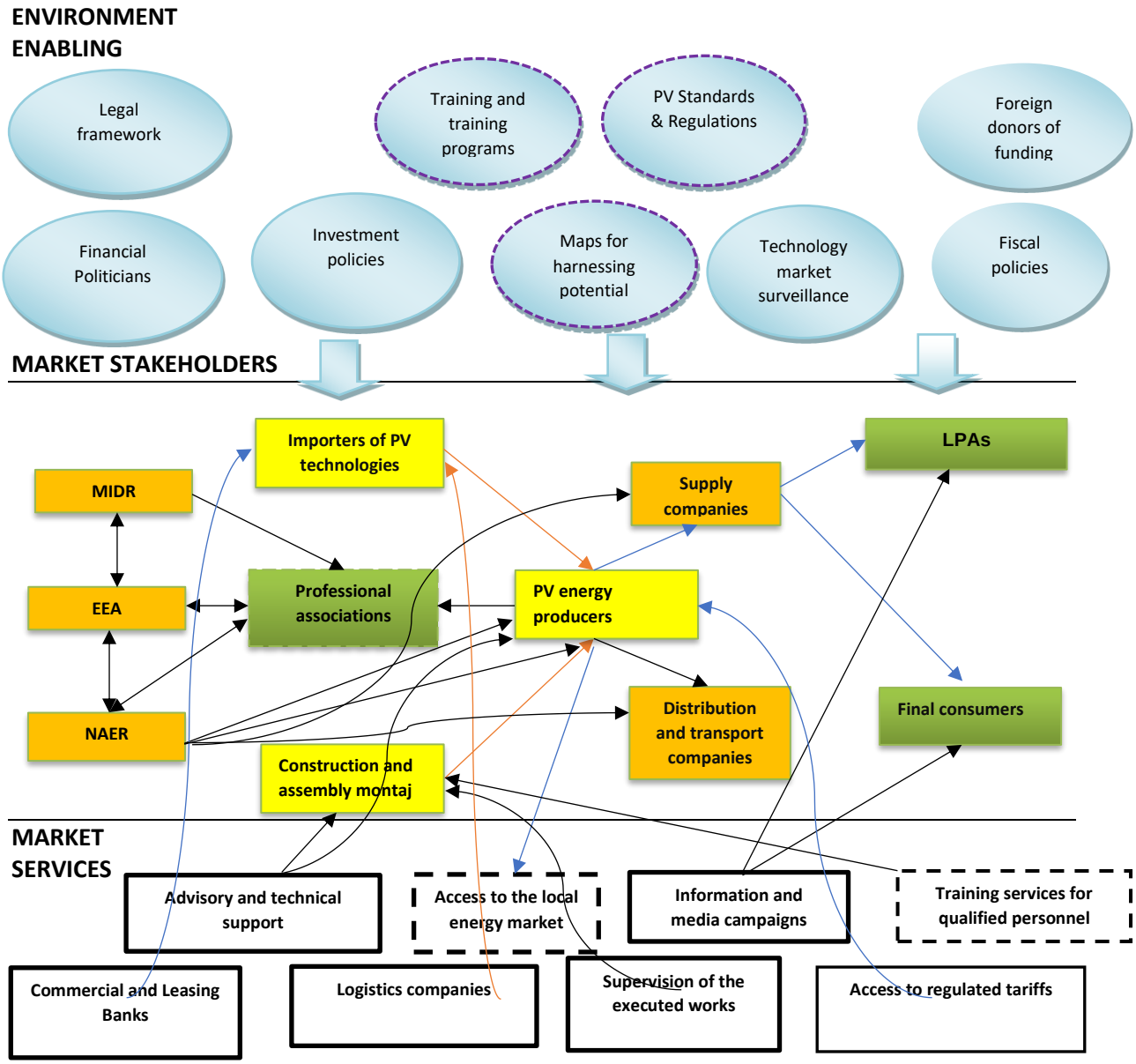
Market actors include technology beneficiaries, such as local public authorities at all levels, the residential and business sectors, technology providers, including importers, construction and assembly companies, consulting services, public institutions related to the development, promotion and implementation of energy policies, etc. At the same time, mapping also includes the relationships that the parties involved have, marked with continuous lines of action. These are in addition to the relationships to be developed, drawn with dotted lines and cells.

Market services are the actors that can support the development of relations between market actors, support the development of the market by providing consultancy, promotion, financing, development and training of specialists, quality assurance of the works performed, etc.

Finally, the **permissive framework** represents the complex of legislative, institutional, political, financial and other frameworks necessary for the promotion of these technologies in the Republic of Moldova. Improving them is essential to succeed in the transfer and diffusion of technologies in the long term. These refer to the respective financial and regulatory policies, development programs and strategies, technical and normative standards in construction, etc.

The market mapping for the prioritized technologies in the water energy sector are presented below.

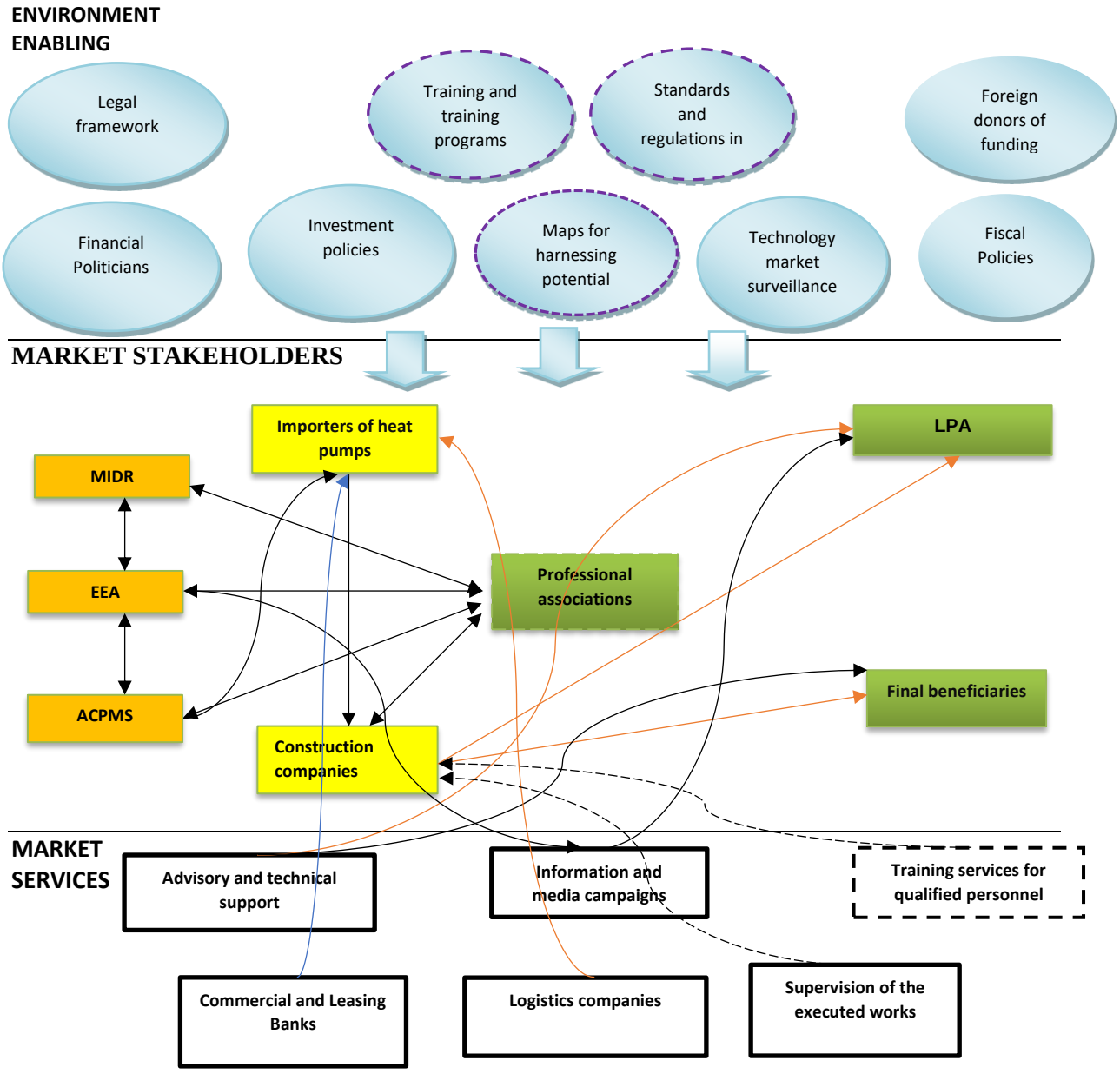
Annex I.I Market mapping. Monocrystalline photovoltaic technologies



Legend

Circulation of money flow
Circulation of material/goods flow
Other service flows

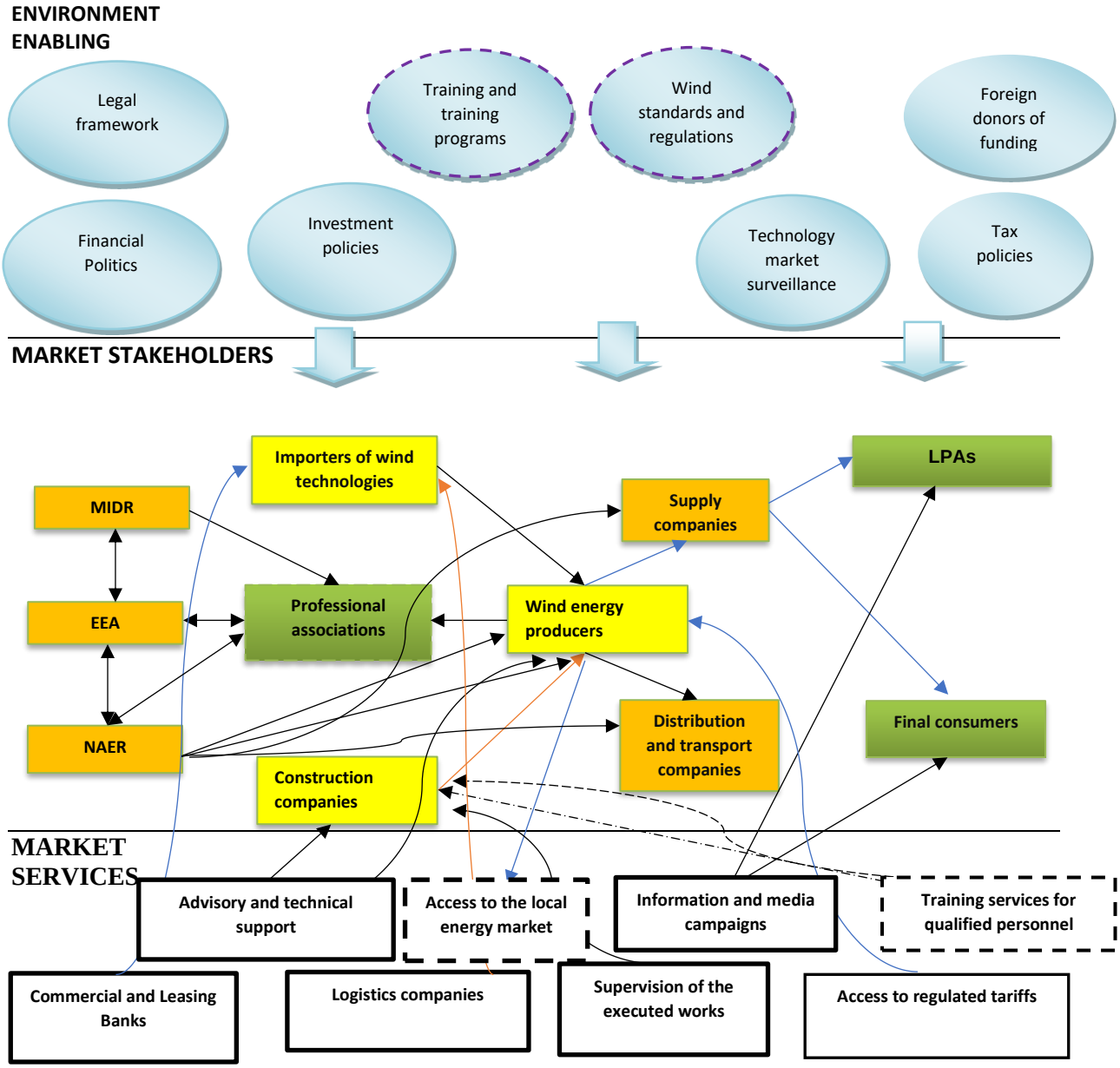
Annex I.II Market mapping. Ground-to-water heat pump technologies



Legend

Circulation of money flow
Circulation of material/goods flow
Other service flows

Annex I.III Market mapping. Vertical axis wind technologies



Legend

Circulation of money flow
Circulation of material/goods flow
Other service flows

Annex II List of stakeholders

Nr.	Name of institution	Contact details	Delegated person
1.	Ministry of Infrastructure and Regional Development	tel.: (+373 22) 250 537, e-mail: serghei.munteanu@mei.gov.md	Mr Serghei Munteanu, senior consultant, Urban planning, construction and housing department.
2.	Energy Efficiency Agency	tel.: (+373 22) 499 444, ext.3, e-mail: valerian.colun@aee.md	Mr Valerian Colun, Deputy Head of the EEA Policy Implementation and Monitoring Directorate
3.	National Agency for Energy Regulation	e-mail: aursu@anre.md 022 823-939 Mob 067612011	Mr Alexandru URSU, Head of the Tariffs and Analysis Section, Electricity and Renewables Department.
4.	National Agency for Research and Development	e-mail: doinita.ulinici@ancd.gov.md e-mail.	Mrs Doinița Ulinici, Consultant, Department for international cooperation and sustainable development,
5.	Institute for Standardization of Moldova	e-mail: ism.diana.titica@gmail.com	Mrs Titica Diana, Head of the Business Support Center in Standardization
6.	Institute of Energetics	Tel.: (+373) 794 77 978 e-mail: energplan.srl@gmail.com	Mr Sergiu Robu, Scientific researcher at the Institute of Energetics
7.	Center of Excellence in Construction	Tel.: (+373) 695 90 737 e-mail: catedra.acgv@gmail.com	Mrs Nicolaev Elena, Head of Quality Assurance Department, Engineering Installation Engineer, Authorized Energy Auditor.
8.	Center of Excellence in Energy and Electronics	Tel.: (+373) 695 30 448 e-mail: g.tofan74@gmail.com	Mr Grigore Tofan, head of the Electrical Engineering Department, professor of specialized disciplines, higher didactic degree
9.	Termoelectrica SA	Tel.:(+373 22) 436 472 e-mail: ghersun.natalia@termoelectrica.md	Mrs Gherșun Natalia, Head of the Technical Regulations Section
10.	Premier Energy Distribution	Tel.: (+373) 621 61 572 e-mail: IMirza@premierenergy.md	Mr Mîrza Igor, Head of Network standards and architecture department
11.	RED Nord SA	Tel.: (+373 231) 5 31 00, e-mail: anticamera@rednord.md	Mr Viorel Corbu, technical director of S.A. ”RED-Nord”
12.	CET Nord SA	Tel.: (+373) 692 06 603, e-mail: oleglomov-92@mail.ru	Mr Oleg Lomov, engineer in the Technical and Production department
13.	Association of Installation Engineers of Moldova	Tel.: (+373) 690 45 215, e-mail: ludmila.virlan@acagpm.utm.md	Mrs Ludmila Virlan, President of the Association
14.	AM SISTEME SRL	Tel.: (+373) 696 76 011, e-mail: natasaursuu@yahoo.com	Mrs Natalia Mereacre, Head of finance department

TECHNOLOGY ACTION PLANS and PROJECT IDEAS REPORT/ TAP (3)

REPORT III TAP

Executive summary

The Technology Action Plans (TAP) in the energy sector of the Republic of Moldova were developed for the technologies that were selected in the first phase of the TAP project and exposed in the first report, the assessment of technological needs for adaptation to climate change. The selection and prioritization of technologies was carried out by the national team of experts in the energy sector, which brings together representatives of the government, non-governmental associations, the private sector and academia. 3 technologies have been selected that respond to the process of adaptation of the energy sector to climate change.

Thus, actions aimed at overcoming financial and bureaucratic obstacles have been identified, in order to oblige stakeholders and companies to use high energy efficiency technologies, but also new ones in the case of wind technologies with a horizontal axis. The success of the implementation of monocrystalline photovoltaic technologies, ground-to-water heat pumps and wind turbines depends primarily on the creation of a favorable framework on the local market in the Republic of Moldova. The electricity market was created recently, which imposes certain restrictions and discourages investors in case of imbalances that are harshly taxed by the transmission system operator. In this sense, specialized software, or forecasting services, will play an essential role in replicating technologies at the country level. In order to start the process of replicating these technologies, several steps are expected to be taken over the next 5 years:

At the same time, between November 25, 2022 and December 2, 2022, the TAP was coordinated with the sectoral working group. In this regard, a comment was received regarding the adjustment of the capacity limits based on the new Government Decision 401/2021 on the approval of the capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources valid until December 31, 2025. The normative act was amended based on Government Decision no. 516 of 22.07.22. This comment was taken into account in the final adjustment of the TAP. Other comments or proposals from the working group have not been received.

Based on the above, we can conclude that it is necessary to urgently implement the technologies proposed in response to the climate impact, which are becoming more and more aggressive in the energy sector of the Republic of Moldova.

Summary of Actions planned to promote priority technologies for adaptation to climate change in the energy sector of the Republic of Moldova

Technology	Ambition	Actions	Activities		Implementation period	Risks
Mono crystalline photovoltaic panels	Promotion and construction of monocrystalline photovoltaic power plants, with a cumulative electrical capacity of 470 MW, for the scenario in which the energy demand in the Republic of Moldova is covered by 100 of the RES, connected to the national public grid, in order to overcome the climate impact on the danger of diminishing the production of electricity due to the lack of technological water at the CET and HPP, as a result of the drought	**Action 1 Development of the secondary regulatory framework**	1.1	Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	2022-2023	1. Delaying the approval of the regulatory framework 2. Insufficient budgetary means 3. Lack of institutional capacities 4. Lack of qualified teachers 5. High bank rates
			1.2	Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	2023- each budget year	
			1.3	Operation of changes in the Electricity Networks Code	2022-2023	
			1.4	Certification and quality verification of products (photovoltaic systems) imported or produced in the country	2023-2024	
			1.5	Revision and transposition of standards for photovoltaic technologies	2023-2024	
			1.6	Development of plans to expand the electricity distribution and transmission networks based on the regional photovoltaic potential	2023-2025	
		Action 2 Development of institutional capacities and training of specialists	2.1	Development and accreditation of training and continuous training programs for specialists in the photovoltaic field	2023-2025	
			2.2	Purchase of specialized software or electricity forecasting services produced based on photovoltaic technologies and training	2022-2025	
			2.3	Development of specialized programs on the identification of photovoltaic potential and training	2023-2025	

				of specialists in the development of feasibility studies		
		Action 3 Increase affordability	3.1	Dedicated credit lines through commercial banks and state programs on financing projects based on photovoltaic technologies	2022-2025	
			3.2	Development of subsidy instruments for photovoltaic installations	2022-2023	
Ground-to-Water Heat Pump	Promotion and installation of ground-to-water heat pumps with a total cumulative thermal power of 225 MW, in order to overcome the climate impact on the danger of decreasing the production of thermal energy due to the lack of technological water at the TECs, as a result of the drought	**Action 1 Development of the regulatory framework**	1.1	Updating the energy strategy of the Republic of Moldova	2022-2023	1. Delaying the approval of normative acts 2. Insufficiency of financial means 3. High bank rates 4. Lack of qualified teachers 5. Lack of qualified specialists 6. Lack of statistical data used for the development of studies
			1.2	Updating the law on the energy performance of buildings	2023-2024	
			1.3	Development of local energy and environmental action plans	2023 – regularly	
			1.4	Development of standards in the construction of ground-water heat pumps	2023-2024	
			1.5	Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of heat pump technologies	2023- each budget year	
			1.6	Update of the Medium-Term Budgetary Framework (MTBF)	2023-2026	
			1.7	Modification of the normative framework under construction regarding the issuance of permissive acts	2024-2025	
			1.8	Ensuring the quality certification procedure of products, equipment	2025-2026	
			1.9	Establishment of a heat pump testing laboratory	2025-2026	
			1.10	Revision and transposition of standards for heat pump technologies	2023-2024	

		Action 2 Development of financial instruments and technology promoting	2.1	Development of subsidy instruments for heat pump installations	2022-2023	
			2.2	Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies	2022-2025	
			2.3	Development of ESCO business models	2023-2025	
			2.4	Media coverage and promotion of heat pump technologies	2022-2025	
		Action 3 Increasing institutional capacities for training specialists	3.1	Development and accreditation of training and continuous training programs for specialists in the field of geothermal installations and heat pumps	2023-2025	
			3.2	Establishment of a laboratory for the practical hours of students from educational institutions	2023-2024	
		Action 4 Development of geothermal potential in the Republic of Moldova	4.1	Elaboration of a study on geothermal potential in the Republic of Moldova	2023-2025	
			4.2	Development of interactive maps with the identified geothermal potential	2025-2026	
			4.3	Development of a study on the identification of buildings that can benefit from ground-to-water heat pump technology	2024-2025	
			4.4	Specialized heat pump sizing software	2024-2025	
Vertical shaft wind equipment	Promotion and construction of wind installations, with a cumulative electricity capacity of 1300 MW, for the scenario in	**Action 1 Development of the regulatory framework**	1.1	Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	2022-2023	1. Delaying the approval of the regulatory framework
			1.2	Update of Law 10/2016 on renewable energy sources	2023-2024	

	which the Republic of Moldova tends to cover 100% of the energy demand from the RES, connected to the national public grid, in order to overcome the climate impact on the danger of diminishing the production of electricity due to the lack of technological water at the CET and HPP, as a result of the drought.		1.3	Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	2023- each budget year	2. Insufficient budgetary means 3. Lack of institutional capacities 4. Lack of qualified teachers 5. High bank rates
			1.4	Modification of the normative framework under construction regarding the issuance of permissive acts	2024-2025	
			1.5	Operation of changes in the Electricity Networks Code	2022-2023	
			1.6	Revision and transposition of standards for wind technologies	2023-2024	
		Action 2 Development of institutional capacities and training of specialists	2.1	Development and accreditation of training and continuous training programs for specialists who maintain, develop and operate wind technologies	2023-2025	
			2.2	Development of training programs on the preparation of specialists for the development of feasibility studies	2022-2025	
			2.3	Organization of trainings or workshops for wind producers to facilitate access to the electricity market	2023-2025	
			2.4	Development of specialized software for forecasting electricity produced based on wind technologies	2022-2025	
		Action 3 Increase affordability	3.1	Dedicated credit lines through commercial banks and state programs on financing projects based on wind technologies	2022-2025	
			3.2	Media coverage and promotion of new wind technologies	2022-2025	

Chapter 1 Technology Action Plan and Project Ideas for the Energy Sector of the Republic of Moldova

1.1 TAP for the energy sector

1.1.1 Overview of the sector

In the electricity sector, according to the NAER activity report for 2019[118], the dynamics of energy flows in electricity networks, during 2019, the transmission system operator, distribution system operators and suppliers purchased electricity in the amount of 4,301.9 million kWh, 0.05% less than in the previous year (4,303.9 million kWh), and the amount of 3,875.1 million kWh was delivered to final consumers, by 0.3 percent more than in 2018 (3,862.7 million kWh). The level of technological consumption and electricity losses in electricity distribution networks in 2019 decreased compared to the previous year's level by 0.2 percentage points and amounted to 8.1%.

In the thermal energy sector, during 2019 the total amount of thermal energy delivered to the network was 1757.9 thousand Gcal, by 221.6 thousand Gcal (-11.2%) less compared to the amount of thermal energy delivered in 2018. Compared to 2017, in 2019 the amount of thermal energy delivered to the network decreased by 127.1 thousand Gcal (-6.7%).

In this regard, a number of primary and secondary legislative acts have been drafted and approved. Table 1.1 and 1.2 lists the main legislative acts and Government decisions.

Table 1.1 *Approved energy and environmental laws*

Nr.	Name	Description
1.	**Law No. 139 of 19.07.2018** on energy efficiency	The purpose of the law is to create the necessary legal framework for the promotion and improvement of energy efficiency by implementing action plans in the field of energy efficiency, by developing the energy services market, as well as by implementing other energy efficiency measures
2.	**Law No. 128 of 10.10.2014** on the energy performance of buildings	The purpose of the law is to promote the improvement of the energy performance of buildings, taking into account climatic conditions, indoor climate requirements and cost-effectiveness
3.	**Law No. 10 of 26.02.2016** on the promotion of the use of energy from renewable sources	This law aims to establish a legal framework for the promotion and use of energy from renewable sources and establishes mandatory national objectives regarding the share of energy from renewable sources in the gross final consumption of energy, as well as the share of energy from renewable sources in the final consumption of energy in transport. The law defines the norms regarding support schemes, guarantees of origin, administrative procedures, access of producers of energy from renewable sources to the networks
4.	**Law No. 166 of 11.07.2012** on the approval of the National	The strategic vision for the development of the energy sector is based on the following pillars: (i) ensuring the energy security of the state and (ii) increasing energy efficiency.

[118] http://www.anre.md/raport-de-activitate-3-10

	Development Strategy "Moldova 2020"	Energy efficiency will be ensured by: Decreasing energy intensity in the residential, industrial, transport and agricultural sectors. modernization of the energy system. the implementation of energy-efficient technologies. the involvement of own energy resources, including renewable ones, in the consumption balance
5.	**Law 151 of 17.07.2014** for eco-design requirements applicable to energy-related products	This law establishes the legislative framework regarding the eco-design requirements applicable to energy-related products in order to ensure the free movement of these products on the internal market. The law establishes requirements for energy-related products placed on the market and/or put into operation, thus contributing to sustainable development, increasing energy efficiency and environmental protection, as well as increasing the security of energy supply.
6.	**Law 107 of 27.05.2016** on electricity	The purpose of this law is to establish a general legal framework for the organization, regulation, ensuring efficient operation and monitoring of the electricity sector meant to supply consumers with electricity in conditions of accessibility, availability, reliability, continuity, quality and transparency. ensuring free access to the electricity market. promoting the production of electricity. ensuring the appropriate balance between supply and demand, the appropriate level of interconnection capacity to facilitate cross-border electricity exchanges. development of the electricity market and integration into a competitive electricity market. establishing measures to guarantee the security of electricity supply. proper fulfilment of public service obligations. ensuring compliance with consumer rights as well as environmental protection rules
7.	**Law no. 92 of 29.05.2014** on thermal energy and promotion of cogeneration	This law regulates the activities specific to centralized heat supply systems, aimed at improving the energy efficiency of the entire economy and reducing the negative impact of the thermal energy sector on the environment, including through the use of cogeneration technologies
8.	**Law no. 44 of 27.03.2014** on the labelling of products with energy impact	This law establishes the regulatory framework for national measures on labelling and standard information on energy-related products, intended for end-users, in particular on the consumption of energy and, where applicable, of other resources essential for use, as well as additional information on energy-related products
9.	**Law no. 1515 of 16.06.1993** on environmental protection	This law constitutes the basic legal framework for the elaboration of special normative acts and instructions on special issues in the field of environmental protection in order to: Ensure the right of every person to a healthy and aesthetically pleasing environment. the realization of the supreme responsibility of each generation for the protection of the environment before future generations, etc.

Table 1.2 *Approved Government Decisions in the Energy and Environment Field*

Nr.	Name	Description
1	**Government Decision No. 102 of 05.02.2013** on the Energy Strategy of the Republic of Moldova until 2030	Specific Objective no. 1 for the period 2021-2030 of the given Strategy is "Ensuring the increase in the use of renewable energy sources. Scenarios on the long-term availability of carbon capture and storage technology". In order to cope with the increase in electricity consumption by 2030, the contribution of renewable sources will increase to 600 MW

2.	**Government Decision No. 45 of 30.01.2019** on the organization and functioning of the Energy Efficiency Agency	The purpose of the decision outlines the main attributions and rights that the Energy Efficiency Agency has in the field of promoting energy efficiency and renewable energy sources in the Republic of Moldova
3.	**Government Decision No. 690 of 11.07.2018** for the approval of the Regulation on the conduct of auctions for offering the status of eligible producer	This Regulation applies to the organization and conduct of auctions for the granting of the status of eligible producer (hereinafter – auctions) in the case of the development of new electricity generation capacities by: - construction of new power plants using RES. - the construction of new hybrid power plants using RES and conventional energy sources. - increasing the capacity of existing power plants using RES.
4.	**Decision of the Board of Directors of NAER no. 375/2017 of 28.09.2017** regarding the METHODOLOGY for determining the fixed tariffs and prices of electricity produced by eligible producers from renewable energy sources	The methodology for determining the fixed tariffs and prices for electricity produced by eligible producers from renewable energy sources (hereinafter – Methodology) aims to determine, approve and update the fixed tariffs for electricity produced from renewable energy sources, to determine and approve the ceiling prices for electricity produced from renewable energy sources that will be proposed to the Government to be used in the organization of the tenders for offering the status of eligible producers, as well as updating the prices set in the respective auctions
5.	**Government Decision No. 301 of 24.04.2014** on the approval of the Environmental Strategy for 2014-2023 and the Action Plan for its implementation	The specific objectives of the Strategy related to the project: - integration of the principles of environmental protection, sustainable development and green economic development, adaptation to climate change in all sectors of the national economy. - reducing the negative impact of economic activity on the environment and improving measures to prevent environmental pollution
6.	**Government Decision no. 750 of 13.06.2016** for the approval of the regulations on eco-design requirements applied to energy-related products	The decision outlines the minimum requirements that an energy product must meet in its eco-design
7.	**Government Decision no. 141 of 24.02.2014** on the creation of the energy statistics system	The decision provides for the creation of an energy statistics system based on information technologies, which would become a reference system meant to support the three key institutions of the central public administration responsible for: (i) official energy statistics – the National Bureau of Statistics. (ii) the energy sector policy – Ministry of Economy and (iii) the implementation, monitoring and verification of the National Action Plan in the field of energy efficiency and the National Action Plan in the field of renewable energy, the production of specific indicators of energy efficiency and renewable energy sources, as well as the production of high-quality energy statistics for reporting both to stakeholders, and to international organizations (e.g. EUROSTAT,

		International Energy Agency, etc.), in accordance with the best European standards – Energy Efficiency Agency
8.	**Government Decision no. 1070 of 27.12.2013** for the approval of the Regulation on solid biofuel	The regulation establishes the concepts, classes and quality requirements, labelling requirements, as well as the conditions for placing on the market and monitoring biomass products both domestically produced and imported, intended for use in households and small buildings in the residential, commercial and public sectors
9.	**Government Decision No. 1093 of 31.12.2013** for the approval of the Regulation on the provision of energy services	The decision regulates the activity regarding the provision of energy services and energy performance contracts
10.	**Government Decision no. 301 of 24.04.2014** on the environment for the year 2014-2023	The vision of the Strategy is premised on the reform implemented in the environmental protection sector, so as to function an institutional, administrative and environmental management system adjusted to the rigors of the European Union, which ensures environmental sustainability and increases the quality of environmental factors. Their purpose is to guarantee the population of the Republic of Moldova the right to a sustainable, unpolluted and healthy environment, in harmony with economic development and social welfare.
11.	**Government Decision no. 444 of 01.07.2020** on the establishment of the mechanism for coordinating activities in the field of climate change	The objective of the National Commission is to coordinate, at national level, the process of implementation of the provisions of the UNFCCC and other international treaties in the field of climate change to which the Republic of Moldova is a party, the national reports in the field of climate change, as well as to ensure the fulfilment of the attributions and objectives, within the limits of the competence established by this Regulation. The Government Decision has three regulations that aim to implement this decision, namely: Annex 2 Regulation on the organization and functioning of the National Commission for Climate Change. Annex 3 Regulation on the cross-sectoral coordination mechanism for adaptation to climate change, Annex 4 Regulation on the coordination of appropriate mitigation actions at national level
12.	**Government Decision no. 1470 of 30.12.2016** on the approval of the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation	The vision of this Strategy is premised on the elaboration of a development mechanism aimed at reducing greenhouse gas emissions and increasing the financial coverage for the promotion of adequate investment policies and projects to mitigate them in all sectors of the national economy. The strategy is to ensure an economic development of the Republic of Moldova based on low greenhouse gas emissions

For the purposes of the above, the following technologies have been identified as a response to the adaptation of the energy sector to climate change:

Monocrystalline photovoltaic installations: These are the equipment for producing electricity based on the conversion of solar energy. At the moment, these technologies cover a fairly small segment on the local market. According to the legal framework, by 2025, their capacities must increase to 200 MW.[119] This technology can significantly contribute to ensuring electricity production as a result of possible reductions in electricity production at existing power plants caused by water scarcity. The generation process will help cover the

[119] https://www.legis.md/cautare/getResults?doc_id=132601&lang=ro#

energy demand needed for the cooling process of the spaces and the energy needs for land irrigation.

Wind technologies with horizontal axes: Wind energy is a clean and renewable energy but it is intermittent, having variations during the day and season, and even from one year to another. Wind turbines operate about 60% of the year in windy regions. Most turbines produce energy more than 25% of the time, with this percentage increasing in winter when the winds are stronger. These capacities are expected to increase in the near future, and by 2025 they will reach 120 MW.[120] The production of electricity based on this type of technology will help to cover the energy demand needed for the cooling process of the spaces and the energy needs for land irrigation.

Ground-to-water heat pump technologies: These are technologies that are mainly suitable for constructions with high heat requirements and lack of land areas or lack of water in the groundwater. The heat is extracted by conveying an intermediate agent (ethanol-water mixture, antifreeze-water) in wells inserted in vertical boreholes. The boreholes are carried out at depths between 60-150m. The efficiency of these systems is superior to air-to-water heat pump systems. Ground-to-water heat pumps with borehole cover a power range from 3 to 1,500 kW. About 13,160 heat pumps of various capacities are expected to be installed in residential insulated buildings, industrial and commercial enterprises, schools, hotels, restaurants and other premises. Most of the heat pumps (12,654) will have a small capacity from 12 kW to 19 kW and will be installed by the owners of existing or newly constructed detached buildings. Around 500 heat pumps with an average capacity of 50 kW will be installed at various enterprises, schools, hotels, restaurants and other premises to meet the requirements of heating and hot water supply. The technological process will significantly contribute to covering the energy demand needed for the heating/cooling process of spaces in the residential and public sectors.

1.1.2 Action Plan for the "Mono crystalline photovoltaic Installations" technology

1.1.2.1 Introduction

Technologies for producing electricity based on photovoltaic systems are in the early stages of development. Two basic technologies used locally are known, namely, mono and polycrystalline photovoltaic panels. Monocrystalline cells are used in the manufacture of monocrystalline photovoltaic panels, and a monocrystalline cell is, after all, a pure silicon crystal. Monocrystalline solar panels are very easy to recognize because there is no free space between the cells that make up the module, unlike other types of photovoltaic panels. It is characterized by flexibility, weight, compactness, reliability and durability.[121]

[120] https://www.legis.md/cautare/getResults?doc_id=132601&lang=ro#

[121] http://www.esolar.ro/sfaturi-utile/toate-tipurile-de-panouri-solare-avantajele-si-dezavantajele-lor.html

The generator of investment stimulation is the benefits of technology, which ensures their recovery within 7-9[122] [123]years. At the local level, the stimulation of investments is promoted through different donors and projects. As an example, Moldovan Orchard can serve, which is a credit line offered by the European Investment Bank (EIB) to the Government of the Republic of Moldova, which in turn grants this loan to participating commercial banks. The loans are intended for investments in the horticultural sector, including photovoltaic financing[124]. Likewise, the European Bank for Reconstruction and Development (EBRD) through the GEFF project and local commercial banks finance projects in the field of photovoltaic technologies predestined for the small and medium-sized enterprises sector. Funding takes place through the Green Technology Selector, which provides a broad platform for selecting the most efficient renewable and energy efficiency technologies[125]. According to the data presented by the Energy Efficiency Agency on January 1, 2022, almost 15 MW, electric power based on photovoltaic technologies, were installed in the private sector in Moldova.[126]

1.1.2.2 TAP's ambition

The ambitious objective related to the A1 technology is related to the promotion and construction of monocrystalline photovoltaic plants, with a cumulative electrical capacity of 470 MW, for the scenario in which the energy demand in the Republic of Moldova is covered by 100 of the RES, connected to the national public grid, in order to overcome the climate impact on the danger of diminishing the production of electricity, due to the lack of technological water at the CET and HPP, as a result of drought.

The long-term target, regarding the expansion of generation capacities, are set out in the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation[127], as well as the study on the Competitiveness of renewable energy sources, for the 100% RES scenario, to cover the electricity demand of the Republic of Moldova[128]. Following the analyses, the main conditions that define the ambitions for the development of the action plan of the mono crystalline photovoltaic installation technology are:

1. In the next 5 years, the key consumers of the mentioned technology will be the residential, public and business sectors.

2. In the case of public institutions, which manage buildings, their roof will be used for the placement of photovoltaic panels, to cover their own energy needs.

3. Given the lack of electrical infrastructure to the pumping stations of agricultural land, the mentioned sector will use these technologies in order to provide pumping stations with electricity predestined for irrigation.

[122] Economic aspects of electricity suppliers using photovoltaic installations and applying the net method support scheme
[123] Pre-feasibility study on facilitating financing of renewable energy (PVh) electricity generation projects to access GCF financial means
[124] https://livada-moldovei.md/
[125] https://techselector.com/moldova-ro/
[126] https://aee.md/ro/page/surse-de-energie-regenerabila
[127] https://www.legis.md/cautare/getResults?doc_id=129232&lang=ro
[128] https://ibn.idsi.md/vizualizare_articol/115080

As a result of the promotion of technologies on the local market, a series of economic and social benefits are to be obtained. Thus, new jobs will be created, both for installers and equipment suppliers. The job market will also be expanded by developing the operation, maintenance and maintenance services of the technology, which must be executed as an operation at least once a year. At the same time, energy savings and reduction of greenhouse gas emissions will be achieved.

1.1.2.3 Selecting Actions and Tasks for A1 technology

Summary of barriers and measures to overcome them. The most important barriers and their analysis were described in Report II, BAEF. On April 13, 2022, the sectoral working group, composed of specialists in the field, exposed themselves on the barriers that block the promotion of the technology on the local market. Those of very high and medium importance have been selected for the development of TAP actions and activities, expressed in the following chapters:

Limited local balancing capacities for the participation of PV system manufacturers in the electricity market

For small capacities, local balancing capacity can be neglected. This is not attributed to large capacities. The secondary regulatory framework resulting from Law 10/2016 also includes how this balancing will be carried out. This aspect becomes even more topical, as we talk about the liberalization of the electricity market, where producers from renewable energy sources have assumed obligations regarding the mandatory insurance of imbalances arising in the network, NAER Decision no. 283/2020 on the approval of the Electricity Market Rules[129].

Legislative barriers

According to the regulatory framework, the new rules of the electricity market are started slowly due to sophisticated and complex procedures. This is related to the lack of a secondary regulatory framework resulting from Law 10/2016 on the promotion of renewable energy sources. Because of the above, until today it has not been able to start the new rules on the electricity market, or monocrystalline photovoltaic systems are part of this process.

Inadequate quality control of imported equipment

In the absence of state control on the import of photovoltaic equipment, it can discredit this technology, if certain technical parameters such as efficiency and efficiency do not correspond to the product label. At the same time, the imposition of a control would also protect the final consumer from having security in the purchased technology.

Limited access to financial resources for the promotion of photovoltaic technologies

[129] https://www.legis.md/cautare/getResults?doc_id=123381&lang=ro

This was caused by the formation of high or exaggerated costs of capital - the high bank interest rate, the imperative of guaranteeing loans at the level of 120-150% of its value, etc. Even if more efforts have been made in this direction through externally financed projects, the cost of bank interest rates remains high. Thus, the impact on the final beneficiaries in terms of ensuring resilience on adaptation to climate change will be low and with a delayed effect over time.

Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased solar potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas

If we examine this barrier from the point of view of the net metering support scheme, then this fact does not represent a major barrier for prosumers. The principle of net metering operation represents the coverage of their own energy consumption, which is why it can be deduced that these categories of consumers already have an electrical infrastructure built around. The situation is completely different in the case of large electricity generation capacities based on fixed tariff and fixed price support schemes.

Lack of high-precision support tools (solar potential map, forecasts)

According to the IRENA report on *the Assessment of the readiness to capitalize on renewable energy in the Republic of Moldova,* the solar technical potential in the country is enormous. However, for potential investors there is a major barrier in correctly and accurately identifying the solar potential for different geographical areas in the country. The first attempt to develop such a map of solar potential took place in 2016 with the support of external technical assistance. In the end, it did not become functional, which stops investments in this direction.

At the same time, producers from renewable energy sources are part of the electricity market. This imposes the obligation to use specialized high-precision software related to the forecast of the amount of energy offered on the market, in order to avoid imbalances within the balancing group. The lack of such accurate forecasts requires the Transmission System Operator to apply penalties to market participants, who have not accurately forecasted the amount of energy offered during the day or during the next day.

Reduced tax incentives

Even if the state partially promotes tax incentives on such technologies, they are focused only on certain elements within a photovoltaic system. Starting from the premise that the Republic of Moldova is not a country producing photovoltaic systems, import tax incentives would reduce the costs of investments in such equipment.

Insufficient training of assembly staff

According to the regulatory framework, GD 1051/2018 for the approval of the Regulation on the qualification and registration of installers of biomass-based boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps,

specialists in the nominated field were to be established and trained in the Republic of Moldova. This has not happened until today, which is why the quality assurance of the execution of the installation and operation of photovoltaic installations is not ensured to the expected extent.

The measures to overcome the barriers mentioned above are selected as actions that will be part of the Action Plan for monocrystalline photovoltaic installation technology:

Action 1 Development of the secondary regulatory framework regarding the integration of photovoltaic technologies in the main branches of the national economy

Activities

1.1 For the development of photovoltaic parks larger than 1 MW, the Government of the Republic of Moldova is to develop and approve the regulation on the auctioning of capacities by type of photovoltaic technologies, based on the fixed price support scheme, established by Law 10/2016. Based on that regulation, the Government will be able to auction the capacities available under GD 401/2021 to reduce electricity imports and make it easier for the energy sector to adapt to climate change.

1.2 In order to attract investments and motivate investors to carry out projects based on photovoltaic technologies, the Government will annually make changes to the Fiscal Code, in order to facilitate and grant the necessary tax exemptions to importers of photovoltaic technologies.

1.3 Facilitating access to the electricity grid and integrating renewable energy producers into the electricity market in the Republic of Moldova by initiating amendments to the Electricity Networks Code.

1.4 The responsibility for ensuring the quality of important products (technologies) in the country lies directly with the bodies empowered with this right in the Republic of Moldova. The certification and verification procedure, through direct measurement of quality indicators for photovoltaic installations, will raise confidence in these technologies, both from the business sector and from the domestic sector. At the same time, the organization of a laboratory in the country would facilitate the celebration of the mentioned measurements, which would increase the competition of photovoltaic technologies with increased yields and longer exploitation period. To this end, the development of a certification system for imported photovoltaic equipment is proposed, produced in the Republic of Moldova, or a mechanism for mutual recognition of quality certificates issued by international bodies in this field.

1.5 Standards in the Republic of Moldova are voluntary, unless the primary and secondary regulatory framework provides otherwise. In order to increase the quality of photovoltaic technologies and harmonize the regulatory framework with the European one in terms of standardization, it is necessary that the standards related to this field are widely applied both by importers of these technologies and by their manufacturers. In this regard, it is necessary to review the existing standards and impose those

identified by the competent body in the field of promoting renewable energy sources and the standards in the field.

1.6 Primary data provided by studies carried out in the field of electricity transmission and distribution show that the capacity of these networks is limited if the network is intensively penetrated with electricity generated from renewable sources. Thus, it is attested to the fact that energy infrastructure is lacking in areas where the photovoltaic potential is high. In this regard, it is necessary to develop plans by electricity distribution and transmission companies, which will take into account the regional photovoltaic potential.

Action 2 Development of institutional and training capacities of specialists in the field of photovoltaic systems

Activities

2.1 Today, in the Republic of Moldova, there is a higher educational institution that trains licensed engineers in the energy field and a Center of Excellence that trains plumbing specialists in the same field. With the development of renewable energy sources, the higher public institution has not developed and accredited a specialty or study program dedicated to photovoltaic system installers. For category IV of training specialists with incomplete secondary education, the Government approved, in 2018, decision no. 1051, which provides for the development and training of installers in the photovoltaic field. In this regard, it is necessary for both institutions to develop training and continuous training programs for engineers and installers of photovoltaic systems, as well as to equip the mentioned institutions with modern equipment for spending practical hours (demonstration laboratories).

2.2 The new electricity market rules require that electricity market participants, including photovoltaic power producers, are responsible for imbalances caused during the day, the next day and bilateral power purchase agreements. As of today, the Central Energy Supplier is responsible for the balancing group and the distribution of imbalances within this group. Any imbalance is charged, and the renewable energy producer is responsible for paying them. In order to mitigate this impact, it is necessary to develop and use specialized high-precision forecasting software, as well as to train market participants to apply these programs.

2.3 Development of specialized programs on photovoltaic potential verification (interactive maps of solar potential) throughout the country.

Action 3 Increasing the affordability of photovoltaic projects

3.1 Increasing the budget and commercial lines for the purpose of financing projects in the photovoltaic field predestined for the sectors of the national economy.

3.2 Development of subsidy instruments for photovoltaic installations predestined for socially vulnerable strata.

Actions to be implemented as a pilot project.

The development of the pilot project combines 2 activities under Action 2 that are considered basic and the rest secondary, which contribute to achieving the security targets for the analyzed technology. These are: Development of specialized software for forecasting electricity produced based on photovoltaic technologies and training of producers and development of specialized programs on the verification of photovoltaic potential and training of specialists in the development of feasibility studies.

In this regard, the idea of the project is to create and develop sufficient capacities in two areas of the country (Center and South) by applying existing support schemes, including capacity auctioning (fixed price), combining good practices for the dissemination of technology and improving the infrastructure for access to the medium and high voltage electricity grid. Thus, it is intended that those interested in such an idea can participate in covering the demand for electricity in the Republic of Moldova and be active producers on the regional energy market.

The mentioned technology is in the engineering field, and this fact in the Republic of Moldova involves few women who can develop, manage and benefit from the results of this technology. Gender inequality in technology appears, including in terms of the level of professional training in the field of installations, where there is a low presence of women.

All actions are gender-neutral and take into account equal opportunities for men and women of all ages to implement them.

These elements create significant barriers in the promotion of technology at the country level, as well as ensuring a lasting and sustainable process of investments made in this field.

1.1.2.4 Stakeholders and timeline for the implementation of TAP

According to the table below, government institutions, agencies, public associations, as well as private economic agents were involved in the analysis of technologies. Table 1.3 sets out the stakeholders responsible for the actions described and the timetable for their implementation.

Table 1.3 *Name of the institutions involved and implementation period*

Nr.	Actions	Activities	Stakeholders	Role of stakeholders	Period
1	**Action 1 Development of the secondary regulatory framework**	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	MIRD, NAER, Foreign donors	MIRD – develops and promotes the regulatory framework NAER – approves the tariffs based on the fixed price support scheme	2022-2023

				Donors – support for the development of the regulatory framework, financing of technologies	
		1.2 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	MIRD, MF,	MIRD – responsible for the development of CBTM in the village. Energetic MF – promoter of annual fiscal changes, including sectoral budget promotion.	2023 – each budget year
		1.3 Operation of changes in the Electricity Networks Code	TSO, DSO NAER	TSO and DSO – Responsible for complying with the imposed technical requirements. NAER – responsible for the development of the code	2022-2023
		1.4 Certification and quality verification of products (photovoltaic systems) imported or produced in the country	CAMA ACPMS	CAMA - The Center for Applied Metrology and Certification ensures the increase of customer competitiveness by offering certification, product testing, metrology and training services ACPMS – Consumer Protection and Market Surveillance Agency is meant to verify the non-compliant placement of products on the market	2023-2024
		1.5 Revision of national standards for photovoltaic technologies	ME, INS	ME- promoting policies in the field of standardization. NIS – ensures the development and transposition of standards at national level	2023-2024
		1.6 Development of plans to expand the electricity distribution and transmission networks based on the regional photovoltaic potential	NAER, TSO, DSO, LPA	NAER – approves the investment plans of TSO and DSO. TSO and DSO – develops investment plans. LPA – develops and proposes to system operators the	2023-2025

				architectural plan for network expansion	
2	**Action 2 Development of institutional capacities and training of specialists**	2.1 Development and accreditation of training and continuous training programs for specialists in the photovoltaic field	TUM, CCL. CEEE	University – represents the public institution in the country that prepares and promotes future engineers in the energy field. Centers of Excellence – prepare and promote young staff with incomplete secondary education in the field of energy and construction	2023-2025
		2.2 Development of specialized software for forecasting electricity produced based on photovoltaic technologies and training of producers	Renewable energy producers	Producers have the obligation to forecast the amount of energy produced, in order to establish the imbalances formed. Suppliers responsible for balancing groups	2022-2025
		2.3 Development of specialized programs regarding the verification of photovoltaic potential and training of specialists in the elaboration of feasibility studies	MIRD, Foreign Donors, Private Sector, DSO, TSO,	MIRD promotes policies in the field of photovoltaics and carries out and carries out the monitoring of the strategic objectives imposed by the policy documents. Foreign donors can be identified as potential funders of these programs The private sector is the end users of this product. DSOs and TSOs: stakeholders who can take into account the PV potential when expanding transmission and distribution networks	2023-2025
3	**Action 3 Increase affordability**	3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on photovoltaic technologies	Commercial banks, ME, EEA, AIPA, EDO, AADM,	Commercial banks are developing dedicated credit lines for the photovoltaic field. EEA encourages the implementation of photovoltaic technologies in different branches of the national economy.	2022-2025

				AIPA and AADM, implementing institutions that can develop dedicated funding programs on the implementation of technologies in the agricultural sector. EDO is an entrepreneurial development organization that can develop dedicated photovoltaic equipment financing programs for small and medium-sized enterprises in Moldova	
		3.2 Development of subsidy instruments for photovoltaic installations	MIRD, Ministry of Labor and Social Protection, Ministry of Finance	MIRD participates in the development and encouragement of mechanisms for subsidizing photovoltaic technologies through dedicated programs at national level The Ministry of Labor and Social Protection supports the policies of subsidizing the socially vulnerable energy strata. The Ministry of Finance identifies the financial means necessary for the subsidy process.	2022-2023

1.1.2.5 Estimation of the resources required for actions and activities

The estimation of the financial resources necessary for the implementation of the actions listed above were made based on the existing regulatory aspects and good practices already implemented in the Republic of Moldova. In this regard, the data provided by NAER Decision no. 76/2022, the terms of reference for the development of specialized software for forecasting the production of electricity from renewable energy sources, as well as the information submitted by various donors carrying out certain activities in the Republic of Moldova in this field. For activities related to trainings and development of financing mechanisms, information on the development of study and professional training programs of specialists from higher education and specialized secondary institutions (study program for DUAL education[130], training and continuous training program for energy auditors in the buildings sector, developed

[130] https://chamber.md/invatamant-dual/

by the Technical University of Moldova[131], as well as the development of study programs for the electro energetic specialty within the Center of Excellence in Energy and Electronics[132], etc.

In the sense of the above, it is necessary to train and prepare managers in the field of installation, operation and maintenance of photovoltaic equipment.

Table 1.4 *Assessment of the resources needed for TAP actions and activities in the energy sector*

Actions	Activities	Estimated budget USD	
		Minimum	Medium
Action 1 Development of the secondary regulatory framework	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	16 000	20 000
	1.2 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	3 000	3 000
	1.3 Operation of changes in the Electricity Networks Code	42 000	60 000
	1.4 Certification and quality verification of products (photovoltaic systems) imported or produced in the country	1 500 000	2 000 000
	1.5 Revision and transposition of standards for photovoltaic technologies	15 000	20 000
	1.6 Development of plans to expand the electricity distribution and transmission networks based on the regional photovoltaic potential	120 000	180 000
Action 2 Development of institutional capacities and training of specialists	2.1 Development and accreditation of training and continuous training programs for specialists in the photovoltaic field	15 000	30 000
	2.2 Purchase of specialized software or electricity forecasting services produced based on photovoltaic technologies and training of producers	300 000	350 000
	2.3 Development of specialized programs on the identification of photovoltaic potential and training of specialists in the development of feasibility studies	180 000	230 000
Action 3 Increase affordability	3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on photovoltaic technologies	12 000 000	16 000 000
	3.2 Development of subsidy instruments for photovoltaic installations	200 000	300 000

[131] http://cfceecp.utm.md/formarea-grupelor-la-programul-de-formare-profesionala-continua-auditul-energetic-al-cladirilor-publice-si-sistemelor-ingineresti-aferente-acestora/
[132] https://ceee.md/specialitati/

1.1.2.6 Management planning

Risks identified when implementing technology

With the outbreak of the conflict in Ukraine, many logistical routes regarding the import of photovoltaic installations into the country were interrupted. As a result, the cost of one kW of installed power, as of today, is already exceeded by the ceiling established by NAER, based on decision no. 76/2022. In order to mitigate this risk, it is necessary to develop new ways of importing technologies into the country or to identify potential producers near the Republic of Moldova or to develop the own production of these types of technologies. At the same time, a path that needs to be capitalized on is the port of Giurgiulesti. It can also be used to import photovoltaic equipment.

Another risk when implementing TAP would be the insufficient lack of qualified specialists for the installation, operation and maintenance of photovoltaic equipment. At present, specialists who are already active in the energy sector in the field of exploitation are recruited to carry out these operations. In order to overcome this risk, the Government of the Republic of Moldova approved Decision no. 1151/2018 on the qualification and registration of installers of biomass boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. Thus, the training and training centers for these specialists are to develop training programs dedicated to this category of employees.

With the entry into force of the new electricity market rules, the obligation of each producer is to forecast the amount of energy produced on the market of the next day and during the day. In this regard, any imbalance recorded on the part of a RES producer, including based on photovoltaic technologies, requires the Transmission System Operator to apply penalties for those who do not correctly plan their electricity forecast. In this regard, there is a risk that producers will be discouraged from investing in such technologies, due to the lack of specialized electricity forecasting programs in the Republic of Moldova, depending on external climatic conditions. In order to mitigate this major risk, through donors and foreign partners, the Government of the Republic of Moldova is to benefit from technical assistance dedicated to this subject.

Steps to be taken

The main steps to be taken in the implementation of TAP are related to the diversification of the import sources of photovoltaic equipment, as well as the training and continuous training of installation specialists in this field. At the same time, it is necessary to speed up the procedure for the development and approval of the Government Decision on the regulation on the auctioning of large capacities for producers of photovoltaic energy sources.

TAP overview table for Monocrystalline Photovoltaic System Technology

Sector	Energy
Sub sector	Generation and distribution of electricity and heat
Technology	Mono Crystalline Photovoltaic Equipment
Ambition	Promotion and construction of monocrystalline photovoltaic power plants, with a cumulative electrical capacity of 470 MW, for the scenario in which the energy demand in the Republic of Moldova is covered by 100 of the RES, connected to the national public grid, in order to overcome the climate impact on the danger of diminishing the production of electricity due to the lack of technological water at the CET and HPP, as a result of drought.
Benefits	Economic, social and environmental: ● Reducing dependence on imports of primary energy resources. ● Increasing the revenues in the local budget from the generation and supply of electricity in the form of taxes and duties. ● Workforce development at local level. ● Savings of money for central and local budgets. ● Reduction of power and energy losses due to the distributed generation of photovoltaic sources. ● Development of auxiliary services for the operation, maintenance and maintenance of monocrystalline photovoltaic technologies. ● Reducing electricity consumption for end consumers. ● Reducing water and air pollution. ● Decrease environmental impact and reduce greenhouse gas emissions. Adaptation benefits:

	• Saving water reserves for the technological cooling processes of the TECs. • Covering the energy demand necessary for the cooling process of the spaces in case of heat waves. • Covering the demand for energy predestined for irrigating agricultural land, caused by droughts.							
Actions	**Activities to be implemented**	**Source of funding**	**Responsible parties**	**Estimated implementation period**	**Risks**	**Success criteria**	**Monitoring and implementation indicators**	**Budget per activity** **USD**
Action 1 Development of the secondary regulatory framework	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	State Budget, Foreign Donors	MIRD, NAER,	2022-2023	Delaying the approval of the regulatory framework	Launch of the fixed price support scheme with the approval of the regulation	An approved normative act	16 000
	1.2 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	State Budget	MIRD, MF	2023 – each budget year	Insufficiency of budgetary financial means to operate tax and customs exemptions for technology	Promotion of import exemptions and taxes for photovoltaic technologies.	An updated Tax Code	3 000
	1.3 Operation of changes in the Electricity Networks Code	TSO, DSO budget, Foreign donors	MIRD, NAER	2022-2023	Delaying the approval process due to lengthy coordination with stakeholders	Harmonization of the regulatory framework with that of the EU	An updated Electricity Grid Code	42 000

	1.4 Certification and quality verification of products (photovoltaic systems) imported or produced in the country	State Budget, Foreign Donors	National Accreditation Center, National Institute of Metrology	2023-2024	Insufficiency of financial means	Development of a certification mechanism for photovoltaic systems at local level	A certification mechanism developed	1 500 000
	1.5 Revision and transposition of standards for photovoltaic technologies	State Budget	NIM, MIRD	2023-2024	Procrastination of the process of transposition through passive activity of the technical committees set up by the NIM	Transposition of international standards into the secondary regulatory framework	Number of standards approved and/or transposed	15 000
	1.6 Development of plans to expand the electricity distribution and transmission networks based on the regional photovoltaic potential	Budget of the TSO, DSO and LPA	TSO, DSO, NAER	2023-2025	Lack of a map of photovoltaic potential in the country	Well-planned network infrastructure	Number of approved distribution and transmission network plans	120 000
Action 2 Development of institutional capacities and training of specialists	2.1 Development and accreditation of training and continuous training programs for specialists in the photovoltaic field	Budget of TUM, CEEE, Foreign donors	Academic environment, AEE, MEC	2023-2025	Lack of qualified teachers	Increasing the training capacities of installation and service specialists	Number of programs developed and/or accredited	15 000

	2.2 Purchase of specialized software or electricity forecasting services produced based on photovoltaic technologies and training of producers	Private Companies, Foreign Donors, Energy Suppliers	MIRD, Central Energy Supplier, Universal Energy Suppliers	2023-2025	Insufficient financial means from the private sector	Reduction of electricity imbalances within the balancing group	Number of software purchased or forecasting services contracted Number of trained personnel	300 000
	2.3 Development of specialized programs on the identification of photovoltaic potential and training of specialists in the development of feasibility studies	Private companies, Foreign donors	MIRD, AEE, Academic environment	2023-2025	Lack of truthful input data from the hydrometeorological service	Harnessing energy potential	Number of software developed. Number of trained specialists	230 000
Action 3 Increase affordability	3.1 Dedicated credit lines through commercial banks and state programmes on the financing of projects based on photovoltaic technologies	Commercial banks, ME, PREPA, AIPA, EDO, AADM, Foreign donors	ME, EEA, AIPA, EDO, AADM,	2022-2025	High bank rates	Increasing installed capacities in the country	Number of credit lines launched Number of approved state programs	16 000 000
	3.2 Development of subsidy instruments for	MIRD, Ministry of Labor and Social Protection,	MIRD, EEA, Ministry of Labor and Social Protection,	2022-2023	Maintenance and maintenance of the system by the state	Increasing the number of people willing to invest in such	A subsidy system launched	300 000

	photovoltaic installations	Foreign Donors, Local Financial Funds				technologies, especially the residential sector		

1.1.3 Action plan for the technology "Ground-to-water heat pump installation"

1.1.3.1 Introduction

These are technologies that lend themselves mainly to constructions with high heat requirements and lack of land areas or lack of water in the groundwater. The heat is extracted by conveying an intermediate agent (ethanol-water mixture, antifreeze-water) in wells inserted in vertical boreholes. The boreholes are carried out at depths between 60-150m. The efficiency of these systems is superior to air-to-water heat pump systems. Ground-to-water heat pumps with borehole cover a power range from 3 to 1,500 kW.

The ground-to-water heat pump is a perfect solution to obtain heat, domestic hot water and even cooling for residential and commercial areas. The technology applied is nothing more than a geothermal pump, which takes its necessary heat directly from the ground. The earth is a source of free heat, available in unlimited quantities, because the soil has a constant temperature at depth. In ground-to-water heat pumps, the constant extracted temperature (10-12 degrees Celsius) is used to obtain the heat necessary for heating or preparing domestic hot water. Heating can be done through radiators, fan coils or underfloor heating system. The advantage of this type of pump is that it can also be used for cooling, by means of a fan coil unit. This successfully replaces the need to purchase one or more air conditioners.

Reducing the phenomenon of the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy costs and making energy consumption more efficient.

At the same time, the Law on Energy Performance in Buildings, no. 128[133] of 11.07.2014, provides that the technical, economic and environmental feasibility of using alternative energy sources, including heat pumps, which are available, should be taken into account when designing new buildings.

In accordance with the energy strategy of the Republic of Moldova until 2030 approved by GD no. 102 of 05.02. 2013 provides for the improvement of energy security and energy efficiency. The proposed technology will enhance national efforts to improve energy efficiency and increase the country's energy security due to decreasing the amount of fossil fuel used to meet heat demand.

According to the above, ground-water heat pumps are used at a low level in the Republic of Moldova. The main cause is also the high initial investment costs, as well as the monopolization of the local natural gas market as a primary heating energy resource. However, according to the estimates made by the Institute of Energetics[134] on the development of the decarbonization scenario of the energy sector for the Republic of Moldova, towards the 2050 time horizon, with a share of renewable energy sources of up to 68%, in the country's energy mix, heat pumps become competitive for heating and can replace centralized and individual heating based on natural gas.

[133] https://www.legis.md/cautare/getResults?doc_id=95262&lang=ro#

[134] https://energetica.md/sites/default/files/2021-02/Raport%20final%20detaliat%20IE%20program%20de%20stat%202020_0.pdf

1.1.3.2 TAP's ambition

In order to define the ambition of the ground-water heat pump technology, the following aspects were followed and analyzed:

Scope of technology: Based on the legal framework on the promotion of energy efficiency and renewable energy sources, ground-to-water heat pump technology aims to reduce the import dependence of the Republic of Moldova's energy resources, by using high energy performance coefficients. Reducing the incidence of energy poverty, mainly by implementing measures that contribute to reducing energy costs and making energy consumption more efficient, is a priority for new buildings built in both the private and public sectors. At the same time, the Law on energy performance in buildings, no. 128[135] of 11.07.2014, provides that the technical, economic and environmental feasibility of using alternative energy sources, including heat pumps, which are available, should be taken into account when designing new buildings.

At the same time, the ambitious objective for the A2 technology is related to the promotion and installation of ground-to-water heat pumps with a total cumulative thermal power of 225 MW, in order to overcome the climate impact regarding the danger of decreasing the production of thermal energy due to the lack of technological water at the CETs, as a result of the drought.

About 13,160 heat pumps of various capacities are expected to be installed in residential insulated buildings, industrial and commercial enterprises, schools, hotels, restaurants and other premises. Most of the heat pumps (12654) will have a small capacity from 12 kW to 19 kW and will be installed by the owners of existing or newly constructed detached buildings. Around 500 heat pumps with an average capacity of 50 kW will be installed at various enterprises, schools, hotels, restaurants and other premises to meet the requirements of heating and hot water supply. A limited number (about 6) of large heat pumps with a capacity of 1 MW will be installed at wastewater treatment plants and other enterprises where low-quality energy sources are available. The implementation of the heat pumps will result in an annual production of approximately 1,743 PJ of heat. The data are provided on the basis of project proposals of NAMA projects submitted by the Government of the Republic of Moldova and registered in the electronic register of the UNFCCC[136]

Adaptation reasoning. The hot summers and droughts of the last decades lead to a decrease in the consumption of technological water necessary for the process of producing thermal energy from municipal district heating power plants. At the same time, during the winter period, there is an increased demand for thermal energy directed to buildings in the residential, private sector (offices and enterprises) and the public sector (administrative buildings). In the absence of own energy sources and the rationale to reduce energy dependence on imports, the promotion of ground-to-water heat pump installation technology would respond to this challenge regarding the adaptation of the energy sector to climate change.

Economic conditions. The economic priority includes the promotion of projects to streamline the consumption of energy resources and the valorization of renewable energy in the public and residential sectors, with the development of financing instruments accessible to the subjects of the respective sectors, with a focus on vulnerable consumers.

[135] https://www.legis.md/cautare/getResults?doc_id=95262&lang=ro#

[136] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

Existing technical conditions. The energy crisis, the high tariffs for this resource, as well as the decrease in dependence on imported gas, make the technology have satisfactory technical conditions to be promoted. As a result of the fact that the expansion of natural gas networks is declining on the territory of the Republic of Moldova, and the access to the electricity grid becomes more accessible, the use of high-performance heating technologies, with low energy potential, will gain momentum in the near future in the entire sphere of the national economy.

The environment for promoting technology. The technology is expected to bring about a 37% reduction in the annual consumption of traditional fuels (natural gas in particular, and also fuel oil), compared to the baseline scenario included in the NDC, and a reduction in greenhouse gas (GHG) emissions of at least 66,741 tonnes of CO^2 equivalent per year.

The Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its implementation, GD no. 1470 of 30.12.2016[137], as well as data from the conditional NDC, 82% of the reduction of GHG emissions should be achieved in the energy sector by 2030 compared to 1990. The implementation of this technology is listed in LEDS, among other measures related to achieving this goal.

The potential for replication of the technology. About 13,160 heat pumps of various capacities are expected to be installed in residential insulated buildings, industrial and commercial enterprises, schools, hotels, restaurants and other premises. Most of the heat pumps (12,654) will have a small capacity from 12 kW to 19 kW and will be installed by the owners of existing or newly constructed detached buildings. Around 500 heat pumps with an average capacity of 50 kW will be installed at various enterprises, schools, hotels, restaurants and other premises to meet the requirements of heating and hot water supply. A limited number (about 6) of large heat pumps with a capacity of 1 MW will be installed at wastewater treatment plants and other enterprises where low-quality energy sources are available. The implementation of the heat pumps will result in an annual production of approximately 1,743 PJ of heat. The data are provided on the basis of project proposals of NAMA projects submitted by the Government of the Republic of Moldova and registered in the electronic register of the UNFCCC[138]

Following the analyses, the main conditions that define the ambitions for the development of the ground-water heat pump technology action plan are:

1. In the next 5 years, the key consumers of the mentioned technology will be the residential, public and business sectors.

2. In the case of newly constructed buildings, it is planned that they will have a higher energy independence, by using heat pumps with high coefficients of performance.

1.1.3.3 Selecting Actions and Tasks for A2 technology

Summary of barriers and measures to overcome them. The most important barriers and their analysis were described in Report II, BAEF. Thus, on April 13, 2022, the sectoral working

[137] https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro#

[138] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

group, composed of specialists in the field, exposed themselves on the barriers that block the promotion of the technology on the local market. Those of very high importance and medium importance were selected for the development of TAP actions and activities. Thus, the following were identified:

High initial investment costs

The investment cost of promoting ground-water heat pump technology at local level is significant and requires mobilization of financial resources in both the private and public sectors. The banking sector will play a significant role in attracting and financing these types of technologies. Thus, the investment costs vary from case to case depending on the installed power of the pump and is equal to 4,600 – 7,600 US$[139], installation with a power of up to 16 kW, for the residential sector and over 20,000 US$ for heat pumps predestined for multi-storey or industrial buildings. Thus, the estimated cost of the total investment per country calculated based on the NAMA project proposal is approximately 180 million USD.[140]

Lack of techno-economic studies and analyses

At the moment there is no clear analysis and vision regarding the economic and technical aspects that would justify the investment in such technologies. At the same time, the lack of such an analysis blocks the promotion of technology especially in the public sector.

Reduced tax incentives

Starting from the premise that the Republic of Moldova is not a country producing heat pump technologies, import tax incentives would reduce the costs of investments in such equipment.

Legislative barriers

According to the primary and secondary regulatory framework, it does not oblige investors or potential end consumers to promote such technologies. Based on the significant dependence on natural gas imports from the East and the intense promotion of renewable energy sources, this type of technology would be a reliable source of heating for the long term in the country. At the same time, no strategic planning act at the country level directly supports the promotion of the mentioned technology, with the exception of the Law on Energy Performance in Buildings, no. 128[141] of 11.07.2014, where it is stipulated that the technical, economic and environmental feasibility of the use of alternative energy sources, including heat pumps, which are available, should be taken into account at the time of the design phase of new buildings.

Lack of support tools on geothermal potential

[139] https://geosolar.md/ro/product-category/tepalvi_nasosi/geotermaliene_tepalvi_nasosi/

[140] https://www4.unfccc.int/sites/PublicNAMA/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1

[141] https://www.legis.md/cautare/getResults?doc_id=95262&lang=ro#

At the market level, the mentioned technologies are promoted without investors or beneficiaries taking into account the real geothermal potential available in each locality. This ultimately generates distrust in the mentioned technology, as well as an incorrect approach in terms of sizing and designing such a heating system.

Long and arduous procedures for obtaining the necessary building permits and permits for heat pump projects

The installation and quality assurance of the execution of the construction and installation works of a geothermal system is ensured in the light of Law 721/96 on the quality assurance of construction works. In addition to the nominated, procedural legislative framework, a potential Beneficiary must go through several steps, which also include obtaining permissive acts, coordination and approvals at the level of authorities and parties involved in the implementation of such a project.

Insufficient training of assembly staff

According to the regulatory framework, GD 1051/2018 for the approval of the Regulation on the qualification and registration of installers of biomass-based boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps, specialists in the nominated field were to be established and trained in the Republic of Moldova. This has not happened until today, which is why the quality assurance of the execution of the installation and operation works of the heat pump installations is not ensured to the expected extent.

The measures to overcome the barriers mentioned above are selected as actions that will be part of the Action Plan for Ground-Water Heat Pump Technology:

Actions identified for the implementation of the selected activities (measures):

Action 1 Development of the regulatory framework for the integration of ground-water heat pump technologies in the main branches of the national economy

Activities

1.1 The strategic planning act in the energy sector is the Energy Strategy 2030. The strategy sets out medium- and long-term objectives, including the promotion of energy efficiency and renewable energy sources. In this regard, the proposed technology of ground-to-water heat pumps has high energy performance indicators, directly contributing to the improvement of energy efficiency and to the achievement of the objectives indicated in the strategy. The inclusion of this technology as a strategic priority in the above-mentioned act would also represent a policy commitment at national level.

1.2 The law on the energy performance of buildings was approved in 2014. At the sector level, it is necessary to update this document by including the new provisions of the EU

Directive on the energy performance of buildings, including the provisions on the obligation to promote the most advanced technologies predestined for heating and/or cooling.

1.3 Local energy and environmental action plans are developed by local public authorities of level I and II. The included measures provide for actions aimed at reducing energy consumption in all subordinated public institutions, which have developed such a plan. The inclusion of heat pump technology would significantly contribute to the diversification of heat supply sources for the authority and increase the interest of foreign donors to invest in such technology.

1.4 The documents in the field of construction that are mandatory for designers are the Moldovan Construction Regulations (NCM) and the Practical Codes in Construction (CP). The direct responsibility for setting up the working group on the elaboration of the respective norms lies with the branch ministry. In this regard, the development of specific regulations for heat pump technology with their application for new houses built at the design phase, would boost the local market and promote the mentioned technology in both the residential and public sectors.

1.5 In order to promote the most energy-efficient technologies, the Government will make changes to the Fiscal Code, in order to facilitate and grant tax exemptions, taxes, customs clearance necessary for the import of heat pump technologies.

1.6 The Sectoral Budgetary Policy Planning Framework (CBTM) is developed by the branch ministry every three years. For the purpose of the mentioned planning in the indicated period, the Ministry responsible for the energy sector will make the corresponding changes to the chapter on reducing the consumption of primary energy resources by promoting measures to adapt the energy sector to climate change with the promotion of heat pump technologies.

1.7 The permissive acts regarding the design or redesign of new objectives are regulated by the normative framework in the field of construction. The long procedures for obtaining permissive documents in the field of construction delay the implementation of projects of national interest. The reduction of the documents necessary to start these works would create a favorable environment for the promotion of the technology.

1.8 The certification and verification procedure, through direct measurement of quality indicators for heat pump installations, will increase confidence in these technologies, both from the business field and from the residential sector. At the same time, the organization of a laboratory in the country would facilitate the celebration of the mentioned measurements, which would increase the competition of heat pump technologies with increased efficiency with a longer operating period.

1.9 The establishment of a laboratory for testing the energy performance of heat pump technology is part of the chain of ensuring the placement of this product on the local

market. In this regard, the confidence of the end consumer will increase if he receives non-compliant equipment.

1.10 In order to increase the competitiveness of heat pump technology and harmonize the regulatory framework with the European one in terms of standardization, it is necessary that the standards related to this field are widely applied by both importers and their manufacturers.

Action 2 Development of financial instruments and promotion of technology

1.1 In the situation where, in the Republic of Moldova, there is a community of donors that finance various projects in the energy field, the analyzed technology can be the subject of discussions for future financing in the public and private sectors.

1.2 It is expected that the Government's contribution to the promotion of heat pump technologies will be supported by facilitating subsidies for potential beneficiaries. This would particularly encourage the residential sector to purchase such technologies.

1.3 Being linked to both the energy crisis and the new trends on the technology market, banking institutions have developed banking products dedicated to potential customers who want to purchase certain equipment. Heat pump technology can be included as part of a dedicated product for the purpose of mitigating energy impact and poverty in the residential and public sectors.

1.4 ESCO business models are widely used in EU countries. In order to take over the bank's financial commitments, the development of such a model removes the financial burden from the customer and the possible technical risks that may arise during the delivery, installation and commissioning of the equipment.

1.5 The process of promoting and publicizing the benefits obtained from the purchase of such equipment is important and requires an individual approach for the target groups that are interested in implementing a project that includes a heat pump technology.

Action 3 Increasing institutional capacities for training specialists

3.1 The national regulatory framework regarding the training of installers in the field of heat pump installation was created based on GD no. 1051/2018. In this regard, it is necessary at the level of Centers of Excellence to develop and accredit a program dedicated to these specialists.

3.2 Trainings and practical tests will play an essential role in the development of the trainees' professional skills. The establishment of dedicated laboratories within the institutions with the right to teach will contribute to ensuring the quality of the material taught.

Action 4 Development of geothermal potential in the Republic of Moldova

4.1 An assessment of the geothermal potential of the Republic of Moldova has not been made so far. Thus, the development of a study on the identification of geothermal potential will facilitate customers' access to this resource, through the use of heat pumps.

4.2 Electronic maps can be used to identify the most suitable areas for a geothermal project within the buildings sector.

4.3 Potential customers of heat pump technology are multi-storey buildings and those in the residential sector. The development of a study on the identification of buildings that can substitute traditional energy resources for non-traditional ones, identified based on geothermal potential, can contribute to the replication of the technology in the country. The justification of the investments will be made based on a technical-economic analysis.

4.4 The development of a software tool for sizing heat pumps for customers will facilitate its choice, as well as determining an initial cost of the investment.

Actions to be implemented as a pilot project.

In order to develop the pilot project idea, the authorities need to take several actions, which would facilitate the launch of this initiative. The following activities are considered as the basis for starting the implementation of the project: *1.8 Ensuring the quality certification procedure of products, equipment, 2.1 Development of subsidy instruments for heat pump installations or action 2.3 Development of ESCO-type company models, 4.1 Elaboration of a study on geothermal potential in the Republic of Moldova.*

Thus, ground-to-water heat pumps are a relatively new technology on the market in the Republic of Moldova, which is rarely found both in the residential sector, but also less often in the public buildings sector. Similar experiences regarding the use of heat pumps have a low percentage of private houses, which had enough free space in the yard to install the pump's heat exchanger, but also sufficient financial capacities to carry out such a project.

Due to the barriers analyzed and the proposed actions, the aim is for this technology to be replicated on a larger scale. As a result of the fact that the given technology is driven by a compressor that also consumes electricity, it is ultimately intended that this consumption is reduced to the maximum in order to have an expected economic and energy effect also from the point of view of finances.

In this regard, the idea of the project is to create a favorable investment climate for the promotion of technology in the residential sector of the Republic of Moldova. By using such an idea, the aim is to reduce electricity consumption and technology to have an increased resilience of the energy sector to climate change. At the same time, project ideas will contribute to the decarbonization of the energy sector and the distribution of distributed thermal energy generation.

1.1.3.4 Stakeholders and timeline for the implementation of TAP

According to the table below, government institutions, agencies, public associations, as well as private economic agents were involved in the analysis of technologies. Table 1.4 sets out the stakeholders responsible for the actions described and the timetable for their implementation.

Table 1.5 *Name of the institutions involved and implementation period*

Nr.	Actions	Activities	Stakeholders	Role of stakeholders	Period
1	**Action 1 Development of the regulatory framework**	1.1 Updating the energy strategy of the Republic of Moldova	MIRD, Foreign donors	MIRD – develops energy policies and strategic planning Foreign donors – technical support for the development of strategic planning documents	2022-2023
		1.2 Updating the law on the energy performance of buildings	MIRD, Foreign donors	MIRD – develops energy policies and the regulatory legislative framework Foreign donors – technical support for the development of legislative acts	2023 – 2024
		1.3 Development of local energy and environmental action plans	EEA LPAs level I and II AEER	EEA – responsible for consulting local public authorities in the development of local action plans. LPAs I and II – local public authorities of level I and II responsible for the development of local action plans. Signatories of the Mayors' Convention AEER – Public association responsible for technical assistance provided to local public authorities signatories of the Covenant of Mayors	2023-periodic
		1.4 Development of the standard in the construction of ground-water heat pumps	MIRD, private sector	MIRD – the establishment of the working group responsible for the elaboration of technical regulations in construction. Private sector – delegation of its staff to the NCM working group	2023-2024
		1.5 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of heat pump technologies	MF	MF – promoter of annual tax changes, including sectoral budget promotion.	2023-each budget year

		1.6 Update of the Medium-Term Budgetary Framework (MTBF)	MIRD MF	MIRD – responsible for the development of CBTM in the energy sector MF – approves the budget planning.	2023-2026
		1.7 Modification of the normative framework under construction regarding the issuance of permissive acts	MIRD	MIRD – responsible for the development and updating of normative acts. Inclusion or exclusion of permissive acts in the field of construction.	2024-2025
		1.8 Ensuring the quality certification procedure of products, equipment	CAMA ACPMS	CAMA - The Center for Applied Metrology and Certification ensures the increase of customer competitiveness by offering certification, product testing, metrology and training services ACPMS – Consumer Protection and Market Surveillance Agency is meant to verify the non-compliant placement of products on the market	2025-2026
		1.9 Establishment of a heat pump testing laboratory	CAMA TUM	CAMA - The Center for Applied Metrology and Certification ensures the increase of customer competitiveness by offering certification, product testing, metrology and training services TUM – higher education institution that trains engineering staff in the energy field	2025-2026
		1.10 Revision and transposition of standards for heat pump technologies	ME, INS	ME- promoting policies in the field of standardization. NIS – ensures the development and transposition of standards at national level	2023-2024
2	**Action 2 Development of financial instruments and promotion of technology**	2.1 Development of subsidy instruments for heat pump installations	MIRD, Ministry of Labor and Social Protection, Ministry of Fine Goods	MIRD participates in the development and encouragement of technology subsidy mechanisms through dedicated programs at national level The Ministry of Labor and Social Protection supports the policies of subsidizing the socially vulnerable energy strata. The Ministry of Finance identifies the financial means	2022-2023

				necessary for the subsidy process.	
		2.2 Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies	Commercial banks, AEE, EDO	Commercial banks are developing credit lines dedicated to technologies. EEA encourages the deployment of technologies in different branches of the national economy. EDO is an entrepreneurial development organization, which can develop dedicated financing programs for small and medium-sized enterprises in Moldova that want to apply ground-water heat pump technology	2022-2025
		2.3 Development of ESCO business models	MIRD, Foreign Donors, Private Sector,	MIRD promotes policies in the field of concept formation and implementation of operating models of ESCO companies. Foreign donors can be identified as potential funders of technical assistance for the development of these mechanisms The private sector is the end users of this product.	2023-2025
		2.4 Media coverage and promotion of heat pump technologies	EEA, free press and mass media	EEA – responsible for promoting the best technologies in terms of energy and environmental friendliness Free press and mass media – channels of communication between authorities and potential beneficiaries	2022-2025
3	**Action 3 Increasing institutional capacities for training specialists**	3.1 Development and accreditation of training and continuous training programs for specialists in the field of geothermal installations and heat pumps	TUM, CCL. CEC	University – represents the public institution in the country that prepares and promotes future engineers in the energy field. Center of Excellence in Construction – prepares and promotes young staff with incomplete secondary education in the field of energy and construction	2023-2025
		3.2 Establishment of a laboratory for the practical hours of students from educational institutions	TUM, CEC	Potential educational institutions to benefit from practical training laboratories	2023-2024

4	**Action 4 Development of geothermal potential in the Republic of Moldova**	4.1 Elaboration of a study on geothermal potential in the Republic of Moldova	Foreign Donors, Research Institutions	Donors to finance the study on the geothermal potential of the Republic of Moldova. The academic environment can be identified as potential institutions regarding the initiation of the elaboration of such studies	2023-2025
		4.2 Development of interactive maps with the identified geothermal potential	Foreign donors, Private Environment	Donors are identified as potential funders of the geothermal potential identification map. The private sector – the potential beneficiaries of the interactive map of the geothermal potential.	2025-2026
		4.3 Development of a study on the identification of buildings that can benefit from ground-to-water heat pump technology	LPAs of all levels. Condominium associations Foreign donors	Local and central public authorities at all levels – owners and managers of the public sector built fund Condominium associations – legal organizational form of fund management in the residential sector and potential beneficiaries of the study. Foreign donors – support for financing the study and technical assistance	2024-2025
		4.4 Specialized heat pump sizing software	Foreign donors Local public authorities at all levels	Foreign donors – potential financiers of specialized software Public authorities – potential entities to benefit from the given instrument.	2024-2025

1.1.3.5 Estimation of the resources required for actions and activities

The estimation of the financial resources necessary for the implementation of the actions were made based on market analyses for ground-water heat pump technologies. For the components of actions on updating or developing the new regulatory framework, the previous experiences of the Republic of Moldova with foreign donors were used. In order to assess the value of the resources needed for the elaboration of studies on geothermal potential and interactive electronic maps, the information on the elaboration of similar actions for determining the biomass potential and the wind atlas of the Republic of Moldova were used. Activities related to trainings and development of financing mechanisms used information on the development of study and professional training programs for specialists from higher education and specialized secondary institutions (study program for DUAL education[142], training and

[142] https://chamber.md/invatamant-dual/

continuous training program for energy auditors in the buildings sector, developed by the Technical University of Moldova[143], etc.

Table 1.6 *Assessment of the resources required for actions and activities within the TAP of the energy sector, ground-water heat pump technologies*

Actions	Activities	Estimated budget USD	
		Minimum	Medium
Action 1 Development of the regulatory framework	1.1 Updating the energy strategy of the Republic of Moldova	30 000	40 000
	1.2 Updating the law on the energy performance of buildings	15 000	20 000
	1.3 Development of local energy and environmental action plans	350 000	420 000
	1.4 Development of standards in the construction of ground-water heat pumps	2 000	3 500
	1.5 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of heat pump technologies	3000	3000
	1.6 Update of the Medium-Term Budgetary Framework (MTBF)	4000	4000
	1.7 Modification of the normative framework under construction regarding the issuance of permissive acts	3000	3000
	1.8 Ensuring the quality certification procedure of products, equipment	12 000	12 000
	1.9 Establishment of a heat pump testing laboratory	75 000	75 000
	1.10 Revision and transposition of standards for heat pump technologies	15 000	20 000
Action 2 Development of financial instruments and promotion of technology	2.1 Development of subsidy instruments for heat pump installations	40 000	50 000
	2.2 Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies	16 000 000	20 000 000
	2.3 Development of ESCO business models	35 000	40 000
	2.4 Media coverage and promotion of heat pump technologies	12 000	15 000
Action 3 Increasing institutional capacities for training specialists	3.1 Development and accreditation of training and continuous training programs for specialists in the field of geothermal installations and heat pumps	15 000	30 000
	3.2 Establishment of a laboratory for the practical hours of students from educational institutions	65 000	70 000

[143] http://cfceecp.utm.md/formarea-grupelor-la-programul-de-formare-profesionala-continua-auditul-energetic-al-cladirilor-publice-si-sistemelor-ingineresti-aferente-acestora/

Action 4 Development of geothermal potential in the Republic of Moldova	4.1 Elaboration of a study on geothermal potential in the Republic of Moldova	50 000	70 000
	4.2 Development of interactive maps with the identified geothermal potential	300 000	320 000
	4.3 Development of a study on the identification of buildings that can benefit from ground-to-water heat pump technology	40 000	60 000
	4.4 Specialized heat pump sizing software	15 000	25 000

1.1.3.6 Management planning

Risks identified when implementing technology

Compared to other types of technologies, ground-to-water heat pumps are poorly known in the Republic of Moldova. This is mainly caused by the lack of information of central and local authorities about these technologies, including potential customers in the residential sector. Thus, the process of publicizing and promoting these technologies will play an essential role in identifying potential beneficiaries.

A major risk for the successful implementation of the TAP is related to the lack of trained staff in this field. Mitigating this risk can be achieved through the accreditation of continuing education programs and the introduction of dedicated specialties within university centers and centers of excellence. The lack of these measures taken can lead to non-qualitative works performed during installation as well as a reduction in the life of the equipment if it is not serviced on time and according to the operating requirements.

Credit lines as well as financing programs from commercial banks and foreign donors do not include in the portfolios of the residential sector. The development of financing programs dedicated to the residential sector, including through the application of subsidy instruments, would encourage household consumers to switch to another source of heating.

Steps to be taken

The main steps to be taken in the implementation of TAP are related to the start of information campaigns about the advantages of ground-water heat pump technology. Development by the specialized central public authorities of financing and subsidizing programs for potential beneficiaries implementing ground-water heat pump technologies. An activity that needs to be started, without the involvement of major costs, is related to the updating of energy policy documents. Adjusting them and charting them as a strategic direction at the national level will encourage the replication of this technology in all spheres of the country.

TAP overview table for Ground-Water Heat Pump Technology

Sector	Energy
Sub sector	Generation and distribution of electricity and heat
Technology	Ground-to-Water Heat Pump
Ambition	Promotion and installation of ground-to-water heat pumps with a total cumulative thermal power of 225 MW, in order to overcome the climate impact on the danger of decreasing the production of thermal energy due to the lack of technological water at the TECs, as a result of the drought
Benefits	Economic, social and environmental: ● Reducing dependence on imports of primary energy resources. ● reducing public and private expenditure on primary energy resources. ● Workforce development at local level. ● Savings of money for central and local budgets. ● Distributed heating generation. ● Development of auxiliary services for the operation, maintenance and maintenance of heat pump technologies. ● Reducing the consumption of natural gas by final consumers. ● Reducing water and air pollution. ● Decrease environmental impact ● Reducing greenhouse gas emissions. Adaptation benefits:

	• Saving water reserves for cooling processes at TECs • Covering the demand for thermal energy during the winter period.							
Actions	**Activity to be implemented**	**Source of funding**	**Responsible parties**	**Estimated implementation period**	**Risks**	**Success criteria**	**Monitoring and implementation indicators**	**Budget per activity** **USD**
Action 1 Development of the regulatory framework	1.1 Updating the energy strategy of the Republic of Moldova	State Budget, Foreign Donors	MIRD, MF	2022-2023	Delaying the approval of the normative act	Setting long-term targets for the energy sector towards 2050	An approved normative act	40 000
	1.2 Updating the law on the energy performance of buildings	State Budget, Foreign Donors	MIRD, MF	2023 - 2024	Delaying the approval of the legislative act	Harmonization of the regulatory framework with that of the EU	An approved legislative act	20 000
	1.3 Development of local energy and environmental action plans	State budget, Covenant of Mayors, Foreign donors	MIRD, EEA, MF, Energy Efficiency and Renewables Alliance Local public authorities at all levels	2023-2024	Low interest from LPAs in the development of the Plans	Promoting the most energy-efficient and climate-adaptive technologies at local level	35 local plans approved	420 000
	1.4 Development of standards in the construction of ground-water heat pumps	State Budget	MIRD, private sector	2023-2024	Insufficiency of financial means	Increasing the quality of construction work	A regulation under construction approved	3 500
	1.5 Annual operation of amendments to the Fiscal Code	State Budget	MIRD, MF	2023 – each budget year	Insufficiency of budgetary financial means to operate tax and customs	Promotion of import exemptions and duties for heat	An updated Tax Code	3000

	regarding exemptions from import and customs duties of heat pump technologies				exemptions for technology	pump technologies		
	1.6 Update of the Medium-Term Budgetary Framework (MTBF)	State Budget	MIRD, MF	2023-2026	Lack of financial means available from the state budget	Well-defined budget structure	An updated Medium-Term Budgetary Framework	4000
	1.7 Modification of the normative framework under construction regarding the issuance of permissive acts	State Budget	MIRD, Employers' Associations in the Field of Construction	2023-2025	The risk of not promoting this initiative	Reduction of permissive acts in the field of construction	An updated normative act	3000
	1.8 Ensuring the quality certification procedure of products, equipment	State Budget	CAMA ACPMS	2025-2026	Insufficient financial means available from the budget	Development of a certification mechanism for ground-water heat pump technologies	A certification mechanism developed	12 000
	1.9 Establishment of a heat pump testing laboratory	Foreign Donors	CAMA TUM	2025-2026	Lack of available financial means	Establishment of a heat pump testing laboratory	An institutionalized laboratory	75 000
	1.10 Revision and transposition of standards for heat pump technologies	State Budget	ME, MIRD, INS	2023-2024	Procrastination of the process of transposition through passive activity of the technical committees	Transposition of international standards into the secondary regulatory framework	Number of standards approved and/or transposed	20 000

					established by the NSI			
Action 2 Development of financial instruments and promotion of technology	2.1 Development of subsidy instruments for heat pump installations	State Budget, Foreign Donors	MIRD, EEA, Ministry of Labor and Social Protection,	2024-2025	Low interest on the part of the state to develop such tools	Increasing the number of people willing to invest in such technologies, especially the residential sector	A subsidy system launched	50 000
	2.2 Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies	Private Companies, Foreign Donors, Commercial Banks	EEA, EDO	2022-2025	High bank rates	Increasing the number of projects applying ground-to-water heat pump technology	Number of credit lines launched Number of approved state programs	20 000 000
	2.3 Development of ESCO business models	Private companies, Foreign donors	MIRD, EEA, Private environment	2023-2025	Annual budget planning for public institutions does not allow the transfer of unused financial means from one year to another	Reducing the financial burden of public institutions	An ESCO model developed	40 000
	2.4 Media coverage and promotion of heat pump technologies	State Budget, Foreign Donors	EEA, media institutions	2022-2025	Misperception of the messages sent in society	Promoting national and international best practices by example	Media campaigns launched	15 000

Action 3 Increasing institutional capacities for training specialists	3.1 Development and accreditation of training and continuous training programs for specialists in the field of geothermal installations and heat pumps	State Budget	TUM, CCL, CEC	2022-2025	Lack of qualified teachers	Increasing the training capacities of specialists	Number of programs developed and/or accredited	30 000
	3.2 Establishment of a laboratory for spending practical hours for students from educational institutions	Foreign Donors	EEA, educational institutions	2022-2023	Lack of financial means	Increasing the practical professional skills of specialists in the field	An institutionalized laboratory	70 000
Action 4 Development of geothermal potential in the Republic of Moldova	4.1 Elaboration of a study on geothermal potential in the Republic of Moldova	ANCD, Foreign donors	MIRD, EEA	2023-2025	Insufficiency of input data in the elaboration of the study	Informing the public about the country's geothermal potential	An elaborate study	70 000
	4.2 Development of interactive maps with the identified geothermal potential	ANCD, Foreign donors	MIRD, EEA	2025-2026	Insufficiency of input data in interactive map development	Support for final beneficiaries in identifying the best places with high geothermal potential	An elaborate interactive map	320 000

	4.3 Development of a study on the identification of buildings that can benefit from ground-to-water heat pump technology	ANCD, Foreign donors	MIRD, EEA	2025-2026	Lack of statistical data on the current use of ground-to-water heat pump technology in the private sector	Buildings identified as potential for the use of ground-to-water heat pump technologies	An elaborate study	60 000
	4.4 Specialized heat pump sizing software	ANCD, Foreign donors	MIRD, EEA	2024-2025	Insufficiency of financial means	Support for potential beneficiaries and design and assembly companies	A specialized software developed	25 000

1.1.4 Action plan for the "Horizontal axis wind farms" technology

1.1.4.1 Introduction

Wind energy is a clean and renewable energy but it is intermittent, having variations during the day and season, and even from one year to another. Wind turbines operate about 60% of the year in windy regions. Most turbines produce energy more than 25% of the time, with this percentage increasing in winter when the winds are stronger. The first wind turbine in the Republic of Moldova was installed in the north of the country, by the company Elteprod SRL.

The priority of the technologies applied for the Republic of Moldova are the horizontal axis wind turbines. It is basically a rotational machine in which the movement is produced by the kinetic energy of the wind when it acts on a rotor that normally has three blades. The rotational motion produced is transmitted and multiplied by a speed multiplier to a generator that is responsible for producing electricity.

The operation of a wind turbine is characterized by its power curve that indicates the range of wind speeds in which it can be operated and the power required for each case.

1.1.4.2 TAP's ambition

In order to define the ambition of the horizontal axis wind turbine technology, the following aspects were followed and analyzed:

Scope of technology: Building on the current legislative framework as well as the strategic directions included in the energy policy documents, the promotion of wind technologies aims to reduce the country's dependence on electricity imports. Thus, according to the operations carried out on the application of the support schemes made available by the Government of the Republic of Moldova, these technologies will be used for the delivery of electricity to the grid by applying the fixed tariff and fixed price support schemes.

In accordance with the provisions on the establishment of capacity limits and capacity quotas in the field of electricity from renewable energy sources, until 31 December, 2025, wind technologies are assigned a total cumulative capacity of 120 MW. At the moment, the total installed capacity of wind turbines in the country exceeds 70 MW. It is worth mentioning that all the wind turbines installed are second-hand, and the producers sell the electricity to local suppliers at unregulated tariffs.

The long-term target, regarding the expansion of generation capacities, are set out in the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation[144], as well as the study on the Competitiveness of renewable energy sources, for the 100% RES scenario, to cover the electricity demand of the Republic of Moldova[145].

[144] https://www.legis.md/cautare/getResults?doc_id=129232&lang=ro

[145] https://ibn.idsi.md/vizualizare_articol/115080

1.1.4.3 Selecting actions and tasks for A3 technology

Summary of barriers and measures to overcome them. The most important barriers and their analysis were described in the BAEF Report. Thus, on April 13, 2022, the sectoral working group, composed of specialists in the field, exposed themselves on the barriers that block the promotion of the technology on the local market. Those of very high importance and medium importance were selected for the development of TAP actions and activities. Thus, the following were identified:

Limited local balancing capacities to cover imbalances caused by intermittent wind technologies

The secondary regulatory framework resulting from Law 10/2016 also includes how this balancing will be carried out. This aspect becomes even more topical, as we talk about the liberalization of the electricity market, where producers from renewable energy sources have assumed obligations regarding the mandatory insurance of imbalances arising in the network, NAER Decision no. 283/2020 on the approval of the Electricity Market Rules[146]. In this regard, producers participating in the wholesale electricity market, based on wind technologies, are obliged to sign balancing contracts with the transmission system operator. At the same time, the production companies that have been issued by NAER a license for the production of electricity are obliged to contact the transmission system operator, within ten working days, after the issuance of the respective license for the purpose of signing the balancing contract.

Legislative barriers

With the liberalization of the electricity market and the new rules of the electricity market, it has become complicated for potential investors and current owners of wind installations to face these challenges. The new mechanisms included and the participation of producers on the local energy market has become complicated and difficult to adapt to the new requirements. Thus, at the local level, it is necessary to amend some legislative acts, which would facilitate the implementation of these rules, including in terms of clearer perception of these games.

Lack of tendering procedures for large wind generation capacities

In accordance with the primary and secondary regulatory framework, the Government of the Republic of Moldova is responsible for auctioning renewable electricity production capacities, through the application of the fixed price support scheme. In the case of wind installations, capacities of 105 MW are to be auctioned. The lack of procedures developed and approved by the government, later made available to investors, blocks the replication of this technology on a larger scale in the country. In this regard, overcoming this barrier, the Ministry of Infrastructure and Regional Development is to benefit from immediate technical assistance to develop the bidding procedures for wind capacities.

Limited access to financial resources to promote wind technologies

[146] https://www.legis.md/cautare/getResults?doc_id=123381&lang=ro

This was caused by the formation of high or exaggerated costs of capital - the high bank interest rate, the imperative of guaranteeing loans at the level of 120-150% of its value, etc. Even if more efforts have been made in this direction through externally financed projects, the cost of bank interest rates remains high. The solution to overcome the barrier would be to mobilize financial resources from Donors and Funding Partners (especially access to cheap financial means from international funding organizations), as well as to mobilize the own financial resources of entrepreneurs and the residential sector.

Limited access to electricity transmission and distribution networks, as well as the limited capacity of existing ones, in areas with increased wind potential, as well as the impossibility of synchronizing the construction of the power plant with the investment plans of the transmission or distribution operator regarding the extension of the electricity network in those areas

Compared to photovoltaic technologies, where the net metering support scheme is widely applied to small production capacities to cover their own energy needs, in the case of wind technologies, they are primarily directed towards the business model by applying the tariffs and fixed prices support scheme. Thus, the lack of transmission and/or distribution networks in areas with high wind potential blocks the promotion of the technology or directly contributes to increasing the investment costs for their expansion.

Low tax breaks

Even if the state partially promotes tax incentives on such technologies, they are focused only on certain elements within a wind system. Starting from the premise that the Republic of Moldova is not a country producing wind installations, import tax incentives would reduce the costs of investments in new equipment.

Long and arduous procedures for obtaining building permits and permits

The installation and quality assurance of the execution of the construction and installation works of a wind system is ensured in the light of Law 721/96 on the quality assurance of construction works. In addition to the nominated, procedural legislative framework, a potential Beneficiary must go through several steps, which also include obtaining permissive acts, coordination and approvals at the level of authorities and parties involved in carrying out such a project, developing studies and analyses. These procedures complicate and delay the realization of such a project over time. At the same time, studies related to the impact of technologies on the environment are mandatory, and the lack of specialized companies in this direction delays the processes of obtaining permissive documents. The recent conditions for obtaining connection permits from potential investors with a power greater than or equal to 1 MW, within the voltage range greater or less than 110 kV, have the obligation to develop studies of solutions for the connection of power plants[147]. This also delays the realization of a project in the wind field, due to the lack of companies specialized in this direction.

Insufficient training of managers in the field of wind equipment

[147] https://www.legis.md/cautare/getResults?doc_id=126419&lang=ro

If we make a comparison between the first two technologies analyzed, the training of staff in the field of assembly, assembly and service are ensured through GD 1051/2018 on the approval of the Regulation on the qualification and registration of installers of biomass boilers, furnaces or stoves, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. In the case of wind technologies, both the construction and the servicing of the mounted equipment are not legally covered, and the training of staff in this direction is not fully ensured by the universities and training centers in the country. At national level, there is a total lack of specialists in the field, as well as accredited training programs and professional training from the mentioned institutions.

The measures to overcome the barriers mentioned above are selected as actions that will be part of the Wind Technologies Action Plan:

Actions identified for the implementation of the selected activities (measures)

Action 1 Development of the regulatory framework

Activities

1.1 In order to develop wind farms with capacities greater than 4 MW, the Government of the Republic of Moldova is to develop and approve the regulation on the auctioning of capacities by type of technologies, based on the fixed price support scheme, established by Law 10/2016. Based on that regulation, the Government will be able to auction the capacities available under GD 401/2021 to reduce electricity imports and make it easier for the energy sector to adapt to climate change.

1.2 In order to motivate investors to carry out projects based on wind technologies, the Government will annually make amendments to the Fiscal Code, in order to facilitate and grant the necessary tax exemptions to importers of wind technologies. These provisions will be introduced, including with the aim of discouraging investitures from importing second-hand turbines.

1.3 Update of Law 10/2018. The transposition of the new EU directives requires the need to update or develop a new law in the renewable field. This will further boost the local market for promoting technology on a larger scale in Moldova.

1.4 . The permissive acts regarding the design or redesign of new objectives are regulated by the normative framework in the field of construction. The long procedures for obtaining permissive documents in the field of construction delay the implementation of projects of national interest. The reduction of the documents necessary to start these works would create a favorable environment for the promotion of technology.

1.5 Facilitating access to the electricity grid and integrating renewable energy producers into the electricity market in the Republic of Moldova by initiating amendments to the Electricity Networks Code and transposition of EU Commission Regulation 2017/2196.

1.6 In order to increase the quality of wind technologies and harmonize the regulatory framework with the European one in terms of standardization, it is necessary that they be widely applied by both importers and their producers.

Action 2 Increasing institutional capacities for training specialists

2.1 Nowadays, in the Republic of Moldova, there is a higher educational institution that trains licensed engineers in the field of energy and energy. With the development of renewable energy sources, the higher public institution has not developed and accredited a specialty or study program dedicated to wind equipment installers. In this regard, it is necessary to develop training and continuous training programs for wind engineers and installers.

2.2 In accordance with the requirements for reconnection to the electricity grid on the high voltage side and the larger generator set with a capacity of 1 MW, it is necessary to develop studies of technical solutions to achieve this measure. Increasing the institutional capacities of companies and their staff will facilitate the development of qualitative analyses, reports and feasibility studies for the conditions described above.

2.3 The new electricity market rules require electricity market participants, including wind producers, to be responsible for imbalances caused during the day, the next day and bilateral power purchase agreements. This action aims to train producers of wind renewable sources in order to adapt more easily to the requirements of the new market, as well as to use specialized forecasting software, of high accuracy regarding the production of the amount of electricity on the current market and those to be developed.

2.4 The imbalances caused by the incorrect forecast of electricity production based on wind technologies represent the biggest problem faced by producers today. Software that can accurately forecast the amount of energy produced by these technologies during the day and the next day can reduce the aforementioned imbalances.

Action 3 Increasing the affordability of and promoting wind technologies

3.1 In order to encourage investments and attract the most advanced new technologies in the field of electricity generation based on wind turbines, it is intended to launch dedicated credit lines through commercial banks and state programs for financing these technologies.

3.2 The process of promoting and publicizing the benefits obtained from the acquisition of such technologies is important and requires an individual approach for potential customers.

Activities to be implemented as a pilot project.

The following basic activities are to be taken into account in the development of the pilot project: *1.5 Making changes in the Electricity Networks Code*, *2.2 Developing training*

programs on preparing specialists for the development of feasibility studies, 2.4 Developing specialized software for forecasting electricity produced based on wind technologies.

Thus, today in the Republic of Moldova, all installed wind technologies are second-hand, imported from EU countries. Based on the analyzed barriers and the causes why new equipment is not imported into the country, replicating these technologies on a larger scale will be difficult if the state does not intervene with legislative instruments, and banks with advantageous credit lines for investors.

At the same time, the electricity market is in its early stages, which imposes certain difficulties in accelerating the replication of this technology on a larger scale and at a faster pace.

In this sense, the idea of the project is to create and implement wind farms based on new technologies, connected to the national public grid in order to increase the feasibility of supplying electricity to end consumers. The integration of wind turbines into the circuit would allow generation and consumption to be done locally, which will lead to a decrease in electricity losses in the operator's distribution network. Improving the quality parameters of electricity will be another benefit that consumers will have.

The mentioned technology is in the engineering field, and this fact in the Republic of Moldova involves few women who can develop, manage and carry out projects based on this technology. Gender inequality in technology appears, including in terms of the level of professional training in the field of installations, where there is a low presence of women.

1.1.4.4 Stakeholders and timeline for the implementation of TAP

According to the table below, government institutions, agencies, public associations, as well as private economic agents were involved in the analysis of technologies. Table 1.7 shows the stakeholders responsible for the actions described and the timetable for their implementation.

Table 1.7 *Name of the institutions involved and implementation period*

Nr.	Actions	Activities	Stakeholders	Role of stakeholders	Period
1	**Action 1 Development of the regulatory framework**	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	MIRD, NAER, Foreign donors	MIRD – develops and promotes the regulatory framework NAER – approves the tariffs based on the fixed price support scheme Donors – support for the development of the regulatory framework, financing of technologies	2022-2023
		1.2 Update of Law 10/2016 on renewable energy sources	MIRD, Foreign donors	MIRD – responsible for the development of policies in the renewable field	2023-2024

				Donors – support for the development of the regulatory framework, financing of technologies	
		1.3 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	MIRD, MF	MIRD – responsible for the development of CBTM in the village. Energetic MF – promoter of annual fiscal changes, including sectoral budget promotion.	2023 – each budget year
		1.4 Modification of the normative framework under construction regarding the issuance of permissive acts	MIRD	MIRD – responsible for the development and updating of normative acts. Inclusion or exclusion of permissive acts in the field of construction.	2024-2025
		1.5 Operation of changes in the Electricity Networks Code	TSO, DSO NAER	TSO and DSO – Responsible for complying with the imposed technical requirements. NAER – responsible for the development of the code	2022-2023
		1.6 Revision of national standards for wind technologies	ME, INS	ME- promoting policies in the field of standardization. NIS – ensures the development and transposition of standards at national level	2023-2024
2	**Action 2 Development of institutional capacities and training of specialists**	2.1 Development and accreditation of training and continuous training programs for specialists who maintain, develop and operate wind technologies	TUM, Centers of Excellence	University – represents the public institution in the country that prepares and promotes future engineers in the energy field. Centers of Excellence – prepare and promote young staff with incomplete secondary education in the field of energy and construction	2023-2025
		2.2 Development of training programs on the preparation of specialists for the development of feasibility studies	Private and academic environment	Private companies and academia provide services for the development of feasibility studies and technical solutions	2022-2025

		2.3 Organization of trainings or workshops for wind producers to facilitate access to the electricity market	MIRD, NAER, Foreign donors, Private sector,	The MIRD promotes policies in the field of renewable technologies and monitors the strategic objectives imposed by the policy documents. Foreign donors can be identified as potential funders of these programs. NAER – the national regulator in the energy field, responsible for implementing the rules of the electricity market. The private sector is the end-users of these trainings.	2023-2025
		2.4 Development of specialized software for forecasting electricity produced based on wind technologies	Renewable energy producers	Producers have the obligation to forecast the amount of energy produced, in order to establish the imbalances formed. Suppliers responsible for balancing groups	2022-2025
3	**Action 3 Increasing the affordability of and promoting wind technologies**	3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on wind technologies	Commercial banks, MIRD,	Commercial banks are developing dedicated credit lines for the photovoltaic field. MIRD can develop dedicated state programs for the financial support of technology	2022-2025
		3.2 Media coverage and promotion of new wind technologies	AEE, Free press and mass media	EEA – responsible for promoting the best technologies in terms of energy and environmental friendliness Free press and mass media – channels of communication between authorities and potential investors in the field	2022-2025

1.1.4.5 Estimation of the resources required for actions and activities

The estimation of the financial resources necessary for the implementation of the actions listed above were made based on the existing regulatory aspects and good practices already

implemented in the Republic of Moldova. For the activities related to trainings and the development of financing mechanisms, the information on the development of study and professional training programs of specialists from higher education institutions and specialized secondary institutions (university study program and from the Center of Excellence in Energy and Electronics[148], etc.) was used.

Table 1.8 *Assessment of the resources needed for TAP actions and activities in the energy sector*

Actions	Activities	Estimated budget USD	
		Minimum	Medium
Action 1 Development of the regulatory framework	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	16 000	20 000
	1.2 Update of Law 10/2016 on renewable energy sources	15 000	20 000
	1.3 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of wind technologies	3000	3000
	1.4 Modification of the normative framework under construction regarding the issuance of permissive acts	3 500	4 000
	1.5 Operation of changes in the Electricity Networks Code	42 000	60 000
	1.6 Revision of national standards for photovoltaic technologies	10 000	15 000
Action 2 Development of institutional capacities and training of specialists	2.1 Development and accreditation of training and continuous training programs for specialists who maintain, develop and operate wind technologies	15 000	30 000
	2.2 Development of training programs on the preparation of specialists for the development of feasibility studies	25 000	30 000
	2.3 Organization of trainings or workshops for wind producers to facilitate access to the electricity market	30 000	50 000
	2.4 Development of specialized software for forecasting electricity produced based on wind technologies	300 000	350 000
Action 3 Increase affordability	3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on wind technologies	30 000 000	50 000 000
	3.2 Media coverage and promotion of new wind technologies	12 000	18 000

[148] https://ceee.md/specialitati/

1.1.4.6 Management planning

Risks identified when implementing technology

With the outbreak of the conflict in Ukraine, many logistical paths regarding the import of photovoltaic installations into the country were broken. As a result, the cost of one kW of installed power, as of today, is already exceeded by the ceiling established by NAER, based on decision no. 76/2022. In order to mitigate this risk, it is necessary to develop new ways of importing technologies into the country or to identify potential producers near the Republic of Moldova or to develop the own production of these types of technologies.

Another risk when implementing TAP would be the lack of qualified specialists for the installation, operation and maintenance of photovoltaic equipment. At present, for carrying out these operations, especially those of mounting the tower and the blades, external companies are contracted, which have the experience and specialized technical equipment necessary for these works. To overcome these risks, training and exchange of experience with other countries can lead to the successful implementation of a project in the field of wind technologies.

The stagnation of the implementation and replication of wind technologies can also be related to the new rules of the electricity market that came into force on June 1, 2022. Insufficient experience, lack of specialized software for electricity forecasting during the day and during the next day, increases the risk of imbalances in the network, respectively major penalties applied by the transmission system operator for the respective producers. In order to mitigate these risks, activities are needed to increase producers' capacities and specialized software with high accuracy for electricity forecasting on existing markets in the Republic of Moldova.

Steps to be taken

The main steps to be taken in the implementation of TAP are related to the promotion of new technologies on the territory of the country, discouraging the installation of second-hand equipment by investors, as well as increasing the institutional capacities of producers to adapt to the new rules of the electricity market. At the same time, it is necessary to speed up the procedure for the development and approval of the Government Decision on the regulation on the auctioning of large capacities for producers of photovoltaic energy sources.

TAP Overview Table For Horizontal Axis Wind Technology

Sector	Energy
Sub sector	Generation and distribution of electricity and heat
Technology	Vertical shaft wind equipment
Ambition	Promotion and construction of wind installations, with a cumulative electricity capacity of 1300 MW, for the scenario in which the Republic of Moldova tends to cover 100% of the energy demand from the RES, connected to the national public grid, in order to overcome the climate impact on the danger of diminishing the production of electricity due to the lack of technological water at the CET and HPP, as a result of the drought.
Benefits	Economic, social and environmental: ● Reducing dependence on imports of primary energy resources. ● Increasing the revenues in the local budget from the generation and supply of electricity in the form of taxes and duties. ● Workforce development at local level. ● Reducing power and energy losses due to the distributed generation of wind technologies. ● Development of auxiliary services for the operation, maintenance and maintenance of technologies. ● Reducing water and air pollution. ● Decrease environmental impact and reduce greenhouse gas emissions. Adaptation benefits: ● Saving water reserves for the technological cooling processes of the TECs. ● Covering the energy demand necessary for the cooling process of spaces in case of heat waves and for heating during the winter period. ● Covering the energy demand of all sectors of the national economy.

Actions	Activity to be implemented	Source of funding	Responsible parties	Estimated period of implementation	Risks	Success criteria	Monitoring and implementation indicators	Budget per activity USD
Action 1 Development of regulatory framework	1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	State Budget, Foreign Donors	MIRD, NAER,	2022-2023	Delaying the approval of the regulatory framework	Launch of the fixed price support scheme with the approval of the regulation	An approved normative act	20 000
	1.2 Update of Law 10/2016 on renewable energy sources	State Budget, Foreign Donors	MIRD	2022-2023	Delaying the approval of the regulatory framework	Taking over European best practices in the field of renewable energy sources	An approved normative act	20 000
	1.3 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of wind technologies	State Budget	MIRD, MF	2023 – each budget year	Insufficiency of budgetary financial means to operate tax and customs exemptions for technology	Promotion of import exemptions and duties for wind technologies	An updated Tax Code	3000
	1.4 Modification of the normative framework under construction regarding the	State Budget	MIRD, Employers' associations in the field of Construction	2023-2025	The risk of not promoting this initiative	Reduction of permissive acts in the field of construction	An updated normative act	4000

	issuance of permissive acts							
	1.5 Operation of changes in the Electricity Networks Code	TSO, DSO budget, Foreign donors	MIRD, NAER	2022-2023	Delaying the approval process due to lengthy coordination with stakeholders	Harmonization of the regulatory framework with that of the EU	An updated Electricity Grid Code	60 000
	1.6 Revision and transposition of standards for wind technologies	State Budget	ISM, MIRD	2023-2024	Delaying the transposition process through passive activity of the technical committees set up by the ISM	Transposition of international standards into the secondary regulatory framework	Number of standards approved and/or transposed	15 000
Action 2 Development of institutional capacities and training of specialist	2.1 Development and accreditation of training and continuous training programs for specialists who maintain, develop and operate wind technologies	TUM Budget, CEEE, Foreign Donors	Academic environment, EEA, MEC	2023-2025	Lack of qualified teachers	Increasing the training capacities of installation and service specialists	Number of programs developed and/or accredited	30 000
	2.2 Development of training programs on the preparation of specialists for the development of feasibility studies	Foreign donors, private sources	MIRD, Academic environment	2022-2025	Lack of teachers at local level	Increasing the institutional capacities of the private sector	Number of programs developed	30 000
	2.3 Organization of trainings or workshops for wind producers	Foreign donors, private sources	MIRD, Academic environment	2023-2026	Low interest from the private sector	Institutional capacity building in the private sector	Number of trained personnel	50 000

	to facilitate access to the electricity market							
	2.4 Development of specialized software for forecasting electricity produced based on wind technologies	Private Companies, Foreign Donors, Energy Suppliers	MIRD, Central Energy Supplier, Universal Energy Suppliers	2023-2025	Insufficient financial means from the private sector	Reduction of electricity imbalances within the balancing group	Number of software purchased or forecasting services contracted	300 000
Action 3 Increase affordability	3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on wind technologies	Commercial banks, Foreign Donors	MIRD, MF, EEA	2022-2025	High bank rates	Increasing installed capacities in the country	Number of credit lines launched Number of approved state programs	50 000 000
	3.2 Media coverage and promotion of new wind technologies	State Budget, Foreign Donors	EEA, Mass media institutions	2022-2025	Lack of financial means	Promoting national and international best practices by example	Media campaigns launched	18 000

1.2 Project ideas in the energy sector

1.2.1 Executive summary of project ideas in the energy sector

All actions selected for the promotion of technologies will take part in the development of project ideas. The essential ones, which will have a major impact, have been highlighted in the previous chapters. The activities developed under each action are interconnected and correspond to an environment that allows the achievement of the targets specified by each technology. The actions with a major impact have been selected as fundamental actions of the technologies, which means that the implementation of the project ideas determines the adoption of a situation of a technology. In other words, the project idea triggers a "shift" in the adoption and dissemination of technology.

The second criterion for selecting the project ideas was their feasibility and commercial attractiveness. Given the lack of state financial support, project ideas should be economically attractive to potential investors, both nationally and internationally. In this regard, the role of the Ministry of Finance will be an important one in terms of budget planning, as well as intersectoral coordination of investment activities on behalf of development partners. Therefore, the chances that the technologies will be successfully implemented and replicated on a sufficiently extensive scale throughout the country increase.

1.2.2 The specifics of the project idea. Covering the electricity demand in two regions of the Republic of Moldova using monocrystalline photovoltaic technologies.

Name	Description
Introduction	Thus, the idea of the project is to create and develop sufficient capacities in two areas of the country (Center and South) by applying existing support schemes, including capacity bidding (fixed price), combining good practices for the dissemination of technology and improving the infrastructure for access to the medium and high voltage electricity grid. The Center and South areas are considered the most attractive for the implementation of photovoltaic projects. In this sense, global radiation can reach a value of up to 1400 kWh/m2/year.
Project objectives	The basic objective of the project is to build sufficient photovoltaic capacities in two areas of the Republic of Moldova, Center and South, with a cumulative electrical power of 200 MW. The indicated power is to be covered by the end of 2026
Project results	**Action 1** Development of the secondary regulatory framework Result 1.1 A Government-approved regulation on capacity auctioning.

	Result 1.2 An annual process for initiating amendments to the Fiscal Code regarding import and customs duty exemptions for photovoltaic technologies Result 1.3 An amended and approved Electricity Grid Code. Result 1.4 A mechanism for certification and verification of the quality of photovoltaic systems imported or produced in the country. Result 1.5 A set of revised and transposed standards for photovoltaic technologies. Result 1.6 Plans for the expansion of the electricity distribution and transmission networks developed based on the regional photovoltaic potential. **Action 2** Development of institutional capacities and training of specialists Result 2.1 Training and continuous training programs for photovoltaic specialists developed and accredited. Result 2.2 A specialized software or organization of electricity forecasting services purchased. Result 2.3 A specialized program on identifying the photovoltaic potential and training specialists in the elaboration of feasibility studies purchased and organized. **Action 3** Increase affordability Result 3.1 A dedicated credit line through commercial banks and state programs on financing projects based on photovoltaic technologies developed. Result 3.2 A PV Facility Subsidy Tool developed
Priorities and sustainable development of the country	In order to promote renewable energy sources, especially photovoltaic ones, a series of legislative and normative acts were approved to increase production capacities in the interior of the country. The basic targets set in the following normative acts ensure the sustainability of the project idea:
Scope of the project and possible implementation	The implementation of the project will be done by the private sector that wants to develop a business in the field of electricity production from renewable energy sources. At the same time, implementers of the project can be considered other sectors of the national economy. In this regard, we can mention the buildings sector, which includes residential and administrative buildings. The implementation of technologies in this sector

	can be considered as a measure applied in order to reduce one's own energy consumption, but also as a measure aimed at covering the demand for electricity during the summer period, when there is an increased demand for electricity for space conditioning.
Project activities	**Action 1 Development of the secondary regulatory framework** 1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning – year 1 1.2 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies – year 2 1.3 Operation of changes in the Electricity Networks Code – year 2 1.4 Certification and quality verification of products (photovoltaic systems) imported or produced in the country - year 3 1.5 Revision and transposition of standards for photovoltaic technologies – year 3 1.6 Development of plans for the expansion of the electricity distribution and transmission networks based on the regional photovoltaic potential – year 2-4 **Action 2 Development of institutional capacities and training of specialists** 2.1 Development and accreditation of training and continuous training programs for specialists in the photovoltaic field – year 2 2.2 Purchase of specialized software or electricity forecasting services produced based on photovoltaic technologies and training of producers – year 2-3 2.3 Development of specialized programs on the identification of photovoltaic potential and training of specialists in the development of feasibility studies – year 2-3 **Action 3 Increase affordability**

	3.1 Development of dedicated credit lines through commercial banks and state programs on financing projects based on photovoltaic technologies – year 2- 3.2 Approval of state programs on project financing – year 3 3.2 Development of photovoltaic installation subsidy instruments – year 2
Project budget/resources	The estimate of the investment value of the given project represents the amount of 18 541 000 USD. Its distribution by activities: 1.7 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning – $16,000 1.8 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies – $ 3 000 1.9 Operation of changes in the Electrical Networks Code – $ 42 000 1.10 Certification and quality verification of products (photovoltaic systems) imported or produced in the country – $ 1 500 000 1.11 Revision and transposition of standards for photovoltaic technologies – $15,000 1.12 Development of plans to expand electricity distribution and transmission networks based on regional photovoltaic potential – $120,000 2.1 Development and accreditation of training and continuing education programs for photovoltaic specialists – $ 15 000 2.2 Purchase of specialized software or electricity forecasting services produced based on photovoltaic technologies and training of producers – $ 300 000 2.3 Development of specialized programs on the identification of photovoltaic potential and training of specialists in the elaboration of feasibility studies – $ 230 000 3.1 Dedicated credit lines through commercial banks and state programs for financing projects based on photovoltaic technologies – $16,000,000

	3.2 Development of PV Installation Subsidy Instruments – $300 000 Due to inflation and high interest rates, the value of these investments is expected to increase in the coming years. In order to attract interest in this technology, it is intended that the money allocated to interested parties also has a grant component, in order to facilitate attractiveness in such projects.
Funding sources	The main source of financing will be made from the private sector. In order to attract investments from them, information and awareness campaigns will be started. At the same time, the Entrepreneurial Development Organization will facilitate the obtaining of grants for companies that want to streamline their energy consumption based on photovoltaic technologies. The activity of the project idea will be financially supported, including by international partner banks, such as the EIB or the EBRD.
Measurement/Evaluation	The Ministry of Infrastructure and Regional Development, as well as the Energy Efficiency Agency, are responsible for the progress made in the renewable field. The specialized central authority has the task of monitoring the indicators established in the national energy strategy, evaluating the performance of the main indicators, as well as reporting the progress made to various stakeholders. Official reports developed by the mentioned institutions will be used to measure performance, as well as other sources of information such as statistical reports and reports of the national energy regulator.
Possible complications/challenges when implementing the project	Possible complications/challenges are related to the risks of high inflation fluctuations, which reached values above 30% in August 2022. Due to the energy crisis, the central public authorities allocate more time and budget to mitigate the impact of the increase in tariffs on imported energy resources. Due to the factors mentioned, there is a risk that companies will have little liquidity to invest in such technologies. The involvement of development partners and donors will have a beneficial impact on the successful implementation of the project.
Responsibilities and coordination	The main actions of the project are planned to be executed by several state structures, such as the Ministry of Infrastructure and Regional Development, product accreditation and certification institutions. Commercial banks will play a decisive role in launching attractive credit lines for potential investors. The Ministry of Finance will coordinate budget planning activities, as well as establishing a favorable investment climate for investments, keeping the inflation rate under control and permanent monitoring.
Project beneficiaries	The beneficiaries of the project are divided into two categories, those who will benefit directly from the project idea and those who will benefit indirectly from the proposal. From the first

	category of beneficiaries are the economic agents who want to invest in such technologies, and the second category will be those who benefit from this investment, i.e. the final consumers. At the same time, key sectors of national economies such as buildings and the business environment, including agriculture, are considered the main beneficiaries of the project. By implementing the project idea, the aim is for the import of electricity to decrease, and the technology to have an increased resilience to climate change. The idea of the project is also gender-neutral, which requires equal opportunities for men and women of all ages to implement it.

1.2.3 The specific of the project idea. Creating a favorable investment climate for the promotion of the heat pump technology in the residential and public sector of the Republic of Moldova.

Name	Description
Introduction	The idea of the project is to create and develop a favorable investment climate for the promotion of heat pump technology on the territory of the country. In this regard, the aim is to attract investments from development partners and to obtain preferential credit lines for potential beneficiaries who wish to invest in such technologies.
Project objective	The basic objective of the project is to develop projects for the installation of heat pumps with a total cumulative power of 225 MW, in order to overcome the climate impact on the danger of diminishing the production of thermal energy due to the lack of technological water at the CET uri, as a result of the drought. The achievement of this target is to be achieved by the end of 2026.
Project results	**Action 1** Development of the regulatory framework Result 1.1 An updated energy strategy for the Republic of Moldova. Result 1.2 Updated Building Energy Performance Act Result 1.3 Local environmental and energy action plans developed. Result 1.4 Regulations under construction on developed heat pump technologies. Result 1.5 In the Fiscal Code on exemptions from import and customs duties on heat pump technologies annually developed. Result 1.6 An updated medium-term budgetary framework.

	Result 1.7 A normative framework under construction regarding the elaboration of permissive acts modified. Result 1.8 A process of certification of the quality of products, equipment developed. Output 1.9 A heat pump testing laboratory set up and operational. Result 1.10 Standards revised and transposed into the national framework. **Action 2** Development of financial instruments and promotion of technology Result 2.1 Instruments for subsidizing heat pump installations developed. Result 2.2 At least one credit line through commercial banks and state programs dedicated to developed heat pump technologies. Result 2.3 A model of ESCO type of companies developed. Result 2.4 A process of media coverage and promotion of heat pump technologies launched. **Action 3** Increasing institutional capacities for training specialists Result 3.1 A developed and accredited training and continuous training program for specialists in the field of heat pump installations. Result 3.2 A laboratory for spending practical hours for students from established educational institutions. **Action 4 Development of geothermal potential in the Republic of Moldova** Action 4.1 A study of geothermal potential in the Republic of Moldova developed. Action 4.2 An interactive map with geothermal potential developed. Action 4.3 A study on the identification of buildings that can benefit from ground-water heat pump technology developed. Action 4.4 A specialized heat pump sizing software developed.

Priorities and sustainable development of the country	The technology is expected to bring benefits both in terms of climate resilience of potential beneficiaries and contribution to GHG reduction. Thus, a reduction of about 37% in the annual consumption of traditional fuels (natural gas in particular and fuel oil) is expected, compared to the baseline scenario included in the NDC, and a reduction in greenhouse gas (GHG) emissions of at least 66,741 tons of CO2 equivalent per year.
Scope of the project and possible implementation	The buildings sector will benefit the most from the implementation of this technology. The aim is for the newly constructed buildings to be equipped with high-performance heating and cooling equipment based on heat pump technologies.
Project activities	**Action 1 Development of the regulatory framework** 1.1 Update of the energy strategy of the Republic of Moldova – year 1. 1.2 Updating the law on the energy performance of buildings – year 2. 1.3 Development of local energy and environmental action plans – year 1. 1.4 Development of the normative in the construction of ground-water heat pumps – year 2. 1.5 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of heat pump technologies – year 1. 1.6 Update of the Medium-Term Budgetary Framework (MTBF) - years 1-4. 1.7 Modification of the normative framework under construction regarding the issuance of permissive acts – year 2. 1.8 1.8 Ensuring the quality certification procedure of products, equipment – years 1-4. 1.9 Establishment of a heat pump testing laboratory - years 3-4. 1.10 Revision and transposition of standards for heat pump technologies – year 2.

	Action 2 Development of financial instruments and promotion of technology 2.1 Development of subsidy instruments for heat pump installations – year 1. 2.2 Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies - years 1-3. 2.3 Development of ESCO business models – years 2-4. 2.4 Media coverage and promotion of heat pump technologies – years 1-4. **Action 3 Increasing institutional capacities for training specialists** 3.1 Development and accreditation of training and continuous training programs for specialists in the field of geothermal installations and heat pumps – years 2-4. 3.2 Establishment of a laboratory for spending practical hours for students from educational institutions – 2nd year. **Action 4 Development of geothermal potential in the Republic of Moldova** 4.1 Elaboration of a study on geothermal potential in the Republic of Moldova – years 2-3. 4.2 Development of interactive maps with the identified geothermal potential – year 4. 4.3 Development of a study on the identification of buildings that can benefit from ground-water heat pump technology – years 3-4. 4.4 Specialized software for sizing heat pumps – years 3-4.
Project budget/resources	The estimate of the investment value of the given project represents the amount of 21 281 500 USD. Its distribution by activities: 1.1 Update of the energy strategy of the Republic of Moldova $40,000. 1.2 Updating the law on the energy performance of buildings $ 20 000.

	1.3 Development of local energy and environmental action plans $ 420 000. 1.4 Development of the normative in the construction of ground-water heat pumps $ 3 500. 1.5 Annual operation of changes in the Fiscal Code regarding exemptions from import and customs duties of heat pump technologies $ 3 000. 1.6 Update of the Medium-Term Budgetary Framework (MTBF) $5,000. 1.7 Modification of the normative framework under construction regarding the issuance of permissive acts $ 3 000. 1.8 Ensuring the quality certification procedure of products, equipment $ 12 000. 1.9 Establishment of a heat pump testing laboratory $75 000. 1.10 Revision and transposition of standards for heat pump technologies $ 20 000. 2.1 Development of heat pump plant subsidy instruments $50 000 2.2 Dedicated credit lines through commercial banks and state programs on financing projects based on heat pump technologies $ 20 000 000 2.3 Development of ESCO-type business models $40 000 2.4 Media and promotion of heat pump technologies $ 15 000 3.1 Development and accreditation of training and continuing education programs for specialists in the field of geothermal installations and heat pumps $ 30 000 3.2 Establishment of a laboratory for the expenditure of practical hours of students in educational institutions $ 70 000 4.1 Elaboration of a study on geothermal potential in the Republic of Moldova $ 70 000

	4.2 Development of interactive maps with identified geothermal potential $ 320 000 4.3 Development of a study on the identification of buildings that can benefit from ground-water heat pump technology $ 60 000 4.4 Specialized heat pump sizing software $25 000
Funding sources	The financial means will be obtained through the EIB and EBRD, as well as through the units implementing energy and environmental projects. The role of the Ministry of Finance will be to coordinate the external technical assistance and align the budget lines to the sectoral needs, required by the market demand for these technologies. The private sector, especially the residential one, will be attracted in the co-financing of the project idea. The mobilization of financial resources and their motivation will be done through media and promotion campaigns.
Measurement/Evaluation	The monitoring and measurement of the progress made in the implementation of heat pump technology will be carried out by the institutions responsible for the energy and environmental field. The percentage values for achieving results are set out in the national strategies set out in this document. The Ministry of Infrastructure and Regional Development, and the Minister of Environment are responsible for monitoring and evaluating the progress made in achieving the sectoral objectives.
Possible complications/challenges when implementing the project	Possible complications/challenges are related to the risks of high inflation fluctuations, which reached values above 30% in August 2022. Because of this, the prices of heat pump technologies have increased compared to the same period of the previous year. Lending rates have also seen a significant increase. This work remains constant for the next period as well.
Responsibilities and coordination	The implementing institutions will be responsible for carrying out the project ideas. At the same time, it is expected that on the professional training side and the increase of the institutional capacities of the companies in the field, the centers for continuous training of specialists, as well as the universities for the training of engineers in the field of installations, will be involved. At the same time, at the coordination level, it will be a responsibility of the specialized central public authority, such as the Ministry of Infrastructure and Regional Development.
Project beneficiaries	The beneficiaries of the project idea will be the construction sector (residential buildings and public buildings). By implementing the project idea, the aim is for the thermal energy consumption for the mentioned sector to decrease, and the technology to have an increased resilience to climate change. The beneficiaries of the project will be distributed equally, applying gender equity.

1.2.4 The Specifics of the project idea. Development of wind farms based on new technologies, connected to the national public grid in order to increase the feasibility of supplying electricity to end consumers

Name	Description
Introduction	The project idea consists in the development of wind farms based on new technologies, connected to the national public grid in order to increase the feasibility of supplying electricity to end consumers.
Project objective	The basic objective of the project is to build new wind capacities with horizontal axes with a cumulative electrical power of 120 MW. The indicated power is to be covered by the end of 2026.
Project results	**Action 1** Development of the regulatory framework Result 1.1 A capacity auction regulation approved by the Government. Result 1.2 An updated law on renewable energy sources. Result 1.3 Fiscal Code on exemptions from import and customs duties on wind technologies annually developed. Result 1.4 A normative framework on the issuance of permissive acts in construction developed. Result 1.5 Amended Electricity Grid Code. Result 1.6 A set of Standards revised and transposed into the national framework **Action 2** Development of institutional capacities and training of specialists Result 2.1 A developed and accredited continuous training and training programme for specialists who maintain, develop and operate wind technologies. Result 2.2 A training curriculum on the preparation of specialists for the elaboration of feasibility studies developed. Result 2.3 At least one organized training or workshops for wind producers to facilitate access to the electricity market. Result 2.4 A specialized software for forecasting electricity produced based on wind technologies developed. **Action 3** Increase affordability

	Result 3.1 A dedicated credit line through commercial banks and state programs on financing projects based on wind technologies developed. Result 3.2 Events for the publicization and promotion of new wind technologies launched.
Priorities and sustainable development of the country	The following acts are considered as the basis for ensuring and prioritizing the sustainable development of the country based on wind technologies: Law 10/2016 on the promotion of the use of energy from renewable sources and GD 401/2021 on the approval of capacity limits, maximum quotas and capacity categories in the field of electricity from renewable sources valid until December 2025.
Scope of the project and possible implementation	In accordance with the national energy and environment strategies, the aim is to reduce electricity imports from external sources, reduce greenhouse gas emissions, as well as adapt this sector to climate change. The selected technology will be implemented by the private sector, attracting financial sources from commercial banks.
Project activities	**Action 1 Development of the regulatory framework** 1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning – year 1 1.2 Update of Law 10/2016 on renewable energy sources – year 1 1.3 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies - year 1 1.4 Modification of the normative framework under construction regarding the issuance of permissive acts – year 2 1.5 Operation of changes in the Electricity Networks Code – year 1 1.6 Revision of National Standards for Wind Technologies – Year 2 **Action 2 Development of institutional capacities and training of specialists**

	2.1 Development and accreditation of training and continuous training programs for specialists who maintain, develop and operate wind technologies – years 2-3 2.2 Development of training programs on the preparation of specialists for the development of feasibility studies – years 2-3 2.3 Organization of trainings or workshops for wind producers to facilitate access to the electricity market – years 2-3 2.4 Development of specialized software for forecasting electricity produced based on wind technologies – years 2-3 **Action 3 Increasing the affordability of and promoting wind technologies** 3.1 Dedicated credit lines through commercial banks and state programmes for financing projects based on wind technologies – years 2-3 3.2 Media coverage and promotion of new wind technologies - years 2-3
Project budget/resources	The estimated investment value of the given project is USD 50,549,000. Its distribution by activities: 1.1 Development and approval by the Government of the Republic of Moldova of the Regulation on the auctioning of capacities $20,000 1.2 Update of Law 10/2016 on renewable energy sources $ 20 000 1.3 Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies $3,000 1.4 Modification of the normative framework under construction regarding the issuance of permissive acts $3,000 1.5 Operation of changes in the Electrical Networks Code $60,000 1.6 Revision and transposition of standards for wind technologies $15,000 2.1 Development and accreditation of training and continuing education programs for specialists who maintain, develop and operate wind technologies $30,000

	2.2 Development of training programs on the preparation of specialists for the development of feasibility studies $30,000 2.3 Organization of trainings or workshops for wind producers to facilitate access to the electricity market $50,000 2.4 Development of specialized software for forecasting electricity produced on the basis of wind technologies $300,000 3.1 Dedicated credit lines through commercial banks and state programs on financing projects based on wind technologies $50,000,000 3.2 Media and promotion of new wind technologies $18,000
Funding sources	The sources of financing will be identified through the development of dedicated credit lines by local commercial banks. It is planned to attract financial resources from the EIB and EBRD, as well as from development partners. The role of the Ministry of Finance will be to coordinate external technical assistance and align budget lines to sectoral needs. At the same time, the development of dedicated programs with a grant component will play a decisive role in promoting the technology. Attracting private financial means will be a priority of the project proposal, by motivating economic agents to invest in such technologies.
Measurement/Evaluation	Official reports developed by the mentioned institutions will be used to measure performance, as well as other sources of information such as statistical reports.
Possible complications/challenges when implementing the project	Possible complications/challenges are related to the risks of high inflation fluctuations, which reached values above 30% in August 2022. The lack of liquidity from economic agents and high bank interest rates are the main complications and challenges when implementing projects. At the same time, the geopolitical situation related to the neighboring state Ukraine increases the cost related to logistics, imports of these technologies.
Responsibilities and coordination	The implementing institutions will be responsible for carrying out the project ideas. At the same time, it is expected that on the professional training side and the increase of the institutional capacities of the companies in the field, the centers for continuous training of specialists, as well as the universities for the training of engineers in the field of installations, will be involved. At the same time, at the coordination level, it will be a responsibility of the specialized central public authority, such as the Ministry of Infrastructure and Regional Development and the Ministry of Environment.
Project beneficiaries	As in the case of monocrystalline photovoltaic installations, the beneficiaries of the project idea will be those who will benefit

	directly from the technology and indirect who will be the final consumers. The business environment will be considered the basic beneficiary of this proposal. By implementing the project idea, the aim is for the import of electricity to decrease, and the technology to have an increased resilience to climate change. The idea of the project is also gender-neutral, which requires equal opportunities for men and women of all ages to implement it.

Roadmap for identified and selected technologies in the energy sector

The implementation of the technologies identified in the energy sector focuses on the strategic objective (SO 5.2) "**Increasing the resilience of the Energy sector through climate investments and reducing the risk of climate hazards**". The results obtained by implementing technologies directly, indirectly or tangentially are found in achieving this objective.

From the priority Sustainable Development Goals[149], which can be achieved through the implementation of the identified technologies, the following can be mentioned:

- SDG: 7 Clean and affordable energy
- ODD: 2 Zero hunger
- SDGs: 12 Ensure sustainable consumption and production patterns
- SDGs: 13 Taking urgent action to combat climate change and its impacts

Climate change adaptation actions in the energy sector will generally focus on 3 priority directions. Firstly, updating the sectoral regulatory framework in terms of the design, construction, operation and maintenance of energy infrastructure, depending on the forecasted climate parameters. Another line of action will be aimed at reducing dependence on certain traditional energy sources (e.g. hydropower) by increasing local energy production capacity and capitalizing on local renewable energy sources. The third strand of action will focus on raising awareness and promoting energy-efficient products, encouraging household consumers to reduce energy consumption and use energy-efficient equipment, as well as by implementing energy efficiency projects in public buildings. It will also consider how to improve the local institutional context and the incentives that could motivate migrants and/or their families remaining in the country to invest in energy efficiency and renewable energy solutions.

For the proposed sector-wide technology set, the adaptation objectives have been identified in the TNA as follows:

- Increasing the capacities of the energy sector to cope with power outages.
- Improving the resilience of the energy sector's infrastructure.
- Reducing vulnerability to drought and floods.
- Improving energy efficiency.
- Increasing the capacities of the energy sector to cope with extreme temperature changes.

From the list of responsible institutions, the largest share belongs to the branch ministry, i.e. the Ministry of Energy, followed by the Energy Efficiency Agency, the Ministry of Finance,

[149] https://sdgs.un.org/goals

the institutions for training staff in the energy field (TUM. CEC) and project funding organizations such as EDO and FNDRL.

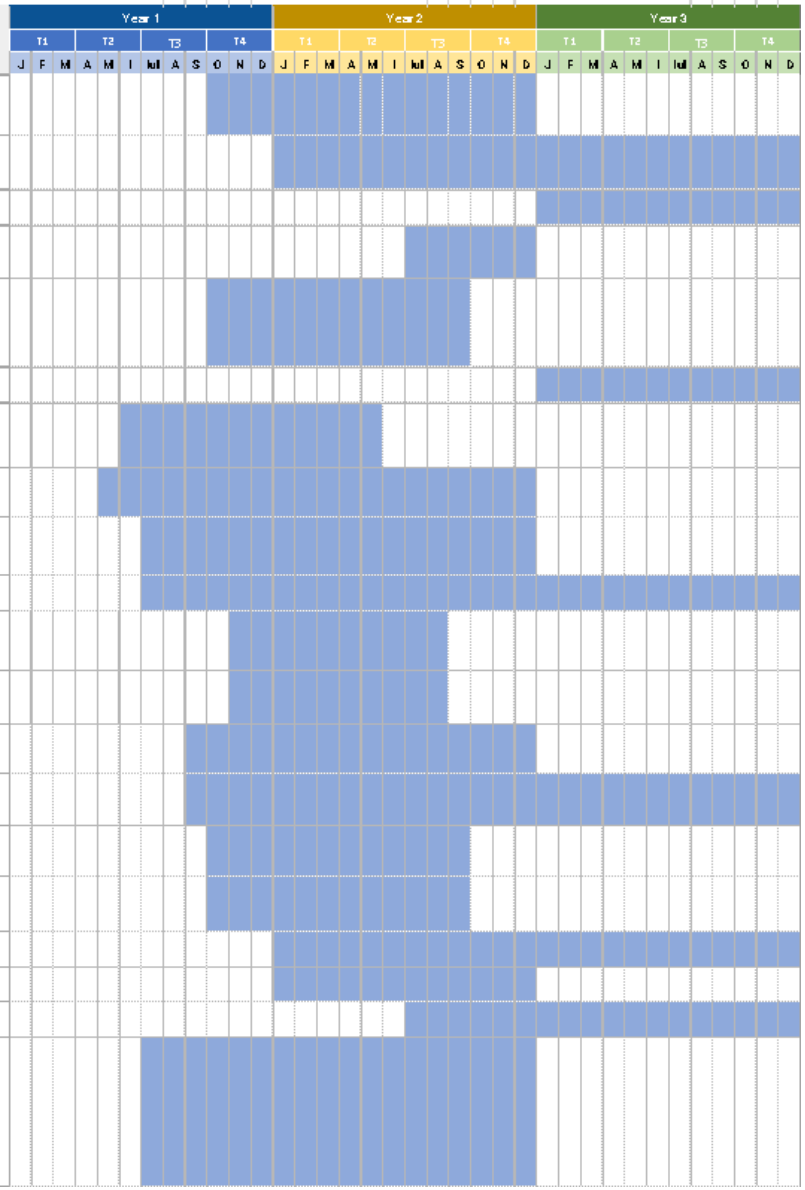
Table 1 below presents the roadmap for the implementation of the 20 technologies identified for the energy sector. In tab 2, the actions carried out for the implementation of the three selected technologies are indicated.

For selected renewable technologies, such as photovoltaic and wind installations, the paradigm shift is to replace energy produced by fossil fuel sources with renewable energy. On a national scale, technologies are expected to have an impact on society through the support schemes proposed and offered by the Government, as well as the promotion of the concept of local energy autonomy. The contribution of these technologies will significantly change the economic development of the country, will contribute to improving living conditions, as well as the population's access to clean and green energy.

In the case of heat pumps, the paradigm shift consists in replacing the energy produced by fossil fuel sources with renewable energy, using the reduced energy potential, such as ground heat. On a national scale, the technology is expected to have an impact on society by switching to another form of heating, less traditional in the Republic of Moldova.

Table 1 Roadmap for 20 technologies identified for the energy sector pentru sectorul energetic

Nr.	IMPACT	Technology	Responsible institutions	Start	Finish	Duration (months)
1	Decrease in the production of electricity and thermal energy due to lack of water at CET and CHE, as a result of drought	Biogas production technologies (trigeneration)	Ministry of Energy, NAER	01.10.2023	31.12.2023	15
2		High efficiency cogeneration technologies using natural gas	Ministry of Energy, NAER, Energy Distributors	01.01.2024	31.12.2025	24
3		Electric energy storage technologies	Ministry of Energy, EEA, Private Sector	01.01.2025	31.12.2025	12
4		Technologies for protecting electrical networks against scale deposits	NAER, TSO DSO	01.06.2024	12.31.2024	6
5		Elaboration of coordinated programs for the development of electrical networks and construction of irrigation stations for agriculture lands	DSO, LPA, Ministry of Agriculture	01.10.2023	30.09.2024	12
6		Water supply tanks of CETs, from alternative sources	ECDHs, Ministry of Energy	01.01.2025	31.12.2025	12
7		Thermal energy generation based on biomass burning installations	Ministry of Energy, EEA, Private Sector	01.06.2023	31.05.2024	12
8		The generation of thermal energy based on natural gas combustion installations by condensation	Ministry of Energy, EEA, NAER, Private Sector	01.05.2023	31.12.2024	20
9		Generating thermal energy for the production of domestic hot water based on clear collectors	Ministry of Energy, EEA, Private Sector	01.06.2023	31.12.2024	18
10		Thermal energy generation based on water-water heat pumps	Ministry of Energy, EEA, Private Sector	01.06.2023	31.12.2025	30
11	Moisture and dust due to extreme phenomena	Technologies predestined for outdoor artificial lighting based on LED bodies with high protection IP	LPAs, Ministry of Energy, EEA, FNDRL	01.10.2023	31.08.2024	10
12	Reduction of heat intakes in buildings during the Hot period of the year	Technologies predestined for indoor artificial lighting based on LED fixtures	Public institutions, Ministry of Energy, EEA, FNDRL	01.10.2023	01.09.2024	10
13	Extreme temperatures and heat waves	Heat accumulators	Ministry of Energy, NAER, Private Sector, DSO, TSO	01.09.2023	31.12.2024	18
14		Dry voltage and power transformers	Ministry of Energy, NAER, Private Sector, DSO, TSO	01.09.2023	31.12.2025	28
15		Thermal insulation materials for the exterior lining of buildings (mineral wool)	Public Institutions, Ministry of Energy, EEA, FNDRL	01.10.2023	30.09.2024	12
16		Thermopane external windows	Public institutions, the Ministry Energiei, EEA, FNDRL	01.10.2023	30.09.2024	12
17		High efficiency cooling and air conditioning technologies	Public institutions, the Ministry Energiei, EEA, FNDRL	01.01.2023	31.12.2024	24
18		Chiller-type cooling technologies	Public institutions, the Ministry Energy, EEA	01.01.2023	31.12.2024	12
19		IE 3 class electric motors	Private sector, Ministry of Energy, EEA	01.07.2024	31.12.2025	18
20		Creating favourable conditions for the implementation of the Energy Management Standard (SMISO 50001:2012 Energy management systems. Requirements and User Guide) at enterprises in Extreme temperatures of heat waves the energy, industrial and public sectors with the aim of increasing energy efficiency and reducing intensity energy	Ministry of Energy, EEA, ME	01.07.2023	31.12.2024	18



Indicatori de Succes	Riscuri	Cost estimat, USD	ODD	Obiectiv de adaptare	Obiectiv sectorial
Creșterea producției proprie de energie non intermitentă	Lipsa Materiei prime	3500 USD/kW	ODD: 7 ODD: 13	Creșterea capacitații de a face față întreruperilor de energie	OS 5.2. Sporirea rezilienței sectorului Energetic prin investiții în domeniul climei și reducerea riscului de hazarduri climatice
Creșterea producției proprie de energie non intermitentă	Lipsa Materiei prime	700 USD/kW	ODD: 7 ODD: 13	Creșterea capacitații de a face față întreruperilor de energie	
Utilizarea energiei stocate la acoperirea dezichilibrelor	Costul investiției majorat	7500/kVA	ODD: 7 ODD: 13	Creșterea capacitații de a face față întreruperilor de energie	
Sporirea feabilității rețelelor de transport și distribuție	Costul investiției majorat	120 000 USD	ODD: 7 ODD: 13	Îmbunătățirea rezistenței infrastructurii energetice	
Sporirea recolelor agricole	Consolidare slabă la nivel de organizare	50 000 USD	ODD: 2 ODD: 13	Reducerea vulnerabilității la secetă și la inundați	
Suplimirea dificitului de apă tehnologică	Lipsa voinție factorilor de decizie	1 000 000 USD	ODD: 12 ODD: 13	Îmbunătățirea eficienței utilizării resurselor	
Sporirea generării distribuite a energie termice	Lipsa Materiei prime	2000 USD	ODD: 7 ODD: 13	Creșterea capacitații de a face față schimbărilor extreme de temperatură	
Sporirea generării distribuite a energie termice	Costuri ridicate la gazele naturale	1500 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Producerea locală de apă caldă	Insuficiența mijloacelor finanicare	3500 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Sporirea generării distribuite a energie termice	Costuri ridicate a tehnologiei	6000 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Sporirea securității in traficul rutier si pietonal pe perioada de noapte	Insuficiența mijloacelor finanicare	150 USD	ODD: 7 ODD: 13	Îmbunătățirea rezistenței infrastructurii energetice	
Imbunătățirea normilor sanitare privind asigurarea iluminatului interior	Insuficiența mijloacelor finanicare	15 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Acoperirea dezichilibrelor cauzate de sursel intermitente	Costuri ridicate a tehnologiei	900 USD/kW	ODD: 7 ODD: 13	Creșterea capacitații de a face față întreruperilor de energie	
Pericol redus de incediu	Costuri ridicate a tehnologiei	25 USD/kVA	ODD: 7 ODD: 13	Creșterea capacității de a face față schimbărilor extreme de temperatură	
Reducerea consumurilor primare de energie predestinat incîlzirei și/sau răcirii spațiilor	Insuficiența mijloacelor finanicare	12 USD/m2	ODD: 7 ODD: 13	Creșterea capacității de a face față schimbărilor extreme de temperatură	
Reducerea consumurilor primare de energie predestinat incîlzirei și/sau răcirii spațiilor	Insuficiența mijloacelor finanicare	100 USD/m2	ODD: 7 ODD: 13	Creșterea capacității de a face față schimbărilor extreme de temperatură	
Imbunatațirea climatului interior	Insuficiența mijloacelor finanicare	1400 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Imbunatațirea climatului interior	Costuri ridicate a tehnologiei	150 000	ODD: 7 ODD: 13	Creșterea capacității de a face față schimbărilor extreme de	
Micșorarea ponderii resurselor energetice în pretul final al produslui	Costuri ridicate a tehnologiei	2400 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	
Micșorarea ponderii resurselor energetice în prețul final al produslui	Lipsa voinței din partea companiilor mari energoface	6000 USD	ODD: 7 ODD: 13	Îmbunătățirea eficienței energetice	

Table 2 Roadmap regarding the implementation of three technologies in the energy sector

TNA Technological Needs Assessment

Project Name	NAP-2	Sector	Energy
National Consultant	Mihai LUPU		

Name of technology: Monocrystalline photovoltaic panels

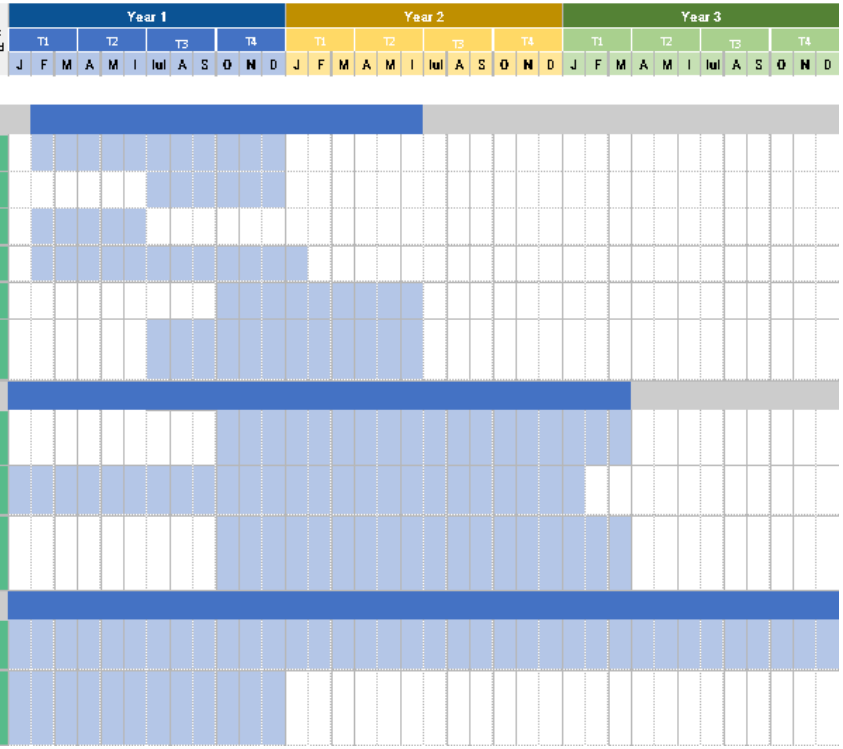
Climate impact: Decrease in electricity and thermal energy production due to lack of water at CET and CHE, as a result of droughts

Adaptation Objective: By 2030, substantial increase in the share of renewable energy in the global energy mix

SDG:7 Clean and accessible energy

OS 5.2 Increasing the resilience of the Energy sector through climate investments and reducing the risk of climate hazards

Nr.	Actions/Activities	Responsible Institutions	Start	Finish	Duration (months)	Percent Achieved
1	**Action: Development of the secondary normative regulatory framework**					
1,1	Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	Ministry of Energy, NAER	01.01.2023	31.12.2023	12	0%
1,2	Annual operation of amendments to the Fiscal Code regarding exemptions from import and customs duties of photovoltaic technologies	Ministry of Energy, MF	01.06.2023	31.12.2023	6	0%
1,3	Operation of changes in the Electricity Networks Code	ME, NAER	01.01.2023	01.06.2023	6	0%
1,4	Certification and quality verification of products (photovoltaic systems) imported or produced in the country	National Center of accreditation, NIM	01.01.2023	01.01.2024	12	0%
1,5	Revision and transposition of standards for photovoltaic technologies	NIM, Ministry of Agriculture	01.10.2023	01.06.2024	9	0%
1,6	Development of plans for the expansion of the electricity distribution and transmission networks based on the regional photovoltaic potential	TSO, DSO, NAER	01.06.2023	01.06.2024	12	0%
2	**Action: Development of institutional capacities and training of specialists**					
2,1	Development and accreditation of training and continuous training programs a photovoltaic specialists	TUM/CCL, CEEE	01.09.2023	31.03.2025	18	0%
2,2	Purchase of specialized software or electricity forecasting services products based on photovoltaic technologies and training	The producers of e RES	01.01.2023	31.01.2025	25	0%
2,3	The development of specialized programs regarding the identification of photovoltaic potential and the training of specialists in the development of feasibility studies	Ministry of Energy, Foreign donors, Private sector, DSO, TSO	01.09.2023	31.03.2025	18	0%
3	**Action: Increasing financial accessibility**					
3,1	Dedicated credit lines through commercial banks and programs of the state regarding the financing of projects based on photovoltaic technologies	ME, EEA, AIPA, EDD, AADM	01.01.2023	31.12.2025	36	0%
3,2	Development of subsidy tools for photovoltaic installations	Ministry of Energy, Ministry of Labor and of Social Protection, EEA	01.01.2023	01.01.2024	12	0%



Success indicators	Risks	Estimated costs, USD	Funding sources
The launch of the fixed price support scheme with the approval of the regulation	Delay in approval of the regulatory framework	16 000	State Budget, Foreign Donors
Promotion of exemptions and import duties for photovoltaic technologies	The insufficiency of budgetary financial means to operate the	3 000	The State Budget
Harmonization of the regulatory framework with that of the EU	Delay in the approval process due to lengthy coordination with stakeholders	42 000	Foreign donors
Development of a mechanism for certification of photovoltaic systems at local level	Insufficiency of financial means	1 500 000	State Budget, Foreign Donors
Transposition of international standards in the secondary regulatory framework	Delaying the transposition process through the passive activity of the	15 000	The State Budget
Well-planned network infrastructure	Lack of a map of the photovoltaic potential in the country	120 000	OST, OST and APL budget
Increasing the training capacities of installers and service specialists	Insufficiency of qualified teachers	15 000	The budget of UTM, CEEE, Foreign Donors
Reduction of electricity imbalances within the balancing group	Insufficient financial means from the private sector	300 000	Private companies, Foreign donors, Energy suppliers
Harnessing the energy potential	Lack of truthful input data from the hydrometeorological service	230 000	Private companies, Foreign donors
Increasing the capacities installed in the country	High bank rates	16 000 000	Commercial Banks, ME, AEE, AIPA, ODA, ADMA, Foreign Donors
Increasing the number of people willing to invest in such technologies, especially the residential sector	System maintenance by the state	300 000	Ministry of Energy, Ministry Labor and Social Protection, Foreign Donors, local finance funds

Name of technology: Ground-water heat pumps

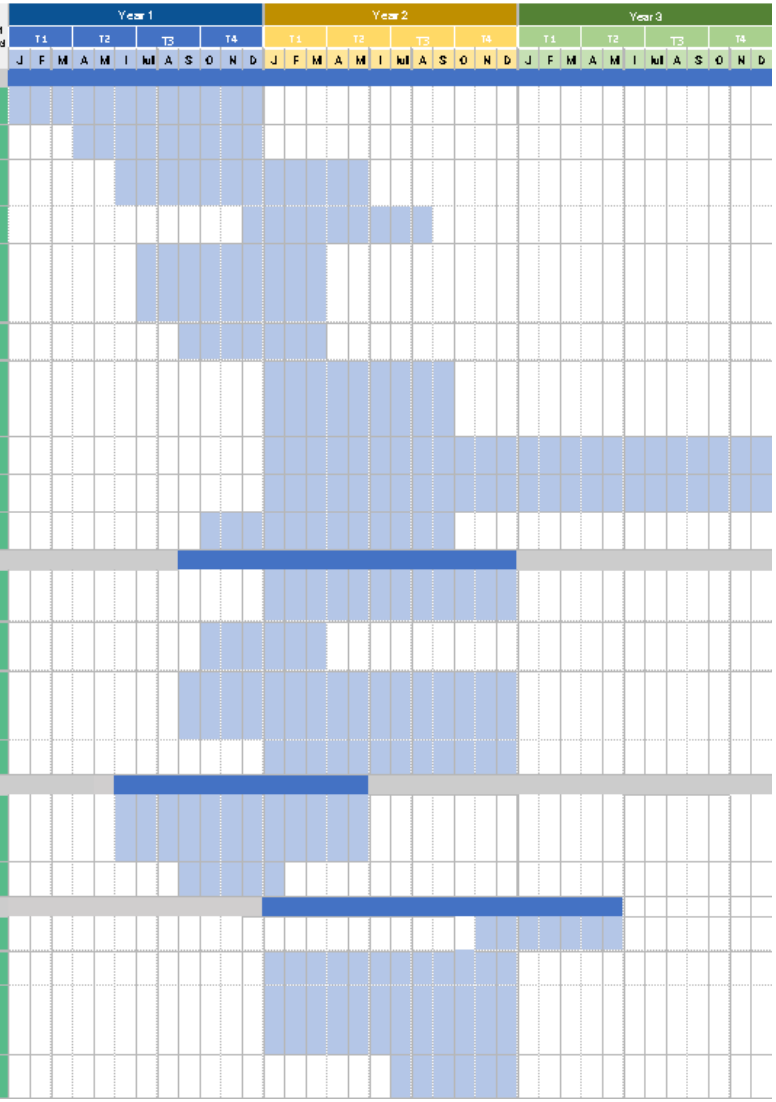
Climate impact: Decrease in electricity and thermal energy production due to lack of water at CET and CHE, as a result of droughts

Adaptation Objective: By 2030, doubling the global rate of energy efficiency improvement

SDG: 7 Clean and accessible energy

OS 5.2 Increasing the resilience of the Energy sector through climate investments and reducing the risk of climate hazards

Nr.		Actions/Activities	Responsible Institutions	Start	Finish	Duration (months)	Percent Achieved
	1	**Action: Development of normative regulatory framework**					
	1,1	Updating the energy strategy of the Republic of Moldova	Ministry of Energy, MF	01.01.2023	31.12.2023	12	0%
	1,2	Updating the law on the energy performance of buildings	Ministry of Energy, MF	01.04.2023	31.01.2024	9	0%
	1,3	Development of local energy and environmental action plans	MIRD, EEA, MF, Alliance for Energy Efficiency and	01.06.2023	31.05.2024	12	0%
	1,4	The development of standards in the construction of heat pumps soil-water	Ministry of Energy, Private Sector	01.12.2023	31.08.2024	9	0%
	1,5	The annual operation of the changes in the Fiscal Code regarding exemptions from import and customs taxes of heat pump technologies	Ministry of Energy, MF	01.06.2023	31.03.2024	9	0%
	1,6	Medium-term budgetary framework (MTBF) update	Ministry of Energy, MF	01.09.2023	31.03.2024	7	0%
	1,7	Modification of the regulatory framework in construction regarding the issuance of permissive documents	Ministry of Energy, Employers' Associations in the field of Constructions	01.01.2024	01.09.2024	9	0%
	1,8	Ensuring the product equipment quality certification procedure	CMAC APCSP	01.01.2024	31.12.2025	24	0%
	1,9	Establishment of a heat pump testing laboratory	CAMA, TUM	01.01.2024	31.12.2025	24	0%
	1,10	Revision and transposition of standards for heat pump technologies	ME, Ministry of Energy, NIS	01.10.2023	30.09.2024	12	0%
	2	**Action: Development of financial instruments and promotion of technology**					
	2,1	Development of subsidy tools for heat pump installations	Ministry of Energy, EEA, Ministry of Labor and Social Protection	01.01.2024	31.12.2024	12	0%
	2,2	Dedicated credit lines through commercial banks and state programs regarding the financing of projects based on heat pump technologies	EEA, EDO	01.10.2023	31.03.2024	6	0%
	2,3	Development of ESCO type company models	Ministry of Energy, EEA, Private Environment	01.09.2023	31.12.2024	16	0%
	2,4	Mediatization and promotion of heat pump technologies EEA, mass media institutions	EEA, mass media institutions	01.01.2024	31.12.2024	12	0%
	3	**Action: Increasing the institutional capacities for the training of specialists**					
	3,1	Development and accreditation of training programs and continuous training of specialists in the field of geothermal installations and heat pumps	TUM, CCL, CEC	01.06.2023	31.05.2024	12	0%
	3,2	Establishing a laboratory for spending practical hours of students from educational institutions	EEA, educational institutions	01.09.2023	31.01.2024	5	0%
	4	**Action: Development of geothermal potential in the Republic of Moldova**					
	4,1	Elaboration of a study on the geothermal potential in the Republic of Moldova	Ministry of Energy, EEA	01.11.2023	30.04.2024	7	0%
	4,2	Development of interactive maps with the identified geothermal potential	Ministry of Energy, EEA	01.01.2024	31.12.2024	12	0%
	4,3	Development of a study regarding the identification of buildings that can benefit from ground-water heat pump technology	Ministry of Energy, EEA	01.01.2024	31.12.2024	12	0%
	4,4	Specialized heat pump sizing software	Ministry of Energy, EEA	01.06.2024	31.12.2026	6	0%



Success indicators	Risks	Estimated costs, USD	Funding sources
Establishing the long-term objectives of the energy sector towards the year 2050	Delaying the approval of the normative act	40 000	State Budget, Foreign Donors
Harmonization of the regulatory framework with that of the EU	Delaying the approval of the legislative act	20 000	State Budget, Foreign Donors
Promoting the most energy efficient and climate change adaptive technologies at the local level	Low interest from LPAs at development of Plans	420 000	State Budget, Foreign Donors
Increasing the quality of construction works	Insufficient financial means	3 500	State Budget
Promotion of exemptions and import taxes for heat pump technologies	Insufficiency of budgetary financial means to operate the tax and customs exemptions of the technology	3 000	State Budget
Well-defined budget structure	Lack of financial means available from the state budget	4 000	State Budget
Reduction of permissive acts in the field of constructions	The risk of not promoting this initiative	3 000	State Budget
Reduction of permissive acts in the field of constructions	Insufficiency of financial means available from the state budget	12 000	State Budget
Establishment of a heat pump testing laboratory	Lack of available financial means	75 000	State Budget
Transposition of international standards into the secondary regulatory framework	Procrastination of the process of transposition through the passive activity of the technical committees	20 000	State Budget
The increase in the number of people willing to invest in such technologies, especially the residential sector	Low interest on the part of the state to develop such tools	50 000	State Budget, Foreign Donors
Increasing the number of projects that apply soil-water heat pump technology	High bank rates	20 000	Private companies, Foreign donors, Commercial banks
Reducing the financial burden of public institutions	Annual budget planning for public institutions do not allow the transfer of unused financial means from one year to another	40 000	Private companies, Foreign donors
Promoting by examples the best national and international practices	Misperception of the messages transmitted in society	15 000	State Budget, Foreign Donors
Increasing the training capacities of specialists	Lack of qualified teachers	30 000	State Budget
Increasing the practical professional skills of specialists in the field	Lack of financial means	70 000	Foreign Donors
Informing public opinion about the geothermal potential of the country	The insufficiency of the input data for the elaboration of the study	70 000	ANCD, Foreign Donors
Support for end beneficiaries in identifying the best sites with geothermal potential	Insufficient input data to develop the interactive map	320 000	ANCD, Foreign Donors
Buildings identified as potential for the use of ground water heat pump technologies	Lack of statistical data regarding the current use of ground-water heat pump technology in the private sect	60 000	ANCD, Foreign Donors
Support for potential beneficiaries and design and installation companies	Insufficiency of financial means	25 000	ANCD, Foreign Donors

Name of technology: Wind turbines with horizontal axes
Climate impact: Decrease in electricity and thermal energy production due to lack of water at CET and CHE, as a result of droughts
Adaptation Objective: By 2030, substantial increase in the share of renewable energy in the global energy mix
SDG:7 Clean and accessible energy
OS 5.2 Increasing the resilience of the Energy sector through climate investments and reducing the risk of climate hazards

Nr.		Actions/Activities	Responsible Institutions	Start	Finish	Duration (months)	Percent Achieved
	1	**Action: Development of the normative regulatory framework**					
	1,1	Development and approval by the Government of the Republic of Moldova of the Regulation on Capacity Auctioning	Ministry of Energy, NAER	01.01.2023	31.12.2023	12	0%
	1,2	Update of Law 10/2016 on renewable energy sources	Ministry of Energy	44986	31.12.2023	10	0%
	1,3	The annual operation of the changes in the Fiscal Code regarding exemptions from import taxes and customs of wind technologies	Ministry of Energy, MF	45292	30.06.2024	6	0%
	1,4	Modification of the regulatory framework in construction regarding the issuance of permissive documents	Ministry of Energy, Employers' Associations in Construction field	01.06.2024	31.12.2024	7	0%
	1,5	Operation of changes in the Electric Networks Code	Ministry of Energy, MF	01.06.2023	31.12.2023	7	0%
	1,6	Revision and transposition of standards for wind technologies	Ministry of Energy, ISM	01.01.2024	31.12.2024	12	0%
	2	**Action: Development of institutional capacities and training of specialists**					
	2,1	Development and accreditation of training programs and continuous training of specialists who maintain, develop and exploit wind technologies	Academic environment, EEA, MEC	01.06.2024	30.06.2025	13	0%
	2,2	Development of training programs regarding the training of development specialists Ministry of Energy, feasibility studies	Ministry of Energy, Academic environment	01.01.2024	31.12.2024	12	0%
	2,3	Organization of training or workshops for wind producers to facilitate access to the electricity market	Ministry of Energy, Academic environment	01.06.2023	30.05.2024	12	0%
	2,4	The development of specialized software for forecasting electricity produced based on wind technologies	Ministry of Energy, Central Energy Supplier Suppliers	01.06.2023	31.12.2023	7	0%
	3	**Action: Increasing financial accessibility**					
	3,1	Dedicated lines of credit through commercial banks and state programs for financing projects based on wind technologies	Ministry of Energy, MF, EEA	01.01.2024	30.06.2025	18	0%
	3,2	Media coverage and promotion of new wind technologies	EEA, mass media institutes	01.06.2023	31.12.2024	19	0%

Success indicators	Risks	Estimated costs, USD	Funding sources
The launch of the fixed price support scheme with the approval of the regulation	Delay in approval of the regulatory framework	20 000	State Budget, Foreign Donors
Taking over the best European practices in the field of renewable energy sources	Delay in approval of the regulatory framework	20 000	State Budget, Foreign Donors
Promotion of exemptions and import taxes for wind technologies	Insufficiency of financial means budget to operate technology tax and customs exemptions	3 000	State Budget
Reduction of permissive acts in the field of constructions	The risk of not promoting this initiative	4 000	State Budget
Harmonization of the regulatory framework with that of the EU	Procrastination of the approval process due to lengthy coordination with stakeholders	60 000	TSO OSD Budget, Foreign donors
The transposition of international standards in the secondary regulatory framework	Delaying the transposition process through the passive activity of the technical committees established by the ISM	15 000	State Budget
Increasing the training capacities of installers and service specialists	The insufficiency of teaching qualified staff	30 000	UTM Budget, CEEE Foreign Donors
Increasing the institutional capacities of the private environment	Lack of teachers at the local level	30 000	Foreign donors, Private sourcese
Increasing institutional capacities in the private sector	Low interest from the private sector	50 000	Foreign donors, Private sourcese
Reduction of electricity imbalances within the balancing group	Insufficient financial means from the private sector	300 000	Private companies, Foreign donors, Energy suppliers
Increasing installed capacities in the country	High bank rates	50 000 000	Commercial banks, Foreign donors
Promoting by example the best practices national and international	Lack of financial means	18 000	The state budget, foreign donors

CONCLUSIONS

This report has been prepared based on the standard template on the Assessment of Technological Needs in the Energy Sector in the Republic of Moldova. It is composed of three chapters and a roadmap on the implementation of nationally selected technologies.

The first chapter of the report describes the current situation in the sector, highlights the role of the responsible institutions in the energy sector, as well as identifies the sector's vulnerabilities to climate change. Persistent extreme phenomena in Moldova were mentioned, such as storms, frost deposits, temperatures that make the sector vulnerable to climate change.

During the preparation of the report, a sectoral working group was set up, which assessed and prioritized the technologies. The working group was attended by representatives of specialized central public authorities, representatives of state agencies and institutions, academia, as well as the private sector. Their activity was coordinated by the team leader and the national consultant responsible for the activity. The national consultant has developed 23 technology sheets specific to the energy sector. These were consulted in the working group, which were divided into sub-sectors and responded to 3 climate impacts. Subsequently, based on the evaluation criteria developed and the consultations with the working group, three technologies were prioritized, which respond to the sector's adaptation process to climate change. These are: photovoltaic technologies, heat pumps and wind installations.

In the second chapter of the report, the barriers and permissive framework of the selected technologies were developed and analyzed. They were divided into three categories: economic, financial and non-financial. Subsequently, they were prioritized and appreciated according to their degree of importance, very important, important and less important. Based on the decision of the sectoral working group, the problem tree for each individual technology and the necessary measures to be taken to overcome them were developed. The market mapping was also done individually for each technology based on three basic aspects, such as the permissive environment of technologies, market actors or players and market services offered at the moment.

In chapter three of the report, the action plan and project ideas for the prioritized technologies were developed. Activities relevant to the actions, their implementation periods, the identification of the responsible institutions, the establishment of their budgets and possible sources of financing of the actions were developed. The activities developed under each action are interconnected and correspond to an environment that allows the achievement of the targets specified by each technology, including sector-relevant results.

Based on the above, we can conclude the following:

- The selected technologies provide an adequate response to the phenomenon of adaptation of the energy sector to climate change.

- The sectoral portfolio of technologies will contribute to the achievement of the Global Sustainable Development Goals and the sector-specific objectives on adaptation.

- The selected technologies will contribute to the achievement of the ambitious objectives of adapting the energy sector to climate change.

- The selected technologies will significantly contribute to increasing the country's energy security and reducing energy poverty among the population. They will lay the foundations for the diversification of alternative energy sources and the reduction of the import of foreign energy resources.

- By implementing the action plan and the proposed measures, a favorable climate for the promotion of technologies will be ensured both at the level of public institutions, the private sector, and in the residential sector.

- Bank interest rates in the Republic of Moldova are still relatively expensive to promote technologies on a relatively high scale. In this regard, attracting financial means from development partners will play an essential role in the implementation of technologies.

- Due to the regional geopolitical situation, the logistics and import chain of technologies has been strongly affected. New interventions are needed in identifying import routes and developing a new logistics chain for transport companies.

- The institutional reforms of the Ministry of Energy and the Energy Efficiency Agency can significantly affect the action plan on the expansion of technologies on a relatively high scale at national level.

- Gender issues are to be addressed at different levels in the promotion of technologies. Starting from the fact that women represent the majority of employees in institutions such as schools, kindergartens, including the residential sector, they will equally benefit from their advantages of matching men.

RECOMMENDATIONS

In order to successfully implement the action plan on promoting technologies for adaptation of the energy sector to climate change, the recommendations developed are made to the management of the TNA 2 project, but also to the central authorities responsible for this field:

- The TNA 2 project management will inform, and where appropriate will make available to the specialized central public authorities, results from the assessment of technological needs for adaptation of the energy sector to climate change.

- To initiate and organize working session with the relevant ministry to facilitate the implementation of the action plan developed in this document.

- The specialized public authority shall examine and take over the activities proposed in the action plan and shall undertake measures to achieve it.

- The relevant Ministry will facilitate communication and exchange of information with the parties involved and responsible for actions to promote selected technologies.

- According to the case, it will take into account the concept of project proposal outlined in this document and will propose them for development to donors and development partners.

- The central public authority shall accelerate the reorganization process of the institution which is responsible for the implementation of policies and the promotion of renewable energy sources.

- In its last turn, will undertake appropriate measures and information campaigns, on the promotion of technologies analyzed on a sufficiently large scale.

- In common with commercial banks, the public authority responsible for implementing energy efficiency policies will identify ways to reduce bank interest rates in order to facilitate and replicate selected technologies on the local market.