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Market research of innovative technologies for EE and climate protection in historic buildings and areas in Republic of Moldova

CROSS BORDER COOPERATION

CONTENT

LIST OF ABBREVIATIONS

EE	Energy efficiency
RE	renewable energy
ME	Ministry of Economy
EEA	Energy Efficiency Agency
EEF	Energy Efficiency Fund
PNAEE	Planul Național de Acțiune în domeniul Eficienței Energetice
PNAER	Planul Național de Acțiune în domeniul Energiei Regenerabile
PNEE	Programul Național de Eficiență Energetică
ER	energy resources
RES	Renewable energy sources
TOE	Tons of oil equivalent
EU	European Union
GES	Gaze cu efect de seră
K sau U	global heat transfer coefficient

MOLDOVA

INTRODUCTION

The economic development has been reflected also in the inevitable energy consumption increase, accompanying all the processes of economic and social life.

In consumer societies, the energy efficiency is becoming increasingly acute issue, which means that the superiority of an economy is not demonstrated only by the amount of energy consumed but by the way it is used, which is related to the level of culture and civilization. Energy issues are mutually related to those of the raw materials used in the power circuit.

Energy production depends on the existence of specific resources (fossil and mineral fuels), and their extraction and processing requires energy consumption.

The development of energy systems over the last decades is conditioned by some factors:

Oil reserves are estimated at 162 billion tons and could provide global consumption for a 40-41 year period.

Natural gas reserves are estimated at almost 175,000 billion m^3 and can provide global consumption for a period of 65 to 67 years.

The coal reserves are nearly 1,000 billion tons and the insurance duration: 160-170 years.

Economic, social and political limits. Rising prices, especially for oil, leads to the dropping of certain consumption. The most affected are developing countries that do not have the financial resources to buy them at prices above $ 30 / barrel.

Increasing pollution from the combustion of the atmosphere. Most of the primary commercial energy is given by fossil fuels: 40% oil, 23% natural gas, 27% coal. Carbon emissions are higher by 44% for oil and 75% for coal compared to natural gas and it is estimated that annually about 6 billion tons of carbon are lost in the atmosphere.

At present, mankind faces a technical challenge in capturing energy and supplying it to consumers; and one of the most effective ways we can meet this challenge is investing in better ways to conserve and use energy.

The global energy crisis has been aggravated by the lack of innovation. According to a US Government Lawrence Livemore government study, over 60% of energy is lost on the way from generation to consumption. This category includes:

- inefficiency in the conversion of fossil fuels into electricity,
- transport losses,negligent behavior of consumers, etc.

Under these circumstances, a new wave of innovation is needed to eliminate losses, reduce pollution and facilitate access to energy across the globe. This involves focusing on following technologies that increase energy efficiency:

- High performance equipment and technologies;
- Smart measurements;
- Better product management;

The main national priorities of all countries are aimed at:

- The national security of the country's energy supply, including the production of energy from renewable sources and, in particular, the use of solar energy;
- Environmental safety;

Renewable energy sources, including solar and wind power, can help meet energy needs.

The energy from these sources is unstable:

- The sun does not always shine;
- The wind does not always blow;

Solution: Effective power storage from renewable energy sources.

New Energy Policy of the European Union

Green Card on Energy Efficiency - A European Strategy for Sustainable, Competitive and Secure Energy - Energy Strategy for the European Union in the Perspective of 2030

- The analysis of the present situation highlighted some important conclusions:
- The current EU primary resource consumption is: 41% oil, 22% natural gas, 16% coal, 15% renewable
- energy, 6% renewable energy. The European Union's existing energy dependence on external sources is 50%;
- The current energy options of the European Union are characterized as follows: nuclear energy - "a
- controversial source", coal - "a glorious past", oil - "still favorite", natural gas - "to a new addiction", new and renewable sources - a political priority ";
- In terms of environmental impact, 94% of CO2 emissions are due to energy and transport activities;
- There is an urgent need for investment. Only in Europe, to meet the forecast for energy demand and to
- replace obsolete infrastructure, over the next 20 years, some € 1,000 billion will be needed;
- Energy efficiency policy is a component of both the European Union's energy security policy and the European Union's policy on climate change;
- The new Energy Policy of the European Union is based on three fundamental ideas:
- Demonstrate that the objectives already set at Community level in the field of energy can not be attained with current policies, and that these policies need to be reviewed;
- To propose a strategic objective that will form the basis for all subsequent energy policy decisions;
- To propose a concrete action plan to achieve the strategic objective.

The proposed overall objective also has an effect on long-term energy security. Achieving this goal will reduce Europe's exposure to the volatility of fossil energy prices, stimulate the development of domestic electricity and natural gas markets, and encourage technological development.

The European Commission proposes the following objectives in the set of documents representing the European Union's New Energy Policy:

- Reducing greenhouse gas emissions by 20% by 2020, compared to 1990; with 30% discount until 2030

and 60 - 80% discount until 2050;

- Increasing the share of renewable energy sources in the total energy mix from less than 7% in 2006 to 20% of the EU's total energy consumption by 2020;
- Increasing the share of biofuels by at least 10% of the total energy content of transport fuels in 2020;
- reducing global primary energy consumption by 20% by 2020;

Thus, given the consequences of climate change, growing dependence on fossil fuels and rising energy prices, the development of renewable energy sources is one of the primary objectives of EU energy policy. The use of RES (solar, wind, photovoltaics, biomass, biofuels and geothermal) will reduce fossil fuel consumption by 200-300 million tonnes per year, thus reducing carbon dioxide emissions by 600-900 million tons per year.

The European Commission as a result of the 2007 assessment of the progress made in the development of RES has reached several important conclusions:

- The European Union remains the world leader in wind power, accounting for 60% of the world's electricity production from this source;
- Energy from biomass accounts for 2% of the total EU electricity consumption;
- The total photovoltaic power installed in the European Union has been steadily rising over the past five years, with an average annual growth rate of 70%.

The European regulatory framework

At present, the European Union and most of its countries are among the countries with the highest energy efficiency, the energy intensity of which is approx. 10 MJ / Euro, or approx. 7.75 MJ / US $, which is over 3 times less than in the Republic of Moldova - 31.7 MJ / US $ in 2006.

The EU regulatory framework for energy efficiency adopted in recent years

1. Directive 2001/77 / EC of 27 September 2001 on the promotion of electricity produced from RES in the internal electricity market.

2. Directive 2002/91 / EC of 16 December 2002 on the energy performance of buildings.

3. Directive 2003/30 / EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport.

4. Directive 2004/8 / EC of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42 / EEC.

5. Directive 2006/32 / EC of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76 / EEC.

6. Directive 2009/28 / EC of 23 April 2009 on the promotion of the use of energy from renewable sources, amending and subsequently repealing Directives 2001/77 / EC and 2003/30 / EC.

7. Directive 2010/31 / EU of 19 May 2010 on the energy performance of buildings.

Directiva 2006/32/CE a Parlamentului European şi a Consiliului din 5 aprilie 2006 privind eficienţa energetică la utilizatorii finali şi serviciile energetice

The purpose of this Directive is to strengthen the improvement of energy end-use efficiency by:

- The provision of the necessary indicative targets as well as mechanisms, incentives and institutional,

Financial and legal frameworks to remove barriers and imperfections on the market that hinder the efficient use of energy;

- Creating the conditions for developing and promoting a market for energy services and providing end-users with other energy efficiency improvement measures;

According to Directive 2006/32 / EC:

- Energy audit is designed as a tool to identify potential measures to improve energy efficiency.
- End consumers of electricity, gas, district heating and / or cooling and district heating are equipped with

Individual meters at competitive prices which accurately reflect the actual energy consumption of final consumers.

European Directive 2010/31 / EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

The Directive promotes the improvement of the energy performance of buildings within the EU taking into account outdoor climatic conditions and local conditions, as well as indoor climate and cost-effectiveness requirements.

European Directive 2010/31 / EU clarifies, extends and strengthens the scope of the current Directive 2002/91 / EC in particular by:

- the extension of the scope of the provision requiring S.A. define minimum energy performance Requirements for new buildings and major renovation work;
- strengthening the provisions on energy performance certificates, control of heating and air conditioning systems, information and independent experts.;
- encouraging Member States to develop frameworks and targets to increase the percentage of low or zero energy buildings ("Net Zero Energy") or low or zero carbon emissions;
- giving up the 1000 m.p. for the obligation to improve the energy performance of existing buildings, which means that with the entry into force of the new Directive all buildings under major renovation, regardless of size, will have to improve their energy performance;
- introducing minimum energy performance requirements for minor renovations (including windows, doors, roofs);
- the requirement for all new buildings to have net energy consumption close to zero as of December 2020; new public buildings will comply with this standard starting in 2018.

Technical systems of buildings (Article 8)

In order to optimize the use of energy by building technical systems, system requirements for overall energy performance, adjustment and control of the technical systems of buildings installed in existing buildings are set. System requirements are set for new technical building systems to replace and improve these systems.
These system requirements shall address at least the following:

- heating systems;
- hot water systems;
- air conditioning systems;
- large ventilation systems;

Buildings with energy consumption is almost zero (Article 9)

Member States shall ensure that:

- by 31 December 2020, all new buildings will be buildings whose energy consumption is almost equal to zero; and
- after 31 December 2018, new buildings occupied and held by public authorities are buildings whose energy consumption is almost equal to zero

Energy Performance Certificates (Article 11)

The directive provides for the certification of the energy performance of buildings to provide information on the energy quality of a building and the improvements that can be made.

European Directive no. 2009/28 / EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (biomass, wind, solar, hydro and biofuels), **amending and subsequently repealing Directives 2001/77 / EC and 2003 / 30 / EC.**

It establishes a common framework for the promotion of energy from renewable sources. The Directive also sets national targets binding for each Member State on the overall share of energy from renewable sources in gross final consumption of energy and the share of energy from renewable sources used in transport.

States will have the duty to increase production and use of renewable energy in three sectors: **electricity production; heating and cooling; shipments.** In each country, biofuels and other renewable fuels should account for 10% of the transport fuel.

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ENERGY EFFICIENCY POLICIES DEVELOPED BY THE REPUBLIC OF MOLDOVA DOCUMENT ANALYSIS

The energy complex is a basic branch of the national economy and fulfills an important role in the successful implementation of the economic development programs as well as in maintaining social stability.

Now, when the situation in the native energy complex continues to be tense due to the increasing the prices of imported energy resources, the total lack of local energy resources and the import dependence in the amount of about 96%, the low energy efficiency (it is 2.6 times lower than in the EU), the more than the reduced use of RES, advanced wear and tear in energy equipment, etc., a new direction is needed for the national economy, similar to the world one, requiring the creation and development of strategic mechanisms and levers to deal with the dependence of the country energy efficiency and, as a result, increased energy efficiency.

As a result of the economic and financial situation that has been created on a global scale and in the Republic of Moldova simultaneously, the issue of energy security of the state remains a primordial one.

To meet these challenges, the RM has developed its own National Energy Efficiency Program for the years 2011-2020. The overall objectives of the Program, designed in line with the Community targets in the field and set for the 2020 horizon, are:

- The Energy Strategy of the Republic of Moldova until 2030 approved by the GD no. 102 of 05.02.2013
- Law on Energy No. 1525-XIII of 19.02.1998
- The Law on Electricity Nr. 107 of 27.05.2016
- Law on Natural Gases No. 108 of 27.05.2016
- Law on thermal energy and promotion of cogeneration Nr.92 of 29.05.2014
- Petroleum Product Market Law No.461-XV of 30.07.2001
- Law amending Law no. 461/2001 on the petroleum products market Nr. 152 of July 20, 2018
- Law on Accession to the Energy Community Treaty, No. 117 of December 23, 2009
- Law on Renewable Energy No. 160-XVI of 12.07.2007
- Law on Energy Efficiency Nr. 139 of 19.07.2018
- National Energy Efficiency Program 2011-2020 - Government Decision No. 833 of 10.11.2010
- National Renewable Energy Action Plan by 2020
- NCM E.04.01–06 Thermal protection of buildings
- SNiP 2.04.05–91 * Heating, ventilation and air conditioning
- SNiP 2.01.01–82 "Building Climatology and Geophysics", 1982
- NCM E.04.03–08 Conservarea energiei în clădiri
- SNiP II. 3 - 79 * "Construction Heat Engineering". The Institutional Framework for Energy Efficiency and Renewable Energy
- Central public authorities and its specific subdivisions (ME, State Energy Inspectorate, etc.)
- Autonomous Agencies: National Agency for Energy Regulation (ANRE), Energy Efficiency Agency (EEA)
- Funds (Energy Efficiency Fund)

- Academic and scientific institutions (Institute of Energy of the ASM, TUM, etc.)
- Local Council on EE. Powers of the mayor

ENERGY STRATEGY OF THE REPUBLIC OF MOLDOVA UNTIL 2030

The vision of the RM in the field of energy system development is exposed until 2030 and reflects the country's priority problems, which require quick solutions and a re-dimensioning of the objectives in line with the need to achieve an optimal balance between internal resources (both currently used and the objectives of the EU and the Energy Community, and the national targets, international obligations on treaties, agreements and programs to which the RM is a member.

The main objectives of the strategic document are:

1. Security of energy supply
2. Creating competitive markets and their regional and European integration
3. Environmental sustainability and combating climate change

The energy strategy of the RM envisages 2020 as the year of full integration into the EU's internal energy market. In line with this objective, the country's legislation will be timely harmonized with the legislative framework and the Energy Community Policies .

In the context of the development of the energy sector, the National Action Plan for Energy Efficiency for the years 2013-2015 is implemented. This plan is to ensure the implementation of the Energy Efficiency Law no. 142 of 02.07.2010. The plan is based on the National EE Program 2011-2020, which sets the general framework for long-term objectives, to be supported every three years and provides for priority actions and measures to achieve the 9% energy savings target 2016 and the national target of 20% energy savings by 2020. The energy strategy of the Republic of Moldova until 2030 offers concrete benchmarks for the development of the energy sector.

The general strategic objectives for the period 2013-2030 and the specific strategic objectives for the 2013-2020 and 2021-2030 phases are defined, specifying the measures for their implementation.

SPECIFIC STRATEGIC OBJECTIVES FOR THE PERIOD 2013-2020 AND RELATED MEASURES

Objective # 1. Ensuring the security of natural gas supply by diversifying supply routes and sources, carrier types (conventional, unconventional gas, liquefied natural gas) and storage facilities.

In the natural gas sector. Analyzing and capitalizing on the alternative ways of supplying and exploiting natural gas, including the reversible connection of the natural gas transmission system with the EU gas pipeline system.

Objective # 2. Strengthening the role of the RMin the electricity transit corridor by building new interconnection lines, connecting to the ENTSO-E system and strengthening the internal electricity transmission network.

In order to meet the objective of connecting the national electricity grid and natural gas transmission system to the EU systems, the financing of related projects will be ensured by: grants, long-term credits, participation of private investors, etc.

Objective # 3. Create a powerful platform for generating electrical and thermal energy through upgrading, efficient central heating and efficient marketing.

For the formation and consolidation of the generation platform, three main directions were identified development:

- cogeneration,
- renewable energy sources,
- thermoelectric power plants (MGRES). MGRES and CHPs in Chisinau require re-technology to increase the efficiency of the first one, or to replace them in the case of cogeneration plants, given the extremely high cost of electricity produced by them.

Objective # 4. Improving energy efficiency and increasing the use of RES.

The main measures to be implemented to improve energy efficiency include: creation of centralized heat supply systems; Installing Individual Heat Points;the acquisition and prioritization of electricity generated by CHPs; performance measurement systems and heat and energy devices;

- Labeling of all electrical devices, according to their energy efficiency class, energy consumption and noise level; energy-efficient buildings etc; developing educational programs to raise public awareness etc.

Objective # 5. Ensuring the legislative, institutional and operational framework for real competition, effective opening of the market, setting the price for energy in a transparent and equitable manner, integration of the energy market of the RM into the EU internal market.

The regulatory framework will define price mechanisms in line with the free market framework. Despite the liberalization of the market, a still significant market share will come under regulated prices through the introduction of support schemes for RES and for cogeneration in the form of fixed tariffs.

National Energy Regulatory Agency will analyze existing alternatives and decide on the most affordable market alternatives as well as market-oriented solutions. As far as cogeneration is concerned, it can be supported by fixed tariffs set only for a transitional period.

The way of purchasing energy for households by the supplier / suppliers of the last option will comply with the provisions of the national legislation, harmonized with EU directives. The main modalities are buying through public auctions on a competitive wholesale market, combined with the purchase of electricity produced from RES.

Objective # 6. Ensuring the modern and competitive institutional framework for the development of the energy industry.

Following market liberalization, the management of state-owned enterprises will be responsible for using market mechanisms to procure and sell electricity.

SPECIFIC OBJECTIVES OF THE STRATEGY FOR THE 2021-2030 PERIOD AND RELATED MEASURES

Objective # 1. Ensure increased use of RES. Scenarios on the long-term availability of carbon capture and storage technology. During the period 2021-2030 carbon capture and storage technology can become an important driving force for determining the contribution of renewable energy use in the energy mix.

In the case of the RM two scenarios are considered:

- without the development of carbon capture and storage: because technology will never reach the desired economies of scale and promising results;

- a limited development of carbon capture and storage: this scenario involves a limited capacity to store CO2 in Moldova, thus reducing the possible development of projects for generation capacities that would use this technology;

The approach of the RM to developing the use of RES in the first place, the aim of ensuring security of supply.

As a member of the Energy Community, the RM will have to follow and implement certain obligations imposed on the Contracting Parties. These obligations include a provision on the development of an implementation plan for the development of renewable energy generation at national level, covered by Directives 2001/77 / EC and 2003/30 / EC, as subsequently amended by Directive 2009/28 / EC has set a binding target of 20% of renewable sources by 2020.

Objective # 2. Improving energy efficiency

The second stage of improving energy efficiency in the RM after 2020 will be based on: the developed institutional framework, existing infrastructure, practical experience in different industries.

This context will allow the RM to develop a much more sophisticated policy and actions than in the period before 2020.The objective of the RM is to join the EU, which means that the country will necessarily join the EU Emissions Trading Scheme. In this case, the policy on CO2 emissions will become an important factor in the energy efficiency policy in the RM.

Objective # 3. Introducing smart grids

Structure of electricity consumption in the RM: the main consumers of energy resources are household consumers.

Future economic development in the country can and should allow the rapid opening and development of small and medium-sized enterprises. This type of customers, along with household consumers, are small,

dispersed and aspire to better control of energy consumption. The smart grid allows for this type of control to benefit from energy savings and ultimate efficiency of operations.

The Intelligent Network is also a development vehicle for the telemetry and communications system of the network. In most cases, the communications system becomes the basis of the installation.

THE LAW ON ENERGY NO.1525-XIII OF 19.02.1998

The energy sector of Moldova is regulated by the Law on Energy.

The purpose of this law is to create a legal framework to ensure energy efficiency, provide a reliable supply of the national economy and the population with energy resources.

The subject of this law:

- Regulating and monitoring the organizational, economic and financial activity of energy enterprises and organizations, their relations with the central public regulatory authority in the energy sector, central and local public administration authorities with natural and legal persons;
- Setting basic principles for the activity of energy producers, transport companies, energy resource providers, legal and economic relations between suppliers and consumers;

The Law stipulates the functions, structure, activity principle of the NERA as the Authority in charge of regulating and monitoring the energy sector and the attributions of the local public administration authorities.

ELECTRICITY LAW NO.107 OF 27.05.2016

This document comes to transpose the European Union directives for the implementation of the 3rd Energy Package.

The purpose of this law is to establish a general legal framework for organizing, regulating, ensuring efficient operation and monitoring the electricity sector aimed at supplying consumers with electricity.

LAW ON NATURAL GAS NO. 108 OF 27.05.2016

The purpose of this law: it mostly describes the normative framework in the field of natural gas. The analysis of these documents highlights the following objectives of the state in this field: ensuring a wide competition on the natural gas market, the ultimate goal being to increase the efficiency of the gas system; separating the production, transport, distribution and supply activity of natural gas in accordance with the Energy Package III, ensuring the environmental protection rules; the reversible connection of the natural gas transmission system with the EU gas pipeline system; interconnection of gas infrastructure between Moldova and Romania.

Regulatory Goals: Natural gas is produced, transported, distributed, stored, delivered and consumed in the most efficient way.

This Law stipulates the administrative and regulatory competences, namely: Government competence, NERA,Competence of the local public administration authorities.

LAW ON THERMAL ENERGY AND PROMOTION OF COGENERATION NR.92 OF 29.05.2014

The purpose of this law is to establish a legal framework for the efficient operation and regulation of centralized heat supply systems in the thermal energy sector, the promotion of cogeneration based on a useful thermal energy demand, the establishment of the principles for carrying out the specific activities and the centralized heat supply , in terms of accessibility, availability, reliability, continuity, competitiveness, transparency, observing the quality, safety and environmental standards for the production, distribution, supply and use of thermal energy.

This law also regulates cogeneration and cogeneration technologies; the promotion of cogeneration and centralized energy-efficient heat supply systems; determination and approval of regulated tariffs for thermal energy.

THE PETROLEUM PRODUCTS MARKET LAW NO.461-XV OF 30.07.2001; LAW AMENDING LAW NO. 461/2001 ON THE PETROLEUM PRODUCTS MARKET, NO. 152 OF 20 JULY 2018

The scope of the present law is the import, transport, storage and marketing of petroleum products with the aim of creating favorable conditions for the internal oil market relations, the reliable supply of quality petroleum products to the consumer, the development of loyal competition and the protection rights and legitimate interests of the consumer.

The Law stipulates the attributions of the NERA on the petroleum products market.

LAW ON ACCESSION TO THE ENERGY COMMUNITY TREATY, NO. 117 OF 23.12.2009

The Republic of Moldova adheres to the Treaty establishing the Energy Community, signed in Athens on 25 October 2005.

Government of the RM:

- Will fulfill the obligations assumed by signing the Memorandum on the conclusion of negotiations between the RM on the one hand and the European Commission acting on behalf of the Energy Community on the other hand with a view to the accession of the Republic of Moldova to the Energy Community signed in Chisinau on 29

April 2009, and specified in the Protocol on the Accession of the Republic of Moldova to the Treaty establishing the Energy Community;

- Shall take the necessary measures to implement the provisions of the proposed treaty.

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THE LAW ON RENEWABLE ENERGY NO. 160-XVI OF 12.07.2007

1.10.1 The subject of this law is the legal framework for the functioning of the energy sector: renewable energy, social and economic relations that constitute the process of capitalizing on renewable energy sources (RES), how to organize the production and marketing of energy and renewable fuels.

1.10.2 Regulatory scope

It regulates RES activities, namely:

- establishes the principles and objectives of state policy in the field; indicates the ways of integrating RES into the national energy system; provides for the correlation of the activities of production, recording, transport, distribution and consumption of energy and fuel from RES;
- identifies the financial resources and the economic and financial mechanism to support the process of capitalizing on RES;

1.10.3 The terms and expressions used for renewable energy are used in the law.

1.10.4 Legal Framework

Activities related to the exploitation of RES are regulated by this law, other normative acts related to the energy field, as well as by the corresponding international treaties to which the RM is a party.

1.10.5 The goal of state policy in the field of RES is to increase the energy security of the state and to reduce the negative impact of the energy sector on the environment.

State policy on RES is implemented in state, branch and local programs.

1.10.6 The objectives of the state policy on renewable energy are as follows:

- ensuring by 2020 the production of about 20% of RES energy.
- in 2020 the volume of bioethanol and gasoline blends and the volume of biodiesel and diesel mix will each account for 20% of the volume of marketed gasoline and diesel;
- the formation of a system for the production, distribution, marketing and rational use of renewable energy and fuel; attracting investment in the field;

1.10.7 The authenticity of the renewable fuel shall be certified by the certificate of conformity issued by the accredited certification bodies in the National System for the Compliance of Products.

1.10.8 State Administration in the Field of Renewable Energy Sources

1.10.8.1 Government attributions.

1.10.8.2 ANRE's attributions:

- approves tariffs for each type of renewable energy and fuel, taking into account the prices of similar products on the international market;

1.10.9 The Renewable Energy Authority is the Energy Efficiency Agency (EEE) - an Energy Efficiency Administrative Body implements state policies in the field of energy efficiency and RES.

1.10.10 Energy Efficiency Fund (EEF). It was created for the purpose of managing financial resources for the promotion and financing of activities in the field of energy efficiency and exploitation of RES in accordance with the strategies and programs elaborated by the Government. The Fund is an independent and financially independent entity. Its activity is regulated by the Law on Renewable Energy and the Regulation on the *Organization and Functioning of the Fund, approved by the Government.*

1.10.11 International collaboration in the field of renewable energy is carried out in accordance with national law and international law.

RES recovery programs are carried out in accordance with international standards in the field. The main directions of international collaboration in the field of ERS capitalization are as follows:

- adjusting the national legislative framework to the provisions of the international normative acts;
- participation in international projects, mutual exchange of information and technology with similar organizations in other countries and with international bodies;

LAW ON ENERGY EFFICIENCY NR. 139 OF 19.07.2018

The purpose of this law is to create the necessary legal framework to promote and improve energy efficiency through the implementation of energy efficiency action plans through the development of the energy services market and the implementation of other energy efficiency measures.

1.11.1 This law establishes policy measures in the field of energy efficiency aimed at achieving the objectives set out below Energy efficiency policy measures apply across the energy chain: primary resources, production, transport, distribution, storage, supply and final energy consumption.

1.11.2 This law regulates activities designed to make it more efficient production and use of energy to increase the country's energy security and to reduce the negative impact of the energy sector on the environment by reducing greenhouse gas emissions.

1.11.3 The basic principles of energy efficiency are:

- promoting energy efficiency by supporting programs to improve energy efficiency, which foresee the implementation of advanced energy generation technologies: cogeneration and trigeneration, distribution, transport and use of energy and fuel by adopting international standards in the field of installations, buildings, appliances and equipment and by monitoring the application of these standards; promoting the private initiative and encouraging the emergence of new energy service providers;
- creating the necessary premises for the development of technical capabilities in connection with the provision of energy services, including in connection with energy auditing and energy management;
- Cooperation with other countries in order to promote high-tech technologies, implementing the advances in science and experience in the field of efficient energy use, etc.

1.11.4. National Goals and policy measures in the field of energy efficiency

State Energy Efficiency Policy and Its Objectives: increasing energy efficiency: a strategic objective of the state's energy policy to improve energy security and competitiveness, save primary energy and reduce greenhouse gas emissions.

National energy efficiency targets are expressed in absolute terms, represent a ceiling for primary and final energy consumption for the entire national economy and are set for a certain time horizon.

State Energy Efficiency Policy is an integral part of state energy policy and aims at achieving the following objectives:

- removing barriers to the promotion of energy efficiency;
- implementation and promotion of high energy efficiency technologies, modern measurement and control systems; use of efficient equipment from the point of view energy view and SER; applying modern energy management principles; promoting energy efficiency mechanisms and financial instruments to achieve energy savings, providing financial and tax incentives under the law; mobilizing investment in building renovation;

1.11.5. National Action Plan for Energy Efficiency

The central specialized body of the public administration in the field of energy elaborates the National Energy Efficiency Action Plan and submits it for approval to the Government.

The National Energy Efficiency Action Plan establishes and describes state energy policy objectives, the Energy Efficiency Obligation Scheme, energy efficiency policy measures, energy savings achieved and expected to be achieved, including at the level of transport, distribution, energy supply or final energy consumption in order to achieve the established national targets.

The Law also provides for administrative powers:

a) Government attributions: establishes the priority directions of state policy in the field of energy efficiency; approves the National Action Plan on Energy Efficiency, the Regulations on Energy Auditors and Energy Audit; on the organization and functioning of the authority responsible for implementing energy efficiency policies, etc.

b) The powers of the central specialized body of the public administration in the field of energy - Ministry of

Economy and Infrastructure, which: develops and promotes state policy and strategies, national action plans, draft laws and draft policy papers, minimum energy performance requirements in the field of energy efficiency and monitors their implementation with the support of the authority responsible for implementing policies in the field of energy efficiency; promotes international relations in the field of energy efficiency and cooperates with international organizations in the field.

c) The authority responsible for implementing energy efficiency policies is an administrative authority subordinated to the Ministry of Economy and Infrastructure as a legal person with treasury and stamp accounts and has the mission to implement state energy efficiency policy, attracting and managing financial resources to fund and promote energy efficiency projects. Tasks in detail are described in Article 12 of this Law.

d) Local government authorities contribute to the achievement of national energy efficiency targets and promote energy efficiency locally. Attributions in detail are described in Article 13 of this Law.

Chapter IV of the Law relates to ENERGY EFFICIENCY IN USE OF ENERGY (Renovation of Buildings).
Chapter V of the Law is related to ENERGY AUDIT AND ENERGY SERVICES.
Chapter VI of the Law relates to ENERGY EFFICIENCY IN THE FIELD OF ENERGY SUPPLY

NATIONAL PROGRAM FOR EE 2011-2020 - GD NO.833 FROM 10.11.2010

Purpose of the National Program

1. The implementation of the provisions of Law no. 142 on energy efficiency, Law of renewable energy no. 160-XVI and Law no. 117-XVIII from for the accession of the RM to the Treaty establishing the Energy Community, and the energy strategy of the RM until 2020.

The program establishes the priority policies and actions to be implemented during 2011-2020, proposes the National Communication Strategy.

2. Increasing energy efficiency by implementing measures to make energy consumption more efficient in the following sectors:

a) the sector of energy transformations, including all the related activities: production of electricity and thermal energy, transport and distribution of electricity, heat and natural gas, as well as the final consumption of all types of energy resources;

b) the industry sector; the construction sector; the transport sector; the public sector.

General objectives

Overall objectives for the base year 2009:

- increase the efficiency of global primary energy consumption by 20% by 2020;
- increasing the share of renewable energy in the total energy mix from 6% in 2010 to 20% in 2020;
- increase the share of biofuels up to about 10% of the total used fuels in 2020;
- the reduction of greenhouse gas emissions by at least 25% by 2020, compared to the base year 1990.

General sectoral objectives:

a. *Electricity sector*: stimulation of investments in electricity production; promoting the production of electricity from RES, etc.
b. *Natural gas sector*: an examination of the National Gasification Program in terms of the opportunities offered by the use of SER; studying the potential and possibility of producing and using biogas for public buildings;
c. *Thermal energy sector*: reduction of losses in transport and distribution networks; valorization of RES for thermal purposes; promoting high-efficiency cogeneration; diversification of energy sources for the preparation of hot water; the promotion of new technologies and efficient types of equipment meant to contribute to reducing the thermal energy consumption, etc.;
d. *Industry sector*: stimulation of investments aimed at the reuse of low-efficiency technological installations and the use of equipment, machines, and technologies with lower energy consumption;

e. *Construction sector:* rational use of petroleum products, natural gas, and solid fuels; reducing carbon dioxide emissions; development of administrative, legal and financial potential, allowing the large-scale implementation of energy efficiency measures in the housing fund; stimulating the public and private sector for investments in the field of energy efficiency of housing;
f. *The transport sector*: promoting biofuels and as a result of the gradual reduction of CO2 emissions; replacing outdated transport units with new energy-efficient ones, etc.;
g. *Public sector*: informing the company about the good practices, the costs, and benefits of efficient equipment and machines, RES, the rehabilitation of public property and social buildings, the use of RES for heating and providing with electrical energy social objects, etc.

The Program stipulates the specific objectives and the technical, organizational measures, the creation of the institutional capacities (energy managers, auditors) necessary to improve the energy efficiency in the sectors mentioned above.

NATIONAL ACTION PLAN IN THE FIELD OF RENEWABLE ENERGY FOR THE YEARS 2013-2020

(GD No. 1073 of 27.12.2013 - amended HG327 din 17.04.18, MO126-132/20.04.18 art.369)

The present National Plan is a key document of the energy policies of the RM to promote the use of energy from renewable sources in order to achieve the main strategic objectives for increasing the energy security. The National Plan defines the sectoral objectives to reach 20% of energy from renewable sources in 2020 and sets out the legislative, regulatory and administrative actions necessary to achieve these objectives.

1.13.1 Goal setting

The overall objective for the consumption of energy from renewable sources in 2020 was determined by the Energy Strategy until 2030: a contribution of 20% of the energy from renewable sources in the volume of energy consumption;

The sectorial objectives being set equal to 10% energy from renewable sources in electricity and 10% energy from renewable sources in transport; in energy from renewable sources - heating and cooling, resulting in 27%.

The overall objective of energy from renewable sources of 17% and the objective of energy from renewable sources in transports of 10% are the obligations of the Republic of Moldova that result from the quality of a contracting party to the Energy Community, being established by Decision D / 2012/04 / MC-EnC a Ministerial Council of the Energy Community.

According to the present Plan, the electricity from renewable sources will be mainly generated by the wind energy installations, starting with 2016 and will be partially supplemented by the energy produced from biogas as well as that produced by the existing small hydroelectric installations. Increasing the competitiveness of the photovoltaic solar technology will contribute towards the end of the decade when generating the share of electricity.

1.13.2 Strategic approach.

The objective of the Republic of Moldova is to strengthen its own generation capacity to become a competitive production platform within the regional flows of electricity.

The measures for the fulfillment of this important objective of the energy strategy are: promoting the production of electricity on the basis of wind sources, modernizing the centralized supply system with thermal energy and the plants with cogeneration system.

Another pillar of the Energy Strategy is the objective of connecting the country's electricity system to the ENTSO-E system, which will facilitate access to the balancing means that will ensure the capacity reserve for the intermittent generation of electricity based on wind sources.

1.13.3. Reaching the objective of energy from renewable sources.

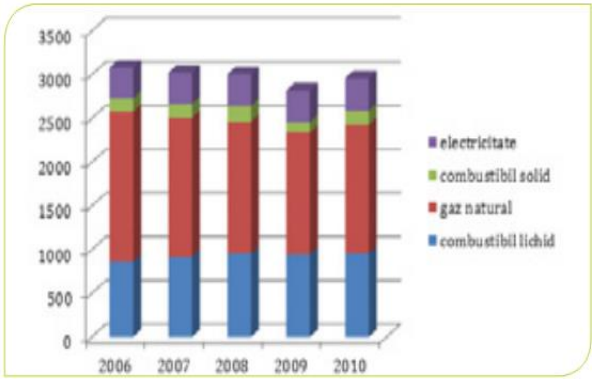
In order to support the use of energy from renewable sources in electricity, the legislation in force is elaborated based on the concept of tendering, the principle of procurement and priority dispatch of electricity produced by power plants from renewable sources, as well as at a regulated tariff for production. of energy from renewable sources in electricity and biofuels.

In this context, the decision was made to implement tender procedures for renewable energy projects in electricity which include two types of ceilings:

- The starting price of the auctions;
- The total volume of the auctioned capacity, which will not exceed the level that the network can absorb at a reasonable cost (about 400 MW);

Analysis of the market of EE technologies in the Republic of Moldova

As mentioned Moldova depends to a large extent on imported energy sources, which constitutes about 95% of the total energy consumed.



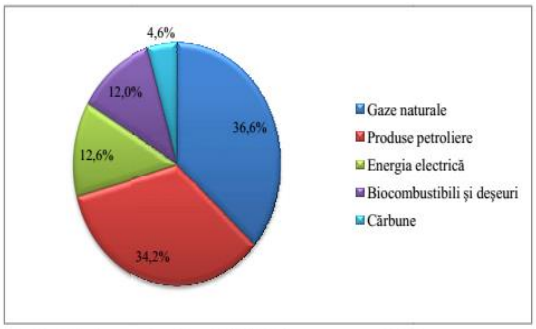
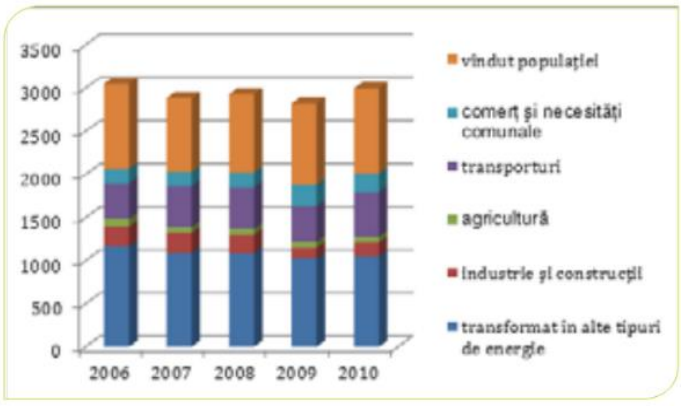


Fig. 3.4: Mixul energetic al Republicii Moldova pentru anul 2014

Sursa: Elaborat de autor în baza datelor Biroului Naţional de Statistică al RM [4, p. 304]

Structure of imports of energy sources (unit of measure: thousand tons coal equivalent) (source: www.statistica.md)

From the diagrams, we mention that, in the volume of imported fuel, the largest share comes from natural gas, petroleum products and electricity and over the last five years, the structure of imports of energy sources has been more or less constant. The diagram below shows the distribution of final consumption of energy and fuel resources by the main activities of the national economy.



From the diagram we mention, that the largest share of the consumption of energy resources is used for the production of other types of energy (ie, electricity, heat) and for consumption in the residential sector. The Republic of Moldova can meet its energy needs and, respectively, ensure energy efficiency by: decreasing the energy intensity in the residential, industrial, transport and agricultural sectors; the modernization of the energy system; implementation of efficient energy technologies using machinery, materials and high-performance technologies; involvement of own energy resources, including renewable energy, in the consumption balance.

Structure of consumption by sectors, period 2006-2010 (units of measure: thousands of tons of coal equivalent) (source: www.statistica.md)

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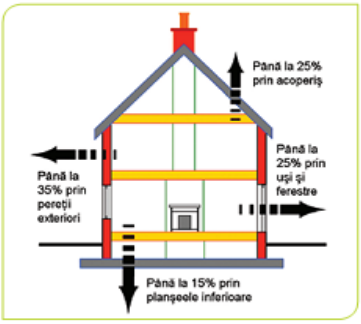
MEASURES OF ENERGY EFFICIENCY IN BUILDINGS



The building envelope

Buildings lose energy through:

- Walls, floors/ceilings
- Exterior walls;
- Ceiling and roof;
- Walls and floors separating the heated/cooled areas from the areas unheated/cooled (eg. basements, technical floors upper floors, attics/bridges, etc.);
- Thermal bridges (places where materials with low conductivity and the insulation materials are penetrated by elements with high conductivity).

Energy losses occur primarily through the thermal conductivity of building materials (λ, measured in W / m · ° C).

The thermal performance of the building elements is determined by the thermal resistance of the respective elements, R (measured in m² · ° C / W), which depends on the thermal conductivity of the materials from which the respective element of the building is made and the thickness of the material layers. The inverse of the thermal resistance R of an element of the building is the coefficient of thermal transfer U, measured in W / m² · ° C (U = 1 / R).

The thermal resistance of the wall is the sum of the thermal resistance of the layers from which it is formed. From the table it can be seen that a relatively thin layer of thermal insulation material, such as expanded polystyrene or 12 cm mineral wool, substantially reduces the wall heat transfer coefficient and offers an R of about 3 m² · ° C/W, which can compensate for a considerable thickness of traditional building materials, which would be necessary to achieve the same R.

Materialul de construcție	Conductivitate termică a materialului (λ) W/m·°C	Grosimea aproximativă pentru R=3 m²·°C/W, m
Beton armat	1,7	5,1
Cheramzit-beton (unele tipuri folosite pe larg în trecut, de exemplu, în formă de panouri prefabricate)	0,7 - 0,8	2,1 - 2,4
Piatră de calcar	0,5 - 0,8	1,5 - 2,4
Cărămidă	0,5 - 0,75	1,5 - 2,25
Beton înspumat (unele tipuri)	0,3	0,9
Polistiren expandat	0,037 - 0,04	0,12
Vată minerală	0,04	0,12

According to the norms of the Republic of Moldova (NCM E.04.01-2006 "Thermal protection of buildings"), the R needed for the exterior walls in residential and public buildings (schools, kindergartens, hospitals, etc.) is between 2.4-2.8 m² · ° C / W, depending on the temperature required inside, the outside temperature in the respective region of the country and the duration of the heating season for the respective type of building.

The exterior walls of the buildings designed during the Soviet period are much lower than the modern requirements and were about 0.65m² · ° C / W - 1.1m² · ° C / W, depending on the type and thickness of the material, which causes energy losses to reach up to 40% of the total volume. Typical examples:

As a result of the market analysis of thermal insulation materials, based on type, technical characteristics, efficiency, application technology, it was found that, as a rule, thermal insulation of:

1. The outer walls are made using expanded polystyrene panels (thickness 120 mm) or mineral wool 100 mm, density 120 kg / m3 or mineral wool 120 - 150 mm, density 140 kg / m3 depending on the construction material and the state current of the wall and respectively a value of R needed is obtained for the exterior walls in the residential and public buildings according to the regulations in force (between 2.4-3.0 m² · ° C / W). Thermal insulation is then plastered from the outside or protected with finishing materials and moisture barriers from the cold side of the new insulation in order to prevent moisture from entering the insulation and into the wall, which can lead to mold development and wall degradation. The insulation materials and their application must comply with the regulations, sanitary and fire safety regulations in force.

2. The ceiling and roof are made using expanded polystyrene panels (120mm thickness) or wool mineral 100 mm, density 120 kg / m3 or mineral wool 100 - 150 mm, density 120-140 kg / m3 depending on the construction material and the current state of the ceiling, roof, ethnic floor, etc.

Providing adequate thermal insulation and waterproofing of the roof, the ceiling greatly reduces energy costs and prevents moisture from entering the interior and damaging the building elements.

Example. R of the flat roofs of Soviet buildings is about 0.9-1 m² · ° C / W and can be considerably increased up to about 3.0 m² · ° C / W. The construction of a new roof with insulated roof / attic type above the flat roof can also improve the energy performance and impermeability of the building. The insulation materials and their application must comply with the regulations, sanitary and fire safety regulations in force.

Analysis of the existing situation and of the thermal performance of the elements of the building envelope, the target performance, the type and thickness of the thermal insulation, to be applied, the method of its installation, the types and technical details of the works, etc. they must be identified during the energy audit and in the design works for the accomplishment of the works.

Natural cooling techniques - Windows and doors

Most schools, kindergartens, hospitals are located in buildings built during the Soviet period. Window construction: single-pane glass; single-row metal frame; double wooden frame. The U of these windows was approximately 3.5 - 5.0 W / m² ° C. The annual loss of energy through windows and doors is huge and is caused by:

1. Unsealed spaces between window / door frame and wall;
2. Insufficient sealing of doors / windows in closed position;
3. Cracked or broken glass at windows or doors;
4. Frames (frames) made of wood / gates physically damaged, damaged at windows / doors;
5. High heat transfer through aluminum frames and gears and as a result, low comfort inside the building.

Solutions:

1. Renovation of old windows and doors, by reducing or eliminating some of the causes mentioned above and as a result - reducing U up to 2.8 W / (m² ° C) and loss of thermal energy.

2. Installation of modern windows and doors, energy efficient, according to the Norm in force (NCM E.04.01-2006 "Thermal protection of buildings") stipulates that R is required for windows depending on the temperature required inside, the outside temperature, and the duration of the heating season for the respective type of building.

Average R value for windows:

- Standard with double glazing, R = 0.34-0.38 m² · ° C / W;
- With double glazing with advanced coatings, R = 0.45-0.55 m² · ° C / W;
- With triple glazing, R = 0.5-0.7 m² · ° C / W, depending on the distance between glass sheets and inert gas filling.

R depends on the material and quality of the frame / sash, the coatings applied to the glass sheets, the number of sheets of glass in the insulated glass units, the distance between the sheets of glass, and the filling with inert gas.

Characteristics of modern, energy efficient windows:

- The insulated glass units consist of two or more sheets of glass, the internal space between the windows sealed and filled with inert gases (Ar, Cr), which reduce the heat transfer due to the reduced thermal conductivity;
- Low-E coatings applied to glass sheets, which reduce thermal radiation losses inside

winter building. Coatings are available that can reduce the penetration of infrared radiation during the summer, thus reducing the temperature inside and the loads required for summer cooling;

- Frames and earrings with good thermal resistance - currently, the most widespread materials are multi - chamber plastic profiles. Such windows have a good performance from the point of cost/durability/ thermal efficiency. Wooden windows and wooden sashes, which also have good thermal performance, are more expensive and require more maintenance;
- Sealing gaskets, which allow the sealing of windows to be sealed;
- Mechanisms that allow different possibilities of opening, with different levels/positions of opening,

Including the reduced vertical opening position for ventilation, and often have a position for micro-ventilation, which allows infiltration of a small amount of air.

- Blinds or curtains, or exterior elements for sun protection;
- Installing new, energy efficient windows costs on average $ 130-150 per m² of window.

The entrance doors must be sealed in the closed position and have sufficient thermal resistance.

It is recommended to install automatic closing mechanisms.

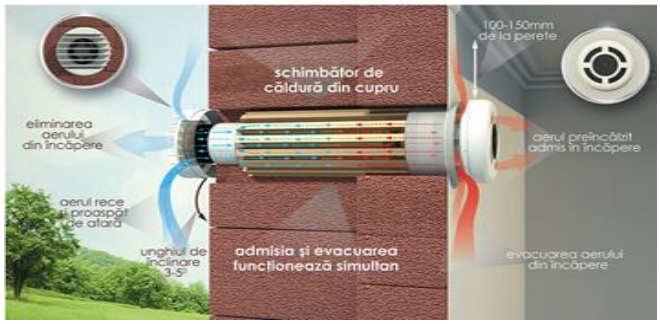
The analysis of the current state of the building envelope regarding the detection of heat losses, as well as the analysis of the results after the execution of the energy efficiency measures is performed with the support of the thermal imaging chamber.

Natural cooling techniques - Ventilation and cooling systems.

The buildings may have mechanical (forced) ventilation systems for inlet and outlet air or natural ventilation. Modern buildings are designed and constructed, with low uncontrolled infiltration, but with the change of air in a controlled way through the use of ventilation systems.

Modern mechanical ventilation systems, energy efficient, recover some of the heat energy from the exhaust air and transfer it to the freshly admitted air, using heat recovery units or energy, thus saving energy. In Moldova, many schools, kindergartens, other public buildings, residential buildings have been designed with natural ventilation (mechanical ventilation only in canteens). Air exchange occurs as follows: clean air is allowed by infiltration (for example, by opening windows) and vented through the ventilation ducts with the exhaust vents on the roof.) The wide ventilation of the bedrooms and the dining rooms by the opening of the windows is done during the periods when the children are not in these rooms (DECISION by Government No.1211 of 04.11.2016 on the approval of the Health Regulations for early education institutions).

Other categories of buildings, such as hospitals, were usually designed with mechanical ventilation systems, ensuring the heating of the air, but without recovering the heat. Today, in most cases, mechanical ventilation systems are not used for economic and technical reasons, and the air exchange in those buildings is done through natural ventilation.



Maintenance work on natural ventilation systems is usually not performed, often being clogged and does not ensure the sanitary requirements in force.

In order to improve the energy performance of the building and the quality of the air, compact ventilation systems with energy recovery, installed in the outer wall, must be installed. Example of recuperator (ventilation and local recovery) for rooms in schools, kindergartens, etc., which are widely used in Moldova: PRANA type, which can provide different air flows depending on the need according to the regulations in force.

It is a compact system - the recuperator is completely hidden in the wall thickness, only the ventilation grilles remain. Air inlet and outlet are performed simultaneously and always provide 8% more volume of air than exhaust air. The copper heat exchanger ensures excellent heat recovery. It normalizes the microclimate in the room and permanently eliminates the causes of moisture, condensation on windows and mold. It works: with the help of a remote control. Low electricity consumption: about 6Wh for an allowable air flow of 235 cubic meters/h and exhaust air flow - 220 cubic meters / h. European Certificate of EC Quality and Energy Efficiency Class A + and A.

In the rooms of the residential buildings and offices, in order to ensure the thermal comfort in the hot seasons, besides the natural ventilation systems fans and air conditioning systems are used.

Fans are a low-energy method. Types of fans: table, floor, ceil or living room ceiling to circulate air.

Air conditioning (AC) systems. Used by people who live or work in buildings without centralized AC. Selecting an energy efficient unit reduces the energy costs over the life of the AC.

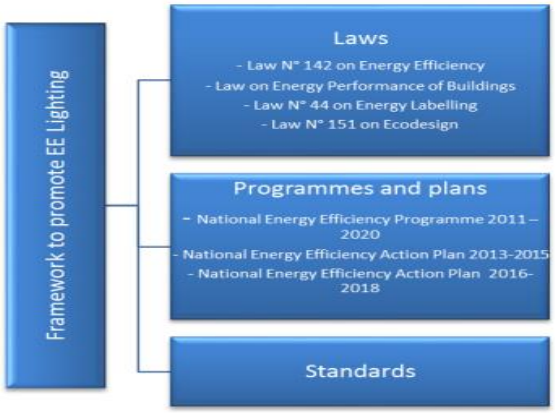
Important parameter for AC for efficient operation: the energy consumption class of the respective system. For the AC systems with window installation the energy efficiency rate (REE) is used, it is the ratio between the cooling efficiency of the unit and its electricity consumption. For room installation, AC units with a REE greater than 10.8 are recommended. The AC unit must have adequate capacity for the room to be cooled.

Indoor and outdoor lighting systems.

Currently, the lighting technologies used in the Republic of Moldova include: various high pressure mercury lamps (HPM) - in the street lighting sector, as well as incandescent (IL), fluorescent (FL) and compact fluorescent (CFL) lamps - in the building sectors public and residential.

The political and legislative framework for promoting energy efficient lighting in the RM.

The objectives of NAMA (National Appropriate Mitigation Actions) actions to promote energy efficient lighting in the Republic of Moldova. Conversion of all LED-free lighting systems into LED-based systems in the sectors of street lighting, public buildings and residential buildings until 2030, with a view to significantly reducing public and private lighting costs. Preliminary estimates show that the conversion to energy efficient lighting will reduce the annual electricity consumption by 502,680 MWh, which will lead to a reduction of GHG emissions of 327 314 tCO2. In addition, based on the estimated annual reduction of electricity consumption as a result of the implementation of LED lighting systems, city halls could save up to 25,169,670 euros per year on street lighting, and 19 344 318 EURO on lighting in the public buildings sector. While the savings of residential consumers would amount to 20 446 902 EURO.



Interior lighting

Indoor lighting systems are equipped with:

1. Incandescent lamps which represented the most used type of lamps and which are characterized by: low purchase price; service life of only 1000 hours (shortest of all available lamps); efficiency of about 5% (smallest of all available lamps).

2. Halogen lamps, which closely resemble incandescent lamps, are much more efficient than incandescent lamps, but less efficient compared to compact fluorescent lamps (LFCs) or luminescent diodes (LEDs).
3. T12 fluorescent tubes, 1½ ”diameter (one-half inch) found especially in

old holes; typeT8, 8/8 ”diameter (1 inch) widely used today. The tubes are mounted in the body that has magnetic ballast, they do not have a good reputation because they often flicker and produce a specific buzz**.**

Lamps LFC

Most of the lighting infrastructure in Moldova is outdated and will have to be replaced in the coming years.

Efficient lighting sources recommended for replacing indoor lighting sources

Compact Fluorescent Lamps (LFC): obvious advantage compared to incandescent lamps, namely: 5-15 times longer operating life and constitutes about 15,000 hours; a much lower energy consumption (50% - 80%); the ratio of transformation and comparison of incandescent lamps with LFC is 5: 1; 3-4 times more lumen / watt); wide color temperature range.

Disadvantages: LFCs are more expensive, the time to reach normal brightness is higher, and intensity adjustment is difficult.

T5 fluorescent tubes, 5/8 ”in diameter (five inches optimum), are generally shorter than T8; are about 20-30% more efficient than T8 tubes. There are adaptive systems that allow the replacement of T8 lamps with T5 lamps without the need to replace the old gaskets.

In order to achieve greater energy savings in T5 tubes, the old magnetic ballast body must be changed to an electronic ballast body and as a result, the fluorescent lamps do not blink and make no noise. The electronic ballast with a "warm start" function is recommended for extending the lamp life (visually, the lamps start with a delay of about 1 second, necessary for heating the electrodes).

An important criterion for lamps is the color rendering index, Ra. Lamps with Ra> 80 are recommended for better color rendering and higher efficiency. Fluorescent tubes Ra> 90 are also available, but they are more expensive and the efficiency is lower. The lamps are marked with three-digit codes, the first referring to Ra, the second and the third - to the color of the temperature. For example, tubes marked with 840 suppose they have a Ra> 80 and 4,000 K (cold white).

Light emitting diodes (LEDs) - semiconductor devices that convert electricity into light. They are considered the future of lighting.

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10 watt lamp that provides 48W, 4000K LED lighting similar to the 60 watt incandescent lamp. source: Phillips

The 60 watt lamp is considered by the US Department of Energy to be the most efficient lamp and provides the highest quality light. LEDs are the most energy efficient and the most durable technology available on the market.

Advantage over CFLs: Longer operating time (25,000 - 50,000 versus 8,000-10,000 hours); cost efficiency: even though LEDs are more expensive, they are more cost-effective in comparison - they consume less power (watts) per unit of light generated (lumens); they do not contain mercury; they have a lower risk of damage and are less sensitive to low temperatures and humidity; Lower CO2 emissions: LEDs consume less energy.

The average lighting efficiency (luminous flux per unit of energy consumed) and the cost for a light bulb indicate a significant decrease in LED prices over the last six years, from nearly $ 70 to about $ 8, and forecasts show that in by 2025, the price of LEDs will reach the price level for CFLs and as a result the lighting industry and large retailers are beginning to focus their efforts on LED-based technologies.

Halogen lamps. They are used for downward facing luminaires (eg work surface in the kitchen). Operating time - 2000 - 3000 hours. Power supply voltage - 220-240V, equipped with 12V transformer transformer, which consumes energy. Thus, a halogen lamp with a power of 50W can consume up to 60W if we also calculate the power consumption of the transformer (the downward-facing CFL lamps consume about 18W and provide about the same amount of light. It is used in special cases.

Lighting control systems. They are used for the purpose of optimizing (reducing) the light usage time and extending the life of the lamps.

Types of control systems: ▸ *Presence sensors* - turn on the light when someone enters the room and turn it off automatically when no one is in the room.

▸ *Empty space sensors* - someone needs to enter the room to turn on the light manually. When no one is in the room, the light goes out automatically.

The use of these control systems is recommended in corridors and stairs, storage rooms, commercial spaces, etc.

Estimated energy savings can vary significantly depending on presence and usage: from 25% to about 60% compared to the continuous lighting variant.

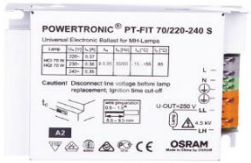
Outdoor lighting

It represents one of the most important responsibilities for municipalities, the rural environment, etc. and has the role of ensuring both the orientation and the safe circulation at night of vehicles and pedestrians, as well as ensuring an adequate environment.

Corp de iluminat

Lampă

Pilon



Balast electronic

Bloc de comandă

The street lighting systems built during the Soviet period are inefficient, morally and physically outdated, have remained practically maintenance-free and in the majority are not functional. Given the importance of rural infrastructure, the achievement of lighting in the localities of the Republic of Moldova is one of the conditions for the accession of the Republic of Moldova to the EU.

Energy efficiency technologies can significantly reduce the costs for street lighting (often from 25% to 60%).

Currently, on the territory of the RM it is approved as national standard EN 13201.Public lighting.

For the realization of modern and energy efficient lighting systems in the RM, there are practically all the conditions: designers, luminaires, infrastructure equipment, the experience of advanced countries, etc. A street lighting system represents a set of technical elements that includes lighting, the source of light, fasteners, electrical wires, control and protection elements.

Lighting lamp technologies

The most important element of the lighting systems is the light source, the determining factor of the quality of visibility; costs; the energy efficiency of the system. The lamps used for street lighting are selected according to the light intensity.

Vibration resistance. Under the conditions of street lighting (and in the case of lifts, airplanes, trains, cars, etc.), the luminaries, mounted at high heights (8-25 m), are subjected to vibration which causes or accelerates the failure of the elements of the classical sources (electric discharge lamps) of light. In the case of LEDs the vibrations cannot cause the component parts to fail all being a consolidated body, thus ensuring the necessary performances. One of four types of lamps is usually used in street lighting systems:

▸ *High pressure sodium vapor lamp (HPSV).* Advantages: they produce a yellow light, they are very energy efficient, brightness is stable over time. Disadvantages: poor color rendering properties.

▸ *Metal halide (MH) lamp.* Advantages: high efficiency, better color reproduction. Disadvantages: rather short operating life (some models - up to 10,000 hours); light intensity decreases during operation.

▸ *Mercury vapor lamp (MV)* is the least efficient of all types of high intensity discharge lamps and has poor light stability.

The HPSV and MH variable intensity lamps are useful for energy conservation technologies and allow the satisfactory level of lighting to be maintained during periods of low or high electrical voltage, which ensures good visibility of the street and during peak hours.

▸ *Luminescent diodes (LEDs)* - significant energy conservation potential for street lighting systems.

Main advantages: luminous efficiency of about 120-160 lm/W; being in operation on average about 12 hours a day, they have a life of up to 10 years, which reduces the replacement costs; the energy consumed is about 50% lower than the other types used; integration into a stand-alone lighting system with photovoltaic cells as power supplies, which offers enormous potential for increasing energy efficiency; vibration resistance; low temperature operation - can be used for applications in refrigerated spaces, freezers, cold rooms, outdoor applications; Compatibility with various electronic control devices, allow adjusting the level of lighting and color indices - innovation in lighting.

The elements of directing and automating the public lighting system - represent a set of controllers, which, being connected to the classic lighting system, allow the programming of different operating regimes by adjusting the time of connection and disconnection without the intervention of the human factor at that time. The interaction with these controllers can be done remotely through modules that can communicate through the Internet, radio waves, electrical wires, etc.

Energy efficient heating and cooling systems

Existing situation

The territory of the RM, once supplied by approximately 40 centralized heat supply systems, currently has only a few partially rehabilitated systems and two systems - Chisinau and Balti, providing coverage of up to 80% of the population of these cities. *The overall efficiency of the existing CETs is below the 80% level* - overall efficiency of the new thermal power plants. *Keeping the tariffs below the cost recovery level*, the producers and suppliers of thermal energy lacked the necessary investments and as *a result: the huge reduction in the quality of services*, which produced massive disconnections and the installation of over *20 thousand individual boilers in Chisinau* alone. Economic crises, the largest consumer companies - the industry were missing. The thermal energy producers did not activate at full capacity. Severe wear and tear of equipment and machinery has caused

substantial losses of energy and heat: in demand (building) often reach 30-50% and consume 3-4 more energy than in the EU.

The potential of developing new generation capacities, such as the construction of small capacity cogeneration plants, is not exploited

The modernization and renovation of the thermal-energy sector is foreseen by its transition towards a higher energy efficiency: by using cogeneration technology, ensuring a rational correlation between centralized and decentralized power supply, the use of local fuels, including industrial, agricultural and household waste, as well as resources. secondary energy sources.

The available information on high efficiency cogeneration plants with electric power from 30 kW to 500 kW and with electric power of more than 500 kW up to 2 MW has been studied, which can use natural gas, biogas, and liquefied gas as fuel. The technical characteristics and parameters of a wide range of high efficiency cogeneration plants that are produced in the Czech Republic, Slovakia, Russia etc.

Recognizing the benefits of cogeneration - the simultaneous production, in the same installation, of thermal energy and electricity, with high efficiency and, therefore, with a reduced impact on the environment and in accordance with Directive 2012/27 / EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, by 2030 the Moldovan Government aims to create a competitive and efficient energy complex, which will provide all consumers with qualitative energy resources, in an accessible and reliable way.

Specific objectives:

- The installation, by 2030, of 10 MW (electric power) for the production of energy under high efficiency cogeneration and operating on the basis of SER. 20 CET IE with the installed electric power of 500 kW each;
- The reuse, by 2030, of 20% of district heating plants in cogeneration plants. Installed electric power: 500 - 2000 KW;
- Covering, by 2030, 10% (about 20 MW) of the electricity consumption used in the sector produced with cogeneration;
- Mini - CETs with installed electric power: 400 - 2000 KW;
- 2% of public buildings to be heated, by 2030, from the energy produced under cogeneration at building level;
- Mini - CETs with installed electric power: 50 - 2000 KW;

Mini CETs on biogas. Examples:

Moldovan - German Company Sudzucker, CET on biogas from wastes from sugar beet processing

The company owns several sugar factories and is the largest producer of sugar in the country, trying to find utility for the 700 thousand tons of waste from beet processing and sugar production.

The CET project is efficient as an investment, because biomass is transformed into energy. It solves the

problem of using biological mass, which was previously inefficiently used. It provides gas during the season, reduces the consumption of purchased gas and, after the beet processing campaign ends, by cogeneration, electricity is produced all year. Three fermenters process about 150 tonnes of biomass daily and mini CETs produce around 2 MW of electricity per hour. The electricity from Sudzucker is already distributed on the network at fairly low rates. It is green energy, the production of which does not form greenhouse gases. There is also a great potential for the production of thermal energy, because cogeneration emits an enormous amount of heat, which can be used for heating the rooms, drying cereals and selling them to the residents around the factory and the production of hot water. But these projects cannot be realized because heating networks and aqueducts do not work in the city. Drochia and must be renewed by the local authorities. The project was made from resources, loans, bank loans and financial means in the form of a grant. The Drochia factory is the only company of its kind in this part of Europe.

SRL "Tevas Grup", CET on biogas extracted from the garbage

The landfill from Țânțăreni, the Anenii Noi area, an area of 24 ha and until recently was a source of pollution, became a renewable energy supplier. The transformation took place thanks to the company "Tevas Grup" SRL, which installed a biogas capture network and the production of renewable electricity. The project is a premiere for the RM and can be extended to other locations.

Throughout the surface of the garbage dumps, 55 wells were drilled through which the trapped gas is extractedwaste decomposition. The pipes are concentrated in 4 points on the perimeter of the polygon, where gas distribution stations are installed. They bring to the surface the gas that supplies a power plant, which produces enough current to implement the entire plant. Wastes are ideal for the formation of biogas composed of half methane and half carbon dioxide and other gases. The electric generator, installed on the polygon, has a capacity of 320 kW. The volume of current that remains after the extraction of the gas is delivered for a fee in the national electricity distribution network. Thus, the production of alternative energy is the second part of the project. The company has built electricity distribution networks with a length of over 2 km to the neighboring village, Geamăna. Electricity can be delivered to the national network. According to estimates, "Tevas Grup" will be able to produce electricity for at least 10-14 years only based on the waste that is already deposited in the landfills.

ÎM „Sudzucker Moldova" SA,
or. Drochia, Rep. Moldova

SRL „Tevas Grup",
s. Țânțăreni, r. Anenii-Noi

Energy management systems in buildings (SMEC)

Purpose of energy management in buildings (hospitals, schools, kindergartens, residential blocks, offices, production blocks, commercial spaces, etc.): improving energy performance, saving energy and reducing costs, ensuring thermal comfort according to the requirements in force and diminishing the impact on the environment .

The energy management process includes all the components of the building: the foundation; tire; IVCA systems; lighting; adjustment and control devices. SMEC is a systematic process for the continuous improvement of energy performance. The basic idea is to implement organizational, behavioral and technical actions aimed at minimizing energy consumption. In order to implement and ensure the energy management process, it is necessary to appoint a responsible person - the Energy Manager, who has the following obligations:

1. Identification of the components of the building, systems, equipment that consume energy by types of energy:

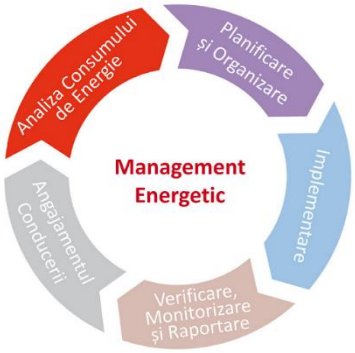
- *Electricity - indoor and outdoor lighting, refrigerators, computers, technological equipment, machines, etc .;*
- *Thermal energy - elements of the building envelope, IVCA systems;*
- *Cooling - air conditioning systems, number of air conditioning units, their types;*
- *Water - the number of water consumption fittings, washing machines, etc .;*
- *Natural gas - gas-fired boilers, gas cookers, etc.*

2. Data collection and analysis (monthly):

- *Records of all energy meters - electric, thermal, cold and hot water, gas.*
- *Analysis of the collected data - the dynamics of energy consumption with the predicted ones and the reference level.*
- *Identifying the factors that influence consumption trends and analyzing the consumption for the purpose identifying the elements of the tire, equipment, engineering systems that require energy conservation measures to reduce consumption.*

3. Monitoring of the operation and maintenance according to the Project documentation, the operating manuals of the elements of the building envelope, IVCA systems maintaining optimal technological and operating parameters ensuring the necessary conditions, for example, comfort, air quality, without using excess energy.
4. Identification and implementation of energy conservation measures (ECM):

- ***ECM that does not involve expenses***: Closing windows, doors; extinguishing light when leaving room; complete or partial disconnection of unused electrical appliances, etc.; location of information panels for users in the building.
- ***ECM involving expenditure with insignificant amounts:*** *Filling cracks and holes in the building envelope; installation of automatic door closing mechanisms; replacement of conventional electric bulbs with economic bulbs and other measures described in the "Interior lighting" compartment; thermal insulation of the pipes of the heating system in unheated spaces and of the ACM pipes; mounting regulators with thermostatic head to radiators; installing energy meters if missing.*
- ***ECMs involving medium or high costs:*** thermal insulation of envelope elements; energy-efficient carpentry replacement; modern automated PTI installation; rehabilitation of the internal eating system; replacement of gas boilers from CT with high efficiency boilers; installation of renewable energy sources, etc.



The activities of equipment operation and maintenance of building components are carried out by the energy manager, the technical / service personnel of the building under the supervision of the Energy Manager, or are contracted to a specialized film in the field. Establishing performance indicators, for example, as a result of the first energy audit, is the first step in the right direction. The values of the performance indicators need to be reviewed and improved at least annually. The method of carrying out the energy management program must be evaluated non-monthly, and documented quarterly.

The Energy Manager must have experience in the field, trained in the courses of energy management and energy efficiency.

SMEC structure

Building Energy Management Systems (SMEC) is a computerized system that ensures the management, control and monitoring of engineering installations in a building or group of buildings. The use of SMEC can reduce the energy costs and the costs of the works to improve the efficiency and effectiveness of the building.
The advantages of SMEC are: the possibility of data processing and obtaining automatic reports; scheduling the periods of heating of the spaces during the night and during the rest days; reduction of energy costs through analytical control, monitoring and centralized management programs; possibility to control the electrical and thermal load of the building; efficient management by alarm signaling, historical records and maintenance programs; improving the performance of the building and the duration of operation. basis for the control and

monitoring functions of the SMEC include: IVCA, ACM and cold water, lighting, energy consumption (for example, reading of electric, thermal, gas, water meters), maximum electrical and thermal load, access equipment and security and fire detection / signaling. In most SMECs, the system management interface at the central station is represented by a personal computer (PC).

The SMEC structure: the central station, the communication network, the controllers and the equipment located in the territory (for example, sensors, control devices and meters).

The diagram of a Monitoring System installed on the object is presented in the Annexes.

Renewable energy sources

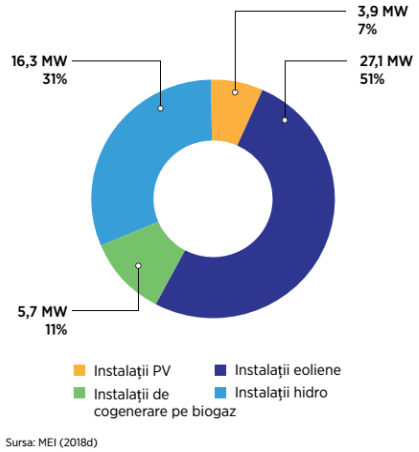
Moldova has a vast potential for renewable energy, which until now has remained almost untapped. The internal path of diversification of energy resources consists in the development of local RES. Capitalizing on the potential of SER creates real premises for achieving strategic objectives: increasing security in energy supply by diversifying sources and reducing the share of energy resources, respectively, sustainable development of the energy sector and environmental protection. SER and energy efficiency are a relatively new field for Moldova with enormous development potential. In order to promote energy efficiency projects and actions, the existence of the legal and institutional framework plays a very important role. The law provides the necessary guarantees for investments, including: connection to the non-discriminatory network, priority supply and an obligation on the part of the central electricity supplier to purchase the electricity generated entirely from renewable sources for 15 years. In addition, the new market-based scheme promotes competition among investors, whereas it provides for the organization of tenders for projects with a capacity of over 4 MW in wind energy case and 1 MW for other technologies.

An	2010	2011	2012	2013	2014	2015	2016	2017	Obiectiv
Energie electrică	6,9	4,4	4,0	1,7	1,9	2,0	2,0	2,2	10
Încălzire și răcire	34,4	36,1	39,0	39,9	43,6	44,5	45,5	46,1	27
Transporturi	0,1	0,1	0,2	0,2	0,2	0,2	0,2	0,3	10
Total energie regenerabilă	21,3	22,0	24,3	24,4	26,1	26,2	26,9	27,8	17

Share of renewable energy in gross final energy consumption, by sector (%):

From the table we can see that, in 2017, the share of RES from the gross energy consumption of R M was 27.8%.

Biomass provides 98% of this weight and is used especially in the heating sector. This significant contribution to the energy mix was recently identified by the retroactive review of the data on household consumption of biomass for the period 2010-2016.



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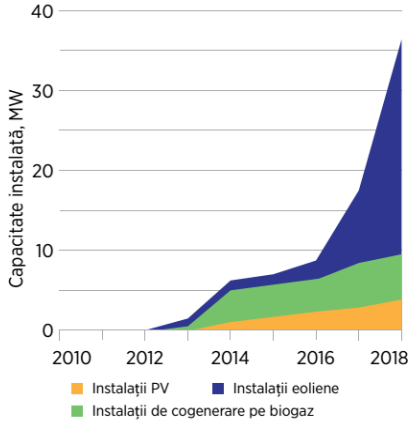


Sursa: MEI (2018d)

From the diagrams we can see that, in the energy sector, the most used renewable energy technology is wind energy, with an installed capacity of 27 MW, followed by 16 MW hydroelectric power station, biogas cogeneration plants and almost 4 MW in solar photovoltaic energy.

Currently, in the Republic of Moldova, some infrastructure for

generating energy from alternative energy sources can be identified.

Solar Energy Systems

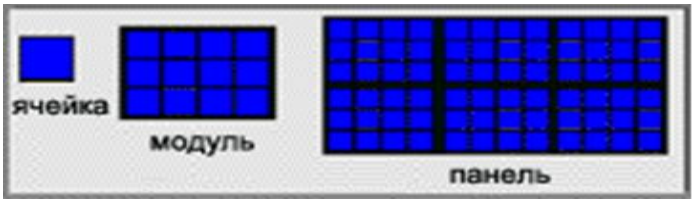
Solar energy is one of the most promising sources of renewable energy in the world being the subject of a separate direction of alternative energy, based on the use of solar radiation to produce energy in any form. The generation of energy by harnessing the solar potential, takes place with the use of ecological technologies, without emissions, without harmful waste, requires a reduced maintenance with a life of 20-30 years, with low operating costs. Solar energy is free, inexhaustible and the most sought after today in developing countries, the fastest growing segment of the photovoltaic market.

Photovoltaic conversion seems to have the greatest possibilities of becoming an alternative technology to the classic mode of electricity production under the current energy crisis. Today, a number of states have focused their energy policy on harnessing solar energy. Among them we could mention Germany, Spain, USA, Japan, etc., which have already implemented tens of MW projects using photovoltaic modules.

A more pronounced ascension of the world situation to this chapter will be recorded with the reduction of the costs of such technologies, a current trend in fact.

The construction of the photovoltaic system is composed of 2 main components - solar panel and inverter.

Photovoltaic systems use cells, made of semi-conductive materials, to convert solar radiation into electricity. Photovoltaic solar cells connected in series make up the solar module.



Modern modules have a current capacity directly peaks at 200 - 400 watts and uses 60, 72 or 96 cells. A few solar modules connected in parallel make up the solar panel. Photovoltaic cells can be made of several semiconductor materials, but over 95% of solar cells are made of silicon.

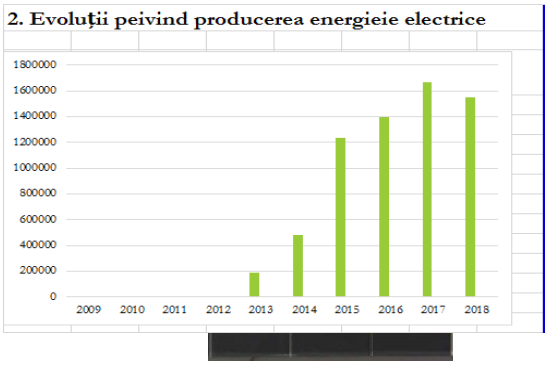
Types of silicon-based photovoltaic cells:

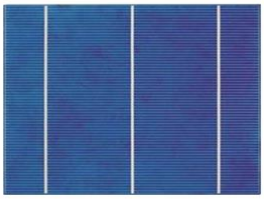
• monocrystalline: in series production, up to more than 20% energy efficiency (efficiency of direct sunlight transfer). The single crystals are obtained in the form of a rod or rod, by pouring pure silica (99.999%). Thickness - 200-300 мкм. It occupies about 82% of the market. High production price. It is mainly used in the cosmic and military industry.

• polycrystalline: in series production, up to 18% energy efficiency. They are obtained from pure silicon and silicon scrap from the metallurgical industry.

• amorphous: in series production, up to 5 - 7% energy efficiency. It represents thin layers of silicon deposited in vacuum on glass or metal foil.

• Cd Te cells: up to 8 - 9%. They are produced in small quantities and used in the cosmic industry.



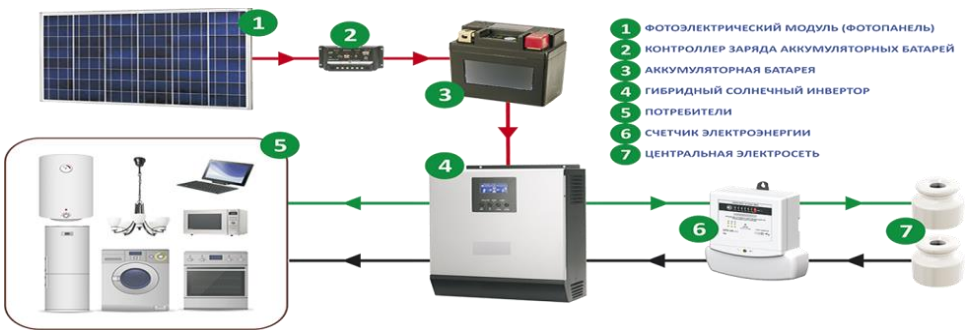


In the RM the actual duration of the sun's brightness is about 2100 - 2300 h. Global radiation (the sum direct and diffuse radiation) on a horizontal surface under average nebulous conditions constitutes 1280 kWh / m² in the northern area and 1370 kWh / m².an - in the south area. In the RM, 3 types of photovoltaic solar installations are used: with accumulation; connected to the network; mixed, that is, with accumulation and connected to the network.

Based on the analysis performed, based on the cost and the daily operating hours of the institution, including the period of summer vacation has come to the conclusion that from these 3 types in terms of efficiency can be implemented only the photovoltaic system connected to the local electricity network, when any excess power generated can be injected back into the electricity network (in educational institutions especially during the summer vacation period) after a special tariff for the injected energy. This type of PV system is called 'network connected'. In this case, there is no need for quite expensive energy storage, complex control devices. The inverter automatic synchronizes it with the network and ensures the disconnection of the installation in case of fault situations.

Main scheme and composition of the photovoltaic solar installation

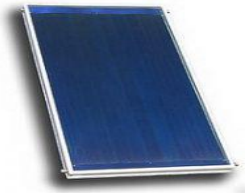
Photovoltaic systems that are not connected to the electricity grid, are called "off-grid systems" - outside the networks and require a battery for energy storage in cases where there is no sun. They are used in the cases of electrification of the rural area or for the energy requirement in



separate cases (in telecommunications, lighting in remote places, etc.). A system with an installed capacity of 1 kW, which requires approximately 6.5 m2 of modules, will produce between 1,050 and 1,200 kWh / year.

The installation price for large systems varies between 1300 and 1800 Euro / kW installed, not including the price of the land and the costs of connection to the network. Prices for an installed KW are falling fast. Solar has fallen rapidly. Maintenance costs are about 0.01 Euro / kWh. The land required for folovoltaic installations is about 2.5 ha for 1 MW installed capacity.

Total photovoltaic installations mounted in the RM. 53 (until a.2019)
Installed power, total kW (from 1.5 to 1000) 4 020.65
Energy produced, total kWh 1 550 752.0
Photovoltaic solar installations - good practices are reflected in the ANNEXES.



Solar thermal systems

The use of solar energy to prepare domestic hot water has proved to be a perfectly viable solution. The principle of operation of the solar water heating system is simple, and the technology is already well known and reliable. The use of solar energy removes the disadvantages generated by the use of wood and fossil fuels (coal, oil, natural gas): increasing costs, pollution, ash, smoke, increasing the greenhouse phenomenon.

Above the problems of pollution and the impact of greenhouse gases the preparation, **Flat collector** of water for domestic heat represents a considerable part of the energy bill of the buildings, which can be reduced up to about 50-60% annually. During the summer, the production of DHW (domestic hot water) is practically free, after the costs of installing solar systems are amortized. This solution is quite energy efficient. :

In today's world, over 150 million m² of solar thermal collectors are being exploited. The technical and economic potential for using solar panels in heating is over 1.4 billion. m 2capable of producing systems over 680 000 GWh thermal energy / year.

The solar collector (also called solar thermal panel) is an equipment, specially designed to convert solar radiation into thermal energy and its use for water heating. Solar collectors, used to heat domestic water: flat, with vacuum tubes.

Vacuum tube collector

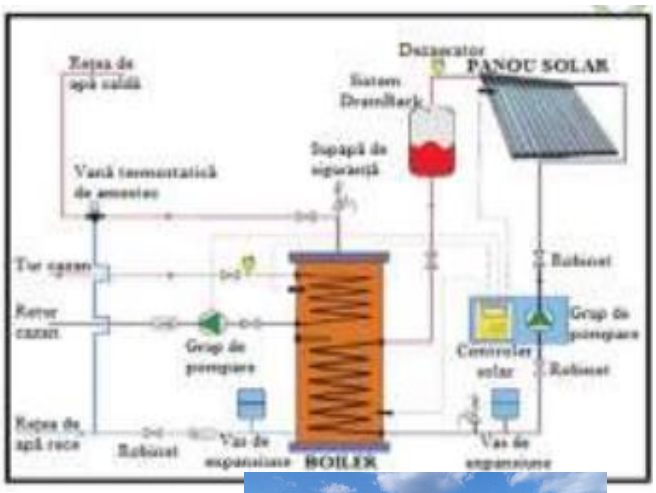
Why are vacuum tube collectors more efficient than flat collectors?

1. Able to receive sunlight throughout the day. Flat collectors can provide maximum energy when the sun is perpendicular to the surface of the collector.
2. Use at temperatures below zero degrees without the system suffering any malfunction. Flat systems typically require the installation of complex and expensive anti-freeze systems.

3. The average for a whole year, the energy obtained on net m² by the absorption surface of the vacuum tube collectors, is between 25% and 40% higher than the flat collectors.

In the framework of the ENERGY and BIOMASS project, the scheme of the solar thermal installation for the preparation of domestic hot water with drainage was developed: SOLAR INSTALLATION type DRAIN BACK.

Benefits. The Drain back system has the role of ensuring the transmission of heat energy in the solar collector only when necessary.



Operating principle:

The Drain Back type solar installation is a system designed and mounted in such a way as to allow gravitational drainage of the thermal agent from the solar circuit, in a special tank. The solar controller decouples the pumping group from the solar circuit when the boiler water reaches + 60 ° C, the maximum level set and the thermal agent flows gravitationally into the Drain Back. The solar collector continues to operate and capture solar radiation and its T continues to grow above values>> + 180 ° C. At the same time the hot water consumption in the boiler takes place, the T in the boiler decreases and the controller starts the pumping group in the solar circuit. The thermal agent, located at room T, + 25 ° C, enters the hot solar collector, where taking its heat transmits it to the boiler.

Within the ENERGIE and BIOMASS project, 78 solar thermal installations have been installed for preparing ACM in kindergartens from different localities of the RM. The solar installations were equipped with high performance equipment and intelligent automation systems. Good practices are set out in the Annexes

Small scale building-mounted wind turbines

Wind energy is derived from solar energy, due to uneven heating of the Earth's surface. Every hour, the Earth receives 10,000,000,000,000 kW • h of solar energy. You already know that about 1-2% of this quantity is converted to wind energy. *Advantages of wind energy*: it is ecological; does not pollute when used; contributes to the fulfillment of international commitments; reduces import dependency; installations require less time for installation and are cheaper to use.

Weaknesses and Challenges: The incentives needed to attract investors can prove costly; the wind is very unstable and hinders the use of wind energy; the wind power stations make a lot of noise during operation (according to European norms they are placed at a certain distance from buildings, so that the pallet gap does not exceed 35-40 dB (decibels); they use useful agricultural land. The statistics of the use of wind turbines in Europe and in the world show that they they occupy at most 1% of the territory on which they are located.

Among the countries advanced in the field of wind energy use are, first of all, Germany, Denmark, Spain, USA. World leader is Germany. The power of a unit in series of wind power units has increased lately from 400 kW to 2.5-3 MW. Over the past 10 years, this branch has provided jobs to over 50,000 people in Europe and has grown faster than the telecommunications sector.

In the R M, in the 1950s, about 350 low-power wind power plants were operating, with their help the water supply of the collective households from the rural localities was carried out. In the 60s, when they were replaced by electric pumps, much more convenient in operation. The current energy crisis generates the need to return to some energy sources exploited in the past.

Wind energy is the most abundant source of renewable energy in the RM, almost the whole country having technically suitable locations for investments in wind energy. The Technical University of Moldova bases the possibility of applying high power wind power plants, and the Energy Institute of the Academy of Sciences of Moldova is working on the creation of a low power wind power plant (IEE) that is not expensive.

Wind energy potential. According to the scenario of the development of wind power in the world, by 2020 wind energy will produce about 12% of all electricity.

Small wind turbines. They can be connected to the central network or used autonomously. The IEE connected to the network ensures a reduction of the electricity consumption needed for lighting, heating devices, etc. If the wind turbine produces more electricity than is necessary for the economy, the surplus can be sold to the central network and, thanks to modern technologies, the switching is done automatically away from high voltage lines. Most are located in rural areas in non-electrified areas and are used by farmers to pump drinking water and water needed for household needs and irrigation.

Small IEEs can be used in telecommunications: the height and location of the antenna are also suitable for wind turbines when charging the batteries.

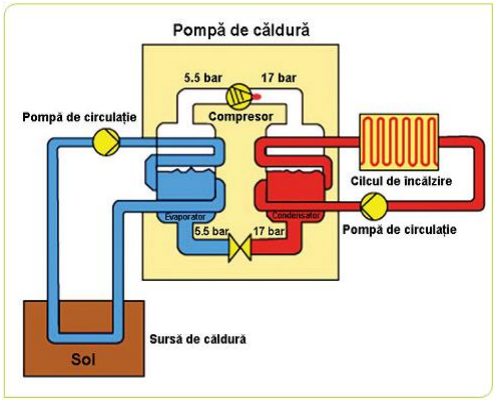
Heat pumps

Heat pumps: systems powered by electricity that provide heating, cooling and hot water for residential homes and commercial buildings, by transferring heat (in winter) from air, water or soil, and (during summer) to air , water or soil. Regardless of the source of heat, heat pumps use indirectly solar energy accumulated in soil, water or air. The soil represents an efficient source of heat, because it accumulates heat both directly in the form of solar radiation and indirectly from rain and air respectively. The heat can be taken up by means of intermediate circuits placed in the ground, which absorb heat and transmit it to the evaporator of the heat pump.

The soil temperature reaches about 12gr. C, by using a suitable refrigerant, the soil can be used both as a heat source and for heat absorption. Thus, a geothermal heat pump can also cool the building by transferring heat from the building to the ground.

The geothermal heat pumps can be closed or open circuit, and can have three configurations of the circuits in soil: horizontal, vertical or with loops installed in shallow ditches. The type chosen depends on the surfaces of

available land, as well as soil type and rice fields instead of installation. The ground loop / loop works best when in contact with groundwater. Closed circuit systems circulate an antifreeze solution through pipes, and open circuit systems take heat from groundwater or wells. In general, closed circuit systems are preferred. Horizontal collectors have the advantage of relatively low costs of achieving the excavations necessary for the location, but it presents the disadvantage of the need for large collector placement surfaces, which reduces the possibility of using these types of collectors, at least in urban areas.



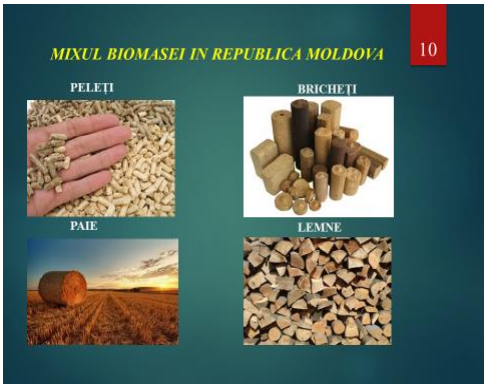
Vertical collectors have the advantage of the need for reduced site surfaces, but they have the disadvantage of the high costs of drilling. Groundwater is a source of heat even more efficient than soil, because its temperature is relatively constant throughout the year, having values of 7 ... 12 ° C, therefore higher than the ground and must be located at maximum depths of 50-70m, which should allows obtaining the drilling permit. The distance between the two wells had to be at least 5m. Disadvantages of using groundwater as a source of heat: it is necessary to have a sufficiently high flow of groundwater and chemical composition according to the requirements.

Air is a free source of heat, available in unlimited quantities. Only external air, which is circulated through tubes with a fan, can be used in heat pumps as a source of heat. These equipments are called air-water heat pumps. Typical geothermal heat pumps for building heating can supply 100 kWh of heat. only 20-40 kWh of electricity used by pumps and compressors. The most suitable for Moldova are the geothermal heat pumps, which have a CP between 2.5 and 5.0. Thus, the feasibility of a heat pump project depends on the cost of the conventional fuel for heating, the cost of electricity, as well as the costs of installation and maintenance of the installation.

The average installation price of a heat pump installation is about 440.0 Euro per MW. The operating cost is about 6,250 Euro per MW. The life of these installations is about 15 years.

Biomass

According to the definition included in the European Directive 2003/30 / EC: *Biomass represents the biodegradable fraction of products, waste and residues from agriculture, forestry, manufacturing and communal households.* In this context we can mention that biomass is the most important fuel used in rural areas. As the Republic of Moldova is an agrarian republic, then, obviously the exploitation of the existing biomass potential is one of the great opportunities of our country. Biomass can be used for heating, cooling, electricity production and biofuels



used in transport. That is why the actions taken by the Moldovan Government in recent years regarding the launch of public-private partnerships, aimed at exploiting the potential of biomass, are welcomed. The energy potential for the use of biomass / biogas in the Republic of Moldova is relatively high, estimated at 20 PJ and insufficient for the biomass to cover about 22% of the annual energy consumption in Moldova (which is enough to heat all the schools and kindergartens in the country).

Biomass heating systems

Biomass heating is very suitable for Moldova. This provides the country with a safe supply of fuel for heating buildings and reduces dependence on imported energy. The technologies are available for homes and buildings, at a reasonable price, they are available and relatively simple from the point of view of installation, operation and maintenance. Also, biomass creates jobs, as well as opportunities for small and medium-sized enterprises to develop.

The efficiency (efficiency) of biofuel systems varies widely, from a few tens of percent for non-automated devices (stoves, wood burning stoves), to about 90% for automatic boilers using pellets, briquettes, nuts, wood or logs (wood chips and condensation technology. Dry biomass can be burned in traditional boilers, cogeneration plants for electric and thermal energy, as well as by more innovative thermal conversion technologies (gasification) for the production of thermal and / or electrical energy. The costs of biomass fuel can be very low when biomass it is a useless waste (straw, nutshell, chop, etc.). The costs on the market for this type of biomass are about 40-50 Euro per ton. The products from biomass (pellets, briquettes) from wood sawdust, sunflower baskets, straws with a moisture content of 10% have an energy content of about 3.6 - 5.2 KW / kg. The price per ton is worth between 90 Euro (from straw) and 150 Euro (from wood sawdust). The cost of fuel for a wood heating system with an efficiency of 90% is about 0.012 Euro per calorie heat delivered. Biomass heating systems usually have a life expectancy of over 20 years under the conditions of proper maintenance.

*One of the largest projects in this field is the **Energy and Biomass Project8**, which was implemented between 2011 and 2018 and which contributed to the creation of a safe, competitive and sustainable system for the production of energy from renewable sources, in particular, biomass. and agricultural waste. Within the project "Energy and Biomass", 221 modern plants were installed based on localities located on the territory of the RM, including in the southern region: in the districts of Cahul, Cantemir, Taraclia, Comrat, Vulcanesti etc.*

By replacing traditional energy sources with readily accessible biomass fuel, the project will continue to contribute significantly to reducing greenhouse gas emissions and environmental pollution. Training programs specific and a national awareness campaign in combination with a school education program will change into significantly the knowledge and attitude of the population towards renewable energy sources, laying the foundation for the increased use of sustainable energy technologies in the future. Total project budget: $ 28 million allocated by the European Commission.

Within the Project:

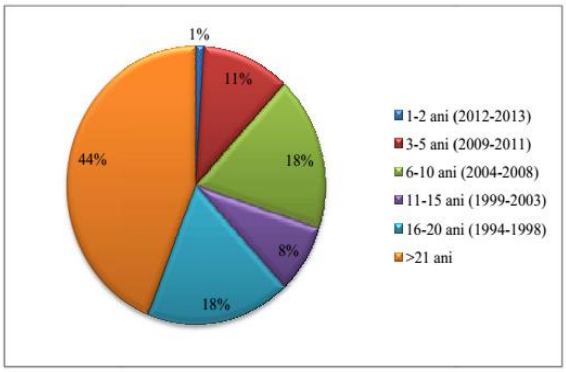
1. A laboratory for testing biomass products was provided;
2. The cluster of producers of biomass products was created.

COMMUNITY SCALE

COMMUNITY SCALE SUSTAINABLE TRANSPORT

The increase of the share of renewable energy in the transport sector as well as the creation of the necessary conditions in order to reach the target of 10% assumed by the RM, represents a real challenge and requires an effort considerably, what is to be submitted in this regard.

Starting with September 2014, the "Euro 6" norm has been implemented in the European Union, with new ecological rules and prohibitions. At the same time, not only in the EU such rules apply, in Ukraine from 01.01.2014 the norm "Euro 4" was introduced, and in the Russian Federation respectively "Euro 5". Although the Republic of Moldova has chosen the path of European integration, it does not currently have any of these norms implemented. The Moldovan car park consists of almost half of cars older than 20 years. The lack of ecological norms adopted, as well as the policies aimed at stimulating the use of modern cars, has led to the fact that Moldova becomes a "garbage can" for old cars. In order to improve the ecological side it is necessary to develop the following proposals:



1. Create long-term strategies regarding the implementation of the “Euro 3-6” ecological norms;
2. Introducing changes to the regulatory framework regarding the import of fuels, so that the entire quantity of fuels to be imported into the country already contains a certain amount of biofuels.
3. Elaboration of studies, which in a complex approach would answer the questions related to the development of the sector, namely the need to reach the target by cultivating their own crops for the production of bioethanol and biodiesel, or conversely - the import of these mixtures.
4. Elaboration of technical measures by the Ministry of Transport and Road Infrastructure through the rehabilitation and modernization of several car and rail transport networks, which hold a major share in this sector, the first dominating the chapter on passenger transport, and the second - when transporting goods. All these measures contribute to reducing fuel consumption used in the transport sector.

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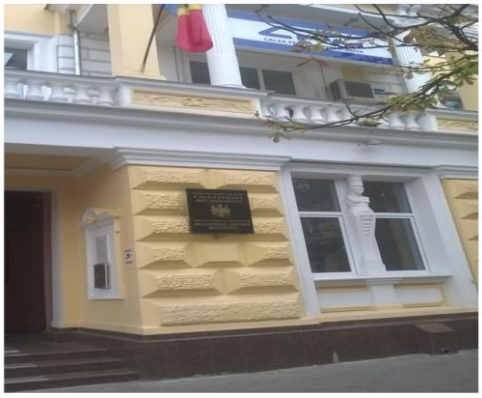
Use of energy efficient technologies on examples of historical objects - Case studies

1. The building of the former district judge, 70 - 80 sec. XIX. Historical and architectural monument of national category No.208 in the Register of monuments of the Republic of Moldova protected by the state.

Now the Railway Directorate of the Republic of Moldova is located here.

Energy efficiency measures “Partial replacement of carpentry windows”



2. The report house, XX century. Historical and architectural monument of national category No.93 in the Register of monuments of the Republic of Moldova protected by the state. Now the offices of the Chisinau City Hall are located here. Energy efficiency measures “Partial replacement of carpentry windows”

These works were accepted for implementation by the Ministry of Culture of the Republic of Moldova on the basis of Law no. 139 of 19.07.2018 "On energy efficiency", Chapter IV "ENERGY EFFICIENCY IN ENERGY USE"

1. Renovation of buildings

(1) In order to promote the exemplary role of public buildings, this law establishes as an objective the annual renovation of a certain area of the heated and / or cooled buildings owned and occupied by the specialized central public administration, so as to meet at least the minimum energy performance requirements. established in accordance with article 9 of the Law on the energy performance of buildings.

(1) The requirements set out in paragraph 1 shall not apply to the following categories of buildings:

a) buildings that are part of the national cultural heritage and where the compliance with certain minimum energy performance requirements would unacceptably change their character or appearance;

In the Republic of Moldova the architectural monuments are protected by the "Law on the protection of monuments" (22.06.1993), elaborated according to the European legislation, in which it is stipulated: "Monuments are objects or assemblies of objects of historical, artistic or scientific value, which they represent the testimonies of the evolution of civilizations on the territory of the republic, as well as of the spiritual, political, economic and social development ".

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LIST OF TECHNOLOGIES, PRODUCERS AND DISTRIBUTORS AVAILABLE AND OPERATING IN THE REPUBLIC OF MOLDOVA

Name of organisation	Contact details (website, phone number, address, contact person)	Description of the organization	Field of activity */energy efficient measures, lighting, transport, BMS* (building management system), *energy services,* RES (*solar systems, heat pumps, biomass, geothermal)*	Examples of good practice (Link to access the example)
"Constanta Prim" S.R.L.	***Name: "CONSTANTA PRIM"S.R.L. Address:*** ***MD-2012, mun.Chisinau, str. Alexandru cel Bun 51A*** ***Telephone/Fax numbers:*** ***+373 60224111, +373 79706101*** ***Email Address:*** ***vitalie.filimon@yahoo.com*** ***Contact person:***	"Constanta Prim" S.R.L. was founded in March 2012 and collaborates across disciplines and industries to bring buildings, energy and resource, and infrastructure projects to life. The works of the entity is concentrated on installations, customized design solutions to companies, professional consulting in planning, engineering, architecture, project management, and project economics begins at the intersection of community, creativity, and client relationships.We ensure time to market solutions through a highly motivated skilled workforce driven by strong design principles, highest levels of quality and ethical business practices. Previous activity work in the framework of UNDP project winning is a prove of reliability and credibility in our work.Our team is equipped with a wide basket of skills and thus assure that the projects will correspond to the law and standards in force and will include solutions and the necessary equipment, hardware	*Energy efficient measures, lighting,* *BMS (building* *management system), energy services, RES* *(solar systems, heat pumps, biomass*	*International work experience in programs with World Bank, as well as a project with the Japanese Government "Introduction of clean energy by solar electricity generation system to the Republic of Moldova", "Design and construction of biomass heating systems" UNDP project and "Technical Design for installation of solar collectors for domestic hot water within social institutions in the Security Zone on the right bank of the Nistru river and Transnistrian region of Moldova" UNDP project;* **See attached files.**

	Vitalie Filimon	and software of the best quality to handle the engineering requirements. Quality assurance procedures include: - develop all the planning processes and procedures in order to try to make sure that the products manufactured or the service delivered by the organization will be of good quality. - define the standards/methodology to be followed in order to meet the customer requirements. "Fit for purpose". - monitor the development process throughout its entire cycle. Testing is the part of quality assurance. The quality control is be made vertically according the management chart. Activation period of 19 years offers to our team members to state surely that we posses the proper knowledge and experience in the field. Our company together with its staff activated together in similar projects at the Oncological Institute, and in one UNDP programme. There is also work experience in a project in the Security Zone on the right bank of the Nistru river and Transnistrian region of Moldova.		
SA Darnicgaz	***www.darnicgaz.md*** *Mob* *+37369365252*	SA „Darnic-gaz" is an active company on the engineering and construction market of the Republic of Moldova. The company was formed under СПМК-11 (mobile column construction) from the city Straseni.The structure itself was formed	*energy efficient measures, transport, energy services,*	**http://darnicgaz.md/?cat=24&lang=en_us** ***International work experience.*** ***2KR The project of effective use of biomass fuel*** . *Project of use fuel from biomass which was signed between Project Implementation Unit 2KR*

	Contact person *Mereacre Andrei* ***RMoldova, Straseni, Stefan cel Mare 1a***	since 1985. Fifteen years later the company was reorganized into a closed joint stock company. Since then the company began to grow considerably and soon came to be a leading one on the country market. Among their regular customers are: "Moldova Gaz" SA, "Glas-Container-Company". In addition the company carries out on guvernamental projects and also foreign funds financed by the World Bank and EBRD, such as MSIF, UNDP, MOREEFF, IFAD, Orange Foundation, BAS Moldova, **Toyota Tsusho Corporation .** The company it is also the official representative of several international brands of engineering equipment, such as Templari (Heat Pumps), Galmet (Hybrid systems producer, heat pumps , solar, panels, Biomass boilers), D'alessandro Termomecanica and SAS company (Biomass boilers).In the last few years being the biggest contractor on Moldavian market for biomass and solar panels projects. According to their estimation at the moment they have more then 67 Mw of biomass boilers delivered and installed. The company also has in their portofolio several projects for heat pumps installments. Other two directions of the company are distribution of heating equipment on local market and also natural gas distribution. *Construction of biomass boiler plants (UNDP)* The project included the design, construction and	RES (*solar systems,heat pumps, biomass, geothermal***)***	*Ministry of Agriculture and Food Industry of Moldova and Toyota Tsusho Corporation .* ***Assembling 25 modular boilers with an output power of over 8.7 MW.*** ***Implementation period: August 2014 – 2015*** ***The total value of the contract : 5 962 047,90 USD*** **Construction of biomass boiler plants (UNDP)** *Construction of biomass boiler plants in of the project was financed by the European Union and coordinated by UNDP* *" Energy and Biomass „* ▪ *Implementation period was December 2011 – 2018.* ▪ *The estimated value of contracts is 3 450 000.00 $.* ▪ *In total was 39 boiler plants were built th were installed 61 boilers.* ▪ *Summary thermal power at boilers plan built it exceeds 9.8 MW.* ▪ *For hot water were installed 50 sol collectors* **See attached files.**

		commissioning of biomass heating plants in different regions of the country.. The works included automation works , electrical works , water and sanitation , according to the latest energy efficiency technologies and use of more efficient equipment.		
S.C. „ESCO-Voltaj" S.R.L.	***Address: Chisinau, Constantin Tanase str. 6, MD-2005*** ***mob.*** *068 233 333* ***tel./fax*** *022 53 13 40* ***e-mail:***	Esco Voltaj is a local company that provides energy services and renewable energy solutions. Our portfolio contains a great diversity of Energy Efficiency Solutions and renewable energy sources, being an Eco friendly company. The company was founded in 2007, at the beginning of the activity the company provides energy services such as:feasibility studies;energy audit reports; technical reports on the quality of electricity; technical reports on the quality and efficiency of electric lighting; design, implementation of energy and energy efficiency solutions: LED lighting; electrical measurements	*energy efficient measures,energy services,* RES (*solar systems,heat pumps,biomass, geothermal*)	**Examples of good practice** ***1.Energy efficient measures*** *Inverter 55 kW, 380 V* *Beneficiary - IM Termogaz-Balti.* **2. *Lighting*** *LED lighting Beneficiary - Keramin.* *Implementation period: 2019* ***3.RES - solar systems***

	info@escovoltaj.md ***Website:*** https://escovoltaj.md/ ***General Manager****: Ion TIMUS*	and tests.With the emergence of market interest in renewable energy sources, Esco Voltaj took over this area by providing consultancy, design and, of course, project implementation. We appreciate the efforts authorities regarding the promoting of renewable energy, so in this regard we strongly believe that this domain will be very attractive and energy efficiency projects will be promoted in the coming period, as well as for investors and final consumers and of course being a great achievement in protecting the environment. **Field of activity:*energy efficient measures, lighting, transport, BMS* (building management system), *energy services,* RES (*solar systems, heat pumps, biomass, geothermal; wind turbines .1*		*Photovoltaic panels with a capacity of 1 MW;* *Company: Skyvolt SRL* *Location: Singerei district* *Implementation period: ongoing* ***RES - solar systems*** *Solar collectors with a capacity of 1500 liters;Company: S.A. "Apa-Canal Chisinau"* ***RES - wind turbines*** *Wind power capacity of 2.6 MW* *Career Cobusca SA,Anenii Noi district, Botnaresti village.* *Implementation period: 2017-2018* ***RES - wind turbines*** *Wind power capacity of 1,5 MW, Elenasig SRL* *Căuseni district, Saiti village* *Implementation period: 2017-2018* **See attached files.**

"Modern Term" SRL	***Chisinau, str. Drumul Crucii 97/2-50,*** ***Tel.-069144264,*** ***dl Tidva Iurie***	"Modern Term" SRL is a company specialized in installation and sales of heat pumps produced in Sweden IVT brand, photovoltaic stations produced in China, design and installation of heating systems in combination with active cooling systems using geothermal heat pumps.The volume of works performed during the activity is estimated at around 850 kW·h of thermal installation or 36 works. Moreover, we worked with photovoltaic power stations with a total power of around 196 kW·h of type: 1.On-grid with the network 2. Off-grid on accumulators. These systems are simple, with UPS, hybrid. 3.On-grid / off-grid which is stored in accumulators. "Modern Term" SRL has been working in the Republic of Moldova since 2011.We are the promoters of the "zero-consumption house" project on the territory of the Republic of Moldova.	*energy efficient measures, RES (solar systems, heat pumps, geothermal)*	**Examples of good practice** *Are the winners of the "MOLDOVA ECO-ENERGETICA" contest, edition 2013, for the best project in geothermal energy and the Photovoltaic and Geothermal Solar Energy Project, edition 2017.* *The house is fit for 350 square meters. The heating system has Q = 14 kW . The ventilation system has Q = 11 kW. Domestic hot water with V = 75l / hour. Conditioning system - 16 kW . Swimming pool with V = 80 m3.* *The house is located in Chisinau. The design, assembly and delivery of the equipment were carried out by LLC "Modern Term" from 2015 till 2016. Two Buderus WPS 17 kW heat pumps are installed in the house. The geothermal collector, which was mounted under the perimeter of the house, has L = 700m.* **/agora.md/stiri/37225/video--prima-familie-din-moldova-care-are-dreptul-sa-livreze-energia-produsa-consumam-doar-20--iar-restul-este-profit** **mir24.tv/news/16269388** **See attached files.**

Tresmus-Grup SRL	***Petricani 18/1*** ***MD 2059 Chisinau*** ***RM*** ***+373 22 46 00 33*** ***+373 22 45 06 63*** ***+373 692 48 949*** ***Igor Slutu*** ***www.metroterm.md*** ***igor.slutu@gmail.com***	Since 1999, we have focused on tens, hundreds and thousands of homeowners, companies, shops, state-owned enterprises to achieve high-quality and affordable indoor comfort with products that continue to be designed and assembled in the Republic Moldova. As a result, Tresmus-Grup has won loyalty and respect for thousands of local professionals in the HVAC system in the Republic of Moldova. Tresmus-Grup SRL offers sales, design and services of HVAC systems that are directly related to the activity you are doing. At present, we have over 45 highly qualified employees in the field, 5 subsidiaries with a central repository, an experience of over 18 years. Among the companies we collaborate with are:Fondital,De Dietrich, Viessmann, Stalmark, Biral, Ski Solar and other companies. Our company imports high quality goods from WESTERN and ESTATE EUROPE, TURKEY and CHINA.	*RES (Solar Systems* *Heat Pumps* *Biomass* *Geothermal)*	**Examples of good practice** ***1. "Orthopedic Center" , Solar System , 6000 liters hot water*** ***per day*** ***2. "Becor SRL" Pharmaceutical Storage*** **See attached files.**

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Compania DEKART SRL	***Str. Kogalniceanu, 85, Chisinau*** ***www.dekart.com*** ***va@dekart.com*** ***Valerii Anestiadi,*** ***+373 79595999***	The private company singe 1994. Dekart ATM has implemented projects for monitoring technological processes in the field of electric power, heat, water, and gas supply. We offer our platform as a means of automation and telecontrol, as well as a service based on it, when equipment is leased or acquired on lease, our specialists are engaged in operational issues, and the client gets the opportunity to control and manage their facilities.	*Telemetry,* *BMS,* *own solar solar* *water heaters* *manufacturing*	**Examples of good practice** ***Online real time monitoring system for 221 biomass boiler for "Proiectul Energie şi Biomasă" in 2017-2018*** **See attached files.**

CONCLUSIONS

As a result of conducting the Market Survey we find the following:

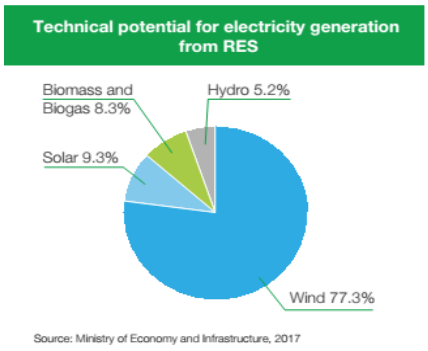
1. The accession of the Republic of Moldova to the European Energy Community is an important step in the process of European integration and approximation of the Republic of Moldova to the EU standards in the energy field, which in the medium and long term will contribute to the increased energy security of the state. In line with this objective, the Energy Strategy of the Republic of Moldova was elaborated by 2030, aligned with the energy objectives of the European Union, the National Program for Energy Efficiency for the years 2011-2020, the National Action Plan in the field of renewable energy for the years 2013 -2020 and outlined the strategic objectives for the period 2013-2020 and the related measures related to improving energy efficiency and increasing the use of renewable energy sources, including ensuring the institutional and operational framework in the field of energy efficiency and renewable energy.

2. As a result of the analysis of efficient technologies and high-performance materials, energy efficiency measures were recommended, based on the quality/price criterion for improving the energy performance of buildings.

3. As a result of the ESRM analysis, the domain of the use of the ESRM and the share of the renewable energy from the ESRM in the gross final energy consumption was estimated and the available ethnic potential of the main types of ESRM.

The available technical potential of the main types of ESRM

RES type	Technical Potential			
	MW	%	GWh	%
Solar PV	4,648	17.1	6,044	9.3
Wind	20,869.1	76.7	50,235.7	77.3
Hydro	840	3.1	3,361	5.2
<10	275	1.0	1,100	1.7
>10	565	2.1	2,261	3.5
Biomass	850	3.1	5,388	8.3
Biogas	134	0.5	805	1.2
Biofuel	716	2.6	4,583	7.0
Total	**27,207.1**	**100**	**65,028.7**	**100**



From the diagrams, it can be seen that:

- wind power has the highest technical potential of about 77.3%,
- solar potential of about 1.3%;
- biomass constitutes about 8.3% (solid biomass 7% and biogas potential is estimated at 1.3%)
- the hydraulic potential is about 5.2%.

The technical potential of the ESRM for the electricity generation in the Republic of Moldova is 65,029 GWh, the equivalent of 5,591 ktoe.